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Conference Proceedings

Lydia Hess/Washington Sea Grant Program

Seeking balance:
Conflict, Resolution & Partnership

The Coastal Society · 15th International Conference
July 14-17, 1996 · Seattle, Washington

Proceedings

of the

Fifteenth International Conference

of

The Coastal Society

Seeking Balance:

Conflict, Resolution & Partnership

July 14-17, 1996
Seattle, Washington

Thomas E. Bigford, Co-Editor
Robert H. Boyles, Jr., Co-Editor

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P.O. Box 25408
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Telephone 703/768-1599
Fax 703/768-1598
Email: coastalsoc@aol.com

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Lynne Mersfelder
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Foreword

The Coastal Society convened this 15th international conference in Seattle, Washington on July 14-17, 1996. Our theme of "Seeking Balance: Conflict, Resolution & Partnership" addressed timely issues related to all components of coastal resource education, research, and management.

This conference also marked the 20th anniversary of The Coastal Society. The Board of Directors and conference planners are pleased to add this event to the Society's long tradition of interdisciplinary communication and problem solving.

This event and these proceedings culminate more than a year of planning and execution. The editors are indebted to each of the individuals and organizations recognized in the preceding Acknowledgments.

We reserve our greatest appreciation for Megan Bailiff, who personally orchestrated our collective efforts.

June 21, 1996

Thomas E. Bigford
Robert H. Boyles, Jr.

Special Note on These Proceedings

This volume includes papers and abstracts for most of the individual presentations included in the final program. Not included are most plenary session manuscripts and most summaries of technical sessions that were presented as panel discussions.

The Table of Contents reflects the order of abstracts in this volume, including those from technical sessions and the poster session.

Thomas E. Bigford, NOAA/National Marine Fisheries Service, Office of Habitat Conservation

Robert H. Boyles, Jr., South Carolina Sea Grant Consortium

Table of Contents

This Table of Contents is organized according to the final program. An * signifies that no abstract submitted for these proceedings.

Session J2 - Incentives for Non-Regulatory Compliance

Session Chair: Roger Griffis, NOAA/Office of Policy and Strategic Planning

Session J4 - Conflict Resolution

Session Chair: Michael Eng, Mediator/Facilitator/Trainer

Session A1, Part I: Dealing with an Angry Public: Facilitating Conflict Resolution
Session Chairs: Sylvia Skratek, Mediator/Facilitator and Robert Whitener, Jr., Northwest Indian Fisheries Commission

DEALING WITH AN ANGRY PUBLIC (FACILITATED CONFLICT RESOLUTION FOR DECISION MAKERS)

Sylvia P. Skratek,
Resolutions International and
Robert W. Whitener, Jr.,
Resolutions International

Introduction

Some people say that the American people are the new "fourth branch of government." In recognition of this new branch, Newt Gingrich has unveiled a vast new electronic archive named Thomas (after the great proponent of democracy, Thomas Jefferson) that makes every bill and every speech immediately available to users of the Internet. His goal is to make the government more responsive to the electorate's will.

Making the government more responsive is not a new idea. For years we've seen initiatives placed on the ballot, term limits imposed, and call-in talk shows reach a new high in popularity.

The speed of information is increasing to the point that we are moving toward the immediate involvement of the entire community in the central acts of decision making (as predicted by Marshall McLuhan). More and more Americans can participate directly in making the laws and policies by which they are governed.

Such direct participation by the public leads to elected officials becoming increasingly reluctant to take stands on important issues without first consulting with poll takers and professional spin doctors. Many of today's leaders are now governing in a perpetual campaign mode. Which in turn leads to gridlock government. The increase in the speed of information, particularly through television's dominance over the past 25 years, has resulted in the first presidential resignation, and three one-term presidents. Only Ronald Reagan, a professional actor, has served two full terms.

No longer can presidents lead based on their strong convictions of what has to be done, rather a president now feels compelled to keep in step with public opinion as the people follow the major events on television and through other technology, day in and day out.

None of this is bad. A 1992 analysis of national policy preferences by Page and Shapiro in "The Rational Public" led to the conclusion that "public judgments have tended to be no worse than the judgments of the political elite." Of concern, however, is the type of information that the public receives and then utilizes to shape its public judgments. And how that judgment then affects the ability to reach and implement public policy decisions.

Moving from a presidential level to a local level, one sees similar activities. People agree that something needs to be done to address specific problems within a community. Difficulties arise when the question of how to address those problems is brought to the forefront for resolution. People clamor for action to be taken; the elected officials appoint task forces; and recommendations are made. As soon as those recommendations are brought forward the opposition begins. Elected officials are lobbied; new organizations are formed to fight; and existing organizations are fearful to move in any new direction. Neighborhoods begin the referendum process to exempt their community. Litigation begins and all forward movement ceases.

Although the legal challenges may be rejected by the court, the organizations will most likely appeal. Elected officials reach a standoff with each other. Legislative delegations introduce bills that are promptly bottled up by legislators who have different constituencies. And some people take to the talk show circuit

These circumstances are not unique. Whenever community leaders try to set standards, allocate resources, or make policy in contemporary society, we can expect a fight.

What is underlying this fight? Why is the public angry?

The answers lie in the recognition that:

1. People have been hurt; they are frustrated with wrongs that cannot be righted;

2. People are threatened by risks not of their own making; they suspect they will be hurt in the future;

3. People believe their fundamental beliefs are being challenged and they will fight for beliefs that give meaning to their lives.

Furthermore, they feel weak in the face of others more powerful; feel they have not been treated fairly, or with respect; and feel they have been manipulated, trivialized, ignored, or lied to. Their anger is a defensive response to pain or the threat of pain, real or perceived.

Why Should We Care?

A continually angry public undermines American competitiveness in the international marketplace. US companies spend $300 billion annually on litigation involving environmental claims, product liability suits, class action securities suits, medical malpractice, and Americans with Disabilities cases. Liability prevention measures increase the price of products and services by at least 5%.

A frustrated and angry public contributes to the erosion of confidence in our basic institutions. In 1966, 76% of Americans trusted the government in Washington to do what's right; in 1992 the number had dropped to 28%.

What Can Be Done?

Obviously, we need to improve the ways in which we use representative democracy to resolve public disputes. We must achieve better results at lower cost. And we need to find ways of dealing with differences that will restore public confidence in government, and improve relationships among the various segments of our society.

This session will examine the typical approaches to dealing with an angry public; provide an overview of the mutual gains approach; and review guidelines for the successful implementation of a process that will address the interests of all of the affected stakeholders.

The major focus of the session will be negotiated approaches to consensus building which have been developed and tested at the Program on Negotiation at Harvard Law School. The goal of the negotiated approach is to enable the parties to function effectively within today's dynamic environment and to transform the challenges of public involvement into opportunities for gain.

Underlying this goal is the assumption that in all public policy disputes there is something in common that we all hold dear and that only through open-ended discussions will we uncover what that might be. Not always will you persuade but you will always get full discussion which in turn can lead to a resolution.

Today, we too often "Decide-Announce-Defend." The goal is to shift that process to a mutual gains approach that addresses the interests of all of the affected parties, the stakeholders.

Power, Rights, and Interests

The movement toward problem solving negotiations away from the more hostile, traditional approaches can be explained through a review of the three approaches to resolving disputes: power; rights; and interests. While all three are linked and play a role in any negotiation, the shift to a strong emphasis on interests and away from power and rights has made greater cooperation possible.

"Power" is the ability to coerce someone to do something they would not otherwise do. The exercise of one's power means the imposition of costs on the other side or the threat to do so. Determining who is the more powerful party without a decisive and potentially destructive power contest is difficult because power is ultimately a matter of perceptions. Despite objective indicators of power, such as financial resources, parties' perceptions of their own and each other's power often do not coincide. Moreover, each side's perception of the other's power may fail to take into account the possibility that the other will invest greater resources in the contest than expected out of fear that a change in the perceived distribution of power will affect the outcomes of future disputes.

"Rights" are determined through an independent standard with perceived legitimacy or fairness. Rights in a public policy dispute are most often determined through a judicial process. A neutral third party adjudicates the matter. The parties present evidence and arguments to the third party who has the power to hand down a binding decision.

"Interests" are the actual needs of the parties - the things that are important to achieving a satisfactory resolution of a dispute. The determination of the parties' interests requires probing for deep-seated concerns, searching for solutions to those concerns, and making concessions where interests cannot be reconciled. Negotiation that focuses primarily on interests is referred to as "interest-based" bargaining or "problem solving" negotiation. The latter term clearly illustrates the goal of the process which is to treat a dispute as a mutual problem to be solved by the parties.

Power, rights, and interests are all inextricably linked with each playing a role in the resolution of all disputes. It is the magnitude of that role that shifts, depending on the parties. Parties who participate in interest-based bargaining are ever cognizant of the rights that are currently provided under the law. They also recognize both the power of their side and of the other side. Underlying their interests at the bargaining table are the levels of power and rights that are available to each of them respectively and their ability to invoke those levels. It is not uncommon for the parties to shift their focus from interests to rights to power and back again. The question becomes: which focus will yield the best result?

The different approaches to the resolution of disputes, interests, rights, and power, generate different costs and benefits. Four criteria are utilized to compare them: transaction costs, satisfaction with outcomes, effect on the relationship, and recurrence of disputes.

"Transaction costs" include the "time, money, and emotional energy expended in disputing; the resources consumed and destroyed; and the opportunities lost." "Satisfaction with outcomes" is dependent upon how the resolution of the dispute fulfills the interests that led the parties to either make or reject a claim in the first place. Satisfaction may also hinge upon whether or not the parties believe that the resolution is fair and whether or not the parties believe that the process used to reach the resolution is fair. "Effect on the relationship" is determined by the long term effect that the approach has on the ability of the parties to work together on a day-to-day basis. "Recurrence of disputes" measures "whether a particular approach produces durable resolutions." All four of the criteria are interrelated. Dissatisfaction with the resolution of a dispute may lead to recurrence of the dispute which in turn will increase the transaction costs.

An interests-based approach can help the parties to uncover the underlying problems that may have led to a dispute. It can also help the parties to identify which issues are of greater concern to one than to the other. Reconciling interests in this manner leads to a higher level of mutual satisfaction with the outcome than does the use of power or the invocation of rights. Mutual satisfaction leads to improvements in the ongoing relationship in which the recurrence of the disputes is less likely to occur.

Doing the Right Thing

Today's leaders need to realize they are engaged in a search for mutually satisfactory outcomes; negotiate as if long-term relationships mattered; work to build trust regardless of what the other "side" does; and build an organizational commitment that matches their individual commitment to honesty. This session will illustrate how leaders develop a strategical and practical approach to more effectively and efficiently address the concerns and anger brought forward by the public regarding an action to be undertaken by an agency or organization. The session will be interactive utilizing peer exchange and a multi-party, interactive role play that requires participants to formulate a problem solving strategy in a proactive situation in which a conscious decision has been made to go forward in the face of risks and strong public opposition. The role play will include private interests, tribal government, state and local government, federal government, and the media.

The session will be based upon the work of Professors Lawrence Susskind and Stephen Goldberg. Professor Susskind is an author of the texts "Dealing with an Angry Public" and "Breaking the Impasse." He is the Director of the MIT-Harvard Public Disputes Program and Ford Professor of Urban and Environmental Planning at the Massachusetts Institute of Technology. Professor Goldberg is the author of "Getting Disputes Resolved." He is a professor at the Northwestern University School of Law and is president of Mediation Research and Education Project, Inc.

Sylvia Skratek
Resolutions International
26324 166th Pl SE
Kent, WA, USA 98042

Ph (206) 639-1130
Fax (206) 639-1130

Session A2: Using Education, Communication, and Social Marketing in Coastal Resource Management
Session Chair: Maureen Wilmot, Ocean and Coastal Resource Management, NOAA/National Ocean Service

> **Session Panelists: Maureen Wilmot, NOAA/National Ocean Service, Ocean and Coastal Resource Management; Melanie Murray-Brown, NOAA/National Ocean Service; Mark Duda, Responsive Management Co.**

No abstracts submitted.

Session A3: The Role of Training in Improving Local Land-use Decision-making.
Chair: Pam Pogue, University of Rhode Island, Coastal Resources Center

INNOVATIVE, COMMUNITY-BASED EDUCATION: THE KEY TO LINKING WORKFORCE AND ECONOMIC DEVELOPMENT WITH ECOSYSTEM RESTORATION

Flaxen D.L. Conway,
Oregon State University Extension Service and
Derek C. Godwin,
Oregon State University Extension Service

History and Context

Vast forests cover nearly one-half of the Pacific Northwest and have played a historic role in the economic development of the region (Brunelle,). Certainly in Oregon, where about 24 million acres of the state's 61 million acres are forested, history and current character have been shaped largely by the harvesting of timber (Conway and Wells, 1993). Natural resource-based industries, such as fishing and timber, are an important source of income for coastal communities in the Pacific Northwest. A study in 1989 estimated that about 36% of the personal income received by residents in Oregon's coastal communities was generated by natural resource-based industries (Radke, 1993). From the small communities dependent on a single mill for their primary employment to the metropolitan areas where many large forest products corporations are headquartered, the forest products industry has accounted for approximately one-third of all manufacturing employment in the Pacific Northwest (Brunelle, 1990).

Forests in the Pacific Northwest have been the focus of a public policy and management controversy for the last several years. As studies on the ecology of late successional forests began to proliferate in the 1970s and 1980s, it gradually became apparent that a simplistic approach to forest management based on high-yield, short-rotation forestry was not going to adequately protect the considerable biodiversity that was present in late successional forests and their associated aquatic ecosystems. The northern spotted owl was the first species to receive recognition in this regard followed closely by the marbled murrelet, anadromous fish, and the recognition that a wide variety of species are closely associated with old forests. More recently, ecologists, foresters, and the public have begun to recognize that the old forests that remain in the Pacific Northwest may be unique ecosystems that developed under climatic and disturbance regimes that may never be duplicated. The same mature coniferous forests that have provided forest products have also provided important and productive freshwater habitat for many species of salmon. Coastal and inland communities have begun to realize that these forests, in general, serve a wide variety of purposes: wood, water, oxygen, forage, wildlife, fisheries, scenery, and opportunities for tourism and recreation (Lee, Field, and Burch, 1990).

Changes in public perceptions and expectations concerning management on federal lands in the Pacific Northwest and elsewhere have led to a gradual increase in protection of unique ecosystems and species, increased concern with riparian areas, and experimentation with methods designed to retain some of the structural features found in old forests and thereby more closely imitate natural disturbance regimes. Top administrators encouraged the region's leading scientists to develop a plan for restoration to speed ecosystem recovery in areas of degraded habitat and to prevent further degradation. In July 1993, the President held a news conference to announce the new land management plan ("The Forest Plan") for resolving the issues that would meet the requirements of the Endangered Species Act. This plan involved severe restrictions on timber harvest in the national forests west of the Cascade mountains. In addition, the President created the Northwest Economic Adjustment Initiative (NWEAI), an extensive assistance program of over several billion dollars over a five-year period targeting timber-dependent communities in the "owl region" of Washington, Oregon, and Northern California. The NWEAI was a means to help these communities develop new economic opportunities for year-round, high-wage, high-skill jobs and to support the inter-relationship of ecology, economy, and community.

However, to do this successfully would require changing "business as usual" in forest resource management. For example, land managers typically design project work contracts without regard for the local employment aspect, they often accept bids based on the lowest cost, and consequently don't get quality work. Traditional forest reforestation work is dominated by contracting practices that form low-cost, low-skill, and low-quality work practices. In short, it is a "lose-lose" for all parties involved.

One Creative Project That Linked Workforce and Community Economic Development with Ecosystem Restoration

In order to actualize the "Forest Plan" and its outcomes, forest management and forestry work will/are transitioning from a primarily forest products harvesting focus to an ecosystem management focus— a forest management industry based on creating and maintaining healthy forests. Concurrent with this transition, there is a desire to sustain healthy, forest-based communities by providing good jobs for community residents. Merging these twin goals of healthy forests and good jobs is the groundwork of the Ecosystem Workforce Project (EWP).

Starting in 1994 as a small-scale pilot effort (1 locale, 10 workers), in 1995 the EWP has grown to 7 locally-based "demonstration projects" illustrating that local dislocated forest workers could be successfully linked with restoration work and skill-building education at family wages with benefits. In short, a situation that was good for the forests, good for the local economy, and good for the personal and professional development of the worker-trainees.

The 75 worker-trainees in these 7 demonstration projects worked for a full work season (7 to 12 months depending on the climatic conditions of their region) utilizing existing skills and developing new skills, knowledge, and abilities. They typically worked four days per week successfully meeting stated resource management objectives and determining and understanding the effects of different approaches on clearly-defined, desired outcomes for project work. In short, these crew accomplished the work in a quality manner and demonstrated that they could learn and use their enhanced skills to excel in work. They were, in fact, setting new industry standards.

Education's Role in the EWP

The many competing demands placed on the forests have illustrated the futility of ignoring the human components of forest ecosystems (Lee, Fields, and Burch, 1990). Communities, whether defined by locality or interest (Hillery, 1955), are the links between humans and their natural environment. As a young man in graduate school in 1939, Harold Kaufman described it as the changes in forest practices that may best be promoted by an understanding of the human process of adoption and diffusion of new knowledge among residents of communities. In recent times, Bill Jordan, University of Wisconsin, concurs when he says that the greatest value of ecological restoration will not be in its ability to transform the landscape directly, but in its ability to transform it indirectly through the education and transformation of the human beings who inhabit and shape it.

The key to this "education" and the resulting transformation is to design and deliver a learning environment that meets the needs and desires of the learners. In other words, most existing, traditional university or community college programs were of no interest (or intimidating at best). Generally speaking, the EWP worker-trainees were adult learners, most with a high school or lower reading level, and little interest in the traditional learning environment. As they have often said, "We like to learn by doing and in the forest management industry we often learn 'side by side'." They possess a great deal of practical knowledge and skills, yet often narrowly focused on one or two tasks. All have agreed that the key would be to design and deliver training that exposed them to practical theory and helped to consummate their understanding of it by combining it with hands-on, field-based, task-specific training. And to deliver this locally where possible.

In the EWP, worker-trainees also spent one day per week, for roughly 23 weeks, in practical, interactive, classroom- and field-based sessions regarding three broad topics:

1. Science (such as forest ecology, stream ecology, forest management, restoration practices and theory, wildlife management, etc.),

2. Technical and Safety (such as measurement and survey, fire behavior/fighting/management, forest practice laws and regulations, worker and equipment safety, etc.), and

3. Business Development and Management (such as business planning and record keeping, applicable laws and regulations, business and worker performance enhancement, contract bidding and management, entrepreneurial skills, etc.) as related to ecosystem management.

The "trainers" were generally a myriad of educators, industry professionals, and other interested partners in the demonstration projects. Most delivered their sessions *in gratis*. All in all, these somewhat makeshift educational programs were well received. Potential employers and worker-trainees alike valued the topics covered in the training and showed appreciation for the "certificates of completion" and apprenticeship credit that the worker-trainees received.

However, in November 1995, when interested partners involved in EWP demonstration projects got together in a two-day forum to discuss challenges and successes, one of the concerns that surfaced was the need for some standardization with regards to the "practical, interactive, classroom- and field-based sessions" described above. All agreed that these sessions should be community based and offer the local regions the flexibility to create meaningful learning experiences that were applicable for their geographic region. However, wasn't there a way to deliver regular, continuing-education that would begin to set the standards in this evolving industry? And how could this be done in a way that cultivated the interest of these adult learners? These workers made it clear that the traditional educational environment was not only not desirable, but was also intimidating enough that most would choose not to participate. All agreed that what was needed was to begin the creation of a "foundation" of a standard curriculum for the continued learning of the forestry/ecosystem workforce, and stay creative in how and by whom it was delivered. The question was, could this be done in time for the 1996 work season (March/April 1996)?

Laying a Foundation

In late 1995, Flaxen Conway, OSU Extension Community Outreach Specialist, convened an innovative, interdisciplinary team of educators from a wide range of educational resources (universities, community colleges, agencies, NGOs, industry, etc.). These educators had expertise in forestry and agricultural sciences, fisheries and wildlife management, watershed management, and forest and stream measurement and survey, worker and equipment safety, contract bidding and management, apprenticeship, and business development and management. This team evaluated existing training materials and used their years of experience, perspective, and research-based information to develop a new, work-based, practical curriculum. This curriculum is comprehensive yet remains flexible to accommodate new learning and management techniques.

It was a big but necessary task. Those involved never lost sight that the idea was to create support materials that would assist local, community-based education efforts to aid workers to diversify their knowledge, skills, and abilities, and to comprehend and use new ways to manage ecosystems wisely. The good news was that we did not have to start from scratch and we weren't ever expecting that we would create the "Sistine Chapel" of a curriculum. Nor should we. Rather, our task was to take existing information that, when "mixed or re-designed the appropriate way," created the "first story" of a curriculum.

The team worked collaboratively and in an unbelievably-short time, produced a rough draft that was reviewed by 10 peer (educators, industry professionals, land managers, scientists, business professionals, and EWP worker-trainees) reviewers. With their careful review, the team then incorporated their input to create an end product that began to meet the needs of these learners. It was a brief, practical, handy, coordinated, easy-to-read/use, and enjoyable teaching and reference resource; something that could be used as is by industry workers or by traditional education providers throughout the region (or nation) in continuing education or specialized training programs for existing workers, businesses, etc.

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Flaxen Conway
OSU Extension Service
Ballard Extension Hall 213
Corvallis, OR, USA 97331-3601

Ph (541) 737-1418
Fax (541) 737-2563
Email conwayf@oes.orst.edu

Session A4: On-line, Byline, or Redefine - How to Communicate with New Coastal Audiences. Chair: Kurt Byers, Alaska Sea Grant Program

ONLINE, BYLINE, OR REDEFINE – HOW TO COMMUNICATE WITH NEW COASTAL AUDIENCES

Kurt Byers, Alaska Sea Grant Program,
Charmaine McClellan, Fleet Capital Corporation,
Bruce DeYoung, Oregon Sea Grant Program, and
Susan McBride, California Sea Grant Program

About 110 million people, almost half of the nation's total population, now lives in coastal areas. By the year 2010, the nation's coastal population will have grown from 80 million in 1960 to more than 127 million people, an increase of almost 60 percent nationwide, according to the NOAA Office of Ocean Resources and Conservation Assessment.

As population increases, new industries and infrastructure develop to serve the populace. Accepted paradigms over best use of resources change or disintegrate. Traditional industries, lifestyles and cultures that thrived prior to the influx of new residents often face a painful period of adaptation. And increasing numbers of people inevitably put new and sometimes extreme pressure on the natural environment.

Coastal managers and other decision makers must grapple with the daunting task of sorting through the complex cause-and-effect relationships created by the movement of people to our coasts. Resource managers become crisis managers as conflicts arise over resource use and environmental quality.

Clear, effective, efficient communication among resource managers, policy makers, scientists, private citizens, and other stakeholders is critical to any strategy aimed at wise and rational management of the social and natural environments of our coastal regions.

The communicators for six Pacific Coast Sea Grant Programs invited a panel of three speakers together to address some of these issues. The speakers are listed below, followed by summaries of their presentations.

<u>Charmaine McClellan</u>
Fleet Capital Corporation

Coastal demographic patterns are shifting in the late 20th century, as coastal cities continue to grow in population and diversity. Coastal audiences are no longer comprised only of fishermen and marine-related businesses, but by residential, recreational and other business uses. As coastal audiences change, those who need to communicate information about natural resources, recreational opportunities, threats to habitat and wildlife, as well as other topics, must expand the reach of their messages and communicate interactively with their clientele.

Information technology provides the tools to analyze audiences and to assist in developing innovative approaches for communicating information.

Management information systems (MIS) help to gather, manage and analyze information about audiences so that communications professionals can best determine how to transmit educational material. At the same time, these tools can be used to assess the way in which the information is used and how audiences respond.

The key to using these systems is research — both in preparation for the dissemination of educational information and for the analysis of responses in target clientele groups. As a first step, communicators need to analyze their own systems for delivering information, in terms of resources, expertise, and message. At the same time, background research on audience interest, size and geographical reach can be conducted. Most important, it is incumbent upon communications professionals to assess how audiences best receive information, and to match the message to be transmitted with what audiences will respond to and actually use.

Tracking the effectiveness of information is dependent upon gathering information about audience response. Pre- and post-delivery sampling provides one way of doing this, and MIS systems help to identify trends in clientele attitude and knowledge, and the weaknesses and strengths of the information delivery methods.

New and innovative information technologies (electronic information services and mass media, along with traditional means of reaching target groups such as publications and personal contacts) promise to improve the ability to communicate to new coastal audiences important information about enjoying and protecting vulnerable natural resources. Proactive planning, information management, and audience analysis are equally important tools for assessing the most effective delivery of this information.

Bruce DeYoung
Extension Sea Grant Specialist
Oregon State University College of Business

The recreational activity of new coastal residents, throngs of tourists and increasing numbers of enterprises serving them is increasing the pressures on fragile coastal resources. While increased enforcement of regulations can reduce some of the anticipated environmental degradation, expanded information, and education is critical to advancing appropriate human behaviors.

The challenge is delivering appropriate information in a timely fashion to encourage people taking personal responsibility for decreasing their environmental impact. This enormous educational task is made difficult by sweeping reductions of public funding for outreach with coastal residents, tourists, and recreation enterprises.

New electronic tools are already being employed to address the coastal recreation and tourism (CRT) educational challenge at hand. The imaginative use of emerging information technology is a strategic response for addressing the growing demand for educational outreach with a shrinking set of human and financial resources.

Three examples of novel techniques being used to boost CRT communication and collaboration include: 1) forming a "virtual CRT community;" 2) distributing CRT educational resources via Internet/WWW; and 3) applying low power AM Radio technology to CRT education.

Virtual Communities — Electronic (email) mail discussion groups enable those with like interests and Internet access to share information across space, time, and culture.

Low Power Radio — The use of limited range AM broadcasts is gaining in popularity and use for reaching targeted audiences with information they desire JIT ("just in time").

Web Sites — Internet/WWW sites are being used as decentralized, interactive databases to distribute information and education on demand by clientele.

These communication channels hold promise for reaching the new coastal clientele. While not yet mainstream communication, these anticipatory tools are experiencing initial success in reaching those surfing the virtual coast.

Susan McBride
Sea Grant Extension Program

Communication to coastal residents who are experiencing a change from the historical employment in large resource-dependent industries to more self-supportive activities resulted in two extension programs in Humboldt County. The first is a rainbow trout cooperative organized by 20 small land owners. The second is revitalization of a publicly owned waterfront structure into a multi-use facility.

The rainbow trout cooperative resulted from several individual requests for information by local residents. To achieve this goal, personal letters, surveys, workshops, technical expertise from the UC Davis Center for Cooperatives and the USDA Cooperative Center were used. Four months after the initial workshop and many meetings later, the cooperative was officially incorporated. Training workshops on trout culture, video-teleconferences on aquaculture issues, and monthly meetings of the cooperative members established the group process. Members either grow trout or operate fee fishing lakes where trout are stocked.

This was a non-traditional project for a Marine Advisor. I found it necessary to expand my usual role of providing technical expertise on aquaculture to providing information on forming a cooperative. Use of resources available through the University of California enabled this to occur. My role in this project was primarily one of providing information. The motivation of the group accomplished their desired objectives.

On the Humboldt Bay waterfront, several groups and individuals were interested in the Fishermen's Building, a large, wooden waterfront warehouse with 500 feet of dock, owned by the City of Eureka. It had historically been used as a shipping warehouse, passenger terminal for coastal steamers, a crab processing plant, and had housed a fishing gear supply store. Those interested in the building were from the fishing and aquaculture industries, local farmers market vendors, recreational boaters, business owners, and a historian.

The group members educated themselves and the community about the history of the waterfront, tidelands issues, the possibilities for the Fishermen's Building, and examined what other communities had done with their waterfront. We exchanged information they researched, participants gave historical tours of the waterfront to interested individuals, and made several displays at public events. Sometimes city staff attended the meetings and often asked for advice or information on particular aspects of waterfront revitalization. Communication between the individuals and groups involved led to a Request for Proposal for redevelopment of the Fishermen's Building. The group worked with one applicant who used the plan the group developed and was granted the redevelopment rights to the building.

Kurt Byers
Alaska Sea Grant College Program
University of Alaska
Fairbanks, AK, USA 99775-5040

Ph (907) 474-6702
Fax (907) 474-6285
Email FNKMB1@aurora.alaska.edu

Session A5: Tools and Approaches for Addressing Contamination and Enhancing Coastal Ecosystem Health
Chair: Alyce Fritz, NOAA/National Ocean Service

NOAA's NEWARK BAY WATERSHED PROJECT: USING A WATERSHED APPROACH IN SUPERFUND

L. Jay Field,
NOAA/National Ocean Service
Jackie McGee and Al Hielscher,
Genwest Systems
Tim Hammermeister and Corinne Severn,
EVS Consultants
Diane Wehner,
NOAA/National Ocean Service

Introduction

The management of complex watershed issues is made easier by the ability to quickly examine and display varied combinations of information at different spatial scales. The National Oceanic and Atmospheric Administration (NOAA) Coastal Resources Coordination Branch (CRCB) has developed a watershed database and mapping system to link and display information regarding contaminant sources, sediment contaminant and toxicity data, distribution of natural resources, and possible habitat restoration projects. The primary goal of these CRCB watershed projects is to collect and organize available information which can be used to prepare geographical presentations that will be useful in addressing important issues on a watershed basis.

NOAA CRCB has applied this approach to four pilot watershed projects for different areas (Newark Bay, San Francisco Bay, Christina River, and Calcasieu Estuary). Although each of these projects has its own particular focus, they share a common framework that promotes data-sharing and allows analysis tools developed for one project to be applied in other areas. The main objectives of these projects are to provide coastal resource managers with information and tools to support decision-making for issues concerning site remediation, dredging and disposal of contaminated sediments, and habitat restoration. These projects use the same database structure and mapping application, but the specific information included varies between the watersheds according to the major objectives for data analysis and presentation.

The Newark Bay Watershed is in an highly industrialized area of northeastern New Jersey, almost entirely within the metropolitan area of Greater New York City. Chemical contamination from seven Federal

Superfund sites within the watershed may seriously threaten aquatic biota and their habitats. Other sources of contamination in the watershed include industrial discharges, municipal wastewater discharges, accidental spills, and non-point stormwater runoff. Since 1983, the watershed has been subject to fishing advisories and closures due to PCBs, dioxin, and chlordane contamination. In addition, required navigational dredging in Newark Bay has been delayed because the sediments are too contaminated for open-ocean disposal. No other disposal sites are available. As the Department of Commerce- designated trustee for marine resources, NOAA CRCB works closely with the U.S. Environmental Protection Agency and other agencies to both evaluate and mitigate the effects of releases of hazardous waste into the coastal zone. Because of the number of Superfund sites within the Newark Bay watershed and the importance of the area both for NOAA trust resources and commercial uses, NOAA included the area as a watershed pilot project.

The approach combines NOAA's mapping application, MARPLOT™, with a relational database system developed in a commercially available software program. This software combination promotes information sharing between users within the geographic area, and provides a rapid and convenient way to create map displays of summarized or unsummarized data. The system provides a flexible selection of scale, which means that the user can examine detailed information on a selected site vicinity or expand the view to put data from the site into a broader watershed context. The primary data types stored in the relational database system include sediment chemistry, sediment bioassay, and tissue chemistry data. The watershed database and mapping programs run on standard desktop Macintosh and Microsoft Windows-based personal computers.

Document Catalog

Creation of a document catalog is the first step in the process. This catalog compiles all of the available studies that have sediment chemistry, tissue chemistry, or biological effects (primarily sediment bioassay) data from the watershed. The catalog synopsizes each study, describes the amount and type of data available, and describes the form of the available data (the electronic format, if available). Distribution of the catalog among other groups working in the watershed makes it possible to determine whether important studies have been overlooked. The catalog also plays an important role in identifying the studies with the highest priority for incorporation into the watershed database. Updates to the document catalog are made as new information becomes available.

Database

Following the review of studies with data from within the watershed, available sediment chemistry, tissue chemistry, and sediment bioassay data sets were prioritized for addition to the database. Data sets were selected based on a number of factors, including the year of sample collection, availability in electronic format, and data quality. Most data were imported directly into the database from electronic spreadsheets provided by the study investigators. Primary data categories include both surface and subsurface sediment chemistry, tissue chemistry, and sediment bioassay data.

The watershed database was developed in Microsoft FoxPro™, which provides the advantages of a relational database and a cross-platform application. The database makes it possible to store a large amount of detailed information from a number of different studies in a standardized format while maintaining easy access and flexible import and export capabilities. Relational Query By Example (RQBE), an important feature of the database, allows detailed queries of the database without the need for programming. The database software also has a powerful programming language for more complex queries. Users can save database queries and programs in a menu of available options tailored to their requirements. The queries are used to provide data to the mapping application or to other applications (*e.g.*, statistical or graphics packages) for further analysis. Data transfer to other users is straightforward, since the database files are in a standard "Xbase" format, which is directly usable by many other software packages. In addition, data can be exported in a wide variety of other file formats.

Mapping

Mapping Application for Response, Planning, and Local Operational Tasks (MARPLOT™) is a general-purpose mapping application program developed by NOAA for use with its Computer-Aided Management of Emergency Operations (CAMEO™) program. MARPLOT allows the user to create, view, and modify maps quickly and easily. Objects on these computer maps can be linked to data in other programs. MARPLOT is also a cross-platform application that is designed to run on both IBM-compatible and Macintosh personal computers. Because of relatively small system and memory requirements, it can easily run on desktop computers and is very portable.

Electronic base maps for the Newark Watershed Project were obtained from Bureau of Census Tiger data files. Base maps of the watershed area also include additional data layers such as the location of National Priority List sites and National Pollutant Discharge Elimination System-permitted facilities. Database queries can be directly linked to the MARPLOT maps.

Application to Superfund Site Investigations

The database-mapping system has a number of direct applications to Superfund site investigations. The system provides a flexible selection of scale, which means that the user can focus on the immediate site vicinity or expand the view to put data from the site into a broader watershed context. The primary data types stored in the database include sediment chemistry, sediment bioassay, and tissue chemistry data.

Simple queries of the database produce maps showing the locations of all sediment chemistry samples for each individual study or for all studies combined. Maps of individual contaminant distributions are useful for identifying hotspot areas or contamination gradients. Maps of sediment chemistry also may be useful in identifying areas or sites that do not appear to be a source for a particular contaminant. Sediment chemistry data includes both surface and subsurface data. Chemical concentrations can be compared to available sediment quality guidelines to determine the number of guidelines exceeded by an individual sample, which can be helpful in prioritizing areas based on the degree of contamination. Maps displaying existing sediment chemistry data from several studies were recently used to help select sampling locations for a Superfund site remedial investigation in the watershed.

Sediment bioassay data include both detailed information on the specific test used and information on the test performance (*e.g.*, control survival) that is important in evaluating the test's quality. Maps can be easily prepared displaying the locations of toxic and non-toxic samples. The combination of sediment bioassay results and sediment chemistry data can help prioritize areas for further study or remedial action.

Tissue chemistry sample data includes details on the organism sampled such as the species, tissue type, size, sex, percent lipid, and number of organisms composited. Maps can be prepared showing the tissue concentrations of bioaccumulative contaminants such as dioxin, PCBs and mercury. Although most tissue data cannot be associated with a specific sediment sample, the tissue data from a specific location can be linked to sediment chemistry data from the same station area to calculate bioaccumulation factors. This can be useful in developing sediment cleanup levels.

Summary

The watershed project, while still in the development phase, already has provided important benefits to different user groups and enhanced cooperation and data sharing. Combining all the data from a Superfund remedial investigation with other recent data in a single database-mapping system helps investigators associate the distribution of contaminants with specific sites. Combining restoration information with contaminant data can facilitate selection of restoration sites with a high potential for success. The resulting integrated data and graphical displays make a powerful tool for sharing and presenting information and accommodating the data needs of managers. The database-mapping system has several important applications to watershed investigations because it allows users to:

1. Evaluate multiple data sets within a geographic area;
2. Identify chemical concentration and toxicity gradients;
3. Prioritize problem areas based on sediment chemistry, sediment toxicity, and tissue chemistry;
4. Catalog and evaluate potential restoration habitats;
5. Identify important data gaps; and
6. Add and share new information.

The Newark watershed pilot project database-mapping system is proving useful throughout the Superfund remedial decision-making process, from identifying locations for the collection of additional samples, to providing the historical context for interpreting the data. This is a versatile tool that can be applied to many different coastal resource issues and improve the effectiveness of coastal resource managers.

L. Jay Field
NOAA/National Ocean Service
Hazardous Materials Response and Assessment Division
7600 Sand Point Way N.E.
Seattle, WA, USA 98115

Ph (206) 526-6404
Fax (206) 526-6941
Email Jay_Field@hazmat.noaa.gov

THE NOAA CHRISTIANA RIVER WATERSHED PROJECT

Gayle Garman, Peter Knight, and
Mary Baker Matta,
NOAA/National Ocean Service;
Benjamin Perkowski, Tim Hammermeister,
Corinne Severn, and Kimberly Stewart,
EVS Consultants;
Jackie McGee and Al Hielscher,
Genwest Systems

NOAA and other agencies serve as natural resource trustees for species and habitats managed by the federal government on behalf of the public and future generations. Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), the Coastal Resources Coordination Branch (CRCB) of NOAA's Hazardous Materials Response and Assessment Division works with EPA and other agencies to ensure that public trust species and habitats affected by hazardous material releases are remediated, restored, or replaced.

In cooperation with federal and state natural resource agencies, and the New Castle County Water Resources Authority, NOAA CRCB has undertaken a combined resource mapping and database project for the Christina River Watershed. The Christina River discharges to the Delaware River, immediately south of the city of Wilmington, Delaware. The Christina River Watershed consists of the Christina River, the Brandywine River, White Clay Creek, Red Clay Creek, and the wetlands and tributaries associated with each waterway (Figure 1). This watershed contains three Superfund sites in the process of remediation, several state hazardous waste sites, and numerous other potential contaminant sources. The state of Delaware has identified several large projects that would improve conditions for species found along the rivers, and other public and private organizations are undertaking habitat enhancement projects. However, existing contamination in the waterways may impede the success of these habitat restoration projects unless information regarding contaminant distribution is part of the planning process. The goal of NOAA's Christina River watershed project is to facilitate successful remediation and restoration at an ecosystem scale by collecting data gathered by other agencies; using a relational database to organize, store and manipulate the data; and analyzing the data spatially through an easy to use geographic display program created by NOAA.

Once the project goals are defined, project participants make a thorough search to identify sources of pertinent information. The sources are contacted to explain the purposes of the project and encouraged to share relevant information with the incentive of future information exchange.

NOAA's watershed projects do not generate new data, and the utility of the project is dependent upon data availability from other sources. However, any area with active Superfund investigations generally is rich in high quality, publicly available data relating to degree and location of contamination. In order to minimize data entry requirements, it is preferable to obtain electronic data files in database or spreadsheet format.

The information obtained from outside sources is abstracted and compiled to create the first product, the Document Catalog. The Document Catalog is a detailed reference list of reports and data sets associated with the watershed. Each report is reviewed by a staff ecologist to abstract detailed information pertinent to the project's purpose; including which subwatershed(s) and type(s) of wetland(s) were studied, any data regarding species utilization, habitat values, bioassay tests, tissue chemistry, sediment chemistry, numbers and locations of samples, chemical analytes reported, and finally, an evaluation of data useability. In addition, each report is abstracted to provide a paragraph of text describing the report and providing clarifying information. The abstracted information and the paragraph of text are entered into the database, which can be queried to create summary tables listing reports with specific data types and quality (*e.g.*, bioassay data, wetland data, or species utilization data). These tables facilitate prioritizing data sets for further analysis and mapping. The paragraphs describing each report and the summary tables are combined in a hardcopy Document Catalog for distribution. The collection, abstraction, and sharing of information from numerous sources, in itself, facilitates coordination among organizations working on natural resource issues affecting the watershed.

The project team uses the information in the Document Catalog to select priority datasets for import into the database. Each dataset must be evaluated for data quality and utility to ensure that data incorporated into the project are appropriate for anticipated decision-making. For example, data from Superfund reports have undergone a data quality evaluation prior to EPA acceptance. Chemistry data from other sources or from older reports may not have gone through this process. All laboratory qualifiers and detection limits are included with sediment chemistry data imported into the database.

The relational database provides for linking of different files that have a common field. For example, chemistry data collected at different times but at one location can be linked through a unique station identifier. Concentration data for a particular analyte collected in several different studies can be combined to develop a file and linked map showing the distribution of the analyte over the watershed. Concentrations for one or many analytes can be compared to a benchmark concentration and sorted so that only concentrations exceeding the benchmark will be displayed. In addition, it is possible to establish ranges of concentrations to display gradations of concentration. The resulting files are linked to map layers which display the spatial relationship between the data and the geographic features of the watershed.

MARPLOT™ is a public domain program created by NOAA that allows the user to create and modify baseline maps, map layers, and objects on map layers. The map layer is a grouping of related objects or data types. For the watershed projects, public domain GIS sources such as the Bureau of Census TIGER files and EPA Landview are searched for relevant geographic data layers to create a baseline map. The baseline map includes shorelines, rivers and streams, roads, census tracts, railroads, industrial sites and Superfund sites. Additional data layers showing watershed, subwatershed, wetlands, habitat characteristics, and species utilization were added as information became available. New area layers, such as wetlands or critical habitat, can be created by using the program's polygon drawing capability. The linkage of the mapping and database applications also provides for on-screen display of the database source for each map layer and map object.

Data from EPA reports are used principally to document contaminant concentrations at specific sampling station locations. By creating a database file that locates each sampling station geographically, the chemistry data stored in the database files can be combined, sorted, and/or transformed to create a new file which is linked by the unique station identifier to specific geographic locations. Through the linkage of data to the unique geographic location a MARPLOT™ data layer is easily created which will display the data as an icon at the appropriate location. For example, lead concentrations in soil and/or sediment can be shown as an open circle for non-detect values, a quarter full circle for values that represent a low risk, a half-full circle for values that represent a moderate risk, a three-quarter circle for values that represent a higher risk, and a full circle for values that represent the highest risk level. Ranges for data representation can be easily modified.

Conversely, a layer can be created that shows stations where no chemical risk screening criteria are exceeded, indicating a location that is ideal for habitat restoration, unless of course, an area of significant contamination is located in close proximity to the proposed restoration site. Again, using a mapping application to display the datasets that are related and combined in the database allows the decision-maker to review all the data, or only selected data, in its spatial context and relate the analytical data to distribution of resources.

The ease with which a non-technical user can scan the information that is geographically organized in MARPLOT™ provides easy access to the combined data sets in an broad range of scales. The increased ease of data access, organized in a geographic context, facilitates planning and coordination between specific projects to optimize successful restoration at a watershed scale. The combined use of mapping and database files to assimilate, manipulate, and display data creates a comprehensive catalog of reports and MARPLOT™ map and data layers relevant to the study area and focus; provides an off-the-shelf mechanism that can run on desktop computers to edit, combine, and compare all of the database information at any user defined scale; and generates data layers that can be exported with a translator to ASCII files suitable for importing into GIS systems.

Advantages of NOAA's Method:

1. A single document locates and describes all available reports, datafiles, and information sources, to facilitate coordination among individual projects.
2. Geographic display of data provides an easy to use mechanism for a range of analyses, from identifying significant data gaps to planning of broadscale restoration.
3. The ability to combine information from throughout the watershed facilitates consideration of ecologic linkages such as hydrologic transport of contaminants, and migration of fish species.

The project is proceeding in steps and increasing in utility as new data become available. Currently, the project includes information on areas and sources of contamination, large and small scale hydrology, utilization of aquatic habitat by trust resource species, and potential areas for mitigation or restoration. In cooperation with the other natural resource agencies, NOAA continues to collect, organize, and analyze data and reports in order to optimize wetland mitigation and restoration projects which will support the longterm recovery of aquatic resources in the watershed. Information developed through the project is shared to improve the efficiency and effectiveness of all agencies in their mutual goal of improving the environment of the Christina River Watershed.

Gayle Garman
NOAA/National Ocean Service
Coastal Resources Coordination Branch
7600 Sand Point Way, NE
Seattle, WA USA 98115

Ph (206) 526-4542
Fax (206) 526-6865
Email ggarman@hazamt.noaa.gov

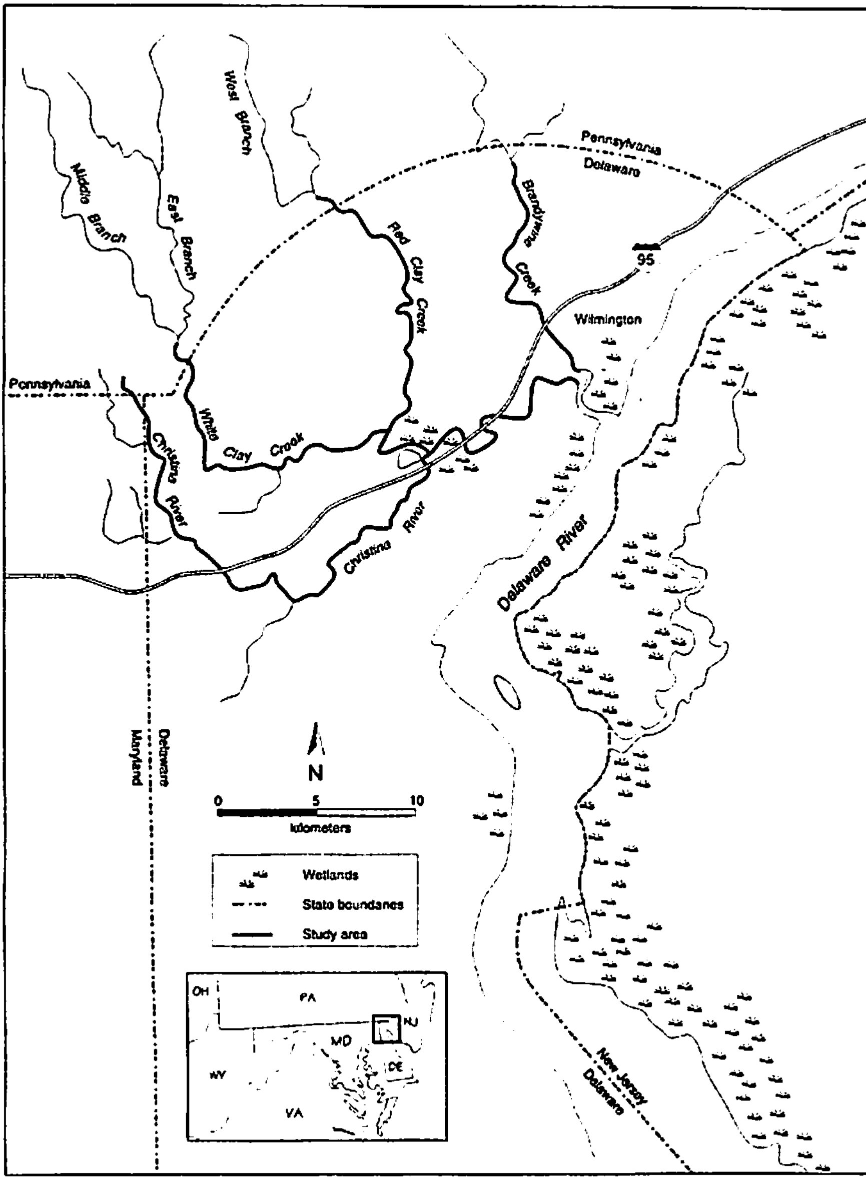

Figure 1. Location of the Christina River Watershed in northern Delaware.

REMEDY SELECTION AND MONITORING: A LOCAL SUCCESS STORY

Mary Baker Matta, NOAA/National Ocean Service
Chris Beaverson, NOAA/National Ocean Service
Chris Cora, EPA Region 10

Background and Site History

The NOAA Coastal Resource Coordination (CRC) Branch serves as a natural resource trustee under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA provides a funding mechanism and decision-making framework for the cleanup and restoration of hazardous waste sites (Figure). The U.S Environmental Protection Agency (EPA) oversees CERCLA, and various natural resource trustee agencies (including states, tribes, and other federal agencies in addition to NOAA) advise the lead agency on cleanup strategies that protect natural resources. The law provides EPA with a number of alternative approaches to cleaning up waste sites and encourages voluntary participation by responsible parties. This abstract describes a site where responsible parties are cooperatively working with EPA, NOAA, and other trustee agencies to provide a cleanup that will protect human health, the environment, and natural resources.

The Strandley-Manning Superfund site is located at the head of Burley Lagoon on south Puget Sound near Purdy, Washington. Surface runoff and shallow groundwater from the site discharge to an on-site stream. The on-site stream is spring-fed and is fewer than 0.5 km long. There is a series of three small ponds along the stream. The stream flows into Burley Lagoon through shallow tidal creeks which meander through a salt marsh. The site is wooded with a canopy dominated by western red cedar.

The site was used for scrapping and salvaging electrical transformers between 1972 and 1983. To recover metals, the transformer cores were burned. Not only were waste transformer oils containing polychlorinated biphenyls (PCBs) stored in a leaky rail tank, they were burned for heat, used as hydraulic fluid in vehicles on site, and used as a dust suppressant on roads. As a result, soil and sediment throughout the site were contaminated with PCB compounds, and some areas of soil contained elevated concentrations of dioxins produced by the burning of PCBs.

EPA conducted an initial removal action in 1985-86 to remove 10,000 cubic yards of soil contaminated with PCBs and dioxins. A siltation basin on the stream (containing sediments and surface water behind a dam) prevented runoff of contaminated sediments. This removal action was followed by extensive monitoring of groundwater, stream and marsh sediment, and estuarine organisms downstream of the site.

Since EPA's initial removal action, the responsible parties have conducted an investigation under EPA's oversight and are planning another removal action under an administrative order on consent. This cooperative order directs the voluntary group, led by Seattle City Light, to take action at the site. Cleanup goals were selected for the site soils and sediments to meet sediment and soil management standards set by the State of Washington for the protection of human health and the environment.

NOAA's Studies

During the process of selecting cleanup goals for the site, the responsible parties noticed that there were cutthroat trout residing in the stream. The installation of the containment dam apparently trapped a small number of fish in 1986. The small size of the stream makes it unlikely that the fish in the stream were year-round residents before the construction of the dam. Since the sediments in the pond and lower reaches of the stream have been highly contaminated with PCBs, and PCBs are known to cause reproductive problems in fish (Von Westernhagen *et al.*, 1981; USACOE, 1988), NOAA was concerned that these fish might be suffering adverse effects from PCB exposure.

During NOAA's initial investigations at the site in February 1994, the unexpected observation was made that, out of 19 adult fish collected in the pond, 17 were spermeating males and two were of unknown sex. Because there were no mature females found in the pond, the original design of the study (to determine early life stage survival by spawning site females) was not feasible. However, this raised the question of why there were no females in the pond.

In addition to the known adverse effects of PCBs on early life stages of fish, PCBs are known to be endocrine disrupters. Some PCB compounds appear to act as estrogenic compounds (Korach *et al.*, 1988). There are some indications that PCBs can influence sex determination (Colborn and Clement, 1992; Crews *et al.*, 1995).

Therefore, an investigation was initiated to determine whether: 1) fish at the site are contaminated with PCBs; 2) sediments from the site have the potential to reduce egg hatchability and larval survival and alter sex ratios in trout; and 3) male fish in the pond are genetically female (and reversed sex during sexual differentiation). The reproductive success of the pond males will also be evaluated.

The first objective was met by chemical analysis of muscle tissue of five fish from the on-site pond and four fish from an uncontaminated reference site in the Olympic National Forest. Individual PCB congeners were measured and summed to calculate total PCB concentrations. Results indicate that fish taken from the pond were highly contaminated with PCBs (muscle tissue contained an average total PCB concentration of 48 ppm wet weight, as compared to 0.014 ppm at the reference site).

The second objective was evaluated by exposing fertilized eggs of trout to extracts of pond sediment and to whole sediments from the pond under laboratory conditions. Embryos and newly hatched larvae were also placed in cages just above the sediments of both the contaminated pond and a relatively uncontaminated reference pond on the site. Preliminary results indicate that the extracts of sediments taken from the lower pond were extremely toxic to eggs and larvae, with 98-100% mortality in larvae within a few hours of exposure. Eggs and larvae caged in the pond over sediments of the lower pond exhibited reduced survival when compared to controls. However, survival of eggs exposed to pond sediments under laboratory conditions did not differ from those exposed to control sediments. Sex ratios of surviving fish were similar in all groups.

The third objective was met by fertilizing eggs of coastal cutthroat from an uncontaminated reference site with sperm from male fish from the contaminated pond. Endpoints include fertilization success, hatch success, larval survival through yolk resorption, and sex ratios of offspring. Male fish from the reference site were used as a comparison to evaluate reproductive success and interpret sex ratios of offspring. The investigation of reproductive success of male fish from the pond is underway.

Cleanup Plans

Based on the results of the initial investigations and EPA's cleanup goals, a removal action has been planned for the summer of 1996. Fish have been removed from the site and are temporarily residing in an artificial pond nearby. The influx of shallow groundwater to the head of the stream will be controlled and clean water will be diverted around the stream to discharge into Puget Sound. Sediment movement and erosion will be prevented. Approximately 3,500 cubic yards of sediment and soil will be removed, temporarily stockpiled, and dewatered on the site. Very highly contaminated soils (those containing more than 300 ppm PCBs) will be incinerated, and other soils will be landfilled. The excavated areas will be backfilled with clean material and graded. The stream channel will be recreated, banks will be stabilized, and in-stream structures will be placed to create fish habitat. Contaminated water generated during the removal will be treated before discharging back to the lower stream. Air quality will also be monitored during the removal.

The riparian wetland area will be revegetated with native species, and fish will be reintroduced to the stream when the benthic community has recovered sufficiently. After it is established that the sediments in the lower pond are not contaminated, the containment dam will be removed and the connection to Puget Sound will be re-established.

Monitoring Plans

The responsible parties have agreed to conduct an extensive monitoring program to validate that the removal action protects the environment. Sediment concentrations will be monitored for five years after the removal action to ensure that they remain below target concentrations. The health of the plantings established during revegetation of the site will be monitored for the first three years after planting. The benthic community in the stream will be monitored annually for five years or until it is determined that the community would be able to sustain fish (whichever comes first). Stream flow and the structural stability of banks will be monitored for five years. Finally, the suitability of the stream to support fish will be evaluated. Temperature and pH will be monitored on the same schedule as sediment sampling. Once the dam has been removed, the use of the stream by fish will be monitored for two years.

Actions to modify the remedy will be taken if sediment or soil samples indicate that the cleanup goals are not met. Dead plants will be replaced within the first year. Within the first three years, an 80% plant survival rate would be considered successful. Benthic community data will be used with chemical concentrations in sediment to determine whether any observed sediment contamination requires additional action. Temperature and Ph must meet state guidelines for water quality before fish can be reintroduced. Stream stabilization structures that prevent fish passage or create a hazard will be repaired. If a section of the stream disappears and flows underground after the first year, alternatives will be undertaken to seal the substrate.

Conclusion

The investigation and cleanup of the Strandley Manning Superfund site provides an excellent example of a cost-effective, cooperative solution to an environmental problem. The risk that the site poses to human health, the environment, and natural resources should be substantially reduced or eliminated by the remedy, and the monitoring program will confirm this. NOAA supported EPA's selection of a remedy by conducting chemical analysis of sediment and fish, and evaluating the threat that contamination presents to fish. By working together creatively, the responsible party, EPA, and the natural resource trustees were able to save substantial administrative and legal costs for all parties.

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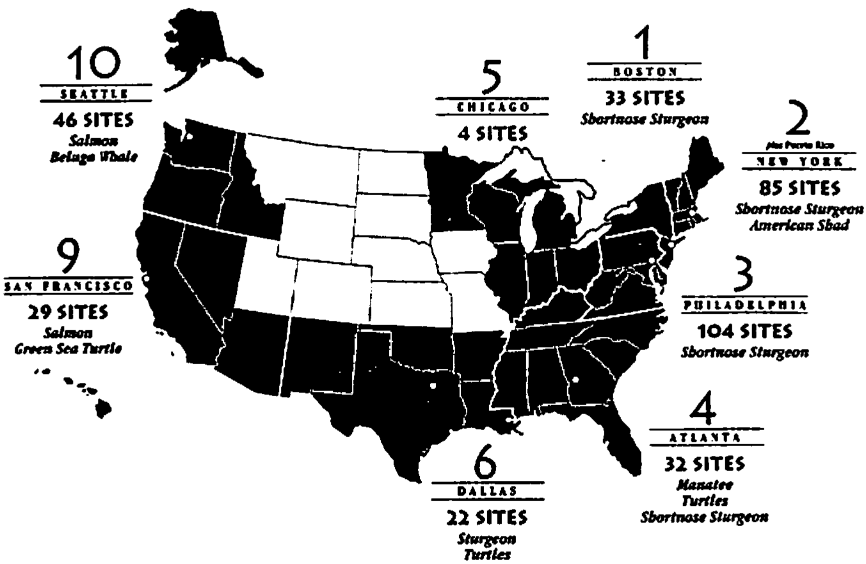
Mary Baker Matta
Technical Support Section Chief
Coastal Resource Coordination Branch
NOAA/Hazardous Materials Response and Assessment Division
7600 Sand Point Way N.E.
Seattle, WA, USA 98115

Ph (206) 526-6315
Fax (206) 526-6865
Email matta@hazmat.noaa.gov

ACTIVE CRC SITES PER FEDERAL REGION / 1995

EXCLUDES: RCRA and non-National Priority List (NPL) sites
INCLUDES: NPL, Federal facilities, and likely NPL sites



CRCs work to:

- Minimize destruction of wetlands
- Mitigate and restore injured habitat
- Protect endangered and threatened species (*examples on map*)
- Protect commercial and recreational fish stocks
- Abate environmental and human health risk from contaminated sediments

NOAA ENVIRONMENTAL TECHNICAL ASSISTANCE TO STATE SUPERFUND PROGRAMS

Alyce T. Fritz, NOAA/National Ocean Service
Helen E. Hillman, NOAA/National Ocean Service

NOAA's Responsibilities as a Natural Resource Trustee

NOAA, the National Oceanic and Atmospheric Administration, is a Federal environmental science and service agency housed in the U.S. Department of Commerce. One of NOAA's responsibilities is to serve as a trustee for marine and coastal natural resources including anadromous fish, marine mammals, and coastal habitat. NOAA's trusteeship is broad, deriving from a number of authorities including but not limited to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund); the Oil Pollution Act; the Clean Water Act; the Magnuson Fishery Conservation and Management Act; the Endangered Species Act; the Marine Mammal Protection Act; the Marine Protection, Research, and Sanctuaries Act; and the Coastal Zone Management Act. NOAA is entrusted with the protection and management of the resources listed under these statutes. At coastal hazardous waste sites, NOAA coordinates with the lead agency for cleanup and with co-trustee agencies to ensure that natural resources are protected and restored by cleanup measures to the maximum extent possible.

NOAA's Coastal Resource Coordination Program

NOAA believes that ecological risk should be addressed as an integral part of the cleanup process wherever possible. If natural resources are not protected by a cleanup, the only alternative available to trustees is a natural resource damage assessment. While an effective tool, natural resource damage assessment costs more money and takes more time to bring about restoration than does designing a protective cleanup in the first place. Integrating natural resource concerns early in the process by working closely with lead clean up agencies is more efficient and often more effective in ensuring natural resource protection.

NOAA created the Coastal Resource Coordination program to use the remedial process as a means to address natural resource injury. Since 1985, NOAA has been placing environmental scientists, called CRCs, in EPA regional offices. There are now 11 CRCs in the 7 EPA regions along the Pacific, Atlantic, and Gulf coasts, and in the Great Lakes (see Figure 1 preceding this abstract). Field staff are supported by a core of 10 scientists located in the program's headquarters office in Seattle, Washington. CRCs work with EPA remedial project managers (RPMs) through all phases of hazardous waste site removal and remedial actions. CRCs help EPA to identify and list sites with natural resource concerns; scope and review remedial investigation plans, feasibility studies, and remedial action work plans; conduct ecological risk assessments and determine risk to natural resources; evaluate methods and standards for final cleanup requirements and protective cleanup levels; recommend cost-effective approaches to remediate sites and minimize coastal resource impacts; achieve more timely and comprehensive settlements; and coordinate technical issues among trustees.

NOAA input to the cleanup process is critical to minimizing ecological impact during the remedial process and ultimately to protecting and restoring marine and coastal natural resources. EPA offices have traditionally emphasized human health risk assessment, frequently leaving little money or staff time for ecological risk assessment activities. If investigations and risk assessments fail to address ecological receptors, the resulting cleanups do not protect natural resources. NOAA provides vital information about the resources at risk and the likely effects of contamination on those resources. NOAA also provides technical assistance in ecological risk assessment, environmental sampling and monitoring, and remedial design to help EPA achieve protective cleanups that will enhance recovery of coastal habitats and fisheries.

Current NOAA Assistance to State Cleanup Programs

EPA is not the only agency that benefits from the activities of NOAA's CRC program. NOAA has a mandate to coordinate with other trustee agencies in implementing its authorities under CERCLA. Although not specifically funded to do so, NOAA has assisted States in dozens of site-specific and watershed-level projects over the past few years. Six examples of such coordination are given below:

Eastern Gas and Fuel

The Eastern Gas and Fuel site is an 3.3-ha parcel located in Everett, Massachusetts along the Island End River, a small estuarine tributary to the Mystic River and Inner Boston Harbor. The site was a former coal tar processing facility that has contaminated the Island End River's intertidal and subtidal sediments with high concentrations of polycyclic aromatic hydrocarbons (PAHs). Independent studies by academic researchers also have found the abnormal occurrence of tumors in resident fish.

Although the responsible parties have completed work to isolate the coal tar from the river by building a bulkhead, a substantial sheen is still evident in the river adjacent to the site. The Massachusetts Department of Environmental Protection (MADEP) and the U.S. Coast Guard have worked with the responsible parties to take further measures to eliminate the sheen without much success. NOAA will meet with MADEP and the Coast Guard to examine this issue and to help develop solutions to this problem. NOAA has provided valuable technical input and reviews of the Phase 1 and 2 River Study Workplans to MADEP and will be meeting with MADEP and the PRP group to discuss potential remedial measures. Not only has NOAA been able to lend technical expertise to the process, but NOAA's interest in the site as a Federal trustee has strengthened the State's enforcement case. Before NOAA's involvement, the PRPs showed little interest in performing site-related studies. The combined efforts of the State, Coast Guard, and NOAA help ensure that remedial action will be taken.

Global Landfill

The Global Landfill is a 60-a non-hazardous waste landfill in Old Bridge Township, Middlesex County, New Jersey. It borders Cheesquake Creek Tidal Marsh which flows to Cheesquake Creek and on to Raritan River and Raritan Bay just 2 mi away from the landfill.

Global Landfill is a state-lead site where the New Jersey Department of Environmental Protection called upon NOAA's expertise to evaluate potential contamination of the marsh. NOAA reviewed the RI/FS in 1993 which suggested metals were migrating from the landfill to the marsh, but it was not clear if the contaminants were bioavailable. NOAA went on several site visits with the state and assisted them in designing a biomonitoring program which included fiddler crab bioaccumulation studies and sediment toxicity tests. The data collected during the biomonitoring indicated that leachate seeps were toxic and possibly, toxicity extended into the marsh.

With NOAA's help, the state was able to develop a reasonable remedy and monitoring program that met all the trustees' needs. The landfill will be capped and the leachate collected and treated resulting in minimal exposure to ecological receptors in the marsh and creek. A 5-year monitoring program will begin once the capping and leachate collection systems are completed. NOAA will continue to provide technical review of monitoring data to ensure effectiveness of the remedial measures.

Naval Radio Transmitting Facility Driver

Naval Radio Transmitting Facility (NRTF) Driver is located in a predominantly rural setting of Virginia and occupies 245 ha of low-lying land adjacent to the tidal streams and marshes of the Nansemond River. The property was first used by the U.S. Navy as a Naval Air Station (Monogram Field) during World War II and between 1952 and 1955, NRTF Driver was constructed. In 1972, the Navy transferred 84 ha of undisturbed salt marsh along the Nansemond River and Oyster House

Creek to the U.S. Department of the Interior (DOI) to form the Nansemond National Wildlife Refuge. In 1993, NRTF Driver was slated for closure, and by 1994 all mission operations had ceased. Currently, portions of the facility are undergoing investigation and cleanup prior to transfer from the Department of Defense, while other "clean" parcels have already been conveyed.

Remedial activities at NRTF Driver are managed by a cleanup team composed of project managers from the Navy, EPA Region III (EPA), and the Commonwealth of Virginia (Virginia). In addition, the Navy has established a Restoration Advisory Board, composed of federal, state, and local representatives, to allow for community participation in the cleanup and closure process at the facility. Since 1989, NOAA CRCs and Virginia project managers have cooperated with the Navy and EPA in the cleanup process at NRTF Driver. Through frequent meetings, conference calls, and correspondence, mutually acceptable solutions for managing the individual hazardous waste sites have been developed.

An example of the benefits of the cooperative effort at NRTF Driver is the solution for remediation developed for a polychlorinated biphenyl (PCB) contaminated site (Site 5) located in a wetland that drains to Star Creek. Initially, the Navy removed the PCB transformers and highly contaminated soil adjacent to the PCB spill site. After removing these source areas, the Navy was reluctant to consider additional action despite high residual PCB levels in the surrounding wetland. The Navy's reluctance was based partially on engineering and cost considerations. Through a cooperative effort involving technical expertise from both NOAA and Virginia, an alternative for addressing PCB "hot spots" at Site 5 was developed by the Navy. The NOAA CRC worked with the Navy and EPA RPMs to provide the Navy with sound scientific data to support the additional cleanup, guidance on cleanup goals, and suggestions for restoration of the impacted wetland. A bioaccumulation study conducted by Virginia and funded in part by NOAA, also helped to document PCB impacts and the extent of residual contamination related to Site 5. The Navy was able to use the technical input to develop and implement a comprehensive and permanent remedy, which satisfied the concerns of both NOAA and Virginia for protection and restoration of the Site 5 wetland area.

ALCOA

The ALCOA (Point Comfort)/Lavaca Bay site is located on the eastern shore of Lavaca Bay, an embayment of the Matagorda Bay estuarine system, on the Texas Gulf coast. The Matagorda Bay system serves as habitats for finfish such as red drum, black drum, and Atlantic croaker; shellfish such as razor clams, oysters, blue crabs, and stone crabs; and benthic invertebrates. A mercury cell chlor-alkali plant, operating on the site from 1965-1979, used brine to produce chlorine gas for sale and sodium hydroxide solution for bauxite refining. Mercury was used in the process as the cathode and was discharged as part of the waste stream into Lavaca Bay. Additional mercury was released to the atmosphere from a mercury reclamation/retorting facility at the plant. The estimated amount of mercury discharged to Lavaca Bay is 44,000 kg (100,000 lb).

NOAA was informed of mercury contamination in Lavaca Bay and its biota in November 1989. After researching the problem, NOAA acted as the catalyst for the coordination of efforts among natural resource trustees, including the Texas Parks and Wildlife Department, the Texas Water Commission (now Texas Natural Resource Conservation Commission), the Texas General Land Office, and the U.S. Department of Interior. The trustees, lead by NOAA, decided to work with EPA to determine what could be done to clean up Lavaca Bay. The trustees working together, successfully petitioned the U.S. EPA to perform a preliminary assessment of the risks presented by the site. In the interim, the trustees began a damage assessment focused on restoring Lavaca Bay. When in 1994, EPA placed Lavaca Bay on the National Priorities List, the trustees decided to address risks/injuries to public resources through the EPA remedial process with the NOAA CRC playing a key role as liaison for technical and trustee issues to endure that efforts are coordinated successfully. Together, EPA, the trustees and the PRPs are designing a thorough approach to ecological risk assessment, remediation, and accelerated restoration.

Alaska Pulp Corporation

The Alaska Pulp Corporation site is a recently closed wood processing plant in Sitka, Alaska on Silver Bay. Several contaminants found in the sediments and water of Silver Bay, including 4-methylphenol, benzoic acid, phenol, copper, and zinc, are at levels that may threaten the health of aquatic organisms. Organic material, built up during the plant's operation, has formed a blanket of solids on the seafloor that depletes oxygen in sediments and bottom water, greatly impacting benthic organisms.

The Alaska Department of Environmental Conservation has the lead for the remedial cleanup and has requested NOAA's technical support. The remedial process will be under close scrutiny by the small community of Sitka which has a large stake in natural resource concerns and related economic issues. Alaska highly values NOAA's national expertise in sediment contamination and potential ecological effects. NOAA's unbiased perspective, and years of experience in waste site investigation and mitigation of ecological risk to the remedial process helps ensure the technical credibility of the efforts to characterize and reduce the risks of contamination to the community.

Rhone-Poulenc/Zoecon Corporation

From 1926 until 1971 the Rhone-Poulenc/Zoecon Corporation site in East Palo Alto, California produced herbicides and sodium arsenite compounds in underground tanks. Numerous releases to the air, soil, and surface water and several floods have allowed arsenic and other metals to migrate off-site. High arsenic levels in groundwater and soils have caused concern among nearby residents, while arsenic in the tidal wetland next to the property may pose a risk to fish, invertebrates, birds, and mammals, including the endangered salt marsh harvest mouse.

The State of California's Regional Water Quality Control Board is lead agency for cleanup. Work to stabilize and remove the worst of the contamination has already taken place. The Board requested NOAA's assistance in characterizing the ecological risk to the wetland. NOAA has worked with the Board, the U.S. Fish and Wildlife Service and the responsible party to identify resources of concern, develop sampling plans, choose appropriate reference sites, and design a solid and defensible ecological risk assessment plan. The site has been hailed by both the State and responsible party as an example of how cooperation among all concerned parties can lead to a protective remedy without significant legal costs or delays.

Increasing State Responsibilities: How NOAA Can Help?

For years, states have been responsible for most of the nation's hazardous waste cleanups. If the Superfund reauthorization bills now being considered by Congress are any measure, states' responsibilities will only increase in the future.

NOAA is interested in further developing state partnerships through a pilot project to place CRCs in state Superfund offices to provide states with the same kind of technical assistance currently provided to EPA. The pilot project would ideally involve three to five coastal and Great Lakes states with strong Superfund programs. NOAA would place CRCs in state Superfund program offices for a trial period of two years. The CRCs would work exclusively on state-lead sites. The program could be expanded after that time if other states expressed interest. Both states and NOAA stand to benefit from such a cooperative program. The states would gain a partner with extensive expertise and co-trustee authorities. The project would enable NOAA to better protect its trust resources by helping design consistent, comprehensive, and environmentally protective remedies at state sites. Coastal resources and habitats would benefit from quicker, more protective contaminant cleanups.

Two potential roadblocks exist: funding and staffing. NOAA proposes a shared funding arrangement, where the participating states and the federal government each pay half of the costs associated with the pilot program. The federal contribution would come from the Superfund monies allocated to state programs. Since NOAA has been under a hiring freeze for more than a year, with no thaw in sight, positions may have to be supplied by Intergovernmental Personnel Assignment (IPA) agreements with participating states.

Any states interested in further information about this pilot project are asked to contact Dr. Alyce Fritz.

Alyce T. Fritz
Coastal Resource Coordination Branch
NOAA/NOS/Hazardous Materials Response and Assessment Division
7600 Sand Point Way N.E.
Seattle, WA, USA 98115

Ph (206) 526-6305
Fax (206) 526-6941
Email Alyce_Fritz@hazmat.noaa.gov

Session B1, Part II: Dealing with an Angry Public: Facilitating Conflict Resolution
Session Co-Chairs: Sylvia Skratek, Mediator/Facilitator and Robert Whitener, Jr., Northwest Indian Fisheries Commission

See text under Session A1, Part I.

THE COAST MAY BE GETTING DIRTIER DOWNSTREAM FROM THE 104TH CONGRESS

Tim Eichenberg,
Center for Marine Conservation

The Clean Water Act (CWA) has made major progress in improving the water quality of our nation's rivers, lakes, and coastal waters since it was enacted in 1972. It has improved the treatment of sewage and industrial discharges, slowed the loss of wetlands, and brought back to life once nearly hopelessly degraded waterbodies. However, the 104th Congress is reauthorizing the CWA and bills passed by the House in 1995, and pending in the Senate, threaten to undermine the substantial progress in water quality that has occurred over the past quarter century. Even if pending reauthorization bills ultimately fail, Congress is also considering ancillary measures that would set back the clock on water quality protection by severely reducing appropriations for the Environmental Protection Agency (EPA), attaching anti-environmental riders to funding bills and continuing resolutions, blocking unfunded mandates, and promoting legislation on "takings," cost benefit analyses and risk assessments. If these efforts succeed, we may return to the days when rivers caught fire, medical wastes washed up on crowded beaches, and raw sewage was discharged directly into our waterways.

The Enactment and Goals of the Clean Water Act

The Clean Water Act began in 1948 simply as a federal funding program for the construction of sewage treatment plants, and it was relatively successful. By 1971, over $1 billion dollars per year was being distributed to the states, and 10,000 construction projects had been funded. But state water quality standards were weak, and the absence of federal standards and discharge permits for industrial polluters created great a disparity among state water pollution control efforts.

Uniform national standards were needed to demonstrate a national commitment to clean water. Therefore, over President Nixon's veto, the Congress overwhelmingly passed the Clean Water Act (officially called the Federal Water Pollution Control Act) in 1972 to accomplish three goals: (1) zero pollutant discharges by the year 1985; (2) on a interim basis, fishable/swimmable waters by the year 1983; and (3) zero toxic discharges in harmful amounts.

Judged by these goals, it could be said that the CWA has been largely unsuccessful. Raw sewage continues to be discharged from combined sewer overflows and sanitary sewer systems, and many stormwater discharges are unregulated. Approximately 40% of waters assessed are not fishable/swimmable. And 200 million pounds of toxics are discharged into our surface waters yearly. These conditions have led to restricted harvest in more than one-third of the nation's shellfish beds, and fish consumption advisories in 46 of the 50 states.

But the Act has also achieved some remarkable successes. The population served by sewage treatment plants has risen from 42% in 1971, to over 75% today. Secondary sewage treatment is up to 80%. Industrial expenditures on treatment technologies has risen significantly due to CWA requirements. And throughout the country, rivers, and lakes, once as hopelessly polluted as the Cuyahoga, Blackthorne, and Hudson Rivers and Lake Erie, are slowly returning to life. Clearly the CWA has made a difference.

How the Clean Water Act Protects Water Quality

The Act's biggest gains have resulted from the control of point source pollution (pollution discharged from pipes). For the first time, the CWA made illegal the discharge of pollutants into the waters of the U.S. (section 301). A federal permitting system was established for point source discharges under section 402 called a National Pollutant Discharge Elimination System permit (NPDES). Sixty-five thousand NPDES permits have been issued by federal and state agencies (21,000 to sewage treatment plants, and 41,000 to industrial dischargers) requiring compliance with state water quality standards, best available technology controls (BAT) for toxic pollutants, and federal effluent controls for conventional pollutants. Secondary sewage treatment is now required for all POTWs, and industrial discharges into POTWs must be pretreated.

Unfortunately, two significant forms of point source pollution are not addressed adequately under the CWA: stormwater discharges, which contain toxics and heavy metals and cause 30% of surface water impairment; and antiquated combined sewer overflow systems (CSOs) sanitary sewer systems, which discharge over 165 billion gallons of raw sewage and more than 1 million pounds of copper, lead, and zinc per year in 1,100 communities.

However imperfect the CWA point sources discharge program, the Act's nonpoint source (NPS) pollution program is far less effective. Polluted runoff from agriculture, logging, urban development, grazing, mining, and other activities causes the majority of pollution (about 60%) in our rivers, lakes, and estuaries. Section 319 of the CWA requires states to develop NPS pollution plans to identify waters damaged by polluted runoff, and develop programs to reduce and eliminate polluted runoff "to the maximum extent practicable" through the implementation of best management practices (BMPs). Unfortunately, state NPS plans have been largely unsuccessful because BMPs are mostly voluntary, state plans lack a watershed focus, adequate funds have not been provided for implementation, and adequate water quality standards have not been prepared.

In 1990, the Act was amended to create an enforceable program to address the impacts of NPS pollution in coastal areas. Section 6217 of the 1990 Coastal Zone Area Reauthorization Amendments (CZARA) establishes a program, jointly administered by the EPA and the National Oceanic and Atmospheric Administration (NOAA), that requires states to implement enforceable BMPs to reduce NPS pollution from existing and new land uses "to the greatest degree of pollutant reduction achievable." State BMPs must be consistent with federal guidelines, and states that fail to develop adequate programs risk losing federal funding under the Coastal Zone Management Act (CZMA). Twenty-seven of the 29 coastal states have submitted their initial programs for threshold review to NOAA and the EPA under section 6217. CZARA demonstrates that a meaningful approach to addressing NPS pollution can be developed.

How the Clean Water Act Protects Aquatic Ecosystems

Wetlands perform many extremely valuable functions including flood control, habitat for fisheries, wildlife, and endangered species, and ground and surface water quality protection. Since colonial times, the U.S. has lost about half of all its wetlands. Congress sought to stem the loss of wetlands by regulating the discharge of dredge and fill material into navigable waters under section 404 of the CWA. The Army Corps of Engineers issues permits pursuant to EPA regulations, and requires development within wetlands to be avoided, minimized, and mitigated or restored if alternatives are not feasible. The section 404 permitting program has not stopped the loss of wetlands, but has reduced the loss to about 300,000 acres per year.

The wetlands permitting program is one of the Act's most controversial provisions because of its effects on private property, although very few applications for section 404 permits are denied. Fewer than 1% of the 48,000 permits issued by the Corps were denied in 1994 (not even including the 50,000 activities that are authorized under general permits). Furthermore, permits are only required for about 20% of the activities that destroy wetlands. For example, permits are not required for normal farming, ranching, and logging practices, the maintenance of dams, levees, and bridges, the construction of farming and forest roads, and draining, channelizing, and flood control activities. Nevertheless, the Act's wetlands provisions remain a major obstacle to the reauthorization of the CWA in the 104th Congress.

Other key provisions of the CWA that protect aquatic ecosystems include section 401, under which federal permits and activities must be consistent with state water quality standards and designated uses. Under section 401, for example, states may block federal hydroelectric projects that interfere with such uses as fishing, contact recreation, or salmon spawning habitat. States also may designate estuaries of national significance under section 320. Twenty-nine "national estuaries" have been designated, and are eligible for federal funding to prepare Comprehensive Conservation and Management Plans to improve water quality and protect aquatic resources. Finally, the CWA also requires states to adopt antidegradation policies to protect existing instream uses, and ensure that high quality waters are adequately protected from degradation.

Prospects for CWA Reauthorization in the 104th Congress

Prospects for the reauthorization of the CWA appeared bleak in May 1995, when the House of Representatives passed the so-called "Dirty Water Bill" (H.R. 961). H.R. 961 is especially hard on coastal resources. It waives secondary sewage treatment for approximately 55 large municipalities that discharge directly into ocean waters, and thousands of smaller communities with populations less than 10,000. It revokes the CWA stormwater permitting program for nearly 800 municipalities serving 90 million people and over 100,000 industries. Instead, it gives states 15 years to prepare voluntary stormwater programs, and even these deadlines are postponed an additional year for every year in which 100% of the promised federal funds are not appropriated.

H.R. 961 delays progress already made in addressing the discharge of raw sewage from combined sewer overflow and sanitary sewer systems by overriding court or administratively ordered deadlines, and allowing 15-year delays in compliance with EPA's 1994 CSO control policy. It grants to states new authority to lower water quality standards, downgrade existing uses, and modify discharge limits. It overturns a U.S. Supreme Court decision that affirms the right of states to object to federal projects that violate state antidegradation policies under section 401. It weakens the section 6217 coastal NPS pollution control program by limiting its application only to those watersheds that states determine are threatened or significantly impaired. It also weakens the section 319 NPS control program by providing that states need to show only "reasonable progress within 15 years" in implementing NPS pollution plans, and repeals provisions calling for the use of "best management practices." H.R. 961 also strips authority from the EPA to designate ocean dumping sites within state ocean waters, and requires the Corps to utilize the "least costly" ocean dumping alternatives ensuring preferences for the ocean disposal of dredged material.

H.R. 961's most damaging provisions may be those substantially weakening the section 404 wetlands permitting program. H.R. 961's wetlands provisions are very similar to those contained in S. 851, "the Wetlands Regulatory Reform Act," introduced in the Senate in 1995 by Senators Johnston and Faircloth (with 20 cosponsors). Both H.R. 961 and S. 851 would eliminate protection for about 60-75% of existing wetlands by changing the definition of a wetland to require clear evidence of all three wetland characteristics simultaneously: wetland hydrology, hydrophytic vegetation, and hydric soils. Both bills require that freshwater wetlands have standing water for at least 21 consecutive days during the growing season, and that tidal wetlands be subject to "predictable tidal influence." They also establish a complex classification scheme to rank all wetlands as Type "A," "B," or "C" wetlands. Only "A" wetlands would be afforded a level of protection comparable to current law, and only if property owners are paid by taxpayers not to destroy "A" wetlands (this "takings" provision is in H.R. 961 only). Both bills exempt development within "B" wetlands from current "sequencing" requirements (that development avoid, minimize, and mitigate wetland destruction). And "C" or low value wetlands would be completely unprotected under the CWA. In addition, S. 851 exempts from protection coastal wetlands excluded by states with approved CZMA management plans (approximately 5.7 million acres in the southeastern coastal states alone).

Three hearings on S. 851 were held during 1995, but progress stalled while the Senate considered a CWA reauthorization bill. Senator Chafee scheduled hearings in the Senate Environment and Public Works Committee during March and April, 1996, on CWA reauthorization, but has not yet introduced a bill. If Senator Chafee moves a reauthorization bill out of his Committee, and it is passed by the Senate, it would conference with H.R. 961 and, if approved, be sent to President Clinton. The President has already stated that he would veto H.R. 961, and it is unlikely that there are sufficient votes in either the House or the Senate to override his veto. If Senator Chafee fails to move a reauthorization bill, Senator Faircloth may move S. 851 separately or attach it as an anti-wetlands rider to an unrelated bill. In that case, the Senate could pass a wetlands-only bill that could also conference with H.R. 961. In either case, the President would be in a position to veto a bad CWA reauthorization bill, if he is so inclined.

However, the CWA could be substantially weakened even without a reauthorization in a number of different ways.

First, appropriations bills for the EPA have already passed in the House and the Senate for FY 1996 that cut the EPA's CWA spending by 25-35%. President Clinton vetoed these bills in December, 1995, and the EPA has been operating on a continuing resolution (CR) ever since (when it hasn't been out on furlough). The CR does not provide sufficient funds for the EPA to properly implement or enforce the law and, as a result, the EPA has cut inspections by 40% and stopped many superfund cleanups. However, cracks in the anti-environmental forces of the 104th Congress began to show in the fall of 1995, when 63 House Republicans joined with a majority of Democrats to defeat appropriation riders that would have prevented the EPA from implementing its wetlands, CSO, and stormwater permitting program (although a rider prohibiting the EPA from vetoing Corps' wetlands permits was approved). The final vote (227-193) indicated for the first time that a block of pro-environment moderate Republicans (led by Representatives Boehlert, Morella, Gilchrist, and Saxton) may be able to prevent major weakening of the CWA in the 104th Congress.

Second, "takings" legislation passed by the House in March, 1995, and pending in the Senate, could make unenforceable the CWA wetlands program as well as many other federal environmental laws. These bills (H.R. 9 and S. 605) seek to reinterpret the 5th Amendment to the Constitution which provides that "private property may not be taken for public purposes without just compensation." The U.S. Supreme Court has interpreted the 5th Amendment to require private property owners to be compensated when government regulation "goes too far" and deprives the owner of the viable use of his or her land. H.R. 9 and S. 605 would revise the 5th Amendment legislatively by establishing a rigid formula by which federal agencies, such as the EPA, must pay property owners not to destroy wetlands or other natural resources when a regulation or government action reduces the value of any affected portion of their property by more than 20% or 33% respectively. These "takings" bills would essentially gut the CWA wetlands regulatory program by requiring that any payments come out of EPA's already devastated budget.

"Takings" bills essentially pay people not to pollute, and distort traditional constitutional interpretations of the 5th Amendment by the U.S. Supreme Court by establishing a one size fits all formula that ignores such unique considerations as the owners investment backed expectations, and the effects of the regulation on the whole parcel. They would bust the federal budget (costs are estimated to exceed $10 billion under the CWA alone), harm public rights, exaggerate the intrusions of federal environmental programs, and ignore the substantial "givings" enjoyed by private property owners from other public programs (such as highways, bridges, flood insurance, and other government subsidies). Thus, "takings" bills pose a substantial threat to water quality protection even if bill reauthorizing the CWA never passes. No wonder "takings" legislation is opposed by 33 State Attorneys General, over 125 law professors, the National Governors Association, the National Conference of State Legislatures, and the National League of Cities.

Finally, a number of ancillary measures pending in Congress would also do serious harm to the CWA even in the absence of a reauthorization bill. The unfunded mandates provisions in H.R. 961 discussed earlier would severely impede the implementation of the section 319 NPS pollution program. In addition, legislation passed by Congress and signed into law by the President in March, 1995 (P.L. 104-4), establishes new procedural hurdles for unfunded mandates that exceed $50 million. Since the CWA rarely provides 100% federal funding, CWA requirements are now subject to a point of order that could kill new clean water initiatives. The House also passed H.R. 450, placing a one-year moratorium on all federal regulations, which would severely impede CWA implementation. Although the Senate did not consider a moratorium, it did pass a proposal that would give to Congress veto authority over federal regulations before they become final (S. 219). A conference committee on the two bills is pending. The House also passed legislation requiring all "major" federal rules (exceeding $25 million) to undergo extensive cost-benefit and risk assessment analyses (H.R. 9) that would permit federal rules and actions to be vetoed by independent peer review panels of scientific experts that include special interest industry and corporate scientists having a vested or financial interest in the outcome of the agency action. It also would allow industry legal challenges to block federal rules before they are even subject to public notice and comment. Comparable legislation in the Senate is being considered (S. 343).

In conclusion, the prospects for legislation reauthorizing the CWA in the 104th Congress are far from certain. Several bills have been introduced and passed in the House that would seriously undermine a quarter of a century of progress in water quality. However, comparable efforts have stalled in the Senate and have been the subject of threatened Presidential vetoes. If these and other ancillary measures ultimately succeed in weakening important CWA provisions, the coastal environment will be getting much dirtier downstream from the 104th Congress.

Tim Eichenberg
Center for Marine Conservation
1725 DeSales Street, NW
Washington, DC, USA 20036

Ph (202) 429-5609
Fax (202) 872-0619
Email eichent@dccmc.mhs.compuserve.com

FLORIDA WATERSHED MANAGEMENT

Stephen M. Hodges,
Florida Center for Public Management

This issue paper, written by Florida State University's Florida Center for Public Management for the Florida Coastal Management Program's Citizen's Advisory Committee (CAC) on Coastal Resources Management, explores and summarizes watershed management and planning issues and activities in Florida. This paper includes descriptions of current watershed management and planning programs and activities at the federal and state levels; the legal framework (including governing mechanisms and associated agencies) in which these activities occur, as well as some of the shortcomings of this framework; a statewide overview of current water issues, impacts, and trends; and a set of recommendations to arrive at solutions to current problems.

Watershed Management Programs and Activities

Watershed management is being practiced in many countries, and has become an accepted methodology within a number of federal agencies and other state and local entities. In the state of Florida, there are a wide variety of watershed management activities in progress. For instance, the Florida Department of Environmental Protection (DEP) is beginning to integrate many environmental programs and activities into the framework of its Ecosystem Management initiative. The management units within this program will be watersheds. Presently, six Ecosystem Management Areas have been designated throughout the state. In addition, DEP's Division of Water Facilities is developing a work plan for the reorientation of its ground and surface water permitting, monitoring, and other activities to a watershed framework.

Florida's five water management districts are involved in watershed management activities as well, having mapped all watersheds within their areas of jurisdiction. The districts are beginning to implement their planning and management programs and activities within a watershed management framework consistent with the Florida Water Plan, which is currently being developed by DEP. The districts are also integrating many of their watershed activities, such as the Surface Water Improvement and Management program, with local governments through the local government comprehensive planning process. DEP's statewide analysis of water quality, the biennial "Florida Water Quality Assessment 305(b) Report," used watersheds as the basic reporting units for the first time in 1994.

Finally, Integrated Coastal Management (ICM), a place-based, comprehensive planning process being developed in response to the multiple stresses and conflicts found in coastal areas, is a relatively new methodology that can integrate coastal ecosystems and watershed management activities. ICM addresses all facets of coastal watersheds, including the land/ocean interface. The Florida Keys National Marine Sanctuary Management Plan is considered to be a case study in ICM, as are those estuaries in Florida which have been brought into the federal National Estuary Program. These are only a sample of the watershed management efforts in progress in Florida at this time.

Legal Framework

Regarding the legal framework for watershed management, the state of Florida has established a wide range of laws, regulations, and programs at the state, regional, and local levels to protect, manage, and restore the state's water resources. These include the Florida Water Resources Act, the Florida Air and Water Pollution Control Act, the State Comprehensive Plan, DEP's Water Policy Rule, and the Florida Water Plan. Although these laws, regulations, and programs have helped reduce the adverse effects on Florida's water resources from development and overuse, several shortcomings in the legal and regulatory framework hinder even greater progress in water resource protection. These shortcomings include: weaknesses in coordination and consistency between plans and programs, insufficient funding, the lack of incentives for the private sector to participate in watershed and other natural resource management efforts, and the insufficient emphasis on coastal ecosystems in ongoing management efforts.

Inadequate coordination and consistency between land and water planning causes conflicts and inefficiencies in the management of water resources, resulting in continued degradation of some of the state's water resources. However, DEP and the five water management districts, through the Florida Water Plan, are creating and strengthening the institutional and data linkages necessary to approach water resources issues and problems on a watershed basis. In addition, there are a number of other intergovernmental coordination activities presently being conducted throughout the state. These include three major state committees which have been assembled to review various aspects of Florida's land and water statutes, rules, and programs. These committees include the Task Force on Land Use and Water Planning, the Water Management District Review Commission, and the House Select Committee on Water Policy. Coordination and consistency between the state's water resources planning and management efforts is part of the focus of these efforts. The work of these committees will be considered in the 1996 Legislative Session.

Insufficient funding is a second shortcoming of the legal framework within which watershed management operates. This is true for intergovernmental coordination activities and consistency reviews, as well as for other ongoing watershed management activities. Many programs are not sufficiently funded at the outset for them to succeed, or funding is eliminated before the objectives of a particular program are accomplished. An example of the latter is the Surface Water Improvement and Management program, which was not funded in the last Legislative session. In addition, the amount of available funding is often not consistent year to year.

A third shortcoming of the legal framework has been the lack of willing participation in state land and water management activities by private landowners. Land and water managers now realize that their efforts to protect Florida's natural resources by themselves will not be sufficient, and that private landowners and managers will have to play a role in these efforts. The Role of the Private Landowner's Committee was established in 1994 as one of the 16 committees formed to delineate issues and recommendations for DEP's ecosystem management initiative, and the recommendations of this committee are being considered in the implementation of this and other natural resource management and planning efforts.

A final limitation of the legal framework within which watershed management operates is that agencies conducting watershed management activities in the past have not sufficiently addressed coastal ecosystems. Coastal ecosystems are only now beginning to be integrated into watershed management programs and activities in a few areas of the state.

Current Issues, Impacts, and Trends

Four major activities are contributing to the degradation of Florida water quality and supply: overwithdrawals of ground and surface water; alteration of surface drainage patterns; stormwater pollution; and interdistrict transfers of water.

Although overwithdrawals of ground and surface water are occurring in both coastal and interior portions of the state, they are particularly problematic in the coastal areas of Florida. This is because they not only impact surface water bodies such as rivers and lakes through the lowering of water tables, but also affect coastal estuaries and lagoons. Examples of areas where this is a concern include the Hillsborough, Apalachicola, and Peace rivers and their watersheds. In addition, overwithdrawals of ground water contribute to saltwater intrusion of freshwater aquifers. This has happened in several regions of Florida, including the Tampa Bay and Miami areas, and threatens to occur in others.

The alteration of surface drainage patterns impacts coastal ecosystems such as the Everglades and Florida Bay by interrupting the volume and timing of natural freshwater flows. This disrupts salinity regimes in coastal waters, which can lead to diebacks of vegetation such as seagrasses and other marine life that depend on this vegetation for cover and food. This is primarily a problem on the lower east coast of Florida, including Florida Bay.

Stormwater pollution is a problem which most affects heavily urbanized coastal watersheds and the waterbodies they drain into. Stormwater pollution occurs from urban and agricultural land use activities. Tampa Bay, the Indian River Lagoon, and Charlotte Harbor, which are discussed in this paper, are examples of waterbodies impacted by polluted stormwater runoff.

The interdistrict transfer of water, although practiced on a relatively small scale in several areas of the state, is increasingly being advocated by some as a solution for those areas of the state which are exceeding their local supplies of potable water. However, such transfers present potentially significant ecological impacts, many of which are largely unknown. The interdistrict transfer of water also does not provide incentives for water conservation or research into innovative solutions to the problem of supplying water for Florida's growing population.

Recommendations

A set of recommendations targeted to develop solutions to current problems is presented in this paper, and is explained in more detail in the Summary and Recommendations section. Specific recommendations requiring action from the CAC include the following:

1. Fund the coastal components of those Department of Environmental Protection Ecosystem Management Area efforts which are located in or near coastal areas.

2. Fund a Coastal Comparative Risk Assessment project.

3. Fund and/or support the delineation and ranking of coastal watersheds by severity of problem(s).

4. Fund and/or support integrated coastal watershed management plans that include barrier islands, embayments, lagoons, and other coastal ecosystems.

5. Create more coastal watershed management education opportunities.

6. Encourage the Florida Department of Community Affairs to require environmental and other monitoring and data acquisition as necessary

within those programs the agency manages that affect coastal areas and watersheds.

7. Fund or support additional coastal watershed management research activities and/or biological monitoring in coastal areas (to complement traditional water quality measurements).

Stephen M. Hodges
2506 Fritz Lane
Tallahassee, FL, USA 32304

Ph (904) 574-4115
Fax (904) 574-4115
Email hodgess@freenet.fsu.edu

PROGRESS IN ADDRESSING COASTAL NONPOINT SOURCE POLLUTION

Peyton Robertson, NOAA/National Ocean Service
Marcella Jansen, NOAA/National Ocean Service
Kenneth Walker, NOAA/National Ocean Service

Since the passage of the Clean Water Act in 1972, significant improvements have been made in addressing point sources of pollution. However, despite this progress, a major portion of our nation's waters remain threatened or impaired. More than fifty percent of these remaining water quality problems are attributed to nonpoint sources of pollution. In 1987, Section 319 of the Clean Water Act was established as the first national program to deal specifically with nonpoint sources of pollution. Section 319 required states to assess their waters and establish management programs to address polluted runoff. Section 6217 represents the most recent and comprehensive approach to the continuing efforts to address nonpoint sources of pollution impacting coastal water quality.

In response to water quality problems evidenced by beach closures, shellfish harvesting prohibitions and the loss of biological productivity, Congress determined that additional protection for coastal waters was necessary and enacted Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) (codified as 16 USC 1455b). Section 6217 applies to the 29 states and territories with coastal management programs approved by the National Oceanic and Atmospheric Administration (NOAA) under the Coastal Zone Management Act (CZMA) and requires the development of Coastal Nonpoint Pollution Control Programs (coastal nonpoint programs). State and territorial programs are reviewed and approved by the U.S. Environmental Protection Agency (EPA) and NOAA.

Section 6217 requires the implementation of management measures reflecting the best available, economically achievable technology to reduce polluted runoff to coastal waters resulting from nonpoint sources. This technology-based approach is a departure from previous efforts to control nonpoint pollution in that it does not rely on a direct connection between sources of pollution and water quality impacts. Rather than focusing on the burdensome and costly process of proving cause and effect linkages, 6217 applies proven runoff controls to all nonpoint sources that impact coastal waters. This allows for more comprehensive, watershed-based nonpoint source control, resulting in more extensive implementation and water quality improvements in a more cost-effective manner.

Categories of nonpoint pollution addressed by the coastal nonpoint program include urban, agriculture, forestry, marinas, and hydromodification. State programs must also address the protection of wetlands and riparian areas which can function to limit the impact of runoff from upland areas on coastal waters. Coastal nonpoint programs must include enforceable policies and mechanisms to ensure implementation of the management measures. The goal of section 6217 is to restore and protect coastal waters by strengthening the links between state coastal management and nonpoint source pollution or water quality (Clean Water Act Section 319) programs.

CZARA provided states and territories with 30 months to complete program development and, to date, all 29 states and territories have submitted programs to NOAA and EPA for Federal review and approval. Although full implementation of coastal nonpoint programs is several years away, this paper will identify some of the early successes of this effort to develop coastal nonpoint programs.

Program Development/Threshold Review

EPA, in consultation with other federal agencies, developed guidance specifying management measures that reflect the best available, economically achievable methods to control nonpoint pollution in coastal waters. The Guidance Specifying Management Measures for Sources of Nonpoint Pollution ((g) guidance, published January 1993) represents the only compendium of its kind on methods to reduce nonpoint source pollution. As part of the technical guidance development, EPA published an Economic Achievability Analysis which includes important information on the costs of implementing nonpoint source controls. Prior to this economic analysis, there were few documents available that compiled information on costs of nonpoint source controls. In an effort to further specify what state coastal nonpoint programs should look like, NOAA and EPA also published Program Development and Approval Guidance. These guidance documents and supporting analysis have proved to be extremely valuable, not only to states and territories developing programs, but also to other government agencies, consultants, and interested citizens.

States and territories were given the opportunity to get early feedback on their program development efforts through a process called "threshold review." Threshold reviews included development of program summary information by states, an analysis of program material by NOAA and EPA, and a face-to-face meeting in the state or territory. NOAA and EPA completed threshold reviews for most of the coastal states and territories subject to the requirements of section 6217.

A number of early successes were evident from the threshold review process. Drawing on a number of different agencies for information to produce a program document, coordination at the state and territorial level improved and resulted in increased communication and cooperation between coastal zone and water quality agencies and other state agencies, such as Departments of Agriculture, Forestry, and Transportation. These ongoing improvements have resulted in better sharing of information, enhanced interagency knowledge of activities and programs, and cooperative ventures to address coastal nonpoint pollution. Development of coastal nonpoint programs also improved public awareness of the impacts of polluted runoff and the need to more comprehensively address nonpoint sources. States conducted public meetings, developed newsletters, and made presentations to the public and affected interests. These efforts have led to a greater public awareness that daily activities within an entire watershed can affect the health of coastal waters.

New Flexibility for Coastal Nonpoint Programs

Based on the threshold reviews, NOAA and EPA learned that states faced a number of challenges in developing their coastal nonpoint programs, including economic, political, and institutional barriers. The comprehensive nature of the program and potential costs of implementation have been and remain a significant obstacle to achieving success. The statute provided only 30 months for program development, which left a limited amount of time for pulling together necessary documentation, much less seeking new legislation or major program restructuring. As institutional change is often in conflict with human nature's reluctance to change, there have also been difficulties in getting both government agencies and private sector interests to adopt the approach of 6217. Recognizing the magnitude of these challenges, NOAA and EPA agreed that several significant changes needed to be made to provide additional time and flexibility to states and territories developing coastal nonpoint programs. These provisions included further flexibility by which states could receive conditional approval of programs, an extended time line for implementation, general deference to states on determination of geographic boundaries, allowance for phased implementation of management measures, and a broader definition of acceptable enforceable policies and mechanisms by which states could ensure implementation.

EPA and NOAA agreed to grant conditional approval of coastal nonpoint programs for up to five years in order to provide more time in cases where states have not fully developed management measures or where states proposed to demonstrate that voluntary approaches, backed by broad authorities such as water quality laws, could serve to ensure widespread implementation of management measures. During the conditional approval period, the penalty provisions of the statute do not apply. In addition, the time frame for implementing management measures for existing nonpoint sources was extended from three years to five years, giving states until 2004 to complete implementation of the basic (g) management measures and until 2009 to complete implementation of any additional management measures necessary to meet water quality standards.

NOAA and EPA agreed to generally defer to state proposals for the 6217 management area, unless NOAA and EPA determined that the proposed management area excludes either existing land or water uses that reasonably can be expected to have a significant impact on coastal waters of the state, or reasonably foreseeable threats to coastal waters from nearby activities landward of the state's 6217 management area. NOAA and EPA reemphasized to states that they could exclude categories, subcategories, and individual nonpoint sources from their programs where those sources, either individually or cumulatively, did not have a significant impact on the coastal waters of the state. Further, states were given greater flexibility for phasing in necessary nonpoint source controls as a result of the extended time frames for program implementation.

Perhaps most importantly, NOAA and EPA expanded the range of acceptable back-up enforcement authorities. This expanded list of authorities could include, for example, "bad actor" laws, enforceable water quality standards, general environmental laws and prohibitions, and other existing authorities. This new flexibility provides states and territories with the opportunity to demonstrate that voluntary approaches, in combination with existing, general state authorities will be effective in achieving widespread implementation of the management measures. In these cases, EPA and NOAA will conditionally approve state programs for up to five years, including an evaluation of progress after three years. When states cannot achieve widespread implementation of the management measures through this voluntary-regulatory strategy, states will need to develop more specific authorities for implementation.

Program Submittal, Review, and Approval

Section 6217 required that states and territories submit their coastal nonpoint programs by July 19, 1995. Since that time, NOAA and EPA have received program submittals from all of the 29 states and territories currently participating in the coastal zone management program. In light of the limited funds available to states and territories to develop programs, the fact that all of them managed to submit a program document is in itself a success story. While some program submittals were more complete than others, all of the coastal states showed a commitment to addressing the serious problem of nonpoint pollution in coastal waters.

NOAA and EPA are currently in the process of reviewing the state and territory coastal nonpoint program submittals. The federal agencies are evaluating the extent to which state programs include management measures in conformity with the management measures specified in the (g) guidance published by EPA, as well as the extent to which states can demonstrate the ability to ensure widespread implementation. For this latter test, NOAA and EPA are considering the degree to which authorities specifically require management measures or whether states are proposing to use a combination of increased technical assistance, education, or other incentives backed by a broader authority. NOAA and EPA are communicating the results of this analysis to states and territories in the form of a program findings document. For categories (*e.g.*, agriculture), subcategories (*e.g.*, urban runoff) or individual management measures, NOAA and EPA make a finding that the state or territory program either includes or does not include management measures in conformity with the (g) guidance and enforceable policies and mechanisms to ensure implementation. Where the finding indicates that either or both of these fundamental requirements have not been met, there will be a condition placed on that program element. These conditions vary in terms of the need to further develop management measures, such as the need to revise a BMP manual to conform with the (g) guidance, or to extend the applicability of existing authorities to a wider range of activities.

Early results of the program review process are encouraging. As of this writing, NOAA and EPA have taken a preliminary look at most of the programs submitted to date. Our initial reactions are very positive. We are impressed by the effort taken by states to assess the current status of their programs and to make or propose significant improvements to those programs. The overall national trend clearly indicates significant progress by states in their efforts to protect their coastal waters from nonpoint pollution. In many cases, the coastal nonpoint program has served as a catalyst to further initiatives that were already planned or underway. In other cases, the coastal nonpoint program has established a programmatic context for an array of activities designed to advance nonpoint pollution control. By inventorying this variety of nonpoint source activities, states and territories are better able to coordinate multiple programs and more efficiently use limited resources.

Looking Back/Looking Ahead

The coordinated efforts of NOAA and EPA to develop the coastal nonpoint program at the Federal level have resulted a better program than could have been accomplished by either agency alone. The marriage of NOAA's coastal resource and land management expertise with the more technical water quality focus of EPA has expanded the federal capacity to address the complex issue of managing nonpoint pollution. NOAA and EPA have also worked closely to provide both technical and programmatic guidance to states and territories for designing programs that will meet federal requirements. As available financial resources are declining at the state and territorial level, "doing more with less" means that cooperation between coastal management and water quality agencies will be necessary in order to accomplish mutual program goals.

Implementing coastal nonpoint programs will demand even greater involvement by the public. The goal of restoring and protecting coastal waters can only be accomplished if there is support from all stakeholders in coastal watersheds. As we are all part of the problem, we must all work together to implement the solution. The challenge ahead will not only be educating the public and affected interests on the need for nonpoint source control, but ensuring that individual responsibility and action lead to real improvements in coastal water quality. As businesses and industry have already recognized that environmental stewardship can improve the economic bottom line, so too may we, as a society, begin to realize that controlling polluted runoff can improve our quality of life.

Peyton Robertson
NOAA/National Ocean Service
Office of Ocean and Coastal Resource Management
1305 East-West Highway
Silver Spring, MD, USA 20910

Ph (301) 713-3098 x137
Fax (301) 713-4367
Email Probertson@coasts.nos.noaa.gov

Session B3: Coastal Erosion
Session Chair: Hugh Shipman, Washington Department of Ecology

SHORELINE ARMORING EFFECT AND ENGINEERING TECHNIQUES FOR SHORELINE EROSION MANAGEMENT IN PROJECT PUGET SOUND

Jack C. Cox, Michael Baker, Jr. Inc.,
Keith McDonald, CH2M Hill, and
Douglas Canning, Washington Department of Ecology

Marine shoreline change is a concern to both coastal property owners and the users and managers of coastal public resources. The shores of Washington's inland coast -- greater Puget Sound -- undergo both shoreline erosion and landsliding. Coastal property owners are naturally concerned with protecting their investments in land and buildings. Unfortunately, houses and other buildings are often built dangerously close to the shoreline. Most property owners react to incidents or erosion or landsliding by erecting erosion control structures such as concrete or rock bulk-heads. If properly constructed, these shoreline armoring structures can slow most forms of wave-induced shoreline erosion for a period of time, but will probably do little to prevent continuing landsliding. Many shoreline property owners consider shoreline armoring critical to the protection of their real estate investment.

Identification of technically acceptable shoreline erosion defense strategies is based on three criteria: the real operational need for protection, the geologic or landform setting of a particular site, and the degree of exposure of the site to erosion. The operational need incorporates the owner's intended use of the waterfront and considerations of how the erosion is occurring. For example, is a bluff being undercut? is there danger of waves running up onto a property? is a fronting beach disappearing? The geologic or landform setting provides a practical limit to the types of solutions that might be employed, in terms of both how prone to erosion the site might be and how compatible the site is with certain construction types. The degree of exposure of the site determines how aggressive or robust a solution must be both to serve and to perform as intended.

The three criteria also provide a basis for focusing shore alteration techniques specifically appropriate to Puget Sound. The combinations of landform, site exposure, and operational needs create unique combinations for possible solutions. For example, Puget Sound shorelines tend to have less active recreational use than elsewhere in the country. Hence, the need for broad expanses of beach for public use is reduced, allowing for the possibility of leaving the shoreline less accessible. At the same time, the relatively protected waters of the Sound, in comparison to other shorelines, afford opportunities to apply large-scale, natural-appearing solutions that are inherently native in appearance but can tolerate only limited wave attack. This introduces an opportunity to promote the clear preference stated in the Washington Shoreline Management Act to "preserve the natural character of the shoreline." The unusually rich and widely recognized biological resources of Puget Sound further reinforce the potential importance of protecting natural shoreline characteristics.

Range of Appropriate Techniques

Protecting the shoreline from erosion can take the form of "hard" construction and armoring methods, "soft" methods such as beach nourishment, composite methods combining both hard and soft components, and nonstructural activities that involve local zoning or land-use regulations. Soft solutions do not necessarily imply unaltered natural protection. Rather, they refer to a compliant method that can naturally deform and adjust over time in response to changing shore conditions. Composite methods incorporate both hard and soft methods and possibly activities. Within each of these primary groupings, several of the techniques can be further subdivided into in-water and out-of-water concepts.

Hard structures entail constructing a rigid installation whose purpose is to defect or attenuate wave energy or retain a failing area of shore. Bulkheads, seawalls, revetments, grout bags, and gabions are all structures built at or behind the water's edge and functioning in essentially the same manner, differing only in the style of construction and ability to survive in the environment. A new and promising application of revetments is to bury them with native-size sediment to maximize aesthetics and shoreline access while providing protection of a hard structure during a catastrophic storm event. Breakwaters and floating attenuators are barrier structures constructed in the water and are intended to reduce the wave action before it reaches the shoreline.

Soft structures are also intended to reduce the erosive action of the water, but are intended either to emulate a natural shoreline or to be nonintrusive in the environment. Artificial shoreline simulation using sand or gravel fill, including creating long beach strands, is intended to absorb wave energy reaching the shore by allowing the shoreline to "deform," flexibly and naturally, in response to wave action. A new shoreline is created in front of the old. This technique occupies more physical space than a hard structure would require. It is therefore more intrusive than a hard method but could have a more natural appearance. Because the shoreline deforms in response to varying intensities of wave action, the beach geometry might change both spatially and temporally, disappearing and reappearing. The line of defense is not constant for a deformable shoreline as it is with hard structure. Therefore, continuous protection of a specific location is less easy to guarantee. However, total shoreline protection, including adjacent properties, is increased as the beach is spread along the shore. Less intrusive, soft solutions entail planting vegetation to hold sediment in place, burying drains in a beachface, or incorporating a drain in the bluff surface or substrata. The drain reduces and controls the flow of water, keeping the sediments drier and, thus, more resistant to erosion.

Composite solutions incorporate the positive aspects of both hard and soft methods. This approach employs limited use of structural elements to reduce, but not eliminate, wave attack, and effectively confines the deformation of a soft solution so that its performance is more controlled and predictable. Examples are the creation of artificial headlands, projecting into the water to create pocket beaches trapped between and creation of perched beaches by installation of underwater sills that allow artificial beaches to be built landward of the sill. Composite structures are physically intrusive, but still give a natural, though perhaps non-native, setting to the shoreline.

Off-the-shelf "manufactured systems" are also available to implement both hard and soft approaches to erosion control. These include a wide variety of interlocking concrete blocks and modules that can be used to build retaining walls, revetments, and offshore breakwaters, as well as offshore artificial "vegetation" such as plastic kelp that can moderate wave action. These systems represent specialize approaches to some of the generic techniques addressed in this report, and their applicability is not substantially different from that of the generic techniques.

Nonstructural activities provide techniques for addressing the source of the problem. Bluffs can be restabilized by removing any bluff weakening factors. Such actions include relocating an existing septic drain field or irrigation system well back from a bluff edge so that drainage into and onto the bluff is reduced. Similarly, the overburden pressure on the top of a bluff that could induce slumping could be eliminated by relocating any structures sufficiently far from the edge.

Several methods of shoreline protection that are used successfully elsewhere have been specifically discarded for use in Puget Sound. An example is the use of submerged reef breakwaters. This innovation in coastal design, highly regarded as being environmentally desirable because it is not visible from land and also creates fish habitat, reduces the wave energy before they reach the shore. This method is particularly sensitive to changes in water depth because the water determines whether a wave will break or not. Widely fluctuating water (tide) level, as occurs in Puget Sound, would make its potential performance marginal in the Sound. Other inappropriate shoreline protection methods were examined and treated similarly. Only certain techniques should be considered appropriate for use in Puget Sound.

Application to Specific Sites

Table I shows the applicability of various shore protection methods to meet the landowner's goals for addressing specific causes of erosion. The applicability is based on professional engineering judgment and observations of field applications as to how well a particular approach meets the goal. For example, if the major threat is toe erosion and bluff collapse, placing a beach fill in front of the bluff will do little to buttress the toe, although it may reduce the frequency with which waves strike the toe and thus slow erosion. Similarly, planting vegetation on a slope will be effective only in controlling surface water runoff and will do nothing to halt deepseated soil slumping.

A retreating shoreline is the most common reason for loss of property. Upland structures are not usually in danger of damage from direct wave attack or flooding, but rather must be protected from undercutting and collapse. The goal of shore protection in these causes is to limit the amount of shoreline retreat or to reduce damage and increase safety in the event of land loss, at least in the area of immediate concern.

Placing a wall-style hard structure (bulkhead) or rock matrix system (revetment, gabions, stacked blocks, or grout-filled bags) at the foot of bluff or behind a beach can reduce land loss at a particular site and provide damage protection to upland areas. Such approaches, however, do not actually stabilize the beach or reduce its tendency to be eroded away. Indeed, installing these hard structures may actually increase local beach erosion and loss rates. In contrast, barrier forms of protection, such as floating attenuators, offshore breakwaters, or beach sills, will actually hold or perhaps even increase the width of a beach area. Soft solutions can be applied to address several of the goals in instances where substantial structural strength is not needed to accomplish a goal. Composite-style solutions, *e.g.*, armored headlands/pocket beaches, can usually be applied to meet all of the goals by incorporating the best features of both hard and soft methods.

When beaches are narrow, waves can attack the toe of the slope directly. When sufficient material is lost from the toe, all or a portion of the slope fails and slides down onto the beach. This loss can compromise upland structures. Slope collapse tends to be progressive from the waterline upward. In this case, the toe area of the slope must be defended in some way so that material can not be removed. Groundwater and surface runoff of a bluff can also lead to a sliding collapse of a slope. In such a case, wave impingement is unrelated to the real problem. These slope failures tend to originate near the crest of the slope and propagate downward. To prevent these upslope failures, the goal is to introduce techniques that will increase slope resistance to sliding either by buttressing the toe against movement or by removing the source of the problem, *e.g.*, poor drainage, excessive groundwater, or soil solution.

Landforms

Table 2 shows the applicability of the shore protection techniques to the four regional landform types. The applicability is presented as a range, again based on professional engineering experience and judgment.

Landforms influence the applicable techniques in two ways: constructibility and adaptability (or compatibility). Certain soils might provide insufficient foundation to support certain types of construction. Topography might simply preclude the use of certain methods that depend entirely on the amount of change in relief.

Marshy areas, quite apart from their sensitivity as regulated, protected, habitats, are generally not well suited to hard wall-type structures because the landform does not permit easy construction. Soft structures such as sand fills at a marsh edge can be equally inappropriate because the hydraulics of the marsh can be disrupted. Beaches, in order to maintain their integrity, require solutions that emulate the natural shoreline or at least allow the shoreline to be sustained without being intrusive. Solutions for banked and bluffed shorelines usually include a need to provide support for some upslope activity. Therefore, compatible solutions for sloped areas either involve hard structural elements or incorporate adjustments to the slope to accommodate the upslope activities.

Certain types of protection techniques are inherently similar to a native landform although their appearance might be different. Artificial headlands with pocket beaches are similar to naturally formed embayments. Nearshore breakwaters simulate naturally occurring rocky reefs. Floating attenuators do not interfere with natural shoreline processes, but simply reduce their intensity. The applicability of a method does not imply camouflaging the approach, but rather introducing an approach or process that could naturally exist at that site.

Wave Energy

Table 3 summarizes the maximum wave energy to which any particular shore protection technique should be exposed. The exposure rating is also cross referenced to the FEMA flood insurance rate classification for the site. The wave energy limits set for each method were determined for use on individual residential property sites, *i.e.*, rather than several adjacent properties considered together. Also considered were the practical limits on how large an installation would be required to resist the wave action.

Application of a particular approach in the next higher energy regime is sometimes possible if appropriate detained professional engineering analysis is performed; however, significant maintenance problems and poor performance can be expected if the applicability range is stretched too far.

Hard solutions most often are used in moderate- to high-energy wave environments where greater resistance to the natural forces is required. Soft solutions tend to be more compliant and can often adjust to a variable range of wave conditions. The limits on soft solutions generally are controlled by the amount of room and the amount of material available to "deform" in a severe storm event. Composite structures increase the applicability range by incorporating the traits of both hard and soft techniques. For example, a sand beach can effectively resist most storms provided the beach is wide enough and long enough. However, for limited sand volumes or beach widths, hard structures must be added to help hold the sand against higher storm waves.

Significant differences in resistance to wave exposure can be seen in Table 3 even for seemingly small differences in shore protection design approaches. The most notable example is the difference in applicability between standard bulkheads and zero-clearance bulkheads. Depending on specific design details, zero-clearance bulkheads (which are built into a bluff face rather than being built in front of a slope and then backfilled) are considered less resistant to wave exposure because of the greater chance for wave overtopping and subsequent direct scour of the bluff face. Conversely, zero-clearance bulkheads project less onto the beach than standard bulkheads, possibly lessening the likelihood of wave overtopping. They may also be vulnerable because of an inability to create protection at the bulkhead ends by providing flanking walls. For these reasons, zero-clearance bulkheads against bluff slopes are best used in low-energy environments. Other differences in the table consider durability of different construction materials and techniques, and whether failure of the method would have catastrophic or noncatastrophic results.

Site-Specific Decision Model

Figure 1 is a logic flow chart for selecting one or more feasible shore protection techniques when only basic information is known at the site. Once it has been determined that a specific site does have an erosion problem that requires an engineering or geotechnical solution, the flow chart is entered first by examining what is happening near the water. If the beach has narrowed, or the toe of a bank or bluff has retreated, erosion of the property is probably wave induced and, thus, requires a wave-related solution. If both loss of upslope area and toe retreat are observed, both wave erosion and upland sources of erosion might be contributing. If the erosion rates are less than these thresholds, the problem might be more of a perception problem than a real erosion problem.

The implementation of shore protection need not be limited to one technique alone, but may incorporate various elements of different shore protection techniques. The environmentally preferred, least destructive approach, generally supported by a cost minimization goal, is to use the lowest energy level option that is applicable. This can often be accomplished by incorporating higher-energy resistant elements with a lower energy approach.

The refinement of design options by the goals and functions that need to be satisfied will usually produce two or three final candidate designs. The selection of the best from that list will need to be made by the property owner, partially based on the level of risk the owner is willing to accept in case of failure, the intended life of the structure, how easily the chosen solution can be constructed and repaired, the aesthetics of what is to be installed, and the cost, but also based on regulatory agency requirements.

The issue of "risk" has a significant impact on the final selection of an appropriate shore protection technique. Risk of failure, or concern about a contractor liability if a solution does fail, often drives the owner, the designer, and the contractor to propose solutions that are substantially more robust than would normally be needed. Currently, solutions are designed to "never" fail, rather than allowing for some anticipated failure under extreme conditions, followed by some repairs. In fact, most solutions eventually do fail, if only due to old age and the corrosive effect of the marine environment on building materials. This "never fail" philosophy has tended to discourage use of methods that have a strong need for maintenance, such as the soft solutions (*e.g.*, beach fills and revegetation). Promoting less rigid, more natural alterations to the shoreline will require careful consideration and allowance for this risk of failure.

Jack C. Cox
Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, VA, USA 22304

TABLE 1 - TECHNIQUE APPLICABILITY TO CAUSE OF EROSION*			
Shore Protection Technique	**Slow Retreat**	**Prevent Undercutting**	**Stabilize Bluff**
Hard Structures			
Bulkhead	••	•••••	•••••
Zero-clearance bulkhead	•	••	••
Seawall	••	•••••	•••••
Revetment	••	•••••	•••••
Riprap	N/A	••••	•••
Gabions	••	••••	N/A
Grout-filled bags	••	••••	N/A
Floating attenuator	•••	••	N/A
Breakwater	•••••	•••	N/A
Soft Structures			
Sand fill	••••	•••	N/A
Gravel fill	••••	••••	N/A
Beachface dewatering	••••	•••	N/A
Beach strand	•••••	••••	N/A
Shoreline vegetation	••	••	N/A
Groundwater drainage	N/A	N/A	•••••
Surface runoff control	N/A	N/A	•••
Slope regrading	N/A	N/A	•••••
Bluff vegetation	N/A	N/A	N/A
Composite Systems			
Headland/pocket beach	•••••	••••	N/A
Perched beach	••••	•••	N/A
Groin system	••••	N/A	N/A

Applicability Rating: • •• ••• •••• •••••
Less >>> to >>> Most

TABLE 2 - TECHNIQUE APPLICABILITY TO GEOLOGIC SETTINGS*

Shore Protection Technique	Marsh	Beach	Banks	Bluffs
Hard Structures				
Bulkhead	•	•	•••••	•••••
Zero-clearance bulkhead	•	•	•••	•••
Seawall	•	•	•••••	•••••
Revetment	•	•	•••••	•••••
Riprap	•	•	•••••	•••
Gabions	•	•	•••••	•••
Grout-filled bags	•	•	••••	••
Floating attenuator	•••	•••	•••	•••
Breakwater	••••	•••••	•••••	•••
Soft Structures				
Sand fill	••	•••••	•••	••
Gravel fill	••	•••	•••	••
Beachface dewatering	••	••••	••••	•••
Beach strand	••	•••••	••••	•••
Shoreline vegetation	•••••	••••	•••	•
Groundwater drainage	•	•	••	••••
Surface runoff control	•	•	••	••••
Slope regrading	•	•	•••••	••••
Bluff vegetation	•	•	•••	•••
Composite Systems				
Headland/pocket beach	••••	•••••	•••••	•••
Perched beach	••••	•••••	•••	•••
Groin system	•	•••••	•••	••

Applicability Rating • •• ••• •••• •••••
Less >>> to >>> Most

TABLE 3 - MAXIMUM WAVE EXPOSURES FOR APPLICABLE TECHNIQUES				
Shore Protection Technique	**Fetch Lgt. (miles)**	**Nearshore Wave Hgt. (Ft)[a]**	**Max. FEMA Class[b]**	**Max. Energy Regime[c]**
Hard Structures				
Bulkhead	<5	<4	AO	M
Zero-clearance bulkhead	<1	<2	All	L
Seawall	>5	>4	V	H
Revetment	>5	>4	V	H
Riprap	<5	<4	AO	M
Gabions	<5	<4	AO	M
Grout-filled bags	<5	<4	AO	M
Floating attenuator	<5	<4	AO	M
Breakwater	>5	>4	V	H
Soft Structures				
Sand fill	<1	<2	All	L
Gravel fill	<5	<4	AO	M
Beachface dewatering	<5	<4	AO	M
Beach strand	>5	>4	V	H
Shoreline vegetation	<1	<2	All	L
Groundwater drainage	N/A	N/A	N/A	N/A
Surface runoff control	N/A	N/A	N/A	N/A
Slope regrading	N/A	N/A	N/A	N/A
Bluff vegetation	N/A	N/A	N/A	N/A
Composite Systems				
Headland/pocket beach	>5	>4	V	H
Perched beach	<5	<4	AO	M
Groin system	>5	>4	V	H

a. Wave height calculated for 30-mph wind speed, 30-foot water depth, and adequate time for full wave development
b.
c. L = low, M = moderate, H = high wave energy regime

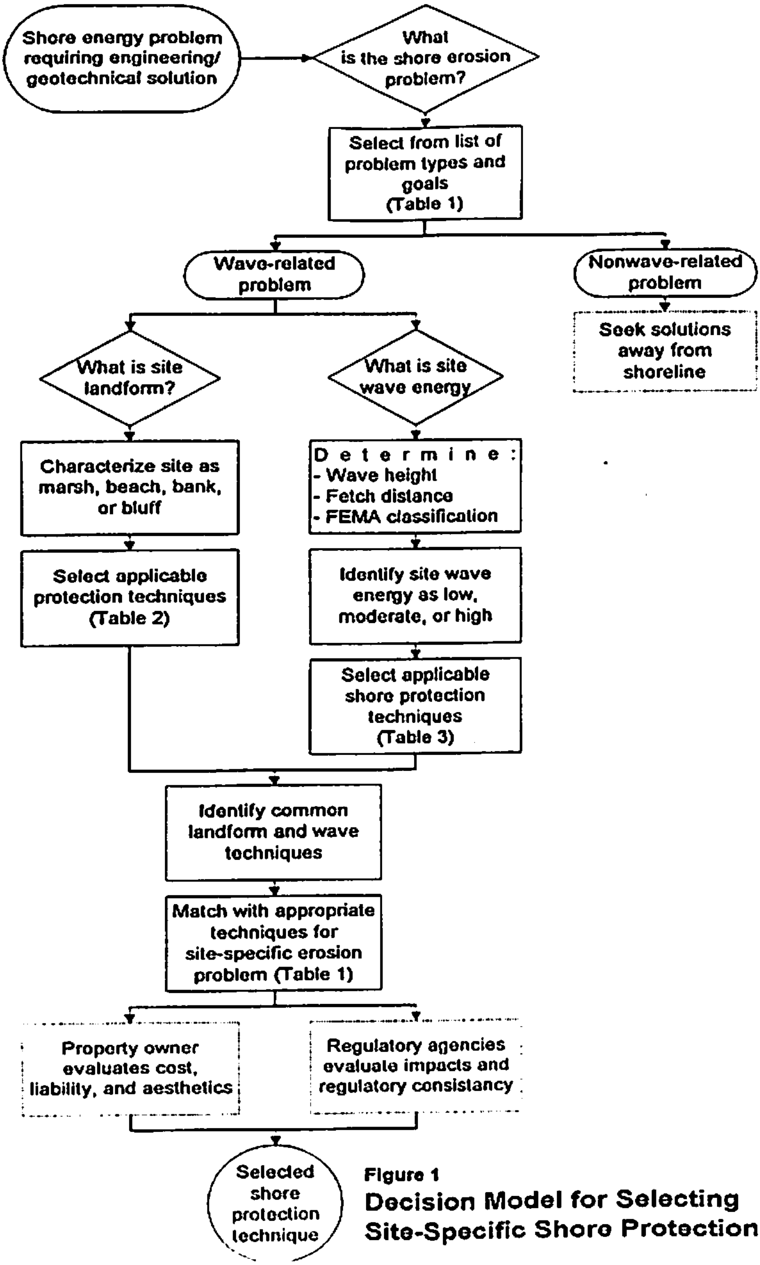


Figure 1
Decision Model for Selecting Site-Specific Shore Protection Techniques

SHORELINE MANAGEMENT IN A SEDIMENT-LIMITED SYSTEM: SAUGEEN-LAKE HURON SHORELINE, ONTARIO, CANADA

Patrick L. Lawrence, University of Waterloo

Introduction

The 80 km Lake Huron shoreline within the Saugeen River watershed from Southampton to Point Clark, Ontario consists of sedimentary bedrock overlaid by glacial deposits including till, relict post-glacial beach and dunes, and boulders (Figure 1). A review of sediment sources and alongshore transport indicates the importance of post-glacial deposits for the maintenance of nearshore sediments, which are essential for beach and dune sustainability.

From 1954 to 1990, industrial, urban and rural residential development along the shoreline in the area has increased from 8% of land cover to 22% (Lawrence and Nelson, 1992). Cottage communities have been established at numerous sites, increasing the number of seasonal residences in the area. Continued construction and development efforts along the shoreline have resulted in the disruption of natural sediment sources, especially beaches and dunes. Shoreline protection and harbor facilities have also impacted alongshore sediment transport patterns.

Land use planning and shoreline management initiatives need to recognize the protection of alongshore sediment processes as a basis for ecosystem protection and enhancing economic opportunities. The study is used as a basis to develop a sediment management strategy in order to balance development with a need for conservation of sediment supplies. The results are discussed in reference to the ongoing preparation of a shoreline management plan and implications for other coastal regions with similar sediment conditions.

Study Area

The Lake Huron shoreline from Southampton to Point Clark is comprised of bedrock or clayey glacial deposits, with pocket beaches consisting of sand and gravel deposits (Figure 1). The bedrock geology consists of Guelph Formation (dolomite) of Silurian age, which is exposed at the surface at Douglas Point. Glacial till exposures occur inland from Poplar Beach and north of Kincardine. St. Joseph till is described as a clayey silt till with low stone count and represents the Port Huron glacial advance, estimated to have occurred 13,000 years ago (Cowan and Pinch, 1986).

Inland the landscape consists of post-glacial lake deposits, with sand and clay till exposures (Lawrence *et al.*, 1992). The study area is located in the physiographic region of southwestern Ontario classified as the Huron slope, which consists of a clay plain of post-glacial lake deposits overlying a clay till and gently slopes westward forming the shoreline bluffs (Chapman and Putman, 1984). Land uses include rural residential development, including seasonal cottages, several urban communities, the Bruce Nuclear Power Complex at Douglas Point, and agriculture (Lawrence and Nelson, 1992).

The climate is continental with January and July average temperatures of -4 and 22°C. The Lake Huron water mass has a moderating effect on temperatures, also resulting in increased local snowfall, and an average annual precipitation of 900 mm (Reinders, 1989). Ice begins to form along the shoreline by mid-December and persists until early April, with peak cover of 40 to 70%, inhibiting wave generation and sediment transport along shore (Saulesleja, 1986). Mean annual wind speed is 10 km/hr, with highest wind speed in January and the most frequent winds from the northwest and southwest (Environment Canada, 1982).

Shoreline Physiography

The study area is a highly indented rocky shoreline, with beaches contained between headlands (Boyd, 1981). The majority of beach sand and gravel deposits are relict post-glacial lake deposits. Pocket beaches occur at Inverhuron, MacGregor Point, Port Elgin and Southampton. Sand movement is restricted to within the bays, with no extensive new supply of sediment from riverine, offshore or updrift sources. Alongshore sediment transport is from north to south (Philpott, 1988). The large beaches at Port Elgin and Southampton are thought to have been created by relict glacial deposits, forming depositional profiles between resistant headlands (Reinders, 1989).

Glacio-lacustrine and beach sand and gravels extend from Southampton to Port Elgin (Figure 1) (Cowan and Pinch, 1986). The shoreline consists of Late Wisconsinian beach sand and gravel with lag resting on till deposits. Extensive post-glacial beach sand and gravel deposits with glacio-lacustrine clay and silt deposits are located inland from Port Elgin south to MacGregor Point.

Post-glacial lakes forming during the retreat of the Laurentide ice sheet, 20,000 years ago, laid down extensive beach sediments. The Lake Algonquin beach comprises an erosional bluff cut into the St. Joseph till and extends from inland of MacGregor Point, south to Point Clark, at an elevation of 203 m above sea level (Karrow, 1988). The Lake Nipissing beach is primarily an erosional bluff, at an elevation of 190 m and is fronted by thin sand deposits (Cowan and Pinch, 1986). Relict Lake

Nipissing sand and gravel dunes and beach deposits are located inland at Inverhuron Bay and north of Point Clark (Figure 1).

The nearshore beach profiles at Port Elgin and Douglas Point are described by Boyd (1981) as having a gentle slope and are mostly comprised of sand and silt, with active offshore sand bars. Boyd (1981) estimated that these beaches experienced net volume increases of 18 and 7 m^3/year respectively from 1973 to 1980. Inverhuron and Poplar Beach are characterized by thin sand lens overlying boulder till deposits or bedrock. With shallow nearshore profiles, due to limited offshore erosion of the material, these beaches show little change.

From McRae Point to Kincardine, the shoreline is irregular, consisting mainly of bedrock with cobble, gravel, and sand deposits between headlands (Figure 1) (Reinders, 1989). Recent beach deposits, sand dunes and relict beach ridges are noted in the backshore zone (Lawrence *et al.*, 1992). South of Kincardine, the shoreline is characterized as a dynamic beach and dune system with offshore migrating sand bars (Figure 1). Offshore boulders, stretches of cobble stone beaches, and a wetland/marshes occur in several locations. Modern beach and dune deposits have formed from Poplar Beach south to Point Clark. Just north, and in the lee of the Point Clark headland, the shoreline consists a course sand and gravel beach, with cobbles and boulders offshore. Amberley Beach consists of a wide sandy beach, with a gentle sandy nearshore profile.

Shoreline Processes

Fetch lengths for the study area suggest the dominant influence of north and northwest waves. The northwest fetch is longer than the west allowing larger waves to be generated by storms and causing high transport rates during storm events (Philpott, 1988). As a result, the large frequency of northwest winds, combined with the open water fetch length in this direction will allow for the development of north and northwest waves, with larger periods (4 to 6 seconds) and significant wave heights in excess of 1.5 m.

Examination of wave hindcast frequency distribution tables completed by Philpott (1988) indicate the presence of the northwest waves. The 35-year hindcast (1952 to 1987) shows that 41.6% of the total hourly frequency are northwest waves. Of the individual wave classes, the long period classes (5 to 7 seconds, 0.9 to 2.1 m waves) are noted in the northwest waves, as a function of the fetch. Wave heights from all directions have been recorded less then 3 m for 95% of the monthly mean records (Saulesleja, 1986).

There exists limited alongshore littoral drift due to low sediment supply (Boyd, 1981; Reinders, 1989). Nearshore transport is generally north to south caused by the predominate north and north-west waves (Figure 1).

North of Douglas Point, no alongshore sediment transport occurs because of limited sediment supply (Reinders, 1989). In the northern section of the shoreline, coarse glacio-lacustrine sediments are extensive and are likely the primary source of the sand present at the modern Lake Huron shore, perhaps transported from inland sources by local streams (Boyd, 1981). At Port Elgin and Inverhuron, large crescentic bayhead beaches form between smaller headlands created by resistant bedrock outcrops.

South from McRae Point to Point Clark (Figure 1) sediment transport is north to south, with small amounts of sediment supplied from streams and creeks. The total littoral transport along this shoreline has been estimated at only 449 m^3/year, most coming from the Pine and Penatangore Rivers (Reinders, 1989). Beach erosion is limited, with some losses inland to dune formation. Sand deposits at Lurgan Beach, Bruce Beach, and Poplar Beach have formed as the stony till shelf offshore protects these features from wave erosion. Rates of offshore platform and nearshore till erosion, along this shoreline are at present unknown.

A stony till shelf extends offshore at Point Clark acting as a natural barrier to any sediments from the north and northwest (Reinders, 1989). Waves from the north direction are most commonly affected by the Point Clark headland and offshore platform. In particular, the larger waves refract around the point into the lee of the headland Sediment transport appears to be south, with a pocket of northward transport in the lee of Point Clark (Reinders, 1989). A large amount of sediment would be diverted offshore and deposited in deeper water. When combined with the insignificant amount of sediment coming towards Point Clark from the north, it can be stated that very little sediment passes around the point.

Further south, in the lee of the boulder till promontory of Point Clark, the shoreline is at first characterized by narrow beaches with sand and gravel and considerable boulders offshore. The beaches rapidly increase in width as sediment supplied either from the south, or encircling around the headland from the north, has led to the establishment of wide sandy beaches with discontinuous foredune development at Amberley Beach.

Management Implications

The distribution of shoreline (coastal) sediments is an important factor in the location, frequency, and magnitude of flooding and erosion as beach and dunes provide important natural barriers to these processes. In addition many beach and dunes areas serve as significant natural habitats and are serve as important economic resources supporting beach use and cottage development.

Beach and dune erosion during high water levels has caused some concerns at Southampton, Port Elgin, and Inverhuron. At Inverhuron beach/dune erosion rates for the period 1973 to 1980 have been estimated at 0.78 m/yr (Boyd, 1981). South from Kincardine to Point Clark, beach erosion has been estimated as high as 0.20 m/yr (Boyd, 1981). Occurring during primarily high water levels, beach erosion causes a hazard to encroaching development and scarping of dune and till terraces lining the backshore beach zone.

Lake Huron experiences a variety of cycles of fluctuating water levels: long term, seasonal, and short term. Continuous reliable measurements taken at stations around the Great Lakes basin since 1860 indicate the presence of long term irregular cycles of water levels, with variations of up to 1.5 m from the mean, seasonal variations in the order of 0.34 m, and short term fluctuations as a result of storm surge, seiches and wave runup which can account for as much as a 1 m increase (International Joint Commission, 1989). The inland extent of the 1:100 year flood plus wave uprush and storm surge, has been delineated by Environment Canada (Figure 1). Flooding is also frequent at several locations including Baie due Dore, McRae Point, Kincardine, and Point Clark.

An understanding of shoreline sediment dynamics will be essential to the development of management and conservation practices in the study area. The Saugeen Valley Conservation Authority is currently preparing a shoreline management plan (SMP) to address the wide range of issues and concerns along the Lake Huron shoreline within its jurisdiction (Lawrence *et al.*, 1993). Included within the plan is a requirement for information related to natural processes that contribute to shoreline flooding and erosion (Lawrence, 1995). The SMP should also contain specific mechanisms to protect and conserve post-glacial relict sediment deposits and ensure uninterrupted alongshore transport processes.

Increasing seasonal cottage development, urban growth, and industrial expansion in many shoreline sites threatens continued sediment supply from these sources. Of particular concern is the encroachment of intensive land use activities along the shoreline located south of Port Elgin, at Inverhuron, and south of Kincardine. For example, residential development south of Port Elgin has increased from 18 to 36% in land cover area since 1954 (Lawrence and Nelson, 1992). This development is occurring in areas prone to shoreline flooding and erosion and which contain significant biotic habitat (Lawrence *et al.*, 1992).

Areas of management concern, reflecting land use pressures in areas containing important sediment deposits, are identified in Figure 1. The limited additional sediment from riverine systems and adjacent shoreline areas results in a natural system dependent on relict post-glacial deposits. Once removed they can not be naturally replaced and artificial nourishment would not be economically feasible. The construction of any shoreline protection structures, such as groynes or breakwalls, should require the preparation of environmental impact assessments in order to determine the potential impact on alongshore sediment transport.

This study provides an example of the need to develop specific management responses to shoreline development and conservation of essential natural processes in areas where sediment supply is limited. In these areas calculation of sediment budgets and the evaluation of the impacts of land uses, shoreline protection structures, and harbor facilities will be necessary. Any long term strategies for shoreline (coastal) management will require a full and proper regard for the sources, distribution, transport, and deposition of sediments that are essential for dune and beach maintenance.

Conclusions

Conservation of post-glacial sediments and protection of alongshore sediment transport in the study area are necessary in order to maintain the natural processes leading to beach and dune deposits. These features provide important values to attract further economic development and protect shoreline development from flooding and erosion during high water level events. The development of a shoreline management plan by the Saugeen Valley Conservation Authority will need to include regulatory or participatory mechanisms to ensure that future construction activity does not remove essential sediment sources.

This study has provided an example of the potential to consider the management of shoreline sediment dynamics in developing land use and resource planning initiatives. In other coastal regions, sediment budget studies should be completed in areas where sediment supply or transport processes are under threat. This information should be considered an essential component of coastal zone management practices and incorporated into environmental assessment procedures.

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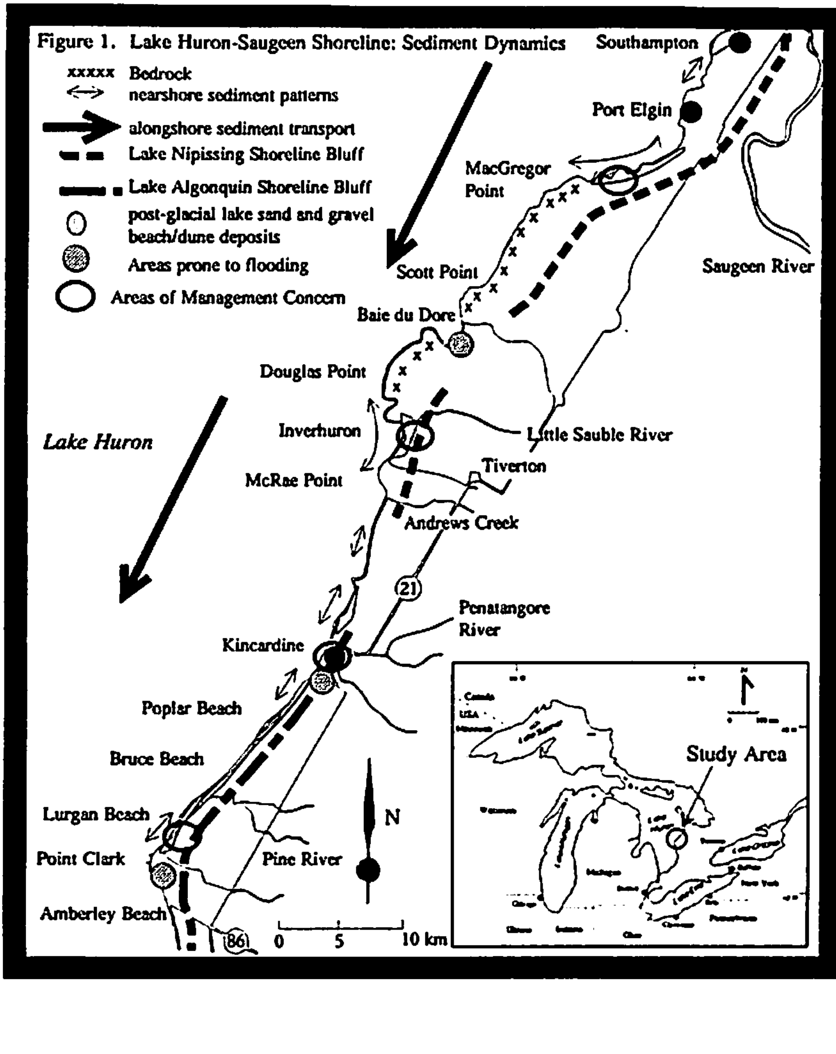
Patrick L. Lawrence
Department of Geography
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1

Ph (519) 746-7662
Fax (519) 746-2031
Email pllawren@fes.uwaterloo.ca

Figure 1. Lake Huron-Saugeen Shoreline: Sediment Dynamics



ESTIMATES OF THE CONTRIBUTION OF ESTUARINE SHORELINE EROSION TO NONPOINT SOURCE POLLUTION OF COASTAL WATERS: EXAMPLES FROM THE ALBEMARLE-PAMLICO ESTUARINE SYSTEM[1]

Christine Burns Bradford,
Apex Environmental and
Lisa Carol Huff,
N.C. Division of Coastal Management

Introduction

Section 6217 of the 1990 Coastal Zone Management Act requires states with federally-funded coastal programs to increase state authority over several land uses. "Enforceable policies" must be developed to control nonpoint pollution sources causing "significant" impacts to "coastal waters." The U.S. Environmental Protection Agency (EPA) developed guidance for coastal states that identifies several sediment sources for which management measures might have to be implemented, including: agriculture, forestry, construction, forestry, dam operation, and eroding streambanks and shorelines.

In North Carolina, little published information is available describing the sediment contributions to coastal waters from eroding streambanks and shorelines. State water quality reports have identified suspended sediments as a cause of coastal water quality impairment only in one area along the southern estuarine coastline. This impact was estimated at 163 acres, or less than one percent of the total impaired acreage of coastal waters in 1991. By contrast, fecal coliform, dioxin and chlorophyll a were major causes of estuarine water quality impairment (62,788; 41,380; and 72,273 acres, respectively) during that reporting year. Development of public policies to control nonpoint sources of pollution must be cost-effective, and based on sound identification of sources and measurements of their impacts. The EPA guidance indicates that "where streambank or shoreline erosion is a nonpoint source pollution problem, [they] should be stabilized." The EPA estimated costs for shoreline and streambank stabilization practices ranging from \$0.05 - \$57.40 per foot for vegetative stabilization practices and from \$60.00 - \$961.00 per foot for structural stabilization practices. Implementing the streambank and shoreline stabilization management measure could prove very costly.

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The N.C. Division of Coastal Management decided to determine whether estuarine shoreline erosion was a major source of sediment for the Albemarle-Pamlico Estuarine System (APES), the state's largest estuarine system. If estuarine shoreline erosion is significant, then further investigation might be warranted to determine the sediment contributions of streambank erosion in the upstream reaches of the state's river basins. In contrast to coastal waters, sediment is reported as the most common cause of freshwater impairments in North Carolina. Sediments are also known to provide a substrate for the storage, resuspension and release of pollutants which can have serious effects on fresh and coastal waters. Thus, streambank and shoreline erosion upstream of coastal waters actually may be of integral concern to coastal water quality.

Objective and Study Area

The objective of this study was to determine the percentage of silt and clay in the bank sediments of the Neuse and Pamlico River estuaries in order to estimate the contribution of estuarine shoreline erosion to the suspended load of the APES. The Neuse and Pamlico River estuaries are located in east central North Carolina and are part of the larger APES. Both estuaries empty into the Pamlico Sound. The estuaries have no free connection to the Atlantic ocean, but the Pamlico Sound has a connection to the Atlantic through four inlets in the Outer Banks (Figure 1).

Four types of bank morphology are recognized in the APES: bluffs, high banks, low banks, and marsh shorelines. Bluffs are composed of sand, silt, and clay and extend 20 ft or higher above mean water level. Bluffs erode slowly because the slumped materials retard erosion by protecting the base of the bluff; thus, wave energy is directed at the slumps and not the bluff. The slumps provide the estuary with a steady stream of sand, silt, and clay creating a wide beach with shallows that can extend several meters into the estuary. Beaches below bluffs are littered with fallen trees and other vegetation. The wide beach, fallen vegetation, and extensive shallows absorb incoming wave energy and retard further erosion. The erosion rate for the bluffs is relatively slow for the volume of sediment that is removed.

High banks (greater than 5 ft and lower than 20 ft) are also composed of sand, silt, and clay. As with bluffs, high banks are undercut by wave action which causes slumping. The same erosion-retarding forces that affect bluffs also affect high banks. In the study area, many of the bluff and high bank faces were riddled with gullies created by runoff from the top of the bank down to the beach. This presumably weakens these formations, making them more susceptible to undercutting. Such erosion was most prevalent where the top surface was not heavily vegetated. The recurrence interval for slumping is unknown, but probably varies with the intensity and frequency of causative events.

Low banks rise from 1 to 5 feet above mean water level and are also composed of sand, silt, and clay. Although low banks have the highest erosion rate of all bank types in the APES (except marsh banks), relatively little sediment is contributed to the estuary from eroding low banks. Thus, the beaches in front of low banks are narrow. Narrow beaches are ineffective wave absorbers, therefore, the low banks are not well protected from wave energy. Vegetation or structures which retain sands retard, but do not stop, erosion. Fringes of emergent marsh grasses can assist in absorbing the energy of storm waves, as can a fringe of cypress trees with their extensive root systems and broad, fluted bases. Despite the mat of roots found at the cypress fringe, this study noted that some low banks were undercut below the root mat. Dead cypress trees extend several meters from the low banks of the Neuse and Pamlico River estuaries, indicating where the shoreline once was.

Marsh shorelines occur where lands adjacent to the estuaries are less than one foot above mean water level and the water is brackish to salty. Marshes become increasingly common eastward along the Pamlico and Neuse River estuaries. Marshes are dominated by cordgrass (*Spartina*) and black needlerush (*Juncus*). As the grasses die, the decaying organic matter is transformed into thick beds of peat. Marsh surfaces consist of a mat of decaying organic matter and roots which is wave-absorbent and relatively resistant to erosion. The underlying peat, however, is relatively easy to erode. Thus, during low tide, marshes are undercut and large blocks of marsh eventually break off into the estuary.

The Neuse River estuary contains more high banks and bluffs than the Pamlico River estuary (Table 1). Several variables affect the rate of any shoreline's erosion, including: fetch, water depth and bottom slope, hank height, bank composition, width of sand beach, vegetation on and in front of the bank, shoreline geometry, shoreline orientation and the proximity to boat wakes. Much shoreline erosion is directly related to high energy wave conditions. The amount of recession at a location is variable over time and depends on the type, direction, intensity, duration, and frequency of storms, as well as tides, currents, and waves.

Sampling and Data Acquisition

In the summer of 1994, sediments samples were obtained from the estuarine shorelines of the Neuse (n=21) and Pamlico (n=19) Rivers in areas accessible by automobile (Figure 1). Although this limited the number and location of samples, it provided an order of magnitude estimate of bank contributions and an opportunity to assess the value of this technique. In addition to the banks of the Pamlico and Neuse River estuaries, samples were taken from major tributary estuaries such as the Pungo River estuary.

To collect a representative sample of each bank type, samples were collected with a quarter cup scoop every 30 vertical inches for banks over 5 ft and every 12 vertical inches for banks lower than 5 ft. Theoretically, the greater frequency of sampling in the higher banks would account for the possibility of greater variability in the sediments. By contrast, the low banks and marshes had relatively little variability so they were sampled with less frequency. The samples from each location were homogenized, taken back to a laboratory, and air-dried. The air-dried samples were broken up by hand and split into quarters to reduce them to manageable size. One quarter of each sample was weighed (dry) and then wet-sieved on a 63 μm sieve (230 mesh). The portion of the sample remaining on the sieve was oven-dried at 80 degrees C for 24 hours. The dry sample was weighed to determine the amount of sediment lost through the sieve. The sediment that passed through the sieve is the silt and clay portion of the sample. The difference between the original sample weight and the sand remaining in the sieve was the weight of the silt and clay within the sample.

The annual amount of silt and clay contributed to estuarine waters from shoreline erosion was estimated by using the U.S. Natural Resources Conservation Service's (formerly the Soil Conservation Service, SCS) Shoreline Erosion inventory (1975) and the estimated percentage of silt and clay for each segment of shoreline examined. The average density for quartz and feldspar silt grains and clay-sized clay minerals closely approximates the density for quartz, 2.65 g/cm3. Using this density (with no consideration of void space) and the total volume of sediment lost for each segment of shoreline (according to the SCS study), the percentages of silt and clay were converted to tons. By dividing the total tons lost by the number of years encompassed by the SCS erosion study (25 - 32 years), we derived estimates of the silt and clay contribution of each segment. Table 2 provides the data used in these calculations for the Pamlico River estuary.

Results and Discussion

Virtually all of the sediment carried by rivers feeding the APES is fine sand, silt and clay. The bed load of the APES consists of approximately 62.5-125 um of fine sand, while the suspended loads consists of silt (2.0-62.5 um) and clay (<2 um). Very little coarse grained (>2 mm) sediment is brought to the estuaries. The Neuse river carries an annual total sediment load of 235,000 ton/yr and the Pamlico river carries 208,000 ton/yr (Table 3).

The sand and gravel fraction of the bottom sediment of the Neuse and Pamlico River estuaries and the Pamlico Sound is derived predominantly from erosion of the estuarine banks. The Soil Conservation Service (1975) estimated that the shoreline of the Neuse River estuary, from New Bern eastward, contributes 736,563 total tons of sediment per year to the APES; the shoreline of the Pamlico River estuary contributes 325,992 tons of total sediment per year (Table 4, Column 3). This study estimated that the silt and clay fractions contributed by the shoreline of the Neuse River estuary is a minimum of 289,291 tons per year, and the silt and clay contributed by the shoreline of the Pamlico River estuary is at least 109,858 tons per year (Table 4, Column 4). Over 50 percent of the sediment contributed by estuarine bank erosion is larger than silt and, therefore, does not remain in suspension during normal flow and fair weather conditions.

The Neuse River estuarine shorelines contribute an estimated 524,291 tons of silt and clay per year to the APES (from Table 4: Column 2 plus Column 4). More than half of the silt and clay contributed to estuarine waters by the Neuse River estuary is due to erosion of the estuarine shoreline: Neuse River 45 percent (235,000 tons/yr) and Neuse River estuary 55 percent (289,291 tons/yr). By comparison, the shoreline of the Pamlico River estuary is a rather small silt and clay contributor to the APES; the Pamlico-Tar River and the Pamlico River estuary shorelines contribute an estimated 317,858 tons of silt and clay per year to the APES (Table 4, Column 2 plus Column 4). The river component is 66% (208,000 tons/yr) and the shoreline component is 34% (109,858 tons/yr) of the total silt and clay fraction contributed to estuarine waters.

The total sediment (sand, silt and clay) contributed by the estuarine shorelines is greater than that contributed by the rivers. Almost all the sand found in the APES originates as a result of estuarine shoreline erosion, because only the silt and clay component of river sediment is carried as suspended load (Table 3) and deposited in the APES.

Due to the difficulties of obtaining samples by automobile, the data collected for this study are only a rough estimate. However, the high erosion rates, coupled with large reaches of high banks and large amounts of silt and clay in estuarine bank sediments indicate that these estimates of shoreline contribution are probably a lower limit. This study indicates that shoreline erosion in the estuarine portions of two, major coastal river basins is a significant contributor to the sediment load of the APES. Supporting data from other studies indicate that the upstream, freshwater portions of these coastal rivers are carrying a significant load of silt and clay sediments. These upstream reaches are worthy of study to determine the sources of the suspended sediment load and to determine if the streambank erosion component is significant.

Lisa C. Huff
N.C. Division of Coastal Management
P.O. Box 27687
Raleigh, NC, USA 27611-7687

Ph (919) 733-2293
Fax (919) 733-1495

Table 1. Types and percentages of banks in the Neuse and Pamlico River estuaries.

Bank Type	% along the Neuse River Estuary	% along the Pamlico River Estuary	APES shoreline erosion rate (ft/yr)
bluff	2.5	1.0	2.1
high bank	5.2	3.9	1.9
low bank	27.5	23.2	2.6
swamp forest	0.5	1.4	2.1
marsh	64.3	70.5	3.1

Table 2. Data for the Pamlico River Estuary. Silt and clay content estimated by the author. Total silt and clay contribution to estuarine water calculated using the volume of shoreline lost (SCS, 1975) and multiplying by the estimated density of the silt and clay minerals (Klein and Hurlbut, 1977).

Sample	% silt and clay	Reach	Ave. width lost (m)	Ave. Ht. of bank (m)	Length of shoreline segment (m)	Years	Erosion rate (m/yr)	Sed. yield (tons/yr)	Ave. amt. per reach (tons/yr)
15-94	52.47	10	16.00	4.24	9656.06	32	0.50	31361.43	
16-94	44.09	10	16.00	4.24	9656.06	32	0.50	26351.70	28856.57
14-94	74.46	9	17.62	0.49	10138.87	32	0.55	5922.16	5922.16
17-94	28.69	11	16.79	1.43	6598.31	32	0.52	4158.14	4158.14
18a-94	15.06	12	9.72	1.71	8690.46	32	0.30	1983.61	
18-94	56.78	12	9.72	1.71	8690.46	32	0.30	7477.41	4730.51
10-94	47.41	13	16.92	1.13	7724.85	32	0.53	6378.49	6378.49
11-94	62.14	16	35.51	0.73	2735.88	32	1.11	4031.72	4031.72
12-94	40.44	9	29.96	0.79	6276.44	32	0.94	5502.64	5502.64
1-94	0.27	7	7.16	0.85	17219.98	32	0.22	25.53	25.53
2-94	33.15	4	18.20	0.94	9977.93	32	0.57	5191.87	5191.87
3-94	14.44	2	23.65	1.40	7885.79	32	0.74	3447.99	3447.99
4-94	35.17	1	14.23	0.73	47314.71	32	0.44	15819.88	
5-94	77.33	1	14.23	0.73	47314.71	32	0.44	34785.25	
9-94	61.62	1	14.23	0.73	47314.71	32	0.44	27718.55	26107.90
6-94	64.09	3	22.86	0.55	23496.42	25	0.91	22071.89	
7-94	10.72	3	22.86	0.55	23496.42	25	0.91	3692.63	
8-94	60.25	3	22.86	0.55	23496.42	25	0.91	20748.87	15504.46

Total Shoreline (miles) = 216.70
Total miles examined = 116.10
Length of eroding shoreline = 194.30 (m)
Total estimate of silt and clay (last column) (tons/yr) = 109,857.97

Table 3. Water and sediment input into the APES from the Neuse and Pamlico Rivers.

Variable	Neuse River	Pamlico River
Area drained (km2)	14,504	11,137
Freshwater discharge (m3/s)	172.6	152.8
Sediment discharge (tons/yr)	235,000	208,000

Table 4. Estimated sediment contribution from the Neuse and Pamlico river and estuary.

River System	River Sediment Yield (tons/yr)	Total Estuarine Shoreline Sediment Yield (tons/yr)	Total Silt and Clay from Estuarine Shoreline (tons/yr)
Neuse	235,000	736,563	289,291
Pamlico	208,000	325,992	109,858

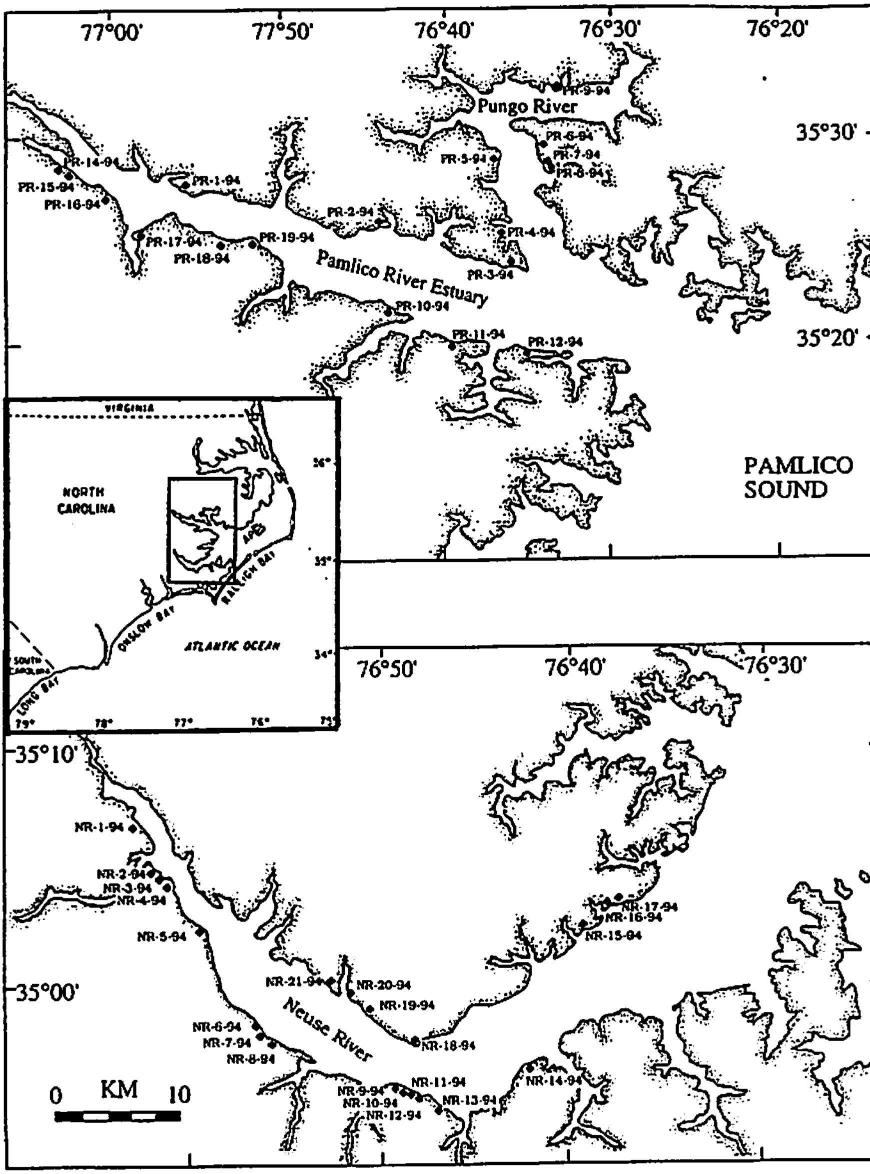

Figure 1. Location of sample points and study area.

A COASTAL COMMUNITY AT RISK EVALUATING FLOODING AND EROSION HAZARDS

Rameshwar Das
Town of East Hampton, NY

East Hampton is the easternmost municipality on the fishtail South Fork of Long Island. The Town has 110 mi of diverse coastline, divided between a northern bay shore with enclosed harbors, bluffs, beaches and salt marsh, and a south shore with direct exposure to the Atlantic Ocean. Coastal topography also varies immensely. On the north shore 100-ft high morainal bluffs descend to narrow beaches and creeks and harbors are fringed by expanses of salt marsh. Along the south ocean shore clay "hoodoo" bluffs at the eastern promontory of Montauk Point give way to broad sandy beaches and dune systems and a low coastal plain with coastal ponds.

Over the past five years East Hampton has been engaged in drafting a Local Waterfront Revitalization Plan (LWRP) under the federal Coastal Zone Management Program, with supervision from New York State's coastal program in the Department of State. Unlike some states coastal zone policy in New York is developed locally and adapted to local conditions, within state policy guidelines. East Hampton elected to research and write its plan through its own planning department rather than contract it out, which has further maintained the LWRP's community orientation.

The flooding and erosion sections of the LWRP have been given renewed impetus by a series of winter nor'easters and near misses by hurricanes that have caused substantial beach erosion. Storm damage has stimulated concern and a spate of applications by waterfront homeowners in East Hampton and neighboring towns for structural protection shoreward of their homes. The planning and zoning boards of the towns have viewed these proposals with skepticism because of previous damage to beaches from shore armoring, but are being pressured by lawsuits and threats of lawsuits to approve them. The boards are asking for more guidance, which the LWRP endeavors to provide.

Shoreline problems with flooding and erosion are only apparent when manmade development interferes with coastal processes. In "The Beaches are Moving," a popular classic of coastal lore, Kaufman and Pilkey portray the conceptual dilemma thus: "Those who live near the shore choose to say that a shoreline moving with the water toward their house is 'eroding.' ... Most geologists speak of beaches *retreating*. Barrier islands are said to *migrate*. Beach erosion, geologically speaking, is not usually a permanent loss, but a strategic retreat. ... Beaches are not stable, but they are in *dynamic equilibrium*. ... Dynamic equilibrium is not stability ... but a net balance among many changes." In her poetic book, "The Thin Edge, Coast and Man in Crisis," Anne Simon (1978) says, "For us, shifting sands is a convenient cliché but an inconvenient reality. We do not accept it. We call it erosion and engage the United States Army Corps of Engineers to fight it."

Coastal development in East Hampton has a long history. The community was settled in 1648, but neither the colonial settlers nor the aboriginal native Americans who preceded them lived on the shore, except for summer fishing camps. It was too cold, too exposed, too precarious. The first resort "cottages" along the beach were constructed in the late 1800s, and those remaining are still some of most imposing homes in East Hampton. Another incremental phase of resort construction occurred in the early 1900s with the advent of rail service to Montauk and the boom of the 1920s, but it wasn't until the post-World War II boom that building really took off. Zoning was introduced in 1957. Before then coastal development and its location on the shore was largely unfettered. Coastal setbacks were introduced by the Town in the 1970s when the flood and erosion risks to some of the earlier development began to be apparent. There was another building boom that extended from about 1962-87, ending with the 1987 drop in the stock market.

The storm damage of recent years may be more the rule than the exception. There are anecdotes of huge hurricanes and winter storms in the 1600 and 1700s. A 1635 account by Governor William Bradford of Plymouth Colony in Massachusetts records "a mighty storme of wind & raine, as none living in these parts, either English or Indeans, ever saw." It was accompanied by a 20-foot storm surge and winds that "blew downe many hundred thouwsands of trees." Anecdotal accounts by the settlers on Long Island record storms throughout the 1700s and 1800s, including a "tremendous gale" in 1723, a hurricane in September 1782, the Christmas Storm of 1811, the Great September Gale of 1815 which was characterized as the "worst and most destructive hurricane ever known in these parts," and the Great Blizzard of 1888, among others.

Hurricanes and severe storms are by no means infrequent visitors to Long Island. The NOAA/National Hurricane Center records show 26 tropical cyclones or hurricanes hitting Long Island since 1886. Winter nor'easters have numbered at least 65 in the last century, with 9 classed as severe and 1 extremely severe (March 1962). Recent severe nor'easters include the Halloween Storm of October 1991, and the winter nor'easters of December 1992, March 1993, and December 1994. Twentieth century records are marked by the hurricane of September 21, 1938, "The Atlantic Express," which made landfall at Westhampton and killed more than 700 people along the east coast, devastating beaches and property. (The Weather Channel wasn't there to warn us.) East Hampton has been hit by numerous other hurricanes and storms since (an unnamed hurricane in 1944, Carol and Hazel in '54, Donna and Edna in the early 1960s), but none packing nearly the loss of life and property as the 1938 storm. The 1938 hurricane would have been a Category 2, or possibly 3, on the present Saffir/Simpson scale of five, with sustained winds of 95 mph.

It's interesting to note the how the storm history interacts with building activity on the coast. Most of the development on the shore has been after the 1938 hurricane, and between the 1962 nor'easter and the most recent series of storms. The immediate post-war boom and the mid-1960s to early 1980s building boom coincide with lull periods in storm activity. Many low-lying areas, barrier beach areas, and high bluffs with water views saw a great deal of construction in this period. Only now are we taking a hard look at the problems posed by this heedless development and trying to formulate sensible policy for the future.

First, what are the problems? Beach loss and shoreline retreat that threatens property is certainly the most egregious. Storms cause probably 70% of the shoreline erosion (at least on the ocean shore), but other coastal processes, littoral drift, sea-level rise, the interference of manmade structures, dredging, and stabilization of inlets, etc. are also changing the shoreline. When portions of the northern bay shore were developed in the 1950s and early 1960s there were few if any restrictions on what property owners could construct to protect their homes.

Permits were granted for a hodge-podge of hard structures that sprouted along the populated shorelines, from bulkheads, gabions, and more recently rock revetments, to groins of timber and concrete, docks that have acted like groins, and all manner of experimental or homemade constructions like sta-pods, dolos, walls of beach stone, and old concrete paving riprap. On some shorelines a domino effect of downstream scouring and beach loss became the norm; hard structures travelled in a chain reaction from one parcel to another, until shore armoring was continuous and fronting beaches vanished.

Along the ocean where there is generally an abundant windborn sediment supply, homeowners have generally used soft solutions like snow-fence and beach grass planting to trap sand and build dunes. This was fortunate because elsewhere in the Hamptons experience with hard structures in the high-energy ocean environment has been disastrous. A groinfield in Westhampton along the barrier beach is illustrative, causing the loss of dozens of homes, years of acrimonious litigation, and leaving government with an open-ended obligation to maintain a beach regularly threatened by overwash.

The clamor for protection of upland property from receding shorelines has triggered an at times acrimonious debate over property rights versus the protection of beaches and other public resources. In East Hampton the beaches were part of the land patent granted to the original town trustees by the King of England for the "commonality" of all the citizens. The town's beaches are the linchpin of its summer resort economy, and even though public access is limited in some areas and beaches may be abused by summer traffic and 4-wheel beach drivers, they remain a vital resource. Along whole sections of the shoreline citizens are becoming acutely aware of the consequences of erosion protection structures where beaches have vanished in front of them.

In seeking to evaluate and manage present and future flooding and erosion problems in the Local Waterfront Revitalization Plan, the town has used mapping tools from several different sources, and is undertaking several projects to acquire more data and assess risks. The standard NFIP FIRM's are used to determine flood zones, corresponding with local implementation in a Flood Hazard Overlay District. Federally designated barrier beaches under the Federal Coastal Barrier Resources Act (CoBRA zones) help in identifying areas prone to flooding and erosion and inappropriate for new development. New York State supplies aerial photo "maps" establishing an inland boundary for State Coastal Erosion Hazard Areas (generally covering only the primary dune or bluff), under a 1983 law that requires a state permit for activity within these areas, a capacity rarely enforced by the State Department of Environmental Conservation. A relatively recent addition are maps from the Army Corps utilizing the SLOSH model (Sea Lake and Overland Surge from Hurricanes) which is designed to delineate a worst case scenario for storm surge inundation given a direct hit from various categories of hurricanes.

The town's Natural Resources Department has also begun its own beach monitoring program, now in a second year pilot phase, to establish surveyed baselines and beach profiles for determining erosion rates. The pilot program is examining erosion hotspots on several typical shorelines, compiling a database that will serve as referents for years to come. The town expects to either contract or gain in-house capacity to perform historical shoreline change analysis, to differentiate between the short term "noise" of interannual onshore and offshore sediment shifts and long term erosion rates. Along some sections of ocean beach studies have documented seasonal changes of more than 200 ft in beach width. In the not too distant future the available mapping, shoreline change analysis, and beach profiles will be overlayed with aerial photographs in a GIS system.

In the meantime the town is also conducting an on-the-ground risk assessment survey of waterfront construction, with evaluations to be made available to individual homeowners, building inspectors, planners and emergency response teams. An aerial video inventory of the entire Town shoreline was conducted in late 1994, with the aid of a National Guard helicopter unit; similar aerial surveys are envisioned on a periodic basis and following major storm events.

How does all this data translate into policy mechanisms and future actions? In the short term the LWRP advocates modifying permit requirements and standards for erosion protection, emphasizing soft approaches in most areas, while permitting existing structures to remain in place, or be replaced in-place in-kind. The report proposes a prohibition on hard structures in the high-energy environment of the Atlantic Ocean beaches. A system of natural resource special permits relating to beach, bluff and wetland setbacks and construction near the water is already in place but is proposed to be strengthened.

The erosion monitoring project is expected to allow eventual designation of local erosion hazard zones. In conjunction the town will likely consider adoption of a local law to implement the State Coastal Erosion Hazard Act. Proposed changes in the NFIP at the national level will be implemented in the town's Flood Hazard Overlay District. Results of the risk assessment survey will be used by various town agencies and find their way into emergency response plans for storm events.

Public education is clearly a vital component of changing attitudes to coastal planning and siting of development. Several measures are proposed as future projects. Educating through local cable access programs, expert forums, manuals and brochures for homeowners, workshops for town officials such as building inspectors, and involved professionals in the insurance and real estate business, are all envisioned.

Over the long term a Hurricane Damage Mitigation Plan is proposed as a follow-up step to complement the risk assessment and erosion monitoring programs. This study will further assess vulnerable areas and infrastructure in the town, propose redevelopment plans for the aftermath of a catastrophic storm event, and prepare for buy-outs of inappropriately sited development using the town's bonding authority and Stafford Act disaster relief funds.

Further long-term attention must be given to monitoring and responding to the potential effects of global warming and accelerating sea-level rise. If sea-level rise occurs within even the low end of the estimated range within coming decades, erosion and coastal flooding may increase dramatically from present rates. If hurricane frequency and severity increases, either from global warming or a resumption of normal activity following the current lull, breaches in coastal barriers and storm damage may become more common occurrences.

All of these prospects, from policy recommendations to changing natural phenomena, will prove extremely challenging within the context of local politics, government regulations and planning procedures, and the litigious arenas of our society. Will we manage to do the right thing? Faced with the pressures of coastal development and profitable real estate markets, can we respond with good planning, develop community consensus and provide sufficient protection for our natural resources?

Rameshwar Das
Town Waterfront Advisory Committee
East Hampton Planning Department
300 Pantigo Place, Suite 105
East Hampton, NY, USA 11937

Ph (516) 324-2178
Fax (516) 324-1476

Session B4, Part I: Managing the Impacts of Public Use
Session Chair: Linda Maxson, NOAA/National Ocean Service

MARINE RECREATION AND TOURISM: RESOURCE MANAGEMENT AND CONFLICT RESOLUTION

James R. Fox, Washington Interagency
Committee for Outdoor Recreation
Linda J. Maxson, NOAA/National Ocean Service

More and more people are seeking recreational opportunities in the Nation's coastal zone, leading to a demand for new recreational sites and facilities. However, land for additional water access and money to acquire new public sites and facilities are becoming increasingly scarce. Growing recreational use of existing coastal resources and changes in recreational use patterns are leading to increased user and resource conflicts. For example the recent popularity of personal watercraft, parasailing, and whale watching is leading to conflicts between recreationists and impacts on the marine environment.

One way to address these conflicts is to include planning for marine tourism and recreation in coastal resource management. Although not always recognized, marine recreation, tourism, and coastal resource planning are intimately interrelated:

- Coastal resources that provide recreational opportunities are often the major draw for a local or regional tourism industry, giving the resource (and protection of the resource) social and economic importance. How the resource is managed can dramatically affect a regional economy.

- Resource planning decisions will undoubtedly affect siting and development of recreational facilities, water access, and types and intensity of recreational uses.

Recreation and tourism has the potential to significantly degrade marine resources.

Although this inter-relationship might seem quite obvious, it is often ignored by planners working in the fields of recreation, tourism, and coastal resources. This is due, in part, to use of very different planning models and planning goals. Recreation planning, historically conducted by resource management agencies (National Park Service, National Forest Service, state resource agencies) and local parks and recreation departments, has focused more on qualitative goals, such as the recreation experience, or on quantitative goals, such as acres of park land per thousand population. Tourism planning has historically been focused on marketing tourism opportunities and assessing and forecasting tourism use patterns in order to develop infrastructure (numbers of beds, etc). The goals have been chiefly economic. Rarely do traditional recreation planning or tourism planning address resource conflicts, especially cumulative impacts to natural resources.

Another reason for the lack of integration of planning efforts is the different legal mandates of planning agencies. Local planning efforts often result in separate and uncoordinated plans for land use, economic development, transportation, infrastructure, recreation, and open space. State and federal agencies' efforts are often focused on a specific resource (fish, navigation, clean water).

Coastal resource management, however, grew out of an increasing awareness of the Nation's terrestrial edge as being "the Nation's most valuable geographic feature" (Stratton Commission), containing both natural and economic value. The Coastal Zone Management Act of 1972 enunciated a national policy "to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." Although these goals are pursued within a national framework, state and local authority over land- and water-use forms the real basis for coastal zone management.

New Ways of Resource Planning

Coordinated, integrated marine resource planning is rarely easy, especially in coastal waters involving multiple political jurisdictions and agencies and given the high degree of connectivity of marine ecosystems. For example, during a typical tide cycle, ocean waters entering northern Puget Sound might pass through several dozen local jurisdictions (port districts, cities, counties) and be affected by regulations from a dozen or more state and federal agencies.

A planning model that is becoming more accepted coordinates public and private sector planning and integrates planning efforts over a geographic area big enough to make sense socio-culturally, economically, and environmentally. More commonly applied to terrestrial environments, these have gone under the name ecosystem, landscape, or watershed planning. The geographic unit is typically a watershed or basin rather than a political subdivision. Ideally, planning is locally driven, with a high degree of coordination between local, state, federal, and tribal agencies, public and private land owners, and recreation, business, conservation, and other interests. Plans integrate not only economic and conservation resource values, but also socio-cultural values.

The Planning Process

Washington State's Growth Management Act (GMA), passed in 1990, has helped to integrate local and regional planning in some areas, such as transportation, infrastructure, and land use. Also, partly as a result of the GMA, there has been a shift from the public simply reacting to government planning to the public directly participating in planning. More recently, this trend has gone further. In watershed planning, for example, planning efforts have been initiated and driven by citizens groups or local governments.

Experience has shown that to be successful, community-based regional planning efforts should:

1) involve all interested or affected parties,

2) use a facilitated, consensus-based decision making process,

3) tailor the process and the outcome to that community and bioregion (i.e., from region to region there are major differences in issues, economy, types of resources, community values, types of property ownership, types of political jurisdictions, involvement of state and federal agencies, available data, etc.),

4) clearly define the role of local, state, and federal government in the planning process and in providing solutions (see below),

Planning and Management Tools

A new array of planning and management tools is becoming available to help cope with conflicts that arise in the planning process and resource management. These include:

1. new methods of group facilitation for use in community-based planning

2. new methods of obtaining public participation

3. negotiated rule making methods

4. carrying capacity assessment process (CCAP)

5. cumulative impact analysis

6. setting limits of acceptable change (LAC)

7. visitor management models such as visitor impact management (VIM), visitor experience and resource protection (VERP), and quality upgrading and learning (QUAL)

8. education of visitors and service and facility providers by public agencies, user groups, nongovernmental organizations

9. using tourism marketing as a management tool

10. time and space recreational use zoning

These techniques can help to attract the appropriate type of person to the resource, directing them to appropriate areas and activities, and educating them about the how to interact with the resource and each other.

Role of Government

In these new approaches to planning and resource management, the role of government will vary considerably, depending on the region, the resources, and the needs of the communities within the region. It is important that government be flexible enough to adjust its role accordingly, and to work with nongovernmental participants to carefully define this role. Possible roles include:

1. Participating in local planning, providing as much or little leadership as appropriate

2. Providing technical assistance (research, GIS, data, facilitation)

3. Coordinating planning, regulatory, and enforcement agencies

4. Developing standards

5. Providing funding

6. Developing new incentives

7. Developing new regulations, using a negotiated rule-making process when possible

Methods of Conflict Resolution

The most effective method of conflict resolution is preventing the conflict from occurring. With traditional planning and management models, conflict often occurs when proposed government-generated plans or regulations are presented to the public for comment; when plans or regulations are challenged in court; and, in the case of implementing plans, when management strategies fail and resource and user conflicts occur.

Use of the new planning models discussed above can be effective in reducing some of the conflicts inherent in the planning process. However, other types of conflict can arise when these new methods are employed. In community-based planning, for example, the process of getting all interested parties in the same room, agreeing on the need to cooperate, and agreeing on goals and outcomes of the planning process can be highly contentious and may take several attempts over a period of years. In addition, increased participation of nonprofit organizations has often added a planning horizon that stretches a generation or more into the future — a far different time scale than is typically preferred by business people or elected officials.

Resource and user conflicts often occur due to over-crowding or change in use patterns. New management techniques, such as those based on carrying capacity analysis, can be effective in minimizing these conflicts. For example, conflicts arising due to the increased use of personal watercraft (PWC) can be reduced by initiating space and time zoning based on analysis of the social and environmental carrying capacity of a body of water.

When government regulation appears to be necessary, the use of negotiated rule-making has the potential to involve all sides of an issue in development of a mutually acceptable — although not necessarily universally liked — law, ordinance, or rule, reducing the likelihood of legal challenge.

With heightened awareness of the impacts of tourism and recreation, self-policing is increasingly being used as a non-regulatory way to reduce various types of resource and user conflicts. For example, in the San Juan Islands (see below), whale-watching business owners and operators meet regularly and have developed a set of voluntary guidelines to minimize whale harassment. And on Long Lake in Washington, a PWC organization has been helping to inform PWC riders about boating etiquette and safety.

Conflict resolution centers, whose staff sometimes make themselves available to communities at low or no cost, are becoming more numerous. Often, experts in mediation and alternative dispute resolution techniques specialize in certain types of issues, such as natural resources.

Case Study: San Juan County, Washington

San Juan County is composed of several hundred islands in northern Puget Sound, bounded by international waters. It is a destination for tourists from all over the world, offering marine recreational opportunities that include sailing, cruising, kayaking, fishing, diving, whale watching, and beach combing.

In the San Juan Islands, like many places in the country, the use of personal watercraft (PWC; also known by the trade name Jet Ski) has become controversial. Waterfront property owners have expressed annoyance due to the noise. Boaters and divers feel a sense of physical threat due to PWC's high speeds and sudden changes of direction, and are concerned with PWC operators' general lack of "boating etiquette" and understanding of boating safety.

In February 1996, in response to a petition from nearly 1,500 of San Juan County's 12,000 residents, the Board of County Commissioners enacted a ban on PWC use in county waters. Although counties have banned PWCs on several lakes in Washington, this represents the first time in the state that PWC use has been banned outright in all navigable marine waters of a county.

The Personal Watercraft Industry Association (PWIA) has questioned the authority of San Juan County to deny "citizens access to the public waters," suggesting that under the Public Trust Doctrine, the public has a right to boating in waters of navigable waters. The industry has also stated their belief that singling out one class of motorized watercraft for regulation is "discriminatory, arbitrary, and capricious." The PWIA has filed suit against the county.

Two endeavors might have provided a framework for resolving PWC conflicts and, as well, provided a more firm legal basis for PWC regulation: San Juan County's tourism planning process, and the proposed Northwest Straits National Marine Sanctuary.

Community-based Tourism Planning

Beginning in the 1980s, an increasing number of county residents began to express concerns about the impact of unmanaged tourism on the social and physical environment of the islands. As a result, the county undertook a community-based tourism planning effort, consisting of a community opinion survey, an issue identification workshop attended by community leaders and interest group representatives, and a series of town meetings on the most populated islands. The process and preparation of the resulting tourism plan was overseen by an advisory committee composed of 10 citizens appointed by the Board of County Commissioners. Three of the members were representatives of the tourism industry.

The tourism plan, completed in 1992, contained numerous recommendations for changes in county policy, including land use policy. In addition, recommendations were offered to the tourism industry and various governmental and nongovernmental agencies and organizations involved in tourism, recreation, and resource management. A major recommendation of the plan was to keep tourism development at a small scale, consistent with the relaxed, relatively undeveloped rural atmosphere of the county. For example, lodging development would, ideally, be limited to small resorts, inns, and B&Bs. Commercial marine tourism would be nature-based and consist of rental of human powered vessels rather than PWCs, and tours on small excursion boats rather than large cruise ships. These recommendations were seen to benefit residents who did not want large-scale development or have their community over-run by visitors. The recommendations were also thought to benefit the existing tourism industry—generally small locally-owned businesses—by protecting them from competition from large out-of-state tourism developers. Also important, the recommendations were intended to protect the natural resources that are valued by residents and are the draw for the tourism industry.

As a result of a change in the composition of the governing body of the county, and opposition from some sectors of the tourism industry, the tourism plan was never formally adopted. However a number of nonregulatory approaches to tourism management and resource protection are currently being used. The self-policing of the whale-watching industry was mentioned above. The kayak tour industry also has joined to develop a "code of ethics" dealing with respect for the environment and shoreline property owners. And a nonprofit marine research and education organization (the Whale Museum) has engaged in educational programs for boaters on ways to behave in the proximity of marine mammals and other marine wildlife.

The Northwest Straits National Marine Sanctuary

In 1983 the marine waters of northern Puget Sound were identified by Congress as a study area for possible designation as a national marine sanctuary. Because the study site is entirely within Washington State waters, participation of the state, along with local governments and interested constituent groups was essential. Local opposition to the sanctuary, changes in composition of local elected bodies, and an arduous public participation process has kept the proposal from moving at more than a glacial pace. Designation, if it occurs at all, is not likely before the end of 1996.

Had the waters around the San Juan Islands been part of a national marine sanctuary, there would have been a structure for coordinated marine resource planning and management, a better understanding of the nature of the resources and possible impacts by PWCs, and a legal basis for PWC regulation that has withstood challenge in another sanctuary.

Conclusion

New planning models, public participation methods, conflict resolution techniques, and resource management tools are available to improve management of our marine resources. In addition, there is a growing awareness for the need to integrate planning for recreation, tourism, and coastal resources — traditionally isolated planning activities — to better manage resources experiencing increasing demands from visitors. In San Juan County, several attempts to do this were less than successful. A political solution, currently being challenged in court, was used to resolve conflicts arising from personal watercraft use.

James R. Fox
Interagency Committee for Outdoor Recreation
P.O. Box 40917
Olympia, WA, USA 98504-0917

Ph (360) 902-3021
Fax (360) 902-3026
Email JimF@iac.wa.gov

THE REVIVAL AND RECLAIMING OF A NATURAL RESOURCE IN AN URBAN SETTING: SAVIN HILL BEACH

Mona L. Haywood,
Massachusetts Institute of Technology

Many environmental remediation efforts have been labeled unsuccessful. In some instances, however, such projects have significantly improved polluted areas. Working with the natural ability of ecosystems to regenerate, human activities and their influences (*i.e.*, technological advancements, raised awareness of communities, and governmental agencies targeting their resources) have improved the conditions of unusable and unhealthy natural resources that had degraded due to human activities[2]. As these community environmental assets are restored a question remains: How can these improvements be sustained to safeguard the resources as valuable ecosystems (inherent worth) that the public can enjoy them (intrinsic worth)?[3] This raises subsequent questions about the roles of technology, educating communities, and governmental and non-governmental organizations. In the summer of 1995, The Boston Harbor Association together with other organizations launched the "Back to the Beaches" campaign[4]. This effort involved targeting communities to raise their awareness of the improved water quality and conditions of the beaches. The primary assumption that all of the involved groups shared was that while it is desirable for communities to use and enjoy the beaches, improving the water quality of the harbor and thereby its beaches was not enough to guarantee maintenance of the beaches. Existing governmental entities cannot be expected to assume the entire responsibility of rejoining communities and beaches for the future support of the beaches: communities themselves have a role to play. These assumptions are based upon theory and practical experience, namely the history of the Boston Harbor.

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[1] John Holusha "Cities Redeveloping Old Industrial Sites With EPA's Aid" The New York Times. CXLV 4 December 1995: 1 & B8.

[2] Dr. Judith T. Kildow collapses these two concepts into *inherent public good*: Boston Harbor Management Study (MIT Sea Grant College: Cambridge, MA), 1981: 5.

[3] A smaller, less publicized effort was made during the summer of 1994. In August of that year, Governor Weld signed into law a $30 capital bond to fund a beaches restoration plan and named TBHA the lead organization to monitor the implementation of the plan. "Restoration Plan for Beaches Receives Funding" *Harbor News*. The Boston Harbor Association. 21 Fall 1994:2.

For generations, citizens of Boston and Massachusetts have perceived the Boston Harbor as unsafe, unclean, and unappealing. And rightly so. There was public criticism of Boston's sewage system as early as 1870s. In 1939 a special legislative commission reported that the conditions of the harbor were "revolting to the aesthetic sensibilities[5] and urged "immediate correction of pollution."[6] Sewage handling policies and technology allowed regular dumping of untreated residential and industrial wastes directly into the harbor. Run-off occurred from agricultural activities, and industrial endeavors, such as rendering plants, compromised the water quality in the harbor and contributed to disease epidemics in the Boston metropolitan area.

The neglect that took place cannot be categorized easily in terms of negative perceptions or complete disregard for the harbor. Communities did appreciate the harbor for recreational, economic, and spiritual reasons. A 70-year old Quincy (MA) resident, can recall the days when "you could walk to the [Wollaston] beach and see . . . hundreds of people on the beach sitting on blankets under umbrellas, and hundreds more in the water . . . back then that was something special, to be so close to the water."[7] Like many South Boston residents, Former Mayor Flynn had a relative who worked along the harbor; his father was a longshoreman for 47 years.[8] The Boston Harbor beaches were in a similar paradoxical position of alternately being held in high and low esteem and being the focus of attention and ignored.

There are 22 Boston Harbor Beaches grouped in five regions: North, South Boston, Dorchester, South, and Harbor Island beaches. The simple explanation for their decline is that poor water quality led to lower demands for use, which led to lower levels of maintenance, and further declines in quality. The end result with few exception has been that both the neighboring communities and the institutions charged with management responsibilities abandoned the beaches.

As a result of the implementation of the Boston Harbor Project by the Massachusetts Water Resource Authority and continued implementation of local and regional sewage infrastructure improvements, this long-term trend

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[5] Eric Jay Dolin. Dirty Water/Clean Water. (MIT Sea Grant College: Cambridge, MA, 1990: 21-22.

[6] "Significant Dates in the History of Boston Harbor." *WaterResources*. 4 (1992): 1.

[7] Alexander Reid. "Tide may be turning for Wollaston Beach." The Boston Globe. 14 May 1995: 1.

[8] Seth Rolbein. "Boston's Floating Crap Game." Boston Magazine. (1987): 150.

in water quality has begun to reverse itself. There has been "increased sightings"[9] of diverse marine life, fewer incidents of fish kills, and the number of beach closings have declined. In recognition of this, Massachusetts Governor and Mayor of Boston established a commission to study the potential uses of and ways in which people could be enticed to visit the beaches. Two years and many town meetings later, the Joint Commission on the Future of Boston Harbor Beaches released its report, which assessed the work of various agencies charged with managing the beaches, set forth a list of overall goals and principles, and delineated a "Beach Improvement Plan."

The Beach Improvement Plan sets forth a list of aims, a management design and a categorization of beach types. Specifically, the plan addresses cleaning beaches, infrastructure and access improvements, sand replenishment, getting better and more information about the beaches to communities, and improved access to the beaches. The management design delineates the roles for various governmental and non-governmental parties. The four beach types described in the plan are "regional," "community," "urban edge," and "natural," and each differs in the level of standards of safety, sanitation, and maintenance[10].

Outreach has played a significant role in the plan and thousands of residents attended the "Back to the Beaches" campaign family events. The "Family Days," coordinated by various groups and agencies, allowed attendees to have a first-hand look at the improvements that have been made, to learn about future plans, and to enjoy themselves. Although many regard the involved organizations' and the communities' participation as a success, both groups continue to conceptualize other methods that will result in a long-term, mutually beneficial relationship between communities and the beaches.

This paper will discuss what residents of nearby communities, governmental officials, and people working in non-profit organizations identify as the challenges to and the opportunities for increased usage of Savin Hill Beach (Dorchester, MA), which is designated a community beach. These "barriers" and "connectors" relate to access, environmental quality, perceptions, and awareness. Furthermore, the paper will include a review of the creative means being employed to (re)interject it into the collective

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[8] Scott Allen. "The Beaches of Boston Harbor, abandoned for years because of pollution, are making a remarkable comeback." The Boston Globe June 26, 1995: 22.

[9] Lane, Frenchman, & Associates, Inc. [in association with Jason M. Cortell & Associates, Inc.). *Plan for the Future of Boston Harbor Beaches*. June 15, 1993: 4-5 - 4-6.

consciousness of nearby communities, recommendations as to how to reconnect communities with their beach, and a discussion of how these recommendations could be applicable to other urban community resources.

Mona Haywood
Massachusetts Institute of Technology
Department of Urban Studies
77 Massachusetts Avenue
Cambridge, MA, USA 02139

Ph (617) 565-9404
Fax (617) 253-7402

THE SUSTAINABLE UTILIZATION OF THE SANDY BARRIER BEACHES ON LEKKI PENINSULA OF LAGOS STATE IN NIGERIA FOR RECREATION AND TOURISM

C. K. A. Asangwe
University of Lagos, Nigeria

As the 21st century draws in, it has been widely observed that tourism will be one of the highest revenue-generating industries worldwide. The sandy barrier beaches on low-lying coastal environments have been known to be traditionally attractive for recreation and tourism. The Lekki peninsula adjacent to Victoria Island, with more than 50 km of accessible sandy beach formations near the posh residential and business district of metropolitan Lagos, is the location for this study. The sandy beaches of Maiyegun, Eleko, Akodo Lekki, and others on the peninsula are the most visited recreational destinations in the Lagos coastal environment, thus giving the area a tremendous tourism potential.

These sandy barrier beaches on Lekki peninsula are made up of belts of sandy ridges accumulated through littoral drifts which form a buffer between the contemporary shoreline and the marginal lagoons. They rim the entire Lekki peninsula washed by the Atlantic Ocean and describe the most unstable and changeable geomorphic features of the Lagos coastal zone.

This paper analyses the results from a geomorphological survey of sandy beaches east of Lagos on the Lekki peninsula. This is with a to providing an understanding of beach forms in relation to their utilization for recreation and tourism. The paper further examines the socio-economic implications of probably sea-level rise on the Lagos metropolis, which will assist in resolving land-use conflicts when further infrastructural developments begin in the extensive rural landscape of Lekki peninsula.

The paper finally argues for environmental analysis based on geomorphic implications of man-induced action as a necessary input into the sustainable utilization of this fragile coastal environment.

C.K.A. Asangwe
Geomorphology Laboratory
Department of Geography and Planning
University of Lagos
Lagos, Nigeria

NATIONAL MARINE FISHERIES SERVICE EFFORTS TO RESTORE FISHERIES HABITAT IN COASTAL LOUISIANA

Erik C. Zobrist,
NOAA/National Marine Fisheries Service,
Tim Osborn, NOAA/National Marine
Fisheries Service, and
Rickey Ruebsamen,
National Marine Fisheries Service

Introduction

Louisiana contains more than 40% of the coastal wetlands in the contiguous United States. These wetlands support the ecological, economic, cultural, aesthetic, and recreational needs of both the state and the nation. They are the source of much of the nation's oil and natural gas, they provide habitat for many species of plants and wildlife, and they serve as a nursery for commercially important species. Louisiana waters alone contributed 79% of the total Gulf of Mexico region fisheries harvest by weight in 1994, generating more than $336 million in dockside value (U. S. Department of Commerce, 1995). The natural processes of accretion and erosion that constantly create and destroy these lands have historically existed in relative equilibrium. But human activities have disrupted that equilibrium and now jeopardize the future health of the state's wetlands, and hence the resources that they support. Louisiana's marshes are eroding at an estimated rate of 25 square miles per year (Britsch and Dunbar, 1993), which accounts for roughly 80% of total national wetland loss. Without intervention, the losses within the next 50 years could total 800,000 acres.

The Coastal Wetlands Planning, Protection and Restoration Act and Task Force

In an effort to reverse the long-term trend of wetland loss, the Louisiana State Legislature passed Act 6 in 1989. The Act created the Coastal Wetlands Trust Fund, which serves as a long-term revenue base for state-sponsored coastal restoration projects. In response to this initiative, the U.S. Congress enacted the Coastal Wetlands Planning, Protection and Restoration Act (P.L. 101-646, CWPPRA), requiring the Secretary of the Army to establish the multi-agency Louisiana Coastal Wetlands Conservation and Restoration Task Force (16 U.S.C. 3951 §303 (a)(1)), responsible for: (1) developing a long-term restoration plan for the state's coastal wetlands and (2) developing an annual priority project list for implementing wetland restoration projects. The Task Force includes the U.S. Army Corps of Engineers, the Department of the Interior (Fish and Wildlife Service and the Minerals Management Service), the Department of Agriculture (Natural Resources Conservation Service), the Department of Commerce (NOAA/National Marine Fisheries Service), the U.S. Environmental Protection Agency, and the State of Louisiana (Office of the Governor).

Task Force activities are supported by a federal trust fund of revenues from tax receipts on small engines and other equipment, 70% of which (not to exceed $70 million annually) is available for wetland restoration projects and associated activities in Louisiana. The remaining 30% is available for coastal wetland restoration in other states. CWPPRA mandates that all federal contributions to restoration projects be matched by a state contribution on 75% federal, 25% state cost share basis. Although Louisiana is a Task Force member, it may not participate in wetland project selection nor may the state be the lead sponsor of a project.

The Comprehensive Coastal Wetlands Restoration Plan

The goal of the Louisiana Coastal Wetlands Restoration Plan, as directed by Congress, is to develop a comprehensive approach to restore, and prevent the loss of, coastal wetlands (16 U.S.C. 3953 §303 (b)(2)). CWPPRA directs the Task Force to integrate existing restoration plans for the state's wetlands, such as the Louisiana Comprehensive Coastal Wetlands Feasibility Study prepared by the U.S. Army Corps of Engineers, and the State of Louisiana's Coastal Wetlands Conservation and Restoration Plan, into the CWPPRA Restoration Plan. The Restoration Plan incorporates two strategies to combat wetland loss: offensive approaches seek to build new wetlands using the freshwater and sediments of the Mississippi River and its tributaries; defensive approaches seek to protect existing wetlands through hydrologic restoration, shoreline protection and enhancement, and vegetative plantings.

Annual Priority Project Lists and Project Development

In addition to the Restoration Plan, the Task Force must annually submit a Project Priority List to Congress. This list identifies projects that will "provide for the long-term conservation of such wetlands and dependent fish and wildlife populations" (16 U.S.C. 3951 §303 (a)(1)). Proposed projects are ranked based on anticipated benefits and cost-effectiveness, with due allowance for small-scale projects necessary to demonstrate the use of techniques or materials for coastal restoration. The National Marine Fisheries Service (NMFS) is sponsoring and implementing 10 of these projects, with federal funding totalling more than $30 million, which will affect more than 46,000 acres of wetlands.

NMFS Involvement in CWPPRA Planning

As a CWPPRA Task Force member, NMFS is responsible for identifying coastal sites to be considered for possible restoration or protection. Priority project development generally involves the following steps: identifying potential sites; gathering preliminary site information; developing project proposals offering possible restoration alternatives with related costs; and conducting wetland value assessments and economic analyses to determine the value of the wetlands and the cost-effectiveness of each project. This effort requires the collaboration of many of the NMFS components as well as additional contractual support.

Point au Fer Island and The Atchafalaya River Delta

Four of NMFS's restoration projects are designed to beneficially utilize the sediment-laden waters of the Atchafalaya River. Two projects on Point au Fer Island are will protect and enhance existing wetland habitat while the other two projects in the Atchafalaya Delta will actually create new wetland habitat.

Point au Fer Island is located in southwestern Terrebonne Parish approximately twenty-eight miles south of Morgan City, Louisiana. The island is bounded by the Gulf of Mexico to the south, Atchafalaya Bay to the west/northwest, and Four League Bay to the east/northeast. Point au Fer comprises 42,073 acres of emergent intertidal marsh (U. S. Army Corps of Engineers, 1992) which provides habitat for numerous terrestrial and marine species of significant ecological and economic importance, as well as habitat for endangered and threatened species. Smooth cordgrass, *Spartina alterniflora*, dominates the salt water marshes that parallel the gulf coast while marshhay cordgrass, *Spartina patens*, dominates the brackish marshes of the island's interior.

Like much of coastal Louisiana, Point au Fer has lost wetlands through both natural processes (*e.g.*, subsidence) and human activity (Boesch *et al.*, 1994). Since 1931, the island has been extensively modified to support human activities such as oil and gas exploration/development, fishing, and hunting. These modifications have accelerated wetlands loss by (1) allowing salt water intrusion into the brackish marshes of the interior island causing mortality of non-salt tolerant plants, (2) reducing the amount of sediment reaching the marsh from the Atchafalaya River and (3) by increasing tidal scour. Consequently, these marsh areas are being converted to open water. Coastal wetlands, such as those being lost on Point au Fer, are critical habitat in the life cycles of 98% of commercially harvested species in the Gulf of Mexico (Hartman *et al.*, 1993).

The Atchafalaya River, which first started to capture Mississippi River discharge in the mid-1500s, offers a much shorter course to the Gulf of Mexico than the Mississippi River. Concern over the risk that the Mississippi River would abandon its course through New Orleans, a control structure was built at the point of diversion. Consequently, the Atchafalaya discharge is currently held at 30% of the Mississippi discharge. It is estimated that over 80 million tons of sediment are carried down the Atchafalaya annually (Mossa, 1990). Studies of river sediment budgets indicate that the Mississippi and the Atchafalaya carry ample sediment to enhance Louisiana's wetlands (Templet and Meyer-Arendt, 1988; van Heerden, 1994).

Description of Projects

The Point au Fer Island Hydrologic Restoration project (CWPPRA Project PTE 22/24) will concentrate on restoring two rapidly degrading areas of the island: in Area 1, two lengthy pipeline canals dredged around 1960 have allowed rapid salt water intrusion into the brackish marshes of the island; in Area 2, on the western side of the island, approximately 600 yards of narrow beach separates the Gulf of Mexico from an oil/gas access canal and has experienced overwash and salt water intrusion. In August, 1992, a 2-meter storm surge from Hurricane Andrew exacerbated the problem in both areas (Stone, 1993). Preventing or reducing salt water intrusion and reestablishing the natural sediment-laden freshwater flow across Point au Fer island from the Atchafalaya River should diminish human-induced wetland loss and allow for natural coastal migration instead of erosion and conversion to open water. To achieve this, the engineering design plans call for construction of a series of seven oyster-shell and wooden plugs in the canals of Area 1 to halt salt water intrusion into the brackish marshes. Plug location is intended to divert fresh water out of the canal and into marshes through natural drainage ways during high flow (flooding) periods in the Atchafalaya basin. At Area 2, engineering design plans will focus on the 600 yards of the island's eroding western shoreline. The entire project will protect/enhance 3,900 acres of wetlands at a total estimated cost of $1,336,000.

The Lake Chapeau Marsh Creation and Hydrologic Restoration Project (CWPPRA Project PTE-23/26a) includes 13,000 acres of wetlands on the western end of Point au Fer Island. The Lake Chapeau area is losing marsh as a result of altered tidal circulation through the northern portion of the island. This circulation is made possible by the many natural and manmade waterways in this area, as well as large areas of open water and broken marsh. Major marsh loss has occurred in the area surrounding Lake Chapeau and continues at a rate of nearly 15 acres per year. The project will include mining 500,000 cubic yards of sediment from the Atchafalaya Bay bottom, spray-jetting the sediment over an 1,800-acre area along Lake Chapeau's shorelines and installing numerous plugs in abandoned oil and gas access canals. The project will restore marshes west of Lake Chapeau, reestablish the hydrologic separation of the Locust Bayou and Alligator Bayou watersheds, and reestablish natural drainage patterns of the Lake Chapeau area. More than 260 acres of open water will be converted to marsh. Reducing open water areas and filling shallow breaks in the marsh will protect 2,500 acres from wind-wave erosion and an additional 1,000 acres from tidal scour. Plugging man-made canals and gapping spoil banks will restore natural sediment pathways enhancing 12,000 acres of wetlands. Total project cost is $4,100,000.

The Big Island Mining Project (CWPPRA Project XAT-7) is located at the mouth of the Atchafalaya River. Big Island was created with dredged material from the Atchafalaya River navigation channel. Although no spoil has been deposited on the island since the mid-1980s, the location and height of the island prevents the river delta from expanding and creating new wetlands along the western side of the river's main channel. Dredging and other alterations have prevented the Atchafalaya River delta complex from growing despite enormous sediment inputs. Combined with erosion, an estimated 2,034 acres could be lost within 20 years. Restoration activities will focus on dredging a 500-foot wide, 10-foot deep channel just north of Big Island at a 45-degree angle to the navigation channel of the Atchafalaya River. The project's main channel will graduate into several smaller channels designed to allow water and sediment to once again reach the western side of the Atchafalaya River delta. Sediment dredged directly from the project will be placed in a series of delta lobes creating approximately 300 acres of wetlands. More than 1,200 acres of march are expected to form naturally over the life of the project. Total project cost is $4,100,000.

The Atchafalaya Sediment Delivery Project (CWPPRA Project PAT-2) is another dredging project which will complement the Big Island Mining Project. The Army Corps of Engineers began placing dredged material at the heads of delta lobes of the eastern (natural) half of the Atchafalaya Delta in association with their maintenance dredging operations. They assumed that this would stabilize existing deltaic islands and the river channel. Unfortunately, in 1988, natural sediment transport processes and erosion sealed the delta's Natal Channel. With the gradual closing of Radcliffe Pass, another major delta channel, sediment delivery loss will reduce the eastward growth of the delta complex and increase the impacts of winter storm erosion on existing wetlands. Total loss over a 20-year period is estimated at 1,932 acres. Dredging both Radcliffe Pass and Natal Channel will allow the natural sediment delivery process to continue. Beneficial use of dredged material will allow creation of 300 acres of new marsh. Natural marsh accretion over 20 years could total 1,800 acres. This would represent a major increase of new marsh in the Atchafalaya delta. Total project cost is $1,100,000.

Current Status of Projects

In September 1995, the CWPPRA Task Force voted to approve construction of Phase I (Area I) of the Point Au Fer Hydrologic Restoration project. Construction of 7 shell and shell-reinforced wooden plugs in canals on the eastern end of the island began in early October and was completed by mid-December. Final engineering and design plans for Phase II (Area II) are soon to be prepared with construction scheduled for summer, 1996. Big Island Mining and Atchafalaya Sediment Delivery have entered the final engineering/design phase are scheduled for construction in summer, 1996. Lake Chapeau is in the preliminary engineering/design phase with construction anticipated to commence in fall, 1996.

Conclusion

These four NMFS-sponsored restoration projects will fortify the wetlands of Point au Fer Island and create thousands of new acres of wetlands in the Atchafalaya delta. This project also offers an opportunity for beneficial environmental cooperation between the U.S. Government and the State of Louisiana, and land owners in order to restore the island's threatened coastal habitats. NMFS has gained invaluable restoration planning and implementation experience from this project and will continue to apply this and other fisheries expertise in future efforts to protect and restore Louisiana's coastal wetlands.

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Erik Zobrist
NOAA/National Marine Fisheries Service
Office of Habitat Conservation/Restoration Division
1315 East West Highway, F/HC
Silver Spring, MD, USA 20910

Ph (301) 713-0174
Fax (301) 713-0184
Email erik_zobrist@ssp.nmfs.gov

WATERSHEDS AND FISHERY HABITAT

Dail W. Brown,
NOAA/National Marine Fisheries Service

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) has placed renewed emphasis on the importance of fish habitat in assuring the health and sustainability of commercial and recreational fishery resources. This emphasis has resulted in new strategic directions by NMFS for habitat research and management. A key element of NMFS activities will be the linkage between watershed processes (both human and natural) and the viability of fishery habitat to sustain resources.

Odum (1971) defined fish habitat as those places where fish live. Ryder and Kerr (1989) and Peters and Cross (1992) refined the definition of fish habitat to reflect the importance of physical, biological and chemical characteristics. A number of studies have demonstrated the importance of habitat characteristics to various life stages of fish, particularly young and juvenile (see, for example, Hoss and Thayer, 1993; Funderburk *et al.*, 1991) The importance of fish habitat (for both fin- and shell fish) is to sustain the populations of fishery resources for commercial, recreational, and aesthetic purposes.

A watershed, by definition, is a funnel where water collected on the surface and from underground flows in rivulets and forms streams and rivers that eventually run to the sea. These flows carry the by-products of human activity as well as organics and inorganics from natural processes occurring within and along the watercourse. Watersheds are also where the footprints of human activity occur. Fish habitats are located in those areas that make up the core of the funnel and include the wetlands and open waters of the rivers and estuaries as well as coastal ocean areas.

The difficulties in linking the effects of habitat alteration resulting from watershed activities to declines in fishery populations are several. First, changes in habitat quality and quantity usually are small and cumulative. Under the best circumstances, healthy populations of fish are numerous and robust. Except for confined populations that cannot buffer the affect of large scale catastrophic or insidious alterations, populations replenish their losses.

Second, certain fish populations contend with commercial and recreational fishing pressure. Many exploited stocks of fish that depend on coastal, estuarine, and river habitat have declined in recent years (NOAA, 1996), and these population reductions are usually attributed to commercial and recreational fishing. However, population reductions may also result from pollution and habitat alterations (which may affect all life stages but most importantly the early ones). Sorting out the dual impact, if there actually is one, is challenging fishery and ecology scientist (*e.g.*, Sindermann, 1994).

Third, our capabilities for documenting what is happening in a watershed as it translates to river and coastal fish habitat are in confusion. Our fish habitat is at the sides, middle, and end of the funnel. With advanced computer power and ever-evolving geographic information systems, we have extensive data bases on watershed characteristics. Land use practices such as forestry, farming, and urban development can affect aquatic environments. At a more detailed level of examination, siltation, non-point nutrient runoff, toxic outfalls, and septic systems, for example, can have a more immediate affect on habitat viability within the landscape of a watershed. We have yet to assemble this information source in a way to make good connections with fish habitat, although strategies for integrating spatial watershed information to link with living aquatic resources have been proposed (Thomas, 1995; Thayer, Thomas, and Koski, 1996).

While tying habitat alteration to declines in fisheries is difficult, the impact of watershed land use activities on aquatic habitat can be identified at several scales of observation -- some linkages obvious, some very plausible, some obscure. The strongest cases (unfortunately, too many of them) are on small scale activities confined to sub-watershed or a reach of a tributary and involve large-scale land use practices such as logging, mining, and agriculture. For example, anadromous populations of spring/summer chinook salmon have been eliminated from tributaries of the Salmon River subbasin in Idaho by activities of the Blackbird Mine (NMFS, 1991). Population declines started in the 1940s when extensive mining activities began in the Blackbird Creek Drainage, and the run was eliminated by the early 1960s. Today, the drainage remains largely uninhabited due to toxic conditions in Panther Creek resulting from mine drainage. In a June 1995 example, more than 25 million gallons of animal waste washed into a tributary of the New River system in North Carolina. Eight miles of stream became anoxic and several thousand fish were killed.
In large watershed systems with tributaries that drain into estuarine areas, the effect of cumulative land practices becomes more difficult to sort out. But we have several illustrative efforts around the country that are grappling with regional watershed issues. South Florida and the Everglades are a high profile issue on the problem of water quality and quantity, and agricultural practices. Major efforts involving all stakeholders have reached agreements and commitments that may change some land use practices.

The Chesapeake Bay has too much nitrogen and phosphorus nutrients that cause algal blooms, contribute to anoxic conditions, and may suppress submerged aquatic vegetation important to fish resources. All partners in the Chesapeake Bay Program have agreed on nutrient reduction levels for the numerous tributaries that flow into Chesapeake Bay (Chesapeake Bay Program, 1994; U.S. EPA, 1995) These tributary strategies will require political commitments to changes in land use and sewage treatment plant practices that may cost a lot of money. A new wrinkle in the Chesapeake Bay watershed picture is new evidence that atmospheric inputs of nitrogen from power plant and auto emissions are more than previously estimated (East Coast Atmospheric Resources Alliance, 1995). Nevertheless, the Chesapeake Bay effort is perhaps the best model we have for regional watershed management and assessment activities.

On a global basis, a recent survey of the world-wide prevalence of hypoxia in coastal marine waters documents the wide spread prevalence of low oxygen habitats as well as threats to benthic and bottom dwelling fish populations (Diaz and Rosenberg, 1995). The authors conclude that hypoxia is a growing global problem, fueled by eutrophication from land-based human activities. This major alteration of habitat can have profound implications to the sustainability of fish populations. This is very likely an early signal of cumulative effects of human activities across coastal watersheds integrated into coastal waters. A specific case is the "dead zone" of anoxic water exists off the Mississippi River delta along the coast of Louisiana caused by eutrophication from the Mississippi River watershed (Atwood *et al.*, 1995). The impact of this degradation of benthic and pelagic habitat on the viability of the rich populations of Gulf fish and shellfish is uncertain but, if trends continue, may be substantial.

Again on a global scale, coastal red tides and other noxious algal blooms are occurring with ever increasing frequency with significant impacts to marine mammals, fish, shellfish and humans.

In the view of many scientist, this could be a perturbation of large areas of marine and estuarine habitat that may be a signal of cumulative effect of human coastal watershed practices (e.g., Smayda, 1989; Woods Hole Oceanographic Institution, 1995).

The National Marine Fisheries Services is attacking the threats to fish habitat through increased emphasis on NMFS mandates to educate and intercede (Waste, 1996). These efforts build on national policies that consider the sustainability of natural resources such as fishery populations in the context of ecosystems and watersheds (see, for example, Interagency Ecosystem Management Task Force, 1995; Ecological Society of America, 1995).

Linking watershed activities more convincingly to the viability of fishery habitat will require expanded efforts by the NMFS Habitat Program on several fronts: (1) a new effort to summarize the status and trends of fishery habitat on a regional and national basis; (2) a geographic evaluation of the impact of changes in land cover and land use on water quality and quantity that may affect habitat; (3) expanded efforts to assure that ongoing and planned coastal watershed and ecosystem management programs reflect the importance of coastal watershed activities on fishery habitat sustainability; (4) the development of new habitat management approaches that consider habitat protection and restoration priorities in the landscape context of the watershed; and (5) more extensive and focused research on the impacts of coastal and watershed activities on living marine and anadromous resources (Thayer, Thomas, and Koski, 1996).

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Dail W. Brown
NOAA/National Marine Fisheries Service
Office of Habitat Conservation/Watershed Division
1315 East-West Hwy, Suite 12643
Silver Spring, MD, USA 20910

Ph (301) 713-2325
Fax (301) 713-1043
Email Dail_Brown@ssp.nmfs.gov

ESSENTIAL FISH HABITAT: A NEW APPROACH IN LIVING MARINE RESOURCE MANAGEMENT

Ramona Schreiber,
NOAA/National Marine Fisheries Service

Background

Living marine resources rely on habitat for a variety of purposes, including food, shelter, nursery areas, and protection from predators. While all species rely on the quality of their habitats, anadromous and nearshore species are especially dependent on estuarine and coastal areas. Many important commercial and recreational marine species depend on and or use estuarine habitat during various life history stages, or utilize estuarine-dependent species as prey. Unfortunately, the nation's living marine resources and estuarine and coastal habitats have been stressed. Where wetlands and tidal flats existed 50 years ago, the effects of development and population have reduced the natural habitat in exchange for housing, industry, and urban expansion. This growth has continued with limited strategic management of the resources and their sustainability.

The National Marine Fisheries Service (NMFS) has a long history in habitat protection, generally through the permit review process under the Clean Water Act §404 regulations. This accounts for a substantial percentage of the program's time and resources and results in some measure of protection for habitats at risk to loss or degradation. However, without additional provisions, the cost/benefit ratio of this process remains fairly high. NMFS recognizes this need for a strengthened role that is supported with legislative mandates. Concurrently, NMFS must transfer efforts from reactive to proactive modes in order to reinvigorate its program.

Given this, NMFS is taking an opportunity to improve its effectiveness and efficiency in habitat protection. A transition is necessary from the traditional mode of permit by permit review, and toward management on an ecosystem/watershed level using new and innovative technologies now available. This redirection will improve management as well as economize current activities through several actions. Improved interactions and strengthened linkages between fisheries conservation management and habitat conservation will result. Development of thorough scientific support materials to document the availability and value of trust resource habitats will enhance project reviews. Likewise it will support greater consideration of habitat needs and recruitment in fishery management. Preventative measures for potential listings under the Endangered Species Act should also tie to increased conservation of mutually important habitat areas. Improved coordination between the state commissions and federal fisheries regulatory process will occur if standardized methodologies for habitat sections of federal and state FMPs can be implemented. These concepts first crossed NMFS' horizon in 1994. Since then, they have manifested from ideas to structural plans and strategies.

The first step in the process of re-inventing habitat conservation was the development of an "Essential Fish Habitat" Initiative. A prototype project was developed in FY95 to address four areas: 1) identify a test species and study area, 2) acquire available habitat and resource data for the species, 3) develop a thorough assessment of life history and habitat needs for the species, and 4) develop and produce geographic maps of this information that would be of use in habitat conservation and management. From this experience, needs for refinement, expansion and further work were identified and the second phase has continued in FY96. This project was conducted in coordination and cooperation with the National Ocean Service (NOS) Office of Resources Conservation and Assessment (ORCA).

Prototype Methods, Data, and Software

Summer flounder was selected as the prototype species because it met the project's preliminary requirements: 1) availability of data; 2) a life history with both estuarine and coastal components, and 3) a NMFS and state managed species. For the purposes of the prototype, only data which was available within NOAA was used. This included three national databases: the National Estuarine Inventory (NEI), Estuarine Living Marine Resource (ELMR) and National Coastal Wetlands Inventory (NCWI). For fisheries catch information, NMFS resource survey data were used.

A literature search was conducted in order to develop a complete life history review and to develop life history tables and habitat association summaries. Based on the available information, habitat characteristics selected for incorporation in the prototype included salinity ranges in estuaries of the Atlantic coast, sediment distributions in selected estuaries, and wetland availability in coastal counties. For species distribution and relative abundance, the NOS Estuarine Living Marine Resource program ELMR data was utilized in estuarine areas, and NMFS resource survey data was incorporated for inshore and offshore areas. One state data set was included to provide an example how state information could improve the overall information available and provide an interface between the NMFS and NOS data sets. The ELMR data provided distribution and relative abundance (highly abundant, abundant, common, rare, not present) for five life stages of summer flounder (eggs, larvae, juveniles, adults, spawning adults), by month and salinity zone for the Atlantic estuaries included in the ELMR program. The NMFS data provided abundance estimates based on fish caught per tow over a period of over 30 years. Likewise, the state survey covered over 20 years of trawl surveys.

One objective of the prototype was to acquire software and hardware necessary to map essential habitats. Mapping was completed using two software packages, Arc/Info and MapInfo. Initial digitizing and development of base layers was completed with Arc/Info, then transferred to MapInfo. Integration of the ELMR, NMFS, and NEI data sets into individual map products was completed with the desktop mapping software.

Products

Products of this prototype included life history tables, a habitat association summary, and a series of species distribution and relative abundance maps. The maps provide a geographic representation of changes in distribution over a latitudinal and temporal gradient. Based on the information gleaned from the products, several conclusions could be drawn. Results indicated that the lower, shallower portions of the Mid-Atlantic estuaries and nearshore coastal ocean areas, especially tidal salt marsh creeks, are important habitat areas for summer flounder. These areas are occupied by summer flounder eggs, larvae, juveniles, and adults during parts of spring, summer, and early fall; estuaries to the south (*i.e.*, Albemarle and Pamlico Sounds) are occupied by juveniles year-round. The coastal and inner shelf waters are important fall-winter areas for spawning adults and young larvae, while the continental shelf and edge serve as a wintering area for adults and older juveniles. This type of information and conclusions are expected to be useful in habitat conservation as support for habitat management decision-making. Geographic representation of data also improves information transfer and documentation for project reviews. With a standardized methodology for use throughout the NMFS Habitat Protection program, regional and national assessments of living marine resource status are possible.

Expansion in FY96

Based on the conclusions drawn from the first year of the prototype, the "Essential Fish Habitat" initiative was expanded in FY96. The Atlantic States Marine Fisheries Commission (ASMFC) expressed interest in coordinating efforts in the process of identifying essential fish habitat and developing protocols for incorporation of this information into NMFS and commission management plans. Weakfish was identified as a species that was under review for amendment by ASMFC. NMFS elected to use this second species as an opportunity to expand the methodology and develop a series of products for incorporation in the ASMFC FMP amendment. In addition to the ELMR and NMFS data sources used in the summer flounder prototype, seven state data sets were collected and included in the weakfish project. The addition of the state information provided a much expanded representation of species distribution. It likewise demonstrated how this process will benefit the FMP process, particularly where historical habitat sections can be improved with more thorough as well as graphic identification of areas essential to managed species.

Further expansion is planned in FY96 to address several areas of the Essential Fish Habitat Initiative: 1) incorporation of additional habitat information into the mapping process; 2) adequate attention to the element of scale (*i.e.*, large marine ecosystems such as the Mid-Atlantic coast versus individual watersheds versus individual project sites); 3) incorporation of threats to habitats and trust resources; and 4) incorporation of management measures to protect available or restore lost sustainability of the commercial resources.

"Essential Fish Habitat" has the potential to significantly improve the way NMFS addresses living marine resource conservation. With improved habitat identification in management and conservation plans, educated decisions can be made that incorporate the requirements of the resources. Identification of essential fish habitat may enhance the ability for fishery conservation to account for the effects of management actions on habitat. For example, gear-restrictions may be required in areas that are primary nursery habitats during key time periods. Habitat protection will benefit by orienting habitat conservation decisions to the requirements of managed stocks. This type of information will be used to support agency comments on potentially adverse effects on important habitats. Should legislative language move through Congress that would make this effort mandatory, it will further strengthen NMFS' role in habitat conservation for NOAA's trust resources. Regardless, integration of the identification of essential fish habitat into existing NMFS habitat conservation and fisheries management activities will support and improve the strategic management of the Nation's living marine resources.

Ramona Schreiber
NOAA/National Marine Fisheries Service
Office of Habitat Conservation/Habitat Protection Division
1315 East-West Highway, F/HC, Rm 12603
Silver Spring, MD, USA 20910

Ph (301) 713-2325 x104
Fax (301) 713-1043
Email Ramona_Schreiber@ssp.nmfs.gov

NOAA'S COASTAL CHANGE ANALYSIS PROGRAM

James P. Thomas, NOAA/National Marine Fisheries Service

Coastal ecosystems receive virtually all of the water flowing off the continental United States. As the human population increases, so do waste loads and use of the terrestrial surface. Changes in land use result in change in land cover, which affects water quality, and subsequently, coastal and estuarine habitats, and their living resources.

Lack of understanding of the cumulative effects of land cover and changes in land cover on these habitats and their resources, has limited appropriate management of landscape activities. Additionally, in the U.S., as elsewhere in the world, human population in the coastal region is increasing at an ever quickening pace. Our ability to monitor resultant land cover and habitat change has not kept pace with the change, and management perforce has been more reactive than proactive.

Remote sensing is a key element in monitoring change in land cover over broad areas of the coastal zone in a synoptic, relatively inexpensive, and dependable way. Such information when assimilated into a geographical information system and blended with transport and process-oriented models would allow us not only to relate land cover and changes in land cover (*i.e.*, development in the coastal zone) to effects on living marine resources, but also to be more proactive in responding to continuing degradation and loss of coastal and estuarine habitats and their living marine resources. NOAA's Coastal Change Analysis Program (C-CAP) was developed to address these issues. C-CAP has ongoing projects in the states of Texas, Louisiana, Florida, Georgia, South Carolina, North Carolina, Virginia, New Jersey, New York, Massachusetts, Maine, California, Oregon, Washington, and Alaska, as well as with the Gulf of Maine Program, the Chesapeake Bay Program, the U.S. Fish and Wildlife Service National Wetlands Inventory, and numerous universities. Some of these efforts will be presented along with implications for living marine resources.

Introduction

The Fisheries and Wildlife subcommittee and the Oceanography subcommittee of the U.S. House of Representatives Committee on Merchant Marine and Fisheries issued a report (U.S. Congress, 1989) which expresses concern for the coastal waters of United States. The report particularly blames the concentration and continued growth of human population in the coastal area for the degradation of coastal waters. Further, the report also hinted at upstream causes contributing to the degradation of coastal waters. Shabecoff (1989) in referring to the report says, "... more than 120 million Americans, roughly half the population, live within 50 miles of the coasts.

The number is expected to grow substantially by the end of the century .... nutrients in sewage, storm water, farm runoff and contaminated rivers have damaged or destroyed many fisheries and shellfish beds. ...elevated levels of bacteria and toxic chemicals have forced the closing of shellfish beds around the country and have lowered the biological productivity of estuarine areas."

Cohn (1989) in an article based on a governor's advisory panel report regarding the Chesapeake Bay said, "...the population of District [of Columbia], Maryland, Pennsylvania, and Virginia residents living in the [Chesapeake] bay watershed would grow 20 percent -- by 2.6 million new residents -- by 2020.... At the same time, if land development trends continue, 59 percent more land will be developed [by 2020] than was developed as of 1980...." She continues by saying that such development potentially will destroy wetlands and other habitats and degrade bay water quality.

The general paradigm is that as human beings move into an area, they build homes and workplaces and change the use of the land which changes the land cover. As the land cover changes, so does the water quality of streams and waters flowing downstream to affect the habitats of living marine resources. The change in these habitats affects the abundance, distribution, and health of living marine resources. As these resources are affected, so are the livelihoods (*i.e.*, economics) of fishermen and others who purchase and sell fish or depend upon clean water and abundant, healthy resources to support recreational and real estate interests. Ultimately, economic impacts (*e.g.*, unemployment, loss of tax base, decaying infrastructure) result in the regulation of human activities and perhaps long-term planning to lessen the adverse effects of people and their activities. The cumulative endpoint impact of anthropogenic effects on harvestable living marine resources (*i.e.*, fish and shellfish) is on economics, either through decreased supply (*i.e.*, abundance, availability) or decreased demand (*i.e.*, public aversion, health advisories). The starting and ending points of this paradigm focus on human beings who can make decisions based on their desires regarding the long-term, sustained productivity, both economic and ecological, of the coastal zone/ocean.

Remote sensing plays a role in the delineation of pathways by which humans and their activities on uplands, perhaps far inland, affect resources downstream and indirectly society itself. For illustrative purposes, the NOAA Coastal Change Analysis Program (C-CAP) will be discussed, including the use of a C-CAP remotely sensed data set for Chesapeake Bay.

Coastal Change Analysis Program

In 1990, NOAA initiated the Coastal Change Analysis Program (C-CAP) to monitor Wetlands, Uplands, and Water and Submerged Land cover and change in the coastal region of the U.S. (Ferguson *et al.*, 1993; Ferguson *et al.*, 1992; Thomas *et al.*, 1991; Thomas and Ferguson, 1990). The long-term goal of C-CAP is to determine how land cover and changes in land cover affect living marine resources -- their abundance, distribution and health. To do this NOAA plans to develop a comprehensive, nationally standardized information system for land cover and change in the coastal region of the U.S. making use of satellite imagery, aerial photography, and other data within a Geographical Information System context. The project is intended to be a cooperative effort with other federal and state agencies. As a consequence the first three years of the program were devoted primarily to developing a standardized protocol based on a series of regional workshops and smaller working group meetings held around the country with other federal, state, and academic personnel (Dobson *et al.*, 1995; Haddad, 1992; Dobson and Bright, 1991; Orth *et al.*, 1991). Additional research and development is continuing in areas such as accuracy assessment, classification, tidal effects, and modelling. The C-CAP has ongoing projects in the states of Texas, Louisiana, Florida, Georgia, South Carolina, North Carolina, Virginia, New Jersey, New York, Massachusetts, Maine, California, Oregon, Washington, and Alaska, as well as with the Gulf of Maine Program, the Chesapeake Bay Program, the U.S. Fish and Wildlife Service National Wetlands Inventory, and numerous universities.

The coastal region to be covered by C-CAP includes those land and water components of the various watersheds within the U.S., its possessions and territories, that most directly influence estuarine and coastal marine habitats utilized by living marine resources. The land cover includes those classes of vegetation and physical cover of ecological significance to living marine resources and/or their habitats (Klemas *et al.*, 1993; Dobson *et al.*, 1995). The major classes are Uplands, Wetlands, and Water and Submerged Land which includes submerged rooted vascular plants (SRVP). These classes can be cross-referenced to the Anderson *et al.* (1976) and Cowardin *et al.* (1979) schemes. Satellite imagery will be the primary data source for coastal Wetlands and Uplands. Aerial photography will be the primary source for determining abundance and distribution of SRVP. The planned time interval for repeated coverage of the coastal region of the U.S. is every 1 to 5 years. Regions with little change or interest will be monitored every 5 years; areas of intense development, every 2 or 3 years; and areas disturbed by extreme events (*e.g.*, oil spills, hurricanes), annually. Data will be collected as synoptically as possible to facilitate change analysis. Additionally, a component of C-CAP is being developed so that functional health is determined, whereby a decline in the functioning of a coastal habitat could be observed prior to its loss (Patience and Klemas, 1993).

The C-CAP Chesapeake Bay Example

In the Chesapeake Bay area four Landsat Thematic Mapper scenes (76,200 km^2) from each of two time periods (1984 and 1988/89) were purchased by C-CAP and processed by Dobson and Bright (1994) to examine changes in land cover in fourteen classes, including coastal Wetlands and Uplands (Table 1). The area of coverage includes all of the Delmarva Peninsula and most of Delaware Bay on the east to the Chesapeake Bay entrance and Norfolk on the south to and beyond the cities of Petersburg, Richmond, Fredericksburg, Manassas, and Frederick on the west to the mouth of the Susquehanna River and southern limits of Wilmington on the north at a 30 m X 30 m resolution. Details of the image processing and field verification are presented in Dobson and Bright (1994). The data were extensively verified.

For the Chesapeake Bay area, the dominant net changes in land cover are shown in Figure 1. The largest net change is from Upland Forest to Cropland/Grassland cover. Most of the change was, in fact, from forest to Grassland, not Cropland, and took place as a consequence of clear-cut forestry practices (Dobson and Bright, 1994). Such practices result in a cycle (*i.e.*, Forest, Exposed or bareground, Grassland, Scrub/Shrub, Forest), which is elucidated when mapping the changes from one time to the next. Continuing in decreasing magnitude, the next largest net change is from Cropland/Grassland to Developed Land. The third largest net change is from Upland Forest directly to Developed land. For the Chesapeake Bay area as a whole, Estuarine Emergent and Palustrine Emergent Marsh area changed little during the interval (*i.e.*, 1984 to 1988/89). The small net change in marsh area may be attributed to federal and state laws which have limited development of the these areas (Tiner, 1991), as well as to some losses being offset by gains due to development (*e.g.*, large borrow pits established during highway construction).

To elaborate further, the Chesapeake Bay area lost approximately 13,869 hectares per year of Upland Forest to Cropland/Grassland and Developed Land between 1984 and 1988/89. Loss of Upland plus Palustrine (*i.e.*, Wetland) Forest to Cropland/Grassland, Developed Land, and Scrub/Shrub during the same period (*i.e.*, 4.5 years) was approximately 14,620 hectares per year. These losses represent a change of about 0.8% of the total area analyzed for the 4.5 year period and about a 4% loss in Upland plus Palustrine Forest area (Dobson and Bright, 1994). At the same time there was a gain in Developed Land of approximately 4,896 hectares per year. This gain represented about a 4.3% gain in Developed Land or a change of about 0.2% of the total area analyzed (Dobson and Bright, 1994). Overall, Figure 1 demonstrates significant net losses of forested lands and significant net gains in Developed Land cover.

What do these changes mean in terms of coastal habitats and effects on living marine resources, their abundance, distribution and health? What are the effects of development in the coastal area on the productivity, both ecological and economic, of the coastal zone and coastal ocean? To answer these questions we must be able to relate or link land cover and changes in land cover to factors that affect living marine resources or their habitats as well as to other resources and activities that reflect the economic productivity of the area. Land cover as measured by remote sensing can assist in the improved management of watersheds, fisheries habitats, and living marine resources through better understanding and management, and planning of human activities.

Forested Land and Water Quality

Because of the change in forested area noted in the C-CAP data for the Chesapeake Bay area, forested land cover is examined in more detail. The USDA, Forest Service accomplishes a rotating inventory of forested land in the U.S. approximately every 10 years. Over the last 70 years the forested area of the U.S. has ranged from a low point of 296,476,300 ha in 1920, to a high point of 308,626,970 ha in 1963, followed by a decline to 298,096,390 ha in 1987, and a slight rise to 298,501,410 ha in 1992 (USDA, 1993). Such inventory data show that for the U.S. as a whole, forested land area decreased by 2,835,156 ha between 1977 and 1992, but increased about 0.1% (*i.e.*, 405,022 ha) during the last five years (*i.e.*, 1987 to 1992), reversing a slight downward trend since 1963 (USDA, 1993).

U.S. Forest Service inventory data for coastal states, including those of the Great Lakes are presented in Table 2. These data are not presented by coastal county as would have been preferred. Coastal county data were obtained from the U.S. Forest Service only for the states Virginia through Texas. In general, changes exhibited in Table 2 are echoed by the coastal counties of these states except for South Carolina and Georgia. For South Carolina the coastal counties lost approximately 96,112 ha between a 1978-85 period and a 1986-91 period, while at the state level there was a gain of about 3,078 ha. For Georgia coastal counties the reverse is true. There was a gain of about 10,612 ha for the coastal counties over the same interval and a loss of 453,219 ha at the state level.

Table 2 indicates, in spite of the recent increase in forested land area for the U.S. noted above, that between 1977 and 1992, Texas, California, Washington, Oregon, and Georgia had large areal losses of forested land, and Texas, Hawaii, and Washington had significant percentage losses in their total forested land. Certain states in the Great Lakes area, whose populations are not growing at the same rate as other coastal states, show significant gains in forested area. Using C-CAP data for the period 1984 - 1988/89 and assuming the loss of forested land during this time represents a steady loss over 15 years suggests that approximately 219,297 ha of forest land might have been lost between 1977 and 1992 in the Chesapeake Bay area analyzed by C-CAP. However, the Virginia coastal counties data suggest that only about 122,000 ha of this loss might be attributable to Virginia coastal counties (*i.e.*, approximate area analyzed by C-CAP). Maryland had a gain of 18,955 ha during this interval. This suggests that higher rates of loss have occurred in more recent years in the Chesapeake Bay area, in spite of the slight positive upturn nationally. Further, the loss of forested land area will result in increased runoff of nutrients as described by Omernik (1977) in his national survey and other contaminants as presented by Chamberlin *et al.* (1991) in their review. Satellite remote sensing can provide an efficient, rapid means of updating the status and trends of forested areas, which as noted below, have major effects on water quality.

Smith *et al.* (1993), in general agreement with Omernik (1977), state that because of the extensive areas of forested wetland and many large reservoirs in the South Atlantic coastal segment, yields of nitrate plus nitrite, total phosphorus, and suspended sediment are comparatively low. In fact, forested land yields the lowest concentrations of fecal coliform bacteria, dissolved solids, nitrate plus nitrite, total phosphorus, and suspended sediment; whereas agricultural lands yield the highest concentrations of fecal coliform bacteria and nitrate plus nitrite; urban areas yield the highest concentrations of total phosphorus and the lowest concentrations of dissolved oxygen; and range land yields the highest concentrations of dissolved solids and suspended sediments (Smith *et al.*, 1993). It appears that the highest water quality may be in waters emanating from forested lands, suggesting that loss of forested lands may be very significant in terms of water quality and effects on downstream estuarine and coastal habitats and their living marine resources (Chamberlin *et al.*, 1991).

Additionally, because of what we know about the loss of forested land in the Chesapeake Bay area, it must be noted that between 1980 and 1989, nitrate plus nitrite increased in Maryland waters (Blomquist, 1993). Of course, the loss in forested area is not the only suggested cause for an increase in nitrate plus nitrite concentrations. Other sources, fertilizer, wastewater and urban runoff, contribute to these loads. However, forested land as a buffer between uplands and water can decrease the contaminant load to surface waters (Chamberlin *et al.*, 1991). Perhaps greater consideration should be given to the preservation, restoration and maintenance of forested lands.

The Role of Remote Sensing

Remote sensing is a key element in monitoring change in land cover over broad areas of the coastal zone in a synoptic, relatively inexpensive, and dependable way. Such information when assimilated into a geographical information system and blended with transport and process-oriented models would allow us not only to relate land cover and changes in land cover (*i.e.*, development in the coastal zone) to effects on living marine resources, but also to be more proactive in responding to continuing degradation and loss of coastal and estuarine habitats and their living marine resources.

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James P. Thomas
NOAA/National Marine Fisheries Service
Office of Habitat Conservation
1315 East-West Highway, Suite 12660
Silver Spring, MD, USA 20910

Ph (301) 713-0174
Fax (301) 713-0184
Email james_thomas@ssp.nmfs.gov

Table 1. The Coastal Change Analysis Program's Coastal Land Cover Classification System (From: Dobson and Bright, 1994). Underlined classes were compared for change analysis.

Uplands
- <u>**Developed**</u>
  - **High Intensity**
  - **Low Intensity**
- <u>**Cropland**</u>
- <u>**Grassland**</u>
- <u>**Forest**</u>
  - **Deciduous**
  - **Coniferous**
  - **Mixed**
- <u>**Scrub/Shrub**</u>
- <u>**Exposed**</u>

Wetlands
- <u>**Forest**</u>
- <u>**Emergent Marsh**</u>
  - <u>**Palustrine**</u>
  - <u>**Estuarine**</u>
- **Tidal Flat**

<u>**Water**</u>

Session C1: Communicating Coastal Issues: Sea Grant's National Forum -- Can America Save its Fisheries?
Session Chair: Stephen Wittman, University of Wisconsin Sea Grant Institute

COMMUNICATING COASTAL ISSUES: A DISCUSSION OF SEA GRANT'S "CAN AMERICA SAVE ITS FISHERIES?" NATIONAL FORUM

Nancy Blanton, Washington Sea Grant Program,
Kathy Hart, North Carolina Sea Grant College Program, and
Stephen Wittman, University of Wisconsin Sea Grant Institute

Overview

Effective strategic communication is essential to resolving conflicts, building partnerships and creating public support for science-based management of coastal resources. This session examined the purpose, structure and effectiveness of a Sea Grant forum on national fisheries issues held September 11, 1995, at the National Press Club in Washington, D.C., that resulted from a collaborative, multi-institutional effort organized by the session's speakers. The session also examined the most appropriate strategies and tools for effectively communicating complex coastal issues to the media and for infusing scientific information into coastal policy-making.

The Importance of Strategic Planning

To be truly effective, the communication of coastal issues must be strategic -- and professionally done.

Sea Grant is a loose national network of 29 university-based programs of research, outreach and education dedicated to the protection and sustainable use of America's coastal, ocean and Great Lakes resources. These programs are funded via the National Oceanic and Atmospheric Administration and participating coastal states. Though modeled after the 19th century's Land Grant university concept of research, extension and education, the National Sea Grant College Program, created in 1967, features a modern fourth component: communications. Consisting of a geographically scattered mix of professional writers, editors, graphic artists, radio programmers, and videographers, Sea Grant communicators traditionally have been limited to a state-level supporting role of publishing reports and newsletters, issuing news releases, and preparing promotional brochures and similar materials for Sea Grant-sponsored workshops and conferences.

Despite a well-documented record of cost-effective success during its first 20 years, Sea Grant's federal funding was essentially flat-lined throughout the 1980s. By 1990, level funding and increased costs due to inflation had begun to threaten the fiscal viability of the entire national network. In July 1993, the Council of Sea Grant Directors charged the network's communicators to work together to develop a long-range strategic communications plan for increasing awareness at the national level of the need for and benefits of coastal and marine research, education and outreach.

Three months later, communicators representing 16 of the network's 29 programs convened an intensive two-day strategic communications planning retreat. After conducting an in-depth analysis of the network's strengths and weaknesses, Sea Grant's major messages and the key audiences for those messages, we identified four strategic communications goals: (1) develop a strong, single national network identity, (2) create national visibility for the network, (3) increase the national availability and access to Sea Grant information, and (4) enhance Sea Grant networking through better internal and external communications.

It was the second goal that led to the idea of hosting a national marine issue forum. We had identified three objectives and six specific actions for creating greater national visibility for coastal issues and Sea Grant. One of these action items called for Sea Grant personnel to organize and host, as well as participate in, a greater number of national marine science meetings and coastal issues conferences. Another was to hire a national media relations coordinator, done in early 1994, which later proved pivotal to the success of the fisheries forum.

At a follow-up meeting in October 1994, we organized five communicator task groups for implementing various ongoing action items in our strategic plan. One of these groups is the National Exhibits, Conferences, and Special Events Task Group, the members of which include the authors of this paper. We concluded that sponsoring and hosting a special national-level event was one of the best vehicles for achieving our goal of creating greater visibility for the network. Such an event also would fulfill the network's goal of communicating the importance of marine and coastal issues to the nation, and thereby demonstrate the need for and benefit of having research, outreach, and education programs such as Sea Grant to address and resolve them. Visibility for the network would come indirectly, but naturally and deservedly so, from being successful in doing that. It seemed like a win-win-win proposition.

Our next step was to select a marine, Great Lakes or coastal topic for the event that had a strong nationwide impact, and one that was also timely and of sufficient current public concern to appeal to news media and policy-makers alike. On the first point, fisheries was an obvious choice, as seafood is important to the residents of every state. On the second point, we observed that the news media throughout 1994 had been giving increasing, if spotty and somewhat superficial, coverage to the decline in U.S. marine fish stocks, culminating with stories in The New York Times and Boston Globe about the decision of the New England Fishery Management Council to virtually ban fishing on Georges Bank in October 1994.

Strategizing, Organizing, and Achieving: The National Fisheries Forum Becomes A Reality

Based on our knowledge of Sea Grant-supported research on fisheries problems, we determined that a national event would be beneficial in heightening national awareness of marine fisheries issues and providing a better understanding of them as national and global in scope rather than just local or regional problems. Moreover, because it is a national, non-advocate network of university scientists, educators, and communicators, we felt Sea Grant was uniquely positioned to present unbiased, science-based information on this issue. But what kind of national event? What is the best way to get information to the greatest number of people? The answer was obviously through the national media. Our event would need to be aimed at national reporters who could use the information to produce better-informed fisheries articles and broadcasts and to thereby improve public understanding of the issues.

Because this project was national in scope, it was important that the principal investigators represent different regions of the nation and as well as key aspects of the national Sea Grant communications:

- Wisconsin Sea Grant communicator Stephen Wittman was at the time chair of the National Sea Grant Communicators Steering Committee, which consists of representatives from all U.S. coastal regions plus the National Sea Grant Office. As such, he also served as the network communicators' liaison on the Council of Sea Grant Directors communications committee.

- North Carolina Sea Grant communicator Kathy Hart chairs Sea Grant's National Media Relations Executive Committee and directs the activities of Sea Grant's National Media Relations Coordinator, Ben Sherman.

- Washington Sea Grant communicator Nancy Blanton, the Pacific regional representative on the steering committee, chairs the National Exhibits, Conferences and Special Events Task Group.

Forum Objectives

With the main concepts outlined, the next steps were to define our objectives, target our funding source and develop an implementation strategy. After much discussion, we settled on the following objectives:

1. To conduct a national forum on fisheries issues for news media and policy-makers in September 1995 (after the Labor Day congressional break) in Washington, D.C. (headquarters for most national media), bringing together up to two dozen of the nation's leading fisheries experts, sociologists, economists, fishery managers, fishing industry representatives, and environmentalists to explain the complexities of fisheries issues and to discuss possible solutions. Anticipated audience: about 150 journalists, policy-makers and concerned citizens.

2. To publish a white paper summarizing the forum's proceedings.

3. To produce and distribute a media guide listing Sea Grant fisheries experts, including a glossary of fishery management terms and a bibliography of Sea Grant fisheries publications.

4. To sponsor a follow-up panel discussion summarizing the fisheries forum at the Society of Environmental Journalists international conference in October 1995 in Boston.

5. To distribute the forum proceedings, media guide and bibliography to SEJ journalists, other media, state and federal policy-makers, and the Sea Grant network.

6. To bolster Sea Grant's visibility among the national media, state and federal policy-makers, and the public as a provider of balanced, science-based information about the nation's coastal, ocean, and Great Lakes resources.

To finance this project, we targeted tactical project funds held by the National Sea Grant Office. Since this effort would benefit Sea Grant as a whole and addressed national Sea Grant strategic plan goals, the fit was a natural. We wrote a proposal and submitted it for funding in February 1995. Because of the limited time line, we moved forward with many of our planning activities in anticipation of funding. The proposal was successful, and funding was approved in April 1995 and awarded that July.

Action Plan

We felt that the best way to approach something as complex as "fisheries" was to present a series of panel discussions. Each panel would include speakers who could approach the issues from diverse vantage points. To accomplish this, we needed a steering committee of fisheries experts who could identify the key topics for discussion and suggest appropriate speakers. An important criterion for speakers was the ability to present their ideas clearly and succinctly, avoiding academic and management jargon.

Our steering committee consisted of Dr. Ronald Dearborn (chair), director of the Sea Grant program in Alaska, which has the nation's largest commercial fishing industry;

- Dr. Michael Sissenwine, then chief scientist and now director of the Northeast Fisheries Science Center, NOAA/National Marine Fisheries Service (representing government); Bradford Matsen, Pacific editor, National Fisherman magazine (representing media); Dr. Michael Orbach, a fisheries sociologist/anthropologist at Duke University (science/sociology aspects); and Dr. John Magnuson, director of the University of Wisconsin-Madison Center for Limnology and chair of the National Research Council's Committee on Fisheries (science/policy aspects). During the first (and only) face-to-face meeting of this committee in April 1995 in Chicago, the members outlined three overarching issues, which became the topics for the fisheries forum's three panel sessions:

1. Who Owns the Fish? -- Are natural resources such as fisheries open access, common property or restricted, private property? Who decides the rights and privileges of access and who derives the benefits?

2. Are We Organized to Manage? -- With regulatory agencies often in conflict, can we ensure the future of the resources? What needs to change?

3. How Are Our Changing Coasts Affecting Fisheries? -- Natural and human-induced changes along our coastlines can influence the present and future vitality of our fisheries. Is there still a place for fisheries in our coastal zones?

A key function of this steering committee was to generate a diverse list of experts, keeping in mind ethnic and cultural diversity as well as the different points of view that come into play with each issue: environmental, legal, commercial, and recreational. It was the principal investigators' role then to contact and confirm speakers, explain what was expected of them for panel presentations, and handle all travel and lodging arrangements. Because of their knowledge of the process and understanding of the forum's purpose, the steering committee members were the most logical choices for panel moderators, and Dr. Michael Sissenwine agreed to set the stage for the forum by presenting the results of the most recent National Marine Fisheries Service report on the status of U.S. fisheries. The title selected for the event was, "Can America Save Its Fisheries: A Sea Grant National Issues Forum."

One of the most difficult parts of completing our forum agenda was finding a keynote speaker. Time and budget constraints eliminated many possibilities. Because our primary audience was media, we chose a speaker who represented both media and interest in U.S. fisheries, George Reiger, the well-known national editor for "Field and Stream."

Several speakers for the national forum also were subsequently invited to speak at the follow-up panel session at the SEJ conference in Boston six weeks later, entitled "Sea Wars: Fighting for the Last Fish." Our final panel for this event included representatives of two environmental groups, government, and marine education.

Resulting Publications, Materials, and Recordings

To make sure our message went beyond the forum itself, we prepared resource notebooks for all who attended the event. These notebooks included biographical information on all speakers, fisheries research information from each Sea Grant program in the country as well as national and regional Sea Grant efforts, a glossary of fisheries terms, a bibliography of Sea Grant fisheries publications, and a national fisheries experts list.

We also arranged for the forum discussions to be recorded by a professional transcription service, so that the proceedings could be quickly edited into a summary report. Science writers from three Sea Grant programs (Alaska, Washington, and Wisconsin) contributed to this effort and produced a 34-page summary, including speaker biographies, photos, and contact information, in just six weeks. The report was distributed in connection with the follow-up panel discussion at the SEJ conference and later mailed to all members of Congress as well as to media and agency representatives unable to attend the forum. Reports about the forum and/or articles promoting the distribution of the proceedings summary were published in several Sea Grant program periodicals.

We took advantage of the proximity of a Sea Grant videographer at the University of Maryland who could tape the forum also, and clips from this taping are being used to create video news releases for future distribution. The forum was also audiotaped by Wisconsin Sea Grant's science writer for use on its regional "Earthwatch" radio program.

Evaluation: What Did It Accomplish?

The National Issues Forum attracted almost 160 people -- a standing room crowd. All attendees were provided a fishery resource notebook and Sea Grant's experts guide at the time of registration.

About 20% of the audience were journalists representing publications such as "Time Magazine," "The Baltimore Sun," "The Chronicle of Higher Education," "The New Orleans Times-Picayune," "BioScience," "Commercial Fisheries News," "Environment Magazine," "National Fisherman," "The Providence (R.I.) Journal," "Seafood Business," and more.

Also in a attendance were several important Congressional staff members from the U.S. House of Representatives' Resource Committee and the U.S. Senate's Commerce, Science and Transportation Committee. These are the legislative committees that oversee fisheries legislation and the funding for the National Marine Fisheries Service and the regional fisheries management councils as well as NOAA and many other coastal and ocean programs.

The majority of the attendees, however, represented key policy organizations and nonprofit organizations with a stake in fisheries management nationally and regionally. These included: National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Coast Guard, National Fisheries Institute, Northwest Indian Fisheries Commission, American Factory Trawlers Association, Inter-American Tropical Tuna Commission, Atlantic States Marine Fisheries Commission, National Institute for the Environment, Pacific Seafood Processors, Texas Shrimp Association, North Carolina Fisheries Association, East Coast Fisheries Federation Association, and the Marine Fish Conservation Network.

The panel and luncheon presentations were well received. The audience asked thought-provoking questions, and several lively discussions ensued. Many panelists were interviewed extensively by journalists in the media room after their panel presentations. Several panelists were videotaped for the purpose of producing Sea Grant video news releases later.

There was no next-day coverage of the forum via any media. The "Asbury Park Press" printed a story a few days later. Several of the panelists were quoted. Most of the journalists who attended were working on long-range stories or series for newspapers or magazines. The goal of increasing media awareness had thus been met, but actual media coverage would come in the months ahead.

At the SEJ meeting, the smaller panel presentation drew a crowd of almost 80 journalists during the concurrent sessions. Journalists from "The Washington Post," "The News and Observer (Raleigh, N.C.)," "National Geographic" and other major media were present. Each attendee was given the fishery information resources notebook, an experts guide and a summary of the fisheries forum held in September. These resources were also distributed to SEJ conference attendees at large. This panel resulted in limited media coverage. For instance, "The News and Observer" reporter wrote a fisheries story that quoted several panel members.

In November and December, several significant media placements resulted from the forum. Among the more notable were two articles appearing in the "Chronicle of Higher Education" (circulation: 100,000 to university administrators and top state and federal officials). Sea Grant Directors Jim Cato and Ron Dearborn were quoted as were other forum panelists. A sidebar story focused on Maryland Sea Grant oyster research efforts in Chesapeake Bay. Additionally the forum was highlighted in "Field and Stream" (circulation: 2,007,234 -- 30th largest magazine circulation in United States) and "BioScience" (circulation: 12,000 to government and industrial research personnel in life sciences).

The fisheries forum continues to produce results. "The Virginian-Pilot' (circulation: 238,000) did a four-part series on the issues of fisheries management in December, and a similar series is planned by "The Providence Journal." One of the forum's main objectives was educating reporters about the complexity of fishery issues. "Pilot" reporter Chris Dinsmore reflects media reaction, writing in a recent note: "My colleague Scott Harper and I learned a great deal from the conference Sea Grant hosted in September. What we learned contributed mightily to our understanding of the problems of the fishery."

In December, panelist Suzanne Iudicello of the Center for Marine Conservation suggested that Sea Grant distribute the forum summary to all members of Congress because of the ongoing debate concerning the reauthorization of the Magnuson Fishery Conservation and Management Act. She felt the summary offered valuable background information that Senators, Representatives, and staff members would find useful. In January 1996, Sea Grant Association President Jim Cato sent a copy of the summary and a cover letter to every member of the U.S. House and U.S. Senate.

In January, the investigators surveyed 80 of the those who attended the forum. As of the end of February, 20 percent of those surveyed had responded. Here's what we learned:

1. Respondents found the forum extremely useful (36%) to somewhat useful (58%).

2. Respondents rated the panel, "Who owns the fish?" as primarily good (47%) to excellent (42%).

3. Respondents rated the panel "Are we organized to manage" as primarily good (47%) to excellent (32%).

4. Respondents rated the panel "How do our changing coasts affect fisheries?" as follows: fair (21%); good (47%); and excellent (16%).

5. Respondents rated the luncheon speaker George Reiger as follows: poor (16%); good (47%); and excellent (32%). Those who rated Reiger poorly did so because they did not agree with his views (according to notes on the surveys).

6. Almost 85% of the respondents found the forum well-balanced.

7. When choosing adjectives to describe the forum, respondents chose these most often: "interesting," "thought-provoking," and "informative."

8. Of those who responded, 82% said the forum helped them to understand that fisheries issues could be viewed in a variety of perspectives.

9. Of those who responded, 87% said they learned something new at the forum.

10. Most (94%) thought the forum format was just right and preferred (81%) a full-day presentation of information.

11. All respondents indicated they would be interested in attending another Sea Grant Issues Forum. When asked to check topic focuses for another forum, here were their preferences in descending order: fisheries, aquaculture, seafood safety, water quality, nonindigenous species, and coastal hazards.

Overall, the forum was an outstanding success. We achieved both our primary and secondary goals of increasing awareness of fisheries issues and of building a stronger visibility for Sea Grant among national news media and policy-makers in Washington. D.C.

Stephen Wittman
University of Wisconsin Sea Grant Institute
1800 University Avenue
Madison, WI, USA 53705-4094

Ph (608) 263-5371
Fax (608) 263-2063
Email swittman@seagrant.wisc.edu

INDICATORS OF COASTAL ZONE MANAGEMENT SUCCESS: ON-THE-GROUND AND IN-THE-WATER EFFECTIVENESS

Douglas J. Canning,
Washington Department of Ecology

Introduction

There is a growing movement in government towards quantification of "success measures" and other means of measuring the performance of specific programs. This phenomenon, in a way, mirrors the broader political spectrum where calls are made for a more efficient and effective government. While it is desirable to believe that public money is well spent on public programs, the path to accountability is not easy, direct, or well marked. Just as there is little agreement on how much government is too little, too much, or just right, there is often little agreement on how to measure or characterize the success of public programs such as coastal zone management.

Assessment of the state of, or quality of, the coastal zone is hampered by the lack of generally agreed upon quantitative criteria or measures for describing shorelands and coastal zone quality. This condition is not unique to Washington state; coastal zone management in general does not enjoy the kind of standards and criteria common to, say, water and air resources. As a result, shorelands and coastal zone management is further hampered by an inability to quantitatively discuss the "state of the shorelands."

Water quality managers, for example, can refer to generally accepted water quality standards and criteria for temperature, coliform bacteria, dissolved oxygen (DO), hydrogen ion (Ph), suspended solids, turbidity, phosphate phosphorus (PO_4-P), nitrate nitrogen (NO_3-N), and other substances. Regulatory standards have been adopted which set thresholds for specific water quality indicators. Generally accepted management guidelines have been published for nutrients such as phosphate and nitrate for management of lake eutrophication. The scientific literature abounds with reports on the lethal thresholds and sublethal effects of numerous specific substances in marine and aquatic environments. Monitoring programs are maintained for the purpose of broad characterization of water quality, and special studies are common. Monitoring protocols for indicator organisms which integrate generalized water quality have been developed, tested, and implemented. Water resources managers are thus easily able to describe the quality of the specific resource they manage, and to identify trends.

The current challenge for coastal zone managers is to develop and use success measures which are relevant to the goals of CZM and meaningful to legislators, coastal zone managers, and the public. This paper is a status report which draws upon the experiences of the Washington State CZM program in working towards development of coastal zone environmental indicators over the past six years.

CZM Assessment History

Program Evaluation Phase

During the formative years of coastal zone management in the 1970s, assessment was quite naturally directed to evaluation of state programs for consistency with federal goals under the CZMA. The literature from this period evolved from assessment design and strategy, to comparative assessments. Ironically, as early as 1978 it was suggested that in an era of increasing public skepticism about government, coastal zone managers are failing to forcefully demonstrate the value of CZM to society. That call for performance or outcome assessment went largely unheeded until the 1990s.

Qualitative Performance Assessment Phase

During the 1980s, the literature suggests a diversity of approaches to CZM assessment in the United States: evaluation of state programs by the federal oversight agency; reprises of state programs, e.g., the internal consistency of California's CZM program; consistency of state programs with the evolving federal program; and comparisons of different approaches to CZM by the states, e.g., state CZM legislation compared with a networking of related authorities.

Quantitative Performance Assessment and Environmental Indicators Phase

During the 1990s, there has been a growing movement in government towards quantification of success measures and other means of measuring performance. Initial demands in Washington state were generated by Washington Environment 2010, a 1989 pioneering effort to project current environmental trends into the future, and two follow-up studies, the 1991 State of the Environment Report and the 1995 Washington Environmental Health Report.

All coastal states participating in the federal coastal zone management program were required to assess specific aspects of their coastal zones in 1991-92. The Coastal Ocean Policy Roundtable completed a preliminary but thorough characterization of the United States's coastal resources on a national scale in 1992; however, few indicators of environmental quality were identified. Recently, the federal Office of Ocean and Coastal Resource Management sponsored a Coastal Zone Management Effectiveness Study which is reported on in several other papers at this conference (The Coastal Society's 15th conference).

Coastal Zone Management Goals

The fundament mandates and goals of the CZMA, and the special priorities of CZMA section 309 for improvement of state programs, include features which can be lumped into two broad categories: institutional efficiency and land and water management effectiveness. The many land and water management mandates and goals can be integrated into five basic elements:

1) foster appropriate development and land use consistent with established statutory and case law;

2) protect marine and aquatic water quality, habitats, and resources from the direct and cumulative adverse effects of development and other human activities;

3) prevent inappropriate development and land use in high-hazard areas;

4) provide for public access and recreational opportunities; and

5) provide special area management for important shoreland and coastal areas.

Coastal Zone Quality Indicators

The challenge is to identify useful measures of coastal zone quality which can be economically developed and maintained. By "useful" I mean both scientifically valid and understandable to administrators and the public. There is a large and diverse body of peer-reviewed and grey literature dealing with environmental monitoring of coastal zone features and resources. However, little of this literature directly addresses environmental characterization, and even less does so in a way that conforms with the need for indicators that are outcome oriented, economical for large-scale application, and easily understandable as an indicator of environmental quality. The literature emphasizes easily quantified chemical, biological, ecological, or economic indicators which can be characterized as follows:

Conventional water and sediment quality - dissolved oxygen or oxygen depletion; contaminated sediments status.

Bioindicators of accumulation - fish tissue contamination; commercial shellfish bed closures; larvae and egg mortality assay results.

Ecological indicators - biodiversity of estuarine and benthic communities; salmon escapement; Oyster Condition Index.

Economic indicators - commercial landings of fish; commercial harvest of shellfish.

Land use practices - extent of impervious surface; wetlands remaining or lost.

Land use amenities - public access; recreation opportunities.

Miscellaneous - marine debris; beach debris.

These indicators all share the virtue of making a direct assessment of the state of the coastal zone waters and lands. Importantly, they are not measures of governmental activity, and are on-the-ground or in-the-water measures of the state of the coastal zone. Notably lacking in the literature, and understandably so, is any substantive discussion of more difficult to assess coastal zone management goals such as land use quality or coastal hazards.

Public Access as an Example

The design of quality measures for the coastal zone, and success measures for coastal zone management is no simple task. The development of a measure of public access provides an illustration. A generally accepted goal of shorelands and coastal zone management is to provide for public access to shorelands and marine and fresh waters, and recreational opportunities. Therefore, some measure of the amount of public access is appropriate. This could be expressed as:

lineal feet of public shorelands

However, this would provide no information on the quality of public access. Since the purpose of providing access is to serve the public's desire and right to visit and use the shore, any measure of public access should include quantitative measures of both the amount of access and the amount of the public (population). A better quantitative measure of the amount and quality of public access would therefore be:

$$\frac{\textit{lineal feet of public shorelands}}{\textit{population served}}$$

This measure can be further refined to better reflect the quality of public access. Public access has little value if it is undeveloped and the public cannot actually use it. Thus the equation can be further expanded as follows:

$$\frac{\textit{lineal feet of developed public shorelands}}{\textit{population served}}$$

In Washington, baseline measures of public shorelands are available only for marine areas. Therefore a more accurate expression of what can be measured would be:

$$\frac{\textit{lineal feet of developed public marine shorelands}}{\textit{population served}}$$

Finally, while this indicator now provides useful information about the quantity and quality of public access to marine shorelands, it provides limited information on the effectiveness of public access programs in general, and no information on the effectiveness of specific public access programs. In Washington State public access to marine shorelands is provided, directly or through grants programs by the state departments of Fish and Wildlife, Natural Resources, Ecology, Parks and Recreation, and the Interagency Committee for Outdoor Recreation (IAC); federal agencies such as Fish and Wildlife Service and National Park Service; city and county park districts; public port districts; and other local and special districts and agencies.

Coastal Zone Assessment in Washington State

Coastal zone assessment in Washington State is both hampered by a paucity of reliable datasets, and aided by a broad interest in environmental assessment. We also benefit from the monitoring and data management activities of other state resource management agencies. During the past six years our approach has evolved. Early on we went through the "bureaucratic bean-counting" stage when we emphasized permits processed, enforcement actions taken, or local coastal zone plans updated. This was easy, but said nothing about the state of the coastal zone. Quickly we and our parent agency evolved to a level where we are emphasizing clean-up and restoration success, as well as on-the-ground and in-the-water measures of the state of the environment.

One of the best coastal zone indicators for which relatively reliable data is readily available is the annual public health status of commercial shellfish beds. Washington has a large commercial shellfish industry which is active in all but the most urbanized areas. Thus, the status of commercial shellfish beds provides an indicator with broad geographic applicability and which integrates watershed management and land use practices in coastal watersheds.

Water and sediment quality monitoring has been conducted for decades in many regions. One of the scientific problems faced by resource managers in assessing estuarine quality and health is the changing nature of collection, monitoring, and analytical protocols, and even which parameters are being monitored. In Washington State, the Puget Sound Water Quality Authority has provided leadership in establishing uniform protocols.

Development of other indicators which integrate goals of CZM are hampered by patchy data and chronic reductions in agency budgets. New assessment initiatives are eliminated along with established monitoring programs. An uncertain amount of wetlands restoration and rehabilitation work is completed annually by a number of state agencies and local governments; we are unable to track and compare those gains with losses to development and agriculture. We suspect that gains in new public access are canceled by privatization of street ends and other losses, but have lost our ability to periodically inventory public access sites.

We are dubious about the usefulness to CZM assessment of economic indicators such as commercial landings of fish. Declines in landings could result from poor watershed management and land use practices, or could be the long-term result of over-harvesting. Increases in landings could result from the introduction of new capture technologies or relaxation of catch limits as well as from industry response to population improvements.

Coastal land use quality and hazards management remain problematic CZM goals to measure. Coastal land use goals vary for areas designated urban, rural, conservancy, and natural under Washington's Shoreline Management Act. We are currently working with the University of Washington's Department of Landscape Architecture on adaptation to coastal zone land use assessment, of the Intrusion Factor model used for scenic river corridor assessment.

Conclusion

Coastal zone managers can draw upon a library of pollution control and resource management environmental indicators which provide either "snap shots" or trend analyses of the state of the coastal zone from those perspectives. Coastal zone management, however, is land use management as much as it is resource management, and we still lack understandable, economical, and generally accepted measures for land use management.

Legislatures have mandated and the public has paid for coastal zone management for 25 years. We need to be able to tell them not just what we are doing with their money, but more importantly, what the results have been on-the-ground and in-the-water.

Douglas J. Canning
Washington Department of Ecology
Shorelands and Water Resources Program
P.O. Box 47600
Olympia, WA, USA 98504-7600

Ph (360) 407-6781
Fax (360) 407-6535
Email dcanning@igc.apc.org

SEEKING BALANCE: ORGANIZATIONAL CONFLICT WITHIN THE ALASKA COASTAL MANAGEMENT PROGRAM

Kerry Howard, Alaska
Division of Governmental Coordination, and
Gabrielle LaRoche, Alaska
Division of Governmental Coordination

Introduction

All organizations and administrative programs experience conflict. Internal and external forces, planned and unpredictable events, task interdependence, and jurisdictional ambiguities are all elements that can create or sustain conflict. Analyzing current internal conflicts within the Alaska Coastal Management Program (ACMP) is important, given the incredible value of Alaska's coastal resources. How Alaska will use and protect its coastal resources in the future depends, in part, on how the program responds to current conflicts. This paper describes the ACMP and current conflicts within the program. It then analyzes current conflicts and finally, concludes with predictions about the future of the program.

The Alaska Coastal Management Program

The Alaska Legislature established the ACMP in 1977. The Alaska Coastal Management Act (AS 46.40) notes that the policy of the state is to: preserve, protect, develop, and use the coastal resources; encourage coordinated planning and decision making; ensure the participation of the public and local, state, and federal governments; and utilize existing government structures and authorities to the maximum extent feasible. The state adopted regulations in 1978, implementing a "networked" coastal management program. Rather than establishing a new, comprehensive coastal agency and permit, Alaska chose to coordinate existing agencies and authorities to achieve coastal management objectives. The Division of Governmental Coordination (DGC) in the Office of the Governor has primary implementation responsibility for the program.

Current Conflicts Within the ACMP

Since the inception of the ACMP, many external and internal variables affecting the program have changed. Externally, Alaska's coast has experienced considerable population and community growth, expanded resource use, new coastal development, and heightened management of the biological, chemical, and physical environment. Increasingly, these changes make conflicting demands on Alaska's coastal resources.

Internally, as the ACMP has matured, participants have developed new ideas, perceptions, and understandings about the program. Staff now have considerable experience in program management. Program participants can also look at the program retrospectively and raise questions about its implementation and effectiveness. Although opinions are not unanimous, an underlying question has emerged: How does the implementation of the ACMP mesh with other agency authorities? This paper focuses on conflicts arising from internal variables.

With a program structure that relies on multiple agency authorities and also affects the relationships between these agencies, examination of this issue is important to the program. The legislature considered program relationships during ACMP authorization, and examining applicable statutes provides some background on expectations. For example, the Alaska Coastal Management Act (AS 46.40) authorizes and requires:

> . . . state agencies to carry out their planning duties, powers and responsibilities and take actions authorized by law with respect to programs affecting the use of the resources of the coastal area in accordance with the policies set out in this section and the guidelines and standards adopted by the Alaska Coastal Policy Council . . .

Another statute (AS 46.40.200) clarifies that

> Upon the adoption of the Alaska coastal management program, state departments...shall review their statutory authority, administrative regulations, and applicable procedures pertaining to land and water uses within the coastal area for the purpose of determining whether there are any deficiencies or inconsistencies which prohibit compliance with the program adopted. State agencies shall, within six months of the effective date of the Alaska coastal management program, take whatever action is necessary to facilitate full compliance with . . . the program.

Clearly the expectation was that agencies were to carry out their independent authorities in accordance with the ACMP. Further, to the extent conflicts were discovered, agencies were to remedy "deficiencies or inconsistencies" early on to ensure program compliance. In retrospect, agencies readily admit that these remedies were never administered.

The ACMP standards further define how agency authorities fit into the coastal management framework. Shortly after passage of the Alaska Coastal Management Act, the State developed the enforceable standards and procedures of the ACMP. The ACMP incorporates the regulations of the Department of Environmental Conservation (DEC), and uses the land and water management authorities of the Department of Natural Resources

(DNR), and the Department of Fish and Game's (DFG) authorities over anadromous fish streams and tributaries to implement the program.

Implementing a program through existing authorities can be viewed as either efficient or redundant. It could be perceived as creating overlap and, with this perception, questions arise regarding how the authorities mesh and who has final say. The ACMP also has different effects on the resource agencies and undoubtedly influences their perceptions of the program.

In spite of implementing a successful coastal management program for almost two decades, concerns about "who" and "how" are fundamental to the program. Because participants perceive them to be issues, regardless whether these concerns are well founded or not, the issues create conflict.

An Analysis of Current Conflicts within the ACMP

Many organizational elements potentially lead to conflict. As recognized by David K. Banner and T. Elaine Gagne in "Designing Effective Organizations" (1995), these may include task interdependence, jurisdictional ambiguities, goal incompatibility, cultural differences, structural differentiation, resource scarcity, uncertainty, low formalization, and communication barriers. The first two elements -- task interdependence and jurisdictional ambiguities -- are particularly applicable to the current internal conflicts within the ACMP because of its networked structure. This paper examines how ACMP implementation meshes with other authorities by examining these two elements.

Task Interdependence: The DGC relies on the participation of the resource agencies to make decisions during consistency reviews. The consistency review is a process where the state resource agencies, coastal districts with approved programs, and DGC collectively evaluate a proposed development project to determine whether it meets the standards and policies of the program.

During a consistency review, resource agencies provide comments to the coordinating agency. The ACMP imposes additional requirements on these commenting agencies. Specifically, in addition to evaluating projects under their own permitting authorities, resource agencies must also consider and comment on statewide standards and district policies under their area of expertise.

Conflicts in meshing agency and ACMP authorities arise when the coordinating agency or another review participant disagrees with the technical information or comments provided by a resource agency during a consistency review. In these situations, the coordinating agency must still work to develop a consensus position. If the coordinating agency cannot reach a consensus, it must compromise and render a consistency decision.

Although all participants in the program are aware that the ACMP requires a balancing of development and conservation interests, some agencies view this compromise as inappropriate control over their independent authorities. Yet, in a networked program, the coordinating agency must consider all valid comments during the review process, even if they are disparate.

If disagreements remain after the coordinating agency renders a consistency finding, an appeal process allows for further discussion. If review participants believe the coordinating agency did not appropriately consider their comments, an "elevation" process allows them to appeal consistency findings to a higher level for review. The limited number of projects that are elevated provides further indication that the consistency review process works well. Typically, fewer than 3% of the projects coordinated by the DGC are elevated.

The consistency review process is highly task interdependent. The potential for conflict is high because interdependence is reciprocal and requires constant interaction and adjustment. Compromise is required if a consensus cannot be reached. Adding further to this interdependence, but not detracting from it, agencies make individual decisions regarding the non-ACMP aspects of their own permits after the State issues a consistency finding.

Political considerations also affect how well authorities mesh. In part, current internal conflicts are due to frustration with the political aspects of the program. The DGC, being housed in the Office of the Governor, is potentially subject to influence by whatever administration is in office. During the previous administration, accusations were frequently raised that the DGC overstepped its consensus-building role.

In 1994, an independent audit of the ACMP by the Alaska Division of Legislative Audit (Audit Report Number 01-4506-95) determined that the DGC had been successful in the role of facilitator and consensus builder. In evaluating political considerations, the audit noted that although relationships between program participants may have been "more strained" than under previous administrations, parties achieved consensus on most projects. The audit also found that the percentage of projects found consistent, or consistent with stipulations, had not changed significantly from previous administrations. If changes had occurred in these areas, it would have suggested inappropriate influence by the DGC.

Although the audit showed the DGC acted appropriately, the perception that the DGC assumed an inappropriate role in a task-interdependent program undoubtedly fueled general program frustration. In times of frustration, people often look to change something, even if the focus of their proposed change may not be factually valid or realistically obtainable. Given the timing of concerns about implementation responsibility, frustrations with the previous administration probably contributed to the current conflict.

The ACMP has programmatic controls in place to ensure that various views on projects are adequately considered and inappropriate political influence is avoided during the interdependent, networked process. Although program roles are clearly interdependent and authorities are networked, statistics do not show that this interdependence or political influence has negatively affected general program performance.

Jurisdictional Ambiguities: Jurisdictional ambiguities in two areas complicate the administration of the ACMP. In spite of clear statutory direction to fully comply with the program, agencies still have permit requirements that conflict with the ACMP. In addition, coastal district enforceable policies sometimes address resource matters where a resource agency has expertise. If a coastal district and a resource agency disagree on application of this policy, who gets deference? This section of the paper examines these two problem areas.

Statutory direction in AS 46.40.200 clarified that in order to make the networked ACMP work, the ACMP was controlling and agencies needed to adjust their own programs accordingly. Adjustments were to occur within six months of program implementation, however, few, if any, adjustments occurred. The result is mismatched permit and consistency review requirements regarding such basic elements such as applications, public notices, and review procedures.

Coordinating permit review processes is not an easy task, which is probably why resource agencies did not fully comply with this statutory requirement. While the coordinated review process has been able to work around some process ambiguities, the task is becoming more difficult as agency responsibilities continue to increase. These ambiguities create inefficiencies that frustrate program participants and contribute to internal conflict.

DGC is currently working with resource agency representatives to streamline review processes and clarify jurisdictional ambiguities. Ideally these actions will fulfill the adjustments that were contemplated at program outset.

The second area of jurisdictional ambiguity concerns districts policies where expertise in policy implementation is not clear. Coastal district policies have the force of law and ambiguities in these laws can create conflict. Although the number of policies with overlapping jurisdiction is limited, we believe these ambiguities may illustrate a breakdown during district program development and approval. During program development, districts are responsible for developing clear policies to help guide the management of land and water uses and activities. A successful district program has policies that are understood by other program participants, can be applied and enforced, and that are not ambiguous.

As a coastal district develops their program and policies, regulations require them to work side-by-side with the agency participants. This interactive process works to identify areas of conflict or concern and resolve them. Fault with this process is suggested because some district policies are unclear or overlap with agency authorities. If agencies are unable to participate during program development to resolve conflict, problems may not be discovered until after program approval.

Several actions can be taken to minimize these types of jurisdictional ambiguities. One is to place greater emphasis on interactive district program development to ensure additional ambiguities are not created. This may require increased communication and a refocussing of program funds to ensure necessary interaction occurs. Finally, to the extent existing ambiguities remain and create conflict, the elevation process can provide policy guidance and clarify ambiguities for future projects.

Conclusion and Predictions on the Future of the ACMP

Because of their interdependence, networked programs like the ACMP may face more difficulties in satisfying their participants. Stephen M. Born and Allen H. Miller in "Assessing Networked Coastal Management Programs" (1988) have shown that agency participants inevitably question the role of the coastal management programs in trying to influence agency functions.

If adequate checks and balances exist to ensure that no one party dominates the consistency review process, other program areas may need strengthening to alleviate conflict stemming from task interdependence and jurisdictional ambiguities. Streamlining and coordinating permit review processes, improving the development and review of district policies, and providing further training about program roles are a good place to start.

Given almost 20 years of running a successful program, if program funding remains similar, We believe the ACMP will continue substantially unchanged from its present form. Alaska's coastal resources are important to state and local governments, and the proper management of these resources should continue to be a matter of concern. The law and resource administrators now recognize the coastal zone as an important place deserving of protection due to high resource values. These high resource values provide many opportunities for resource development and, therefore, for conflict between participants in the program.

The ACMP will continue to mature and be fine-tuned, but the general program goals will remain the preservation, protection, development, and wise use of our coastal resources. As Peter Douglas notes in "The Future of Coastal Management" (1993), coastal management, like every land and water use planning program is dynamic. As new needs arise and circumstances change, coastal management programs will adjust as appropriate.

Kerry Howard
Alaska Division of Governmental Coordination
P.O. Box 110030
Juneau, AK, USA 99811-0030

Ph (907) 465-8794
Fax (907) 465-3075
Email Kerry_Howard@gov.state.ak.us

OCS LEASE SALES: RECENT ACTIONS TO IMPROVE STAKEHOLDER INVOLVEMENT IN ALASKA

Kerry Howard, Alaska Division of
Governmental Coordination
Maureen McCrea, Alaska Division of
Governmental Coordination
Glenn Gray, Alaska Division of
Governmental Coordination

Introduction

This paper examines the effectiveness of recent efforts by the federal Minerals Management Service (MMS) to improve stakeholder participation during planning for proposed Outer Continental Shelf (OCS) oil and gas lease sales in Alaska. The paper describes administrative requirements of OCS lease sales, OCS oil and gas activities in Alaska, and the experience of the Alaska Regional Stakeholders Task Force (Task Force). It concludes with an analysis of Task Force efforts.

Administrative Requirements of OCS Lease Sales

The OCS Lands Act (OCSLA) (43 USC 1344) governs the management of the nation's offshore oil and gas and mineral resources and specifies conditions under which the Secretary of the Interior may grant rights to explore, develop, and produce those resources. The Secretary has assigned the responsibility for carrying out the requirements of the OCSLA to the MMS, an agency within the Department of the Interior (DOI). Planning for individual lease sales to obtain these rights occurs under the umbrella of a 5-year lease sale program.

In 1995, the MMS began preparation for the next 5-year program that will cover the period from 1997-2002. Early planning is necessary because section 18 of the OCSLA requires a lengthy, multi-step process of consultation and analysis that must be completed before the Secretary may approve a new 5-year program. The process requires completion of the following steps: solicitation of comments from federal agencies, coastal states, and others; development of a draft program, a proposed program, and a proposed final program; and approval by the Secretary.

The MMS must prepare a programmatic Environmental Impact Statement (EIS), as required by the National Environmental Policy Act (NEPA), for the new 5-year program. The MMS evaluates comments received during the solicitation period when deciding the scope of the programmatic EIS.

OCS Activities in Alaska

Since the early 1980s, much of the OCS oil and gas lease sale activity in the U.S. has taken place in "planning areas" in Alaska. There are 26 planning areas nationwide and 15 in Alaska. Each planning area is unique in its resource potential; exploration and production history; environmental conditions and other uses; and the laws, goals, and policies of adjacent coastal states.

Although the Central and Western Gulf of Mexico planning areas continue to produce the most oil and gas, industry remains interested in Alaska. State onshore and offshore reservoirs next to OCS sale areas have produced considerable oil. The state generally supports federal leasing plans except in the North Aleutian Basin Planning Area. The state actively opposes existing oil and gas leases and future lease sales in this area because of possible effects to Bristol Bay salmon fisheries.

Since 1976, the MMS has held 17 OCS lease sales in 8 Alaska planning areas. Subsequent exploration has resulted in several hydrocarbon discoveries, but none of these discovery sites are commercially viable under current economic conditions. Development of offshore oil and gas deposits in Alaska is expensive and difficult due to extreme environmental conditions and distance to existing infrastructure.

Previous Formal Coordination Efforts

The first formal coordination within Alaska occurred through the Regional Technical Working Group (RTWG). The charter of this group stated that they were to provide guidance on technical matters of regional concern. In addition to meeting periodically through the years, the RTWG for Alaska prepared a report on transportation in the mid-Beaufort Sea region. In 1994, the RTWG charter was not renewed.

The second significant effort occurred with the MMS Mining Program in conjunction with a Norton Sound Lease Sale. A cooperative agreement between the DOI and the State of Alaska formalized the Joint Federal-State Technical Coordination Team (CT). The goal of the CT was to cooperate during EIS scoping, during EIS evaluation, and while preparing comments about the possible leasing and development of OCS mineral resources. The CT included federal and state resource agencies, local communities, and interested parties representing fishing, mining, environmental, and Native subsistence interests. The CT provided a valuable forum for exchanging information -- including a workshop to which experts in the field of mercury in the marine environment were invited -- and for reviewing NEPA documents. Following the publication of the final EIS, the group disbanded.

A final effort took place through the Social and Economic Studies Program. Through a Risk Assessment study, the MMS hosted a series of meetings designed to address perceived risks associated with OCS oil and gas leasing. These meetings provided valuable scoping information for Sale 149, scheduled for Cook Inlet and Shelikof Strait, and assisted MMS staff in preparing for this lease sale. No report of the risk-assessment effort was prepared, however, and funding for the second year of the study was cut from the studies program.

The Alaska Regional Stakeholders Task Force

In 1993, the OCS Policy Committee, an independent body set up by the OCS Lands Act to advise the Minerals Management Service and Secretary of the Interior on matters related to OCS oil and gas lease sales, recommended the use of regional task forces to help reach consensus on OCS lease sales. In 1994, the OCS Policy Committee established the Alaska Regional Stakeholders Task Force to help the MMS develop the Alaska Region component for the next 5-year oil and gas lease program.

The Task Force developed recommendations on the size, timing, and location of lease sales. Task Force members represented Alaska Native, subsistence, environmental, commercial fishing, oil and gas industry, and government interests (*i.e.*, local, state, and federal governments, coastal districts, and coastal resource service areas). Two gubernatorial appointees participated, as did invited representatives from the scientific community.

The Task Force held two meetings in Anchorage -- one in January and one in March, 1995. Subcommittee meetings held in Barrow, Homer, Kodiak, Kotzebue, and Yakutat solicited local information and comments. All meetings were "public noticed" and open to the public. Individual Task Force members solicited information from the constituents they represented and presented it to the Task Force.

The Task Force developed a list of evaluation criteria to weigh selection of OCS planning areas for the next 5-year program. These criteria included prospectivity (the likelihood of finding viable oil and gas prospects based on industry interest and resource potential); infrastructure; technology; local and tribal government and community interests; subsistence, socioeconomic, and cultural interests; and environmental concerns and values.

Based on these criteria, the Task Force identified five planning area locations that should be considered for analysis in the next 5-year program, although the Task Force did not reach consensus on whether these areas should be leased. The five planning areas identified included Beaufort Sea, Chukchi Sea, Hope Basin, Gulf of Alaska, and Cook Inlet-Shelikof Strait. Other planning areas were excluded because of low prospectivity or a combination of the other evaluation criteria. The staff of the MMS completed a report of the findings and recommendations of the Task Force including 10 specific recommendations regarding size, timing, and other concerns.

Several representatives of the task force presented the report to the OCS Policy Committee in May 1995. The OCS Policy Committee unanimously accepted the report and passed a resolution to use the task force process in other areas of the country.

The Task Force continued its work informally, but the MMS canceled two meetings scheduled for September 1995 and February 1996 because of logistics problems. The September 1995 meeting to discuss the draft proposed program was replaced by a survey sent to Task Force members. The MMS canceled a meeting of the Task Force scheduled for February 1996 to discuss the draft EIS and the proposed program because of scheduling problems and because Task Force members did not think a meeting was necessary. The MMS plans to hold a Task Force meeting following the public comment period in May 1996 to develop final recommendations on the size timing and location of the proposed sales.

In January 1996, the MMS revised the membership of the Task Force in an attempt to make it smaller and better reflect the areas affected by the proposed sales. Due to the enthusiasm and interest of members, however, the size of Task Force was not substantially reduced.

Analysis of the Alaska Task Force

The two primary purposes of the Alaska Regional Stakeholders Task Force were to help the MMS develop the Alaska Region component for the next 5-year planning period and to reach consensus on OCS lease sales.

The Task Force provided a unique opportunity for those who have an interest in activities that occur on the Alaskan OCS to work together to develop comments on oil and gas lease sales in Alaska. The time frame for making recommendations was short (3 months), and the membership of the task force was large (28, including invited members). These factors made this effort an ambitious undertaking and limited the Task Force's ability to deal with issues that would be specific to a particular sale area, such as deferral of particular areas or specific mitigating measures.

Using the criteria established at the outset, the Task Force quickly eliminated 10 planning areas from further consideration, based on agreed-upon criteria, and identified ten general concerns about leasing in the remaining five areas. Ultimately, the lease sale options presented by the MMS in their draft leasing program were consistent with the Task Force recommendations.

Achieving consensus on a controversial topic such as OCS lease sales was problematic. From the first meeting, Task Force representatives expressed near unanimous concern that they could not represent or commit to a consensus recommendation for the interests they represented. As such, members agreed they would attempt to work toward consensus, but not necessarily commit to each recommendation. Given the diverse stakeholder interests -- industry, regulatory agencies, environmental groups, and subsistence users -- represented on the Task Force, the key to reaching agreement on the 5 sale areas and 10 recommendations was to keep the recommendations general. The lack of detail raises the question of whether recommendations were adequate to meet MMS's expectations and needs.

A special difficulty for state and federal representatives was the timing of the Task Force effort. The Task Force met and developed recommendations while the MMS was seeking agency recommendations on the next 5-year planning period. As such, each agency representative on the Task Force had to comment in a public forum before their agency developed a position.

Although the Task Force report submitted a single report to the OCS Policy Committee, the Task Force member representing environmental groups insisted on submitting a minority report. That member, while attempting to fully participate in the Task Force, did not support any OCS oil and gas activities and desired to submit a minority report to that effect. The other Task Force members conceded this was acceptable.

Future Task Force Efforts

Current plans include continuation of the Task Force until completion of the 5-year plan. Task Force members may be asked to continue their work during planning for individual lease sales. The future of the Task Force, however, will likely depend on funding, direction from the OCS Policy Committee, and continued interest by the MMS. Since Task Force members represent a wide cross section of the state, a major expense relates to transportation and per diem costs. The MMS cannot be expected to use its limited resources to support Task Force efforts without additional funding.

Conclusion

In summary, in spite of some difficulties, the Task Force provided an opportunity for increased communication and discussion of salient issues among concerned stakeholders. This was the first opportunity for many stakeholders to sit at a table as equals and listen to the concerns of other parties. The meetings were often long, but participants listened respectfully to the comments of other interests.

Only through the monetary and staff support provided by the MMS was the Task Force able to fulfill its responsibilities. Without these contributions of time and money, it is doubtful that the Task Force would have been successful.

At some point one must question whether the information obtained is meaningful, considering the time, effort, and dollars spent to achieve it. Both the OCS Policy Committee and the MMS believed the effort was worthwhile and a good first step toward cooperation.

If possible, future task forces should develop specific recommendations after agencies have had time to develop an official position or have those at the table be the individuals who can make a commitment. The extra time provided to the process could possibly enable participants to develop more specific recommendations in spite of the diverse interests on the Task Force. This might take the form of identifying deferral areas within planning areas or developing specific mitigating measures. In addition to the 5-year plan task force, there appears to be a benefit in establishing sale-specific task forces.

Rather than strive for consensus, it may be more appropriate to strive for "informed consent" whereby members who may not agree with a decision, agree not to oppose the decision because the process by which the decision was reached was fair. Because some members of the Task Force oppose all leasing on the OCS or specific planning areas, consensus is not possible.

Intergovernmental coordination and public opinion are essential components of a collaborative planning process. The challenge for administrators will continue to be developing truly meaningful input given diverse and complex stakeholder interests. Coordinating agency and public participation is a process that distributes power, access, and resources. Obtaining meaningful participation is important, and planners should not underestimate its value.

Glenn Gray
Alaska Division of Governmental Coordination
P.O. Box 110030
Juneau, AK, USA 99811-0030

Ph (907) 465-8794
Fax (907) 465-3075
Email Glenn_Gray@gov.state.ak.us

SPECIAL AREA MANAGEMENT PLANNING IN ALASKA

Sara Hunt, Alaska Division of
Governmental Coordination

Introduction

Coastal land and water use planning at the local government level is the foundation of Alaska's coastal management statute and federally approved program. Local coastal districts are charged with identifying special management areas under Alaska Statute 46.40.030 (7). The Division of Governmental Coordination (DGC), Alaska Office of the Governor received Section 309 Enhancement Grant Program funds for a special project from National Oceanic and Atmospheric Administration (NOAA) to improve and update the Alaska Coastal Management Program (ACMP) special area management planning process and products. At the same time, Alaska is conducting an overall assessment of its coastal management program to address three cornerstone issues: 1) How do the ACMP authorities relate to the management and regulatory authorities of state agencies and local government? Who has the responsibility for implementation and enforcement?; 2) Is the networked system of ACMP implementation through existing authorities still be the preferred system?; and 3) What should be the role of the Alaska Coastal Policy Council in establishing policy and in overseeing implementation and enforcement change? The future direction of the ACMP will affect the implementation and effectiveness of special area management plans and the basic coastal district plans in Alaska.

The information in this paper is derived from: the review of State and federal regulations governing coastal management; review of historic program files on Alaska coastal district programs; telephone interviews with staff of 14 coastal states; review of regulations, planning guidance, and special area management plans provided by the 14 coastal states; review of literature on coastal management and special area management; the results of a questionnaire on coastal district planning and two questionnaires on the implementation of coastal district programs and special area management plans; the discussions and recommendations of a District Planning Working Group formed to assist with this project; and the current Assessment of the ACMP which began in 1994.

Background

The federal Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. §1451 *et seq.*) set the stage for "the effective management, beneficial use, protection, and development of the nation's coastal zone." The CZMA addresses the conflict between development and the protection of the coastal ecosystem and identifies planning as the key to more effective protection and use of the land and water resources of the coastal zone. The CZMA "encourages the preparation of special area management plans which provide for increased specificity in protecting significant natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, including those areas likely to be affected by land subsidence, sea level rise, or fluctuating water levels of the Great Lakes, and improved predictability in governmental decision-making."

Federal regulations 15 CFR Subpart C §923.22-25 describe five different categories of areas that require special management attention that a state coastal program must address: geographic areas of particular concern, areas for preservation or restoration, other areas of particular concern, shorefront access and protection planning, and shoreline erosion/mitigation planning. Areas of particular concern can be either generic (such as all wetlands or port areas), site-specific, or both. The CZMA focuses on areas that are of particular concern because of their coastal values or characteristics, or because they may face pressures beyond what the general planning and regulatory system in a state's coastal management program can address. Emphasis is placed on designating areas of particular concern where a state's coastal management program policies and authorities are not sufficiently comprehensive or specific to effectively manage particular resources and uses.

In 1977, in response to the need to engage in comprehensive land and water use planning for all of Alaska's coastal areas at the local level, the Alaska Legislature enacted the Alaska Coastal Management Act (ACMA, AS 46.40). A primary purpose of the Act is to provide for local involvement in coastal development issues. The Alaska Coastal Management Program (ACMP) provides for shared state and local management of coastal areas and resources. The ACMP is a "networked" program which designates a lead agency in the executive branch and relies on improving and coordinating existing State authorities.

Local governments were a strong influence in shaping the Alaska Coastal Management Act. Because of the immense size of Alaska and regional differences in geography, coastal resources, development and settlement patterns, it was apparent the standards of the ACMP had to be general. Local governments were given the responsibility to tailor their district coastal management programs and provide the specificity to meet regional needs. Under the ACMA, coastal management plans with policies specific to a coastal district can be developed at the local level, then approved by the Alaska Coastal Policy Council and NOAA as incorporated into the state's coastal program. All state and local activities and regulatory approvals must be consistent with the local program and the ACMP.

Coastal districts are the grass-roots of the Alaska Coastal Management Program. To date, there are 35 coastal districts, including four existing coastal resource service areas (CRSA), 12 boroughs, and 19 cities. As defined in AS 46.40.210, coastal districts are certain municipalities (cities and boroughs) or coastal resource service areas that include a portion of Alaska's coastal zone. The Alaska State Legislature provided for the creation of CRSAs to give residents in the unorganized borough the chance to undertake planning to manage their coastal resources. Once a CRSA coastal management program is fully approved, the CRSA can participate in the consistency review process established in 6 AAC 50. Otherwise, the state resource agencies have the responsibility for implementation of the CRSA's coastal management program.

As the ACMP has evolved over the years, the relationship between Title 29 (municipal powers and planning) and Title 46 (coastal district powers and planning) has been tested in new ways. For example, a city with Title 29 planning powers inside a borough or coastal resource service area (CRSA) is not a coastal district, yet the city is charged with certain responsibilities under the ACMP. In this instance one must ask, "What standing should the city have in the ACMP?" While AS 46.40.090 requires a municipal coastal district to implement its coastal management programs, the regulatory requirement at 6 AAC 85.100 is minimal. Should the ACMP regulations strengthen and establish minimum requirements for district implementation? Should the CPC have oversight over all municipalities? On what basis should the CPC require a district or municipality to take some other action? The City of Unalaska within the Aleutians West CRSA is wrestling with these questions as the Unalaska Bay special area plan is being considered for approval by the city and the CRSA board this spring.

AS 46.40.090 directs state agencies to implement district coastal management programs where a coastal resource district does not have and exercise zoning or other controls on the use of resources within its district. A coastal resource district which has and exercises zoning or other controls on the use of resources must implement its coastal management program. Municipalities and state agencies must also administer land and water use regulation or controls in conformity with approved district programs (AS 46.40.100).

Special Area Management Planning

The Alaska Coastal Policy Council (CPC) developed regulations in 1978 that include standards for coastal development and guidelines for the development of detailed coastal management programs by local coastal resource districts. The ACMP final environmental impact statement (FEIS) states that these standards are the minimum standards of review for local program development and for project consistency with the ACMP until more detailed standards are crafted in local district programs. The original

ACMP envisioned an open planning and management process where interested parties could be brought together to resolve differences and achieve their goals for the use of Alaska's coastal resources. Districts are charged with identifying Areas Which Merit Special Attention (AMSAs) under AS 46.40.030(7). AMSAs are analogous to the federal areas of particular concern the CZMA requires coastal states to identify. To date, there are 23 special area management plans in Alaska.

Coastal districts are directed to conduct a resource inventory and analysis (6 AAC 85.050 and 85.060) when developing coastal district plans or special area plans. This analysis enables a district to determine what coastal issues need to be addressed through policy development. In some cases, the analysis may conclude that certain areas within the district (*e.g.*, harbors, beaches, anadromous streams, subsistence areas, villages, wetlands) differ in the value of coastal resources present, available information to support specific policy development, and the types of existing or potential uses and activities that can occur. District coastal management programs must include policies that are specific and enforceable (6 AAC 85.090).

Federal regulations governing the designation of special management areas in a state's coastal management program emphasize that the need to designate special areas is directly related to the degree of comprehensive controls applied throughout a state's coastal zone [15 CFR 923.20(b)]. Hence, where a district's coastal management program contains specific information and policies about resources and uses, the designation of areas of particular concern may not be necessary. In some cases, it may be more appropriate for a district to revise its basic coastal plan to develop the specificity on resources and uses district-wide rather than undertake specialized management planning for a particular area. The CPC has approved several coastal district programs or program amendments that include detailed enforceable policies specific to the values, resources, and use conflicts within certain subareas of the district. This approach maximizes the use of information inventoried during district program development and enables the district to develop area-specific policies -- in essence, a strategic planning approach. Coastal districts that have taken this approach include Aleutians East Borough, Cenaliulriit (Yukon-Kuskokwim Delta), City and Borough of Juneau, City of Nome, and the City and Borough of Sitka.

The review of several states coastal management programs reveals some key differences from Alaska's coastal management program. One significant aspect is the political subdivision of the states. While most coastal states are organized into counties, townships, or boroughs, only 39% of Alaska is organized into boroughs. Because Alaska is not organized so the entire coastal zone is subject to local zoning controls, reliance on its nexus of state and local implementation techniques is essential. For some regions in Alaska -- coastal resource service areas -- the Alaska Coastal Management Program offers the only opportunity for meaningful local participation in state and federal decision-making.

The coastal states vary in whether the development of local coastal management programs are mandatory or voluntary. Several coastal states have enacted other planning laws directing local comprehensive planning and zoning to achieve specific state goals. Coastal states have integrated the various state planning mandates to address areas of particular concern. A strong correlation exists between the specificity of the states' guidelines to manage coastal resources, uses and activities and the prevalence of special area management plans. Those states with particularly strong mandates for local planning and zoning achieve management of special areas through the local comprehensive plans or growth management plans that include several specific policies for coastal areas or resources.

Assessment of the ACMP

In August, 1994 about 60 Alaskans familiar with coastal issues brainstormed ways to adjust the ACMP to fit Alaska's need in the 1990s. Since then there have been two statewide work sessions, numerous focus group discussion, surveys, interviews, and several analytical "white papers" prepared by affected state agencies. The findings and results of some of the Section 309 funded special projects have contributed or provided some of the fundamental analysis and recommendations for improvements to the ACMP. In January 1996, the Assessment Steering Committee, a subcommittee of the CPC, addressed the most fundamental issues raised and decided the cornerstones upon which the details of the ACMP program revisions would stand. The cornerstones are:

1. Alaska's Coastal Management Program will continue to be implemented through existing permits and approvals issued by state and local government.
2. The state will continue to manage the consistency review process, however, the coastal districts' standing and responsibilities in this process will increase. Attention will also be given to refining the roles between Alaska Statute Title 29 (Local Government Powers) and Title 46 (ACMP).
3. Petitions to the Coastal Policy Council (CPC) will be substantially simplified.

At a Southcentral District Conference in Anchorage (January 1996), coastal districts encouraged the CPC to clarify and redefine "due deference" to give more credence to the notion that the coastal district should interpret the district plan. Due deference addresses how much weight is given to the recommendations from a commentor, depending on their area of expertise, during the review of a project for consistency with the ACMP. The conference participants suggested the ACMP Assessment focus on these options:

1. Develop criteria to differentiate between an agency's best professional judgment and district's local expertise.
2. Give districts the authority to define and/or determine public need unless a state agency demonstrates an overriding use of state concern.
3. Give districts a seat at the table when the elevation decision is discussed and made.

Proper implementation through existing state authorities requires assurance that agencies have the authority to enforce coastal management stipulations on state permits. To be certain that state agencies have enforcement authority for the ACMP, statutory adjustments and refinements in civil penalty provisions must be made.

Since coastal district plans are the building blocks for ACMP implementation, improvement to the ACMP necessitates making the district programs work better. This means writing better enforceable policies, clearly identifying implementation tools, and streamlining the process for program amendments so that revisions can be more readily incorporated into the approved coastal district programs. Some of the benefits of the program changes DGC is considering include:

1. Protecting citizen concerns at the local level and raising the standing of coastal districts in the consistency review process should improve responsive decision-making and lessen the need for administrative remedies;
2. Shifting the ACMP away from judicial procedures to mediation and negotiation to lessen the administrative burden for state agencies and to provide enticement for cooperative problem-solving;
3. Raising the standing of coastal districts in the consistency review process, which encourages districts to take a hard look at improving enforceable policies and raises comfort in considering performance based policies, making it easier for state agencies to implement coastal district plans through existing authorities;
4. Clarifying the role of state agencies and coastal districts in the consistency review process to benefit all players.

Summary

In response to the questionnaires from the Section 309 project, some districts responded that Areas Which Merit Special Attention (AMSAs) or special area management plans (SAMPs) provide greater "due deference" and local control for areas with high resource values and pressures of growth and development. Other benefits from participating in the development and implementation of a special area plan were also identified: giving the area or resources special status that would be considered by state and federal agencies; providing more detail on resources, uses and activities; resolving resource management conflicts; and improving the permitting process. Another benefit is increased public participation and awareness of coastal management at the local level.

The predominant concerns raised about coastal district planning include: 1) the need for more involvement of state and federal agencies during plan development; 2) the length and complexity of the plan amendment process -- a deterrent to making plan revisions; 3) and myriad problems with plan implementation at the local and state level, including confusion about local, state and federal responsibilities: problems with policy interpretation; vague policy language; homeless stipulations; monitoring; and enforcement. These concerns have been highlighted as Alaska is taking a holistic look at improving its coastal program through the current Assessment of the ACMP.

Through statutory or regulatory revisions, enhanced standing and responsibility of coastal districts in the ACMP, preparation of a planning Guide Book, improvements to grant management, and clarification and strengthening of implementation responsibilities, special area management planning as well as basic coastal district planning can be enhanced in Alaska.

Sara Hunt
Alaska Division of Governmental Coordination
P.O. Box 110030
Juneau, AK, USA 99811-0030

Ph (907) 465-8788
Fax (907) 465-3075
Email Sara_Hunt@gov.state.ak.us

AQUATIC LANDS: STATE SOVEREIGN AUTHORITY AND FEDERAL CONSTITUTIONAL CAPACITY

Genevieve Pisarski,
Washington Department of Natural Resources

Summary

Power to dispose of aquatic lands is an inseparable incident of state sovereignty and is not delegated to the United States by the Constitution. Without Property Clause power over aquatic lands, the United States has constitutional capacity only to control, use, or own aquatic lands coextensively with exercise of other delegated powers and can not benefit from creation of a fee simple in private parties by the state. Property Clause, Enclave Clause, Supremacy Clause, Necessary and Proper Clause, and Tenth Amendment jurisprudence appears to support a conclusion that United States title to aquatic lands is defeasible to the state. State sovereign authority over aquatic lands shares its historical basis with the equal footing, public trust, and navigational servitude doctrines. Although the Submerged Lands Act preserves United States title to aquatic lands while in use, it does not alter state sovereign authority over aquatic lands and does make United States title absolute.

State Sovereign Authority and United States Constitutional Capacity

Aquatic lands are unique. No one, ever, obtains the full bundle of rights of an estate in fee simple absolute. Under the common law of England, ownership and dominion of lands under navigable waters were in the sovereign, in trust for the people. After the American Revolution, ownership and dominion of the aquatic lands within their borders, an inseparable attribute of sovereignty, vested in the original states, in trust for the people, and, under the equal footing doctrine, likewise, vested in all new states. The Constitution did not grant aquatic lands to the United States but reserved them to the states.

During territorial times, ownership and dominion of aquatic lands was held by the United States in trust for the future states. As trustee, the United States could grant title, but only when Congress did so expressly and only for performance of international obligations, improvement of commerce, or other public purposes appropriate to the territory. Aquatic lands were not part of the public domain of the United States; and any patents of aquatic lands had no effect of their own force, unless subsequently ratified by the state. For international obligations, the power of the United States over aquatic lands was its treaty power; and for commerce, it was the commerce power. The source of power to dispose of aquatic lands for public purposes related to the territory, however, was the Property Clause and was effective only during trusteeship. Upon vesting of sovereignty in the state and termination of United States trusteeship, United States power to grant aquatic lands terminated for lack of constitutional Property Clause power.

After statehood, the power of the United States to control, use, or own any land in a state is constitutionally delimited by the Commerce Clause, the Enclave Clause, and the Property Clause. The Supremacy Clause and the Necessary and Proper Clause operate within the scope of the former powers and their incidents. Neither the state nor the federal government is immune from the jurisdiction of the other, unless it is immediately and directly exercising its respective sovereign powers. Neither may destroy the other nor substantially curtail the other's exercise of its own power.

The Commerce Clause and the Enclave Clause confer governmental jurisdiction on the United States, while the Property Clause confers proprietary power. Under the Commerce Clause, the power of the United States is exclusively governmental, although the navigational servitude that is incidental to the commerce power does confer a right to take and use lands under navigable waters without compensation. Under the Enclave Clause, the United States has power of exclusive jurisdiction over any land acquired for constitutionally enumerated purposes by purchase with the consent of the state, within the scope of the public purpose for which lands are held. Through the Necessary and Proper Clause, the United States has additional power to acquire lands by eminent domain, in which case any governmental jurisdiction beyond what is required for the specified purpose is delimited by state consent. Under the Property Clause, moreover, Congress has exclusive power over territory and property. Because the Property Clause power is exclusive, presumably, no latent powers remain that could belong to a state under the Tenth Amendment. Under the Supremacy Clause, furthermore, the Property Clause supersedes any conflicting state laws.

The scope of the Property Clause, however, does not include aquatic lands. Under the common law, these are sovereign lands. Dominion, or sovereign authority, over aquatic lands is an incident of state sovereignty under the common law and is not expressly delegated to the United States by the Constitution. It is non-preempted matter reserved to the states. Dominium (sovereignty, dominion, and control) and imperium (governmental jurisdiction) may ordinarily be separable, but in the case of aquatic lands, property interests are subordinated to sovereignty and follow sovereignty.

After statehood, therefore, the only power of the United States that is paramount to a state's sovereign authority over aquatic lands, for practical purposes, is the commerce power. The treaty power, generally, does not come into play after statehood, except as it may relate back to territorial times. In any other respect, paramount rights run to the states. This is not a derogation of United States sovereignty, however, because the United States has constitutional power to control aquatic lands under the Commerce Clause and to own and control under the Enclave Clause to the extent needed for any and all constitutional purposes. The United States merely lacks exclusive Property Clause power, because aquatic lands are an incident of state sovereignty.

Equal Footing, Public Trust, and Navigational Servitude Doctrines

The equal footing doctrine vests in any state the same sovereign ownership and dominion of aquatic lands as belonged to the original 13 states. This sovereign ownership and dominion has three aspects: the *jus privatum*, or proprietary interest, which can be conveyed into private ownership by the sovereign; the *jus publicum*, or public trust, which burdens any proprietary title to aquatic lands with a public use easement; and the *jus regium*, or sovereign authority, which is the right of dominion and control. The *jus publicum* and the *jus regium* tend to be treated collectively and called the *jus publicum* or public trust. The sovereign authority is, nonetheless, distinct from the public use easement. It is the prerogative to exercise dominion and control, the exclusive authority to define the public use easement and to dispose of aquatic lands in the public interest.

This right of prerogative, or sovereign authority, is not vested by the Constitution in the federal government. The state may dispose of aquatic lands as it sees fit, but retains its sovereign authority over disposition as against the United States. Under the Supremacy Clause, the United States can take title for a public purpose, preempting any state public trust use, but it cannot destroy the state's sovereign authority. The United States can, for public purposes, acquire a fee simple title in aquatic lands, but it is a fee on limitation, so that, upon cessation of use, the fee, title, and rights revert to the original owner, the state by virtue of sovereignty.

The navigational servitude, an incident of the Commerce Clause power, does give the United States a property interest in aquatic lands, in connection with its governmental power. The navigational servitude, however, confers only the right to use property without compensation in pursuit of navigation-related Commerce Clause purposes, not the right to take title. It attaches to the United States, furthermore, solely as a result of the Constitutional surrender of the commerce power by the states.

State Law

Although the United States can always acquire and control aquatic lands for appropriate constitutional purposes, the interest that it acquires is created by state law. The United States, however, can not benefit from an antecedent title in fee simple in aquatic lands that the state created in a private party, because of the lack of Property Clause power over aquatic lands, so that any aquatic lands acquired by the United States become defeasible to the state.

Although the state cannot prevent or limit the United States in the legitimate exercise of its delegated powers in respect to aquatic lands, the state has exclusive sovereign authority to control rights and interests in aquatic lands, as distinguished from uplands, where state law, under the Property Clause, can not circumscribe United States title. Where aquatic lands are the issue, it is not state law that limits the United States. It is state sovereign authority that is paramount, because the authority has not been delegated under the Property Clause, so that state law necessarily defines United States title. In the case of aquatic lands belonging to the state of Washington, for example, state statutes grant the United States only a use for the duration of its public purpose, and, thereby, codify the reversion that the state has by virtue of sovereignty. In the case of aquatic lands previously granted to private parties, the Washington statute giving consent to acquisition of land in general by the United States under the Enclave Clause cannot be presumed to include aquatic lands. The state cannot be presumed to have intended to relinquish its sovereign authority over aquatic lands to the United States; nor can the United States divest the state of its sovereign title without the state's express consent. Any implied inclusion of aquatic lands as a result of including Commerce Clause purposes in the statute is not dispositive, because the navigational servitude is the means for the United States to obtain as great an interest as it needs under the Commerce Clause, no more than a use. Any state consent to acquisition for Commerce Clause purposes would be construed, therefore, to mean consent to acquisition of a use and not of title. Courts will infer neither congressional intent to defeat a state's title nor a state's intent to convey it.

It is, likewise, not dispositive that the state has granted aquatic lands to private parties in fee simple, apparently making them freely alienable. Lacking Property Clause power over aquatic lands, the United States cannot benefit from the state's creation of a fee simple in private parties. That the state can dispose of aquatic lands into private hands as it sees fit, limited only by its public trust doctrine, is the state's prerogative by virtue of sovereignty, not preempted by the Property Clause. Moreover, where the United States acquires title by eminent domain, a new title is created, as if no other party had held the aquatic lands before, leaving the United States effectively in the same position in relation to the state as it was during territorial times.

Submerged Lands Act

The Submerged Lands Act confirms the equal footing doctrine; it does not alter the doctrine's scope or effect. While the Submerged Lands Act retains

United States title to aquatic lands actually in use for constitutional purposes, it also confirms that the rights and powers of the United States do not include proprietary rights of ownership.

That United States title is defeasible in favor of the state is not inconsistent with the Act. The Act confirms a state's title to beds of navigable waters within its boundaries as against any claim of the United States. The Act specifically retains the United States' paramount powers of regulation and control for purposes of commerce, navigation, national defense, and international affairs, while stating that these do not include proprietary rights of ownership. Thus, the Submerged Lands Act does not alter the basis of the state's claim to sovereign title under the equal footing doctrine, and, furthermore, recognizes that proprietary ownership is not among the paramount constitutional powers of the United States. The United States, in the Submerged Lands Act, disclaims any proprietary power in aquatic lands among its constitutionally delegated powers, consistent with lack of Property Clause power, and reserves only such title as it may have acquired according to state law.

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Genevieve Pisarski
Aquatic Resources Division
Washington State Department of Natural Resources
P.O. Box 47027
Olympia, WA, USA 98504-7027

Ph (360) 902-1072
Fax (360) 902-1786
Email gpkk490@wadnr.gov

Session C3: National Ocean Service Partnerships with Local Communities -- Integrated Support for Maritime Commerce and Coastal Resource Management
Session Chair: David McKinnie, NOAA/National Ocean Service

NOAA/NATIONAL OCEAN SERVICE WEST COAST PROJECTS

David McKinnie, NOAA/National Ocean Service

Introduction: Doing More with Less

Today's political and economic climate demands a smaller government, significant reductions in the federal deficit, and less federal regulation. Combined with the increasing complexity of regional problems and the obvious advantages of collaborating with the local community, these challenges place new demands on federal agencies in their response to statutory mandates. The National Ocean Service (NOS) is devising more effective ways of meeting its statutory missions, refining its products and services, and seeking efficiencies in operations.

The National Ocean Service is the primary civil agency within the federal government responsible for maritime charting, geodesy, and sustainable coastal management. Significant regions on the west coast (Alaska's Cook Inlet and Prince William Sound, Washington's Puget Sound, and San Francisco Bay) present maritime and coastal challenges that make them natural locations in which to integrate National Ocean Service activities organized around these specific geographic areas.

Opportunity and Challenge

The United States' west coast embraces rich and diverse coastal and nearshore ecosystems along its 3,000 miles of shoreline. From Alaska to Southern California, irreplaceable natural systems host marine mammals, commercially critical fisheries, and abundant waterfowl. Significant portions of the coast are pristine.

Yet the west coast also supports major ocean shipping ports, oil terminals, and refineries, and other activities vital to the nation's economy. Major shipping routes along the coast carry container vessels from Asia making calls in Puget Sound, San Francisco Bay, and points south. Oil tankers carrying North Slope crude transit from Valdez to Puget Sound and San Francisco Bay and soon will carry oil from Alaska west, along the Aleutian Islands.

The need for expanding maritime commerce along the west coast combined with the need to manage the coastal zone wisely for this and future generations create management challenges NOS can help to address through an integrated approach to maritime commerce and coastal management in three locations:

1) Cook Inlet and Prince William Sound are home to major marine ports. NOS is working in partnership with the U.S. Coast Guard to help ensure that the area's marine-based transportation activities can continue to expand while the area's ecological resources are protected properly.

2) Puget Sound ports are experiencing growth in volume of vessel traffic, along with an increase in the diversity of users of the region's waterways. At the same time, the public is concerned that the natural resources of Puget Sound, already stressed by urbanization, may face additional threats brought on by this increase in waterborne traffic. NOS is working collaboratively with Puget Sound area interests to address information needs and enhance communication .

3) San Francisco Bay and the Delta comprise the largest estuary on the west coast. The Bay is also the fifth largest U.S. port in crude oil handling and fourth largest container port. NOS is working in partnership with coastal management and shipping interests to support the expansion of the Bay area's maritime economy while the Bay's ecological resources are protected and managed for the future.

National Ocean Service

As part of the National Oceanic and Atmospheric Administration, NOS's mission is to support the growth of maritime commerce while ensuring the sustainability of healthy, productive, coastal ecosystems. NOS also has direct management responsibilities through the National Marine Sanctuaries and an indirect role in coastal management through its support of state coastal management agencies and National Estuarine Research Reserves.

NOS meets its mission primarily by:

- providing industry, coastal resources management, protection, and regulatory agencies; the private sector; and the public with products and services that support sound decision making in the coastal zone; and

- convening the interests in the coastal zone to address common concerns.

The sum of NOS's technical services is the means by which the agency exercises its management responsibilities. The common data these services require, which are collected primarily to meet NOS' marine navigation mandate, bridge the agency's maritime commerce and coastal management responsibilities. NOS's independent relationships with coastal resources users allow the agency to bring together diverse parties to tackle regional challenges that require the involvement of all interested parties.

Local Focus and Involvement

Three major principles underlie these projects:

Local Focus - Regional problems are too complex to address with broad programs designed for national implementation. To meet a particular area's needs, these programs must be tailored—with local community input—for that particular geographic area.

Local Involvement - The kinds of relationships needed to address regional navigation and coastal resource management issues effectively are not possible at a national level. Limited resources at all levels of government require that we work with other agencies and the private sector to create efficiencies to achieve far more than is possible working in isolation. Consultation and collaboration with the local maritime and coastal management communities are essential to improving the design and delivery of existing NOS products and services and to identifying and to providing appropriate new products and services.

Efficiency - Geographic data must be accessible to a broad array of users. Under its maritime safety and navigation mandates, NOS collects data used in the construction of nautical charts and other products. These data are also needed by the coastal management and protection communities for analysis, modeling, and other purposes. Historically, however, these data have not been made available to a larger community, or are collected in formats that make them less useful outside of the maritime community. Both because these data are high-quality sources of information and because it is efficient to do so, NOS must make data collected for specific programs available and accessible to a much larger community of users in common formats and protocols.

NOS is supporting local focus and involvement in these west coast projects through a collaborative approach. Local community clients include: Bay Area Conservation and Development Commission; Port of Oakland; Puget Sound Steamship Operator Association; San Francisco Bar and Puget Sound Pilots Associations; the Marine Exchanges of the San Francisco Bay Region and Puget Sound; Recreational Boating Association of Washington; North Pacific Fishing Vessel Operator Association; Universities of Washington and California (at Berkeley); San Francisco Estuary Institute; Center for Marine Conservation; California Office of Oil Spill Prevention and Response; Alaska State Ferry System; private sector charting and navigation system developers and manufacturers; tanker, and break-bulk operators; tug and tow operators; cruise ship operators and recreational boaters.

Key Objectives

Discussions with local groups at each location yielded issues of concern where NOS's capabilities and resources could be brought to bear, thus illustrating key objectives common to each project.

Collaboration

Successful projects are undertaken in collaboration with the local maritime commerce and coastal resource management communities. The projects form local-federal partnerships to bring to bear local authorities and federal resources and capabilities on issues of concern.

Service to Primary Clientele

Local concerns and the needs in both the maritime commerce and coastal management communities are the impetus to focus on improving NOS's products and services. NOS is tailoring its products and services to meet local needs, improve product distribution, and is developing new information tools for coastal managers from these improved products and services.

Integrating NOS Functions

NOS will use the experiences of Cook Inlet and Prince William Sound, Puget Sound and San Francisco Bay to shape its organizational structure for maximum efficiency and responsiveness to local community needs nationwide. These projects provide opportunities to highlight the synergies that exist both within the National Ocean Service and the communities' maritime and resource management interests.

David McKinnie
NOAA/ NOS/National Geodetic Survey
N/NGS3, #8211
1315 East West Highway
Silver Spring, MD, USA 20910

Ph (301) 713-0443
Fax (301) 713-4572
Email dmckinnie@ngs.noaa.gov

THE EFFECTS AND MANAGEMENT OF VISITOR PRESSURE ON ROCKY SHORES IN NORTHEAST ENGLAND

Helen Fletcher, University of
Newcastle-Upon-Tyne, UK, and
Chris Frid, University of
Newcastle-Upon-Tyne, UK

Introduction

Ever-increasing demand for public outdoor recreation in recent years has meant that "trampling" (the passage of people across the shore) has become more widespread on British coasts. Studies in other temperate regions have suggested that these increasing levels of human activity can add to background levels of disturbance and cause irreversible changes in the composition of rocky intertidal communities (Brosnan and Crumrine, 1994). Evidence for causal relationships between biological patterns and human activities in the intertidal zone has been provided by surveying areas subjected to differing levels of visitor pressure. In separate surveys in California, for example, both Beauchamp and Gowing (1982) and Ghazanshahi *et al.* (1983) found that species diversity decreased with increasing level of public use.

Abundances of certain species have been shown to decline in heavily-visited areas. Cover of foliose algal species such as fucoids may be reduced by sustained trampling pressure (Ghazanshahi *et al.*, 1983). This loss of canopy exposes smaller understorey algae which, under undisturbed conditions, are afforded protection by the overlying flora. Some fauna, for example barnacles, may be crushed even by single steps (Povey and Keough, 1991). Community-level effects, such as changes in composition to a community dominated by species of algae with turf-like growth forms have also been observed (Brosnan and Crumrine, 1994). Perhaps most significantly of all, trampling can result in localized increases in the amount of bare space, the major limiting resource for sessile organisms in rocky intertidal communities (Dayton, 1971).

On heavily-visited shores then, it is clear that unmanaged public access can result in both change and mortality to the ecosystem. If the aim of management is to conserve shores in a natural, unaltered state, public access must be maintained below the level which results in ecological damage. Such a level of use is termed the "recreational carrying capacity" and is defined as "the maximum intensity of use that an area of shore can continue to support without there being a change in the biotic environment" (Goldsmith, 1974).

The concept of a "threshold level" has been used to develop management plans in both terrestrial and coastal areas, despite being criticized as both time-consuming and expensive to determine (*e.g.*, Hayden, 1975). Yapp and Barrow (1979), for example, supported use of this technique, concluding that without this kind of ecological evaluation, application of management strategies may be ineffectual and ecosystems insufficiently protected. If an estimation of carrying capacity is made before the application of management techniques, however, the concept could be highly effective as an aid to the conservation of protected areas (Goldsmith, 1974).

The aim of this study was to subject experimental plots in the rocky intertidal zone to different sustained trampling intensities in an attempt to quantify the carrying capacity of these areas of shore.

Methods

Study sites

The study was conducted at two moderately exposed rocky shores on the north-east coast of England. At both sites, the substratum consisted of large areas of flat sandstone. St. Mary's Island, a Local Nature Reserve, is heavily visited by tourists and local residents throughout the year. Cullercoats Bay, 5 km south of this site, is subjected to lower levels of visitor pressure.

Experimental design

A series of 1 m^2 plots were established on parts of shore distant from the main sites of visitor activity at both sites. These were arranged in blocks of four in the mid-eulittoral zone and there were four replicate blocks. One of four trampling intensities was assigned to each of the four plots in a random block design. Trampling intensities were designed to approximate normal and heavy usage of the shore and were determined by prior surveys of visitor pressure at both sites. The four treatments were 0 (control), 20, 80, and 160 footsteps per m^2, applied once every set of spring tides (hereafter referred to as steps/m^2/st). Plots were unmarked so as to reduce trampling bias, associated with people being attracted to marked areas of shore out of curiosity, and were thus relocated by means of maps only.

Patches were established in March 1994, and were monitored monthly for the first three months and then bimonthly until November 1994, when the sampling interval was increased to four months. Sampling ended in July 1995, a total of eight sampling times. At each sampling instance, percentage cover of each algal species and of exposed substrate were recorded. To ensure consistency, these estimates of ground cover were made by the same worker at all times.

Data analysis

Values of percentage cover for algae and bare space were arc-sin transformed and were then tested for normality prior to analysis. Pre-trampling data were analyzed for statistically significant differences, both between blocks and between treatments within a block (ANOVA). Any block differing significantly from the remaining blocks at that site at time 0 was excluded from all subsequent analyses. Oneway ANOVA was used to test for significant differences in the percentage cover of algal species and bare space between the two sites at time 0.

Kruskall-Wallis analysis was used to test for significant differences in counts of species richness between treatments at any sampling time. Similarly, significant differences in the amount of bare space present between treatments at any sampling instance were analyzed by ANOVA.

Transformed data for the eleven most common algal species at each site were subjected to Principal Components Analysis (PCA). The mean values of percentage algal cover for the blocks combined (one block omitted in the case of Cullercoats Bay) were used.

Results

A total of 28 species of algae were recorded, the most abundant at both sites being *Fucus serratus*, L., *F.spiralis*, L. and *F.vesiculosus*, L..

Species abundances in one block at Cullercoats Bay were found to differ significantly from those in other blocks at time 0 (ANOVA, $p > 0.05$). This block was thus excluded from all subsequent analyses, giving replication of three at Cullercoats Bay but four at St. Mary's Island.

Species richness differed significantly between treatments at Cullercoats Bay after eight months of sustained trampling (KRUSKALL-WALLIS, $H = 9.23$, $p < 0.05$), with species richness being greatest in untrampled plots. At St. Mary's Island, there were no significant between-treatment differences in species richness at any sampling instance.

Two months of sustained trampling pressure had a significant effect on the amount of exposed substrate present at Cullercoats Bay (ANOVA, $F = 12.58$, $p < 0.01$), with the greatest abundance occurring in the most intensely trampled quadrants (160 steps/m^2/st). At both sites, there were significant differences in the amount of exposed substrate present between treatments after 12 months of sustained trampling (Cullercoats Bay, ANOVA, F =

8.07, $p<0.01$; St. Mary's Island, ANOVA, $F = 5.90$, $p<0.05$). Again, greatest amounts of exposed substrate were present in plots subjected to most trampling pressure (160 steps/m^2/st).

Of the 28 algal species observed, 11 were used in multivariate analysis. The criteria for selection was that a species occurred at more than one of the eight sampling instances and in more than one replicate. Principal Components Analysis (PCA) was performed on the mean data of the replicate blocks combined: three blocks at Cullercoats Bay and four at St. Mary's Island.

The first three principal components accounted for 57% of the variation in this 11 species data set at Cullercoats Bay. Control plots occurred in a distinct, although widely-dispersed group, which was presumably a reflection of the natural seasonal changes in the community (Figure 1a). Trajectories of trampled plots through time were similar to each other but differed from those of control plots. All three showed displacement to the right of axis 1 as time progressed, which correlated with increased abundance of the green opportunistic alga *Enteromorpha* spp. and the turf-like red alga *Audouinella* spp. After four months of sustained trampling pressure (July 1994), however, data points for all four treatments showed displacement along axis 2 (Figure 1a). This coincided with a summer bloom of the opportunist *Enteromorpha* spp.

At St. Mary's Island, 59% of the variation in the data was accounted for by the first three principal components. Again, control plots formed a widely dispersed but distinct group (Figure 1b). After one month of sustained trampling, treated plots, which all showed a similar trajectory, were displaced along axis 2. As at Cullercoats Bay, this pattern was correlated with increased prevalence of *Enteromorpha* spp.. A gradient, corresponding to trampling intensity, is apparent along axis 1, with a progression from 20 to 160 steps/m^2/st from right to left (Figure 1b). Again, the trajectories of the trampled plots through time are correlated with increased abundance of both *Enteromorpha* spp. and *Audouinella* spp.

Discussion

"Recreational carrying capacity" at both sites was exceeded by as few as 20 steps/m^2/st, resulting in changes to the composition of the algal community (Figure 1a and 1b). This intensity could be realized by only five people, with an average gait of less than a meter, taking the same route out and back across the rocky shore each spring tide period. Similarly low intensities have been show to have deleterious effects on Australian intertidal communities (Povey and Keough, 1991). Here, two visitors a day, walking across a 0.5 m by 2.0 m strip of shore for four months, resulted in a significant decline in algal cover and increased the availability of exposed substrate. Sensitive species, for example the alga *Hormosira banksii*, were damaged even by single steps.

The intensity and frequency of a disturbance, in addition to factors such as season, are important in determining community response to perturbation (Sousa, 1985). As results from this study show, even low intensity disturbances can precipitate community change if sustained through time, as recolonization cannot occur (Sousa, 1985).

Community response to trampling was similar, irrespective of trampling intensity or site (Figures 1a and 1b). At St. Mary's Island, there was evidence for a gradient in community change, with more marked community response being correlated to increased trampling intensity. Evidence for a link between increased levels of visitor pressure and increased community change has been provided by previous studies. Boalche *et al.* (1974), for example, observed that the foliose alga *Ascophyllum nodosum* Le Jol. declined dramatically when trampling pressure increased after construction of a car park adjacent to the shore. Similarly, Beauchamp and Gowing (1982) made a comparative survey of sites differing in their degree of human visitation and found higher algal abundance and species diversity at less trampled sites.

In addition to compositional changes, the most intensive trampling regime (160 steps/m^2/st) induced a decline in species richness at Cullercoats Bay after eight months of sustained trampling pressure. Reduced species richness is a characteristic feature of heavily-trampled shores, for example in the USA (*e.g.*, Ghazanshahi *et al.*, 1983), where use of shores has increased rapidly in recent years (Brosnan and Crumrine, 1992).

Both the frond and the holdfast of algae were affected by trampling, the latter often resulting in dislodgement of whole plants. The abundance of foliose species has been observed to decline significantly in other trampled intertidal areas (*e.g.*, Brosnan and Crumrine, 1994), this susceptibility being attributed to their small discoid holdfasts which offer little resistance to repeated impacts (Brosnan and Crumrine, 1992). Loss of this canopy layer will result in mortality of understorey algal species, both directly and due to dessication during tidal emersion (*e.g.*, Brosnan and Crumrine, 1992).

Loss of algal canopy resulted in increased amounts of exposed substrate, important in determining species composition of rocky intertidal areas by providing opportunities for attachment of new individuals (Dayton, 1971). In this study, amounts of open space at both sites were consistently greatest in plots subjected to the most intense trampling regime (160 steps/m^2/st) after two months of sustained impact. This open space allowed colonization of opportunistic species in trampled plots. Abundance of the green alga *Enteromorpha* spp., for example, increased (Figures 1a and 1b). This species is able to thrive in disturbance-dominated conditions. Further changes in community composition were evident. The red alga *Audouinella* spp., which has a turf-like growth form, increased in abundance in trampled plots at both sites. This phenomenon was due to the reduced susceptibility of the holdfasts of this species to trampling, when compared to foliose species (Brosnan and Crumrine, 1992).

During the summer, daily numbers of visitors at both sites reach figures in the hundreds. On areas of shore most accessible to visitors, for example those closest to access points, the recreational carrying capacity is being exceeded. Spatially, damage is generally confined to existing pathways, which are characterized by reduced fucoid cover and large amounts of exposed substrate (pers obs). These features could be considered "sacrificial," as they represent only a small area of the shore as a whole. Trampling on a lesser scale, however, occurs over the entire shore area and, as our estimations of carrying capacity have shown, ecological damage can ensue from the activities of as few as five visitors each set of spring tides.

Regulation of visitors is suggested as an effective means of minimizing loss of biodiversity and aesthetic appeal on the shore. A possible solution is use of designated pathways, which can be set up in pre-existing paths, created by trampling. An alternative on large areas of shore such as these is to encourage use by the public of just part of the shore area. This can be achieved by limiting access to shore areas under protection (Brosnan and Crumrine, 1993). Zedler (1978), for example, when devising a management plan for part of the Californian intertidal zone, proposed that the area available for public use be restricted to one "small but representative area" near the car park. Although enforcement of such measures could prove difficult, biodiversity and ecological value of the shore could be preserved whilst still maintaining public access.

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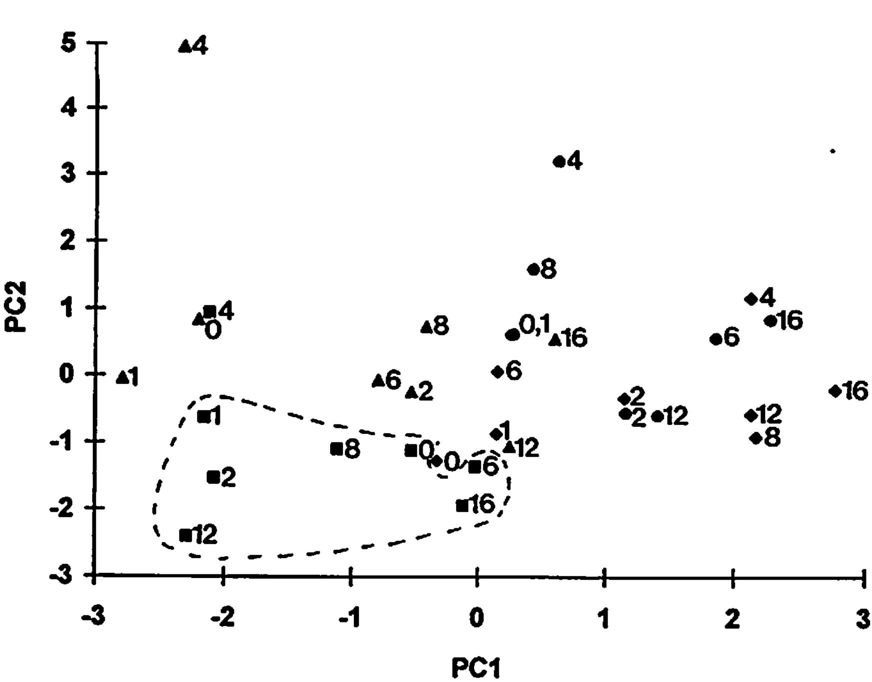
Helen Fletcher
Dove Marine Laboratory
University of Newcastle upon Tyne
Cullercoats
North Shields, Tyne & Wear, UK NE30 4PZ

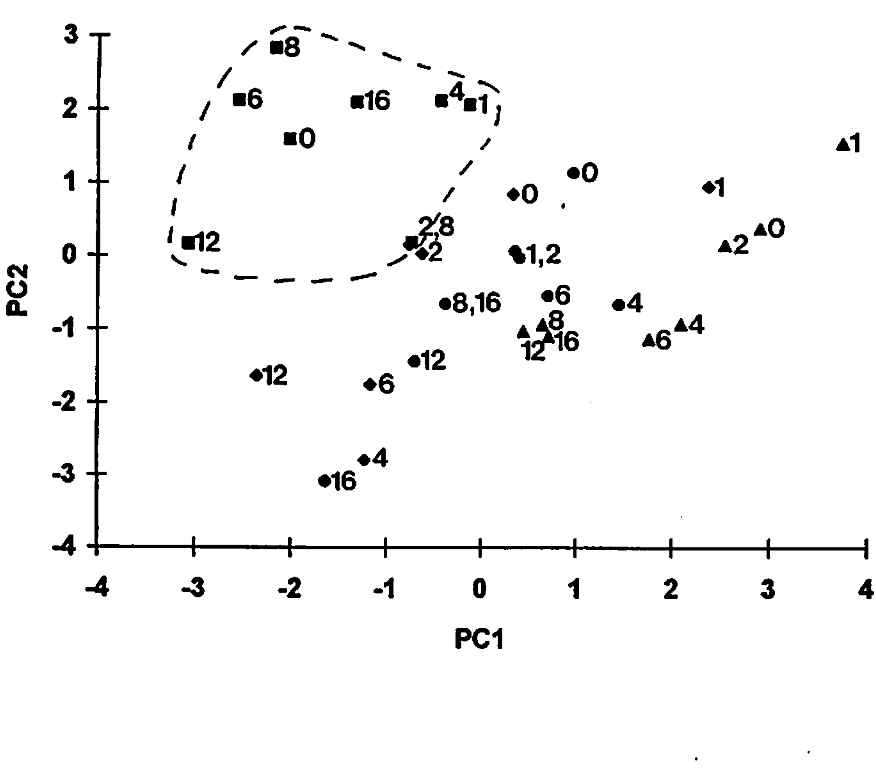
Ph (UK +191 252 4850)
Fax (UK +191 252 1054)
Email helen.fletcher@ncl.ac.uk

Figure 1. Principal Components Analysis for eleven algal species matrix. The scores of samples in the co-ordinates of the first two principal components are plotted. The level of applied trampling intensity (symbol) and the number of months after the onset of trampling (numbers) are used as markers, a) at Cullercoats Bay, where the first two principal components accounted for 41% of the variation, and b) at St. Mary's Island, where the first two principal components accounted for 45% of the variation in the data. Trampling intensity is denoted as n (0 steps/m^2/st), s (20 steps/m^2/st), l (80 steps/m^2/st), and u (160 steps/m^2/st).

a.



b.



BOSTON HARBOR WASTEWATER TREATMENT AND OUTFALL RELOCATION: TOOLS FOR EVALUATING ENVIRONMENTAL IMPACT

James J. Fitzpatrick, HydroQual, Inc.,
Dominic M. DiToro, HydroQual, Inc.,
Richard R. Isleib, HydroQual, Inc.,
Michael S. Connor, Massachusetts Water Resources Authority, and
Wendy Smith Leo, Massachusetts Water Resources Authority

Background of the Boston Harbor Cleanup Project

As population growth and industrial development continues along the coastal zones of the world, the near-shore continental shelf and coastal-plains estuaries are being subjected to increasing environmental stresses caused by the discharge of nutrients and potentially toxic wastes. Therefore, scientists and policy makers are increasingly faced with the often opposing issues of providing cost-effective wastewater treatment and disposal versus protecting and maintaining the near-shore coastal environments. One such case in point is the Boston Harbor cleanup project.

Located in northwest Massachusetts Bay, the City of Boston (Figure 1), as is typical of many large east-coast metropolitan cities, has a centralized sewer system which dates back to the late 1800s and early 1900s. The system was built to provide conveyance of domestic and industrial sewage to a centralized location, Boston Harbor, for disposal. The present system was completed in 1904. Millions of gallons of untreated waste were discharged in Boston Harbor every day, until the construction of primary treatment facilities on Nut Island in 1952 and Deer Island in 1968. These facilities were constructed to reduce the discharge of total suspended solids by 60 percent and organic matter, including fecal material, by 25 percent. However, lacking alternative methods for disposal, approximately 35 dry tons of digested sludge were discharged into the harbor daily until December 1991. Adding to the pollutant inputs to the harbor were discharges from combined sewer overflows (CSOs) during wet weather. These discharges occurred approximately 60 times per year and added more than 5 billion gallons of raw sewage to the harbor every year.

The present day cleanup of Boston Harbor began with the passing of the Clean Water Act of 1972 which mandated an upgrade to secondary treatment (85 percent removal of suspended solids and biochemical oxygen demand concentrations) by 1977. However, the cleanup story is not without several chapters. In 1979, after exploring several other options for wastewater treatment, the Metropolitan District Commission (MDC), the state agency responsible for managing water and wastewater treatment in the Boston metropolitan area, applied for a waiver from secondary treatment as provided by the 1977 Clean Water Act. Rather than construct secondary treatment facilities, the MDC proposed instead to discharge primary treated effluent into northwestMassachusetts Bay via a 11.2 km outfall pipe, to stop ocean dumping of sludge and to reduce CSOs. This proposal was based on water quality studies which purported to show that secondary treatment would not be cost-effective. In June 1983 the US Environmental Protection Agency (USEPA) denied the wavier, primarily due to concerns about maintaining the dissolved oxygen standard in the bay and protecting the benthic organisms around the outfall site. Subsequently, MDC modified the waiver request by relocating the outfall 14.7 km into Massachusetts Bay so as to provide better effluent dilution. In March 1985 the USEPA again denied the waiver request.

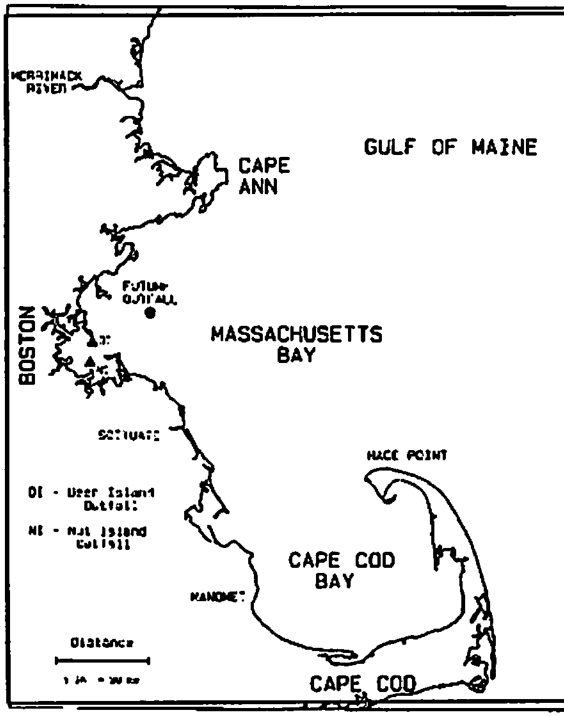


Figure 1
Massachusetts Bay Study Area

In response to state and federal lawsuits for violations of the 1972 Clean Water Act filed by the City of Quincy and the public advocacy group Conservation Law Foundation, a new agency, the Massachusetts Water Resources Authority (MWRA), was formed and charged with the cleanup of Boston Harbor. This cleanup included a court-ordered schedule for the construction of a land-based sludge processing facility to end the discharge of sludge by 1991; construction of new 1,270 MGD primary and 780 MGD secondary treatment plants on Deer Island with a 15.2 km outfall by 1999; and provisions for solving the CSO problem.

As construction of the secondary treatment facilities and outfall pipe began in the early 1990s, the choice for the new outfall at a 35 meter depth 15.2

km east of Boston in Massachusetts Bay resulted in a substantial controversy from various citizens groups within the region. Of particular concern to some residents of Cape Cod was the potential for the nutrient enrichment (and in particular nitrogen enrichment) in the waters of Cape Cod Bay some 32 km from the future outfall location. This concern was built on the hypothesis that nutrient enrichment might stimulate nuisance algal blooms and/or result in bay-wide eutrophication that could threaten North Atlantic right and humpback whales, both endangered species, which use the Massachusetts Bays system as a feeding ground.

Monitoring and Modeling Efforts

In an effort to develop a more rigorous and detailed understanding of the potential impact of the outfall relocation on the water quality of Massachusetts and Cape Cod Bays, the MWRA has funded a number of data collection and research efforts focusing on the Massachusetts Bays system. Included in these efforts have been the implementation of a bays-wide water column and sediment quality monitoring program and funding leading to the construction of detailed mathematical models of circulation and water quality in the bays system.

The monitoring program serves two purposes: to provide long-term monitoring of environmental conditions and to provide data for validation of the water quality model. The monitoring strategy provides for the detection of meaningful changes in biological, chemical and physical measurements at levels far below, and thus in advance of, those that could be of concern. The monitoring strategy is also designed to detect those changes both in the nearfield (*i.e.*, in the immediate vicinity of the outfall) and farfield (*i.e.*, southeastern Massachusetts Bay and Cape Cod Bay). The monitoring program was begun in February, 1992 in order to provide information on baseline water quality conditions before the outfall goes online.

To date data collected from the outfall monitoring program have provided a basis for drawing some broad generalizations about the bays:

- Massachusetts and Cape Cod Bays are not pristine environments.
- There is transport of pollutants from Boston Harbor to Massachusetts Bay and some evidence of associated impacts.
- Chlorophyll-a, and to a lesser extent nutrient, concentrations show considerable variability on daily as well as seasonal time-scales.
- Cape Cod and Massachusetts Bays are distinct ecosystems, as evidenced by differences in both chlorophyll concentrations and the benthic faunal community.

Data collected as part of the monitoring effort are also being used to validate the Bays Eutrophication Model (BEM), a mathematical water quality model of Boston Harbor, Massachusetts Bay and Cape Cod Bay. The purpose of the BEM is threefold: (1) to obtain further understanding of the processes relating eutrophication, nutrients, and dissolved oxygen within the bays system; (2) to assimilate and interpret the large volume of data collected through monitoring, thus allowing future monitoring and research to be focused in the most important areas; and, (3) to use the resulting modeling framework as an aid in understanding the potential impacts of wastewater treatment and outfall relocation of water quality in Massachusetts and Cape Cod Bays.

Water Quality Model Framework

The underlying framework, upon which the BEM is constructed, is based on the principle of conservation of mass. Simply stated, the conservation of mass accounts for all of a material entering or leaving a body of water, transport of material within the water body, and physical, chemical and biological transformation of the material. The BEM incorporates, then, three components -- external pollutant inputs, transport due to freshwater flow and tidally-induced advection and dispersion, and the kinetic interactions between the water quality variables.

Other than exchange with the Gulf of Maine, the principal inputs of nutrients and oxygen demanding material entering Boston Harbor and the bays system include: point source discharges from municipal wastewater treatment plants, inputs from CSOs, loadings associated with the various tributaries draining to Boston Harbor, nonpoint source inputs from study area rainfall runoff, groundwater loadings, and atmospheric inputs impinging directly on the water surface of the bays. Data necessary to make estimates of the various pollutant loadings to the system were obtained from report prepared by Menzie-Cura and Associates (1991) and the MWRA (Alber and Chan, 1994).

The kinetic equations used in the BEM framework are designed to simulate the annual cycle of phytoplankton production, its relation to the supply of nutrients, and its effect on dissolved oxygen. The model considers twenty-four state-variables, including salinity, two functional phytoplankton groups, particulate and dissolved forms of organic nitrogen, phosphorus and carbon, biogenic silica, inorganic nutrients including orthophosphate, ammonia and nitrate nitrogen and silica and dissolved oxygen, which are space and time dependent. In order to address the role that the sediments play in the overall nutrient and dissolved oxygen balance, an interactive water column-sediment nutrient flux model, developed as part of the Chesapeake Bay modeling effort (DiToro and Fitzpatrick, 1993), was included. Circulation and dispersion fields used in the water quality model are obtained from a fine-grid hydrodynamic model developed by the U.S. Geological Survey (Signell *et al.*, 1993).

Model Validation

A critical requirement for establishing the credibility of the BEM is a complete calibration which compares the model computation to the available observations. While limited data, collected prior to the implementation of the outfall monitoring program, were available for model calibration purpose, these data were not as extensive, either spatially or temporally, as were available from the 1992 monitoring effort. Hence, the 1992 monitoring data provided a more rigorous test of the model's calibration. The following observations can be drawn from comparisons of model computations and observed data. In general, the model reproduces the observed data fairly well. The hydrodynamic model reproduces the annual cycle of surface water heating and stratification, and also reproduces the spring freshet associated with the Merrimack River and other northern rivers discharging to the Gulf of Maine. The water quality model provides a reasonable reproduction of the annual cycle of phytoplankton biomass as represented by chlorophyll-a, fluoresence and particulate organic carbon, although it appears to under-estimate the magnitude of the fall bloom in October. In particular, the model also reproduces the annual cycle of surface and bottom water nutrients, including the marked stratification between the surface and bottom waters. The model reproduces the near depletion and algal growth limiting concentrations of surface inorganic nitrogen and the non-limiting surface inorganic phosphorus or orthophosphate concentrations. The model also provides a reasonable comparison to the observed dissolved oxygen data, reproducing the observed stratification and minimum concentrations that are observed in October and November. The model does not, however, reproduce a decrease in dissolved oxygen concentrations that occurs between early April and late May in northern Massachusetts Bay.

Although the data for comparison purposes are not as extensive for Cape Cod Bay as are available for the Massachusetts Bay, it appears that the BEM can also reproduce ecosystem differences between these two bays. For example, the model computes a phytoplankton bloom in Cape Cod Bay, which is larger than that computed in Massachusetts Bay, as is observed in the field data. The model also provides a reasonable calibration to the observed annual cycle of inorganic nutrients. Both the model and data suggest that the winter bloom in Cape Cod Bay becomes limited first by dissolved silica, rapidly followed by inorganic nitrogen. The model also reproduces the observed seasonal cycle for dissolved oxygen reasonably well.

With respect to the sediment component of the water quality model, the sediment nutrient flux submodel approximately reproduces the annual cycle of SOD and inorganic nutrient fluxes, with low values occurring during the winter and early spring, followed by increasing levels during the summer months, followed by diminishing values into the late fall. The model also reproduces the observed spatial gradients in SOD and nutrient fluxes, with high levels of SOD and nutrient fluxes within Boston Harbor as contrasted to very low levels of SOD and nutrient fluxes for Massachusetts Bay and Cape Cod Bay stations.

Model Projections

A number of management scenarios were run using the calibrated version of the BEM. These projections considered the following: outfall relocation with the upgrade of MWRA facilities to secondary treatment; outfall location with no upgrade at the treatment facilities; and, upgrade to secondary treatment but continued discharge at the current outfall sites. In reviewing the model projection results four water quality variables were evaluated so as to judge the effects of wastewater treatment and outfall relocation: concentrations of dissolved inorganic nitrogen, chlorophyll-a and dissolved oxygen and the flux of particulate organic carbon (POC) to the sediment bed. The latter variable is important because it acts as a food source to the benthic community. However, an excess of POC deposition can result in high sediment oxygen demand and have an adverse impact on the benthic community, *i.e.*, species diversity is reduced as only sewage tolerant infauna survive.

All three remediation alternatives presented above show improvements in water quality in Boston Harbor. Relocating the outfall will reduce chlorophyll-a levels and the flux of particulate organic carbon (POC) to the sediment in Boston Harbor. Dissolved oxygen levels are projected to improve in the Harbor as well. Model computations also indicate that most effects from the outfall relocation appear to be very localized to the outfall location. Model computations for the flux of POC to the sediment bed at several locations within Boston Harbor and at and in the vicinity of the future outfall location at presented in Figure 2 for present (1992 baseline) conditions and under future conditions of secondary treatment and outfall relocation. The model computations show a significant reduction in POC depositional flux in Boston Harbor; approximately a doubling of the POC flux at the future outfall location (but still below levels that are of environmental concern); and, virtually no impact at other stations in the vicinity of the outfall site.

Upgrading the MWRA treatment plants to secondary treatment and discharging to the current outfall location will also improve the concentrations of dissolved oxygen within the harbor and reduce the flux of POC to the sediment; the latter, however, not as significantly as for the outfall relocation strategies. This is in part due to the fact that secondary treatment without outfall relocation will do little to change chlorophyll-a levels within the harbor. However, currently there is no regulatory standard for chlorophyll-a and current levels do not appear to pose a problem. Model predictions indicate that updating to secondary treatment and relocating the outfall will provide the greatest improvements in water quality for Boston Harbor and the Massachusetts Bay and Cape Cod Bay ecosystem.

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James J. Fitzpatrick
HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, NJ, USA 07430

Ph (201) 529-5151
Fax (201) 529-5728
Email jimf@hydroqual.com

COASTAL ZONE DEVELOPMENT PLANNING THROUGH THE USE OF ECOLOGICAL RISK ASSESSMENT

Brian Pawlak
University of Washington
School of Marine Affairs and
Graduate School of Business

Ecological risk assessment is broadly defined as the process that evaluates the likelihood that adverse ecological effects will result from exposure to anthropogenic stressors. Risk assessment is intended to identify hazards (risks), and to systematically measure the frequency and magnitude of their consequences through a standardized methodology. As a discipline, ecological risk assessment is still developing, and the application of ecological risk assessment to coastal environmental decision-making is new. This presentation examines the role of risk assessment in coastal policy development. Specifically, ecological risk assessment will be discussed by examining its use in predicting the impact of creosote-treated timber pilings used in marine improvements.

Ecological risk assessment is a departure from the simplified standards approach to decision-making, and risk assessment can improve the nexus between a potential hazard and its probable impact on the environment. In particular, a risk-based approach to environmental decision-making provides managers with an understanding of the primary risk and uncertainty surrounding management decisions. Risk assessment also accounts for ecosystem dynamics in determining priorities for decision-making. Additionally, ecological risk assessment can convey information on the value of the data available for decision-making.

As highlighted by the risk assessment for creosote-treated pilings (Pawlak 1996), one of the primary limitations in performing an ecological risk assessment is the problem of extrapolating across scales of space, time, and ecological organization. Even defining the boundaries of the "ecosystem at risk" can be difficult. Nevertheless, ecological risk assessment is likely to play an increasing role in environmental decision-making. Practitioners of ecological risk assessment, however, will not be without problems. For example, choosing what endpoints to select, and what toxicological criteria to use will remain difficult, and will be subject to public scrutiny. Similarly, environmental managers who choose to use risk assessment to facilitate decision-making will inevitably be involved in a political process that combines risk characterization with economic, legal, and social concerns before performing risk management.

A risk-based approach to decision-making can inform managers of the primary risks and uncertainty surrounding coastal zone development (*i.e.*, the use of creosote-treated pilings). It is the explicit recognition of uncertainty and acknowledgment of gaps in ecological information that makes risk assessment an effective management tool. Knowing the primary risks from a given activity in relation to the level of the uncertainty of those risks, allows for the prioritization of environmental protection. Subsequently, knowing what actions (*i.e.* alternatives) could reduce a risk, and the relative costs and expected benefits of those management actions, provides the basis for adopting an appropriate risk management plans for coastal zone development.

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Brian Pawlak
University of Washington
School of Marine Affairs
8712 19th Ave NW (Upper Apt.)
Seattle, WA, USA 98117

Ph (206) 781-9561
Email bpawlak@u.washington.edu

Session D1: Public Access
Session Chair: Dennis Nixon, University of Rhode Island

PUBLIC ACCESS AND WILDLIFE: SCIENCE, PROCESS, AND DESIGN

Joseph LaClair, San Francisco Bay
Conservation and Development Commission

This paper briefly summarizes a limited literature on the observed impacts of recreationists on wildlife; it proffers a palette of methods to resolve these conflicts, and discusses how process influences trail development in wintering, resident and staging habitat areas in the San Francisco Bay Area, using project case studies and past and on-going research efforts.

The San Francisco Bay Area is home to approximately 6 million people. Human population growth and concomitant development increase the pressure on the remaining wildlife habitat areas within the region, and these pressures are particularly acute in the San Francisco Bay for several reasons. First, historical diking and filling of the Bay tidal wetlands has eliminated or severely compromised approximately 90% of these habitat resources from their pre-1850 size. Since the San Francisco Bay and related marshlands are important wintering, staging and breeding habitat to more than 34 species of shorebirds and up to 1 million waterfowl annually (Estuary Project, 1992), these habitat reductions have increased the significance of remaining habitat resources. Second, the burgeoning popularity of outdoor recreation combined with meteoric population growth creates pressure for trail development in and adjacent to areas which have not supported regular human activity since hunter-gatherers harvested them over a century ago.

Until recently, recreational trail use was considered a relatively benign activity with no real significant deleterious affects on wildlife. A small but growing body of research indicates that this is not true, and that trails near sensitive wildlife habitat areas can have a variety of negative impacts, including some severe impacts such as species abandoning their habitat due to human disturbance. The construction of pedestrian and bicycle pathways adjacent to San Francisco Bay marshes and mudflats sometimes increases human intrusion in sensitive wildlife areas. Frequently, historic and proposed development significantly limit the width available for proposed trail alignments, increasing the likelihood of an intersection between humans and sensitive wildlife species. Unmitigated use of these trails could result in decreased use of the marshes and mudflats by waterfowl, shorebirds, and wading birds. At high tides, when foraging is restricted to these narrow bands adjacent to proposed pathways, the magnitude of the impact would be highest. Dabbling ducks which forage in the marsh fringe during high tides, would be particularly affected due to the lack of alternative foraging habitat. Shorebird roosting in upland areas adjacent to feeding areas can also be affected at high tides when the marshes and mudflats are covered.

During migration, birds use the San Francisco Bay as a wintering and staging area. Wintering areas are the southern endpoint of the migratory route. Staging areas are locations between wintering and breeding sites, where migratory birds feed intensively to acquire energy reserves (Pfister, 1992). These reserves are necessary for the long-distance, non-stop flight to the next staging area, frequently thousands of kilometers away, as well as future reproduction and survival (Pfister, 1992; Havera, 1992). Foraging patterns are influenced by tidal cycles. Shorebirds forage when mudflats are exposed and they follow the water line of the ebb and flow tides. Dabbling ducks forage in the marsh fringe during high tides.

Assessment of potential impacts of shoreline trails is often complicated by the levels of disturbance already present at the trail sites. The Albany Mudflat site is currently subject to disturbance from the adjacent freeway and urban development. The trail Point Isabel site is heavily used by dog owners from the Point Isabel Park at the south end and by casual hikers, bikers, and runners from recently constructed residential development in the north. The Spinnaker Point Levee trail is located adjacent to newly constructed single-family homes and the trail has been used historically by residents of the area. Moreover, scientific inquiry into the effects of human disturbance at migratory staging sites has been very limited. The following partial summary of available literature, clarifies some of the issues needing further exploration and points to some preliminary findings. In the studies surveyed, avian response to human presence ranges from increased vigilance to site abandonment. Intermediate responses include decreased duration or intensity of foraging bouts, altered diurnal foraging patterns, flight and return to the same site, flight to a nearby site, and flight to a distant site (Kaiser, 1984; Havera, 1992; Josselyn, 1989; Burger, 1981; Burger, 1993; Klein, 1993; Pfister, 1992).

The species studied can be divided into three general groups - wading birds (Family Ardeidae), shorebirds (Families Recurvirostridae, Charadriidae, and Scolopacidae), and waterfowl (Family Anatidae). In all studies, shorebirds and wading birds exhibited high sensitivity to human presence. At the Ozark Natural Scenic Waterway, a publicly owned refuge commonly used for recreation, Kaiser (1984) concludes that the number of green-backed herons present at the study sites is inversely proportional to the number of people (usually canoeists) at the site. In addition, the individuals which continued to use the sites in the presence of human recreation exhibited decreased duration of foraging bouts (Kaiser, 1984). In San Francisco Bay, Josselyn (1989) measured that the flushing distance, the distance at which human presence causes flight, for two wading species - the great blue heron (195 feet) and great egret (55 to 65 feet).

Observations of shorebird response to disturbance vary. In a study conducted at the Gateway National Seashore Jamaica Bay Refuge in New York, Burger (1981) found that shorebirds usually responded to human presence by flying to distant marshes. Josselyn (1989), however, observed this behavior in only 50% of disturbance events, noting also that flushing distance ranged from 75 to 175 feet. Instead of leaving the site, some shorebirds respond to human disturbance by altering their foraging behavior, including abandoning preferred foraging locations (Pfister, 1992), increasing dependence on tactile-dependent nighttime foraging (Burger, 1993), and altering foraging intensity during feeding bouts (Burger, 1993; Kaiser, 1984). In response to the presence of joggers, Burger (1993) observed that piping plovers increased time spent in vigilance and avoidance behavior by 100%, decreased time spent in foraging by as much as 43%, and decreased pecking rate by 67%. (Piping Plovers do not range in San Francisco Bay.)

Findings regarding the response of waterfowl, including dabbling ducks, diving ducks, geese and coots, also vary among studies. Josselyn (1989) found that waterfowl flushed at a distance of 15 to 105 feet, dependent upon the species. Dabbling ducks frequently left the study site. Burger (1981) found that, although waterfowl took flight in response to human presence, they usually landed nearby. Havera (1992) found that waterfowl flight in response to human presence on the shoreline ranged from 0.8 kilometers (68% of occurrences) to out of site (2% of occurrences).

In summary, despite differences in findings regarding the relative sensitivity of these groups to human presence at foraging and roosting areas, each study concludes that human presence results in decreased frequency of occurrence and decreased number of individuals present at the disturbed sites. The individuals which continue to use the sites may abandon preferred habitat and spend more energy on vigilance and avoidance behaviors at the expense of foraging activity. This decrease in the duration and intensity of foraging may result in decreased accumulation of energy reserves necessary to complete the migration cycle and successfully breed. Human disturbance at wintering and staging sites, therefore, may adversely impact individual survivorship and fecundity, thereby affecting the species at the population level (Burger, 1981; Burger, 1993; Pfister, 1992). Currently, the viability of avian species is becoming increasingly vulnerable as staging and wintering habitats are eliminated or degraded by development, human disturbance, and sediment and water pollution (Pfister, 1992).

This review of the literature explores only the impacts of human disturbance at non-breeding sites with unmitigated public use of pathways and beaches. I was unable to locate references which systematically assessed the effectiveness of buffers or barriers in mitigating human recreational impacts on wildlife. Some regulatory agencies such as the US Fish and Wildlife Service and the California Coastal Commission have formulated buffer width policies which are based on field experience, but lack a scientific foundation based on field observed effectiveness. In the San Francisco Bay, the San Francisco Bay Conservation and Development Commission (BCDC), the agency responsible for improving public access to the Bay and its shoreline has no formal buffer standards for trails adjacent to sensitive wildlife areas.

BCDC is a small regional planning and regulatory agency which controls the filling of San Francisco Bay and facilitates the development of public access along the Bay shoreline through its permitting program. The Bay Commission's process at developing a consensus decision on controversial public access projects where wildlife and access advocates have very different positions relative to the merits or detriments of a public access trail. Projects are modified during the preparation of environmental documents, interagency review, public hearings and the guidance of hired consultant experts to develop proposals that a majority of stakeholders can support.

Strategies which may reduce or eliminate the negative impacts of public access on wildlife include creating vegetated buffers, installing visual buffers such as opaque fences, and regulating trail use at particularly sensitive times of year. Education and site interpretation can also provide trail users the information needed to modify their behavior in sensitive areas to reduce impacts and provide a volunteer enforcement mechanism to ensure that others do not disturb sensitive species on the winter migration route. Trail design in the Bay Area has evolved in response to both an increase in recreational trails use over time and to the awareness that increased public access can have negative impacts on sensitive wildlife and their habitat.

These three project case studies demonstrate a limited palette of strategies for mitigating the effects of trail development and use on sensitive wildlife species. The assessment of impacts and design responses focus primarily on avian species and do not address the broad range of impacts and species of concern present in the San Francisco Bay. The three projects include (1) a one-mile-long recreational trail wedged between a freeway and a marsh and mudflat area, which is an important staging area for migratory waterfowl and shorebirds, (2) a recreational trail built atop an abandoned railroad levee cutting across a large marsh with nearby mudflats, and (3) a trail atop a levee separating a tidal mudflat from a muted-tidal wetland, adjacent to a residential development. All of these case studies are on narrow sites with the trail immediately adjacent to sensitive habitat areas.

The Albany Mudflat provides some of the most important shorebird habitat in the Central Bay. The importance of this site is reflected by the high number of individual birds and high species diversity using the site, especially during the winter season when migratory species are present. The construction of a pedestrian and bicycle path adjacent to the Albany

Mudflat would increase human intrusion at the site. Unmitigated use of this proposed trail could result in decreased use of the mudflat and marsh by waterfowl, shorebirds, and wading birds. At high tides, when foraging is restricted to the narrow band adjacent to the proposed path, the magnitude of the impact would be highest. Dabbling ducks which forage in the marsh fringe during high tides, would be particularly affected due to the lack of alternative foraging habitat. Shorebirds appear to roost off-site at very high tides and, thus, are less affected during very high tides when the mudflats are covered.

With the assistance of the Commission's Consultant, Dr. Michael Josselyn of Wetlands Research Associates, the BCDC staff identified five sections of the Albany shoreline with unique characteristics. The Commission's Design Review Board, BCDC staff, Dr. Josselyn, California Department of Transportation (Caltrans) staff, and East Bay Regional Park District staff conducted a one-day design charette, and, using the shoreline descriptions, developed design principles for each section of the shoreline trail. The design principles called for: a concrete curb with a 4.5-foot fence atop it, a 10-foot wide asphalt path with 1-foot chokers, removal of existing shoreline riprap, aggressive planting of screening plants on the Bay side of the fence, depressing the path where drainage would allow below existing grade to decrease visual impacts to wildlife, extending a freeway retaining wall to allow the pathway to be depressed below existing grade, building up soil on the Bay side of the path to elevate screen planting to improve its effectiveness, using opaque fencing where the screen plantings would be unlikely to provide the needed screening, relocating the trail beneath the freeway in the south to decrease visual impacts, placing several signs along the path to explain the sensitivity of the habitat area and the need to prevent human intrusion (including visual intrusion), and implementing an aggressive management program to ensure trail users and their pets stay on the trail. This reach analysis and design charette provided a foundation on which Caltrans developed the detailed pathway design. The design includes opaque fencing along the entire trail which was not envisioned during the charette.

The Commission staff consulted with Dr. Josselyn regarding the impacts of the Albany trail, asking whether these impacts would be excessive, and whether there are additional design measures which could further reduce these impacts. Dr. Josselyn believes that there would be little impact from the trail for shorebirds and that there would be localized significant impacts to dabbling ducks, because the dabbling ducks would feed nearer to the proposed pathway at high tides. He reported that the highest tides occur in December and January and that during approximately 30% of the day light hours of the period from November to January the site would experience high tides. Thus, he believes the opportunity for the intersection of humans and wildlife was high and could lead to significant impacts. He concluded that, although the local effects may be significant, they would not be excessive in terms of Bay-wide populations. Dr. Josselyn determined that the design strategies developed by the Commission's Design Review Board and staff, in conjunction with the other agencies, would successfully limit the likely impacts on wildlife from the path. He said the design strategies would not lower the impacts to a level of insignificance, but would reduce any excessive losses. He added that the five-year monitoring requirement with the potential to modify the trail design or its management if monitoring indicates such measures would be prudent further ensures that any unanticipated impacts will be addressed.

The Corps of Engineers staff maintains that developing the Albany trail would incrementally "increase the level of disturbance and would change the nature of the disturbance at the proposed trail site which would adversely impact the wildlife functions." The Corps staff also said that:

> [A] solid barrier which fully shields joggers and cyclists from view and which effectively prevents humans and pets from entering the mudflat and marsh may mitigate the predicted disturbance related impacts of the pedestrian and bicycle path. Any reduction in the degree of visual screening would likely increase the magnitude of the adverse impacts to the wildlife habitat value of the project area. In addition to screening, seasonal closure of the pathway during the winter migratory season may be an appropriate means of avoiding adverse impacts.

The Fish and Wildlife Service opposed the construction of a shoreline pathway adjacent to the Albany mudflat. The Service recommended that the area proposed for pathway construction should instead be revegetated with native plant species to provide enhanced refugial habitat and buffer from the adjacent freeway use. The Service also stated that if the combined solid fence and barrier and the access path were retained as revised project features, that the barrier should be a minimum of 6 feet high.

The Albany mudflat trail is approximately 4,900-feet long with a 10-foot-wide, asphalt path with 2-foot gravel chokers on each side, between Central Avenue in Richmond and Buchanan Street in Albany. A 4.5 foot to 5.0 foot-tall fence, consisting of a 0.5-1.0-foot tall concrete curb with a 4.0-foot-tall opaque fence atop it, (vinyl-clad with PVC slats), will be constructed along the bayward side of the existing and proposed multi-use pathways. The fence will be designed to minimize human and pet disturbance to the wildlife habitat within the Albany Mudflats. The fence between the path and the Bay will limit visual access from the multi-use path to the Albany Mudflats, the central Bay, Mount Tamalpais, and the Golden Gate Bridge. This fence will also partially obscure views for motorists on Route 580 for a distance of approximately 1,300 feet along the existing path and approximately 1,700 feet along the path required herein. This approximately 3,000-foot-long impact (0.57 miles) will occur where the top of the bayward fence is higher than the concrete barrier separating the freeway from the path. However, it will incorporate up to four small windows to allow pedestrians and cyclists limited view opportunities.

The Spinnaker Lagoon Levee Trail traverses an L-shaped, approximately 1-mile-long levee on the Bayside perimeter of a muted tidal salt marsh which is used by the City of San Rafael for flood control purposes. The trail is a public access amenity provided as part of a residential development project adjacent to the San Francisco Bay and is a segment of an approximately 3 mile, continuous shoreline trail in the City of San Rafael's Shoreline Park. On the Bayside of the levee, a wide, mud-sand flat extends into the Bay characterized by sandy muds and scattered riprap rock and rubble displaced from the levee face by tidal action. This flat provides limited shorebird feeding habitat and brown pelican habitat. The lagoon landward of the levee is characterized by approximately 70% coverage of pickleweed growth, an indicator plant for the endangered salt marsh harvest mouse, brackish marsh plants and exposed Bay muds. The inboard levee face was planted with a mixture of native shrubs and a native hydroseed mix to enhance its limited refuge habitat values.

The trail atop the levee is paved 8 feet wide with asphalt with narrow gravel shoulders. Since the habitat values on the Bayside or outboard face of the levee were not deemed to be extremely sensitive, no barrier or buffer was proposed on this side of the trail. However, the lagoon or inboard side of the levee was deemed a sensitive habitat area due to its potential for supporting the endangered salt marsh harvest mouse, and due to its use by feeding shorebirds and dabbling waterfowl. Therefore, the City of San Rafael, in consultation with BCDC staff required that the developer install a 3-foot-tall, post and cable barrier fence at the levee top on the inboard side and a 3.5-foot tall, vinyl-clad, chain link fence at the 3-foot contour line NGVD (National Geodetic Vertical Datum, which is just above mean high water in this case) to further discourage encroachment into the lagoon by humans, their pet and feral cats.

A significant concern faced in all three examples is the intrusion of pets and feral cats into these sensitive wildlife areas. Impenetrable barriers which function with low maintenance regimes are the typical design response in this situation. Although well intentioned, the fence at the base of the levee also serves as barrier to wildlife migration. Salt marsh harvest mice have been observed scurrying across levee tops from the Bay side to the inland side of other seasonal wetland areas adjacent to the Bay. This fence could impede this species normal migration patterns. Moreover, shorebirds sometimes roost on barren slopes of levees and a vegetated barrier fence could eliminate this type of important refugia habitat. Finally, the fence prevents downslope migration for certain species into the lagoon from the Bay to the inner lagoon.

The Point Isabel Shoreline Trail is an approximately 1.0-mile-long trail atop an historic railroad levee which traverses a tidal salt marsh and mudflat for approximately half its trajectory, and is adjacent to light industry and mudflat on the other half. The trail was developed by the East Bay Regional Park District on land it purchased from the railroad. The trail serves as a vital link in a developing continuous shoreline trail system which will soon link five East Bay cities along about 7 miles of shoreline. This trail project would connect via an intermediate trail segment to the Albany trail. The trail was developed as a 10-foot-wide asphalt trail with gravel shoulders centered atop the levee. The trail crosses three historic timber railroad bridges which were strengthened to avoid replacing them. At its southern terminus, the trail connects to the Point Isabel Regional Shoreline which is a heavily used, off-leash dog park. There are few sites in the East Bay where pet owners can exercise their dogs off leash which contributes to the popularity of this facility.

Environmentalists expressed grave concerns about any shoreline trails connecting to this park fearing the extension of the off-leash activity to other sensitive habitat areas.

The Bay side face of the levee on the Pt. Isabel trail is characterized by a 2:1 slope protected with riprap sloping down to a mudflat and emergent salt marsh. As sedimentation slowly increases the elevations Bayward of the levee face, cordgrass (*Spartina* sp.) and pickleweed (*Salicornia* sp.) have colonized the margin of the levee toe and other Bayward mounds. The mudflat provides excellent feeding habitat for resident and migrating shorebirds and waterfowl. Although the shorebirds and waterfowl concentrations are much lower than the nearby Albany Mudflats, the diversity of shorebird and waterfowl species observed here is equally rich. On the inboard side of the levee along the southern half of its trajectory, the trail abuts the vibrant Hoffman marsh which is bordered on its east by the I-580 freeway and on the west by this levee. This marsh is fed by Bay tidal flows passing through a channel traversed by the southernmost of the three rail bridges. The northern half of the inboard side of the trail abuts light industrial development and pocket marshlands and connects to a 1.0-mile-long trail developed in conjunction with a large adjacent multi- and single-family residential development.

To address the concerns about trail users disturbing waterfowl and shorebird use of the wetlands surrounding the levee-top trail, the Park District agreed to install screening plants and fencing along the middle one third of the trail to address the sites where the intersection trail users and wildlife was determined to be most likely. The sensitive areas were identified by several site visits by agency staffers and interested local professional ornithologists who consensually developed the screening design.

The screening plants installed included various California native shrubs to create a continuous vegetative screen between those habitat areas particularly close to the levee. In addition to the vegetative screen, a 4.0-foot-tall, wood and hog-wire fence was installed along approximately 2,200 feet of the Bayside shoreline and along approximately 1,000 feet of the levee where it enclosed tidal marshes separated from the open Bay. The fences were then screened with the above mentioned plant materials. Finally, in addition to the planting and fencing, the District agreed to install three interpretive signs at each of three trail entry points notifying trail users of the sensitive nature of the adjacent wetland areas and educating the public on how the path can be used while minimizing the affects on nearby wildlife.

The Spinnaker Lagoon Trail and the Point Isabel Shoreline Trail designs were developed through the BCDC permit process. In the Spinnaker Lagoon example, the City of San Rafael had developed the San Rafael Shoreline Park Master Plan with its consultants MPA Design which described in great detail the design of the path and its fencing and screening components. In the Point Isabel Shoreline Trail example, the BCDC staff relied heavily on the trail development and design experience of the East Bay Regional Park District staff and the volunteer assistance of members of the Golden Gate Audubon Society who participated in field visits which identified sensitive habitat areas and devised the necessary screening parameters to limit impacts.

In each case, the cooperation, compromise, and communication were essential in devising solutions which maximized each stakeholders agenda. An important component of the Albany project which distinguishes it from the other examples is the on-going monitoring program required in the BCDC and Army Corps permits. This five-year monitoring program will provide the data which the Bay Commission will use to determine whether the design or management of the trail should be modified to address any unanticipated impacts. This study will also contribute to the limited body of scientific literature which policy makers rely on to make decisions on these complex questions. Recreational activities are widespread, yet our understanding of their effects on wildlife are rudimentary (Knight and Cole, 1995). Many questions related to the conflict between human recreational activity and the goal of preserving wildlife need to be answered. The designs presented here represent a first step towards achieving sustainable coexistence.

Joseph LaClair
San Francisco Bay Conservation and Development Commission
30 Van Ness Avenue, Suite 2011
San Francisco, CA, USA 94102
Ph (415) 557-3309
Fax (415) 557-3767

RESOLVING A PUBLIC BOATING ACCESS ISSUE IN MINNESOTA

Glenn Kreag, Minnesota Sea Grant Program and
Dale Baker, New York Sea Grant Institute

The Public Access Issue

Minnesota's Lake Superior coast, known as the North Shore, stretches 155 miles from Duluth to the Canadian border. Boaters regard the North Shore as "hostile" due to the steep adjacent coastal land, rapid drop-offs, and abundance of rocky areas that deny boating access and shelter. These characteristics and the high cost for constructing protected harbors have virtually shut boaters out. There are few sheltered accesses where boaters may launch or retreat to in bad weather. On the North Shore, there are only four locations with marina services for pleasure boaters (Duluth, Knife River, Grand Marais, and Grand Portage), and only two other protected locations (Two Harbors and Silver Bay) are available for launching and retrieving small craft. The access to shelter in Duluth is through a shipping canal. During bad weather, the canal becomes extremely turbulent and dangerous, blocking small craft from safe access to the boating facilities in Duluth.

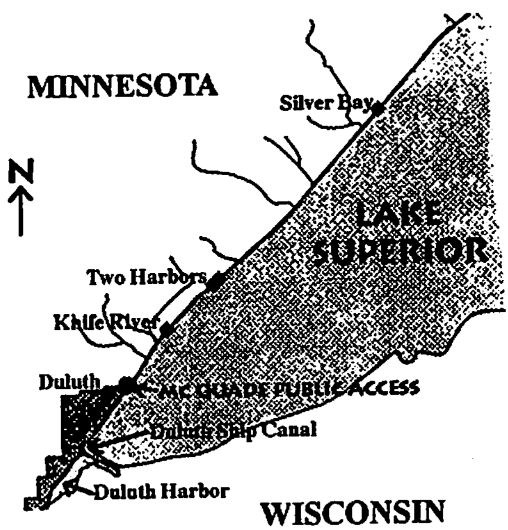
Boating activity near Duluth is significant. Users include sailors, cruisers, pleasure boaters, and especially anglers, anxious to take advantage of good fishing. The salmon and trout fishery attract local anglers, and those from throughout Minnesota and nearby states. Boats range from 16-25 ft, but smaller and larger craft are also present. During the prime fishing times in spring and early summer, hundreds of boats use the lake on a good weekend day. The potential for disaster is great if a sudden storm catches people before they can reach shelter. In the immediate Duluth area, boaters must travel 8-10 miles from the Duluth or Knife River boat launches. New boat launching locations are desirable to allow fishermen closer access to an area of the lake where much fishing occurs and to provide a closer safe place if bad weather strikes.

Options for boating access sites are extremely limited. With the large amount of unsuitable shoreline topography and a considerable amount of protected land, finding sites is difficult. Many locations have rapid drop-offs that make breakwater construction too expensive or technically impractical. Current costs for the most basic protected harbor on a site with suitable characteristics range from $3.5 - 4.5 million. Most of the cost is for design and construction of the breakwater. Topography and solid rock eliminate the option of excavating an inland basin.

Many individuals oppose development of the North Shore or prefer only low impact development, such as second home and residential housing. Local control of land use is a major issue. With so much attention paid to the North Shore by developers, environmental groups, state government and proposed federal programs such as Coastal Zone Management, there is concern that local residents as well as city, township, and county government will not be able to exert influence on what or how development occurs. These concerns had a major influence in the process used to identify an acceptable boating access site between Duluth and Knife River. But before this process was used, a major failure occurred.

Background: A Public Access Failure

In the early 1980's, recreational boating groups sought to develop a boat launch facility between Duluth and Knife River. At that time, Brighton Beach, a neglected park adjacent to the Lester River, was being studied by the City of Duluth for renovation. As planning progressed, a boat launch facility was included in the design. Park renovations were completed in the mid-1980's and the park, which contains over a mile of shoreline, was an instant hit with both local residents and visitors. The boat launch was not part of the renovation. Requests to the city and to the Minnesota Department of Natural Resources (DNR) by boating and fishing groups initiated action to proceed in finalizing an appropriate site within the park for the launch facility. The site selected was at the far east end of the park beyond picnic and beach locations. Funding was requested from the state legislature's Legislative Commission on Minnesota Resources and funds were appropriated for preliminary engineering and design. A committee of representatives from boating and fishing groups and federal, state and local government agencies worked cooperatively on the project. The DNR funded contracts for extensive preliminary designs that were completed.



Public hearings were held early in 1989. The hearings produced an unanticipated uproar. Opponents surfaced and later hearings had hundreds attending. Polarized viewpoints were voiced both for and against the project. A strong and well-financed group, Save Brighton Beach, was formed in response to the proposed boat launch facility. Opponents charged that the project was a marina and that it would spoil the character of Brighton Beach and introduce commercial activity to an area designated as park and natural open space. They also charged that there was no justification for a boating facility when other facilities existed in Duluth and Knife River. Proponents felt that opponents were misrepresenting the project to the public and that they were being unfairly attacked for wanting a boating access site. Emotional battles raged between the groups for many months until the Duluth City Council finally withdrew support for the project. In addition to the city council, DNR and legislators felt that they had been tarnished by the effort. After the city council vote, the matter was considered a politically dangerous issue. Debate continued as alternate sites were proposed by both proponents and opponents. TV and radio stories were frequent and the Duluth newspaper many carried stories, letters to the editor, and editorials about the issue and various possible sites.

Trying Another Approach

Fishing interests remained unsatisfied with the outcome and continued to press the city for a solution. Privately they continued to present their case for a boat access, lobbying hard with Duluth's mayor. As time passed and emotions settled, the mayor decided on another approach. His solution was to appoint a "Duluth Safe Harbor Committee" made up of people representing all sides of the issue. Members include representatives from two townships, the county government, fishing and boating groups, North Shore protection interests, local shoreline residents, and "advisory" representatives from the Regional Development Commission, MN Department of Natural Resources, Minnesota Sea Grant Program, US Army Corps of Engineers, the St. Louis County Public Works Department, and the Duluth City Planning Department. Appointed in September 1992, the committee met regularly between March 1993 and February 1994, including four public input sessions. Their charge was to find a suitable location for a boat launch facility.

The meetings were open to all. During the formal agenda proceedings, discussions were limited to committee members only. The chair determined the order in which committee members could speak. Observers could watch but not provide ideas unless invited to speak. This minimized any outside disruptions and let the committee go on in an orderly manner. With this style of close management by the chair, the perspectives of all factions were heard.

One feature of the committee's operating style was critical. Rather than vote on issues, the committee agreed to operate under a consensus format. This meant that all committee members would have to find an issue acceptable to go on. Whenever there were objections, the committee would have to continue to debate and search for an alternative acceptable to all. This operating style required skilled facilitation and fortunately, one committee member became the "neutral" member to help all members consider each others' points of view. The consensus process required that members get to know each other and develop a level of trust. This proved to be a lengthy process, given the wide gap in positions.

The result was the eventual agreement among all groups about the harbor location and key criteria under which a public access will eventually be developed. Choosing a facility size acceptable for all parties provides an example of how the consensus process worked. Boating and fishing interests wanted a facility that would be sized to accommodate boater needs both now and in the future. This meant an adequate-sized breakwater with interior basin to accommodate increases in activity, and land space for additional boat launch lanes and car/trailer parking. Shore protection groups wanted no facility but were willing to search for a location that was already "spoiled," primarily locations closer to downtown Duluth where the land has already been developed. Early meetings were filled with posturing and positioning, accusations and challenges.

Participants continued to debate a range of issues. Finally, to achieve consensus, the group decided to create a document called, "Assurance Statement for Development of Safe Harbor Boat Access Facility," which contained the agreed-to goals for the project. The groups on both sides of the issue were jittery and the document seemed to satisfy the need to publicly identify the specific scope of the project. Just as important as what elements were part of the project was what was specifically not in the project. Once agreed to, it was possible to come to consensus on a site. The document states:

The following list is an attempt to state what features of elements of a safe harbor boat access facility are under consideration by the committee at this time:

1. There is no intent for commercial use of the water area (NO marina).
2. The facility must have a multi-use focus which incorporates nonboating activities incidental to the boating function, *i.e.*, visitor parking and viewing, picnicking, shore casting, etc.
3. The entire facility must be publicly owned to assure controlled land/water use.
4. The facility should preserve or enhance aesthetic qualities of the specific site and North Shore.
5. The facility must be environmentally sensitive.
6. The facility should be planned to accommodate a variety of boating use including sailboats, fishing and cruising vessels.
7. The facility must be nonintrusive. It should have a park-like quality including items such as buffer areas between the facility and adjacent

residential and commercial uses, and perhaps a wide nonconventional breakwater to create a more natural appearing structure.
8. The location and operation of the facility should have a positive relationship with adjacent privately owned properties and land uses.
9. The committee will focus on the public portion of the facility and not become involved or make recommendations about adjacent land use.
10. Amenities under consideration for the facility include:

A. A protected boat basin, harbor/access
B. Access ramps
C. Vehicle/trailer parking area(s)
D. Launching docks
E. Transient tie-up docks/facilities
F. Rest rooms (holding tank)
G. Handicap accessibility
H. Public Information
I. Telephone
J. Accommodations for visitors (parking, viewing, picnicking)
K. Necessary security safety and navigational lighting
L. Possible storm-warning devices
M. Fish cleaning station
N. Solid waste disposal

11. Amenities not under consideration as a part of this project include:

A. Long-term dockage facilities
B. Electrical hookups
C. Sanitary pump-out facilities
D. Water hookups
E. Land side camping accommodations
F. Fueling facilities
G. Commercial sales of bait, tackle, equipment, food clothing, etc.
H. Repair of motors and/or boats
I. Seasonal storage

None of the basic issues were easy to solve, and finding common ground took extensive debate. This even extended to the name of the project. Originally called the Safe Harbor Boat Access Committee, protection interests took issue with the words "Safe Harbor," saying that they were seen by many of their supporters as code words for "Marina." The issue was debated long and hard before a proposal to label the project a "Public Access" was put forth. Positioning the project as something that benefits everyone diffused the argument that it was a special interest effort. Eventually, consensus was reached on a site at McQuade Road, about 5 mi northeast of the Lester River. It had taken 31 meetings along with much staff support to reach this point. This demonstrates the tenacity displayed by groups on both sides of the issue but also shows their willingness to continue to search for mutually acceptable solutions.

Project Description

The boating access calls for a protected boat launch with adequate parking, rest rooms, and other basic features to allow for safe launching and retrieval of boats. In case of storms, the site should be designed as a safe harbor allowing boaters safe return and shelter from high waves and foul weather. As an access-only site, there are no commercial marina services such as fuel, boat moorage, retail sales or repair facilities included as part of the project. The project proponents requested the site to be close to the Lester River mouth, known for its excellent salmon and trout fishing.

A Continuing Process with a New Committee

With the selection of the site at McQuade Road, a new committee was formed (retaining many original committee members) and began meeting in April 1994 to help in the design and funding phase. The committee renamed itself the McQuade Public Access Committee (MPAC). Its job is to provide the public opinion needed to create the facility, help find designs acceptable to all groups, assist the government in finding money for construction, and work out agreements on the operation and maintenance of the facility. As of February 1996, it is still meeting (at least 36 additional meetings held to date) and progress is steady. The group is currently working to obtain funding from state appropriations and a regional development board.

The McQuade Road site has the unusual (perhaps daunting) characteristic that portions of it are located in the City of Duluth, and the townships of Lakewood and Duluth. As such, all three local governments, as well as the St. Louis County government, are represented.

MPAC employs two part-time staff, one of whom represents protection and "no development" interests. This is an important link designed to prevent the project from being "ambushed" as planning and implementation proceed. At the same time, protection interests feel more assured that the project will continue to be acceptable and that they will be kept informed. The DNR provides funding through the City of Duluth to support the staff. Leadership of MPAC was assumed by the Township of Duluth. A volunteer subcommittee, the "Design Advisory Committee" (DAC) was established, consisting of local residents who are near the proposed public access. As a third major interest group, the DAC keeps project neighbors informed and provides ideas on site and design considerations and encourages a spirit of cooperation among local residents and MPAC.

Both MPAC and DAC take an active approach to their tasks. While not being professional engineers or architects, MPAC and DAC members actively contribute design ideas in an attempt to get the overall design concept to a satisfactory stage. A key strategy has been to divide the project into specific components (harbor basin, breakwater, land requirements, launch ramp system, parking, road design, amenities, landscaping) and work on them individually. When one component design reaches consensus, work begins on another.

Perhaps the greatest hurdle was reaching consensus on the size of the project. Until this was settled, no components could be planned. The size of the basin and the number of launch ramps was determined by how many boats would use the facility on a given day. However, estimating demand was not an acceptable strategy to some committee members who argued that the project be modest. Lengthy debate ensued. Finally, the issue came down to sizing the parking lot for a set number of car-trailer combination spaces and then sizing the harbor and launch facilities to meet the needs of the parking lot. The final consensus, reached in August 1994, was for 95 parking car-trailer spaces and ten additional car-only and handicapped spaces. Since then, there has been agreement to some modifications. Currently, the agreement is for 93 car-trailer spaces and 37 car-only spaces.

MPAC has endeavored to keep the public informed about the project, with public meetings, opinion surveys, newspaper articles, and even its own newsletter. These have helped surface how well the project is being accepted and has often helped identify project opponents. This has allowed the committee and staff to provide additional information to groups or individuals who may oppose the project based on misconceptions about what it entails. Local government councils have been kept informed on the project status. State legislators and the area's Member of Congress has been regularly provided information. Elected officials have been helpful in suggesting additional work and supportive regarding the process being used and the pace of activity.

The project is now gathering momentum. Consensus has been reached on many difficult issues. While project completion is still in the future, it now seems to be an acceptable political risk -- a sure sign that the controversy and emotion that once blanketed it have been diffused and replaced with an acceptable solution for all.

Funding approval is expected and project activities should soon begin in earnest. The current timeline calls for purchase of land and final design to be completed in 1996. Construction is to begin in 1997, with completion in 1998. No ending date has been set for MPAC. It is anticipated that MPAC will continue to meet for the duration of the project.

Conclusions

When there is widely divided public opinion about development proposals, the creation of a committee made up of people representing all points of view on an issue can be a useful tool. The manner in which the committee chooses to operate (decisions by consensus) appears to be just as important to the outcome. Paying particular attention to the interests opposing the project and having them be part of the decision process meant that much more time was needed to reach consensus, but this all but eliminated the confrontational setting of the previous attempt. When the public access boating facility is completed, all factions can take credit and have pride in the way it turned out.

Glenn Kreag
Minnesota Sea Grant Program
Minnesota Extension Service, University of Minnesota
2305 E. 5th St.
Duluth, MN, USA 55812

Ph (218) 726-8714
Fax (218) 726-6556
Email gkreag@mes.umn.edu

THE MARY E. THELER WETLANDS: A PARTNERSHIP FOR PUBLIC ACCESS AND ENVIRONMENTAL EDUCATION

Peter Hummel, Bruce Dees & Associates

Every school day, children from the North Mason School District are taking part in hands-on environmental education at the newly completed Mary E. Theler Wetlands project. The 135-acre site has an exceptionally diverse array of wetlands ranging from the open salt marsh estuary of the Union River, to dense freshwater forested swamps.

The project is located 25 miles west of Seattle, Washington. The wetlands border the head of Hood Canal, a narrow 65-mile-long fjord that connects to Puget Sound. The trail system was completed in 1993, and an Environmental Education Center was completed in 1995. The project represents a unique vision and partnership between three property owners -- the North Mason School District, Washington Department of Fish & Wildlife, and a private landowner -- to provide public coastal wetland access and educational opportunities. The project was made possible by the cooperation of these groups as well as the talents and efforts of community volunteers, design consultants, an earlier donation of 75 a to the school district, and state and federal grant funding. Kindergarten through 12th grade students of the North Mason School District now use the project every day as part of their science curriculum. The 2.0 mi disabled accessible trail system is open to the public seven days a week.

Partnerships

The dream of developing a wetlands education center at the Mary E. Theler Wetlands became a reality in large part because of the strong partnerships that developed. These partnerships included adjacent landowners, educational institutions, grant funding agencies, and community volunteers. Each group made its own special contribution to the project. The key ingredients to making these partnerships happen were:

- A common vision
- Master planning
- Extensive outreach

A Common Vision

The project was blessed with excellent timing and inspired leadership. These two factors enabled a vision of wetlands protection, combined with environmental education, to emerge. The site, with its exceptional collection of saltwater, freshwater, brackish, and wetland types, is ideally suited to this concept. As a result, consideropriate funding sources to implement the plan.

Master Planning: The project's sponsors (North Mason School District through the Mary E. Theler Community Center Board of Directors) realized that having an exciting vision was not enough. The vision needed to be carefully articulated into a master plan by qualified professionals. The landscape architecture firm of Bruce Dees & Associates was selected to execute the master plan. Through this planning process, critical new partnerships emerged. These included the addition of the adjacent Washington State Department of Wildlife lands and the need for linkage to them utilizing an existing dike on the edge of a privately-owned farm. Completion of this plan further accelerated the project's momentum and broadened the sphere of interest and support for it. This plan became a primary vehicle for obtaining grant funding.

Extensive Outreach: Considerable momentum followed the master planning phase. What was then needed was skillful outreach to the appourses and are now used by the North Mason School District's teachers, among others. The site and facilities continue to be available for use by colleges and universities.

The outreach effort was led by a supportive North Mason School Superintendent and a volunteer wetland committee chairman who is a retired television executive and former minister. Their highly effective outreach efforts to state and private grant funding sources and state and federal political leaders resulted in more than $1.5 million in project funding. Outreach techniques included writing letters, giving site tours, meeting with key individuals, and excellent grant writing skills.

The project's success is attributed to all of the ingredients mentioned above that led to an ever-expanding web of mutual interests and public benefits. This is the essence of forming partnerships.

Design and Construction

While the articulation of the project's visionary concepts at an early stage was a key to building project momentum and obtaining funding, designing, and constructing an extensive disabled accessible trail system through a sensitive wetland environment involved extensive research and innovative trail design and construction techniques. Sensitivity to this fragile ecosystem was also required to obtain local, state, and federal permits. Articles about the new wetland trail construction techniques used on the project have sparked inquiries from across the United States.

The project had three distinct development phases: master planning, detailed design, and construction. Each step was built on the information and conclusions of the previous stage. Once completed, the Mary E. Theler Wetlands project became very popular with the community, and has been recognized regionally and nationally for its significance, as evidenced by its "Sunset Magazine" and "Landscape Architecture" magazine articles, and awards from "Pacific Northwest Magazine" and The American Society of Landscape Architects. Here's a look at each stage of design and construction:

The Master Plan

As stated previously, this stage began with an inspired vision. This vision was given form by Bruce Dees & Associates, the project's landscape architects. What developed was a general plan for development that acknowledged the environmental sensitivity of the site and provided enough glimpses of its diversity to foster appreciation and public education. The first step was to gather all relevant background information. This information gathering included finding existing environmental documents, plus direct dialogue with field ecologists studying the site (from Evergreen State College) as well as school district staff, community volunteers and landowners (such as the Department of Wildlife) interested in its development. These groups then reviewed a series of alternative design plans that the landscape architects presented to show varying degrees of trail and education center access and impacts. With feedback from these groups, the options were narrowed down to one Master Plan with two alternative methods of linking the two-piece site across the private farm that separated them. The plan emphasized wetland habitat protection while showcasing the extremely diverse array of plant and animal communities for educational purposes. These two seemingly opposing goals were accomplished by avoiding habitat fragmentation with new trails, utilizing existing dikes where possible and designing the trails themselves appropriately. Several types of trails were proposed to handle the variety of site conditions and to eliminate the need for any wetland fill. The wetland education center was centrally located on an existing fill area with parking and automobile access limited to service vehicles. Walk-in access from an existing parking area in the uplands and disabled trail access were key components of the plan.

Detailed Trail Design

Extensive research and innovative, minimal impact trail construction techniques resulted from this stage of the design. Acquisition of local, state, and federal permits occurred concurrently with detailed design. In addition, educational signage, under a separate contract, was developed while trail design took place.

The innovations in wetland trail design included a recently-developed "pinned" foundation for trail bridge posts and a pre-fabricated floating boardwalk utilizing marina dock technology and recycled materials. These features were uncovered by researching and applying existing available technology to wetland conditions. Other more conventional trail design techniques that were applied included: timber pile installation for elevated trails in exposed salt marsh locations; and disabled accessible crushed rock trails on existing earthen dikes and other upland areas.

Due to the landscape architect's thoughtful design of the trails (and preceding Master Planning), obtaining local, state, and federal permits proceeded smoothly and steadily. One key reason was that wetland fill was avoided by using the trail techniques described above.

Trail Construction

The project was constructed by a professional contractor selected through the public bidding process. Complete and accurate construction documents prepared by the landscape architect in collaboration with structural and geotechnical engineering consultants, were essential in keeping bids and subsequent field changes well within the limited budget.

Construction of the trail system began in the late summer and was completed the following spring. Construction was complicated by seasonally high, winter ground and surface water levels, and high winter tides. Considerable thought, experience, research, and preparation were needed to complete the project without impacting the fragile site, delaying the schedule, or incurring additional costs. Some of the factors that made a difference include:

- Gathering accurate geotechnical information on site soils
- Accurate topographic survey of an extensive field located trail route
- Locating a local pile driver with specialized amphibious equipment
- Low impact pinned foundation and floating boardwalk installation techniques

The result of these efforts was complete natural regeneration of all areas temporarily impacted by construction in less than one year, plus the completion of the entire trail system within the available project budget.

Education

The completed project represents an exceptional commitment to environmental education by all of the participating partners. This site's microcosm of wetland habitats offers one of the state's best opportunities for such an educational effort on a relatively small, 135-acre site.

The educational effort involved as wide a range of audiences and participants as possible. These groups include:

- The North Mason School District's K-12 science classes
- Other neighboring school districts with a 40,000 student population
- College level education and research uses
- Education of the casual or recreational visitor through seven strategically placed and professionally designed interpretive signs.

North Mason School District: An innovative K-12 science curriculum was developed around the wetlands as an outdoor classroom. The school district received a state "Schools for the 21st Century" grant because of their creative approach to utilizing the wetlands site for this purpose. The trail system and newly completed education center building (with lab and other teaching facilities) is used on a daily basis by the students who are learning firsthand about the complex web of interactions that occur in wetlands.

Other Neighboring School Districts: Frequently, the site is a field trip destination for other nearby school district students. The large student population (40,000 within 45 minutes of the site) and the scarcity of other such high quality outdoor learning facilities has made the wetlands a truly regional educational opportunity.

College Level Education and Research: From the beginning of the project, college level education and research has taken place on the site. Evergreen State College students, under the direction of a faculty ecologist, conducted a complete inventory of the wetlands flora and fauna. The results were published as part of field ecology crable interest in the project was developed early-on.

Education of the Casual Visitor and Recreationist: General public visitation rates exceeding 100 per day are common at the wetlands. The volume of visitors offers an excellent opportunity to expand the public's understanding of the myriad of wetlands on this site, and to transfer that understanding and stewardship to wetlands in other locations. Seven interpretative signs were designed by a team of professional artists and naturalists working with local volunteers, school district staff, and landscape architects. The signs are located at the main entry and key points around the site to highlight its significance and diversity. The signs (like all site improvements) were designed to be durable and low maintenance -- and have proven to be so.

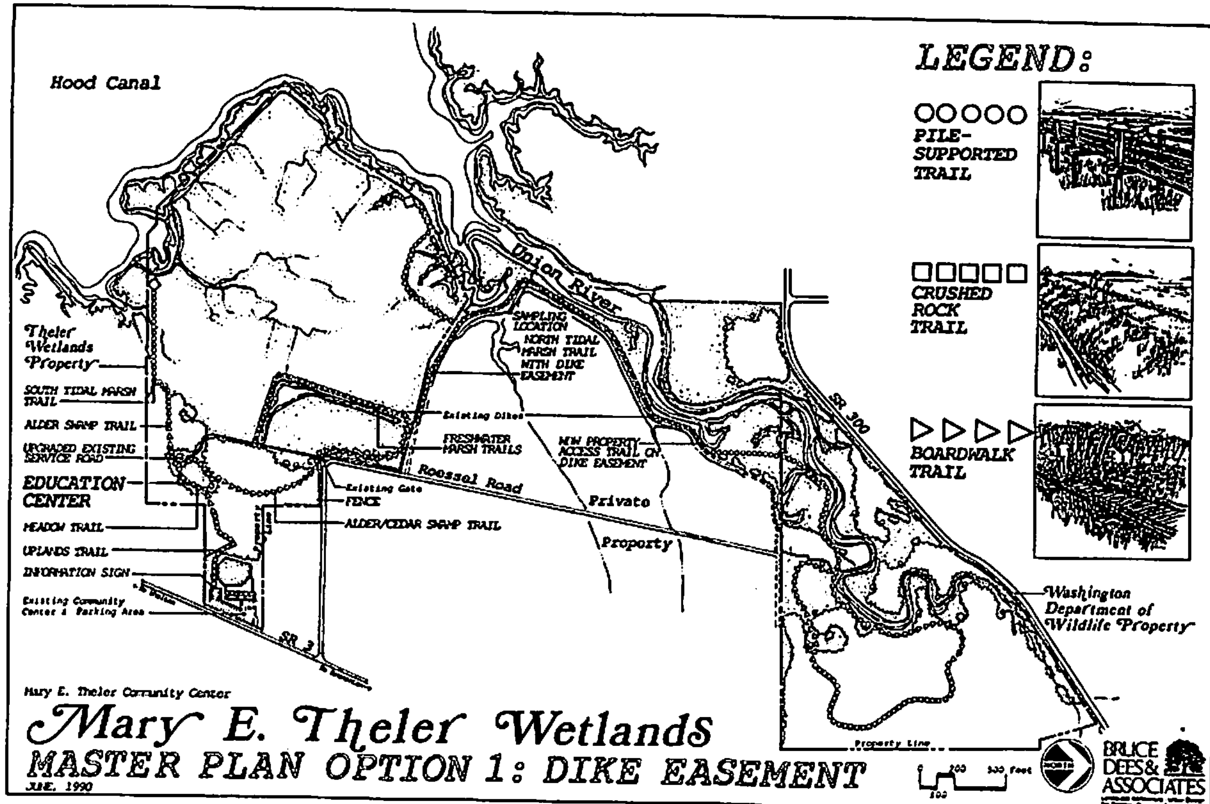
Conclusion

The Mary E. Theler Wetlands project is significant in terms of how the partnerships, planning, and design came together to deliver long-term educational and recreational assets to the community and region. The success of the project is evidenced not only by the regional and national recognition it has received (in the form of published articles and awards) but more importantly by the steady, day-to-day opportunities for learning it will continue to provide to future generations.

Peter Hummel
Bruce Dees & Associates
222 E. 26th Street, No. 202
Tacoma, WA, USA 98421

Ph (206) 627-7947
Fax (206) 627-6661

FIGURE 1


Hood Canal
LEGEND:
PILE-SUPPORTED TRAIL
CRUSHED ROCK TRAIL
BOARDWALK TRAIL
Union River
SAMPLING LOCATION
NORTH TIDAL MARSH TRAIL WITH DIKE EASEMENT
Existing Dikes
FRESHWATER MARSH TRAILS
NEW PROPERTY ACCESS TRAIL ON DIKE EASEMENT
Roessel Road
Private Property
SR 300
Theler Wetlands Property
SOUTH TIDAL MARSH TRAIL
ALDER SWAMP TRAIL
UPGRADED EXISTING SERVICE ROAD
EDUCATION CENTER
Existing Gate
FENCE
ALDER/CEDAR SWAMP TRAIL
MEADOW TRAIL
UPLANDS TRAIL
INFORMATION SIGN
Existing Community Center & Parking Area
SR 3
Washington Department of Wildlife Property
Property Line
Mary E. Theler Community Center
Mary E. Theler Wetlands
MASTER PLAN OPTION 1: DIKE EASEMENT
JUNE, 1990
NORTH
BRUCE DEES & ASSOCIATES

Session D2: Coastal America: A Partnership for Action
Session Chair: Gail Updegraff, Coastal America, U.S. Department of Agriculture

THE COASTAL AMERICA PARTNERSHIP: LESSONS LEARNED

William L. Klesch,
U.S. Army Corps of Engineers, and
Norman T. Edwards,
U.S. Army Corps of Engineers

The Process

Over the last four years, the Coastal America Partnership has developed a way of merging the missions of Federal agencies with multiple responsibilities in the coastal regions of the United States. Fundamentally, each agency maintains its individual program responsibility but seeks to find areas of mutual concern. This enables the Partnership to develop and implement multi-agency (federal and non-federal) local projects designed to achieve specific environmental protection and restoration goals. These efforts are facilitated through eight interagency Regional Implementation Teams (RITs). The process has served to promote innovative solutions to coastal ecosystem degradation.

In its first four years, Coastal America has initiated more than 150 projects in 26 states and territories in partnership with more than 300 non federal organizations. Upon their completion, these projects will have contributed to protecting the habitat of more than 20 endangered species, restored over 100,000 acres of wetlands, reestablished hundreds of miles of anadromous fish habitat, instituted Best Management Practices (BMP) on more than 50 farms and watersheds, and generated numerous public educational outreach products.

During 1995, Coastal America has both reviewed and evaluated its efforts and worked to improve its operational structure. Specifically, the partnership addressed education/outreach and technology transfer issues at the national level, developed a national strategic plan to guide future efforts, developed and refined action-oriented strategies at the regional level, and initiated 30 new projects and completed 20 ongoing projects at the local level.

Education/Outreach

To increase awareness of the Coastal America partnership and expand our network, we produced a descriptive video; developed national and regional exhibits, displays, and informational brochures; established a homepage on the world wide web; and initiated an effort to establish a network of regional coastal learning centers throughout the country.

Technology Transfer

To strengthen the partnership process and operational structure, we sponsored a National Technology Transfer Workshop for Project Managers during July in Tampa, Florida, held a planning conference of national and regional team representatives during November in Tiburon, California, and completed a technical report entitled "Coastal Restoration and Protection: Lessons Learned."

National Strategic Plan

During the year, a strategic plan was developed to guide future efforts. The Strategic Plan focuses on the partnership process, program initiatives, and policy issues. The plan recognizes that the partnership process can be strengthened by using the Coastal America process to implement the Administration's ecosystem management recommendations; increasing state, tribal, local, and nongovernmental (NGO) involvement in regional structure; strengthening links to federal agency sub-components; and increasing the ability of RIT's to function more efficiently. Program initiatives include increasing awareness of the Coastal America process; broadening education and outreach activities; developing a strategy to monitor, evaluate, and identify projects through advanced technologies; enhancing technology transfer mechanisms; and improving communication through the use of bulletin boards and the Internet Homepage. Policy issues include expanding funding sources and mechanisms, and strengthening ties to other multi agency initiatives.

Regional Strategic Plan

Coastal America's nine regional teams (RITs) are the implementing mechanism for the partnership, examining their agency's programs and authorities looking for areas of overlap and determining the potential for implementing joint projects to address coastal problems in a more efficient and effective manner. The RIT's develop regional action strategies designed to define major issues, special focus areas, goals and objectives within each region and to specify the processes whereby joint projects are identified and implemented. Within the framework of each regional strategy, site-specific coastal projects addressing such issues as habitat loss, nonpoint source pollution, and contaminated sediments are identified and planned. Each

RIT establishes priorities for project implementation from their suite of proposed collaborative projects.

Lessons Learned Report

On July 12, 1994 the Principals (an executive level assembly of the Assistant Secretaries of the Partnership agencies) directed Coastal America to ". . . develop a publication that outlines the ideas and concepts that are making the partnership and projects successful." In response, 50 projects were critically examined and the Lessons Learned Report prepared jointly by the Technology Transfer Working Group (TTWG), the respective Regional Implementation Teams (RITs) and individual project managers of Coastal America. The projects evaluated were organized into six categories, based upon the type of habitat restoration being conducted, whether the project focus was upon endangered or threatened species or whether the project was mitigating a source of pollution threatening a coastal resource. The lessons learned were divided into two broad categories, technical and procedural.

Procedural Lessons Learned

Five major procedural themes were identified as follows: The Partnership Process; Public Involvement/Education; Technology Transfer; Systems Approach; and Adaptive Management and Monitoring.

The first procedural theme noted that the partnership process really works, as it allows the agencies to accomplish a number of important functions. First, it provides for the combination of agency resources and authorities in such a manner as to achieve common objectives and to collectively accomplish more than any single agency would be able to do alone. Secondly, it leads to the timely resolution of policy conflicts identified among the partnership agencies.

The second procedural theme identified public involvement and education as vital components of the partnership process because they utilize the public's knowledge and interest in problem identification. Another area in which great dividends are seen is through the public's volunteer efforts. Finally, the active involvement of the public increases their environmental awareness and leads to positive local action.

The third procedural theme addresses technology transfer and how we can improve, for example, the regulatory process by considering the results of testing and monitoring required to permit technology in one region and applying that same technology in other regions. Coastal America has also successfully demonstrated new and proven technologies in various regions of the country.

A fourth procedural theme that emerged is that often a local project, addressing a specific problem, will assume a broader view and can lead to a more systematic approach. Conversely, we've also seen how a broad regional issue can be addressed at the local level.

Finally, our last procedural theme addresses the concept of adaptive management and monitoring and how they can modify agency responses in a manner that allows multiple objectives to be accomplished and expectations to be realistically met. Additionally, the value of monitoring and surveys have been demonstrated to positively influence project design and implementation.

Technical Lessons Learned

The major technical lessons learned were developed from each of the six categories into which the Coastal America projects were organized, namely: Wetland Restoration and Protection; River System Protection and Restoration; Beach/Dune Protection and Restoration; Offshore Habitat Protection and Restoration; Non-Point Source Mitigation; and Assisting Species at Risk.

In the Wetland Restoration and Protection category a number of important technical lessons were identified by the RIT's, including: the use of aerial imagery in the northeast to identify degraded wetlands dominated by the common reed, *Phragmites australis*, and to demonstrate the use of this species as a change indicator; the beneficial use of dredged sediments was demonstrated in a variety of wetland restoration efforts, further substantiating this concept; and, in the southeast, the resiliency of some wetland ecosystems was demonstrated by their return to pre-disturbance conditions following heavy agricultural use with little to no human intervention.

In the River System Protection and Restoration category some of the important technical lessons learned included: how the application of ecological principles increases the likelihood that environmental restoration activities will succeed; that when examining alternative solutions to restoration projects it should be remembered that older technologies have been proven and will work; and, there is no substitute for appropriate planning activities in order to achieve implementation success.

In the Beach/Dune Protection and Restoration category some of the important technical lessons learned included: when designing project features within fragile ecosystems it is important to ensure that the design is compatible with the ecosystem in which the project is located; the use of collaborative planning activities will assemble a more diverse mix of engineering and scientific disciplines to examine the problem(s) and generate a more comprehensive solution ; and the use of native plant species in restoration projects will not only provide a more natural looking restoration, but will increase the likelihood that wildlife species, native to the area, can successfully return.

In the Offshore Habitat Protection and Restoration category some of the important technical lessons learned included: the use of coal combustion fly ash pellets as oyster reef substrate is a viable technological solution; however, the regulatory process for approving this technology in other regions of the country must be improved; and, in order to ensure seagrass bed restoration activities are successful they must be routinely monitored and adequate protection provided as they mature.

In the Non-Point Source Mitigation category some of the important technical lessons learned included: when installing mitigation measures to control non-point source pollution, it is very important to accurately characterize the watershed to determine all possible sources of pollution; non-point source vegetative control is best applied at the source of the pollution; and, public involvement is an integral feature of non-point source mitigation projects.

In the Assisting Species at Risk category some of the important technical lessons learned included: the use of existing investigations to characterize species' needs and develop appropriate management plans can greatly reduce project costs; when designing projects for fish and wildlife species, it is important to recognize the need to link habitats that have been fragmented and thus increase the use of available habitat within the region of concern; and, when designing projects it is important to realize that wildlife population changes will require time, thus expectations should be set accordingly.

Norman T. Edwards
U.S. Army Corps of Engineers
CECW-PD
20 Massachusetts Ave. N.W.
Washington, DC, USA 20314-1000

Ph (202) 761-8569
Fax (202) 761-0140
Email Norman.Edwards@inet.hq.usace.army.mil

COASTAL AMERICA NORTHEAST REGIONAL IMPLEMENTATION TEAM

William A. Hubbard, U.S Army Corps of Engineers

Regional Strategy

The Northeast Regional Implementation Team (NERIT) of the national Coastal America partnership has achieved success by providing a coordination vehicle that supports interagency cooperation and collaboration on projects of coastal ecological importance. The partnerships involve federal agencies, tribal governments, state agencies and local entities. The NERIT team provides a central focus for priority projects, but emphasis is placed on the actual restoration projects.

The regional strategy evolved at early NERIT meetings into a recognition that the most important and achievable habitat management goals involved the restoration of full tidal exchange and anadromous fisheries movement into the estuaries of New England. The region is heavily populated and infrastructure development along coastal features have adversely impacted the free exchange of tidal waters. The construction of navigation channels, interstate highways, railroad corridors and hydropower features all independently influenced the movement of waters in the estuarine systems. These were all independent development efforts that cumulatively reduced the net productivity of the Northeast's temperate estuarine salt marshes. Over time, the reduced ecological productivity has evidenced itself through the proliferation of the common reed, *Phragmites*. Monospecific stands of *Phragmites* provide lowered ecological services and habitat vale than the normally diverse *Spartina* dominated salt marshes. The challenge to the NERIT was to recognize the need for the infrastructure support to society and restore the ecological productivity to sustainable levels.

The process used by the Coastal America NERIT is to have projects nominated to the regional teams that have ecological priority on a regional scale. Candidate projects are then evaluated by the NERIT agencies to determine appropriate programs that may support project implementation. Additionally, these projects may benefit from some of the advanced government technologies available to the NERIT, such as remote sensing capabilities of the Air-borne Multispectral Pod System (AMPS) of the Departments of Navy and Energy. The following describe some of the NERIT's collaborative efforts in New England.

Connecticut Coastal Salt Marsh Studies

The Corps, DOT, EPA, FWS, NOAA, and Connecticut DEP and DOT have completed a collaborative technical analysis of all eastern Connecticut salt marshes. Numerous sites were recommended for restoration. The DOT has already funded two (Sybil Creek and Mill Meadows). The NERIT is investigating funding opportunities for several others and CT DEP will conduct some restorations using in-house staff.

Sybil Creek Salt Marsh Restoration Project

ISTEA funds were granted to the Long Island Sound Program to implement restoration at this Branford, CT site. The NERIT is providing technical assistance. The project is being funded through CT Department of Transportation's Intermodal Surface Transportation Efficiency Act (ISTEA) funds and the CTDEP's Coves and Embayments Program (a.k.a. LIS Cleanup Account).

Mill Meadows Salt Marsh Restoration

ISTEA funding and NERIT technical assistance are also being implemented at this Old Saybrook, CT site. Significant progress has been made at this site. A previously unknown tide gate (within a manhole under a local road) was partially responsible for the tidal flow restrictions. Even with the tide gate removed, the existing culvert has been determined as undersized.

Long Island Sound Habitat Restoration

The Long Island Sound Office of the EPA has initiated a project to identify degraded coastal resources in coastal CT and NY. Low altitude, oblique angle video photography is being conducted for the entire coastline. EPA Region II has provided a helicopter for the effort and FWS, NYDEC, and CTDEP are providing staff and equipment. The Corps anticipates assisting with the interpretation of the data. Implementation of the restorations identified by this effort will receive a priority from the NERIT.

Milford, CT Beach Dune

The FWS, Corps, and CTDEP are cooperating in an effort to restore a portion of the McKinney Wildlife Refuge to a coastal dune habitat. This effort is currently being investigated under the Corps Section 1135 program.

Stratford, CT Salt Marsh Restoration

The FWS, Corps, and CTDEP are cooperating to restore various habitats in the Great Meadows Salt Marsh. The restoration project is being initiated under the Corp's Section 1135 program.

Lighthouse Point Salt Marsh Restoration

The Long Island Sound Program (EPA) has funded Yale University to conduct preliminary investigations for restoration of this previously used dredged material disposal site to salt marsh. The COE anticipates implementing the restoration at this previously used dredged material disposal site under their Section 1135 authority.

Mohegan Tribe Coastal Management Plan

The Mohegan Tribe of Connecticut has requested the NERIT assist in the development and implementation of their coastal management plan. A facilitated planning workshop has been sponsored by the NERIT early in 1996 to address various habitat and anadromous fisheries restorations, as well as other priority tribal goals. Already the Corps has identified a potential Section 1135 (salt marsh, eelgrass and shellfish habitat restoration) and a Section 22 (Planning Assistance to States and Tribal Governments) project.

Long Island Sound NPS, New London County, CT

Urban expansion and residential development in New England have contributed to non-point source inputs of nutrients and coliform bacteria that substantially decrease the quality of coastal embayments. In 1991, Coastal America funded a pilot program that informed coastal residents in New London County, Connecticut of techniques that homeowners can employ to reduce their non-point source impacts on adjacent coves. This project was so successful that the methodology was actually taken door to door in the study areas.

Rhode Island Habitat Restoration

Navy Eelgrass Remote Sensing

The Navy (NUWC) in Newport, RI has begun the funding request process to develop its remote sensing technology for submerged eelgrass and algal beds in conjunction with other NERIT eelgrass efforts. This partnership with Navy, EPA, NOAA and the Corps will develop military technology with direct civilian environmental applications.

Sachuest Point Salt Marsh Restoration

NOAA, the Corps of Engineers, USFWS, and EPA are conducting technical studies that will recommend hydrologic changes that could be undertaken to restore productivity to this southern Rhode Island salt marsh. NOAA is considering this site as a restoration effort using the "World Prodigy" oil spill Natural Resources Damage settlement funds. The FWS is planning to implement Phragmites control in an area adjacent to the NOAA salt marsh restoration and manage that site as a freshwater wetland. In conjunction with these restorations, the Corps Defense Environmental Restoration Program (DERP) will restore an old artillery range into an open coastal grassland, to be managed by FWS. This unique partnership involves the expertise and programs of all the NERIT and our RI state agency partners (RIDEM and CRMC). Ultimately a very valuable coastal landscape will be constructed, with the coastal migratory wildlife benefiting from its ecological diversity.

Galilee, RI Salt Marsh

The Corps of Engineers has the lead in restoration of tidal flows into this important salt marsh. The USFWS is contributing funds, EPA and NOAA are providing technical assistance. Local partners include RIDEM, they are contributing 25% of the cost and RIDOT who have agreed to construct required mitigation on-site. Construction is anticipated in 1996. A video documentation of the restoration will be produced using the Corps environmental data acquisition program.

Boyd's Marsh, RI

At a recent coordination meeting discussing the Sachuest Point project, the state of RI staff suggested the NERIT evaluate Boyds Marsh in Portsmouth, RI as a salt marsh restoration project. The Corps has initiated an initial appraisal of the site under its Section 1135 program.

Narragansett Bay, RI Eelgrass Restoration

NOAA/NMFS is conducting studies and will now implement a major reintroduction of eelgrass (Zostera sp.) in Narragansett Bay, RI. The NERIT is currently coordinating with the Navy to obtain the support of Navy divers to conduct the plantings as a training exercise.

Massachusetts Habitat Restoration

Blackstone River, RI and MA

The National Park Service has the lead in managing the Blackstone River National Heritage Corridor. The river system has impediments to anadromous fisheries migration, contaminated sediments, high hazard dams and significant opportunities for wetlands and waterfowl habitat enhancement. The Corps has conducted a reconnaissance of potential restoration initiatives with FWS providing fishway designs, EPA providing contaminant analyses and NOAA providing technical support. A general investigation (GI) study has been approved by the Corps and funding was included in the President's FY-96 budget.

Ballard Street Salt Marsh Restoration, Saugus

EPA has the lead in this salt marsh restoration project. Their technical expertise is being used to coordinate a restoration of tidal flows in balance with flood protection. The Massachusetts EOEA Office of Wetlands Restoration and Banking and the NERIT are providing technical assistance in this project.

Sagamore, MA - Scusset Beach Salt Marsh

This large marsh also has reduced tidal flushing and the NERIT is participating in a Corps of Engineers Environmental Restoration Project (Section 1135) in conjunction with MA Executive Office of Environmental Affairs Office of Wetlands Restoration and Banking. The EPA, FWS and NOAA are all providing technical support and potentially some funding.

Cape Cod MA Salt Marshes

COE Planning Assistance to States funding is being matched by DOT funds to EOEA in Massachusetts to examine the tidal hydrology of several Cape Cod salt marshes. Those that are found to be tidally constricted will be restored as the routine transportation corridor maintenance occurs. FWS, EPA, and NOAA are all providing technical assistance.

Boston Harbor Eelgrass Restoration

The EPA Water Management Division of Region I has been conducting studies and will now implement a major reintroduction of eelgrass (*Zostera* sp.) in Boston Harbor. The NERIT is currently coordinating with the Navy to obtain the support of Navy divers to conduct the plantings as a training exercise. The existing eelgrass beds will be mapped by the Air-borne Multisensing Pod System (AMPS) that the Navy and Department of Energy will supply to the NERIT.

Neponset River Watershed, MA

The NERIT is supporting the MA Office of Wetlands Restoration and Banking comprehensive assessment of wetlands restoration opportunities in this large eastern Massachusetts watershed.

New Hampshire Habitat Projects

Rye Harbor, NH - Awcomin Salt Marsh

The FWS has completed restoration of this previously used state dredged material disposal site. NOAA and EPA have contributed technical support. The restoration activity reintroduced saline tidal flushing to a significant portion of this salt marsh.

Little River Marsh, North Hampton, NH

The NRCS has conducted a regional overview of salt marsh restoration in New Hampshire. Their report and the strong support of the town of North Hampton have generated a NERIT investigation for funding opportunities at this site.

Clark Island, Portsmouth Naval Shipyard

The Navy is proposing to use "Legacy" funds to preserve this coastal island and adjacent habitats. This effort has the strong support of the Coastal America NERIT. Technical assistance is being provided to the Navy by all participants, including FWS, EPA, HUD, COE, and NOAA, as needed. One of the NERIT meetings was held onsite, hosted by the Navy. After viewing the proposed island ecological reserve the NERIT and local University of New Hampshire experts conducted a facilitated workshop to provide the Navy a report with NERIT interagency expert recommendations to aide in its planning efforts.

New England Regional Projects

Sediment GIS Boston Harbor, MA; Casco Bay ME and Providence, RI

In August of 1993 the NERIT published a GIS mapping and database of all recent Boston Harbor, MA aquatic sediment chemistry. This interagency collaboration between the Corps, USGS, EPA and NOAA produced an agreed data format to manage contaminated sediments by spatial mapping. In August of 1994 the NERIT published a similar GIS database to the Boston Harbor one for recent sediment chemistry in the Casco Bay National Estuary Program focus area. The data from the Providence Harbor Navigation Maintenance Project is also being entered in this system.

New England ports and harbors predominately have fine grained sediments underlying their urbanized waterfronts. Historical dredging and disposal operations have relocated these potentially contaminated sediments to many aquatic disposal sites. The NERIT has various efforts underway to map existing contaminated sediments in an interagency compatible GIS (Geographic Information System) format. This will allow reasonable management decisions to be made in an informed manner. Additionally, several abandoned offshore dredged material disposal sites are being examined to determine the extent of residual contamination. It may be feasible to cap contaminated offshore sites (*e.g.*, abandoned disposal sites) with uncontaminated dredged material from ongoing navigation dredging projects.

In summary, the collaboration of numerous partners on priority ecological solutions has resulted in a series of projects being identified and executed. As the NERIT develops more projects, and the previously developed ideas are implemented, the ecological productivity of the temperate New England Salt marshes will improve. The support of the Coastal America partnership increases the awareness, priorities and efficiencies of the participants.

William A. Hubbard
Chief, Environmental Resources Branch
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA, USA 02254-9149

Ph (617) 647-8552
Fax (617) 647-8560
Email William.A.Hubbard@ned01.usace.army.mil

COASTAL AMERICA: A PARTNERSHIP IN ACTION – A VIEW OF THE SOUTHEAST REGIONAL IMPLEMENTATION TEAM

Megan Greiner, DOI/National Park Service and
George Dodson, Air Force

A View of the Southeast

The Southeast Regional Implementation Team (SERIT) emphasizes the formation of partnerships and the coordination of the full range of stakeholders to address critical coastal problems. The biggest threats to our southeast coastal areas identified include urban expansion and water management projects. Both threats have resulted in significant habitat degradation, and declines in native species. A process for identifying and championing Coastal America project opportunities is described in the Southeast Region's Action Plan, with a strong focus on the actual "process" of partnering and collaborating with stakeholders.

SERIT believes that collaboration and partnerships are integral to achieving results in today's world. In this collaborative process, agencies and organizations of different authorities, and expertise, are able to maximize their efforts by coupling them with others. This sharing of information and resources in order to address coastal resource issues is necessary in order to manage our resources in a sustainable manner that will address all ecosystem needs. The southeast teams strategy outlines how we are implementing this "Coastal America collaborative process" in order to implement projects that address ecosystem coastal issues in a sustainable manner.

SERIT members work closely together to build collaborative partnerships. This is done through a series of regular meetings in which Coastal America, and individual agency information is shared among the team members. Members also work in an outreach type of capacity within their own agency by communicating the Coastal America information to field offices and other organizational units of their agency. Project ideas and implementation are often carried out at the field level, and thus this level of communication is extremely important.

We also recognize the fact that it is not only the federal agencies who should be involved in this process; all levels of government, and all forms of organizations are stakeholders in our coastal ecosystems. With this in mind, the southeast team has recently been involved in outreach activities to encourage, and involve non federal entities in this collaborative process. We have begun by publishing a quarterly newsletter entitled "The Coastal Environment" which we have been mailing to all federal partners, as well as state and non-government organizations. Through networking, and various letters sent to different organizations, we have greatly expanded our distribution to numerous non-federal organizations. As well, we have developed a homepage for our regional team to post highlights of projects in the southeast, our newsletters, and provides links to our regional partner homepages. We expect that this will prove to be a significant outreach tool to non-federal organizations. Expanding the Coastal America idea and process beyond the federal collaborative effort is an exciting path for us. We hope to use our current regional group to demonstrate the advantages of multi-agency work, and to enable more projects to come to fruition.

Since Coastal America's establishment in 1992, SERIT has been very effective in demonstrating the advantages that can be gained through collaboration of numerous agencies. While still a relatively new group, SERIT has been successful in pulling together projects that effectively and accurately reflect the goals of the organization; the right whale, red mangrove and Quaker Neck Dam projects are all testament to the ability of the Southeast team to partnership their federal agencies, and to coordinate with state and local organizations to address some of our critical coastal issues, in an effective and timely manner.

One of our biggest and most successful projects involves protecting the right whale, considered to be the most critically endangered marine mammals. The North Atlantic Stock of right whales numbers about 350 individuals. Several years ago, the near shore waters off Georgia and Florida were identified as the only known calving grounds for the species. Calving occurs betweens late November and early March with a peak in January. NMFS designated the calving grounds, as well as summer foraging habitat near Cape Cod, Massachusetts and Stellwagen Bank, as critical habitat for the right whale. The major causes of human induced mortality to the species are entanglement in fishing gear and vessel collisions. Fishing gear interactions are rare off Georgia and Florida, but vessel collisions and strandings from suspected vessel collisions have been documented.

In 1993, NMFS designated an Implementation Team that included NMFS, Georgia Department of Natural Resources, Florida Department of Environmental Protection, the US Coast Guard, the US Navy, the US Army Corps of Engineers (COE), and the New England Aquarium to design a program to minimize ship strikes. An early warning system was developed that employed aerial surveys to sight whales on the calving grounds, pinpoint their locations and convey this information to commercial and military vessels in the area. Once informed of whale locations, ship traffic may alter speed and direction and thereby minimize the chance of collision.

Moreover, just this last year, the Coastal America Southeast Implementation Team coordinated their current efforts with the Marine Resources Council to establish a Volunteer Right Whale Sighting program to enhance the current federal program. This new volunteer program will provide local knowledge and full time coverage of the coasts. The Marine Resources Council of East Florida is organizing coastal residents, pilots, boaters, and lifeguards to identify whales and report their location to researchers.

Volunteers confirm each others sightings and notify the Florida Department of Environmental Protection, part of the Right Whale Recovery Team. This triggers two responses: (1) a state scientist flies to the sighting location to photograph and document behavior; (2) information is forwarded to the Coast Guard, Navy, ports, and the commercial maritime communication network. This early warning system alerts ship traffic in order to avert whale/ship collisions. To date, this project has been very successful in reducing human injury and death to the right whale. Furthermore, this project demonstrates the benefits of agency partnerships among different government agencies and levels, as well as in working with citizen and not-for-profit organizations to protect and enhance valuable coastal resources.

Another prime example of the southeast team approach to addressing coastal issues was in response to damage to important red mangrove forests on the island of Culebra, Puerto Rico. This project was initiated in order to restore native species, and focussed on the issue of biodiversity. It is believed that restoration of this site will help to maintain the ecological web of the area, which is already heavily impacted by human use and encroachment.

In 1992, the Caribbean Field Office of the FWS began to develop a Coastal America project to rehabilitate, and, where necessary, transplant red mangrove seedlings in areas damaged by the hurricane. In the transplant area, most of the dead trees were cleared, while some were left to serve as breakwaters fro the new trees. Germinated seeds were then collected from the unaffected red mangrove forest of the southwest coast of Puerto Rico to be planted at the newly cleared site. Through the cooperative efforts of Coastal America partners, University of Puerto Rico personnel, and citizens' groups, approximately 4,000 seedlings were planted at Culebra. At the completion of the project, approximately 15,000 feet of shoreline had been replanted.

The restoration of the fringe mangrove forest will result in significant environmental benefits when the trees mature. Mangrove roots stabilize the shoreline, thus protecting inland areas during storms and hurricanes. Mangrove re-establishment also prevents re-suspension of fine sediments, thus enhancing water clarity for oysters, seagrass beds, and coral reefs. The mangrove trees provide foraging, nesting, and roosting habitats for many important species of wildlife.

The Red Mangrove Restoration Project achieved a number of goals, including the restoration of one of Culebra's most important natural systems, the employment of members of the local community of Boqueron, and the education of all involved -- from the university students to community members -- on the importance of such projects. Again, Coastal America partners were able to involve other agencies in the process of a collaborative commitment to the natural environments of the island.

A significant amount of the work completed and underway that has been initiated through the Coastal America process has involved projects to restore critical habitat areas. One unique project, currently underway, involves efforts to remove obstructions to anadromous fish migration along the North Carolina coast. This project is projected to restore access to historic anadromous fish spawning habitat in the Albemarle-Pamlico sound watershed through the removal of dams and the construction of fish passages.

Coastal America partners (Environmental Protection Agency (EPA). Fish and Wildlife Service, Army Corps of Engineers, and NOAA/National Marine Fisheries Services) are working with Carolina Power and Light, the North Carolina Coastal Federation, and a coalition of fishery interest groups, and the Albemarle-Pamlico Estuarine Study (APES) to remove the Quaker Neck Dam in North Carolina. A Fish and Wildlife Service survey identified the dam as an obstruction to anadromous fish migration and spawning. Studies performed by the Corps indicated that construction of a weir dam in the plant's intake canal would eliminate the need for the larger dam.

Dam removal will restore access to some 139 miles of spawning habitat for American shad, hickory shad, Atlantic sturgeon, and striped bass. The Neuse River at one time supported one of the largest American shad fisheries on the east coast. Dam removal may also benefit freshwater mussel species, including the federally endangered dwarf wedge mussel, which evidence suggests are dependent on anadromous fish as intermediate hosts in the mussels' reproductive cycle.

The dam removal project, the red mangrove restoration and the right whale warning system are all excellent examples of what a number of organizations, with different missions, and different levels and types of resources, as well as different philosophies with regards to resource management can do through a collaborative effort. These three projects highlight not only the unique partnerships, but also provide examples of the different type of approaches that Coastal America is willing to take to respond to coastal resource issues. In all three cases, numerous organizations recognized a problem, and agreed on an effective way to

respond to this problem. Furthermore, all organizations were willing and able to contribute to the cause, and it is through this sharing of resources that positive results for the coastal environment were able to be achieved.

Recently, the southeast team has been actively recruiting non-governmental organizations and non-federal agencies to attend meetings and to adopt the Coastal America process of collaboration and sharing resources to address coastal issues. We are encouraged by the response of NGO's and state agencies to our efforts, and hope to see more projects initiated at the non-federal level, as many of the local organizations in certain areas are able to see the needs more clearly, and provide excellent projects that will restore/protect the resources for the future. In the future we hope to continue to be active in numerous projects that approach coastal management from an ecosystem approach, and that we are able to continue to effectively partner with our federal agencies.

George Dodson
U.S. Air Force/CCR-A
Suite 295
77 Forsyth Street, SW
Atlanta, GA, USA 30335-6801

Ph (404) 331-5313
Fax (404) 331-4517

BEAUTY MAY BE ONLY SKIN DEEP, BUT COASTAL GOES ALL THE WAY TO THE MOUNTAINS

Walter R. Briggs, U.S. Navy

Coastal America's Pacific Northwest Regional Implementation Team (PNW RIT) is a partnership of 13 federal agencies operating under the national charter of the Coastal America Initiative to protect, conserve and enhance coastal resources. The role of the PNW RIT agency members has been that of facilitator and catalyst. Each member has been responsible for coordinating Coastal America activities throughout their own agency and for helping to form partnerships inside and outside their agency. This has necessarily involved state organizations, tribes and NGOs. Team members have identified high priority projects, assessed funding sources, and moved projects from the drawing board to the ground.

Currently, the Northwest region is struggling with a multitude of complex environmental issues covering broad geographical areas and interwoven jurisdictions and interests. The focus of these issues is primarily driven by the listing of species under the Endangered Species Act, particularly the northern spotted owl and various salmon stocks, that affect vast tracts of land. In attempting to address these issues, numerous interagency efforts and forums have been established which are not specifically associated with the Coastal America program. It is the desire of the Pacific Northwest RIT to assess how it might fit within these other forums or to determine the special niche it might carve out in addressing other environmental issues. The Pacific Northwest RIT will generally utilize existing interagency communication to integrate Coastal America efforts with other interagency regional programs to the extent possible.

A set of regional strategies, patterned after the Costal America criteria, were developed as a framework for defining the regional programs and identifying high priority projects. While the Team follows the Coastal America charter concerning coastal resources, it has expanded this concept to a watershed approach for efforts to protect and restore living resources and habitats beyond the immediate coastal area. The strategy criteria are:

1) The project must benefit anadromous fish, migratory birds, threatened, endangered or candidate species, or marine mammals.
2) The project must include a long-term monitoring plan. Habitat restoration and sediment remediation are still relatively new sciences, and we need to continue refining our knowledge so that future projects are well focused, cost-effective and successful.
3) The project should be clearly non-compensatory in nature. Compensatory actions such as mitigation for a development project or Superfund cleanup , or resulting from a Natural Resources Damage

Assessment (NRDA) process should not be funded with federal money identified through the Coastal America program. Those cost should be borne by the developer or the responsible party in a Superfund or NRDA action.

Three projects typify the Northwest efforts:

- At Winchester Bay, OR, Coastal America participated in a two-phase dredged material disposal project. Phase one involved the creation of a deflation plain marsh. The second phase was the establishment of nesting habitat for the federally listed threatened species western snowy plover (*Charadrius alexandrinus nivosus*).
- On the Duwamish River near Seattle, WA, the federal General Services Administration owns a parcel of intertidal land that was restored to useable habitat. Work included a physical survey, removal of an existing structure, associated pilings and parking area, and regrading of 6,700 sq ft along the shoreline to the elevation of existing marsh; creation of an intertidal bench; placement of wave attenuators; and a marsh grass planting program.
- About 50 mi north of Seattle, a new micro-scale hatchery has been constructed to raise salmon for the Stillaguamish River run. Salmon releases from the hatchery will increase the fish runs reaching the ocean which will help the offshore and tribal fishing industries. Spawning and rearing habitat enhancements will provide additional capacity for returning salmon. The hatchery is located on the Naval Radio Station, Jim Creek.

The successes of these and other projects in the Pacific Northwest are directly attributable to two prime factors: the ability of Coastal America member agencies to cut through bureaucratic red tape by using the Regional Implementation Team forum; and the formation of project partnerships among federal agencies, NGOs, and tribal governments. Because of the interwoven jurisdictions and legal interests, partnerships have proven to be an essential and valuable component of a successful project.

Walter R. Briggs
Staff Forester
Naval Facilities Engineering Command
Engineering Field Activity, Northwest
19917 7th Avenue, N.E.
Poulsbo, WA, USA 98370-7570

Ph (360) 396-0922
Fax (360) 396-0854
Email wrbriggs@efanw.navfac.navy.mil

BENEFICIAL USE OF DREDGED MATERIALS FOR MARSH RESTORATION IN THE SAN FRANCISCO BAY ESTUARY

Ellen M. Sampson
San Francisco Bay Conservation and Development Commission

Background

Dredging San Francisco Bay to maintain maritime trade and recreational boating, to deepen existing channels and berths, and for other public trust uses is projected to generate approximately 6 million cubic yards (mcy) of material annually during the next 50 years. The pressure to dredge and dispose of the material is tied to the region's economy; historically, more than $5.4 billion of economic activity each year has directly depended on commerce involving the use of navigational channels and berthing areas in the San Francisco Bay region. In the past, most dredged materials have been disposed where convenient: in the Bay. Through the years, however, in-Bay disposal and dredging activities in general have become increasingly controversial. First, contaminants have been found in commercial and military ports and water-related industrial areas, and so dredging and disposal of material from these sites may redistribute those contaminants. Second, in-Bay disposal is believed to adversely affect the Bay ecosystem by: burying bottom dwelling organisms; reducing sandy and rocky habitats for commercially valuable fish species; and increasing turbidity which reduces light penetration and lowers aquatic plant productivity, reduces the sensory abilities of fish species affecting their ability to find prey and reproduce, and abrades and clogs gill and mouth organs thereby causing mortality during sensitive life stages. Third, the capacity of Bay disposal sites is limited. For instance, at the primary disposal site near Alcatraz Island, an approximately 80 ft high mound was discovered in 1982 which had been created by volumes of material disposed over many years. As a result, public focus was brought to bear to solve the dredging and disposal problem.

Concurrently, the focus on restoration of lost tidal wetlands around the Bay has increased. In 1988, the U.S. Environmental Protection Agency (EPA) established the San Francisco Estuary Project which developed a management plan to restore and maintain the estuary's resources. That plan recommended upland use of dredged materials as a primary goal. Also, given the adverse environmental effects of dredging and disposal, and the limited capacity of the traditional in-Bay disposal sites, the regulatory agencies, the ports, and the interested public commenced a planning process to manage the disposal of dredged material over the next 50 years in a way that is environmentally and economically sound. This is Long-Term Management Strategy (LTMS)[1] will evaluate disposal of dredged materials at sites upland of the Bay are managed by the San Francisco Bay Conservation and Development Commission (BCDC), a state agency with a mandate to facilitate proper management of Bay resources. The LTMS goals are to: (1) identify, develop, and analyze opportunities for the upland disposal and beneficial use of dredged material including contaminated sediments that are unacceptable for unconfined aquatic disposal; (2) analyze and, where possible, resolve the physical, regulatory, and institutional constraints to using dredged material for beneficial uses at upland sites; and (3) develop and evaluate implementation strategies and plans for reusing dredged material at upland sites generally, as well as at specific sites.

Beneficial Use of Dredged Material

The beneficial use of dredged material in levee maintenance, landfill capping, and the restoration of tidal wetlands within the historic margins of the Bay would not only revolutionize the way dredged material has been treated in the past -- as a resource instead of as waste -- but also would result in the restoration of diked historic baylands. Many areas around the Bay that were formerly tidal marsh, were diked and drained around the turn of the century and used for hay farming, livestock grazing, and salt ponds. The North Bay, for example, has about 24,000 a of diked, historic baylands in agricultural use. Ironically, although many agencies, public interest groups, and others agree that restoration of lost tidal wetlands is a laudable goal, the path to achieve that goal has been obstructed by, among other things, conflicts among permitting agencies, controversies over mitigation for the loss of existing habitat due to conversion to tidal marsh, and difficulty in finding sufficient clean material to use in the restoration of sensitive habitat.

The use of the "spoils" to restore tidal marsh has great promise because it addresses two of the Bay's most pressing problems—the historical loss of 90% of Bay wetlands, and the need to find environmentally sound, as well as economic, ways to dispose of dredged material. Due to drying and subsidence, the original elevations of the diked historic baylands have dropped from 4 to 9 ft. One design option involves breaching the existing levees and allowing sediments to accumulate over time to elevations that could sustain marsh vegetation. Another approach favors placement of dredged material in the subsided areas to hasten the restoration process. Because the subsided areas are large, they could hold large quantities of dredged material. For example, the proposed Montezuma Wetlands project

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[1]The topic of another paper given at this conference

in the Suisun Marsh plans to utilize 20 mcy of dredged material to create 1,800 a of tidal and seasonal wetlands. Not only is this project the largest proposed upland disposal site in the estuary, it is also one of the few that is privately sponsored, thus affording an opportunity to evaluate whether the private sector can make a profit helping solve a regional problem.

In addition to the Montezuma Wetlands, other restoration efforts are underway around San Francisco Bay including the Sonoma Baylands Project near the mouth of the Petaluma River in the North Bay, and Hamilton Air Force Base located on the west shore of the North Bay. The project most advanced through the process is the Sonoma Baylands Project. The Sonoma Land Trust, with a grant from the State Coastal Conservancy acquired 830 a of land in southern Sonoma County near the mouth of the Petaluma River. This entire site was tidally influenced before it was diked in the early 1900s, and used for hay farming. The southernmost 322 acres of Sonoma Baylands was identified as a site where tidal action would be restored to provide habitat for endangered species such as the salt marsh harvest mouse and the California clapper rail. The project is using approximately 2.5 mcy of dredged material to attain elevations suitable for marsh vegetation. A 31-a portion at the restoration site was designated as a pilot project under the Coastal America Program, and will benefit from $78,000 allocated for the project by the U.S. Army Corps of Engineers. Disposal was completed in the fall of 1995, and after a period of settling, in January 1996 the dike was breached. The site is now subject to tidal action for the first time in 70 years. Experiences at Sonoma Baylands also highlight the important areas of conflict and possible resolution.

Issues in Conflict

For over 140 years, dredged materials have been used in the Bay and Delta to build levees and to provide construction and fill material. Demand for dredged material remains high, particularly for rehabilitating levees and restoring wetlands. While the restoration of valuable marsh habitat is a commonly accepted goal, when applied on a case-by-case basis various obstacles threaten to defeat innovative approaches to solving the dredged material disposal problem in the Bay. Chief among these obstacles are: concern about the environmental and health risks posed by contaminants in dredged materials; concern about the loss of existing habitats, particularly seasonal wetlands when these areas are restored to tidal wetlands; limited coordination among government agencies in processing dredging permits; absence of a broadly accepted public policy advocating the beneficial use of dredged material; and institutional caution resulting from the lack of experience with the effects and performance of dredged material in these upland projects. Some of these obstacles were exemplified at the Sonoma Baylands project.

Provision of Adequate Dredged Material

The pilot project required approximately 300,000 cy of sediment from maintenance dredging of the Corps' Petaluma River channel. Because less material than expected had accumulated in the Petaluma River channel, it was necessary to perform advance maintenance dredging to obtain sufficient quantities of material for the project. This experience points out that adequate supplies of dredged material must be identified and available in a timely manner in order to fulfill the restoration schedule. In this regard, the LTMS effort to streamline the permit application process among the agencies, and to develop policies that encourage upland use of dredged material, is crucial to future success.

Habitat Conversion

A main source of conflict has been the issue of conversion of seasonal wetland habitat to tidal wetlands. The U.S. Fish and Wildlife Service (USFWS) requires that in-kind mitigation be provided for the loss of seasonal wetlands and perhaps other habitats that can occur when the diked historic baylands are restored to tidal marsh. Other resource agencies believe that such mitigation is inappropriate for projects that will result in substantial increases in wetland functions and values, although of a different type. Understanding the process for restoration explains why this is so.

Most of the projects where dredged materials are proposed for use in marsh restoration involve placing dredged materials in subsided, diked historic baylands to accelerate the restoration of these lands to tidal wetlands. These diked baylands consist of more than 80 square miles of diked land that historically were part of the Bay and were either tidal marshes or mudflats. These areas represent the best opportunity for enlarging the Bay and restoring lost natural resource values. However, the seasonal wetlands which have formed on portions of these areas may serve as important habitat for Bay species, particularly shorebirds and migratory waterfowl.

This issue arose at the Sonoma Baylands project, where the USFWS and some environmentalists sought in-kind mitigation for the loss of approximately 56 a of seasonal wetlands as a result of conversion of this diked historic bayland to tidal marsh. In an effort to resolve this issue, the state Coastal Conservancy contracted with an independent biological consultant to participate in a Habitat Evaluation Procedure (HEP) to compare existing habitat values with expected values once the site is restored. The LTMS upland studies were also augmented to provide an analysis of the values provided by seasonal wetlands and map their location in the North Bay. In addition, two other planning efforts have commenced that will address this issue of habitat conversion: (1) an EPA-sponsored initiative involving federal and state agencies, property owners and the public to prepare a comprehensive plan for the North Bay diked baylands, including habitat goals, which should help address the issue of habitat conversion and serve as a foundation for a regional wetland plan; and (2) BCDC's planning work with North Bay local governments to prepare a North Bay Special Area Plan that will protect wetlands and other natural resources while permitting upland disposal projects and appropriate development. Pending the outcome of these longer-range policy efforts, in the end the Sonoma Baylands project was modified to include mitigation for the seasonal wetlands.

Contaminants

Another source of conflict is over the quality of dredged material that could be used in these projects. Dredged material disposal in any environment, whether in the Bay, the ocean, or at an upland location, can increase the risks that contaminants buried with or bound to the dredged sediments may be released with potentially harmful effect. Because the traditional in-Bay disposal sites were selected partly because they are highly dispersive, disposing dredged material at in-Bay sites increases the chance that any contaminants will become biologically available and widely dispersed through the estuary. These risks appear to be of less concern for upland disposal where the contaminants in the dredged material can be managed and contained. Nonetheless, because there is limited information about the relative risk of contaminant exposure with the various disposal options, fear of contamination is an issue that will accompany any disposal option.

While there is good understanding of the processes that restrict contaminant mobility and biological availability, management practices for containing contaminants in some of the proposed upland uses are controversial due to: (1) a lack of experience in the region in managing contaminants for some proposed upland uses (such as containment under marsh restoration projects); (2) the difficulty in drawing general conclusions regarding the contaminant risks of upland disposal because these risks are determined by numerous project-specific factors including sediment characteristics, contaminant levels, and the characteristics of individual disposal sites; (3) the visibility of most upland uses contrasted with the largely unseen effects of aquatic disposal; (4) the fact that testing standards and protocols for materials disposed upland are still under development; and (5) our understanding of how contaminants affect living organisms is rudimentary. Such unknowns make project monitoring essential to ensure that future projects benefit from past experience.

Regulatory Policies

Another concern is that upland use projects are not readily addressed by existing regulatory programs, which contributes to delays and obstacles in implementing these projects. Most regulatory programs allow discretion in the interpretation of agency policy. To date, primarily because of uncertainties about the potential risks of contaminants in dredged materials and concerns about the loss of existing wetland habitat at upland disposal sites, some regulatory agencies have interpreted their policies conservatively with regard to upland disposal. Although the environmental risks associated with in-Bay disposal are no better understood or more certain, regulatory agencies are often more willing to accept those risks and uncertainties because aquatic disposal represents the status quo. While there are no known environmental benefits from in-Bay disposal, upland projects that restore wetlands and improve existing levees provide considerable benefits to wildlife and water quality.

To address this inequity, the same level of information and the same risk assessment should be required of all disposal options. In addition, senior agency personnel need to actively work with their regulatory and environmental staffs in setting reasonable standards and criteria for evaluating upland projects involving the use of dredged material and in balancing the impacts of upland disposal with the impacts of continued in-Bay disposal.

The Corps' regulatory program provides another example of a conflict between regulatory policies and the overall goal to restore tidal wetlands. Before approving a project, the Corps requires an analysis of a reasonable range of practical project alternatives. Because the potential upland sites harbor a variety of environmental values and each site is unique, the requirement may necessitate exhaustive investigations which may discourage future upland disposal efforts. In addition, the Corps' policy that upland disposal sites with the least environmental resource values be used before sites where resource values are higher will preclude achieving the LTMS objective of having many potential upland sites available throughout the estuary to maximize the efficiency of upland disposal. These types of conflict exist to some degree among each of the regulatory agencies. In order to overcome these conflicts, policies supporting the use of dredged material must be more thoroughly developed so that this effort becomes a priority. Also, comprehensive management programs to protect, restore, and enhance Bay Area wetlands should be prepared and adopted jointly by federal and state resource, water quality, land use planning and regulatory agencies, and local governments. The first management program should be for the North Bay because most of the promising marsh restoration sites are located in this area.

Summary

Dredged materials from San Francisco Bay have already been successfully used at upland sites. However, upland disposal is generally not a dredger's first choice because: (1) it is usually more costly than Bay disposal; (2) most upland sites have a limited capacity; (3) few upland sites are currently available; and (4) environmental protection regulations make it difficult to get quick approval for upland disposal. In order to ensure the future success of restoration projects using dredged material, we should strive for an agreement on an overall plan to protect and restore Bay Area wetlands, so that the conflicts do not repeatedly arise as each project is evaluated. Resolution of the conflicts is one of the most important policy matters that must be addressed in a management approach to restoration and protection of overall Bay habitats. This is essential in order to encourage other public projects, as well as private projects such as the proposed Montezuma Wetlands project in the Suisun Marsh. BCDC has made specific recommendations to further this goal including the following.

Regarding contaminants, the LTMS should actively promote research regarding contaminant effects at Bay Area universities and colleges and at federal research agencies, such as the U.S. Geological Survey and the Corps' Waterways Experiment Station. Grant applications for conducting needed research should be supported, and the results of these research efforts widely disseminated. In addition, continuing work is needed to refine the testing procedures to make them shorter and more cost-effective. Efforts should continue to improve technical knowledge and regulatory controls to ensure proper management of dredged materials used in upland disposal. It is essential that contaminant monitoring be an integral part of upland use projects and that the monitoring be conducted over an extended period of time so that long-term effects can be detected. Federal and state resource and water quality agencies should establish additional programs and guidelines for managing and monitoring contaminant effects from the disposal and beneficial use of dredged materials at upland sites.

Sponsors of upland disposal projects should be required by state and federal regulatory agencies to contribute to project monitoring and the evaluation of sediment screening criteria, biological uptake of contaminants, and the methods used to reduce contaminant mobility and availability. Their level of contribution should be the same as required of project sponsors for other disposal alternatives.

The State and Regional Water Resources Control Boards, the California Environmental Protection Agency, and the U.S. Environmental Protection Agency should undertake further studies to more comprehensively determine: (1) safe levels of different contaminants commonly found in Bay dredged materials for different upland disposal alternatives; (2) the general dispersion of contaminants from upland disposal through the Bay-Delta ecosystem; and (3) the accumulation of contaminants in the tissues of Bay and Delta aquatic organisms.

Regarding habitat goals, comprehensive management programs to protect, restore, and enhance Bay Area wetlands should be prepared and adopted jointly by federal and state resource, water quality, and land use planning and regulatory agencies, and local governments. The first management program should be for the North Bay because most of the promising marsh restoration sites are located in this area.

A regional approach to enhancement of Bay resources, including determining optimum acreages and locations of different habitat types, will help ensure that the habitat needs of Bay Area wildlife will be met by optimally using available land. Ensuring that there is no time lag between the loss of a particular wetland habitat and its restoration elsewhere will be an important component of this regional wetland plan.

Based on existing information, the marsh restoration projects at Sonoma Baylands and other locations will likely provide far greater natural resource values than currently exist at these sites. If the environmental analysis corroborates that these projects pose little environmental risk, similar projects should be brought on-line quickly and used to test restoration design, risks associated with contaminants, techniques to restrict contaminant availability in tidal wetlands, and adequacy of current sediment testing and evaluation protocols.

Ellen M. Sampson
San Francisco Bay Conservation and Development Commission
30 Van Ness Avenue, Room 2011
San Francisco, CA, USA 94102

Ph (415) 557-8784
Fax (415) 557-3767

THE CLEAR LAKE MARSH RESTORATION PROGRAM: COOPERATION AND CONSERVATION

John A. Huffman, Galveston Bay Foundation

Introduction

In 1994, the Galveston Bay Foundation (GBF) began a two-year program to protect 15,000 linear feet of shoreline and create approximately 9 a of marsh habitat in the Clear Lake watershed by planting smooth cordgrass (*Spartina alterniflora*). The Clear Lake area has lost as much as 90% of its marshes in some areas, due primarily to subsidence, caused by the withdrawal of groundwater, and erosion. The Galveston Bay National Estuary Program declared habitat loss as the highest priority for management in the Galveston Bay system.

The program began with an agreement with Houston Lighting and Power Company (HL&P), and expanded to include support from federal and state agencies, private foundations, industry groups, and environmental programs. An advisory task force was formed with representatives from these entities which cultivated cooperative relationships between diverse partners. These partnerships resulted in a greater focus on marsh restoration needs in the Clear Lake watershed, and the motivation to continue monitoring restoration projects.

Participants

Funding for the Clear Creek/Clear Lake Marsh Restoration Project in the amount of $159,000 was obtained from the following sources (building on the initial commitment by Houston Lighting and Power Company): HL&P, $50,000; National Fish & Wildlife Foundation, $20,000; U.S. Fish & Wildlife Service, $20,000; Gulf of Mexico Program, $16,000; East Harris County Manufacturers Association, $5,000; Texas Department of Transportation, $48,000. This funding has provided the financial support needed for the Galveston Bay Foundation to tackle the critical issue of habitat loss affecting the entire Galveston Bay system. Without this support, the GBF could not have attempted such a large-scale project and experienced the successes resulting from the program.
In addition, some of the plantings were supported by the Marsh Outdoor Education Program (MOEP), which was funded in 1995 by the Union Carbide Corporation, Ed White Youth Center and the Neighborhood Centers JTPA program. The MOEP is a wetland education workshop for youth, which includes cordgrass planting activities.

A Clear Lake Marsh Restoration Task Force was assembled to provide coordination of restoration efforts, as well as technical assistance and expertise. Members include representatives of the Galveston Bay Foundation, U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, Armand Bayou Nature Center, Texas General Land Office, U.S. Natural Resource Conservation Service (USNRCS), NOAA/National Marine Fisheries Service, Port of Houston Authority, and HL&P. The Texas Department of Transportation and the U.S. Army Corps of Engineers have also participated in the task force. The task force met monthly, in the beginning, to evaluate restoration strategies. As the project progressed, meetings where held less frequently, but the task force has continued to be an invaluable source of information, and provides recommendations from several different viewpoints.

Volunteers were recruited from industry groups, federal and state agencies, civic groups, local high schools and middle schools, universities, youth work programs such as the AmeriCorps program, church groups, and interested individuals. Some individuals were part of the Galveston Bay Foundation's Volunteer Conservation Corps (VCC).

Methods

Planting methodology used at each site varied according to wave energy, substrate, and area of suitable elevation. For most sites, the standard scheme of planting, one stem per square meter, was used. The transplants used in the program were grown from seed, in pots, through the Galveston Bay Foundation's cordgrass cultivation project. In late summer and early fall potted plants grown from seed had become so dense that the separation of each pot to single stems left very little root mass intact. Pots were generally divided into four or eight groups, then multiple sprigs were planted in each plot.

Several types of fences were constructed to protect planting areas from predators (from land and/or water), provide a wave barrier, exclude water hyacinth, and increase sedimentation. All fences are constructed similarly with four-foot plastic fencing, lashed with nylon rope to wooden posts set manually. Predation fences are designed to prevent or discourage predation primarily by nutria or grass carp (by water) and cattle or deer (by land).

Wave barriers are constructed to dampen the wave energy and prevent transplants from washing away before establishment of root systems. In addition, the exclusion of water hyacinth has been a serious issue at sites located in Armand Bayou, and without protection many young transplants can be crushed by floating mats of hyacinth. Brush fences were used to dampen the erosional effects of wave action, facilitate the accretion of sediments, slowly increasing elevation to a level where a marsh can become established, and protect the new transplants from rafts of water hyacinth. Brush fences consist of two rows of fence approximately three feet apart, with the area between the rows filled with Christmas trees, or other source of brush material.

A unique approach to restoring intertidal marshes using a dredge was implemented during the 1995 season. This project differed from other dredging projects by focusing on the fill area instead of the excavated area. A plan was developed to use a hydraulic dredge to move material from the middle of Armand Bayou to the designated project area, to restore appropriate elevations for the planting of approximately 6 a of smooth cordgrass. The new sediment and plants were to be protected by a brush fence constructed by volunteers.

Results

The Clear Lake Marsh Restoration Task Force identified 19 sites in the Clear Lake watershed suitable to plant smooth cordgrass. The sites are located in Armand Bayou, Taylor Bayou, and Clear Creek (tributaries of Clear Lake), and several small waterbodies in the town of Seabrook. A map of the project area is shown at the end of this abstract.

During the first year of the program, 1994, marsh restoration activities began around Clear Lake. Previously unidentified factors adversely affecting marsh development emerged in each of the four planting regions. Concerns in each region were addressed as appropriate.

Armand Bayou experienced heavy flooding in 1994, resulting in the movement of a large raft of water hyacinth downstream. As water receded, the hyacinth rafts broke and drowned many of the young cordgrass transplants. Wind driven waves caused severe erosion in portions of the Bayou. Fences were constructed at most sites to deflect water hyacinth rafts and dissipate wave energy. Damaged sites were replanted in 1995, and to date are developing well.

Clear Creek marsh restoration sites were heavily damaged by predation from exotic species, including nutria (*Myocaster coypu*) and grass carp (*Ctenopharyngodon idella*). No further planting occurred at the two Clear Creek sites in 1995.

Three sites were planted in Seabrook. Of the three, two suffered heavily from predation by nutria, and planting was halted until the nutria problem can be addressed. The third site has developed very well. Originally planted in 1994, it has continued to expand to more than 2,000 sq ft of marsh.

Some of the six sites in Taylor Bayou have suffered from predation, not from aquatic predators, but from cattle grazing. The problem has been reduced by fencing along the shore restricting access of cattle to the new cordgrass transplants. Plantings have been very successful in Taylor Bayou, with most sites developing rapidly.

The restoration of smooth cordgrass marshes in these areas has been very successful, with the few exceptions stated above. To date, 5.26 a of marsh have been successfully established in Armand Bayou, 1.5 a in Taylor Bayou, and 0.03 a in Seabrook. During marsh restoration efforts a survival rate of approximately 60% in transplants was maintained.

The volunteer participation in the two-year program has been excellent. In 1994, 247 individuals volunteered on 25 dates, representing 15 groups, and in 1995, 383 individuals volunteered on 35 dates, and represented 22 groups. With more than 600 individuals volunteering, a significant educational opportunity was created.

The educational component of the program included the identification of aquatic organisms found in salt marshes by sampling with a seine net. It also included a discussion of other functions of marshes for shoreline stabilization, water quality improvement, and flood water retention. Volunteers were also informed of the impacts of human activities and causes of wetland loss in the area.

Through the plantings of 1994 and 1995, 6.81 a of marsh were successfully established. This newly established marsh is expected to develop well, and expand from originally planted areas.

Conclusions

The Clear Lake Marsh Restoration Program has been a success by allowing GBF to introduce hundreds of volunteers, both young and old, to the importance of coastal wetlands. It has fostered cooperative relationships between federal and state agencies, industry, civic groups, and citizens. Through the program, various innovative restoration techniques were evaluated, including the unique Armand Bayou Site #4 dredging project, which although still new, is showing signs that a smooth cordgrass marsh will successfully develop at the site. Pending further evaluation, using dredging for the explicit purpose of marsh restoration may be an effective option for restoring marsh where suitable elevations have been lost.

Finally, the Clear Lake Marsh Restoration Program has resulted in the establishment of 6.8 a of marsh. With some acreage remaining to be planted in 1996, approximately 9 a of marsh should develop through the Clear Lake program.

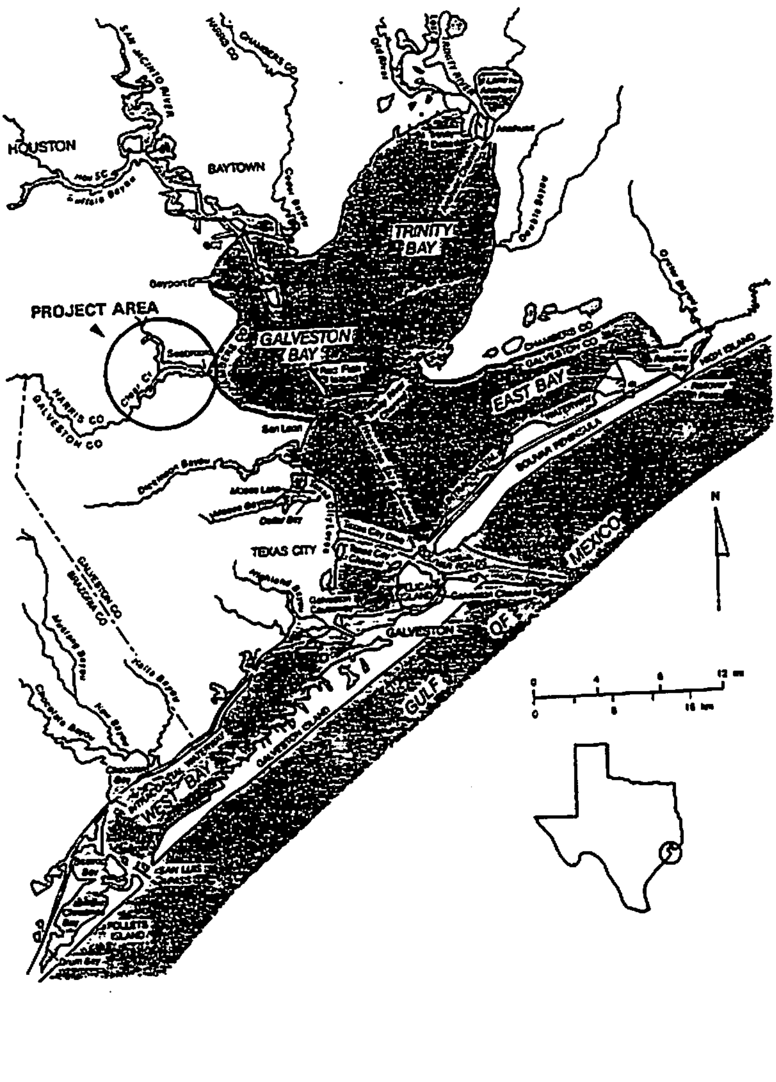
Some of the lessons learned through the program have been that communication and cooperation between agencies, industries and citizen groups is key to successful project development and prevention of work duplication. Also, when evaluating restoration sites, special consideration should be given to potential problems, such as predation, when developing restoration plans for those sites. Finally, public education and outreach play key roles in increasing public awareness of wetland importance and providing continued project support. The experiences and lessons learned through this project will be long-lived and contribute to future marsh restoration success.

The Clear Lake Marsh Restoration Program has demonstrated the efficacy of large-scale marsh restoration performed primarily by volunteers. The Clear Lake program was a watershed approach to marsh restoration and can serve as a model for other watershed projects, cultivating cooperation, participation, and education among diverse partners.

John A. Huffman
Galveston Bay Foundation
17324-A Highway 3
Webster, TX, USA 77598

Ph (713) 332-3381
Fax (713) 332-3153

Appendix A Project Area Map



Clear Creek/Clear Lake Marsh Restoration Program
Planting Summary Table For 1994/1995

	1994	1995	TOTAL
Acres of marsh planted.	3.47 A	5.89 A	9.36 A
Acres of marsh established.	1.61 A	5.20 A	6.81 A
Acres remaining to be planted.			2.00 A
Linear feet of shoreline protected.			14,900 ft
Planting/Fencing trips	25	35	60
Participants*	326	506	832
Individual volunteers	247	383	630
Participating groups	15	22	37

* Participants includes individual volunteers that participated on more than one occasion.

PRIVATE SECTOR INFLUENCE ON COASTAL DEVELOPMENT ACTIVITIES IN SMALL ISLAND DEVELOPING STATES

Leah Bunce, Duke University and
Foster Derrick, Environmental Awareness Group

Natural resource conservation and sustainable development issues are critical in small island developing states where resources are extremely limited and there is intense pressure to support increasing levels of growth. Due to the small size of these states, coastal resources are threatened by island-wide development activities that lead to habitat loss, coastal pollution and ecosystem degradation. In the Caribbean, the transition from agricultural to tourism-based economies has placed intensive pressure on these limited coastal resources. As activities intensify, private sector groups, including community groups, non-government organizations, user group associations, and individual constituencies, have begun to play an increasing role in natural resource management. Evidence of collaborative efforts in the Caribbean include the active involvement of fishermen and dive businesses in the establishment of marine zoning regulations in St. Lucia, the participation of dive operators in coral reef mooring programs in the British Virgin Islands, and the financial support of hotels in coastal environmental assessment studies in Barbados.

As a case study in coastal management in small island developing states, this paper focuses on the role of the private sector in influencing coastal development activities in Antigua. This paper examines the strategies employed by a coalition of environmental and community awareness groups to pressure the government and coastal developers into adapting sustainable development practices for construction of a large tourist development. This case, which became known throughout the Caribbean as the Coconut Hall conflict, was the first instance of effective private sector influence on development practices on the island. This paper is based on document analysis of Development Control Authority files and coalition members' records and interviews with the coalition members, Development Control Authority officials, and the developers.

Central Players in the Coconut Hall Conflict

The Coconut Hall conflict initiated in 1990 when an Italian development company, La Canzone Del Mare Ltd., proposed a large tourist development project in the northeast area of the island. The initial plans for the development covered a 86-acre area and included: a 25-room hotel, residential facilities for 1,200 residents, a marina, a shopping center, an amphitheater, tennis and golf facilities, a church, a disco and casino, an extensive road network, and parking facilities. The development was intended to eventually extend to 300 acres, which was viewed by the developers as otherwise desolate land.

At the Cabinet level, the Antigua and Barbuda government expressed strong support for the project noting that it would provide employment and economic influx during a time when Antigua was undergoing an economic lull. As the manager of the Antiguan construction company contracted to Canzone noted, the hotel is very important to Antigua at a time when investment in the economy has slowed to less than a trickle, in the face of economic downturn in the industrialized world" (Outlet, 1993). Cabinet granted the company "approval in principal" for the project, indicating Cabinet supported the project.

The government agency legally responsible for reviewing and approving development projects on the island, the Development Control Authority (DCA), expressed strong concerns with regards to the paucity of information available on the project plans and the impacts of construction activities on the mangroves. Despite intense pressure from Cabinet to approve the project, the Acting Town and Country Planner (TCP) of DCA, whose approval was legally required in order for construction to begin, refused to grant permission without an environmental impact assessment.

There were four distinct private sector groups which formed a coalition to pressure the government and developers involved in the Coconut Hall development into ensuring sustainable development practices were conducted. Central to this coalition was the Concerned Citizens of Seatons, a group of citizens from the community near the development. Based on the limited information available on the development, the group had serious concerns regarding impacts on the marine environment and the community's way of life. Furthermore, they objected to being excluded from the consultation process given the anticipated impacts on the community. In order to strengthen their position, the Concerned Citizens of Seatons sought the support of other organizations. The Environmental Awareness Group became strongly involved because of members concerns regarding the impacts of construction activities on the surrounding mangroves and the general coastal ecology of the bay area. The Old Road Community Group and the Bethesda/Christian Hill Community Group, both of which joined the coalition, were undergoing similar experiences in which they were protesting foreign developments on their respective coastlines. By joining forces these groups felt they could be a stronger voice against unplanned development on the island.

The primary objective of this coalition was to inform the public about the development plans and their anticipated impacts on the community's way of life, including restrictions on beach access and increased activity in the area, and to update the public of the construction activities, specifically the destruction of the mangroves. The secondary objective of the coalition was to pressure Cabinet into investigating and mitigating the adverse effects of construction activities and the development project as a whole. Finally, through international publicity, the coalition sought to reach the Coconut Hall investors themselves to make them aware of the devastation they were financing.

Brief History of Coconut Hall

Despite lacking DCA approval, land clearing initiated in September, 1992, instigating a six-month battle between DCA, the coalition, the government ministers, and the developers. During this period, construction activities escalated from clearing of terrestrial vegetation to excavating mangroves below the high-water mark. The coalition initiated an active campaign to pressure the government and developers to mitigate the environmental degradation caused by construction practices and to address the coalition's concerns that sustainable development practices be followed. The coalition efforts were successful in temporarily halting construction activities on four occasions. However, with ministerial-level support, construction resumed within a few days to weeks on all four occasions. After one particularly dramatic demonstration on the construction site, the Prime Minister vowed to call the defense force out after the protesters if they didn't stop "harassing" the developers, warning "when people lie down in front of bulldozers, sometimes bulldozers run them over" (Wilson, 1993).

The TCP informed the developers repeatedly that their actions were illegal; however, his objections were literally over-written by the Prime Minister and the Minister of Housing, Lands, Fisheries and Agriculture, who maintained strong support for the project. Originally, the Prime Minister and the Minister tried to pressure the TCP into granting approval. In one case, the Prime Minister held a meeting at the construction site with Cabinet and the TCP in which the Prime Minister publicly berated the TCP for opposing the project. Finally, after unsuccessfully pressuring the TCP into granting project approval, the Minister of Housing, Lands, Fisheries and Agriculture drew up a letter on DCA letterhead and signed it granting construction to continue. As public pressure increased during the six months, the other Cabinet members began to distance themselves from the project leaving the Prime Minister and the Minister alone to defend the project.

The Coconut Hall incident finally drew to a close in February, 1993, when the developers declared bankruptcy. At this point half a mile of mangroves had been destroyed, which remains bare three years later. Shortly after the end of the Coconut Hall conflict, the TCP, realizing that his opposition to the development project would limit his future career in the Antigua and Barbuda government, resigned and left the country.

Coalition Strategies to Pressure Government and Developers

To pressure the government and the developers into reducing the environmental destruction caused by construction activities and adapting sustainable development practices for the development project, the coalition employed a combination of five strategies, involving five separate sources of power: (1) unified resources; (2) highly publicized and grandized demonstrations; (3) international and national media attention; (4) pressure from politically-influential individuals; and (5) court action.

Unified Resources

The existence of a coalition enhanced the resources available to pressure the government and developers. Each of the four coalition members contributed an important and complementary skill or resource to the coalition. The Environmental Awareness Group (EAG) and the Concerned Citizens of Seatons (CCS) together strategized and coordinated coalition efforts, finding that they provided a good team of information with regards to how Antigua works. EAG was particularly effective in meeting with government officials because members had the technical expertise to comment on the environmental impacts of the construction activities. EAG was also critical in providing office support, including issuing regular press releases. CCS provided the manpower and moral support for the demonstrations and legitimized efforts by providing community concern. Since Old Road and Bethesda/ Christian Hill Community Group were undergoing similar experiences, they were able to advice on how to effectively work with government and contributed to presenting a large, vocal voice against unplanned development on the island. The leader of the Old Road Community Group was particularly effective in providing support and boosting morale among coalition members which was critical during the six-month process.

Highly Publicized and Grandized Demonstrations

One of the coalition's most effective means of pressuring the developers and the government was through on-site demonstrations. On several occasions, coalition members went to the construction site and either talked with the operators and/or threatened to stand in their path and in the process created a substantial enough raucous to halt the construction activities for several days.

The dramatic nature of these actions attracted international and national media attention. The protests were highly publicized and to some extent grandized by the press. For example, the media reported a protest in November in which "a group of young environmentalists formed . . . a human barricade to prevent bulldozers from bull-dozing the remainder of the mangrove at Coconut Hall" (Outlet, 1993). As a result of the press coverage of this incident, the protesters became known throughout the Caribbean as having laid down in front of the bulldozers. In actuality, one morning the leader of the coalition observed an excavator digging out the mangroves and called a few other members to come over to protest. Four coalition members went to the site, talked to the excavator operator, showed him the DCA document refusing construction approval and the excavator stopped clearing the area.

International and National Media Attention

Throughout these events, the media was used to attract national and international attention to the conflict and subsequently pressure the government into addressing the coalitions concerns. Initially, the members of the coalition issued daily press releases. The coalition members also held two panel discussions on a popular local radio station "Talk to Me," which brought island-wide attention to the conflict. Caribbean News Agency began following the protesters, including taping confrontations between the protesters and the developers, and these stories were carried by local and regional stations from Jamaica to Grenada. At the height of the conflict, the BBC interviewed the leader of the coalition and subsequently broadcast the story throughout Europe and the United States.

Pressure from Politically Influential Individuals

Another tactic employed by the coalition was to contact politically influential individuals and request they use their influence to pressure the government and the developers into mitigating construction damage and ensuring sustainable development practices for the duration of the project. The coalition members used their personal contacts to reach and meet with these individuals. Each contact was presented a facts file which included copies of all the public records on the project. The contacts were asked to simply read through the documents, make their own judgments regarding the impacts of the development, and then do what you can behind closed doors. Given the social nature of business and politics in Antigua, this was an important means of reaching politicians. Although there are no records of the influence these contacts had on policy-makers, coalition members considered the pressure Cabinet members and other government members felt from behind closed doors was one of the most significant means of pressuring Cabinet members into distancing themselves from the project.

Court Action

The final strategy worth note was court action which was intended to draw further media attention to the case and to publicly embarrass the developers. Within the first months of the construction activities, the leader of the coalition filed a private criminal action against La Canzone Del Mare Ltd. for initiating development activities without DCA approval. The magistrate heard the case in March and, following four postponements, delivered his verdict in May 1993 after construction had ceased. The magistrate failed to pass judgment on the legality of the development activities declaring that no license had been granted to the developers. Subsequently, no sentence or reprimand was passed on either the prosecution or the defense. Although the case was left unresolved, it succeeded in embarrassing the developers and attracting further media attention.

Impacts of Coalition Strategies

The most direct impact of the coalitions efforts was to halt construction activities temporarily and to draw international and national attention to the conflict. The delays in construction, which cost the developers both time and money, are felt to have contributed to the eventual bankruptcy of the project. In addition, the delays succeeded in reducing the amount of mangroves destroyed prior to bankruptcy.

The coalition efforts also had several indirect impacts. For the first time in Antigua, environmental issues became a major national issue. The coalition received financial and moral support from numerous individuals concerned with the development activities, although unwilling to participate in the public protests. Support came from abroad as well. Members of the Antigua and Barbuda Cultural Society and Children of Freetown Antigua, based in New York, wrote a letter To All Antiguans in the Outlet, an Antiguan paper, stating their outrage at the developers' "indifference to the irreversible damage the construction . . . would cause to Antigua . . ." (ABCS and COFA, 1993). This new interest in sustainable development and environmental issues sparked discussions and action throughout the island. For instance, a year following the Coconut Hall conflict, teenagers discussing environmental concerns on a local youth television show noted the importance of mangroves and commented that the destruction at Coconut Hall "should never happen again" (ABS, 1994). Finally, in the months following the conflict, the coalition leaders were asked to give presentations to community groups experiencing similar conflicts in order to provide advice and support to these groups. These experiences indicate that the Coconut Hall conflict brought the publics concerns and expectations regarding sustainable development in Antigua to the forefront of political issues.

The coalition actions had repercussions throughout the Caribbean. Most significantly, the coalition members provided support to other private sector groups working to affect sustainable development in their states. Following the conflict, the coalition leader attended conferences in Martinique, St. Lucia, and Tortola on natural resource management where he was a key participant on the role of community groups in sustainable development. It was clear that news of the coalition's efforts had reached throughout the islands. The coalition leader noted, "I could see the recognition in their faces. Just seeing my face or hearing my voice, they knew me as the man who laid down in front of the bulldozers."

Finally, the coalition's opposition to the development project provided support to government officials dissatisfied with the ministers manner of superseding government procedure. Tired of being bulldozed by top-level politicians, officials were more willing to speak out when they had the support of the community and the environmentalists. For instance, at the monthly meetings of the Historic, Conservation and Environment Unit, representatives of the government agencies on the board spoke readily about their concerns and opposition to the project due to the environmental damage from the land clearing and their sincere dissatisfaction with the skirting of government procedures by the ministers.

The Coconut Hall conflict demonstrates the impact private sector groups can have on coastal development activities in small island developing states. The strategies employed by the coalition of community and environmental groups had significant direct and indirect impacts on furthering sustainable development on the island and to some extent throughout the region.

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Leah Bunce
Duke University Nichols School of the Environment Marine Laboratory
135 Duke Marine Lab Road
Beaufort, NC, USA 28516-9721

Ph (919) 504-7566
Fax (919) 504-7648
Email llmb@acpub.duke.edu

Session D4: Valuing the Coast and the Management of Coastal Recreation: Examples from England
Session Chair: Simon Edwards, Center for Coastal Zone Management, Portsmouth, United Kingdom

THE CONTRIBUTION OF DEVELOPMENT PLANS TO COASTAL ZONE MANAGEMENT: THE CASE OF RECREATION PROVISION

Jane Taussik
Centre for Coastal Zone Management,
University of Portsmouth, UK

This paper examines the contribution that statutory development plans can make to coastal zone management, a non-statutory activity in many countries. It suggests that opportunities for integration and interaction between the two types of plans should be maximized. Using case studies of England/Wales and Sweden, it suggests that institutional frameworks can enhance or limit the opportunities for such integration. Coastal recreation is used as an exemplar of the types of policy included in both development and coastal zone management plans.

Introduction

Recreation contributes to the conflict of interests experienced in the coastal zone. It is increasingly difficult to be unaware of this as attractive coasts become overdeveloped by tourist use or sand dunes become eroded by overuse. Conflict within the coastal recreation sector is equally obvious where, for example, noisy and dangerous recreation coexists with family use of beaches or water-based recreation operates at a level dangerous to less skilled users.

Coastal zone management is proving a valuable approach to resolving these conflicts between and within use groups at the coast. Issues and conflicts, opportunities, and constraints are identified as preliminary stages to establishing objectives and determining strategies for the best and sustainable future use of the coastal area. The needs of and opportunities for recreation form part of these strategies. However, in many countries, including Great Britain, such an approach is non-statutory. It has no basis in law. There is no requirement for coastal zone management to be undertaken. The coastal zone management plans are not supported by statutory mechanisms of implementation but are dependent on the positive support of contributory and affected bodies.

Most developed countries have some form of statutory town and country planning system involving a combination of approaches for forward planning and mechanisms for the control of development. This offers opportunities for the policies of non-statutory coastal zone management plans to be incorporated into a statutory system (Taussik, 1996a). While this will not cover the non-development aspects of, for example, coastal recreation, it does offer a more reliable mechanism for the implementation of coastal policy. However, the characteristics of any planning model greatly influences its ability and scope to respond to policies generated for uses spanning the land/water divide.

The objectives of this paper are, therefore:

1. to identify statutory mechanisms which can assist in the implementation of coastal zone management plans;

2. to establish how recreation policies can be incorporated in statutory plans; and

3. to demonstrate the effect of legislative frameworks on the ability of statutory plans to incorporate policies for coastal recreation.

It will draw evidence from the planning systems of England/Wales and Sweden.

Planning Systems

Both England/Wales and Sweden have well established planning systems for resolving conflicting demands in the use and development of land and property. Both can make a significant contribution to coastal zone management. Both employ plans setting out policies and proposals for the future use and development of land and property: the development plans of England/Wales and the comprehensive (översiktsplan) and detailed plans (detaljplan) of Sweden (Taussik, 1996b). The preparation of both countries' plans involve input from a wide range of interests as well as the public. They are ideally placed to incorporate management policies which involve the use and development of land and property and, indeed, should both inform and be informed by the coastal zone management plans. This can include policies for coastal recreation or any other coastal activity.

Development Plans in England and Wales

In England and Wales, development plans include the more strategic structure plans prepared by county planning authorities and the more detailed local plans prepared by district authorities or unitary development plans produced by London boroughs and metropolitan districts.

Development plan policies for coastal recreation are wide ranging and this is one of the most frequently occurring types of coastal policies (Taussik, 1995), reflecting the value of the coast as a recreation resource and the conflicts that result between different categories of recreation use and between recreation and other users of the coast.

Plans include restrictive policies protecting the undeveloped protected coast from further recreation (or other) development and more positive policies encouraging the provision of recreation facilities in the developed coast. In many cases, very specific policies for particular types of recreational development in particular areas are included and, increasingly, recreation and tourism development is proposed as the basis for urban regeneration of port and dock areas. Increasingly authorities are including policies providing for public access to the coast, intending to see this incorporated into development proposals and implemented through obligations or agreements associated with planning permissions. These are legal agreements between developers and planning authorities which require the developer to provide particular aspects of development on or off the development site, either directly through the provision of land or development or, less directly, through a financial contribution to associated facilities required by the community.

The limitations of land use planning in England and Wales to deal with, particularly, informal recreational use of the coast are recognized by authorities, some of whom make reference to the importance of management measures or plans to protect sensitive or congested areas, thereby giving enhanced status to what are, otherwise, non-statutory policies. Similar policies should be incorporated to relate to the new estuary, harbor and coastal management plans now being produced.

In England and Wales, local planning authorities are further limited by the area of their jurisdiction which, normally, extends only to the low water mark. This limits the opportunity for policies for water areas to be incorporated in development plans so that, normally, only land-based aspects can be included. While government advice states that planning authorities need to consider the effect of land based uses and activities on coastal water areas, very few authorities demonstrate such consideration in their development plans. It appears that the areal extent of their administrative responsibilities has allowed them to pursue a very land based system of planning which has generated a "land by the sea" approach to coastal planning matters (Taussik, 1995). The emerging coastal management plans in England and Wales could do much to help address this shortcoming.

There is scope, therefore, in England and Wales, for recreation aspects of coastal management plans to inform the preparation of development plan policy and for appropriate recreation and other policies in coastal zone management plans to be incorporated in development plans where their effectiveness is enhanced by the statutory status of the development plan. This scope could be extended if local planning authorities were less constrained by their administrative boundaries.

Planning in Sweden

A different planning model exists in Sweden where municipalities are charged with planning the use of land and water areas (water areas include rivers, lakes, ground waters and coastal waters). The jurisdiction of municipalities extends to the limit of the territorial sea, *i.e.*, to 12 nautical miles. Clearly, therefore, the Swedish system allows for there to be much closer integration between coastal zone management and planning. This is evidenced by the substantial contribution that can be made by the mandatory comprehensive plans (Ackefors and Grip, 1994) which provide the framework for the detailed plans. Comprehensive plans must be prepared by all municipalities to show, not only the use of land areas but, also, the use of water areas. These plans identify, for example, navigation channels, areas for different recreational uses and seabed areas protected for scientific or fisheries resources as well as land protected for its conservation or economic value (Taussik, 1996b). They provide the context for decision making for development on land or at sea. It would appear, therefore, that the Swedish planning system is well equipped to overcome some of the shortcomings associated with the England/Wales system.

While planning is well established in Sweden, the requirements for planning to include land and water areas and for comprehensive plans are relatively new, being introduced in 1987. At that time, planning was also made more decentralized with the municipalities' role enhanced at the expense of central Government's National Land-Use Planning which had operated for some 20 years (Westman 1991).

The first round of comprehensive plans have been disappointing in their treatment of water areas (Boverket, 1995). Land and water are not universally included in comprehensive plans and, even where both exist, they frequently generate separate elements of the plan so the intended integration is lacking. Secondly, coastal water and sea areas are frequently not identified as municipal planning areas and are, therefore, not included in the plan. Thirdly, while some municipalities include their archipelagic land and water, relatively few include the full extent of coastal waters (*i.e.*, to the limit of the territorial sea). Fourthly, where municipalities have included coastal water areas, its treatment is much less satisfactory than the treatment of land areas. It also tends to relate only to the water surface and not to include the water column or the seabed. Finally, the linkages between land use and water quality and its control are not clearly developed in the plans. Although some municipalities have advanced considerably in terms of coastal water planning generally and the planning for water based recreation specifically, there is great uncertainty among municipalities about the extent of their planning responsibility and the methods they should use for planning in coastal and sea areas. None the less, where comprehensive plans for land and water areas have been produced, they do demonstrate the very real potential of the planning system to provide a strong, implementational framework for coastal zone management and it is expected in Sweden that the second round of comprehensive plans will incorporate land and water planning in a much more satisfactory manner (Taussik, 1996b).

Conclusions

In many countries coastal zone management is a non-statutory activity. Coastal zone management plans depend on the support of the contributory and affected bodies for their implementation. Town planning, on the other hand, tends to be a statutory activity, incorporating plans expressing intentions for the future use and development of land and property and, perhaps, water areas. Both types of plans include policies and proposals for the future recreational use of coastal areas and it seems clear that all possible opportunities must be used to integrate and interrelate the two. Both provide opportunities to inform the other, each provides a context for the policies and proposals of the other and each can reinforce the policies of the other.

However, it is clear that the planning model of any nation can enhance or limit the opportunities for such integration and interaction to take place. Where the planning system is limited to land areas or to land above the low water mark, the opportunities to develop a framework of integrated policy for water-based recreation are limited, even where contexts exist for the consideration of on-shore activities on off-shore areas. Where the planning system extends over the territorial sea, opportunities exist for considerable interaction and for the incorporation of a wide range of elements of the coastal zone management plan in the development or other type of plan.

Whatever model of planning exists, all opportunities for integration must be maximized. Most planning systems, and certainly the two discussed above, incorporate provisions for public participation in plan making. Advantage must be taken of these provisions to ensure that integration happens with increasing frequency and purpose.

The experience of Sweden demonstrates that the provision of appropriate institutional frameworks is not sufficient to ensure the consideration of coastal issues universally or the full integration of coastal policy, including for recreation. Those operating the planning systems need to have an increased awareness of the need for a strategic approach to a coastal zone which incorporates the land, the sea bed and the water area. Only in this way will appropriate policies for coastal recreation, including water based recreation, be generated in statutory plans in nations where coastal zone management is not a statutory activity.

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Jane Taussik
Centre for Coastal Zone Management
Department of Land and Construction Management
University of Portsmouth
Portsmouth, Hampshire, UK PO1 2LF

Ph +44 (0) 1705 843151
Fax +44 (0) 1705 843154
Email taussikj@lacm.port.ac.uk

THE MANAGEMENT OF RECREATION IN ESTUARIES AND HARBORS IN ENGLAND, THE WAY FORWARD

Simon Edwards
Centre for Coastal Zone Management, University of Portsmouth, UK,
and David Nowell
Centre for Coastal Zone Management, University of Portsmouth, UK

Summary

This paper considers management of coastal recreation in England using examples from Poole Harbor, Dorset; The Medway and Swale, Kent; the Medina Estuary, Isle of Wight and Portsmouth Harbor, Hampshire. It is suggested that while the use of zoning for heavily congested and environmentally sensitive areas may be appropriate in some circumstances, other less restrictive methods may prove to be more successful in the long term, particularly through improvements in provision of information, liaison and education. This is especially true when the costs of enforcing zoning or bylaws is taken into the account and the difficulties in achieving successful prosecution of those who regularly disregard such initiatives.

Background

Coastal recreation in England has undergone an unprecedented period of change since the Second World War, with increasing numbers of people taking up water-borne activities. Post-war growth in prosperity, matched by increasing leisure time and increased car ownership (Ratcliffe, 1992), has led to an increase in water-borne recreation nationally, placing pressure on inland water resources and on coastal water bodies. Over the last 40 years, there has been a progressive transformation from traditional casual activities, such as sailing, rowing, and canoeing, pursued by small groups of enthusiasts, to wider public participation, both as individuals and formal groups. Both the range of activities and their technological complexity have demonstrated marked growth with activities such as water-skiing, personal water craft, windsurfing, and motor boating being added to the list of popular sports. The coast's attraction for such recreation lies in part with its scenic quality, its wilderness appeal, the available space, and the relative lack of control and regulation compared to some inland waterways (Pickering *et al.*, 1995).

Estuaries and natural harbors have always been popular venues for recreation, due to their relatively sheltered waters compared with the open coast, but these areas are also very important for the flora and fauna that they support and for commercial activities, particularly port related operations. It is now considered that recreation is a prominent activity in at least 60% of British estuaries, to the point of exerting pressure on both the natural environment and other user groups (Davidson, 1991).

English Nature, the UK government's agency for advising on nature conservation in England, has developed a strategy to address the problem of balancing the demands of the various uses of estuaries with the need to maintain their ecological value for the benefit of future generations. This is known as the estuaries initiative and forms part of their "Campaign for a Living Coast" (English Nature, 1993). One of the principal aims of this initiative is to promote the development of integrated multi-sector estuary management plans through the provision of advice and financial assistance with 19 estuaries initially selected for such support in 1993/4. One of these was Poole Harbor in Dorset, where a significant number of conflicts had been identified between commercial, recreational, and nature conservation interests and where an innovative zoning scheme was devised to improve the management of recreational activity. More recently English Nature have subsequently extended support to a number of other estuaries including the Medway and Swale in North Kent, Portsmouth Harbor, Hampshire, and the Medina Estuary on the Isle of Wight (see Figure 1 for locations).

The management of recreation on these estuaries and harbors will now be considered focusing on the methods used or proposed, associated problems and suggested solutions.

Poole Harbor

This harbor has long been popular for water sports but growth in these activities and expansion of the commercial port has led to increasing concerns over safety and the enjoyment of the recreational experience. Added to this is the importance of the harbor in terms of its ecology and landscape, being both an Area of Outstanding Natural Beauty (AONB) and a Special Protection Area (SPA) under the European Community Birds Directive (1979). Within the harbor, there is an element of natural zoning with the southern half being relatively inaccessible and at the same time constituting the area of greatest ecological significance. However, there was potential for serious conflict between commercial shipping and recreational craft in the main shipping channels and narrow harbor entrance which needed to be addressed.

In response to this a zoning plan has been put into place (Figure 2) allocating specific areas of the harbor for individual recreational pursuits. This was based, as far as possible, on existing patterns of use and the proximity of suitable launch points and parking. In order for the zones to be enforceable, a bylaw limiting the speed of power driven craft to 10 knots has been imposed throughout the harbor, which is then relaxed within the specified zones to enable the activity to take place. The provision of zones is also intended to minimis the risk of conflict between different recreational activities. For example, water skiing and personal water craft operation were considered to be incompatible and, therefore, spatially segregated.

The implementation of the zoning arrangement has necessitated the use of some considerable resources, including the production of publicity material and adequate signposting, as well as the need to allocate resources to the enforcement of the zones. It is recognized that many of the recreational users of the harbor are not necessarily local, or members of clubs or national governing bodies for particular sports and that only a small minority of users cause significant problems for the authorities. How successful this will be in managing sports in the harbor is yet to be seen, although there are indications that some user groups are not happy with the level of discussion which took place incorporating their views on the needs of their sports. Water skiing was an exception to this and the British Water Ski Federation was fully involved in the zoning arrangement for water skiing, which is now managed by a local affiliated club, although some long established users of the harbor are thought to be unhappy with the new £60 annual fee imposed for a water ski permit.

Medway and Swale

The future management of recreation on this important waterway for sailing is being considered under the North Kent Marshes Initiative. There are a considerable number of activities which take place here and two zones already exist for water skiing. These are based on the lifting of speed restrictions to allow the activity to take place, but do not necessarily preclude other users from these areas. One stretch is under the control of a water ski club and can only be used for this purpose with their permission, which in turn has been granted by the port authority. This goes some way to ensuring the good behavior of those who take part. There is a possibility of creating an additional zone for personal water craft, although a suitable location has yet to be found and agreed upon. However, access to the water throughout the marshes is limited, particularly in terms of public launch points, where there have been a number of incidents due to congestion. One of the initiatives here has been the formation of a recreation user group forum, which includes representatives from all the sports represented in the estuary, including land-based recreation. Representatives from the Personal Watercraft Association are included and have been able to discuss with other users the requirements of their sport. This has given greater support to the idea of a zone for this activity. This type of involvement in the management process is now being seen to be crucial to the successful implementation of any plan and, in the case of the Medway & Swale, may help to alleviate pressure on access points by encouraging private clubs to allow their launch facilities to be made available to non-members. The port authority lack the resources, but not the willingness, to fully police the waterways and it is hoped that the user forum will go some way towards reducing recreational pressure on the waterways for the benefit of all users.

Medina Estuary

The Medina estuary is covered by two harbor authorities, namely Newport and Cowes, and is dominated by non-motorized recreational activities, principally sailing, but also including rowing, canoeing and on the landward side, angling, walking, and cycling. The main concern here is congestion and consequent safety implications in Cowes Harbor, particularly during the busy summer months. The Harbor Master does have bylaws to control the speed of craft and is prepared to enforce them, however the cost of doing so is far greater than the fines imposed for successful prosecution. Consideration is now being given to alternative methods of management, particularly the use of education and information provision, a process which has already started through the creation of a recreation topic group, representing members of clubs and associations which use the estuary. This group has been working together to establish management priorities for recreation and through this process are themselves becoming more aware of the needs and interests of other recreationalists. This also gives the clubs and associations an involvement in the management process and a sense of ownership which means that future management initiatives are more likely to be supported and, therefore, ultimately more successful.

Portsmouth Harbor

In many respects, Portsmouth Harbor is fortunate in that many recreational activities are not permitted to take place within the Harbor, for example personal water craft, water skiing, and windsurfing. However, significant numbers of sailing craft are located within the harbor and there are concerns from some quarters over the possible effect they may be having on the ecology of the harbor, which is of international importance through its designation as a Special Protection Area (SPA). In a recent survey carried out by Smith (1996), 48% of sailors were unaware of the nature conservation designations and exactly which areas of the harbor were most sensitive to intrusion from sailing vessels. However, 67% expressed the view that if they did know then they would take steps to avoid those locations, reflected in the view of one sailor who said "I would avoid nesting/conservation areas, if I knew where they were." This would seem to suggest that a well designed program of information provision and signage would go along way toward reducing the possible negative effects of sailing within the harbor, without the need for more restrictive management.

Discussion

Sidaway (1995) has suggested that a good relationship is required between interest groups and resource managers if coastal recreation conflicts are to be avoided, and that it is the nature of the relationship rather than the nature of the impact which is important. It is, therefore, vitally important that managers consult or involve user groups as early as possible on issues which effect them. This is particularly true of recreation where it can be very difficult to identify individuals or groups of participants. In England this advice has not always been followed with consequent problems at the implementation stage of any proposed management initiatives, as has been the case in Poole Harbor. However, this and other early initiatives have been a useful learning experience, with greater emphasis now being placed on user involvement in the development stage of plan preparation.

The input of sports national governing bodies is now actively sought and to this end the Royal Yachting Association (RYA) have now produced a document which details their concerns and requirements for coastal planning and environmental policies, entitled "Recreation on the Living Coast." Included in this document is an invitation to all those charged with producing management documents:

We support the formation of estuary management groups to do this work, but their success will depend on the full involvement of recreational users in the plan making process. Together with our regional committees and affiliated clubs, we will make the best use of opportunities for such involvement (RYA, n.d.).

In addition to this guidance, Hampshire County Council have produced national guidance on coastal recreation signs (Badman, 1995), which addresses the issue of information provision and useful design criteria. It is not suggested that all signs should be the same, but that there are certain basic principles which, if adhered to, will improve recreational experience at the coast for all concerned.

Gubbay (1994) suggests that greater input from the public in the approach, content, and implementation of plans could make the whole process more positive and less likely to cause conflict. This approach appears to be the way forward for the majority of estuaries in England, although more restrictive options will still be necessary in some of our more congested waterways.

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Simon Edwards
Centre for Coastal Zone Management
University of Portsmouth
Department of Geography
Lion Terrace
Portsmouth, Hants, UK PO1 3HE

Ph (01705) 842009
Fax (01705) 842512
Email edwardss@geog.port.ac.uk

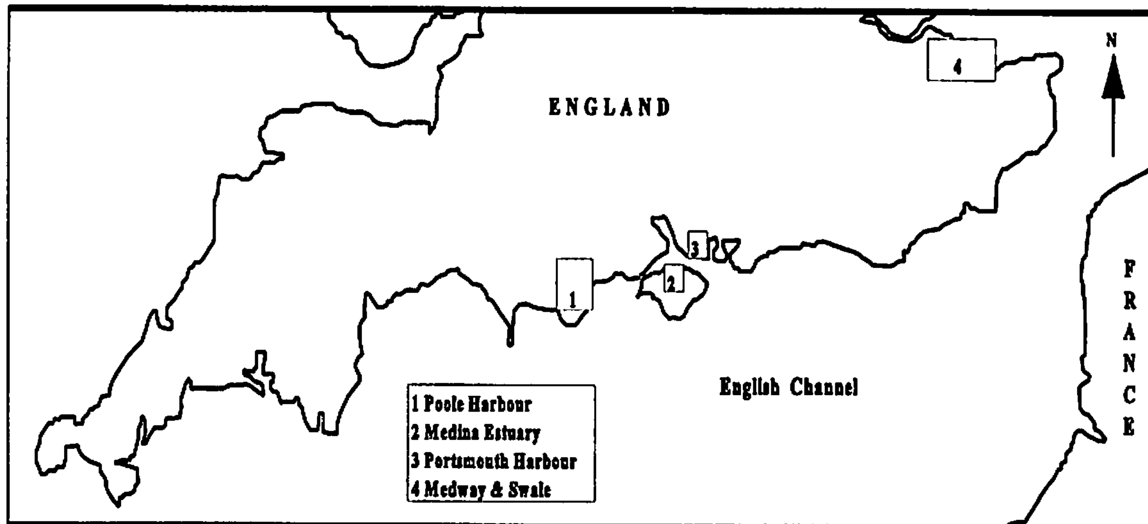

Figure 1 Location of Estuaries and Harbours Referred to in Text

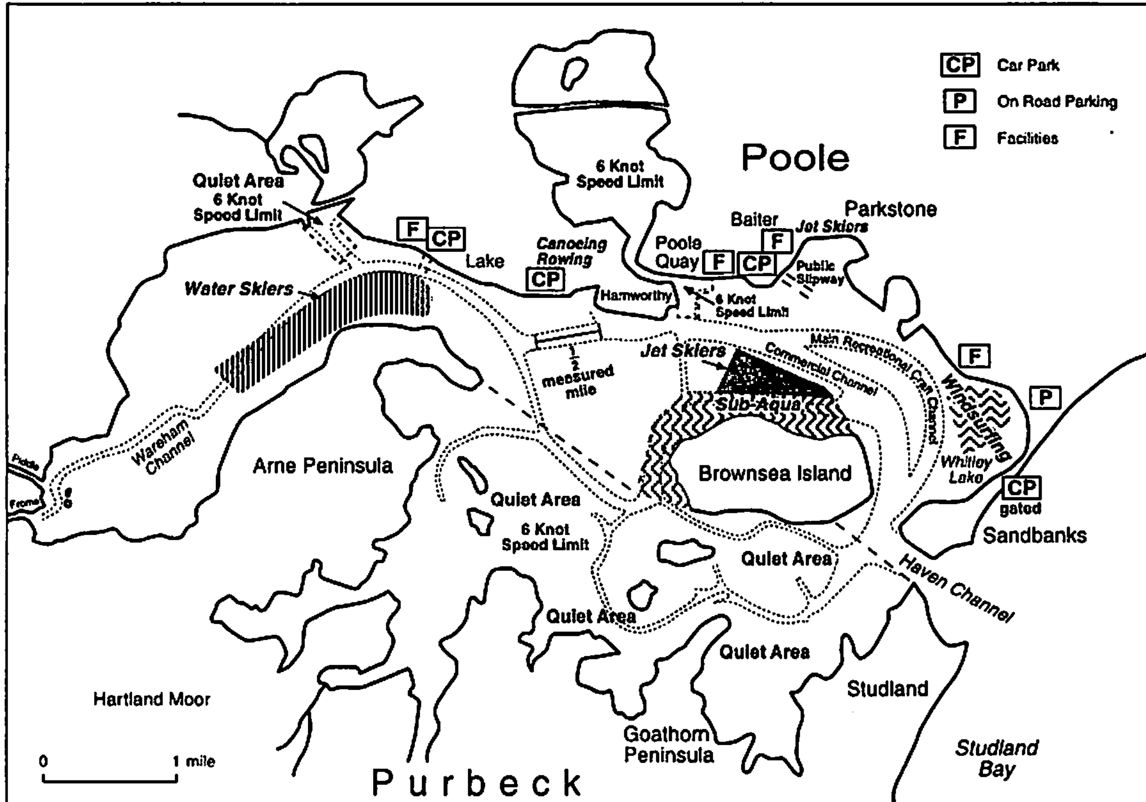

Figure 2 Poole Harbour Zoning Arrangements
(Source: Poole Harbour Aquatic Management Plan)

THE PROCESS IS AS IMPORTANT AS THE PRODUCT: AN EXAMINATION OF THE ROLE OF PUBLIC PARTICIPATION IN ESTUARY MANAGEMENT PLAN DEVELOPMENT IN THE UK

Caroline Davis,
Centre for Coastal Zone Management, University of Portsmouth, UK

Introduction

The need to incorporate public participation into the development of coastal zone management initiatives is becoming increasingly recognized within the UK. This paper examines the importance of involving the public in coastal zone management and will focus on the Medina Estuary Management Initiative as an example of how participation can be achieved in the context of estuary management plan (EMP) development.

Public Participation in CZM in the UK

Public participation in coastal zone management (CZM) has long been recognized as of benefit in the USA and Australia. Grenell (1995) asserts that the key to the success of California's coastal decision-making process has been the citizen-driven coastal movement of the 1970s. Consultation has resulted in community ownership of the plans and realistic recommended options making implementation much more straight forward.

Within the UK, public participation in CZM has been traditionally elicited through consultation, as based on the land-use planning system. Reports, policies, plans, and other documents are prepared on the basis of initial discussion with interested parties, then publicized and circulated for comment. In recent years the role of the public within CZM has been readdressed, in particular through the development of EMPs.

Estuary Management Plans

It is now recognized that the estuarine resource of the UK is under increased threat due to the increased levels of conflict between different uses and priorities (Rothwell and Housden, 1990; Pickering *et al.*, 1995). The need to adopt a strategic approach to estuarine planning and management was recognized by the UK government by its response to the 2nd report from the House of Commons Environment Select Committee on Coastal Zone Protection and Planning (DoE, 1992a) and through the government's development of Planning Policy Guidance 20: Coastal Planning (DoE, 1992b).

In 1993 English Nature (the government agency in England responsible for advising central and local government on nature conservation) launched the

"Campaign for the Living Coast" (English Nature, 1993). The Estuaries Initiative, which has provided the springboard for the development of EMPs, was developed as part of this campaign. One of the principle aims of the initiative is to produce widely accepted strategies for estuaries, through the cooperation of government, public bodies, estuary and maritime users, and the voluntary sector. As a result, the development of EMPs has recognized the need for public participation throughout the process of plan development and has extended the traditional view of public participation, from a purely consultative role to one of participation.

Reasons for Public Participation within EMPs

The involvement of the public within the development of EMPs is beneficial for a number of reasons:

Provision of information

One of the major sources of information that provides the basis of plan development are the users. They provide a range of valuable information including whether facilities are adequate or lacking, what conflicts are occurring, and changes in estuary use. Information of this nature in a readily usable form does not generally exist and it is only the user who can provide the information.

Local experience and knowledge

Estuary users have the experience and knowledge to know what recommendations and policies are realistic. Once the baseline information has been collected, any issues and conflicts will need to be addressed. Local knowledge and expertise is fundamental to ascertain the validity of the issues and conflicts and is beneficial in the development of appropriate management strategies and recommendations for future management.

EMPs are non-statutory

EMPs are non-statutory, and as a result, effective implementation of the plan will be dependant upon the development of recommendations and policies which can be implemented by voluntary mechanisms. Successful implementation is contingent upon public guidance at the plan formulation and implementation stages and requires the development of a feeling of local ownership. It is essential that the public consider that there is scope for their involvement and that they recognize the importance of the plan's recommendations. Participants are more willing to comply to rules they have been involved in designing. Rather than imposing solutions, EMPs seek to encourage, at a local level, the resolution of conflicts and the development of opportunities. To achieve this public involvement is imperative.

Education

Education is the key underlying process which will influence the effectiveness of the EMP. The development of the plan involves on-going education. Education has a dual role. First, the project officer, who manages the development of the plan, is educated through the provision of information and expertise by the public. Second, plan formulation with its various stages of public involvement will educate the public. Education is critical to increase the user's understanding of other users' needs and demands and is fundamental for effective implementation of the plan.

Minimize suspicion of the plan's objectives

Public participation ensures that the plan development process is open to the public and will minimis suspicion of the plans objectives.

It is easy to see that public participation is required, however, it is much more difficult to involve the public successfully. The Medina Estuary Management Initiative provides an insight into how public participation has been incorporated into EMP development within
the UK. It is important to note that the incorporation of public participation into EMPs will vary from estuary to estuary depending upon the resource, its users, and administrative structures.

Medina Estuary Management Plan

The Medina estuary is used for recreation, tourism, agriculture, and commercial activity. In addition, it has national and international nature conservation status and is of historical and cultural importance. Following the recommendations of the Department of the Environment and the development of the Estuaries Initiative, the need for the development of an EMP for the Medina estuary was identified. The Medina Estuary Management Plan was commissioned in May 1995 and will be formally launched in December 1996. Its central aim is to ensure the sustainable use of the Medina estuary through integrated management of its natural, economic, recreational, and tourism resources (Centre for Coastal Zone Management, 1995).

The Medina Estuary Management Initiative is a useful model to demonstrate the mechanisms for public participation within EMPs for two main reasons. First, the Medina EMP has benefited from the experiences and lessons learnt during the development of other EMPs. Second, the Medina EMP extends over an area of approximately 6 km2, which is small when compared to the vast areas covered by the Thames, Severn, and Mersey EMPs.

Figure 1 provides a summary of the phases of public participation adopted within the production of the Medina Estuary Management Plan. At the time of writing, plan development had reached Phase 3.

Phase 1 - Initial Consultation

It is essential that the public are involved with the development of the management plan at the outset, as it will provide the basis for local ownership, will help minimis suspicion, and will begin the education process. On the Medina estuary the initial consultation was threefold: dissemination of information; a public meeting and workshop; and liaison with key individuals.

Information was disseminated locally in the form of a leaflet. It provided the public with basic information about the management plan and invited the public to attend a meeting and workshop. A statement of interest form was attached to the leaflet which provided the opportunity to register an interest in the production of the plan and inform the project officer of interests and perceived issues.

The public meeting and workshop provided a public launch for the plan. It achieved three key objectives. First, the opportunity for the plan and its objectives to be presented to the public. Second, the opportunity for the public to ask questions. Third, a workshop to involve the public in the collation of information and the sharing of views and concerns. The meeting achieved consensus and broad support for the production of the plan.

Finally, initial consultation occurred with key individuals to inform them about the plan and gather additional information. To augment this process, consultation occurred with individuals who were skeptical or apprehensive about the plan to try and alleviate their concerns.

Phase 2 - Consultation on the Scoping Document

A scoping document was prepared to collate existing information, identify areas requiring additional research, and to identify critical issues. The document was deposited in public libraries for consultation purposes. Members of the public were asked to provide written comments on the document and the issues and conflicts raised, and to assess their validity and comprehensiveness.

Phase 3 - Development and Production of the Topic Reports

Initial consultation and the scoping exercise highlighted key areas which required further investigation through the development of Topic Reports. The Topic Reports developed focused on the areas of Agriculture, Historical and Cultural Resource, Nature Conservation, Physical Processes and Coastal Defence, Recreation and Leisure, Tourism, and Water Issues. The aim of the Topic Reports was to produce information on specific uses, identify issues or conflicts within the areas of concern, and to develop recommendations for future management.

The Topic Reports were prepared by Topic Groups consisting of representatives from agencies, organizations, and individuals with knowledge or interests within the subject areas addressed. The development of the reports, through the partnership of agencies and individuals, provided the public with a significant input into the plan. The process created a feeling of local ownership and in most instances provided the first opportunity for discussion between key agencies and individuals involved in a particular use of the estuary. This form of consultation provided information, developed partnerships, resulted in individuals being educated about other activities and provided a strategic overview of the management and polices required within key areas of interest. In addition, it provided individuals, who had often been working in isolation, with the opportunity to liaise with others to develop a strategic overview to meet similar ends.

Phase 4 - Discussion and Analysis of Topic Reports

The preparation of the draft management plan requires the analysis and integration of the Topic Reports. In order to resolve conflicts raised, discussions between agencies, organizations, and individuals will be required to try and identify solutions and recommend action or polices to attempt to alleviate areas of conflict.

Phase 5 - Draft Management Plan Consultation

The draft EMP will be promoted at a public launch to inform the public about the policies and recommendations identified. It will be deposited in public libraries for public consultation. Written responses will be taken into consideration prior to the production of the final Medina Estuary Management Plan.

Conclusions

The role of public participation within CZM is beginning to be addressed in the UK. The development of the Estuaries Initiative and EMPs has lead to increased public participation in the formulation of CZM plans. It is too early to gauge the benefits of involving the public within the process. However, it has become evident that the process is as important as the product. While EMPs and coastal initiatives all vary in their ability to involve the public, public participation is necessary to achieve consensus, local ownership, education, and the information and expertise required to produce a plan.

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Caroline L. Davis
Centre for Coastal Zone Management
Department of Land and Construction Management
University of Portsmouth, UK PO2 1LF

Ph +44 1705 843536
Fax +44 1705 843154
Email daviscl@lcm.envf.port.ac.uk

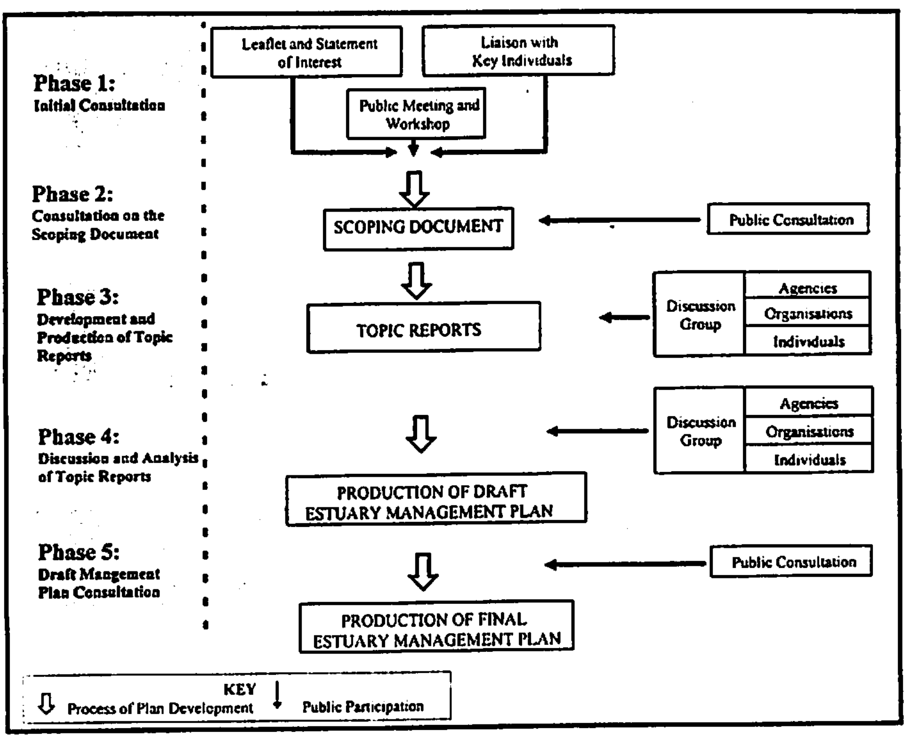

Figure 1: Public Particpation within the Medina Estuary Management Plan

ADDRESSING COMMON ENVIRONMENTAL ISSUES IN BRITISH COLUMBIA AND WASHINGTON: THE ENVIRONMENTAL COOPERATION COUNCIL

Glen Okrainetz, British Columbia Ministry of Environment, Lands and Parks and
Carol Jolly, Washington State Department of Ecology

The BC/WA Environmental Cooperation Council was established under an Environmental Cooperation Agreement signed by the Premier and Governor in May 1992. The Agreement committed the state and province to work together "to promote and coordinate mutual efforts to ensure the protection, preservation, and enhancement of our shared environment," and identified five issues for immediate attention. These included Georgia Basin/Puget Sound Water Quality, Columbia River Water Quality, Nooksack River Flooding, Regional Air Quality, and Ground Water in the Abbotsford-Sumas Region. Each issue is being addressed by a transboundary task force or work group.

The Council's members are Mary Riveland, Director of the Washington Department of Ecology and Tom Gunton, Deputy Minister of the BC Ministry of Environment, Lands and Parks. The Regional Directors of Environment Canada, Fisheries and Oceans Canada, and the U.S. Environmental Protection Agency are formal Council Observers and participate in all meetings. The Council works to align and operate programs on both sides of the border more cooperatively; transfer tools, techniques and information; and ensure that activities are evaluated in light of their potential benefits and costs to the neighboring jurisdiction. The Council meets twice a year; all Council meetings are open to the public.

Glen Okrainetz
BC Ministry of Environment, Lands and Parks
Strategic Planning, Policy and Legislation Branch
810 Blanshard Street
Victoria, BC, Canada V8V 1X4

Ph (604) 387-9641
Fax (604) 387-8894
Email gokrainetz@executive.env.gov.bc.ca

ASSESSING AND PROTECTING SHARED WATERS: THE BRITISH COLUMBIA/WASHINGTON MARINE SCIENCE PANEL

Andrea E. Copping, Washington Sea Grant Program,
Richard Beamish, Department of Fisheries and Oceans,
Curtis Ebbesmeyer, Evans-Hamilton, Inc.,
Chris Garrett, University of Victoria,
Bruce McCain, NOAA/National Marine Fisheries Service, and
Tom Pedersen, University of British Columbia

The BC/WA Marine Science Panel was appointed by the state of Washington and the province of British Columbia (Canada) to examine the condition of the inland marine waters of Puget Sound and the Georgia Basin. The panel is comprised of three scientists each from WA and from BC, representing a variety of disciplines including oceanography, fisheries and microbiology. The panel members are drawn from universities, federal agencies and the private sector.

The panel members were asked by the state and province to assess the health of the inland marine waters of BC and WA; to project the status of those marine waters, sediments and biological populations in the future; and to assist the two governments in directing management efforts towards the most needed marine environmental issues.

Through a process of consultation with scientific colleagues, NGOs and managers, the panel prepared a report for the Governor and Premier by late 1994. The panel made 12 recommendations, including: preventing ongoing losses of nearshore habitat; creating marine protected areas; minimizing freshwater diversions; controlling introductions of non-indigenous species; initiating joint strategic planning across the border; conducting environmental audits of management programs; and improving communication among scientists, managers and the public on each side and across the border.

Andrea Copping
Washington Sea Grant Program
University of Washington
3716 Brooklyn Ave NE
Seattle, WA, USA 98105

Ph (206) 685-8209
Fax (206) 685-0380
Email acopping@u.washington.edu

IMPLEMENTATION EFFORTS TO PROTECT THE SHARED WATERS: THE PUGET SOUND/GEORGIA BASIN INTERNATIONAL TASK FORCE PROCESS

Dave Peeler, Washington State Department of Ecology and
Peter Newroth, British Columbia Ministry of Environment, Lands, and Parks

Because of the complexity of the international issues, the Environmental Cooperation Council created the Puget Sound/Georgia Basin International Task Force (Task Force) to work on problems shared in inland marine waters of British Columbia and Washington. The Task Force has representatives from U.S. Environmental Protection Agency, U.S. National Marine Fisheries Service, Fisheries and Oceans Canada, Environment Canada, Puget Sound Water Quality Authority, Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, British Columbia Ministry of Environment, Lands and Parks, and the Northwest Indian Fisheries Commission.

The objectives of the Task Force are to:
1) Serve as a catalyst for action to improve water quality and resource management in the shared waters of Puget Sound and the Georgia Basin,

2) Establish more efficient, resourceful and nonduplicative environmental programs,

3) Increase public involvement in caring for the shared waters,

4) Increase awareness and communication about transboundary issues and foster informed decision-making among agencies and across the border.

Since July 1995, the Task Force has focused its efforts for the Council on four of the Marine Science Panel recommendations, and these are: minimizing habitat loss, establishing marine protected areas, protecting marine plants and animals, minimizing introductions of exotic species. The Task Force has also undertaken the three other Panel recommendations within its purview; these include: controlling toxic inputs, establishing monitoring and research frameworks, and developing transboundary strategic planning processes. Work Groups have been formed for each of these topics and have been meeting to develop strategies for addressing these issues. Recommendations for action from these work groups will be presented to the Task Force and the Council for their consideration, as appropriate.

Dave Peeler
Washington State Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA, USA 98504-7600

Ph (360) 407-6461
Fax (360) 407-6426
Email dpee461@ecy.wa.gov

AN EXAMPLE OF THE TRANSBOUNDARY WORK GROUP PROCESS: MINIMIZING EXOTIC SPECIES

John Armstrong, U.S. Environmental Protection Agency,
J. Roderick Forbes, Fisheries and Oceans Canada, and
Ralph Elston, Battelle Research Center

Issue

The uncontrolled introduction of non-native or non-indigenous species is receiving worldwide attention. These "exotic" species have the potential to create havoc in the ecosystems into which they are introduced. While numerous examples of devastating introductions exist around the world, there have also been some substantially deleterious introductions into the Pacific Northwest.

Work Group Process

This presentation will describe how working groups from Washington and British Columbia have evaluated the existing means for keeping unwanted introduced species from the inland marine waters of Puget Sound and the Georgia Basin of British Columbia. The Washington work group is chaired by John Armstrong, U.S. EPA and John Dohrmann, Puget Sound Water Quality Authority. In British Columbia, the work group is chaired by Rod Forbes, Fisheries and Oceans Canada.

At the time of this writing, the work groups are in the process of having a joint report written to discuss the approach to the issue, the various modes of entry of exotic species and existing regulations and policies designed to limit problems caused by these species. The presentation for this conference will include the findings based on this study and preliminary recommendations from both work groups for improving our ability to limit the unintentional introductions of non-indigenous species. A summary of the report will be provided during the conference.

John Armstrong
U.S. Environmental Protection Agency
Office of Ecosystems and Communities
1200 Sixth Ave.
Seattle, WA, USA 98101

Ph (206) 553-1368
Fax (206) 553-6984
Email armstrong.john@epamail.epa.gov

HOW EFFECTIVE ARE CONSENSUS AND EDUCATION IN PROMOTING BOATING POLLUTION PREVENTION?

Leigh Taylor Johnson, University of California Sea Grant

Introduction

In 1990, boaters, boating businesses, regulatory agencies and environmental groups in San Diego County, California were frustrated with boating water quality management. Regulatory approaches suitable for large pollution dischargers had been applied to local boatyards when they were required to obtain National Pollution Discharge Elimination System (NPDES) permits. The adversarial process and high costs had caused distrust and slowed progress. A new approach was needed.

A University of California Sea Grant Extension and Agricultural Extension consensus educational program during 1991-1992 had resolved similar local issues related to agriculture and coastal nonpoint source pollution (NPS). (Johnson and Mellano, 1993). In 1993, representatives of the boating, regulatory and environmental communities accepted a Sea Grant Extension Program offer to conduct a consensus and technical education program on boating and nonpoint source pollution (NPS). With their support funding was obtained from the United States Environmental Protection Agency (USEPA) and the California Sea Grant Extension Program to demonstrate and evaluate this approach for promoting boating pollution prevention.

Consensus Education

In 1993 and 1994, 128 representatives of boating clubs and businesses, government agencies and environmental groups were interviewed on their concerns about the new, federal NPS program (USEPA, 1993) and their recommendations for implementing it in San Diego County. Results were summarized and distributed to interview participants and other interested parties. Thirty-five people, representing all four groups, participated in a forum that recommended educational and regulatory approaches for implementing a local NPS program. Interview results were presented as background for forum deliberations and a consensus process was used to reach decisions. Forum results were summarized and distributed to all project participants. Forum and interview results were also provided to the California Technical Advisory Committee on Nonpoint Source Pollution from Marinas and Recreational Boating and incorporated in their report

(Marinas and Recreational Boating Technical Advisory Committee, 1994). Realistic best management practices education was among the top recommendations.

Technical Education

During 1994-1995, a marina pollution prevention planning manual, six educational brochures for boaters and boat maintenance services and an annotated bibliography of 125 references were published and disseminated to about 350 people in California. Material was developed through: literature review; interviews with experienced marina managers, boat maintenance businesses and product manufacturers; and extensive review of drafts by industry, agencies, boaters, environmental groups and scientists.

Six pollution prevention workshops were conducted in the San Francisco, Monterey, Lake Tahoe, Los Angeles and San Diego areas in 1995 in cooperation with the Marina Recreation Association, California Association of Harbor Masters and Port Captains, San Diego Dockmasters Group, San Diego Association of Yacht Clubs, Association of Monterey Bay Area Governments, Monterey Bay National Marine Sanctuary, several San Francisco area groups and Sea Grant Extension Program colleagues. Ninety-seven marina managers and boatyard operators, more than 100 boaters and about 25 port, regulatory agency, trade association, marine service business, and environmental representatives participated in the educational program. Nearly all of the boaters and 33 marina managers and boatyard operators were from San Diego County. Topics included a brief summary of the developing nonpoint source pollution program, guidelines for developing a marina pollution prevention plan and best management practices for marinas, boaters and boat maintenance businesses.

Evaluation and Analysis

In December, 1995, two to four months after the workshops, 97 marina managers and boatyard operators were surveyed by mail to determine early effects of the educational program. A total of fifty-two people responded, including 49 marina managers and 3 boatyard operators. Sixteen had participated in the San Diego area workshop, 4 had participated in the Monterey area workshop, 11 in the San Francisco area workshop, 12 in the Marina Recreation Association workshop and 17 in the California Association of Harbor Masters and Port Captains workshop.

First, the questionnaire asked whether, on a scale from 1 = disagree strongly to 5 = agree strongly, the information presented in the meetings or publications would be helpful in planning and carrying out a pollution prevention program. Forty-four people answered these questions. The mean for information presented in the meetings was 4.43 and the mean for information presented in the publications was 4.53. Thus, they believed that the information would be very helpful.

The questionnaire also asked whether they were already using each BMP before the educational program, whether they had implemented it as a result of the educational program or whether they intended to implement it in six months, one year, more than one year, or did not intend to implement it. More marinas are using each of the BMPs. Percentage increases of marina managers using each BMP varied from 12.5% for "Establish exchange program for leftover paint, varnish, etc." to 42.3% for "Encourage boaters to use oil absorbent bilge pads." Several additional marina managers intended to implement each of the BMPs in the future. Data are presented in Table 1.

Among Trash, Oil & Fuel, and Sewage BMPs (Numbers 1 - 9), the top five that had been implemented were:
- Encourage boaters to use sewage pumpouts
- Provide trash collection stations
- Encourage boaters to use restrooms, instead of boat heads
- Encourage boaters to use oil change services that recycle
- Keep oil and fuel spill containment booms handy.

Overall, fewer marinas had implemented Hazardous Waste and Boat Maintenance BMPs (numbers 10 - 20). This is in line with the fact that pollution from boat maintenance has been regulated fairly recently. In this group the top four BMPs that had been implemented were:

- Require contractors to have a business license and insurance
- Provide boaters with guidelines for topside work
- Advertise hazardous waste collection stations and events
- Require boat maintenance contractors to use BMPs.

Among Pollution Prevention Planning and Education BMPs (numbers 21 - 28), the top five BMPs that had been implemented were:

- Have a pollution prevention plan
- Train staff on the plan
- Discuss the plan with a regulatory agency
- Educate boaters on the pollution policy via posters
- Educate boaters on the pollution policy via lease.

The greatest increases in percent of marina managers implementing BMPs occurred for number 5: Encourage boaters to use oil absorbent bilge pads and number 20: Require boat maintenance contractors to use BMPs. The smallest increases occurred for number 4: Encourage boaters to install whistles in fuel lines; number 10: Hazardous waste collection station at marina; number 18: Require boaters to use maintenance service from list of those using BMPs; and number 28: Educate boaters on pollution policy via meetings. Interviews and comments have indicated that the last four BMPs would be among those that are more difficult to implement.

At their request, the Sea Grant Extension Program is cooperating with the Port of San Diego, local marinas and yacht clubs to organize pollution prevention seminars for boaters and to draft a proposal for a regional marina pollution prevention program.

Conclusions

Early effects of the local and statewide technical education programs show that they increased implementation of marina best management practices and provided information that would be useful to marinas in developing individual pollution prevention programs.

One hundred and twenty-eight San Diego County boaters, boating businesses, government agencies, and environmental groups cooperated to develop recommendations and educational materials for a nonpoint source pollution program. Thirty-six local marinas and boatyards participated in technical workshops. They are continuing to cooperate with government to extend education to boaters and develop a regional pollution prevention program.

Thus, the 1993-1994 consensus and technical educational program was effective in promoting cooperative problem solving on boating water quality issues by groups that were polarized prior to the project.

Acknowledgments

I wish to thank Erika McCoy, Clay Clifton and many others who contributed to the success of this project.

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Leigh Taylor Johnson
University of California Sea Grant Extension Program
5555 Overland Avenue, Building 4
San Diego, CA, USA 92123

Ph (619) 694-2852
Fax (619) 694-2849
Email ltjohnson@ucdavis.edu

Table 1. Early Effects of Education Program on Marina Best Management Practices Implementation

#	Best Management Practice	N	% Pre	% Post	% Post + Intend
1	Trash Collection Stations	49	69.4%	87.8%	93.9%
2	Trash Recycling Program	51	49.0%	68.6%	84.3%
3	Oil Spill Containment Booms Handy	51	51.0%	70.6%	88.2%
4	Encourage Boaters to Install Whistles in Fuel Lines	44	6.8%	22.7%	61.4%
5	Encourage Boaters to Use Oil Absorbent Bilge Pads	52	25.0%	67.3%	96.2%
6	Encourage Boaters to Use Oil Change Services that Recycle	50	42.0%	72.0%	92.0%
7	Encourage Boaters to Use Sewage Pumpout Stations or Mobile Services	52	63.5%	92.3%	100.0%
8	Provide Pumpout Station Maps to Boaters	49	38.8%	67.3%	91.8%
9	Encourage Boaters to Use Restrooms (Instead of Boat Heads)	52	61.5%	84.6%	98.1%
10	Hazardous Waste Collection Station at Marina	52	44.2%	59.6%	75.0%
11	Advertise Hazardous Waste Collection Stations/Events	52	44.2%	65.4%	96.2%
12	Leftover Paint, Varnish, Solvent, etc., Exchange Program	48	18.8%	31.3%	62.5%
13	Work with Marinas & Government to Make Hazardous Waste Disposal Convenient/Affordable	50	36.0%	60.0%	84.0%

14	Provide Hull Cleaning Guidelines to Boaters	50	36.0%	62.0%	90.0%
15	Provide Topside Work Guidelines to Boaters	49	44.9%	69.4%	93.9%
16	Provide List of Hull Cleaners Using BMPs	49	26.5%	57.1%	87.8%
17	Provide List of Topside Services Using BMPs	46	26.1%	52.2%	89.1%
18	Require Boaters to Use Listed Services	42	28.6%	45.2%	64.3%
19	Require Boat Maintenance Contractors to Have Business License & Insurance	52	55.8%	78.8%	84.6%
20	Require Boat Maintenance Contractors to Use BMPs	46	28.3%	65.2%	82.6%
21	Have Pollution Prevention Plan	51	43.1%	64.7%	4.1%
22	Have Discussed Plan with Agency	49	36.7%	63.3%	83.7%
23	Have Trained Staff on Plan	50	48.0%	74.0%	96.0%
24	Use Pollution Report & Outcome Logging System	46	26.1%	45.7%	82.6%
25	Educate Boaters on Pollution Policy Via Lease	46	37.0%	60.9%	89.1%
26	Educate Boaters on Pollution Policy Via Bills	41	19.5%	41.5%	78.0%
27	Educate Boaters on Pollution Policy via Posters	43	41.9%	62.8%	90.7%
28	Educate Boaters on Pollution Policy via Meetings	40	27.5%	42.5%	80.0%

WATER QUALITY WORKSHOPS FOR BOATERS: A SKILLS-BASED APPROACH

James P. Bolger, Washington Sea Grant Program and
Susan M. Texeira, Washington Sea Grant Program

Introduction

The mild climate and an abundance of accessible, sheltered bays, and inlets help the Puget Sound region of western Washington support one of the largest recreational boating communities in the country. Puget Sound's designation as an estuary of national significance as well as the prominence of its commercial shellfish industry has also focused significant attention on the Sound's water quality. A great deal of human and economic resources have been spent on addressing nonpoint sources of pollution such as contaminated stormwater runoff, harmful agricultural practices and failing on-site sewage treatment and disposal system. To a lesser extend, activities associated with recreational boating and marina operations are also receiving attention for how they might better conduct activities in a manner sensitive to maintaining clean water. This paper describes a skills-based approach used in water quality workshops presented for recreational boaters in Kitsap County, Washington, conducted as part of the Washington Sea Grant Program's Sound Boater Program (SBP).

Kitsap County is located on the Kitsap Peninsula which separates the main basin of Puget Sound from the Hood Canal basin. The total area of the county is 393 sq mi, but contains 228 miles of marine shoreline (Beam, per. com.). With a population of over 200,000, Kitsap County is one of the most densely populated county in Washington State. The county's proximity to Seattle, its many bays and inlets and its tourist friendly communities make Kitsap County, not only a major area for year-round moorage, but also a popular day and weekend destination for boaters from throughout the region. There are 28 moorage facilities in Kitsap County, which includes public ports, private marinas, condominiums, small boatyards, yacht clubs and state parks (Table 1), along with countless private mooring buoys and a sizable boat trailer population.

The SBP is a water quality education program developed and implemented by the Washington Sea Grant Program in Kitsap County. It is the education element of the Boat Waste Control Program (BWCP) being administered by the Bremerton-Kitsap County Health District, which also is working on regulatory control of illegal sewage discharge in local marinas. In addition to the workshop series addressed in this paper, the SBP developed signs for local moorage facilities encouraging tenants and guests not to discharge their holding tanks while in the marina and to use available pump-outs and shoreside facilities. It also includes a stewardship program which trains boaters in environmental and natural resource issues and practices. In return for training, volunteers provide "pay-back" service by acting as a clean water resource in their marina and by participating in water quality enhancing activities related to boating.

Workshop Development

The initial phases of the SBP included several activities that helped to establish the direction of the SBP and its workshop series. When Sea Grant was originally requested to implement the education element of the BWCP, the focus was sewage discharge from boats with an audience that included marina operators, recreational boaters and boating industries. The first activity of the SBP was to refine the target audience for the program, recognizing that the diversity of audiences identified in the BWCP would require very different educational approaches, which might not be feasible given the level and duration of funding. In addition, there were existing education programs for some of the specific audiences and duplication would be inefficient. The second activity was an expansion of the issues to be addressed by the SBP. While sewage is a major concern of the program, the opportunity to develop a more comprehensive program, addressing a suite of water quality topics related to boating, was pursued. It was also believed that to develop a successful education program around sewage alone would require a marketing miracle.

In order to determine a target audience for the program and confirm other issues to address in the SBP, a two stage needs assessment was conducted. The first stage included interviews with a majority of moorage facility operators in the county that included harbormasters from public ports, private marina managers, yacht club Commodores and small boatyard owners. The second stage was a non-scientific mailed survey to local marina tenants requesting information on topics of interest and season of the year and time during the week they would be most likely to attend educational programs.

Interviews with marina operators pointed to several considerations that the SBP should make in developing its education program. It was apparent that the management styles of the various facilities would require a tailored approach for education programs. A program that might be effective for a port district, would not necessarily be useful for private marina managers or yacht clubs. There are also environmental programs in the area, such as the Puget Sound Alliance's Clean Marina+Clean Boating+Clean Water Partnership, addressing water quality from a facilities management perspective. One point that was made by a majority of the facility managers was the need to educate their tenants to the impacts of their boating practices on water resources and to provide practical solutions to such problems as disposal of hazardous wastes and spill prevention and response. Most managers also felt that sewage disposal was not of great concern in their facilities. They also felt that liveaboard tenants were conscientious about using shoreside restrooms. Managers were also helpful in indicating boating information sources tenants used.

Surveys mailed to tenants of local marinas provided an indication of what topics were and were not of interest to them as far as they might be addressed in the SBP. The response rate was 10% of the 1,400 surveys mailed. Responses varied from enthusiastic support of an education program to anger over money being spent on water quality education for boaters. Survey forms asked boaters to rank their level of interest for suggested topics as well as provided them with space to suggest additional ones. They were also asked to indicate the season and time during the week they would be most likely to attend a program. Of the boaters who responded to the survey, the suggested topics with the most interest were Puget Sound wildlife, environmental regulations and boating and slip-side maintenance. Respondents also indicated an interest in electrolysis.

With the information gathered from the needs assessment, an advisory committee was convened to solicit input on workshop content and format from representatives of other boating education programs, state and local agencies, boating organizations and industry and recreational boaters. There was general agreement among the committee members that an approach that emphasized the use of area experts and professionals to present information relevant to the needs and interests of area boaters was likely to be most successful. The committee also endorsed the concept of teaching people boating-related skills that are safe, cost effective and beneficial to the marine environment. A similar approach has been applied successfully in the Washington State University Cooperative Extension's Country Living workshop series (Simmons, per. com.).

Results from interviews and surveys, and confirmed by the SBP Advisory Committee, lead to the development of a series of four workshops designed to provide local boaters with practical skills for conducting boating activities in a manner that was safe, cost effective and sensitive to maintaining water quality. Evening, 2.5 hour, workshops were conducted at various sites around the county and presented by area industry professionals, boating organization representatives and local and state resource agency staff. Workshop formats were generally a mix of lecture-style instruction followed by small group participation in demonstrations. Workshop topics included exterior maintenance projects, interior maintenance, environmental regulations and winterizing your boat. A workshop focusing on fish and wildlife was planned and scheduled, but was canceled due to a lack of pre-registered participants.

Workshop Descriptions

The first two workshops, Exterior Slip-side Maintenance and Interior Slip-side Maintenance, focused primarily on do-it-yourself projects boaters might undertake while their boats are moored. The objective was to provide practical information for boaters to accomplish these tasks, or determine that it is more than they should try, in a safe and responsible manner both for themselves, others and the environment. Both workshops were scheduled in June, on consecutive Wednesday evenings.

Projects and topics related to exterior maintenance that were covered in the lecture portion of the workshop were cleaning various surfaces, refinishing materials and techniques, proper disposal of project waste and best management practices to avoid spills and immediate response if spills occur. There were three small group demonstrations or activities following the lecture portion of the workshop. Workshop participants were divided into three small groups and spent 20 minutes at each demonstration or activity. One activity examined hazardous materials. Local health department and solid waste professionals explained product labeling terminology, discussed human and environmental health risks associated with marine cleaning and refinishing products and demonstrated cost and cleaning effectiveness of less toxic/non-toxic cleaning alternatives. Another small group session lead by a local boat refinishing specialist included discussions on when and how to refinish exterior surfaces, types and costs of finishes available and how to prepare and conduct projects in a manner that is safe and environmentally sensitive. The third small group sessions provided workshop participants with demonstrations of absorbent materials which can be used in the event of fuel and oil spills as well as exhibiting the contents of spill response kits which most boaters can keep on board their boats in case of emergency.

The Interior Slip-side Maintenance Workshop had a similar format of lecture followed by small group sessions. Topics for the lecture portion of the program covered issues of regular do-it-yourself maintenance, inspections and trouble-shooting associated with the engines, plumbing and through-hull fittings common to most boats. There was also some coverage of spill prevention and response. Again, there were three, 20 minute small-group sessions. Likewise these sessions included demonstrations for less toxic/non-toxic household products, with emphasis on alternatives not discussed at the previous workshop, like drain cleaners. There was also another session on spill prevention that included demonstrations of materials used for soaking up coolants and oils in bilge water. The final session included taking the groups out to the slips at the marina where the workshop was held and actually demonstrating how to use a sewage pump-out system. A demonstration holding tank was filled with fresh water and workshop participants were instructed on priming the pump, emptying the tank and flushing the sewage lines.

The remaining three workshops in the series were scheduled for three consecutive Wednesday evenings in September, 1995. The series was split over the summer to avoid, as much as possible, conflicting with the prime boating season in the area.

The third workshop in the series was Puget Sound Wildlife. This program moved away from the operation and maintenance of boats to water-related activities associated with trips. Objectives of this program were to provide boaters with an appreciation for the valuable wildlife resources of Puget Sound from ecological and recreational perspectives. Emphasis was placed on "low-impact" enjoyment of the resources. Like the first two workshops, this one included a lecture portion to the program followed by small-group activities. Lecture topics addressed fishing, shellfish harvesting, marine birds and mammals. Presentation of these topics addresses ecology, seasonality, human impacts on the resources and techniques for catching, harvesting or viewing. Small-group sessions were planned to provide more specific question and answer time, demonstrate gear associated with various activities and exhibit artifacts.

The fourth workshop, Environmental Regulations and Boating, was a panel presentation followed by questions from the audience. Panelist represented federal, state and local resource agencies and a state-wide boating interest group. During individual presentations, panelists were asked to explain the jurisdiction and involvement their agency or group has in the development and/or enforcement of environmental regulations that effect boats and marinas; what they saw as the emerging issues in boating and the environment; how citizens can participate in the activities of their agency or organization. This workshop was really the first extensive use of government agency staff people and prior to the workshop they were requested not to use their presentations for a public relations opportunity, but to keep to specific elements of their programs related to boating. Questions from the audience covered such topics as the Coast Guard's MSD regulations and enforcement, oil spill liability, environmental fees charged by boatyards and the possibility of gray water regulations.

The final workshop in the series was Winterizing Your Boat. This workshop was similar to the first two maintenance workshops in that it focused on do-it-yourself projects. The lecture portion of this program was broken down into various systems on most boats, such as engine and propeller, fuel tanks, electrical systems and general checks. There was also a reprise of cleaning information. Small-group sessions were less structured for this last workshop, but presenters did bring in examples what worn equipment looks like, commercial products used for winterizing boats and demonstrated specifically how to lubricate steering and control lines. This workshop no only provided boaters with information on how to prepare your boat for the off-season, but also how to prepare it for use the following season. As with all the workshops, presenters made a considerable effort to relate boat-related activities to the environment in addition to providing the practical information most workshop participants were there to receive.

Results and Conclusions

Average attendance for each of the four workshops was twenty people. The workshops were rated as "very good" to "excellent" in over 85% of participant evaluations. There were no evaluations rating the workshops below "good." Written comments reflected the diversity in workshop objectives. For example, from the Exterior Slip-side Maintenance workshop, participant responses to the question of the most important thing they learned included personal safety in projects, alternative cleaners that really work, importance of prevention and quick responses, oil recovery, boat cleaning, and refinishing techniques.

These results help validate the approach and formats used for the SBP workshop series. The approach, of performing a needs assessment and developing workshops emphasizing the use of area experts and professionals to present information relevant to the needs and interests of area boaters, incorporates many of the fundamentals for successful environmental education programs (Washington State Department of Ecology, 1992). Namely it recognizes that adults learn best when they feel they need to know something and it provides information relevant to those needs. The workshops also provide specific information people can use to achieve project and environmental goals. The format of the workshops, incorporating lecture and small-group activities and facilitating workshop participant/presenter interactions, reflects a collaborative mode of instruction, which builds on past experiences of participants and provides new ones, that is recognized as the most effective and appropriate teaching style for adults (Conti, 1989; Lewis and Williams, 1994).

While attendance at the workshops was smaller than anticipated and a lack of 15 pre-registered participants necessitated the cancellation of the Puget Sound wildlife workshop, this apparent lack of interest may have been the result of scheduling difficulties. Due to funding constraints, scheduling of the workshops did not coincide with the seasons people indicated they would most likely attend an education program. The scheduling of the workshops in June and September likely created conflicts with more seasonal boating activities and holidays. Supporting this conclusion were numerous requests for re-scheduling of the Puget Sound wildlife workshop. Should continued funding for the SBP be secured, following workshops will be scheduled for late autumn, winter, and early spring months.

Another factor possibly contributing to the low attendance may be a lack of program recognition. The SBP is a new program and the workshops series was the first public aspect of the program. Just as the Country Living program has grow with time, through word-of-mouth advertising and continued marketing, the SBP workshops may increase in popularity as well.

One of the difficulties in assessing the success of nonpoint source pollution education efforts is quantifying the impacts a specific program may have on an individual's behavior. Under these circumstances, anecdotal information can serve as a useful measure of a program's success. With this in mind, unsolicited comments received from SBP workshop participants such as the "need for more boaters to attend these programs" and "I like the way you're not lectured at," demonstrate a successful approach to educating recreational boaters about water quality issues.

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James P. Bolger
Washington Sea Grant Program
University of Washington
614 Division St., MS-16
Port Orchard, WA, USA 98366

Ph (360) 876-7165
Fax (360) 895-4864
Email jbolger@u.washington.edu

THE CRUISE SHIP PASSENGER TURNED WATCHDOG: OUTREACH AND EDUCATION TO REDUCE OCEAN POLLUTION

Kate Hinch, Center for Marine Conservation

Since the first U.S. National Coastal Cleanup in 1988, CMC has been keeping track of collected debris that is directly traceable to passenger cruise ships. Although the vast majority of cruiseline debris is indistinguishable from debris from other sources, some of the debris is usually embossed with the name and/or logo of a specific line or vessel. Items include plastic shampoo bottles, cups, pens, balloons, and shoeshine kits.

It is encouraging to note that debris which can be directly linked to the cruise industry has decreased significantly in recent years. Dropping from an all-time high of 59 items collected from 14 different cruise lines in 1991, the total number of items collected during the 1994 cleanup amounted to only seven pieces, traceable to a single cruise line, Norwegian Cruise Lines.

Even though the amount of cruise-related debris collected on a beach have decreased, reports of cruiseline dumping violations continue to be filed with CMC. Sources range from passengers to crew who have actually witnessed illegal dumping activities. One report even came from recreational watermen who found plastic bags filled with cruiseline debris floating in coastal waters.

Since the early 1990s, CMC has coordinated a cruise industry outreach program to monitor the compliance of cruiselines with the ocean dumping laws. The program encourages individuals-- from passengers to crew-- to contact CMC when they witness pollution violations. Due to the demand and effectiveness of this project, CMC activated a Cruise Watch reporting program, which has been the impetus behind several cruiseline dumping convictions. In response, it should be noted that several cruiselines have implemented greener corporate policies and have taken significant strides toward addressing the problem of solid waste management aboard their ships.

To inventory and measure these green policies, CMC has developed a newer cruise ship survey conducted by passengers. The survey seeks the assistance of passengers in reporting first-hand information on the efforts cruiselines are making. The survey gives the passengers an opportunity to educate themselves and crew members in the process.

The Center intends to use the Cruise Ship Surveys to monitor efforts within the industry and to help the cruise industry promote environmental responsibility among passengers and crew alike. The findings will also help promote greener policies industry-wide.

Nonetheless, because eye-witness reports continue to be filed with the Center and because cruise line debris still washes up on our nation's beaches, CMC will continue to promote the Cruise Watch program, all the while providing helpful assistance to those lines that wish to implement and maintain greener cruising policies.

Introduction

Plastic debris is responsible for the deaths of thousands of birds, marine mammals, turtles, fish, and other marine animals each year. Additionally, plastic debris and other garbage disposed of at sea pollutes our beaches and poses a threat to coastal tourist-based economies. In a 1975 report, the National Academy of Sciences estimated that approximately 14 billion pounds of trash are dumped by ships into the world's oceans every year. With the realization that persistent marine debris and other forms of waste were posing a series threat to the well-being of the world's oceans, international conventions were convened in 1973 and 1978 to negotiate agreements to reduce the overboard disposal of ship generated wastes. The resulting MARPOL Treaty, consisting of five annexes, deals with the disposal of various wastes - from oil to noxious and toxic substances to sewage and garbage. In 1987, the United States joined over 30 other nations and ratified MARPOL Annex V, the annex addressing ship-generated garbage, both plastics and other persistent materials.

The purpose of Annex V of MARPOL is to reduce the discharge of ship-generated garbage into the marine environment. A particular focus of Annex V is to prevent the discharge of plastics, including synthetic fishing nets, and other debris which persist in the marine environment. In December 1987, federal legislation implementing MARPOL Annex V passed Congress. The legislation, entitled the Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA), restricts when and where an individual may dispose of his waste. Under MPPRCA, it is illegal to throw plastic trash off any vessel. It is also illegal to throw any other garbage, from orange peels and paper plates to glass jars and monofilament fishing line, overboard while navigating in inland waters (including lakes, rivers, bays, and sounds) or within three miles offshore. The greater the distance from shore, the fewer restrictions apply to non-plastic garbage.

The U.S. Coast Guard (USCG) is the enforcement agency for MARPOL Annex V within the all U.S. waters and within the Exclusive Economic Zone (within 200 nm of the U.S. shoreline).

However, to cite a vessel for illegally discharging plastics, garbage and other wastes into the sea, an individual must see the event and report it, or provide sound evidence that such a discharge occurred. As a result, many pollution violations go undetected, unreported, or are never fully pursued (due to lack of evidence).

Recognizing the Garbage Dumping Problem

As a non-profit marine conservation organization and a widely recognized leader in the field of marine debris, many citizens contact the Center when they witness potential dangers to the marine environment. Since the implementation of federal legislation implementing Annex V, CMC has received an increasing number of complaints from cruise and crew who have witnessed illegal overboard garbage disposal on the vessel on which they are vacationing or working. The reports received have described all manner of trash items including toxic chemicals, plastics, deck furniture, old mattresses, paint cans and gas canisters. Witnesses who see such dumping incidences, express their outrage that these cruise ships are blatantly disregarding not only the laws regulating such dumping, but the welfare of the very seas which support a cruise line's livelihood and which they, the passenger, have paid dearly to enjoy.

Creating Solutions

In response to the public outcry, CMC coordinated and orchestrated a massive cruise industry outreach program. The purpose was two-fold: 1) To educate crew members, industry leaders, and cruise passengers about the dumping laws and to teach them ways to become part of the solution; and 2) To put into place a watchdog program to monitor the compliance of cruiselines with the laws. The watchdog program encourages individuals -- from passengers to crew -- to contact CMC when they witness pollution violations.

Interested cruise passengers were supplied information about the ocean dumping laws, a citizen pollution report form and a tip sheet on reporting suspected cruise violations.

Not long after the Watchdog Program was put into place, CMC received numerous reports of cruiseline dumping. The most telling accounts come from staff aboard vessels themselves. As they became familiar with the inner operations of the ship, many found that overboard disposal of garbage was a routine occurrence. A musician working on board a cruise vessel in the Mediterranean contacted the Center after witnessing a nightly ritual of dumping. In the ensuing voyage across the Atlantic, through the Caribbean and Panama Canal to Long Beach, California, he was able to document fourteen separate dumping incidences while at sea, all involving the disposal of plastic as well as other items. In conversations with the garbage room employees he learned that the only ports of call where the ship offloaded all of its trash were in Scandinavia where MARPOL enforcement is strict. In other ports the ship offloaded only a small amount of garbage in order to appear to be in compliance with the law. According to the crew, the staff captain does not want garbage offloaded at port because of the cost involved. Although the incident was brought to the attention of the USCG, it was never prosecuted by the U.S. because the violation occurred outside U.S. territorial waters.

The common thread running through many accounts is the fact that overboard disposal was carried out with the consent of those in command, at times including the captain. This is also borne out by both passengers and crew who witnessed dumping at sea. They report that the complaints they lodged with the captain and other officers fell on deaf ears.

Cruise Violations

On October 25, 1991 while on vacation aboard the Regal Princess, a ship operated by Princess Cruises, Inc., two passengers witnessed crew members dumping at least twenty plastic bags filled with garbage into the sea, approximately five nautical miles southeast of Duck Key in the Florida Keys. One witness videotaped the event and upon returning to shore, contacted the Center for Marine Conservation. The passenger was instructed on how and where to report the case and he turned the evidence over to the US Coast Guard Marine Safety Office (USCG-MSO) in Miami.

After an article appeared in a St. Louis, Missouri newspaper mentioning this case, four other witnesses to the same event came forward and contacted CMC. The Center encouraged them to send a written report of what they had seen to the US Coast Guard (USCG).

After further investigation was conducted by the U.S. Attorney's Office and criminal intent was further verified, Princess Cruiselines received the largest fine for unlawful discharge of plastics at sea. The fine of $500,000 -- the maximum allowed under U.S. law -- was set after the company agreed to plead guilty to a felony violation of discharging garbage-filled plastic bags.

The conviction was made possible due to this passenger's videotape and recordkeeping. Due to an incentive written into the law, the passenger received a substantial reward for his efforts from the Department of Justice.

Cruise Industry Responds

The pay-off from passenger and crew pollution reporting eventually trickles down to all levels -- industry representatives implement greener corporate policies, crew and passengers learn more about marine conservation issues, and less litter ends up in the sea.

Examples of corporate policies include Princess Cruises environmental program called "Planet Princess," the cruiseline's new environmental program for solid waste where all waste on board the ship is source separated and disposed properly. Holland America, it is reported, has set forth an environmental manifesto, educating crew and passengers about marine conservation and pollution issues. Other examples of industry efforts have been compiled by CMC. Table 1 lists the various compliance efforts within the cruise industry.

Total Compliance Needed

However, even when corporate policies are set forth and corporate dollars are spent on instituting environment-friendly policies, violations continue to occur. As a result, it is imperative that crew members understand the issues and appreciate the needs for not dumping waste overboard.

CMC's Cruise Ship Survey will ensure dialogue among passengers and crew, and in an indirect manner, educate both passengers and crew about the ocean dumping laws. The same survey also will allow passengers to inventory and witness first hand the green efforts being implemented aboard cruise ships industry wide. It will show the cruiselines that their passengers are concerned about the environment, and that they support green corporate practices. Additionally, it is hoped that passengers, upon completing the survey, will be able to inventory their own habits and practices and adapt "greener living" policies in their own lives.

The CMC plans to continue its work in the cruise industry and will partner with various cruiselines to accomplish various tasks, including instituting green policies, taking environmental messages to the crew and passengers, and promoting environmental compliance efforts within the industry.

Kate Hinch
Center for Marine Conservation
1725 DeSales Street, NW
Washington, DC, USA 20036

Ph (202) 429-5609
Fax (202) 872-0619
Email hinchk@dccmc.mhs.compuserve.com

TABLE 1 . MARPOL Annex V Compliance Grid for Cruise Lines

Cruise Line (# of vessels)	Plastic Segreg. Disposal	General Waste Segreg.	Waste Minimize	Training/ Education of Crew	Training/ Educ. of Passengers	Refuse Disposal Record	Waste Process Equip.	Shoreside Reception Facilities
Carnival (8)	6 yes 2 no	8 yes	3 yes 5 no	6 yes 2 no	1 yes 7 no	8 yes	8 yes	8 yes
Cunard (3)	3 yes	3 yes	3 yes	3 yes	2 yes 1 no	3 yes	2 yes 1 no	3 yes
Holland (4)	4 yes	4 yes	4 yes	4 yes	3 yes 1 no	4 yes	4 yes	4 yes
Norwegian C.L. (2)	2 yes	2 yes	2 no	1 yes 1 no	1 yes 1 no	2 yes	2 yes	2 yes
Royal Caribbean (4)	4 yes	4 yes	2 yes 2 no	4 yes	3 yes 1 no	4 yes	4 yes	4 yes
Celebrity C.L. (2)	2 yes	2 yes	1 yes 1 no	2 yes	1 yes 1 no	2 yes	2 yes	2 yes
Regency (3)	3 yes	3 yes	2 yes 1 no	3 yes	2 yes 1 no	3 yes	1 yes 2 no	3 yes
Princess (9)	9 yes	9 yes	8 yes 1 no	9 yes	7 yes 2 no	9 yes	6 yes 3 no	9 yes
Crown (2)	2 yes	2 yes	1 yes 1 no	2 yes	1 yes 1 no	2 yes	2 yes	2 yes
Premier (2)	2 no	2 yes	2 no	2 yes	2 no	2 yes	2 yes	2 yes
Kloster (2)	2 yes	2 yes	1 yes 1 no	2 yes	2 yes	1 yes 1 no	2 yes	1 yes 1no
Am. Hawaiian (2)	2 no	2 no	2 no	2 no	2 no	2 no	2 yes	2 yes
Odessa (1)	1 yes	1 yes	1 yes	1 yes	1 yes	1 yes	1 yes	1yes
Gold Star (1)	1 yes	1 yes	1 yes	1 yes	1 no	1 yes	1 yes	1 yes
Commodore (1)	1 yes	1 yes	1 yes	1 yes	1 yes	1 yes	1 yes	1 yes
Majesty (1)	1 yes	1 yes	1 yes	1 yes	1 no	1 yes	1 yes	1 no

Information obtained from U.S. Coast Guard, Marine Environmental Protection Unit

THE RECREATIONAL BOATER: OUTREACH AND EDUCATION TO REDUCE WATER POLLUTION

Kate Hinch, Center for Marine Conservation

According to U.S. industry estimates, a record 75 million people participate in recreational boating activities annually, and the number of registered recreational craft in use has increased to more than 16 million. With these numbers on the rise, the environmental impacts associated with the boating community can no longer be overlooked. This user group, if educated to understand the environmental impacts boating has on the environment, the ways to personally reduce marine pollution, and the environmental laws that regulate boats, can become a formidable ally on the seas and a tremendous source of action in the quest for cleaner coasts and cleaner oceans.

Recognizing the potential strength of an informed boating community, the Center for Marine Conservation (CMC), a non-profit environmental organization dedicated solely to the health of the marine ecosystem, launched the Boaters Education Project in partnership with the U.S. Coast Guard Marine Response Division (USCG-MRO). The project targeted the recreational users of the water, teaching them about MARPOL and other important marine pollution laws, as well as the environmental impacts their activities (such as boat maintenance, sewage discharge, litter and debris from picnics and fishing) can have on the water environment.

The program targeted three primary information outlets: boaters, teachers and students. It also focussed energies on the Coast Guard Auxiliary, since they posses strong community ties with the maritime public.

For boaters, CMC developed an education series teaching about citizen pollution reporting and how to recognize and report pollution violations. For teachers and students, CMC produced materials and an activity book for use in the classroom and for distribution at boat shows and other public venues. Finally, CMC combined efforts with the Coast Guard Auxiliary and designed ways to educate the boating community about the various sources of marine pollution. To accomplish this, CMC developed additional outreach materials and implemented a pilot "train the trainers" workshop specifically for the USCG Auxiliary.

Having concluded the pilot phase of the Coast Guard Auxiliary "Train the Trainers" project, it is important the USCG phase the project into future training plans.

Introduction

In December 1987, federal legislation implementing MARPOL Annex V passed Congress. The legislation, entitled the Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA), restricts when and where an individual may dispose of his waste. Under MPPRCA, it is illegal to throw plastic trash off any vessel. It is also illegal to throw any other garbage, from orange peels and paper plates to glass jars and monofilament fishing line, overboard while navigating in inland waters (including lakes, rivers, bays, and sounds) or within three miles offshore. The greater the distance from shore, the fewer restrictions apply to non-plastic garbage.

The law also requires owners of boats 26 feet or longer to prominently post at least one MARPOL garbage dumping restriction placard on the vessel. Boats 40 feet or longer are also required to have written waste management plans that describes the proper handling of refuse onboard, as well as a waste logbook that details disposal and waste discharge operations.

All garbage from a boat should be brought ashore and properly disposed of in a trash can, dumpster, or recycling container. Under the law, docks and marinas are required to provide facilities to handle normal amounts of garbage from their customers.

Fines for violating MPPRCA were updated in July 1992. Under the revisions, violations may result in a fine of up to $50,000 for each incident. If criminal intent can be proven, an individual may be fined up to $250,000 and/ or imprisoned up to 6 years. If an organization is responsible, it may be fined up to $500,000 and/or 6 years imprisonment.

The U.S. Coast Guard (USCG) is the enforcement agency for MARPOL Annex V within the all U.S. waters and within the Exclusive Economic Zone (within 200 nm of the U.S. shoreline)

However, to cite a vessel for illegally discharging plastics, garbage and other wastes into the sea, an individual must see the event and report it, or provide sound evidence that such a discharge occurred. As a result, many pollution violations go undected, unreported, or are never fully pursued (due to lack of evidence). Because enforcement alone will not achieve compliance with MARPOL Annex V or MPPRCA, the USCG has established several education and outreach efforts to teach the maritime community about the law and its requirements. The CMC-USCG boaters education outreach program is a product of the USCG's efforts.

Program Design

Boaters as Educators

Since MPPRCA was passed, enforcement has been difficult. To enforce the law, the dumping incident must be witnessed and reported. Since the USCG cannot follow every ship and vessel seeking potential polluters, the CMC designed an anonymous citizen reporting and other components to educate and assist individuals in reporting violations they witness entitled "How's the Water?" series.

The series includes a poster, a citizen pollution reporting brochure and a garbage dumping placard. The series explains what is legal and what is illegal to discharge from a vessel into the water. The poster and report form provide pollution information on relevant boating issues, including garbage, fuel and oil, and sewage. All three materials stress the importance of environmental stewardship, advocate citizen pollution reporting and promote the special 1-800-424-8802 reporting number operated by the National Response Center.

The anonymous reporting process continues to operate today. The USCG has received numerous reports. Several ocean dumping reports have come from recreational boaters and fishers and generally involve large ship dumping, not individual recreational boaters.

Teachers, Students and Young Boaters

CMC worked with the USCG-MRO to design an activity book and curriculum for upper elementary and junior high school children to complement its own public education and outreach program called Sea Partners. Both products focus on marine pollution and ways people can personally change their habits and reduce the their contribution to marine pollution.

The "Adventures of Captain Cleanwater" activity book introduces the kinds of pollution associated with boats (litter, trash, sewage, fuel, oil, and even detergents). The school curriculum, "Exploring Clean Water Through the Eyes of the Boater," focuses upon marine pollution and the impacts human activities (including boats) have on the water environment.

Outreach Products for the USCG Auxiliary

Of all the branches of the USCG, the USCG Auxiliary has the most day-to-day contact with the boating community through its classrooms and outreach programs. As a result its members are a natural conduit through which MARPOL information can be passed.

Consequently, in addition to the above teaching materials, CMC developed outreach products specifically for the USCG Auxiliary's boating safety branch. Materials were tailored to supplement existing Auxiliary outreach activities. During the creative process, CMC worked closely with members of the Coast Guard and Coast Guard Auxiliary to ensure the materials would easily fit present outreach opportunities.

Listed below, the materials were designed for easy distribution at boat shows, courtesy marine exams (CMEs), marine dealer visits, and during Boating Skills and Seamanship (BS&S) courses:

Your Ticket to an Environmentally-safe Boat Trip -- The brochure introduces several boating safety tips and explains why these same safety tips can also help protect the water environment.

Tips to Keep Your Boat in Top Shape -- The brochure is written for the "Do-It-Yourself" boater. It offers ways to protect the water environment while cleaning, sanding, painting, or performing general maintenance on a boat.

Environmental Impacts of Boats slideshow and script -- The slideshow provides graphic detail of the impacts boats have on the underwater environment.

Materials stocked at the Auxiliary National Supply Center (ANSC) -- Current inventories of the above materials as well as activity books and curricula were supplied to the ANSC. USCG Auxiliary Headquarters in Washington, D.C. maintains an inventory.

In addition, after many Auxiliary requests for ideas for a boat show boot, CMC published a booklet of five ways to enhance boat show presentations.

Additions to the Boating Skills and Seamanship (BS&S) curriculum

CMC has found that most boaters are interested in ways they can take action to prevent pollution, and when educated, many boaters are willing to follow the laws. Consequently, the BS&S classroom offers an ideal setting to impart environmental impacts information to them. CMC worked directly with members of the National Auxiliary Education Committee to develop the new environmental additions to the reprint of the BS&S curriculum.

Most of the subject matter related environmental choices to personal safety. When the new curriculum was released, CMC assisted the National USCG Auxiliary Education staff in drafting a "Speed Gram," detailing the changes and ways to teach the material. The Speed Gram was issued to all Auxiliary educators.

Finally, when introduced to the fundamentals of the maritime outreach program, many members of the USCG Auxiliary received the idea with enthusiasm, yet admitted they themselves needed to learn the subject matter. In response, a training program was developed.

The training course introduced Auxiliary officers to marine pollution issues and ways to reach the recreational boating public. Two pilot programs were designed and implemented, one in St. Petersburg, FL and the other in Sandy Hook, NJ.

Participants spent the morning hours learning about pollution and impact problems associated with boats, as well as ways to take action, and the relevant pollution laws (important to recreational boating). The afternoon was filled with hands-on, interactive activities ranging from science experiments, BS&S classroom brainstorming, to working group presentations. Auxiliarists learned what pollution information was available and ways to incorporate this information into their existing public outreach.

Assessing the Program

Auxiliarists in the pilot areas have started to incorporate environmental outreach into their classrooms and existing outreach projects.

In Florida, USCG Auxiliary Rear Commodore, Helmut Hertle (RCO-N7), has travelled across the Seventh District, promoting the environmental message and new materials to the entire Auxiliary in his region. Two Auxiliarists were designated with researching and developing strategic ways to include the environmental message in the public education outreach -- from designing lesson plans for the BS&S and PWC courses to re-designing the school outreach program. Videos and slide shows have been reproduced for each flotilla, and plans for working marine environmental information into boat shows and regattas are underway. Leaders from Flotilla 7-4 report they have already devised an entire "Marine Environment" unit to their PE courses, a goal for all the workshop participants. The flotilla has also published an article, highlighting the workshop and its purpose, in its newsletter. One auxiliarist designed an instruction block on the environment for Member Trainers and BS&S course. He presented the lesson plan to a division-wide meeting at Bahia Beach last September. Division 7 plans to roll out environmental messages into the CME, MDV and other outreach shortly after the addressing the PE programs.

In New Jersey, leaders from the First District, Southern Region prepared outreach plans and strategizing policies for PE course implementation. Copies of the training manual were distributed to all Division 10 PE officers. PE officers from across the First District, Southern Region met to develop a uniform lesson plan for introducing an environmental message into their PE outreach, particularly the safe boating classes. They have requested CMC presence and assistance in designing and implementing a division-wide training. One public request for more information came from auxiliarist who learned of the training from his colleagues. Upon receiving materials from CMC, he reproduced the training manual for his officers and distributed it to them. An article addressing the fundamentals of the USCG Auxiliary and USCG-MEP Memorandum of Understanding (and the training workshop) was published in the autumn edition of the flotilla's newsletter.

Moving Into the Future

Since the implementation of MPPRCA in 1988, the U.S. Coast Guard's role has evolved from a position of a strict, law enforcer to one of a community leader-- encouraging citizens to understand the pollution problem and to pursue ways to protect our nation's waterways from debris. In May 1995, the Chiefs of the USCG Auxiliary and USCG Marine Environmental Protection Division signed a Memorandum of Understanding (MOU) that engages both divisions in a joint venture to, "aggressively promoting marine environmental protection and effectively reducing pollution in our nation's waterways." Consequently, it is important that the USCG ride the wave of interest and continue training its public education endeavor.

Because the Auxiliary interest in the program is high and the workshops have been well received so far, it is important to continue them while interest is high. In order to do so, CMC recommends that the USCG and Auxiliary:

1. Integrate environmental questions into the BS&S exams, furthering the need to implement environmental messages into the classroom.

2. Implement additional "Train the Trainer" workshops at the division level where the policy and action plan could be tailored to best meet local issues of concern, classroom teaching techniques, etc.

3. Offer a series of workshops at the Auxiliary annual meeting, annual training session, and additional Auxiliary meetings and gatherings. Trainings are valuable and highly effective in smaller group settings (16-28). If implemented at a large meeting such as N-Train, sessions must be designed for small group dynamics.

4. Develop a supplemental training session specifically for teaching water pollution laws to increase the auxiliarists' familiarity and working knowledge of the laws.

5. Develop the ability to monitor and design a reporting system for outreach conducted by "Trainers" workshop participants.

6. Establish an "M" (Marine Environmental) Division within the USCG Auxiliary National Headquarters to oversee and implement environmental outreach and education enhancement.

The USCG has furthered its commitment to environmental excellence by moving beyond its own resources and identified resources and partnerships in the communities in which it operates. We commend the efforts and encourage more action recognize the need for future planning, outreach, and training workshops. However, to date, the two pilot areas are the only places where funding has allowed training to occur.

Kate Hinch
Center for Marine Conservation
1725 DeSales Street, NW
Washington, DC, USA 20036

Ph (202) 429-5609
Fax (202) 872-0619
Email hinchk@dccmc.mhs.compuserve.com

Session E2, Part I: Environment, Marine Affairs and Policy, and Coastal Management: Marketing Your Professional Skills
Session Chairs: Michael Orbach, Duke University and Marc Miller, University of Washington

> **Session Panelists: Charles Broches, Director of Oregon-Washington States, AIPAC; Leah Bunce, Duke University; Christina Mormorunni, University of Washington; John Peterson, Impact Assessment, Inc.**

No abstracts for this session.

Session E3, Part II: Private Non-Profit and Partnership Approaches to Resource Protection
Session Chair: Mary Langlais, NOAA/National Ocean Service

NORTH CAROLINA BIG SWEEP — ESTABLISHING PUBLIC AND PRIVATE PARTNERSHIPS TO RID WATERWAYS OF AQUATIC DEBRIS

Kathy Hart, North Carolina Sea Grant Program

From a small beach cleanup, North Carolina Big Sweep has expanded into a far-reaching statewide event that is guided by a partnership of public and private supporters. Public agencies, led by North Carolina Sea Grant, shepherded the growth of the cleanup after its 1987 start. It grew inland two years later. But partnerships with private corporations and media outlets have made possible a 100-county watershed cleanup — the largest in the nation to cover an entire state. The event consistently attracts more than 12,000 volunteers and collects more than 150 tons of debris each September. And now, the self-supporting, nonprofit organization operates a year-round education program.

Because Big Sweep has relied so strongly on the marriage of public and private support, it has been able to draw on the talents and abilities of a range of experts who have brought innovative ideas and creative solutions to the problem of aquatic debris in North Carolina waterways.

Since its onset, thousands of hours have been invested by state employees who coordinated and promoted the cleanup, developed education efforts and shaped the nonprofit organization that now serves as a foundation for the effort. Among the public partners were North Carolina Sea Grant; N.C. Division of Coastal Management; N.C. Wildlife Resources Commission; and N.C. Department of Environment, Health and Natural Resources.

In each North Carolina county, Big Sweep leaders sought an individual to locally spearhead the cleanup — to designate cleanup sites, to recruit and direct volunteers, to distribute materials, to act as a local spokesperson and to arrange for trash collection after the cleanup. More often than not, these individuals were county employees: Keep America Beautiful coordinators, solid waste directors or cooperative extension agents. These county coordinators provide the all-important ties to local communities that are necessary to sustain the cleanup.

Although hours of in-kind time provided the energy needed to coordinate the cleanup, it did not provide the funds necessary to adequately promote Big Sweep. Financial support of corporate neighbors was needed to expand and support the cleanup and its educational materials. Big Sweep organizers solicited funding from companies and corporations who had a vested interest in North Carolina and its miles of coastal and inland waterways. These companies included: First Citizens Bank, R.J. Reynolds Tobacco Co., Duke Power Co., Carolina Power and Light, MCI, Glaxo Wellcome, ITW Hi-Cone, N.C. Beer Wholesalers, and the N.C. Soft Drink Association.

In some cases, the companies Big Sweep organizers approached were ones whose products were often among the litter collected. Instead of denying the problem, these companies — R.J. Reynolds, ITW Hi-Cone, N.C. Beer Wholesalers, and N.C. Soft Drink Association — took a proactive stance, providing funding and urging their consumers to properly dispose of their products.

R.J. Reynolds instigated a publicity campaign urging smokers not to litter beaches with cigarette butts, which have consistently been the most prevalent litter item collected by Big Sweep volunteers. They erected billboards along highways and placed tent cards in motels, hotels, restaurants and stores. Their slogan, "Don't leave your butt on the beach," became prominent. They also developed portable, pocket ashtrays. Big Sweep county coordinators helped to distribute thousands of these pocket ashtrays to Tar Heel smokers.

To compensate corporations for their funding support, Big Sweep offers the companies lots of positive publicity. Sponsors names are prominently attached to promotional materials and educational products. As a result, these companies build a proactive, environmentally friendly image among their customers and other North Carolina residents.

In 1990, Big Sweep leaders decided to accept a title sponsor — First Citizens Bank — for its one-day cleanup event. In exchange for a sizable contribution, the cleanup became the First Citizens Bank Big Sweep. The title sponsor's name was attached to the cleanup in all references in news releases and on promotional materials such as T-shirts. The bank's donation was used to print posters and more than 100,000 event brochures were distributed through their branch offices. Their funds also aid in the support of the Big Sweep office.

To maintain corporate interest and instill a sense of ownership for the cleanup, organizers offered the executives of key sponsors positions on the Big Sweep board of directors. This has reaped multiple benefits. The corporate representatives offer a different perspective, bring added expertise, offer valuable services and aid in the solicitation of other corporate sponsors.

The media was also asked to donate thousands of dollars of free air time in major television markets in the state. A television sponsorship program was arranged with six state television stations. In exchange for exclusive ownership of the cleanup in their market, the stations provided free promotional time, news coverage and crosstalk on their nightly news programs. This arrangement allowed Big Sweep to reach 4.5 million television viewers with its no-litter message and to increase participation in its cleanup.

The final and perhaps most important link in the Big Sweep partnership is the public. Citizens from Manteo to Murphy donate fours hours of weekend time each September — volunteer time worth half a million dollars — to the important task of ridding North Carolina waterways of aquatic litter. The support of these watershed stewards makes Big Sweep a continued success and has raised awareness of aquatic debris to an all-time high. In some cases, it has affected change — less litter, more trash receptacles at recreational areas and boating ramps, increased litter fines, storm drain stenciling projects, etc.

Big Sweep has attracted an army of volunteers through a variety of means. It has spread the word though our television media partners. Big Sweep has blanketed state newspapers with news releases. We have developed radio public service announcements, brochures and posters. We have solicited the participation of employees of corporate sponsors. We maintain a toll-free hotline for volunteer and cleanup site information. All of this effort brings thousands of volunteers on cleanup day.

Together these public agencies, private companies, media sponsors and private citizens have built Big Sweep into a nonprofit organization governed by a board of directors. In 1994, the cleanup hired a full-time executive director and established an office separate from the supporting agencies and corporations. In 1995, the executive director established cleanup sites in every North Carolina county — a goal Big Sweep had worked toward since 1989 when organizers realized aquatic debris was a watershed problem not just an ocean and beach concern.

Big Sweep organizers also realized that litter wasn't a one-day problem. They quickly saw the need for year-round educational program aimed at a diversity of audiences. Big Sweep leaders also wanted to capitalize on the data collected during the cleanup. Each year, Big Sweep volunteers record the amount and type of trash collected on detailed data cards. The summary information gleaned from the cards gives Big Sweep leaders a clear picture of the types of trash littering North Carolina's waterways and who's tossing it overboard or leaving it behind.

Using this information, Big Sweep organizers developed a multifaceted educational effort. They developed two award-winning aquatic debris curriculum guides for educators working with children ages 5 to 12. For adults, particularly boaters and anglers, Big Sweep leaders developed a boat-litter bag, posters and two videos. They supported a storm-drain stenciling project. Currently in production is a boaters' pledge card. Boaters pledge to bring back their own litter plus one additional piece. Big Sweep's education committee is also developing a boat sticker/ruler (for measuring catch) with a no-litter message. By making the sticker multifunctional, Big Sweep leaders believe the sticker will gain wider usage and the message greater visibility. Also in development is a teacher activity calendar that will offer student educational exercises, watershed information and a list of environmental events. Big Sweep has sought and secured corporate funding for all of these projects. Very little public money has been used to pay for these efforts, but state and university employees have provided time and talent to develop them.

Because Big Sweep has relied so strongly on the marriage of public and private support, it has been able to draw on the talents and abilities of a range of experts who have brought innovative ideas and creative solutions to the problem of aquatic debris in North Carolina waterways. North Carolina Big Sweep has been touted as a national model, and other states are now imitating the organizational structure of this successful partnership. The cleanup won five consecutive Take Pride In America national awards and was inducted into the national Take Pride in America Hall of Fame.

In looking back over Big Sweep's growth, there are several keys to the cleanup's success, including:

1. A single, consistent message. From its inception, Big Sweep organizers have focused on one message: no litter in North Carolina waters. We have directed the message at a variety of different audiences and tailored the words to the audience, but the message has always been the same.

2. A positive approach. Big Sweep leaders have avoided pointing fingers, instead choosing to encourage people with positive slogans ("You are the solution to water pollution") and educational efforts (boat litter bags).

3. Sharing credit for the program's successes. Big Sweep organizers have graciously given credit to all of the state and local agencies, companies, civic groups and individuals who coordinate and fund the cleanup. Sharing credit instills ownership and a sense of pride for the cleanup.

4. Lots of publicity. The continued support of sponsors and growth of volunteer support can be directly linked to the amount of media coverage the event draws. Last year, Big Sweep information appeared in 460 newspaper clips and reached 4.6 million television viewers. It was heard on

the radio and seen on posters, brochures and T-shirts. In addition, information about the cleanup was prominently displayed at more than 290 First Citizens Bank branches across the state and in the First Citizens Bank and Duke Power Co. customer statements.

5. Coupling data collection and education projects with a cleanup event. Although volunteers like collecting litter and leaving behind cleaner waterways, they also appreciate that the cleanup is more than a single day event. They like knowing that the data they collect is used to develop targeted education efforts that have a lasting impact.

Kathy Hart
North Carolina Sea Grant College Program
Box 8605, N.C. State University
Raleigh, NC, USA 27695

Ph (919) 515-2454
Fax (919) 515-7095
Email k_hart@ncsu.edu

FORGING PARTNERSHIPS WITH STATE AND LOCAL GOVERNMENTS

Joseph G. Farrell, University of Delaware

Delaware's inland bays and their tributaries cover about 34 square miles in southern Delaware and drain a 255-mile square watershed rich in agriculture and tourism. Nutrient over enrichment and habitat loss have been identified as the two critical problems facing the bays.

The Inland Bays Citizen Monitoring Program was established in 1990 to collect verifiable water quality data to support public policy decisions regarding the management of Delaware's inland bays and to increase public participation and support for the protection and management of these resources.

The program is managed by the University of Delaware Sea Grant Marine Advisory Service. Funding support initially came from the National Estuary Program. The program is now funded by the state of Delaware through a Memorandum of Understanding with the Delaware Department of Natural Resources and Environmental Control.

The Citizen Monitoring Program has been successful at forging partnerships with data users, most notably state agencies and local governments. The data is included in the state 305(b) report, is an integrated component of the Inland Bays Monitoring Plan, and has been used to support the opening of closed shellfish areas and the siting of submerged aquatic vegetation test plots. Citizen monitors, in cooperation with state agencies and private industry, have planted clam beds and monitored the clams for growth and survival to support the development of a shellfish management plan. In the spring of 1995, the town council of a coastal resort community requested assistance in identifying water quality problems in the town's extensive canal system to support the development of a stormwater management plan. I will describe this project in more detail later since I believe volunteer programs can provide an important community service by responding to short-term research needs of local governments.

From the beginning, our emphasis has been on collecting information that can be used to increase the understanding of the inland bays' watershed and to support resource management decisions. While we have always tried to maintain a strong public education element in our program, that goal is secondary to collecting information of known quality that is used to support decision making.

Before we collected a water sample, we spent the first six months talking to resource managers, marine scientists, and coordinators of other volunteer monitoring programs about everything from identifying gaps in data collection to sampling protocols to recruiting volunteers. We were fortunate to be able to draw on the expertise of scientists at the University of Delaware's College of Marine Studies, state resource managers who were intrigued with how volunteers could support their program goals; and program coordinators who had maintained successful volunteer monitoring programs over a number of years.

We maintain a base monitoring program that has varied in size from 20-30 sites. We collect and analyze samples for dissolved oxygen, water depth and clarity, salinity, Ph, air and water temperature, and weather conditions on a weekly basis (every other week in the winter). We also collect samples for nutrient concentrations and bacteria levels at a subsample of these sites. Many of our volunteers also participate in special projects—projects of fixed durations that are intended to answer specific questions. These include the clam reseeding project, a macroalgae survey, a benthic fauna study, and a boater use survey.

The canal study that we conducted in the town of South Bethany was unique for us in that the request originated from the town council and a town council member recruited volunteers and served as the local project coordinator. During a meeting between state and local officials regarding the financing of a stormwater management plan, it became clear that more water quality information was needed to evaluate the stormwater management options and to set priorities. Because there had been some communication breakdown among the parties in the past, we were, in effect, asked to step in as a neutral third party to design a study to answer their questions. We met with all stakeholders and, based on their concerns, designed a sampling program to answer two main questions: 1) the overall water quality conditions during a nine-week period during the height of the summer (a worse-case scenario) and 2) effect of stormwater runoff from the Route 1 corridor. We then trained community members (not our regular monitors) to collect and analyze samples; conducted a nine-week sampling program at 13 sites; analyzed the data; and provided a report to the town council and community. The project results are being used as the basis for implementing stormwater management measures and further discussions between town officials and state agencies.

More subtle project benefits included the following: 1) improved understanding of water quality dynamics in canals by community and resource agency staff; 2) sense of "ownership" of the study by the community and interest in improving water quality through better water quality management practices; 3) a lot of cooperation among resource agencies and community leading to trust and ongoing relationships.

Citizen monitoring programs can be a cost-effective (though not free) means to collect important trend information, as well as answer short-term research questions. Coastal managers, who are considering partnerships with citizen monitoring programs, should be aware of the strengths and limitations of volunteer programs. Developing a clear understanding of the objectives among the partners prior to sampling is key to ensuring that expectations of all parties will be met. The Quality Assurance Plan is a good place to state these objectives. I believe that one of the key ingredients to our program's success and credibility is a written Quality Assurance Plan. This is a dynamic document. We revise and update the plan on a regular basis. Any volunteer program that is interested in having the data used for anything more than public education needs to have one of these. (EPA has a good guidance document available.)
Other important considerations are recruiting, training, data management and reporting, maintenance of equipment and supplies, field coordination, funding, feedback to volunteers, and the nature of effective partnerships (will elaborate on each).

Joseph G. Farrell
University of Delaware
Sea Grant College Program
700 Pilottown Road
Lewes, DE, USA 19958-1298

Ph (302) 645-4250
Fax (302) 645-4007
Email Joseph.Farrell@mvs.udel.edu

TRANSITION TO SUSTAINABLE SALMON MANAGEMENT: INTEGRATING INNOVATIONS IN HARVEST POLICY AND TECHNOLOGY TO RECONCILE ECONOMIC AND ECOLOGICAL GOALS

William K. Jaeger, Williams College

The recent decline in the abundance of Pacific salmon, especially wild stocks, in the Northwestern US has been brought on by a multiplicity of causes, including degradation and destruction of spawning habitat, overharvesting by commercial and sport fishers, hydroelectric dams, and hatchery practices. While there is no consensus on the relative importance of any one of these factors, there appears to be widespread agreement that all four have contributed to the current crisis, which has resulted in the listing of numerous species under the Endangered Species Act.

Complicating the quantitative picture of declining salmon abundance is the qualitative issue of the stocks' integrity and resilience. High levels of hatchery salmon production are likely to adversely affect wild stocks by competing for nutrients during their life cycles. Moreover, there is increasing concern that reliance on hatchery production is not sustainable because artificial spawning and rearing does not preserve the behavioral, physiological, and genetic integrity of the wild species. Survival rates of hatchery-reared salmon have been shown to be lower than for wild fish, and this difference appears to increase through successive generations of hatchery fish.

Harvest pressure has clearly contributed to the decline as well. Even if a given catch limit were sustainable when established, the degradation of spawning habitat over time has surely reduced those sustainable levels in many cases below the allowed catch. The option of reducing harvest levels to restore stocks is complicated by the reliance of fishing communities and individuals on harvest levels sufficiently high to support their livelihoods. The economic pressure to maintain harvest levels has been met by expansion of artificial rearing, further threatening the wild salmon stocks. Moreover, protecting wild salmon is complicated by current harvest techniques that capture assemblages of mixed stocks that include different salmon species from different sources, as well as both hatchery and wild fish.

The current conundrum is how to restore the integrity of salmon stocks without imposing extreme costs on commercial and sport fishers and fishing communities, landowners, or hydropower consumers. There would appear to be no easy answers. Under the assumption that continued reliance on hatchery production at current levels is unwise, and that reduced reliance on artificial rearing is desired, the path to a long run future of economic health and ecological integrity would appear to be impossible without substantial economic hardship for some or all interested parties.

In this paper an alternative scenario is considered for achieving improved ecological and economic outcomes sooner, and at lower cost, than alternative proposals. Specifically, the paper demonstrates the possibility that a shift in policy and harvest technology could produce a gradual transition to a healthier fishery economy, and greater reliance on wild salmon stocks.

Three attributes of salmon fisheries and the way they are currently managed in the Pacific Northwest appear to offer some opportunities for improvement. First, ocean conditions and other factors create enormous uncertainty and variability in the stocks each year (and therefore in the efficient catch). But due to uncertainty, the "optimal" or efficient level of harvest in any given year is essentially unknown, and unknowable.

Second, current methods of commercial harvest are inefficient. Gill net harvests and other techniques are costly compared to some alternatives. These methods persist due to local economic considerations and regional political support. Commercial fisherman are very reluctant to abandon their traditional way of life; and they have considerable support among the general public.

And third, because harvest takes place where salmon occur in mixed assemblages of different species and stocks, including hatchery as well as wild salmon, it is virtually impossible to restrict harvests to appropriate levels for each species or stock. Gill net and purse seine fishers are unable to identify and return selected species or stocks in viable condition once they have been taken on to the boat. Although sport fishers are required to release some caught fish in viable condition, this regulation achieves mixed success. Moreover, it is difficult in these situations to cull hatchery fish while releasing wild salmon.

In the presence of variable and uncertain fish stocks it can be shown analytically that a fixed total allowable catch (TAC) that is optimal in the average year (*i.e.*, the maximum economic yield, or MEY) will be suboptimal in most other years. That is, in years when exogenous factors result in lower stocks, the MEY will be too high resulting in partial recruitment failures (the inability of the biomass to replenish itself), and in years when the stocks are very high, the MEY will be too low, resulting in excess escapement and lost economic value from the foregone harvest. Indeed, excess escapement may actually hinder spawning productivity, thereby increasing the loss from insufficient harvest. The net effect may be large losses of economic and ecological value if stocks will tend to be either higher or lower than the average for which the MEY was established. Therefore, harvest management systems that are thought to be the most efficient, for example individual transferable quotas based on average bioeconomic relationships, may actually be very costly and inefficient in most years.

Although economists consider direct regulation of the types of fishing gear used or the length of the fishing season to be inefficient for managing such stochastic fisheries, it may be preferable if such instruments produce catches that are correlated with actual (but unknown) stocks. If it is possible to devise an institutional/technological mechanism that will result -- somewhat automatically -- in higher harvests when stocks are high and lower catches when stocks are low, then uncertainty and variability may be less of a hindrance to efficient and sustainable fishery management. The simple analytics of this point are presented in the paper in an economic framework.

Fish wheels are one example of harvest technologies where the catch for a given level of gear would vary year-to-year proportionally with the stock. Various other types of "fixed gear" such as fish traps would also function in a similar manner. And the paper explains how institutional mechanisms might be designed in such a way to achieve a similar kind of self-modulating catch level from year to year. However, the paper focuses on the potential for fish wheels and other complementary policy changes. Fish wheels are in-river rotating wheels that scoop up salmon as they begin their ascent up river. The fish are guided into a holding tank as the wheel rotates around. This technique has several advantages. First, as mentioned, the wheels will catch a fairly constant proportion of a salmon run in any given year. Thus, the management decision reduces to a simpler one of choosing the optimal number of fish wheels, and the annual catch becomes endogenous and will vary automatically in general accordance with the allowable pressure on the stock. Second, because the fish are held live in a holding tank, selective harvesting for species, or between hatchery and wild salmon, is feasible and quite easy. Third, fish wheel harvesting is less costly than current methods and therefore would produce benefits to consumers as well as a significantly higher return to commercial fishwheel fishers compared to gill net or other fishers.

Indeed, fish wheels are a proven technology for salmon harvesting in the Northwest, although they are not applicable to all situations or all species. They were used historically with such high success on the Columbia river, that their use was banned because it was believed they would drive the salmon to extinction. This historical example of irrational conservation, however, only reinforces the cost advantage of the method, if overharvesting can be controlled by regulatory catch limits. Fish wheels are currently used on the Yukon River in Alaska. And modern versions are being used experimentally in British Columbia.

This remainder of the paper uses a set of simulation models to represent alternative scenarios of possible transition paths from current harvest, hatchery, and depleted stock situations, to alternative situations dominated by fish wheels, healthy wild salmon stocks, and economically stable commercial fisheries. Depending on the assumptions made, the analysis shows that such a coordinated transition path can achieve economic and ecological goals sooner, and at a lower cost, than alternatives currently under consideration.

William K. Jaeger
Williams College
Economics Department
Williamstown, MA, USA 01267

Ph (413) 597-3213
Fax (413) 597-4045
Email william.k.jaeger@williams.edu

USING ECONOMIC VALUES TO ALLOCATE COASTAL SALMON FISHERIES

Daniel D. Huppert,
School of Marine Affairs, University of Washington

Introduction

The prevalence of salmon allocation battles is perhaps best exemplified by the prolonged struggle of Treaty Indians for fishing rights, which was settled in 1974 by Judge Boldt's assignment of 50% of the fish to the tribes. Treaty Indian rights to shellfish and other marine harvests are still being negotiated. Long-standing tensions between recreational and commercial salmon fisheries re-surfaced during last fall's election. The ill-fated Initiative 640 (I-640) called for stringent bycatch standards on commercial fishing gear and for allocation of salmon to the recreational fishery based upon economic value. These examples are straightforward catch allocations, but more complicated allocations often involve numerous parties and resources. As an example, the 1989 Washington State prohibition on groundfish trawling in the Puget Sound addressed anglers' and shoreline property owners' suspicions that trawls damage benthic habitat, litter shorelines with discarded fish, and deplete recreational fish stocks. The trawl prohibition is a complex allocation of fish catch, space on the water, and coastal amenities. I use the Initiative 640 controversy to show how rudimentary economic accounting has been used to influence voters, and to indicate how a more rigorous assessment of economic values could contribute to coastal resources management.

The practical role of economic valuation needs to be clarified. Coastal resource allocations are often guided by "non-economic" principles of custom, precedent, legal obligation, and justice. Examples include Indian treaty fishing rights, and water rights based on historical use. Where these principles predominate, economic values are not influential. Other allocations are driven by the individual economic values for resources or resource-based commodities. Shoreline property sales, and commercial salmon fishing permit sales are examples of economic value-driven allocations. Because resource use often causes off-site spillover effects (economic externalities), economic values and other principles are often mixed to varying degrees in resource allocation policy. Hydropower sites are selected and authorized based upon prospective electrical power values relative to generation costs, but federal licensing should also attend to in-stream flow and wildlife values.

Common mechanisms for resource allocation include administrative action, legislation, judicial decree, and market transactions. State legislation created the administrative authority to allocate the salmon fishing permits, for example, followed by free transferability in markets. The principles for initial permit allocation were past fishing activity and economic dependency on the fishery -- clearly a mix of economic value and precedent/custom principles. Possible combinations of allocation principles and allocation mechanisms are illustrated in Table 1. Potential users of economic value information may be confused about when to seek economic value information. Market allocations are heavily influenced by individual economic values, but economists' resource valuations are not needed for the market to operate. In contrast, most administrative/legal allocations adhere to non-economic principles, and again economic valuation is not influential. Only one combination of allocation principle and mechanism -- administrative decisions based on economic values -- calls for objective resource valuation in a public arena. This combination of allocation principle and mechanism occurs in federal water development projects, for example, and in recent allocation decisions concerning salmon in Washington State.

Concepts and Measurement of Economic Value

Effective use of economic information requires consistency and rigor in choice of value concepts, measurement methods, and scope of effects considered. The main values (Table 2) pertaining to salmon harvest, allocation, and conservation decisions are recreation values (willingness to pay for angling), commercial values (what are salmon consumers willing to pay), and "non-use" values (what citizens in general are willing to pay to conserve viable salmon populations).[1] Each of these can be expressed as a gross amount (the value to recipients without regard to cost), or as a "net economic value" (the value to recipients minus the costs of provision). The three economic values for salmon are more precisely defined as follows.

(1) Net economic value of commercial fishing is the value of salmon delivered to consumers minus the costs of harvesting, processing, and transporting those fish to market. This is often labelled as a "market value" because it is largely revealed by market transactions.

(2) Value of recreational is the value enjoyed by anglers in pursuing their multi-attribute activity. Catching fish is an important aspect, but anglers also enjoy being outdoors, using boats and gear, and other aspect of fishing. It is a non-market value, as recreation is not sold. Costs of gear, transportation, and other angling costs are subtracted to get a net economic value.

(3) Non use value (or existence value) is a value that people hold for salmon even if they do not actually catch, view, or eat salmon. Because it is not revealed by sales of anything or reflected in outdoor activities, the magnitude of existence value is estimated from public surveys designed to directly elicit information about values. Preservation costs are subtracted to get net economic value.

A difference concept -- "economic impact" -- is used by regional economists in gauging the contribution of various industries and activities to employment and income. However, while people generally want greater employment and income levels, the contribution of any given industry to the total level of income does not measure its net economic value. Two activities generating the same regional income and employment could have vastly difference net economic values, especially if one activity causes the degradation of resources needed to sustain other activities. So, it is important to recognize that economic values and economic impacts yield distinctly different and inconsistent ranking of alternative resource allocations.

When valuing changes due to policy actions, the scope of the specific actions must be carefully examined. If we are contemplating the creation of a new fishery or the elimination of a fishery we want an "all-or-nothing value" -- the total value for the fish stock or fishery. If the change is an increase or decrease in fishing, an incremental value is needed. If we are assessing an allocation decision, we focus of relative values in the competing sectors.

Initiative 640 - The Issues and Counter-claims

Initiative 640 was promoted in 1995 by an organization named Save Our Sealife. It would have, among other things, re-allocated some salmon harvests between commercial and recreational fishing sectors. Initiative 640 required that allocations of harvestable food fish and shellfish be designed to "maximize economic benefit to the state" (Sec. 4 (5)). Further, I-640 noted that "chinook and coho salmon [are] . . . more valuable in recreational fisheries and should be utilized in this manner . . ." (Sec. 10). Pink, chum, and sockeye salmon would be allocated to commercial fishing (except for Lake Washington and Lake Wenatchee sockeye). The Department of Fish and Wildlife would be required to use accepted statistical and economic methods to develop comparative values before altering the Initiative's allocation of salmon. I-640 applies only to non-Indian fishing in State waters (especially within internal waters of the Juan de Fuca Strait, San Juan Islands, and Puget Sound). The main consequences would be felt by gill net and purse seine salmon fishermen catching some coho and chinook salmon while pursuing pink and sockeye salmon from the Skagit River and Canada's Fraser River.

Commercial fishermen, organized under the banner Salmon for Washington, successfully opposed the Initiative. They claimed that passage would cost Washington State 20,000 jobs and $250 million annually. They also noted that the commercial fishing industry is devoted to sustained fish stocks and that they contribute to numerous conservation efforts. Various environmentalist organizations joined with the commercial fishing industry in opposing I-640. It is unclear whether the economic claims were a significant reason for the state voters' rejection of the Initiative, or whether the perceptions of unfair treatment of the commercial fishery were a predominant concern.

The economic reasoning of I-640 was clearly stated in the Initiative itself -- that coho and chinook salmon (and some sockeye salmon) caught by recreational fishing are more valuable than the same fish caught by commercial fishing. If so, reallocation of harvests under I-640 would generate net economic benefits. The Initiative did not acknowledge the economic hardships it would impose on the commercial fishery, nor did it propose to compensate the commercial fishery. The claim that recreational value exceeds commercial value of coho and chinook is largely based upon a 1988 study done for the State's Department of Community Development by ICF Technology Incorporated[2]. Clearly distinguishing economic value from economic impact, that study shows commercial salmon fishing in the state during 1983-85 with average gross sales of $19.6 million and variable fishing costs of $18.5, leaving roughly $1.1 million per year in net economic value.[3] Recreational salmon fishing had an estimated gross value of $133.3 million and expenditures of $89.7 million, leaving a net economic value of $42.6 million per year. So the overall net value favors recreational fishing. Further, using regional economic multiplier analysis, state income generated by commercial salmon fishing is estimated as $44.3 million (involving 2,215 full-time equivalent jobs), while the state income generated by recreational fishing is $148.8 million (involving 7,342 full-time equivalent jobs).[4] Again, recreational salmon fishing has more economic impact than commercial fishing.

The economic comparison that these numbers invite is problematic for two reasons. First, the re-allocations directed by I-640 do not call for eliminating either the commercial or recreational fisheries; hence, the total, all-or-nothing values of the two fisheries are not particularly relevant information for judging the effects of the re-allocation. We need to focus on specific changes in the two fisheries. Second, the net value estimates for the two sectors are inconsistent in content. For the commercial fishery, the net economic value reflects net income earned by fishing for salmon; it does not include value to salmon consumers, or earnings of processors, distributors, and wholesalers. For the recreational fishery, the net economic value estimate reflects the amount angler's are willing to pay for salmon fishing trips minus the amount the anglers spend on fishing trips plus the net incomes earned in the salmon charter boat fleet. The recreational value is, in essence, a retail value of angling, while the commercial value is a raw product value which will be augmented by processing, transportation, and final retailing. The additional value which is ignored on the commercial side may be fairly small if the allocation causes only a small reduction in local supply and if alternative sources of salmon are available for in-state processors and retailers.

The anti-Initiative 640 groups distributed a leaflet claiming the I-640 measures would have an economic impact of 20,000 jobs lost and $250 million in economic impact loss.[5] According to tables in the report referenced by Salmon for Washington, these impacts correspond to the whole Pacific coast salmon industry, and are not pertinent to limited re-allocation called for in I-640.[6] Neither the proponents nor opponents of I-640 presented the public with a well-reasoned summary of the economic information available.

Economic Information Relevant to a Salmon Re-allocation

A reasonable estimate of marginal net economic values in the two sectors under a moderate re-allocation of fish from commercial to recreational would be useful. One is tempted to assume that, because the value per fish is higher in recreation, shifting a fish from the commercial to the recreational fishery will cause a net increase in economic value of salmon harvest. But this may not be so in all segments of the salmon fishery. In the commercial ocean salmon fishery for example, trollers target the chinook and coho salmon, and the Pacific Fishery Management Council has already made an explicit allocation of these fish to recreation based upon both economic information and other arguments presented in public hearings. In that allocation, there is a fairly simple one-to-one trade-off of commercial for recreational value of the targeted fish.

In contrast, most chinook and coho salmon caught in the Puget Sound commercial fishery are apparently taken as bycatch. Each chinook that the commercials take may be accompanied by a large quantity of pinks, sockeye, and chum -- fish that do not contribute significantly to recreational fishing in the Washington state waters. If this is the case, a rule which reduces the allowable coho/chinook take in that commercial fishery may cause a significant reduction in the commercial catch. For example, if 50 5-lb sockeye are caught for every 15-lb chinook, and both sell for $1.80/lb, prohibiting the catch of one chinook will reduce the commercial fish sales by $477. Even after subtracting fishing costs, the net economic value could rival that of a sport-caught chinook. Now, the fish "lost" by one commercial fishery may be gained by another, such as the tribal gill net fishery or the Canadian fishery in the Fraser River. Hence, my calculation is only roughly illustrative of the economic trade-off inherent in the allocation decision. More specific information must be developed from fishery records, and the effects of the reallocation on other fisheries must be assessed to establish a more precise relationship.

Finally, because recreational fishing is an complex mix of outdoor activities (fresh air, solitude, the excitement of the hunt, communion with nature, etc.), its value is not increased in proportion to the number of fish caught, except under specific conditions. For example, if the recreational fishery is strictly limited by a seasonal quota, then each increase in recreational catch allocation could yield an increase in fishing season and a proportional increase in fishing trips. If value per trip is constant, then total economic value rises in proportion to catch. On the other hand, where sport fishing is subject to a bag limit (maximum number of fish allowed per day), a reallocation of harvest from commercial to recreational could permit a larger bag limit. While number of fishing trips may increase somewhat when bag limits increase, the economic value per trip will not increase in proportion catch per trip. Research has shown that the marginal value of fish catch declines as catch per trip increases. As a consequence, additional fish allocated to recreation are worth less than the reported average net economic value per fish. To make a valid inference about increased recreational value, we need to specifically study the way in which increased recreational catch contributes to the recreational fishing values -- something that none of the available studies in Washington State do for us.

Conclusion

The basic principles for economic valuation of salmon are pertinent to numerous coastal resources. Circumstances under which economic valuations contribute to decision-making for salmon allocations are also germane to water, shoreline, and other allocation issues. I suppose no one is surprised to find that the economic assessment of coastal fish allocations requires careful application of theory and complicated calculations based upon in-depth data, nor that an academic economist would call for further research on the issue. What is surprising is that with so much at stake, and with so many public statements of economic value being distributed, so little serious effort is made to quantify and validate the economic effects of the resource allocation decisions being made.

Daniel D. Huppert
School of Marine Affairs
University of Washington
3707 Brooklyn Ave. NE
Seattle, WA, USA 98105-6715

Ph (206) 543-0111
Fax (206) 543-1417
Email huppert@u.washington.edu

Table 1. Resource Allocations Characterized in Two Dimensions: The Principles Followed in Allocation (Precedent and Custom vs. Individual Economic Values) and the Social Mechanisms for Allocation (Administrative/legislative vs. Markets).

Mechanisms → Principles ↓	Allocation by Administrative, Legislative, or Judicial Rules	Allocation by Markets or Individual Contracting
Allocation based upon Precedent, Custom, Obligation, Justice	Indian Fishing Rights. Western water rights Federal grazing leases	Organized crime businesses.
Allocation Based on Economic Values to Individuals	Water resource developments under Benefit Cost rules. Salmon allocation under I-640.	Federal offshore oil leases Sales of fish catch. Charter boat leasing.

Table 2. Economic Values and Impacts of Fish Allocations

	A. Components of Value	B. "Economic Impacts"
Use Values 1. Recreational Fishing	Angler's willingness to pay for fishing (i.e. costs of fishing detract from value).	Employment and income in support sector (tackle, bait and boat suppliers, charter boat operators).
2. Commercial Fishing	Local market price times quantity minus harvesting and other costs.	Employment and income in commercial fleet, fleet support sectors, fish processing and wholesaling.
3. Wildlife Viewing	Willingness to pay for opportunities to view salmon.	Employment and income in economic sectors supporting the travel and activities of viewers.
4. Other	Religious, ceremonial and bequest values	None
Non-Use Value (also, existence or passive use value)	Value of knowing that salmon continue to survive and prosper.	No direct impact, but these values may induce migration of population and economic activity to regions with high environmental amenities.
Total Value	Sum values across users consistent with harvest allocation plus non-use values	Sum of impacts across all economic sectors affected by salmon use.

Endnotes

[1] Technically, economic values can be expressed as compensation demanded for loss of salmon fishing rather than willingness to pay to obtain salmon or salmon fishing. The compensation-type value can be pertinent where reductions in salmon or salmon habitat are being considered. For simplicity and because I am considering cases in which prior rights to salmon harvest are ambiguous, I limit my discussion to values associated with positive payment for salmon fishing.
[2] "Economic Impacts and Net Economic Values Associated with Non-Indian Salmon and Sturgeon Fisheries". ICF Technology Incorporated, Redmond, WA (1988).
[3] The variable fishing cost estimate leaves out capital costs of vessels and gear.
[4] All these figures are contained in Tables 11-16, pp A-12 through A-17of ICF Technology Inc. (1988).
[5] Information distributed by Salmon for Washington - No on 640. Seattle, WA. Economic projections are from "Economic Activity Associated with Fisheries Products in the United States". Report for the US Department of Commerce by the Kearney/Centaur Division of A. T. Kearney, Inc., Washington, D.C.
[6] See Kearney/Centaur Report, p. 7-48.

VALUING MARINE RESOURCES: APPLICATIONS INVOLVING NATIVE AMERICANS

Michael L. Taylor, Northwest Economic Associates

Introduction

Anadromous fish are central to the lives, livelihoods, and cultural traditions of many Northwest Native Americans tribes. The importance of salmon to Northwest tribes is arguably the greatest of any socioeconomic or ethnic group in the country. The determination of the total value to Native Americans of fish runs and the resources which sustain them -- instream flows and riparian habitat -- are important considerations in the choices society makes involving the preservation of endangered or threatened salmon species.

Northwest tribes can play a major role in restoring fish runs. Indians control vast amounts of contiguous land area, and have the opportunity to provide the physical habitat necessary for fish survival and reproduction. Many tribes have dedicated programs towards restoration of natural or native runs. But as the treaty rights under which many reservations were established are asserted, settled, and implemented, Indian tribes could control the most important resource necessary for fish survival: water. Such a prospect has the potential for being beneficial for endangered species.

Importance and Value of Fish to Northwest Tribes

Many fisheries, wetlands, rivers, and wildlife habitats were impaired and flows diminished as the West was settled and water diverted for agriculture and other uses. Many tribes still highly value the abundant natural resources upon which their communities survived, and seek environmental restoration as a high priority.

The fishery resource is not only a major food source for Northwest tribal members, it is also an integral part of the tribes' cultural, economic, and spiritual well-being. Many tribal ceremonies occur during fish spawning or involve harvesting fish. A survey of members of the Umatilla, Nez Perce, Yakama, and Warm Springs tribes of the Columbia River Basin found that, on average, adult tribal members consume nine times and children three times the estimated national fish consumption rate. Salmon represents nearly half of this consumption by weight, followed in order by trout, lamprey, smelt, and whitefish.

The economic value of fisheries can be measured in terms of its commercial or market value. However, market price and quantity clearly fails to capture the full value of fish and its habitat, to both individuals in general and Native Americans in particular. Non-market values are those benefits associated with fish or the activity of fishing that are not traded in the market place. Determining a non-market recreational value associated with fish has occupied the time of economists over the years, and the methods for eliciting this value are well-developed. They typically involve measuring actual expenditures associated with the activity (Travel Cost Method), or by eliciting a willingness-to-pay value through a direct survey (Contingent Valuation Method).

There are also values associated with the non-consumptive use of fish, which are much more difficult to measure: option value (a willingness-to-pay for continued availability of a resource in the future) and existence value (a willingness-to-pay to preserve the resource in a given location, apart from any desire to personally benefit from the resource).

Some economists argue that additional values exist for tribal members associated with fish and fish habitat, because of the more extensive role fish plays in the tribe's well-being. These values are variously called traditional, cultural, or "subsistence" benefits. In theory and practice, estimation of the subsistence value is very difficult; many tribes object to the concept of trying to value a cultural resource. Nevertheless, this important category of benefits should not be overlooked when evaluating tradeoffs involving fishery resources.

One method of estimating the relative magnitude of subsistence benefits is to examine past legal precedents which may have key factors in common. Several settlements and negotiations have involved compensation for loss of traditional or subsistence uses of natural resources, and can indicate a rough range of values for cultural services lost. Compensation was made to the Yakama, Umatilla, Warm Springs, and Nez Perce tribes for inundation of Columbia River salmon fisheries (although the tribes retained fishing rights to the fishing grounds). Evidence suggests that the final payment, made in 1956, was not entirely voluntary. The payments were equivalent to $1,078 per capita annually in 1992 dollars. Other settlements associated with natural resource losses on reservations elsewhere in the country ranged from $823 to $1,424 per capita annually in 1992 dollars.

Federal Reserved Water Rights

In the 1800s, many Indian tribes entered into treaties with the United States that preserved all rights except those not expressly ceded to the tribes, in exchange for a reservation as a homeland. When those lands were set aside, the natural resources were also reserved for tribal people. In 1908 the historic *Winters* decision was handed down by the Supreme Court. This decision affirmed that tribes were entitled to sufficient water to fulfill the purposes of the Reservation. The courts recognized these federal reserved water rights as having a priority date coinciding with the date of the establishment of the Reservation, and these rights were retained regardless of whether the tribes have put the water to beneficial use.

Because Indian reservations generally were established prior to extensive non-Indian settlement, *Winters* rights usually have very senior priority dates, making them the most reliable and thus most valuable. But for years these rights were not enforced. It is only recently that the federal government has provided assistance to tribes in asserting their reserved rights.

In the 1963 decision *Arizona v. California*, the Supreme Court established "practicably irrigable acreage" as the standard for quantifying reserved water rights on reservations set aside with agriculture as a purpose of the reservation. This standard limited the water right to that which was "beneficial," that is, which could be economically put to use. Most treaties imply agriculture as a purpose of the reservation.

But what of tribes for which fishing was the primary purpose of the reservation? What of non-agricultural Homeland purposes, such as domestic, and stock watering, or instream flows for fisheries, cultural, or religious purposes? The courts have not established a comparable standard, and have not been consistent in concurring with tribal claims for instream flows. However, more recent decisions of the courts and several negotiated settlements indicate a greater emphasis on demonstrating beneficial and "non-wasteful" use of water. Thus, economic values associated with instream flows, including commercial, recreational, option, existence, and cultural benefits, could play an important role in quantifying the rights of tribes as the most senior water users of many important Northwest streams.

Current Efforts of Northwest Tribes

The prospect of a shift in water rights to Indian tribes can have positive implications for the preservation of fish for several reasons. First, many reservations represent significant land bases in the coastal and interior Northwest, the natural range of salmon. Second, in many cases treaty language includes fishing rights to lands beyond the reservation boundaries, a tribal "aboriginal" territory. Third, the stated objectives and actions of many Northwest tribes concerns the restoration of riparian habitat and establishment of instream flows consistent with the management of fishery resources. Recent efforts of four Northwest Tribes provide examples of how tribal water rights may be implemented.

The Warm Springs Tribes of Oregon are currently involved in negotiations with the State of Oregon to quantify the water rights of the Reservation. A major component of the settlement is instream flow levels for fish in the Deschutes River.

The Confederated Tribes of the Umatilla Indian Reservation have been pro-active in working with the U.S. Bureau of Reclamation and the irrigation districts located between the reservation and the Columbia River. The tribes have secured water for flows in the late summer and fall which are sufficient to allow fish passage on the Umatilla River, which has not been otherwise possible for many decades. They have also implemented an aggressive stream restoration program on the reservation, and plans are underway to develop a commercial nursery operation growing native plants for riparian rehabilitation projects throughout the Northwest.

The Lummi Nation and Nooksack Tribe, located in northwest Washington, both seek to assert instream flow rights for fish in the Nooksack Basin. Efforts are underway among the State, Federal agencies, and various water interests to come to agreement on diversion amounts and instream flow levels.

The Nez Perce Tribe is currently involved in negotiations with the State of Idaho in the Clearwater River Basin covering the Tribe's aboriginal territory. The United States has filed on behalf of the Tribe instream flow water right claims with the State of Idaho on 1,133 sites in the basin, covering a large segment of northern Idaho, as a part of the Snake River Basin Adjudication.

Conclusions

Northwest Native American tribes have only recently begun to quantify and have recognized their federal reserved water rights. For many inland tribes the standard for quantifying these rights has been determined by the economically beneficial use of diverted water for irrigation, as a purpose of the reservation. But many other tribes place a high value on salmon and resident fish, and seek to put their water rights to use as instream flows beneficial for fish. The economic value, including non-market subsistence benefits, may play an important role in determining or asserting instream flow rights.

Northwest tribes, as senior water right holders, can play an important and significant role in the preservation of endangered or threat fish species. Many tribes have goals of habitat restoration and fisheries management, often retain treaty rights over broad land areas of the Northwest, and in many cases could be in control of significant quantities of water as the primary scarce resource.

Michael L. Taylor
Northwest Economic Associates
13101 N.E. Highway 99
Vancouver, WA, USA 98686

Ph (360) 574-2554
Fax (360) 574-7083
Email 72050.3666@compuserve.com

ESTABLISHING MARINE PROTECTED AREAS IN THE SHARED WATERS

Mary Lou Mills, Washington Department of Fish and Wildlife
Ken Morrison, British Columbia Ministry of Environment, Lands and Parks

Issue

Destruction, alteration, and degradation of habitat along with declines in fish and shellfish populations, were noted by the Marine Science Panel as the two highest priority issues/problems facing the shared waters. A resulting recommendation from their report shows establishing marine protected areas as the second highest recommended action to the Council and the Task Force.

As one solution to the habitat loss issue and the problem of declining marine plant and animal populations, marine protected areas could serve several positive purposes, including protecting against further human encroachment on sensitive areas, permit recovery of depleted fish stocks, and provide refuge areas for marine fish, mammals, and birds.

Work Group Process

The Province of British Columbia began a joint federal-provincial Marine Protected Areas (MPA) Strategy initiative before the Task Force work groups were established. The objective of this initiative is to develop a marine protected areas strategy for the Pacific coast of Canada. At the time of this writing, the MPA Strategy work group has convened one multi-stakeholder forum to discuss the concept of MPAs and strategy development, developed a two-layered marine ecological classification system for protected areas system planning purposes, and developed metadata on existing MPAs. A short-term action plan following from the multi-stakeholder forum is presently being developed which includes a review of existing marine parks and ecological reserves to determine where additional closures can be implemented to achieve "no-take" status; the identification of existing coastal protected areas which could benefit from the addition of marine components; designating new MPAs; a marine atlas for the Strait of Georgia; and policy development.

The Washington work group began with the Task Force process. In Washington, approximately 100 MPAs of varying definitions exist under various authorities. The work group is currently inventorying existing MPAs to compile metadata on them and developing recommendations on future management or potential future designations. The work group is also developing short and long-term strategies for designating MPAs, including developing criteria, management alternatives and implementation schemes for establishing MPAs.

Mary Lou Mills
Washington Department of Fish and Wildlife
P.O. Box 43144
Olympia, WA, USA 98504-3144

Ph (360) 902-2834
Fax (360) 902-2944
Email millsmlm@dfw.wa.gov

Ken Morrison
BC Parks
2nd Floor, 800 Johnson Street
Victoria, BC, Canada V8V 1X4

Ph (604) 356-0536
Fax (604) 387-5757
Email kmorrison@galaxy.gov.bc.ca

SYNTHESIS AND ASSESSMENT OF SECTION 312 EVALUATIONS: HELPING TO ACHIEVE NATIONAL COASTAL MANAGEMENT GOALS

Vickie A. Allin, Matthew E. Menashes, and
Alexis Wright, NOAA/National Ocean Service

Introduction

Programmatic evaluations of the 29 approved state and territory coastal zone management (CZM) programs are mandated by Section 312 of the Coastal Zone Management Act (CZMA). The authors reviewed 214 Final Evaluation Findings (Findings) for state and territory CZMPs issued by NOAA's Office of Ocean and Coastal Resource Management (OCRM) between 1978 and 1995. The study synthesized and analyzed a total of 2,346 accomplishments and 1,743 recommendations cited in the Findings. The study identifies regional and national trends in the accomplishments of coastal zone management and in the difficulty in implementing CZM programs.

The accomplishments and recommendations were categorized in seven general issue areas: (1) Implementation and Enforcement; (2) Federal/State Consistency; (3) Other Effectiveness Measures; (4) Involving the Public; (5) Administration; (6) Resource Protection; and (7) Sustainable Use. These general categories, with the exception of Federal/State Consistency, contain specific issue areas (subcategories) for a greater level of detail to assist in analysis. A total of 26 subcategories were needed to cover the scope of issues raised in the Findings, reflecting the complexity and broad scope of CZM programs.

Total Accomplishments

Most accomplishments were in the Permitting subcategory (267). State and territory CZM programs have had remarkable success in streamlining permitting programs, reducing unnecessary duplication for agencies, and saving time and money for applicants.

There were also many accomplishments in all the Resource Protection and Sustainable Use subcategories, but especially in the area of Public Access (223). The study clearly documents that state/territory CZM programs increased public access to the coasts substantially through outright purchase of coastal property, acquiring public access easements, legal research to document public access rights under the public trust doctrine, subdivision regulations, and other innovative means. It also documents the clear success of the Low Cost Construction Program in assisting local governments in building dune walkovers, boardwalks, parking facilities, restroom facilities, kiosks, and other facilities that improve public access.

The study also documents significant accomplishments in the areas of Habitat Protection (170), Hazard Mitigation (157), Coastal Dependent Uses (136), Urban Waterfront Revitalization (103), and Living Marine Resources (96). The study shows that designation and management of Special Areas was the most used technique for habitat conservation by state and territory CZM programs.

Total Recommendations

The study found that most recommendations also were in the Permitting subcategory (237), followed by Monitoring and Enforcement (195), Program Management (164) and Federal and State Consistency (160). There is a rough correlation between the number of Permitting accomplishments and recommendations, but this balance does not hold for Monitoring and Enforcement (M&E). The number of M&E recommendations (195) outweighs the number of M&E accomplishments (120) by more than 50%. Therefore, the data seem to indicate a bigger problem program-wide with M&E than with Permitting. Since many states have strict statutory deadlines for processing permits, permit processing is the top priority for available staff. In such states, when budget constraints lead to staff reductions, areas other than permitting are trimmed first, including M&E.

The same imbalance between numbers of overall accomplishments and recommendations that exists in M&E also exists in Federal/State Consistency (FSC). Federal/State Consistency recommendations (160) outnumber FSC accomplishments (98) by more than 60%. The study team's review of these accomplishments and recommendations indicates that problems with effective implementation of FSC result from both inadequate staff resources and difficulties in understanding the complexities of Federal consistency and how to use this potentially powerful tool to best effect. The recommendations clearly show that FSC problems are greatest among some networked programs. This is understandable because, under this program structure the lead CZM agency is usually not the agency with the program's major permitting authorities. Therefore, states develop and operate a separate coordination system for FSC review, rather than reviewing projects that come in through the state permitting system for FSC at the same time.[2]

An exception to this generalization is the Alaska CZMP, where State permitting and consistency review are completely integrated

Program Structure

The CZMA and NOAA's regulations (15 CFR Subpart E) allow three types of approaches to structuring an approvable CZM program. The three structures are: (a) Direct Permitting (CNMI, LA, MI, NJ, NY, NC, RI, SC and VI); (b) Networked (AL, AK, AS, CT, DE, FL, GU, HI, ME, MD, MA, MS, NH, PA, PR, VA, WI); and (c) Local Coastal Programs (CA, OR, WA).

The study team expected to see significant variations based on program structure, especially in recommendations. The study data did not, however, bear out this hypothesis. The distribution of both accomplishments and recommendations among the various categories was fairly uniform for all three program structures.

We had expected to find an increased level of recommendations in Implementation and Enforcement for networked programs, as compared to the other program structures, based on the increased operational complexities of networked programs. The study data show that although there were somewhat fewer accomplishments in the Implementation and Enforcement category for networked programs (20% versus 28% for direct permitting programs and 25% for local coastal programs, respectively), there were also fewer recommendations in this category for networked programs (33%) than for either direct permitting or local coastal programs (both 40%). The surprising similarity among the three program structures may in part be because there are few CZM programs that represent a "pure" form of any of the program structures. Instead, most CZM programs represent a combination of two or even all three of the allowable structures.

A review of the Local Coastal Program (LCP) recommendations also clearly shows that the development and approval of LCPs is complicated and resource intensive, and takes longer than any of the coastal states anticipated. As a result, although several states started developing LCPs only three West coast states (Washington, Oregon and California) have been able to implement their CZM programs predominantly through LCPs. Only Oregon has state-approved LCPs implementing permitting programs along its entire coastline.

At the same time, however, the study also shows that local governments are playing a larger and larger role in coastal zone management, whether there are state-approved LCPs or not. This is in part because building and retaining public support for coastal management has become even more essential as the state CZM programs have matured.

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in one process run by the lead CZM agency.

Regional Breakouts

We summarized data according to OCRM's regional structure. In addition, we summarized the island CZM programs separately for analysis.

North Atlantic

Most accomplishments for the North Atlantic region were in Sustainable Use, that is, providing increased public access to the coast, providing priority for coastal dependent uses, revitalizing deteriorated urban waterfronts and ports, and planning for special areas, including harbor management planning. The biggest challenges for this region were in Implementation and Enforcement (recommendations in this category exceeded accomplishments by 50%) and Administration. These two categories interrelate because funding constraints and insufficient staffing lead to problems with implementation and enforcement of approved programs.

South Atlantic

Most accomplishments were in Resource Protection. In particular, these programs made significant accomplishments in Habitat Protection and Hazards Management. They also made substantial accomplishments in the area of Sustainable Use, especially increasing public access and revitalizing urban waterfronts. Like the North Atlantic, the biggest challenges in this region were Implementation and Enforcement and Administration, for many of the same reasons.

Gulf

Most accomplishments were in Implementation and Enforcement and Resource Protection. Also noteworthy, 12% of Gulf region accomplishments were for public involvement, second highest of all regional breakouts for this category. This indicates the high priority placed by these programs on public participation and public education to increase awareness of coastal issues and bolster support for sound planning and management. As with other regions, the biggest challenges were Implementation and Enforcement and Administration. This region also had the second highest percentage of recommendations in the Administration category (27%), indicating that funding, staffing, training, and grant-related issues were especially severe.

Great Lakes

The highest percentage of accomplishments was in the Sustainable Use category. Great Lakes CZM programs originated the CZMA's Low Cost Construction Program to aid communities in building boardwalks, bike paths, dune walkovers, restroom facilities, and other amenities to improve public access to the coast and stimulate revitalization of deteriorated urban waterfronts and ports. This was the only region where Administrative recommendations slightly exceeded Implementation and Enforcement recommendations (27% to 26% respectively). This reflects not only funding and staffing constraints but also the somewhat complex grant administration of Low Cost Construction and other programs with local governments. In addition, this region had the highest percentage of recommendations in the Public Involvement category of any region. This does not mean there was less public involvement in this region than elsewhere, but it does indicate that some of the vehicles for public involvement, including Advisory Committees, were somewhat complex to operate.

Pacific

This region had high levels of accomplishments in Implementation and Enforcement, Resource Protection, and Sustainable Use, reflecting well-rounded attention to all the national coastal management objectives of the CZMA (contained in Section 303). However, there was a very high rate of Implementation and Enforcement recommendations, third highest of all regions. This indicates both the complexity and difficulty of implementing LCPs and the special challenges for island programs in implementing mainland style regulatory programs.

All Islands

For the islands combined, most accomplishments were in Implementation and Enforcement, and Resource Protection. This indicates that despite some difficulties these programs made substantial progress in implementing land use and development planning through their CZM programs. The very high percentage of recommendations in Implementation and Enforcement (44%) reflects the continuing challenges faced by island programs in implementing and enforcing their regulatory programs in particular. In several instances, evaluators were told that regulatory programs are not in tune with island cultures and that alternatives for controlling coastal uses that rely more on island cultures and traditional authorities should be explored.

Time Series

The time series were particularly interesting in showing the progression of the national CZM Program over the years and how different issues took on major importance at different times. For example, while the percentage of recommendations in Implementation and Enforcement has remained relatively consistent over time, the percentage of recommendations in the Administration category has steadily increased, from 14% in 1978-80 to 31% in 1993-95. The high level of Administration recommendations reflects not only increasing budget and staffing constraints, but also continuing difficulties in dealing with grant and program change issues.

The data show that the percentages of accomplishments in Resource Protection and Sustainable Use have stayed relatively constant at relatively high levels over time, reflecting the sustained attention and success of coastal programs in these areas.

Conclusions

Streamlining regulatory processes is a success of State and territory CZM programs. The results of this study show, however, that effective implementation of the regulatory component of state/territory CZM programs is the still the biggest challenge for all state and territorial CZM programs.

Administrative issues continue to loom large, reflecting the continuing and, in many cases, increasing budget constraints on state/territory governments. Low budgets relate directly to the difficulty of obtaining and keeping adequate staff for implementation; inadequate training of some staff to perform program functions; and problems in almost every state and territory of keeping current with program changes and submitting them to OCRM for review and incorporation into the approved CZM program.

The study results indicate that program structure is less of a determinant of performance issues and problems than previously thought. Partly, this may result from the fact that there are few "pure" examples of any of the three program structures allowed by NOAA's regulations: direct permitting; networked; and local coastal programs. Instead, most approved state and territory CZM programs combine different features of two or even all three of the allowed structural forms.

The results also indicate the great difficulty of successfully developing and implementing a purely local coastal program (LCP) form of state or territory CZM program. Although several states started out that way, only Oregon has been able to implement its CZM program along its entire coastline through LCPs. On the other hand, all state and territory CZM programs are trying to maintain and increase the local role in CZM, but not necessarily through LCPs.

If there is one area where on-the-ground program accomplishments stand out the most, it is in the area of increasing public access to the coasts. The study documents the clear success of CZM programs in increasing public access, including the clear success of the Low Cost Construction Program in assisting local governments in increasing public access and revitalizing deteriorated waterfronts and ports into economic assets.

Finally, although there are relatively few recommendations in the Habitat Protection and Sustainable Use categories, the study documents continuing high levels of accomplishments in these categories. This reflects that although evaluations document on-the-ground outcomes of state/territory CZM programs, under the CZMA, OCRM cannot require that on-the-ground outcomes be made. Rather, the CZMA mandates a plan and an implementation process and evaluations document whether or not states have adhered to and effectively implemented their plans. The study shows that substantial on-the-ground outcomes do result, however, from state/territory CZM plans and implementation processes.

Vickie A. Allin
Office of Ocean and Coastal Resource Management
NOAA/National Ocean Service
1305 East-West Highway, N/ORM4
Silver Spring, MD, USA 20910

Ph (301) 713-3086
Fax (301) 713-4370
Email vallin@coasts.nos.noaa.gov

COMMUNITY-BASED COASTAL RESOURCES MANAGEMENT PLANNING: AN EFFECTIVE TOOL FOR FACILITATING SUSTAINABLE DEVELOPMENT

David A. Tarnas, Hawaii State Representative
Marine and Coastal Resources Consultant

Coastal Resources Management Plans: An Integrated Approach

An ecosystem approach to coastal resources management recognizes the ecological linkages of the coastal and marine environment. The water cycle connects mountain to the sea, from upland watersheds and forests down steams and rivers to the coastal mangroves, into coastal waters with coral reefs and seagrass beds. Coastal resources management is based on integrated management of the entire watershed. This includes managing human communities, resource and land uses, with all the resulting impacts to the surface, ground, and coastal waters. The scope of the coastal area in island environments also includes the archipelagic waters around and among the islands as well.

Based on Community Values

The management program must be integrated with the lifestyle of the community members, in which resource use is and often has been a central social and economic activity of the community. Despite short-term economic incentives to capture or harvest as many individual fish or other unit of a particular resource as possible, most of the local users have an historic appreciation of the need for protecting the resource base to ensure long term sustainability of the resource. Local fishers, for example, often wish to have their children carry on the tradition of fishing, and therefore have a strong commitment to protect and rehabilitate the fishery resources in the community's waters. In most communities, coastal resources have significant cultural importance. These social, economic and cultural values must be integrated within a management scheme to make it effective. Community-wide collaboration ensures this sensitivity is incorporated in the plan.

Inclusive of the Entire Community

This community-based management approach must include members from the broad spectrum of the coastal community. This is an exercise in power sharing among landowners, resource users and their families, government and nongovernmental organizations, and members of the larger community as well. The participation must also be equitable for gender, age, and social class. This broad-based participatory program reinforces the principle that since we are all part of the problem, we all need to be part of the solution.

Landowners must be integrally involved in any decisions relating to use of private land and resources. While respecting private property rights, the public trust resources must be sustained in a high quality for future generations. Social, economic, and cultural incentives for participation will be important to landowners.

Resource users must be involved since they are the ones that use, and sometimes collectively overuse the resources. They are also the ones with extensive local knowledge of the resource, including trends of resource quantity and quality, trends in resource use levels and types, as well as the interrelationship with other resources and their users. These local resource users are the ones that make the decisions that most directly affect the resource base itself. Their involvement is essential to a successful management program.

Government clearly is a partner in this process, being the one with the responsibility for environmental protection and resource management. The government must be open to collaboration with these other partners and be willing to authorize these community-based groups' authority to make resource management decisions. Nongovernmental organizations (NGOs) are another key partner in this participatory management process. NGOs provide a complementary service to the government as well as the resource users, through community organizing, technical advisory assistance, staff for resource assessment, monitoring, and enforcement activities, and a network with similar organizations in the region and nation that do similar work. Private enterprise is also a vital partner as coastal and marine businesses rely on a quality environment and their investments in facilities and equipment can add value to marine resources and provide alternative employment necessary to reduce fishing pressure.

Participatory and Facilitated Decision Making

In the planning area, such as one watershed, bay or island, a broad-based participatory organization must be empowered to make resource management decisions. At each step of the process, facilitated group decision making is utilized. These process skills enable the organization to form a mutually agreed upon decision making method. The group can create its own mission, goals, objectives, plans, and implementing actions. Training in facilitation and facilitative leadership is central to the local capacity building to carry on this community-based coastal resource management effort.

Flexible planning process

Though the process for participatory decision making is the same in each site or community, there must be flexibility to adapt to each site because of that site's uniqueness. Therefore, the combinations of participants as well as the strategies for managing the resources are tailored to that site. The process must have a good system of evaluation and monitoring to ensure that feedback is available to redesign projects and methods to improve their effectiveness. Performance-based evaluation with specified milestones are essential for accountability and learning.

Using Nonregulatory and Regulatory Mechanisms for Coastal Management

Successful mechanisms for coastal management must be a mix of nonregulatory and regulatory approaches. Certainly, statutory and regulatory measures must be promulgated to lay the policy foundation for sustainable coastal environmental management, with specific goals and objectives for the national and local governmental area. Statutory environmental quality standards, resource use limits and licensing, and area restrictions are necessary, along with the penalties for violation of these standards.

However, international experience shows that a purely regulatory and enforcement approach is not effective enough in achieving these environmental quality goals and objectives. Experience in Hawaii and elsewhere in addressing coastal management issues highlights the benefits of a nonregulatory, incentive-based program for controlling detrimental impacts on coastal environment.

For example, the most critical coastal management problem in Hawaii is nonpoint source pollution, which is primarily sediment-laden runoff going into the nearshore waters. To address this, the Hawaii Coastal Zone Management Program is developing a coastal nonpoint source pollution control program. The recommendations that resulted from the facilitated process involving affected community members, emphasize that nonregulatory mechanisms for controlling this pollution will have the most effective success. Not only is enforcement difficult for regulatory measures to reduce soil erosion, but the heavy emphasis on regulation and enforcement sets up an adversarial relationship between the resource users and the resource managers. This is counterproductive to successful management. The most effective approach recognizes this social dynamic and emphasizes the need for communities to get involved in identifying the critical problems, selecting the most appropriate management measures, and establishing a voluntary compliance program.

The Evolution of the Facilitation Process and the Hawaii Experience

The process of facilitating community-based coastal resource management utilizes social technologies that were introduced about twenty years ago. The field of meeting facilitation, group decision making, strategic planning, and visioning workshops can trace its roots to a widely used 1976 guidebook called "How to Make Meetings Work" by Doyle and Strauss. In 1981, alternative negotiation techniques were refined at the Harvard Negotiation Project and presented in a book entitled "Getting to Yes" by Fisher and Ury. Numerous books have been written since.

During the past 20 years, research and development of these social technologies has refined and specialized different processes for facilitating meetings, strategic planning, and visioning. Even though this social technology has been around a relatively short time, it has seen widespread use throughout private industry, nongovernmental organizations, and in government.

In Hawaii, the state government has a Center for Alternative Dispute Resolution (CADR) within the State Judiciary Department. Meeting facilitators and recorders are trained by the CADR. These skilled professionals are utilized by different government agencies in facilitating meetings that often involve different agencies, the private sector, community groups, and the general public.

Other effective training programs are available through the University of Hawaii Family Leadership Program, Cooperative Extension Service, Agriculture Leadership Training Program, and the Neighborhood Justice Project. Some nonprofit organizations, private companies, and individual professionals also provide facilitation services.

Recent experience in Hawaii has shown that facilitated decision making improves the effectiveness of government-sponsored collaborative resource management efforts. Such projects include the development of the Hawaii Ocean Resources Management Plan (Hawaii Ocean and Marine Resources Council, Department of Business, Economic Development and Tourism - Ocean Resources Branch), the Natural Areas Working Group (Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife), Kaneohe Bay Task Force (Office of State Planning), Kona-Kohala Watershed Roundtable (Office of State Planning), Kawaihae Small Boat Harbor Design Project (nongovernmental group initiative), and the development of the Hawaii Nonpoint Source Pollution Control Program (Office of State Planning, Coastal Zone Management Program).

Common Techniques Used in Community-Based Coastal Resource Management Planning

Focus groups of stakeholders: In a facilitated dialogue, stakeholders brainstorm and work together to identify and prioritize resource problems. The facilitator must ensure equitable participation of all stakeholders so that the hierarchy that exists outside the room is not transferred into the discussion. Thus, for example, resource users or land renters participate on the same footing as landowners and government agency representatives.

Volunteer monitoring -- Resource users as partners in resource assessment: With some training, resource users and other interested stakeholders can gather information on the resource status, and map the resource type and quality. They work together to map the resource uses and areas of conflict. Volunteer monitoring programs for the quality of water, stream habitat, coral reef, wetland and mangroves are all feasible utilizing simple field environmental chemistry kits. Parameters that would be analyzed include nutrients, salinity, temperature, turbidity, and dissolved oxygen. Habitat quality is determined by indicator species, vegetation type and density, soil erosion areas and other parameters.

Community-based authority to make decisions on resource management: With the resource problems identified and the resources assessed and mapped, an organization with broad-based community participation should be given the statutory authority to make decisions on resource management. Many governments hesitate to grant such broad powers to a non-elected council. An alternative is to retain the final decision making authority and only grant the council advisory powers. This can still work if the council's recommendations are considered seriously and are adopted more often than not by the government agency.

Evaluation

This same community-based organization or council should also perform periodic reviews and evaluations of the program. Criteria for performance should include quantitative data for critical coastal and marine resources. In addition, it should include qualitative indicators such as: (1) the participants experience improvements in collaborative spirit, as well as knowledge and application of social process skills (e.g., facilitation and facilitative leadership), (2) the community has a greater sense of empowerment in local government decision making regarding coastal and marine resources, (3) leadership is democratically selected, voicing the needs of its members, and using democratic decision making techniques, (4) members of the group demonstrate project implementation skills, make their own linkages to other NGOs for support, (5) representatives of the poorest of resource users are able to work as equals in the council, and (6) the council must be authorized as resource managers by ordinance.

Conclusion

Community-based coastal resources management planning provides a process by which the community, business sector, university, and government collaborate to envision a sustainable economic future and develop strategies to facilitate the achievement of this goal. This has been shown through successful experiences in Hawaii and elsewhere, on a variety of coastal resource management scenarios. This experience has shown that community-wide participation ensures a broad base of support for plan implementation and voluntary compliance. These well-established techniques have been refined for use in the context of coastal resources management and are readily available to interested government and nongovernmental organizations.

David A. Tarnas
Hawaii State Representative and Coastal and Marine Resources Consultant
P.O. Box 2523
Kailua-Kona, HI, USA 96745

Ph (808) 586-8510
Fax (808) 586-8514
Email dtarnas@aloha.net

NORTH CAROLINA'S OCEAN RESOURCES PLAN

Lawrence B. Cahoon, UNC Wilmington,
Walter F. Clark, UNC Sea Grant College Program, and
Kim P. Crawford, N.C. Division of Coastal Management

Introduction

North Carolina will complete and submit to the state's Coastal Resources Commission a plan for the management of ocean resources off its coast in 1996. The plan will encompass North Carolina's ocean stewardship area -- an area defined as the Atlantic Ocean and lands thereunder from mean high tide oceanward to the end of the 200-mile Exclusive Economic Zone. This abstract reviews the important resources within the stewardship area including available resource data, the history of the state's ocean policy efforts, and the recommendations that will be forthcoming in the 1996 plan.

North Carolina's Ocean Resources

North Carolina's offshore region encompasses a variety of significant living and non-living resources. Rapid development in the state's coastal region has increased pressure on many of these resources. Also, national and global trends in resource utilization have raised concern and interest in the state's offshore resources.

The state's offshore waters contain extensive populations of living resources. These resources have traditionally supported commercial fisheries for shrimp, scallops, menhaden, and rock reef-associated fishes. However, the economic value of recreational fishing activities has recently surpassed that of commercial fisheries, with substantial interest in king mackerel, marlin, tuna, the snapper/grouper complex, and other fishes. Both commercial and recreational fishery resources are under pressure and there is increasing tension among user groups utilizing these resources. There is also pressure on several endangered or threatened species of marine mammals and sea turtles. Many marine species migrate through North Carolina's waters, including a large percentage of North Atlantic sea bird populations.

The state's offshore waters also contain an array of non-living resources. The most well-described mineral resource is the large deposit of phosphorite in Onslow Bay. Estimates of the quantity of phosphorite available (based primarily on surface phosphorite contents and limited core samples) are on the order of 2×10^9 tons with some of the deposit approaching 75% phosphorite content by weight. A study conducted by a joint federal-state task force in the 1980s concluded that the technological capability to mine this phosphorite ore is available, but that the economic and regulatory aspects of developing the resource are not favorable.

Potential hydrocarbon resources off North Carolina have attracted the most significant commercial interest, *e.g.*, offshore oil and gas lease sales in the early 1980s and a gas exploration proposal by Mobil Oil in a consortium of oil companies in 1988. Seismic exploration and analogs from other gas producing areas in the Atlantic and Gulf of Mexico indicate a potential for significant gas deposits in the continental slope region that includes most of the blocks leased in 1981, but no firmer evidence of economically important hydrocarbon deposits has been generated from that area. Recent attention has also focused on methane gas hydrates located in much deeper water on the Blake Plateau. These deposits are poorly known at present and recovery is not now possible, but the limited data on the distribution and extent of this potential resource suggest a very large pool of methane.

Interest in development of sand and gravel resources in North Carolina's ocean waters has increased significantly in recent years as demand for material for beach renourishment, the state's preferred response to beach erosion, has surpassed the supply from traditional sources, principally channel and harbor maintenance dredging. There is interest in identifying offshore sand resources that are economically viable for beach renourishment.

North Carolina's ocean waters also contain a variety of "non-consumptive" resources. These include numerous shipwrecks, some of cultural and anthropological value, such as the wrecks of the U.S.S. Monitor and several U-boats. The state's waters carry substantial boat and ship traffic, and are grounds for extensive military training. Offshore sewage disposal has been discussed as a potential use of the state's ocean waters. Finally, North Carolina's tourist industry benefits from the perception that the state's ocean waters are relatively clean and uncrowded.

History of Ocean Policy

North Carolina first attempt to address ocean issues holistically is embodied in a 1984 report, "North Carolina and the Sea: An Ocean Policy Analysis." The report discussed 16 ocean issues including solid and liquid waste disposal, impacts of offshore oil and gas development, state-federal interaction, ocean transportation, marine fisheries management, sanctuaries, and cultural resources. Recommendations included: (1) creation of a complete inventory of the state's natural and cultural resources; (2) studies of state-federal revenue sharing, extended state jurisdiction, and changes in federal laws to strengthen the roles of states in coastal and offshore affairs; (3) development of policies for leasing submerged lands and ocean dumping; (4) expressions of support for regionalization of federal OCS decision-making and improved data input to regional fisheries councils; and (5) opposition to federal supersession in marine fisheries. However, few of the report's recommendations were implemented, owing to lack of funding and changes in federal priorities. Also at fault was the state's focus on its extensive and valuable estuarine waters and issues surrounding their use and management.

North Carolina was unprepared for a 1988 proposal by a consortium of oil companies headed by Mobil Oil Company to explore for natural gas in federal waters offshore of Cape Hatteras. Despite the recommendations of the 1984 ocean policy report, little consideration had been given to the state's policy needs regarding this or other ocean resource questions. Extensive areas of the U.S. Outer Continental Shelf (OCS) in the southeast had been leased for oil and gas exploration in the early 1980s, including the Manteo Block that drew the interest of Mobil *et al.* When a proposal was finally submitted, the state found it difficult to respond to the specific and general policy issues that needed to be addressed.

North Carolina learned from the Mobil experience that ocean resource development can pose complicated and expensive issues for the state to consider, and can arise with little warning. Consequently, the state's Ocean Affairs Council recommended the development of a comprehensive state ocean resource policy. The Division of Coastal Management, one of several state agencies responsible for marine policy issues, received funding for development of North Carolina's Ocean Plan through the NOAA/National Ocean Service's Office of Coastal Resource Management's Section 309 Coastal Zone Enhancement Grants program. The program was created in 1990 by an amendment to CZMA (section 309) designed to provide funding to states to examine means of better managing coastal and ocean issues of national importance. Funding began in federal FY 1993 and will expire in 1997.

Development of the Ocean Resources Plan

Funding from Section 309 of CZMA supported a variety of activities integral to the development of the final plan. These activities included several public meetings and conferences to discuss ocean resource and policy issues, a review of relevant state and federal ocean resource management laws and policies, the formation of the North Carolina Ocean Resources Task Force to develop policy recommendations, and creation of a comprehensive ocean resources data base as part of the state's Geographical Informational System (GIS).

The Ocean Resources Task Force was formed in early 1993 and charged with formulating recommendations for action by the Division, the Coastal Resources Commission and other divisions and commissions within the state's Department of Environment, Health and Natural Resources. The 24-member Task Force included representatives from state and federal agencies, the ocean science community, local government, and various user groups.

Other activities leading to the development of the final plan included several public scoping meetings in the coastal area designed to gauge public opinion on issues and regular Task Force meetings to introduce members to information, including the experiences of other coastal states. In May 1993, the Division of Coastal Management sponsored a conference, "Managing the Coastal Ocean for the 21st Century: North Carolina's Role," to identify and introduce the public to ocean resources and management issues. Conference topics included fisheries and related resources, hard minerals and hydrocarbon resources, socioeconomic aspects of ocean resource utilization, and the current status of North Carolina's coastal ocean management capabilities. In May 1995, the Division expanded the format and ideas generated by the 1993 conference to a regional workshop on ocean management for the south Atlantic.

Ocean Resource Data

Early discussions of the Task Force focused on identification of ocean resources, available databases, geographical information needs and data quality. Although considerable amounts of data were available, they were frequently in formats incompatible with the state's Geographical Information System (GIS) and required extensive transcription. In some cases, oceanic data presented novel problems for the GIS, e.g., the 200 nautical-mile limit for the Exclusive Economic Zone had to be converted to statute miles. Data with a vertical dimension, such as current patterns, required special treatment, as did data describing transient properties, such as surface circulation patterns, migratory species, or seasonal fisheries catch data. In other cases data sets were considered adequate to identify resources and management areas, such as surface maps of phosphatic minerals, but were not adequately descriptive for economic purposes. A study was funded to examine existing data sources and compile the widely scattered information already in existence regarding the distribution of hard bottom areas that support distinctive fisheries populations. Some of the ocean information now available in the state's GIS is presented in Figure 1.

A study of the relevant state and federal law, regulation, and enforceable policies important to ocean resource management was completed in 1994. The study, "North Carolina's Ocean Stewardship Area: A Management Study," identified eight major areas of concern: ocean jurisdiction; links between coastal and ocean management laws and policies; solid mineral extraction; oil and gas activities; fisheries management; marine pollution; recreational uses; and marine protected areas. The Task Force used issues raised and recommendations presented by the study as a starting point for its discussions and subsequent recommendations.

The Final Recommendations

Key recommendations offered by the Ocean Resources Task Force include:

1. Ocean Jurisdiction and Stewardship: North Carolina should define an Ocean Stewardship area to extend from the mean high tide oceanward to 200 nautical miles. In areas close to the shoreline, the jurisdiction and authority of local governments should be clarified.

2. Marine Fisheries: Marine reserves and a saltwater recreational fishing license should be considered as management tools. Harvest of live rock should be carefully controlled.

3. Hard Mineral Mining: General ocean mining policies should be developed. Environmental impacts from dredging activities should be considered. Additional research is required to refine hard mineral data bases and to understand oceanographic processes that regulate impacts from hard mineral extraction. Beach renourishment needs require particular attention from both resource evaluation and regulatory perspectives.

4. OCS Oil and Gas Activities: The state's OCS energy policies should provide greater protection for natural resources. North Carolina must consider future OCS energy development to be likely and maintain a capability to respond to it. The state must develop appropriate criteria and information bases for consistency reviews.

5. Ocean Sewage Outfalls: Outfalls can not be rejected or endorsed at this time, but careful consideration must be given to site-specific concerns, scientific issues, and management of secondary impacts from proposed outfalls.

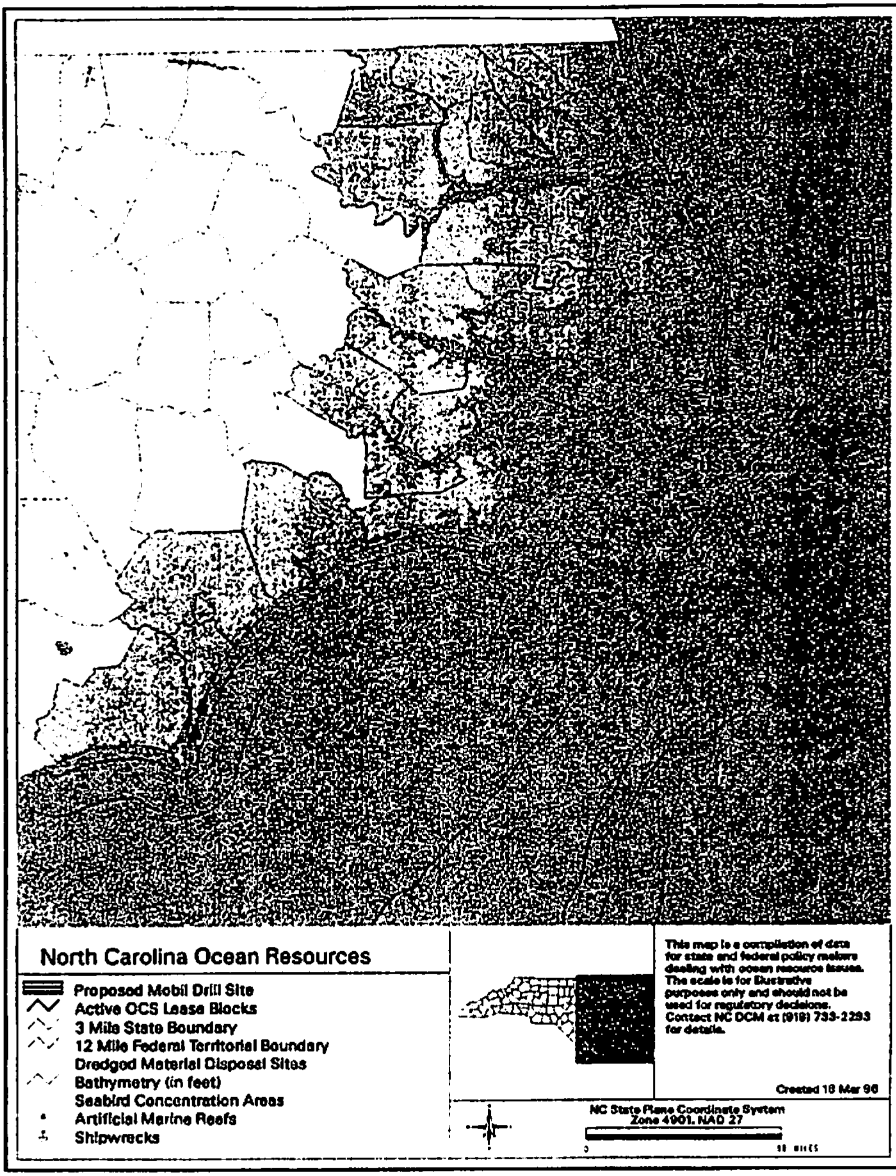
6. Marine Debris: North Carolina should act to eliminate debris from its waters in cooperation with other levels of government and other organizations and through improved prevention, enforcement, and education efforts.

7. Marine Protected Areas: The state should support continued efforts to identify and protect marine areas with particular natural or cultural value.

8. Education: The state should support expanded efforts to improve public awareness of marine resource issues through all its educational institutions and programs.

Lawrence B. Cahoon
Department of Biological Sciences
UNC Wilmington
Wilmington, NC, USA 28403

Ph (910) 395-3706
Fax (910) 350-4066
Email Cahoon@uncwil.edu


North Carolina Ocean Resources
Proposed Mobil Drill Site
Active OCS Lease Blocks
3 Mile State Boundary
12 Mile Federal Territorial Boundary
Dredged Material Disposal Sites
Bathymetry (in feet)
Seabird Concentration Areas
Artificial Marine Reefs
Shipwrecks
This map is a compilation of data for state and federal policy makers dealing with ocean resource issues. The scale is for illustrative purposes only and should not be used for regulatory decisions. Contact NC DCM at (919) 733-2293 for details.
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NC State Plane Coordinate System
Zone 4901. NAD 27

Session F2, Part II: Environment, Marine Affairs and Policy, and Coastal Management: Marketing Your Professional Skills
Session Chairs: Michael Orbach, Duke University; Marc Miller, University of Washington

> **Session Panelists: Charles Broches, Oregon-Washington States, AIPAC; Leah Bunce, Duke University; Christina Mormorunni, University of Washington; John Peterson, Impact Assessment, Inc.**

No abstracts for this panel discussion.

Session F3: Approaches to Involving and Informing the Public
Session Chair: Susan Handley, U.S. Environmental Protection Agency

NATIONAL MARINE SANCTUARY ADVISORY COUNCILS: A COLLABORATIVE APPROACH TO MANAGEMENT

George A. Galasso, Olympic Coast National Marine Sanctuary

National Marine Sanctuary Program Background

The primary goal of the National Marine Sanctuary Program (NMSP) is to provide resource protection of marine areas of national significance through the identification, designation and management of national marine sanctuaries. Prior to designation sanctuary resources are protected and/or managed to varying degrees by numerous government agencies and acts of legislature. These resources also have constituents interested in their exploitation and/or protection. Designation does not supersede, but augments existing institutional frameworks, providing enhanced resource protection through comprehensive and coordinated conservation and management. Effective sanctuary management ultimately depends upon the cooperation of these institutions and other interested constituencies.

Sites receive varying levels of support for sanctuary designation. Despite the fact that they supported sanctuary designation, during transition to an operational sanctuary supporters can become uneasy, or even distrustful, of the Federal government's management of their sites. Some opponents to designation see sanctuary status as yet another incremental restriction on traditional uses of the marine waters in question. In drafting management plans and making the transition from a proposed site to an operational sanctuary, management must balance the mandate to provide enhanced resource protection with the reality of pre-existing interests. In order to be ultimately successful, local sanctuary management must build the trust of both local governments and special interests. One means of involving the community, in both the designation process and in the transition to operational status, is the formation of a sanctuary advisory council (SAC). The purpose of this paper is to review differences in how SACs are established, which interests are represented, how seats are filled, and what role they play.

Authority for Sanctuary Advisory Councils

The first SAC was mandated in 1990 by the Florida Keys National Marine Sanctuary and Protection Act (P. L. 101-605). The Oceans Act of 1992 (P. L. 102-587), which amended the National Marine Sanctuary Act (NMSA), acknowledged the importance of collaborative efforts in managing NMSs by adding the following purpose: "The purposes and policies of this title are . .

. . to develop and implement coordinated plans for the protection and management of these areas with appropriate Federal agencies, State and local governments, Native American tribes and organizations, international organizations, and other public and private interests concerned with the continuing health and resilience of these marine areas."

The Oceans Act of 1992 provided explicit authority for the establishment of SACs, and exempted them from the administrative requirements of the Federal Advisory Committee Act. Congress provided this exemption because of excessive delays, related to FACA requirements, to the establishment of the Florida Keys SAC. While exempting SACs from FACA, Congress did set requirements which embodied FACA's intent to promote responsible government, e.g., the amendment requires open meetings, public notice of meetings, and the keeping of minutes. The amendment also limits membership to 15 for sanctuaries designated after the enactment of the amendments, makes recommendations on membership and provides for administrative support. To date, the 15-member limit only applies to the Olympic Coast National Marine Sanctuary.

SAC members may be employees of federal or state agencies with expertise in management of natural resources, members of relevant Regional Fishery Management Councils, representatives of local user groups, conservation and other public interest organizations, scientific organizations, educational organizations, or others interested in the protection and multiple use management of sanctuary resources. Membership of SACs are intended to be balanced in terms of points of view represented and in terms of the functions the SAC will perform. The authority to establish SACs and to appoint members has been delegated by the Secretary of Commerce to the Director of the Office of Ocean and Coastal Resource Management (OCRM).

Current Status of SAC Development

By February 1996, 3 of 12 sanctuaries in the NMSP had functioning SACs (Florida Keys, Monterey Bay, and Olympic Coast). Two others (Hawaiian Islands Humpback Whale and Stellwagen Bank) were in the process of seeking applications for membership on new advisory councils. Of these sanctuaries, Florida Keys and Hawaiian Islands Humpback Whale are currently working on their Final Environmental Impact Statements(FEIS), which establishes a sanctuary management plan (MP).

In instances where the Secretary of Commerce designates a sanctuary under the authority of the NMSA, the FEIS/MP also serves as the "designation document." In recent years, in response to frustration with the pace of sanctuary designation, Congress has directly designated a number of sanctuaries. In these situations, e.g., Florida Keys and Hawaiian Islands Humpback Whale, sites are designated prior to having their management plans in place. Advisory councils for these sanctuaries are more active in determining the scope of the sanctuary's role in managing the marine resources of the site. The distinction between advice given on the drafting of a management plan and advice on the management of an operational sanctuary is important when considering the differing roles that SACs play.

Each SAC operates under an approved charter which outlines the objectives and duties of the council, the number and type of seats, and how council members are selected as well as the term of their appointments. The formation and composition of each SAC will be discussed briefly.

Florida Keys National Marine Sanctuary

The Florida Keys National Marine Sanctuary (FKNMS) was designated by Congress in 1990. This legislation called for the establishment of an advisory council "to assist the Secretary in the development and implementation of the comprehensive management plan for the Sanctuary." Members of the SAC were appointed by the Secretary of Commerce, in consultation with the Governor of Florida and Monroe County.

Under terms of its charter Florida's SAC is limited to 25 members. Of the 5 SACs reviewed Florida is unique in that seats are not dedicated to specific agencies or user groups. Currently the SAC has 24 members, with 2 government seats and 22 non-government seats. The government seats include the U.S. Fish and Wildlife Service and a Monroe County Commissioner. The seat representing the Governor's office is currently vacant; however, the Governor is involved in making recommendations on filling SAC vacancies. The non-government seats currently include citizen-at-large (7 seats), backcountry guides, recreational divers, dive industry (3 seats), commercial fisherman (2 seats), tropical fishing industry, charter fisherman, business, treasure salvors, education, research, and conservation (2 seats). The FKNMS Advisory Council first met in February 1992, and has served as a direct link to the Keys' user communities during the drafting of the FKNMS management plan. The SAC worked to educate the public as to the management alternatives being discussed and educated FKNMS staff as to the concerns of the public.

NOAA established 3 teams in addition to the SAC, which in concert with the SAC provided a comprehensive approach to developing the draft management plan: (1) the interagency core group, composed of Federal, State, and local agencies with direct jurisdictional responsibility; (2) a strategy identification work group, composed of 49 local scientists and management experts; and, (3) a NOAA team. There was considerable interaction, and some overlap in membership and function, among the 4 teams.

On April 4, 1995, NOAA released a "Strategy for Stewardship: the Draft Management Plan for the FKNMS." In the cover letter accompanying the release, Superintendent of the FKNMS, Billy Causey, stated that, "This draft document is the result of 4 years of hard work by over 90 individuals and over 20 Federal, State and local government agencies and includes unprecedented input from the public." The SAC's involvement in all aspects of the draft management plan resulted in a document which largely reflects management options acceptable to the community-at-large.

Monterey Bay National Marine Sanctuary

Monterey Bay National Marine Sanctuary (MBNMS) Advisory Council is comprised of 20 voting members, 8 government and 12 non-government, and an additional 4 non-voting members, consisting of sanctuary and estuarine reserve managers. The government seats include 3 Federal seats for the Coast Guard, EPA, National Marine Fisheries Service; 3 State seats for the California Coastal Commission, California EPA, California Resources Agency; and 2 local seats for the Association of Monterey Bay Area Governments and local harbors. The non-government seats include citizen-at-large (3 seats), research, education, conservation, fishing, diving, agriculture, business and industry, tourism, and other recreational users. The MBNMS advisory council had their first meeting in March 1994.

While not required to keep the size of the SAC to 15, an attempt was made to honor this limit as a means to keep the SAC to a more workable size; however, after reviewing the representation of groups already in existence it quickly became obvious that 15 was not enough. Advisory bodies in existence prior to the SAC's formation included: (1) the MBNMS task force; (2) Research Activity Panel; (3) Conservation Working Group; and, (4) Sanctuary Education Panel. This task force was convened by Rep. Leon Panetta, to advise NOAA on the final designation process. The representation of that group was an influencing factor in which interests were to be represented on the SAC. The task force assisted the MBNMS in forming their SAC by screening applicants for each of the non-government seats. A number of task force members continued to represent their constituents' interests by being named as SAC members. These members provide an institutional memory regarding promises made to the community during the designation process.

During the first year the MBNMS staff worked with the SAC in clarifying what issues were sanctuary related, and what issues were beyond the purview of the NMSP. In a compromise between alternative views, the SAC meetings have evolved from strictly addressing sanctuary issues to a forum for discussing local issues. Issues which may have an impact on the marine environment, but are beyond the sanctuary's jurisdiction, may be addressed through the SAC's involvement. The SAC, in their advisory position, may take positions on issues that the sanctuary is not at liberty to comment on. When Congress directed the NMSP to review the possibility of augmenting the NMSP's appropriated budget with user fees, the SAC voiced a strong and unanimous opposition. The SAC has also addressed a number of very controversial issues brought forward by the public, e.g., chumming for shark and the collection of jade. The SAC held public hearings and made recommendations that may result in amendments to MBNMS's regulations.

The SAC has been instrumental in turning a local initiative of seeking enhanced protection for Monterey Bay to a NOAA run program. It has resulted in a reasonable comfort level for both the community and for State and local government. The SAC was seen locally as a continuation of the Task Force in giving the local community a voice in sanctuary management and resource protection.

Hawaiian Islands Humpback Whale National Marine Sanctuary

The Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS), like FKNMS, was designated by Congress and is currently working on their management plan. HIHWNMS began accepting applications for SAC membership in February 1996. Their SAC will consist of 25 member, 10 government, and 15 non-government. The government seats include 4 federal seats for the Corps of Engineers, Coast Guard, National Marine Fisheries Service, and Western Pacific Regional Fisheries Management Council; and 6 state seats for State Planning, Department of Health, Department of Land and Natural Resources, Department of Business, Economic Development and Tourism, Kahoolawe Island Reserve Commission, and Department of Education (county governments are included as part of the non-government seats). The non-government seats represent county government (4 seats), citizen-at-large (2 seats), native Hawaiian, research, education, conservation, whale watching, business/commerce, ocean recreation, fishing, and tourism.

Prior to the formation of the HIHWNMS, a 50-member State-administered Sanctuary Working Group had been providing input into the development of the draft management plan. The HIHWNMS charter states, "In seeking to ensure that the aforementioned user groups and activities have a voice on the Council and that a balance in interests and geographic representation is realized, a candidate Selection Panel will be formed using the recommendations from members of the State-administered Sanctuary Working Group." This panel will screen the applicants and provide recommendations to the Sanctuary Manager. The final selection will be made by the Sanctuary Manager and the Office of State Planning, with the concurrence of the Chief of the Sanctuaries and Reserves Division.

Stellwagen Bank National Marine Sanctuary

Stellwagen Bank National Marine Sanctuary (SBNMS) is similar to the MBNMS in that sanctuary designation and the drafting of the sanctuary's management plan preceded the formation of a SAC. SBNMS ·began accepting applications for SAC membership in February 1996. Their SAC will consist of 25 member, 15 non-government members and 10 government "ex-officio" members. The government seats include 8 federal seats for the Coast Guard, U. S. Geological Survey, EPA, National Marine Fisheries Service, and New England Fisheries Management Council, Corps of Engineers, U.S. Fish and Wildlife Service, and the National Park Service; and 2 state seats for Massachusetts Coastal Zone Management, and Massachusetts Water Resources Authority. The non-government seats include citizen-at-large (2 seats), fixed-gear fisherman, mobile-gear fisherman, party and charterboat operator, recreational fisherman/boater, whalewatch operator, commercial shipping, marine sciences, social sciences/economics, marine education specialist, outreach/media specialist, and environmental/conservation groups (3 seats).

Olympic Coast National Marine Sanctuary

The Olympic Coast National Marine Sanctuary (OCNMS) was designated in July 1994, after the 1992 NMSP Amendments, and is therefore limited to a SAC of 15 members. The SAC charter states that "membership is designed to be balanced in terms of points of view represented and functions the SAC performs." The SAC is comprised 9 government and 6 non-government seats. The OCNMS advisory council had their first meeting in January 1996. The government seats include: 2 federal seats for the Coast Guard, and the Olympic National Park; 2 state seats for the Washington Department of Ecology and the Department of Natural Resources; 4 tribal seats for the Hoh, Makah, Quileute, and Quinault tribes; and 1 local government seat which will be rotated among Clallam, Grays Harbor and Jefferson Counties. The non-government seats include citizen-at-large, research, education, tourism and economic development, marine businesses and industry, and conservation. Current plans include the formation of research and education working groups chaired by the SAC research and education representatives.

The OCNMS is unique in the NMSP, in that the sanctuary includes the usual and accustomed fishing areas of 4 federally recognized treaty tribes. A significant portion of OCNMS's inshore boundary is adjacent to these 4 coastal tribes. In recognition of the sovereignty of these tribes, each tribe is represented on the SAC. The remaining seats were selected by a panel formed by representatives from NOAA, the state of Washington and the 4 coastal tribes. The limited number of seats resulted in some very difficult decisions on which interests would be represented. By necessity, an attempt was made to identify seats which would represent broader constituencies than has been the case in sites with larger SACs. The tradeoff between a smaller working group and broader representation is worth further investigation.

Analysis of SAC Formation and Composition

All advisory councils operate under the authority of the NMSA. The Florida SAC was originally established under the FKNMS's enabling legislation and FACA. Since the 1992 program amendments, the original FACA charter has been allowed to expire and the SAC currently operates under the authority of the NMSA. Each SAC is established and operates under a charter, approved by the Director of OCRM. While some variation occurs, these charters generally contain the following sections: Introduction, Establishment, Objectives and Duties, Initial Selection, Subsequent Appointments, Scope of Responsibilities, Administration, and Operation.

The charter places a limit on the size of the SAC and, with the exception of FKNMS, lists which interests hold a dedicated seat. A review of how each SAC was formed revealed common approaches to selecting SAC representation. All sites had in common the desire to include representatives from governments/agencies with shared jurisdiction of sanctuary resources, primary user groups, research and education representatives, and representatives from the community-at-large. An effort is made to select broad and balanced representation of interests. It is especially important to include groups which will be affected by sanctuary management decisions. Given the mandate to provide comprehensive management, this is by definition a very large group, and with the number of seats limited, difficult decisions had to be made. Differences in SAC composition are due to differences in each sanctuary's resources, what demands/conflicts are related to those resources, whom in the community is dependent upon those resources and finally who has jurisdiction over those resources. The history of sanctuary designation and local politics also have significant implications.

In cases where a sanctuary had an advisory group(s) in place prior to the formation of the SAC, *e.g.*, MBNMS and HIHWNMS, that group played a role in determining the composition of the SAC as well as screening applicants for filling the resultant dedicated seats. The OCNMS, which did not have a preexisting advisory group, formed a selection panel which played a similar role. This panel which consisted of representatives of Federal, State and tribal governments determined the dedicated seats by consensus and screened applicants for each of the non-government seats. In both of these situations the precedent of working in a collaborative manner in managing the NMSs occurred prior to the formation of the SAC. This inclusive process of establishing SACs is more defensible then if the SAC membership was unilaterally appointed by NOAA.

Once it has been determined which interests would be represented, the next step is the selection of candidates to fill each seat. In the case of government seats, it is common to allow the appropriate government/agency head to determine who will be appointed. For non-government seats the major consideration was how well each applicant could represent the interests for the seat they had applied. Preference was shown to applicants who were active in organized user groups and had an intimate knowledge of the issues of greatest concern to that group. Besides the obvious advantage of selecting a council member with previous knowledge of the issues, these members can also serve as an institutional memory of the original intent of the sanctuary designation. In some cases, these members have a more intimate knowledge of how the sanctuary designation was negotiated, than the sanctuary staff. Some consideration is also given to geographic representation, an attempt is made to ensure a balance not only in interests but also in communities.

Conclusions

Ultimately, for a sanctuary to be successful, the local community must accept the NMS concept, they must take ownership and see it as "their sanctuary." This is by no means to say that there must be consensus on all issues, that would be impossible, given the nature of increasing demands on limited resources and cumulative effects of coastal development. However, the goals of the NMSP cannot be achieved unless the local communities and jurisdictions agree that sanctuary resources need to be protected for future generations and that their concerns and rights are being considered. This can only happen gradually, and we must consider the possibility that in some cases it may never occur. Policy statements and good intentions are not enough, trust can only be built over time through actions.

The SAC process is one means which can give a community a sense of security and influence. The term community could include both government and non-government interests. This community will differ from sanctuary to sanctuary. Influenced by resource issues, history and politics of each site, different approaches are utilized to ensure that legitimate interests are given a voice in advising NOAA in the conceptualization and implementation of comprehensive and coordinated management of each sanctuary.

FKNMS and MBNMS have already become more integrally connected to their local communities through their SACs; however, this has not been without the cost of placing significant demands on small sanctuary staffs. The limited jurisdiction of NMS, and the broad mandate to provide comprehensive ecosystem-wide management, in most cases precludes independent actions by a sanctuary manager. The involvement of SACs in sanctuary management, while only advisory, does represent a loss of autonomy; however, this is necessary for the legitimacy of, and the continued support for, the program.

George A. Galasso
Olympic Coast National Marine Sanctuary
138 West First Street
Port Angeles, WA, USA 98362-2600

Ph (360) 457-6622
Fax (360) 457-8496
Email ggalasso@ocean.nos.noaa.gov

ACHIEVING CONSENSUS ON WATER QUALITY ISSUES IN RURAL COMMUNITIES: A PEER EDUCATION MODEL

Joy E.S. Garitone, Kitsap Conservation District

The diversity of rural communities is often surprising. Within what may seem an easily stereotyped group, there are unique lifestyles and contrasting opinions. These opinions extend to environmental issues and this collection of folk presents a bonafide challenge to environmental educators. Clearly, there is a need for educators to find a method to reach rural residents with practical, useful, information in order to sustain water quality.

Program Development

In 1991 the Washington State Conservation Commission funded a grant for small farm education (Small Farm Grant 1991-1993). The results of this first grant were simple and straight-forward and this contact with the rural community of Kitsap County held promise for future educational programs.

One grant objective was to convene a community based committee of local livestock owners, businesses and organizations to oversee and implement the grant. Over two years, eight small farm demonstration sites were selected by the Project Management Group (PMG). The project goal was to achieve greater public awareness of water and soil management practices which could be used by local farmers. Conservation achievements were then brought to the attention of the farm community and county residents so other farmers could adopt these management practices.

This valuable objective brought together a cross-section of the ag-based community in monthly meetings of discussion and educational presentations. The group had strong participation the first eight months and waned through the first winter. Two things brought on a recovery; a group consensus to produce a day-long event of ag-related workshops and the opportunity to piggy-back with a Puget Sound Water Quality Authority Public Information and Education (PSWQA PIE) project on ag-related educational activities. Efforts were merged to form Kitsap County Sound Farmers (Pizzano, 1993). This was the inception of another program that focused on peer education.

In 1987, the Puget Sound Water Quality Authority developed a bold approach to water quality education. Through its PIE Fund, the Authority entered into contracts with local organizations to provide education and public involvement programs that help affect local audiences and solve local or regional environmental problems (Steelquist, 1993).

In 1992 the Puget Sound Water Quality Authority funded $22,000 for a program in Kitsap County called "Sound Farmers." This first chapter of Sound Farmers was established to train farmers to help their neighbors prevent livestock waste from running off their lands. Sound Farmers was aimed at rural residents who had a degree of livestock husbandry experience but were interested in more advanced training. Demonstration sites, a tool used in the earlier Small Farm Grant, were a key part of the training. During two field days, 80 people analyzed their farms' soil, toured the demonstration farm, analyzed grasses and weed control, and planted and evaluated cover crops. More than 100 residents attended a day-long seminar on small farm management.

Identifying and reaching small farmers is a problem for government agencies. Having a small, non-commercial farm is something that many types of people do. In this project, a group of concerned rural citizens, all of whom had small non-commercial farms, banded together to teach each other about non-point pollution. The result was trust, ideas that work for their area, and an on-going commitment to their water and each other to be part of the solution (Garitone, 1993).

The project ended in May 1993 but interest in the project continued. Participants still met bi-monthly to receive training on farm management. The group "Sound Farmers" was written into new grant proposals by the Kitsap Conservation District. Members served as peer educators and a voice for the rural community with other agencies. By the fall of 1993, members were less active and it was time to evaluate and re-group in order to continue peer education with rural residents.

In the spring of 1994 conversations began between Washington State University Cooperative Extension (WSU) and the Kitsap Conservation District regarding outreach and education. The result was the formation of the WSU Kitsap County Livestock Advisors. The original program began in neighboring Snohomish County, but Kitsap's unique version brought together the Conservation District's interest in water and soil management and the WSU interest in continuing education. A steering committee was formed to develop the curricula and the first small farm owners were in class by October 1994.

Livestock Advisors received 80 hours of specialized instruction and then volunteered a minimum of 80 hours in return. They were trained by WSU specialists, Extension Agents, Conservation District experts, and local professionals. Participants were tutored in areas of small farm management, animal husbandry, and water quality. The participants were concerned with ground and surface water protection, sustainable agriculture, and networking with local government and decision makers to increase understanding of small scale agriculture.

Program Outcome and Products

One measure of success with this project is to simply look at the outreach that volunteers have provided to the community. Graduates from the 1994-1995 class have accomplished meaningful goals.

Each participant wrote a farm inventory/plan for their own working farm. This plan was critiqued by the Conservation District. Cooperation between agency and landowner began in order to implement the Best Management Practices (BMP) set out in the written plan. Numerous farms have been changed and upgraded to protect water and soil. Each landowner was listed as an advisor for rural residents who may call the Conservation District or WSU Cooperative Extension for help. They are prepared to make farm visits, suggest resources for cost-share of BMP implementation or just help "first-time" farmers with management questions. Several graduates are putting their knowledge of small scale farming to work by having joined the Conservation District's Board as associate members. Others have produced field days and seminars for the public on wetlands, farm forestry, manure composting, plant propagation, seed saving, wildlife gardens, well and septic care, pasture management, and farm planning. Four individuals have applied for grants to fund future training sessions, to research marketing for cottage industries and to develop a permaculture system for an island community. Of 25 graduates, 9 were from neighboring counties. These landowners set to work developing Livestock Advisor programs in their own county. Their first classes began in October 1995.

Graduates from the 1995-1996 class are planning their volunteer efforts. Their diverse talents as artists, lawyers, engineers, city council representatives, horseshoers, weavers, builders, and students will help infiltrate the community with the water quality and sustainable agriculture message. Plans to build a parade float, teach pre-schoolers about agriculture, provide information at fairs, and write a newsletter are in progress.

Evaluation of Peer Education Project

The benefits of this project are obvious and far-reaching. Still, there are some finer points to peer education and small scale agriculture. Attitudes about agriculture are beginning to change in Kitsap County. Only five years ago there were limited statistics on the number of farms in the county. Through revitalized interest in small farms and non-point pollution, Washington State Centennial Clean Water Funds have paid for watershed inventories. This research has enumerated the small farms in the nine Kitsap watersheds. The results indicate some 2,000 agricultural holdings in the county. Statistics such as these change the way communities think about agriculture. These farms are individually owned, yet they are part of the unique ag-economic base in the county and Puget Sound. They collectively contribute to non-point source pollution.

Peer educators are able to affect these small farms and their stewards with new information and skills. They are able to establish consensus from conflict by teaching water quality "morality" in a non-regulatory format.

It is human nature that we look to people like ourselves for advice -- and for recognition when we do what we feel is right. Through peer education, water quality problems and their solutions are viewed from the unique perspectives of project teams and their audiences. Effective water quality education programs honor an audience's own values about water quality. They also focus on messages and techniques that are appropriate to that audience. Who can know these values, messages and techniques better than a person or organization specifically identified with that audience? Peer education does more than just teach water quality in "user friendly" terms. It lets a group declare its own commitment to water quality and recognize or reward those friends, neighbors and business associates who act responsibly. It also makes irresponsible parties answer to their peers--in some instances, their competitors; in others the people who work alongside them (Steelquist, 1993).

The Conservation District has had excellent contact with the rural community and receives rapid feedback on water quality concerns from its peer educators and their network of farm associates. The District has been able to establish the quantitative results to show local government and legislators. This promotes future funding for projects and opens conversations between decision-makers and rural citizens.

Project participants, having changed their own farms, are willing to speak on behalf of water quality programs. This is impressive to other rural residents and to local government. There is a revived respect for small scale agriculture in the county. Commitment by peer educators to provide assistance and continuing education is strong. The desire to "live in the country" or practice sustainability is perhaps what first brought students to the project's training. After training and working with the rural community, graduates are more committed to preserving rural life and culture. They strongly feel that education is the path to this preservation.

Conclusions

In conservation programs the human element and its diversity must be served by educators, agencies, the community, and the land. The exact results or the end of this project may never be known. The energy of devoted peer educators is taking unexpected turns and returning inspired results. They are affecting change in a gentle, non-threatening way. They are changing behaviors in rural residents in an economical, efficient manner. Their ability to carry environmental messages to the rural community may be one of the most important parts of sustainable agriculture.

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Joy E. S. Garitone
Kitsap Conservation District
817 Sidney
Port Orchard, WA, USA 98366

Ph (360) 876-7171
Fax (360) 876-7172

OCS LEASE SALES: RECENT ACTIONS TO IMPROVE STAKEHOLDER INVOLVEMENT IN ALASKA

Kerry Howard, Alaska Division of Governmental Coordination,
Maureen McCrea, Alaska Division of Governmental Coordination, and
Glenn Gray, Alaska Division of Governmental Coordination

Introduction

This paper examines the effectiveness of recent efforts by the federal Minerals Management Service (MMS) to improve stakeholder participation during planning for proposed Outer Continental Shelf (OCS) oil and gas lease sales in Alaska. The paper describes administrative requirements of OCS lease sales, OCS oil and gas activities in Alaska, and the experience of the Alaska Regional Stakeholders Task Force (Task Force). It concludes with an analysis of Task Force efforts.

Administrative Requirements of OCS Lease Sales

The OCS Lands Act (OCSLA) (43 USC 1344) governs the management of the nation's offshore oil and gas and mineral resources and specifies conditions under which the Secretary of the Interior may grant rights to explore, develop, and produce those resources. The Secretary has assigned the responsibility for carrying out the requirements of the OCSLA to the MMS, an agency within the Department of the Interior (DOI). Planning for individual lease sales to obtain these rights occurs under the umbrella of a 5-year lease sale program.

In 1995, the MMS began preparation for the next 5-year program that will cover the period from 1997-2002. Early planning is necessary because section 18 of the OCSLA requires a lengthy, multi-step process of consultation and analysis that must be completed before the Secretary may approve a new 5-year program. The process requires completion of the following steps: solicitation of comments from federal agencies, coastal states, and others; development of a draft program, a proposed program, and a proposed final program; and approval by the Secretary.
The MMS must prepare a programmatic Environmental Impact Statement (EIS), as required by the National Environmental Policy Act (NEPA), for the new 5-year program. The MMS evaluates comments received during the solicitation period when deciding the scope of the programmatic EIS.

OCS Activities in Alaska

Since the early 1980s, much of the OCS oil and gas lease sale activity in the U.S. has taken place in "planning areas" in Alaska. There are 26 planning areas nationwide and 15 in Alaska. Each planning area is unique in its resource potential; exploration and production history; environmental conditions and other uses; and the laws, goals, and policies of adjacent coastal states.

Although the Central and Western Gulf of Mexico planning areas continue to produce the most oil and gas, industry remains interested in Alaska. State onshore and offshore reservoirs next to OCS sale areas have produced considerable oil. The state generally supports federal leasing plans except in the North Aleutian Basin Planning Area. The state actively opposes existing oil and gas leases and future lease sales in this area because of possible effects to Bristol Bay salmon fisheries.

Since 1976, the MMS has held 17 OCS lease sales in 8 Alaska planning areas. Subsequent exploration has resulted in several hydrocarbon discoveries, but none of these discovery sites are commercially viable under current economic conditions. Development of offshore oil and gas deposits in Alaska is expensive and difficult due to extreme environmental conditions and distance to existing infrastructure.

Previous Formal Coordination Efforts

The first formal coordination within Alaska occurred through the Regional Technical Working Group (RTWG). The charter of this group stated that they were to provide guidance on technical matters of regional concern. In addition to meeting periodically through the years, the RTWG for Alaska prepared a report on transportation in the mid-Beaufort Sea region. In 1994, the RTWG charter was not renewed.

The second significant effort occurred with the MMS Mining Program in conjunction with a Norton Sound Lease Sale. A cooperative agreement between the DOI and the State of Alaska formalized the Joint Federal-State Technical Coordination Team (CT). The goal of the CT was to cooperate during EIS scoping, during EIS evaluation, and while preparing comments about the possible leasing and development of OCS mineral resources. The CT included federal and state resource agencies, local communities, and interested parties representing fishing, mining, environmental, and Native subsistence interests. The CT provided a valuable forum for exchanging information -- including a workshop to which experts in the field of mercury in the marine environment were invited -- and for reviewing NEPA documents. Following the publication of the final EIS, the group disbanded.

A final effort took place through the Social and Economic Studies Program. Through a Risk Assessment study, the MMS hosted a series of meetings designed to address perceived risks associated with OCS oil and gas leasing. These meetings provided valuable scoping information for Sale 149, scheduled for Cook Inlet and Shelikof Strait, and assisted MMS staff in preparing for this lease sale. No report of the risk-assessment effort was prepared, however, and funding for the second year of the study was cut from the studies program.

The Alaska Regional Stakeholders Task Force

In 1993, the OCS Policy Committee, an independent body set up by the OCS Lands Act to advise the Minerals Management Service and Secretary of the Interior on matters related to OCS oil and gas lease sales, recommended the use of regional task forces to help reach consensus on OCS lease sales. In 1994, the OCS Policy Committee established the Alaska Regional Stakeholders Task Force to help the MMS develop the Alaska Region component for the next 5-year oil and gas lease program.

The Task Force developed recommendations on the size, timing, and location of lease sales. Task Force members represented Alaska Native, subsistence, environmental, commercial fishing, oil and gas industry, and government interests (i.e., local, state, and federal governments, coastal districts, and coastal resource service areas). Two gubernatorial appointees participated, as did invited representatives from the scientific community.

The Task Force held two meetings in Anchorage -- one in January and one in March, 1995. Subcommittee meetings held in Barrow, Homer, Kodiak, Kotzebue, and Yakutat solicited local information and comments. All meetings were "public noticed" and open to the public. Individual Task Force members solicited information from the constituents they represented and presented it to the Task Force.

The Task Force developed a list of evaluation criteria to weigh selection of OCS planning areas for the next 5-year program. These criteria included prospectivity (the likelihood of finding viable oil and gas prospects based on industry interest and resource potential); infrastructure; technology; local and tribal government and community interests; subsistence, socioeconomic, and cultural interests; and environmental concerns and values.

Based on these criteria, the Task Force identified five planning area locations that should be considered for analysis in the next 5-year program, although the Task Force did not reach consensus on whether these areas should be leased. The five planning areas identified included Beaufort Sea, Chukchi Sea, Hope Basin, Gulf of Alaska, and Cook Inlet-Shelikof Strait. Other planning areas were excluded because of low prospectivity or a combination of the other evaluation criteria. The staff of the MMS completed a report of the findings and recommendations of the Task Force including ten specific recommendations regarding size, timing, and other concerns.

Several representatives of the task force presented the report to the OCS Policy Committee in May 1995. The OCS Policy Committee unanimously accepted the report and passed a resolution to use the task force process in other areas of the country.

The Task Force continued its work informally, but the MMS canceled two meetings scheduled for September 1995 and February 1996 because of logistics problems. The September 1995 meeting to discuss the draft proposed program was replaced by a survey sent to Task Force members. The MMS canceled a meeting of the Task Force scheduled for February 1996 to discuss the draft EIS and the proposed program because of scheduling problems and because Task Force members did not think a meeting was necessary. The MMS plans to hold a Task Force meeting following the public comment period in May 1996 to develop final recommendations on the size timing and location of the proposed sales.

In January 1996, the MMS revised the membership of the Task Force in an attempt to make it smaller and better reflect the areas affected by the proposed sales. Due to the enthusiasm and interest of members, however, the size of Task Force was not substantially reduced.

Analysis of the Alaska Task Force

The two primary purposes of the Alaska Regional Stakeholders Task Force were to help the MMS develop the Alaska Region component for the next 5-year planning period and to reach consensus on OCS lease sales.

The Task Force provided a unique opportunity for those who have an interest in activities that occur on the Alaskan OCS to work together to develop comments on oil and gas lease sales in Alaska. The time frame for making recommendations was short (3 months), and the membership of the task force was large (28, including invited members). These factors made this effort an ambitious undertaking and limited the Task Force's ability to deal with issues that would be specific to a particular sale area, such as deferral of particular areas or specific mitigating measures.

Using the criteria established at the outset, the Task Force quickly eliminated 10 planning areas from further consideration, based on agreed-upon criteria, and identified ten general concerns about leasing in the remaining five areas. Ultimately, the lease sale options presented by the MMS in their draft leasing program were consistent with the Task Force recommendations.

Achieving consensus on a controversial topic such as OCS lease sales was problematic. From the first meeting, Task Force representatives expressed near unanimous concern that they could not represent or commit to a consensus recommendation for the interests they represented. As such, members agreed they would attempt to work toward consensus, but not necessarily commit to each recommendation. Given the diverse stakeholder interests--industry, regulatory agencies, environmental groups, and subsistence users--represented on the Task Force, the key to reaching agreement on the 5 sale areas and 10 recommendations was to keep the recommendations general. The lack of detail raises the question of whether recommendations were adequate to meet MMS's expectations and needs.

A special difficulty for state and federal representatives was the timing of the Task Force effort. The Task Force met and developed recommendations while the MMS was seeking agency recommendations on the next 5-year planning period. As such, each agency representative on the Task Force had to comment in a public forum before their agency developed a position.

Although the Task Force report submitted a single report to the OCS Policy Committee, the Task Force member representing environmental group insisted on submitting a minority report. That member, while attempting to fully participate in the Task Force, did not support any OCS oil and gas activities and desired to submit a minority report to that effect. The other Task Force members conceded this was acceptable.

Future Task Force Efforts

Current plans include continuation of the Task Force until completion of the 5-year plan. Task Force members may be asked to continue their work during planning for individual lease sales. The future of the Task Force, however, will likely depend on funding, direction from the OCS Policy Committee, and continued interest by the MMS. Since Task Force members represent a wide cross section of the state, a major expense relates to transportation and per diem costs. The MMS cannot be expected to use its limited resources to support Task Force efforts without additional funding.

Conclusion

In summary, in spite of some difficulties, the Task Force provided an opportunity for increased communication and discussion of salient issues among concerned stakeholders. This was the first opportunity for many stakeholders to sit at a table as equals and listen to the concerns of other parties. The meetings were often long, but participants listened respectfully to the comments of other interests.

Only through the monetary and staff support provided by the MMS was the Task Force able to fulfill its responsibilities. Without these contributions of time and money, it is doubtful that the Task Force would have been successful.

At some point one must question whether the information obtained is meaningful, considering the time, effort, and dollars spent to achieve it. Both the OCS Policy Committee and the MMS believed the effort was worthwhile and a good first step toward cooperation.

If possible, future task forces should develop specific recommendations after agencies have had time to develop an official position or have those at the table be the individuals who can make a commitment. The extra time provided to the process could possibly enable participants to develop more specific recommendations in spite of the diverse interests on the Task Force. This might take the form of identifying deferral areas within planning areas or developing specific mitigating measures. In addition to the 5-year plan task force, there appears to be a benefit in establishing sale-specific task forces.

Rather than strive for consensus, it may be more appropriate to strive for "informed consent" whereby members who may not agree with a decision, agree not to oppose the decision because the process by which the decision was reached was fair. Because some members of the Task Force oppose all leasing on the OCS or specific planning areas, consensus is not possible.

Intergovernmental coordination and public opinion are essential components of a collaborative planning process. The challenge for administrators will continue to be developing truly meaningful input given diverse and complex stakeholder interests. Coordinating agency and public participation is a process that distributes power, access, and resources. Obtaining meaningful participation is important, and planners should not underestimate its value.

Glenn Gray
Alaska Division of Governmental Coordination
P.O. Box 110030
Juneau, AK, USA 99811-0030

Ph (907) 465-8794
Fax (907) 465-3075
Email Glenn_Gray@gov.state.ak.us

COMMUNICATIONS STRATEGIES UTILIZED TO DEVELOP A PUBLIC DISCUSSION OF LONG ISLAND SOUND ISSUES

Norman Bender, University of Connecticut,
Luane Lange, University of Connecticut,
Carole Fromer, University of Connecticut, and
Peg Van Patten, University of Connecticut

Introduction

Long Island Sound (LIS) is not only Connecticut's largest natural resource system, it also provides significant contributions to the state's economy, historical perspective, and cultural heritage. LIS is viewed in many diverse, and at times, conflicting ways by the state's 3.25 million people. Society's relationships with Long Island Sound include a multitude of commercial, industrial, recreational, residential, and waste disposal activities.

Recent ecological conditions, societal activities and resulting public policy issues have contributed to public concerns about the health of the Sound, and interest in learning about causes and potential solutions to those issues. In response to growing public interest, the authors developed a project designed to provide opportunities for the public to increase its awareness of major LIS issues and for the presentation of a wide range of perspectives.

A project was developed to address the following objectives:

1. Enhance public awareness of resource use issues related to LIS.
2. Increase knowledge of selected audiences, including youth, about LIS issues.
3. Strengthen interaction between citizens, environmental organizations, marine business and industry, educators, community leaders, and public officials as they address LIS use issues.
4. Enhance town meeting participants' knowledge of group processes and coalition building skills.
5. Document new or expanded efforts to achieve resolution of selected LIS use issues resulting from the project.

The project, initiated in fall of 1992, was a collaborative effort of the Sea Grant Marine Advisory Program, Cooperative Extension System, Connecticut Public Television, and Sea Grant College Program. Funding from Sea Grant, Connecticut Public Television, and Cooperative Extension resulted in multi-faceted public discussions involving and educating tens of thousands of people in Connecticut, and neighboring states.

The following educational activities and products were developed to help achieve the objectives:

1. A 30-minute documentary (Long Island Sound: Worth Fighting For!) and a 30-minute panel discussion.
2. Four regional round-table discussions identifying key LIS issues.
3. A poster illustrating LIS benefits, impacts and problems.
4. A teachers' guide to facilitate student discussion of LIS issues, and
5. Distribution of the video and poster to audiences including legislators, coastal resource managers, formal and informal educators, industry officials, and environmental leaders.

Communications strategies used to develop and implement the public education activities are reviewed with a focus upon both internal and external communications activities.

Public Issues Education and Citizen Involvement

Public issues education has become an area of enhanced interest of the Cooperative Extension System with its Strategic Planning Council commissioning a policy statement that identified three areas of focus: research on public policy issues, leadership skills, and public policy processes.

Common public issues methodologies include workshops, forums, round tables, media and printed materials. Special emphasis has been placed upon creating opportunities for community dialogue. Participation in community dialogue can be traced to the late 1880s. Boyte (1986) has described "new populism" as democratic renewal that goes beyond economics of populism and supports people's ownership of policy.

Adult education theory is based on life-long learning and learner participation in planning and implementing educational activities. Specific participation in public policy dialogue between policy makers and citizens first occurred in Canadian National Farm Radio Forum, Citizens Forums and Discussion programs (Selman, 1985).

Cooperative Extension is developing educational programs that enables people to address community issues by developing expertise and tapping educational resources in public policy education, policy analysis, leadership development, community development, and citizen involvement. Combining Cooperative Extension Public Policy Education and Sea Grant Advisory technical expertise became a working model for this project.

Communication Methods

Internal communications involved working with faculty sharing information about project objectives, and soliciting information regarding coastal issues, organizations and contacts. These included issues which could be addressed in the Connecticut Public Television documentary and round-table discussion meetings. Contacts identified by Marine Advisory staff and project coordinators were used to select people for filmed interviews for the documentary as well as participation in the round-table meetings. Project communicators provided perspectives which helped bridge potential gaps between educational and entertainment goals.

Questions arose regarding how to select people to participate in the round tables and the documentary. There were concerns about individual political agendas, power issues, and how to ensure that a broad range of perspectives, organizations, and communities would be included. The CES Public Policy Specialist became the point person to respond to group concerns about their level of involvement in project activities. The objective was to be inclusive, rather than exclusive, when involving issues, individuals, and groups.

Round-table discussion meetings were scheduled for three coastal locations and one inland location in Connecticut during fall 1993. Nominal group process was used to enable the breadth of perspectives to be shared while providing an opportunity for participants to identify three or four high priority issues. Use of this process left some CES faculty uncomfortable since they conduct their educational programs using a technical expertise approach rather than an open-ended educational process.

After discussion with graphics and Marine Advisory staff, it was decided to create a poster that presented positive contributions of LIS resources to Connecticut. This approach supported the video theme of assisting people to develop a sense of identification with the Sound.

The poster was designed to be used over time without becoming out-dated. It was distributed to libraries across Connecticut, state legislators, public agencies, and participants at the preview session of the video. One legislator commented that it was good to see a "supportive perspective on the Sound rather than one just pointing out issues and problems."

A major educational product was the documentary/video, "Long Island Sound: Worth Fighting For!," developed by producer John O'Neill and Connecticut Public Television. The producer initiated the script as interviews were being filmed and several scripting issues evolved. First, there were some important people who had not been included, with knowledge that needed to be included in the video. There were several voids in the content and some filming was done according to whom was available at the time. This was addressed, with two interviews added and adjustments made to the script. The timing of the interviews, scripting, review and responses were a critical component and pointed out the need for timely feedback and input between the producer and University team.

The second scripting issue was the depth to which some topics were being addressed. More emphasis was placed on historical segments than LIS educators were comfortable with. A tight schedule prevented some changes. Yet, the final product created an effective bridge between education and entertainment goals. In total, the ability to identify numerous approaches to LIS provided many ways for viewers to identify with the Sound.

The LIS Watershed Alliance provided insights into a wide variety of organizations which could be involved in the filmed interviews, round tables and distribution of the video.

While the documentary was being developed, invitations were extended to a carefully identified list representing LIS stakeholders to attend one of four round tables. Some of the groups represented had already participated in other, more homogeneous "issues identification," programs.

The groups at these round tables represented: Those who are "official players" and familiar with Sea Grant/CES involvement with LIS issues; those who were "players" but did not know, or were opposed to UConn's involvement; and those that were involved with the issues, new to UConn and new to a broad discussion of coastal issues. The discussions were facilitated by a CES faculty member and a trained volunteer.

The top five priorities identified by the round tables differed by locale and mix of participants. The issues lists contained commonalities and repetition, with different rankings within the lists. The top priority, sewage treatment/nitrogen reduction was among the top issues at three round tables as was the need for public education.

A report of round-table identified issues was distributed to key legislators and agency personnel. It provided a more diverse list than some reports from advocacy or legislatively appointed groups. Two months later, a key legislator contacted the Marine Advisory Program leader requesting information for the Legislative Session's LIS issues agenda.

A state-wide forum on LIS issues was scheduled one month after completion of the round-table meetings. It had to be canceled due to it being inadvertently scheduled for the same day as a major environmental conference.

A panel discussion was taped for broadcast on public television along with airing of "Long Island Sound: Worth Fighting For!" Panelists included two key state legislators, a business association spokesperson, a coordinator for the LIS Watershed Alliance, a state environmental official and a federal Long Island Sound Study director. The panel discussion fluctuated between being enlightening, controversial, and boring.

The panel discussion was aired at the original public television broadcast of the video, it was not included in subsequent broadcasts or in the distribution of the video. The canceled state-wide forum and the panel discussion were identified as providing the weakest contributions to achieving the project's goals.

A teachers' guide for issues dialogue, grades 6-12, was developed and used in a pilot program by the Maritime Center of Norwalk. It was made available to marine and environmental science educators. A flyer describing the video was distributed to educators participating in a Southern New England Marine Educators Association Conference. An article in "Nor'easter" magazine discussed the video and the LIS project along with other Sea Grant videos.

Impacts and Conclusions

The project was successful in reaching most goals through a variety of communications strategies. Internal communications played a key role in identifying themes and issues for the video/documentary, "Long Island Sound: Worth Fighting For!" Marine Advisory faculty's knowledge of issues and on-going contacts with key individuals, organizations and public agencies provided a solid foundation for the project team and CPTV producer to conceptualize the video.

Project coordinators and team members learned how to blend two cultures (higher education and public television) when developing the television documentary. The need to combine educational and entertainment goals became evident as the first drafts of the script were reviewed. An educational approach was carefully introduced to the producer to ensure that the entertainment approach did not overwhelm the objective educational approach.

The two cultures dealt with different realities regarding timing and scheduling, blending education and entertainment, and ensuring representation of a broad range of perspectives. Frequent communications between the project team and producer was an important method of sharing perspectives and information, as well as addressing issues that arose while developing the video.

The four round-table discussion meetings were successful in bringing together a broader array of people, organizations, and perspectives than normally meet to discuss LIS issues. Most participants seemed comfortable in an open-ended discussion format where they were one of many people expressing their views and hearing other opinions. A handful of people, uncomfortable with this approach, questioned round-table facilitators about why certain others were invited. It is possible that inflated egos and turf considerations played roles in these views.

External communications involved a variety of methods. The video was broadcast three times over the Connecticut Public Television Network reaching 51,000 households per broadcast. Most of these were in Connecticut with some in neighboring regions of Massachusetts, New York State, and Rhode Island.

LIS posters were distributed statewide to public libraries and members of the Connecticut General Assembly (State Legislature). Videos were distributed at no charge, to a mailing list of 142 people representing: selected state legislators, Connecticut Congressional delegation, teachers, environmental and science centers, regional library centers, Sea Grant communicators, organizations, trade associations, and universities.

The diverse communications strategies have contributed to the on-going public discussion of LIS issues. An enhanced appreciation of Long Island Sound's contributions to the regional environment, economy, history and culture will be the major outcome of these activities.

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Norman K. Bender
University of Connecticut Cooperative Extension System
562 New London Turnpike
Norwich, CT, USA 06360

Ph (860) 887-1608
Fax (860) 886-1164
Email nbender@canr1.cag.uconn.edu

COMMUNITY-BASED AND MULTIPLE-PURPOSE PROTECTED AREAS: A MODEL FOR SELECTING AND MANAGING PROTECTED AREAS WITH LESSONS FROM THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

Eric L. Gilman, Governor's Office,
Commonwealth of the Northern Mariana Islands

Overuse and misuse of coastal systems are causing natural resources to dwindle. During the past two decades, governments have attempted to establish protected areas in recognition of the negative impacts to the coastal zone from anthropogenic activities. However, past models for selecting and managing protected areas have not allowed for multiple-uses, made provisions for traditional uses, nor otherwise dealt adequately with conflicts between interest groups and the protected area's management goals. This talk presents a model for selecting and managing protected areas that proposes two changes to past models: (1) The process for selecting and managing a protected area considers the social, economic, environmental, and political context. The process does not only consider the suitability of a site for environmental conservation or recreation as have past models. Instead, protected areas have multiple purposes and permit multiple uses. Allowing for multiple purposes in protected areas fosters success as it allows for flexibility, compromise, and conflict management by accounting for the needs of all interest groups. (2) The selection and management processes are conducted by representatives of all interested groups who are given equitable decision-making authority, and not just by government agency representatives. This bottom-up approach, called scoping, facilitates the development of successful protected areas because it instills a sense of ownership for the protected area and its rules by interest groups, and reduces conflict because all groups have equitable input in making decisions.

This method presents a comprehensive process to establish protected areas, including community education and organization, site selection, identification of boundary requirements, site designation, funding acquisition, developing a management plan and regulations, training staff and administrators, enforcement, public education, and ongoing evaluation and adaptation. Figures 1 and 2 show the selection and management processes in a flowchart format. Examples are drawn from protected areas of the Commonwealth of the Northern Mariana Islands to explain the principles of the model and to justify the model's tenets.

This model is flexible, avoids conflict, and provides for equity by establishing a committee composed of representatives from all interest groups. This committee selects a site and multiple uses to be permitted in the protected area according to the specific social, political, environmental, and economic context of the country. The local people participating in the establishment process have equitable decision-making authority. They employ principles of conflict management to rectify real or perceived imbalances of power. Through their participation and decision-making, the local people acknowledge that the protected area benefits them, take credit for the protected area, and support and enforce the rules they established.

A successful protected area achieves the purposes for which it was created. Allowing for community-based decision making and multiple purposes in the processes for establishing and administering protected areas minimizes deterrents to success. When establishing protected areas, community-based decision making (scoping) and allowing multiple purposes results in success because:

- There is a perception of equity among all interest groups, a basic tenet of conflict management;
- This approach is flexible, allowing for the protected area to fit the needs of the local context;
- Local ecological knowledge, the knowledge that comes from observing and using natural resources, is used to select and manage the protected area;
- Scoping enhances the communicability of results because interest group representatives disseminate information throughout the community;
- Tenets of traditional management systems are respected when making decisions;
- Scoping ensures that all issues are identified, ensuring the compatibility between local conditions and selection and management decisions;
- Community involvement results in educated interest groups who take credit and responsibility for the protected area, and thus encourages community support for the protected area and its rules;
- Continuing scoping after initial rules are adopted allows managers to continuously evaluate the efficacy of the protected area, identify problems with the management principles, and effectively adapt the protected area's management measures;
- Community-based selection, management, and enforcement is more effective and economical than a process run solely by government agencies; and
- Allowing for multiple purposes in a protected area allows for a consideration of social, economic, environmental, and political needs, and avoids conflict.

When the modern government does not give the community input in decision making to establish and manage protected areas, natural resources are placed under a de facto open-access regime: If the community is not involved, enforcement measures are ineffective because economic and political sectors, which often favor short-term profit and do not consider long-term issues, perpetuate environmental degradation. If decisions are made without consulting the resource users, protected areas are not successful because:

- Decision-makers do not know resource user's popular knowledge;
- Traditional users do not support decisions that are made without their consultation;
- Government agencies lack the expertise to assess and manage resources themselves;
- There are too few government personnel to effectively monitor resource use; and
- Without communicating with representatives from the community, the government does not know how to educate the public about the need for the protected area and its restrictions.

An island with a contemporary, strong, and functional government that can access management resources that does not employ scoping or allow for multiple purpose protected areas may still have somewhat successful protected areas if the manager presents a high degree of visibility and a strong enforcement regime for the protected area. Active patrolling and surveillance by park staff can result in marginal success. However, scoping and allowing for multiple purposes in the selection and management of protected areas is preferable to policing because policing requires constantly dealing with hostile user groups, and is a less cost effective approach.

For this model, "scoping" is a process where all interested parties participate, with equal decision-making authority, in identifying issues and either directly making decisions or making recommendations to decision-makers. While government personnel attempting to coordinate the establishment of a protected area may understand the importance of scoping, it is not always easy to involve relevant interest group representatives. Table 1 provides methods to involve community groups in the decision-making process.

Establishing protected areas through scoping, where all interest groups have equitable and direct involvement in decision making, and by allowing for multiple-purposes to prevent alienating interest groups maximizes the likelihood that the protected area will successfully achieve the purposes for which it was created. Allowing for multiple uses and scoping creates flexibility, equity, and conflict management. Selection and management decisions reflect the opinions and needs of all interest groups, including the least powerful ones, in order to avoid conflict, and to lead to successful management. All interested groups participate in making decisions, and identify their social, political, economic, and environmental concerns. Thus, this model minimizes deterrents to successful management.

There are two options for governments that lack the ability to effectively patrol and produce a high degree of visibility in their protected areas: the islands can either develop strong and functional governments and spend a significant amount of time and energy enforcing protected area regulations, or allow for scoping and multiple purposes in their protected areas. The former option is not easily achieved, but using scoping and allowing for multiple purposes is feasible, economical, and the preferable choice.

Eric L. Gilman
Commonwealth of the Northern Mariana Islands
Governor's Office
PPP 171 Box 10000
Saipan, MP, USA 96950-9504

Ph (670) 664-2238
Fax (670) 664-2390
Email eric.gilman@saipan.com

The Selection Process

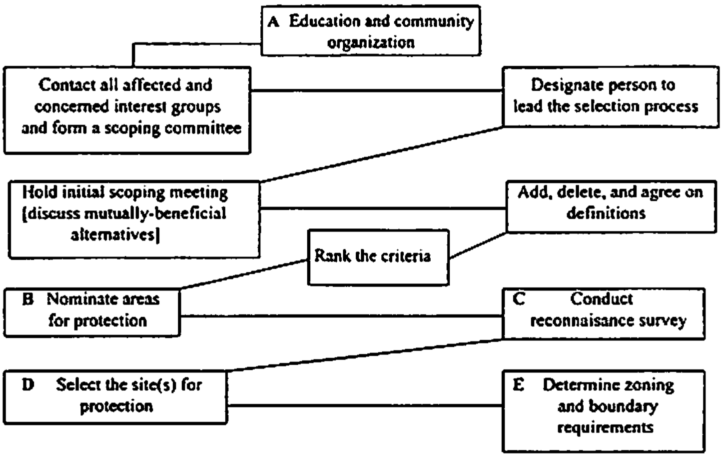

Figure 1. Flowchart showing steps to select a protected area.

The Management Process

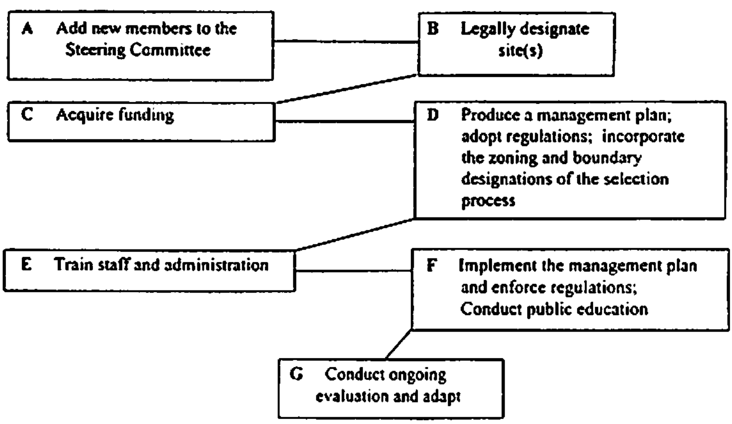

Figure 2. Flowchart showing steps to manage a protected area.

Table 1

Suggestions for Successful Scoping to Encourage Participation by Representatives of all Interest Groups in the Protected Area Selection and Management Processes

Action	Purpose or Effect
Conduct education	Explain to the community the need to establish a protected area. It may be helpful to teach the community basic tenets of marine or wildlife ecology.
Form organized interest groups	Identify all interest groups that need to be represented in the decision-making process. If these groups are not cohesive, form organized groups. For instance, if you are forming a marine protected area at a site that is used by subsistence fishers, if there is no association of fishers, coordinate its formation.
Establish a scoping group	Encourage representatives of all interest groups who can speak for their constituency to participate on the scoping committee to make decisions concerning the establishment of the protected area. It is critical to have all groups represented on a committee where participants have equitable authority, creating trust and a perception of fairness.
Select a coordinator	The coordinator or chair of the scoping group needs to be perceived as neutral by all interest groups. The coordinator will likely need to be a local person who is not biased towards any of the participating interest groups.
Select a meeting location	Hold scoping meetings at a location that is perceived as neutral to all interest groups so that no groups are alienated. For instance, hold meetings at a public library or university, and not at the Governor's Office, the Sierra Club's office, the National Rifle Association's office, or the Fish and Wildlife Office.
Create momentum	The coordinator should start the scoping meetings with mutually beneficial, non-political issues that have easy solutions. For example, at the first meeting, it is appropriate to select a schedule for future meetings, identify interest groups that are not represented but should be, identify some of the issues surrounding the proposed establishment of a protected area, and identify information gaps.

Table 1 (continued)

Identify all issues	Encourage interest group representatives to voice all of their concerns at an incipient stage in the establishment process. This avoids potential conflicts in the future. Allow interest groups to identify all issues including those related to environmental, social, economic, and political concerns. In order to ensure that all issues are identified, it is necessary to have all interest groups represented.
Ensure all interest groups are directly involved	The community will claim credit for the decisions made concerning the selection and management of the protected area only if interest group representatives are directly involved in and responsible for accomplishing the establishment process steps. Interest group representatives will continue to participate in scoping meetings only if they feel they are making a valuable contribution. For instance, the coordinator of the process could request that the representative of the divers association identify restrictions for areas zoned for SCUBA, write the relevant section of the management plan, and coordinate the production of public education materials.
Have direct involvement of decision-makers	To instill the community's trust, have the decision makers participate on the scoping committee so that the community perceives that their recommendations have an impact and that their concerns are being heard and considered. Or better yet, promulgate decision-making authority over the selection and management of the protected area to the scoping committee.
Compromise	Balance the need for conservation with the myriad interest group needs through the selection of multiple purposes to be allowed in the protected area. Develop a zoning plan that identifies the permitted locations of different uses.

CONFLICTS - PAST AND FUTURE - IN THE UTILIZATION OF THE COASTAL ZONE OF MADRAS, INDIA

Jayapaul Azariah, University of Madras, India,
K. Kanthimathi, University of Madras, India,
S. Angelina, University of Madras, India, and
Hilda Azariah, University of Madras, India

Early History

The British East India Company paved the way for the establishment of The British Empire in India. With the building of Fort St. George in 1639 the foundation stone for the creation of the city of Madras was laid. Prior to seventeenth century there were two major river systems in Madras, the Triplicane River (Cooum River) and the Elumboore River (North River), and one minor river called Uttara vathani (river flowing towards the northern direction). The Triplicane River and the Elumboore River were connected at the sea coast and the British East India Company built the Fort St. George at the confluence of the two rivers as a part of defence strategy.

The British East India Company incurred loss of merchandise while unloading from ships to coastal land. A pier was constructed during the year 1862 to minimize the off loading damage which ended in the construction of a full scale artificial harbor during 1870s. At the time of building the harbor the coastline was very near to the Fort.

Ecological Value Loss and Conflict

The economic growth brought about by the imports and exports through the Madras port resulted in the population of Madras city. From a population of about 7,000 people during 1639 the city has grown to about 5 million, with four population doubling periods. During 1980s the city generated about 75 million gallons of sewage per day (mgd) of which 39 mgd was discharged into the river and later reduced to 19 mgd. The fecal coliform bacterial load registered a phenomenal level of 24×10^6 MPN index. Today, the Cooum River is highly polluted, discharging directly into the inshore waters of Madras. From a rich riverine fish fauna of 49 species in 1949 the species diversity is now zero, never to be enriched again. For all practical purposes the river is read. Discharge of diseased water has put the costal ecosystem under stress.

Due to developmental activities and unplanned growth of the City of Madras, the Elumboore River has been reduced to a canal and the River Uttara vathani is now extinct. The conflict between the environmental quality and human developmental activity has resulted in the extinction of the minor river and the degradation of the Elumboore river to a sewage canal. The Cooum River is in the verge of extinction. Economic values have out weighed ecological value. Unfortunately, there is a lack of political and peoples' will.

Impact on Coastal Ecosystem

An estimate of fecal coliform bacteria in the coastal waters was made. The MPN index varied from 130 - 5420 depending upon the open/closed condition of the river mouth. The people who rear buffaloes in the coastal zone have developed an unethical practice of washing a herd of buffaloes in the costal waters. The washing also contribute to the high incidence of fecal coliform bacteria of the coastal waters. The incidence of fecal coliform bacteria in the gut of intertidal organisms, such as *Emerita asciatica* varies from 75 to 175 MPN index. People who frequent the sea coast on religious days for a holy dip usually complain of sore throat and eye infection.

Reclaimed New Land Area - The Beautiful Marina

The engineers who built the harbor did not take into account the existence of the littoral drift along the East coast of India which moved about 1 million metric tonnes of fine sand. The construction of the harbor obstructed the littoral drift which resulted in the accretion of sand on the Southern side and sea erosion on the Northern side. New land area continued to appear and the coastal erosion was a perennial problem. During the Governorship of Sir Grand Duff (1881-1886) the new land area as named as The Marina which was recognized as the most delightful promenade for the citizens of Madras and served as one of the chief lungs of the city. The Marina beach was frequented by people for recreational activities. Currently, the area is utilized for political and economic activities. The ecological consequence of this developmental activity is the formation of a permanent sand bar at the mouth of the River Cooum for ten months in a year, leading to stagnation of water. Water hammering due to heavy influx of monsoon rains the river mouth is forced to open only during November and December. During this period all the polluted water rich in fecal coliform bacteria is discharged into the coastal zone.

The Conflict

The length of the Marina Beach stretching from the Napier Bridge to the Lighthouse is about three kilometers. The 200-acre stretch of the Marina Beach was the concern of Government of Tamil Nadu for beautification. The beautification of Marina Beach was carried out during November 1985. About 1,202 catamarans and 1,000 fishing nets belonging to about 668 fishermen were removed from the Marina Beach, stretching between Anna Mausoleum and the lighthouse on November 4, 1985. Armed Reserve Police and local police were mobilized for maintaining law and order situation. A month later, clash erupted between fishermen and police leaving behind six fishermen dead in police firing. The Supreme Court by its orders dated December 5, 1985, had directed that the catamarans seized from fishermen on November 4, as part of the "Operation Beautification" of the beach should be restored to them at a place on the Marina Beach, under the supervision of a Deputy Registrar of the Madras High Court. The Supreme Court further directed (December 10, 1985) that no attempt should be made to remove fishermen from the Marina Beach in Madras or collect any rent from them. The court also directed that the fishermen be allowed to continue their fishing operations for the time being. Left to themselves, there is no conflict due to the presence of fishermen in the Beach ecosystem. Besides the fishermen there are other user groups of this beautiful ecosystem. An attempt was made to study their perception of the beach environment.

Perception of User Groups

The Marina Beach, as a managed coastal ecosystem, was studied from a scientific, socio-economic, and environmental approach for preserving this unique ecosystem. In this human use ecosystem, five user groups were identified: 1) visitors; 2) fisherfolk; 3) beach morning walkers; 4) sports persons; and 5) shopkeepers.

Five different *a priori* hypotheses were formulated:

1 a. The perception of people on the Marina beach ecosystem recognize the following uses: 1) Recreation; 2) Health; 3) Livelihood; 4) Religious activities; 5) Political activities; 6) Public functions; 7) Literary activities; 8) Romance; 9) Criminal activities; 10) Tourism; 11) Nature observation; and 12) Environment.

1.b. People will also perceive the pollution present in Marina beach and the need for improvement of this beach.

2. The visitors will give more importance to recreation in their perception than the other groups.

3. The shopkeepers and fisherfolk will give more importance to livelihood than the other groups.

4. The beach walkers who carry out physical exercises and sportsmen will give more importance to health in their perception than the other groups.

5. Fisherfolk and shopkeepers will give lesser importance to the improvement of Marina beach than the other three user groups.

6. Fisherfolk and shopkeepers will give lesser importance to the pollution in Marina beach than the other three groups.

The perception of the five user groups were compared using ANOVA and Student t-test. Hypothesis 1.a predicting environment perception of different groups based upon various uses was fully accepted. Hypothesis 1.b was also accepted as people perceive the pollution and the need for improvement. Certain perceptual differences of the user groups have been predicted in Hypotheses 2 to 4. Hypothesis 2 was rejected since fisherfolk and shopkeepers give more importance to recreation than the other groups. Hypothesis 3 was fully accepted. Since fisherfolk and shopkeepers realize that beach environment promotes health more than the others. Hypothesis 4 was rejected. Hypothesis 5 was partially accepted as fisherfolk were the only group giving importance to improvement of Marina beach. Hypothesis 4 ("Fisherfolk and shopkeepers will give lesser importance to pollution in their perception than the other three groups") was accepted, except that the visitors do not differ significantly from these two groups.

The Persisting Conflict

In a recent study environmental perception of the user groups was correlated with the actual pollution status of the coastal Zone. The following hypothesis was formed. "A group of people closely involved in the beach environment will not differ on the emerging factors regarding the pollution and to the improvement in the coastal region of Madras."

The environmental perception analysis showed conflicting perceptions among the five user groups. Such differences in perception may be due to the end utility value perceived by the user groups. That is from their own use of the environment. If their actions contribute the pollution the results, suggest, then they might not own the responsibility of their actions.

Damage to the territory had a factor loading of 0.78 as a high factor loading for the variable "belongings of the fishermen pollute the environment. The visitors perceived that the user group namely the fishermen are the main cause for pollution. On the other hand, fishermen did not seem to accept this position. Secondly, there is a conflict between the perception of people other than fishermen community who feel that the business activities around the beach is an integral part of the beach environment. Whereas a section of the people may prefer, in general, the removal of fishing nets and catamarans and other accessories from the beach.

Industrial Scenario of Coastal Tamil Nadu

The industrial scenario of Tamil Nadu is very bright. There are about 10,000 industrial facilities in Tamil Nadu of which 3,200 have high pollution potentials. The major industrial complexesal; 2) Petroleum refining; 3)

Fertilizers; 4) Thermal Electrical Power Generation; 5) Engineering; 6) Pharmaceutical; and 7) others such as leather tanning and textiles. Along the coastal Tamil Nadu the following four locations are potential red light areas of pollution: 1) North Madras-Manali and Ennore area; 2) Cuddalore; and 3) Tuticorin.

Ecological Conflict Due to Flyash and Chlorine

The Ennore Thermal Power Station has a capacity of 450 MWe and uses 8,000 tonnes of coal per day. It generates a total quantity of 3,200 tonnes of fly ash. The ash collected in the precipitator hopper are flushed out at the bottom using sea water. The ash slurry is pumped out through specially lined pipes (basalt) into the sea through a discharge jetty. About 38,400 m^3 of ash slurry is disposed off into the coastal zone per day. In addition 1.6 x 10^6 m^3/day of condenser cooling water is passed through a once through cooling system is discharged into the coastal zone. The Madras Atomic Power Station (MAPS) has two units, each with a rated capacity of 220 MWe. MAPS draws about 35 m^3/s^{-1} of sea water through a sub-sea bed tunnel. When the 12 pumps are in operation, the water takes about three minutes to travel 468 meters from the intake point to the forebay. In this once through flow special ecosystem a total of 145 biofoulants has been identified. To reduce biofouling in the intake and at the condenser cooling system, low dose chlorination, shock dose chlorination and continuous chlorination have been followed.

On an average, about 750 kg of chlorine per day have been used as antifoulant. The volume of sea water pumped during a year varies from 1,000 to 3,700 thousand m^3 per day. Taking into consideration the critical velocity need to prevent the settlement of biofouling, the environmental impact of chlorine in biofouling control has been discussed. A predictive estimate has been given for the entire ocean has been commented upon. Currently there are about 434 nuclear power stations in 26 countries with a capacity of 316,000 MWe. Their impact adds a cumulative influence on the health of the system. It is supposed that an inch of fly ash is sedimented on the inshore area of Madras. But there is no study to document this statement. Similarly, the fate of chlorine in the marine ecosystem and its movement in marine biota remains a virgin field for further study.

The Tuticorin Thermal Power Station (TTPS) with its 5 units in operation can generate 4,500 mt tons of fly ash. It is reported "TTPS is generating 3,000 tonnes of fly ash per day and just 300 tonnes are removed for cement production in lorries, the rest being dumped into the sea." Satellite photograph confirms such a statement. As a result, productivity in the Gulf of Mannar area has shown a steady decline from 7.3 g C/m^2/day to 3.5 g C/m^2/day during 1987. The productivity fell further to 0.6 g C/m^2/day leading to drastic fall in fish catch in the Gulf of Mannar region. It may be pointed out the Gulf of Mannar is designated as a National Marine Park due to its rich marine biodiversity. The cumulative effects of Industrial activity, however good it may be its Environmental Management Plan with reference to pollution control measures, should not impinge on the health of the marine ecosystem.

Health of Coastal Society

Data on the incidence of diseases in Tuticorin were collected. Among the top five diseases, rheumatic heart conditions rank first followed by respiratory diseases. It may be pointed out that dust fall and particulate matter in the ambient air is high and the household sanitation conditions are poor as the installed drainage capacity is only one third of the total municipal area. Such a condition may add to the death toll due to respiratory and gastro-intestinal diseases. The city is dusty and the wind direction changes during the month of October-Dece northeast direction when the dust will be carried into the sea. It is likely that the dust in the air may cause allergic respiratory diseases.

Conclusion

It is suggested that an independent watchdog program may be organized to preserve the health of the coastal city ecosystem as well as this unique marine biome. To achieve this aim, there is a need for interactive collaborative effort among like minded Research Departments. There is a good scope for collaborative study. An open invitation is extended to all those who would be partners in this endeavor.

Jayapaul Azariah
Professor of Zoology
University of Madras, Guindy Campus
Madras 600 025, India

Ph 235 1269 Ext. 206
235 1367 Ext. 206
Fax 91 44 491 8747
91 44 491 0910

INCORPORATING PRINCIPLES OF THE RIO DECLARATION INTO THE COASTAL ZONE MANAGEMENT ACT – A COMMENT ON ACHIEVING SUSTAINABLE DEVELOPMENT IN THE COASTAL ZONE

Glenn Boledovich,
University of Oregon School of Law

Introduction

Adopted in 1972, the Coastal Zone Management Act[1] recognizes the nation's coastal zone is "extremely vulnerable to destruction by man's [sic] alterations."[2] The CZMA aims "to preserve, protect, develop, and where possible, to restore or enhance" coastal resources.[3] Eighteen years later, Congress noted these goals were not being achieved and declared "not enough is being done to manage and protect our coastal resources."[4] Three years later, a Congressional Research Service report stated there is "increasing evidence" of continued ocean and coastal deterioration.[5] Today, the CZMA again faces reauthorization in Congress,[6] providing another opportunity to assess how the nation's primary coastal environmental law might best achieve its objectives.

The international community has developed principles to enhance the ability of nations to achieve that often elusive balance between development and the environment, *i.e.*, sustainable development. Specifically, this abstract will examine the summary document produced at the 1992 Earth Summit in Rio, the Rio Declaration on the Environment and Development, as a source of principles aimed at balancing economic with environmental concerns. Incorporating these principles into the CZMA should increase the potential for achieving the Act's objectives. The United States will also be living up to its international obligations while assuming a leadership role in implementing international environmental principles.

The author acknowledges that the 104th Congress has not demonstrated a commitment to improving the Nation's environmental laws. This, however, hardly detracts from the need to prevent further coastal degradation or to restore already damaged resources. The options presented herein contemplate a cooperative federal, state, and local effort. The options do not require increased federal regulation. By turning primary management authority to the states, the CZMA provides an opportunity for the states to develop innovative methods for achieving sustainable development. One must, however, assume there will be certain costs if a serious effort to restore and protect coastal resources is undertaken.

II. The Rio Declaration's Mandate: Implement Policies to Achieve Sustainable Development

A. Defining Sustainable Development

The fundamental principle to emerge from Rio was that of "sustainable development." Critics have argued this concept is "difficult to define and operationalize."[7] Actually the term is fairly well defined. In 1989 the United Nations Environmental Program defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs, . . ."[8] The essence of sustainable development is that economic and environmental concerns cannot be treated separately.[9]

Sustainable development then includes two underlying elements:
1. That the interests of future generations are fundamental (called intergenerational equity); and,
2. That economic and environmental concerns must be addressed together before new development proceeds.

B. The CZMA: An Early Articulation of Sustainable Development

The underlying policies of the CZMA clearly articulate the same underlying elements. In the CZMA's initial policy statement, Congress declared it is the national policy "to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for 'this and succeeding generations.'"[10] Congress further declared that the "wise use" of coastal resources depends on consideration of the "ecological, cultural, historic and esthetic values as well as the needs for compatible economic development,..."[11] Furthermore, the CZMA's findings state the need "for resolution of serious conflicts among important and competing uses and values," and to give "high priority to natural systems."[12]

The two underlying notions of sustainable development therefore are explicit and implicit in the CZMA. Intergenerational equity is explicitly mentioned. The need to balance development with the environment is almost as explicit. How to "operationalize" sustainable development within the context of the CZMA is, of course, the primary challenge. The inquiry then must turn to the tools provided for achieving sustainable development. The Rio Declaration, in part, served to clarify and provide such a "how to" guide.

III. Achieving Sustainable Development: The Policies Rio Directs Nations to Codify

The Rio Declaration is a summary statement of 27 principles. Some articulate the need for international cooperation. Others note the needs of the poor. The principles to be discussed here articulate specific measures that nations should incorporate into domestic laws. The ethical principle of intergenerational equity is inextricably tied to the concept of sustainable development; it will be discussed first. Balancing developmental with environmental concerns will be addressed second. The Rio Declaration offers at least four tools that address the democratic, scientific, legal, and economic concerns involved in reaching such a balance. They are: public participation, use of environmental assessments, polluter pays, and the precautionary approach. After an introduction of these principles, the discussion will turn to integrating them into the CZMA.

A. Intergenerational Equity

Like sustainable development, intergenerational equity is broad in application and is more akin to an overriding ethic than to a specific policy. As an ethical principle, its general goal is to ensure that "we do not borrow from our children and grandchildren a debt we cannot repay."[13] Given the repeated mention of this principle, one author has concluded it "has crystallized into a general principle of international law."[14] Because of its philosophical nature, intergenerational equity provides little guidance for implementation. It also presents a paradox -- only present generations can implement it, suggesting an inherent bias for the present at the expense of future generations.

B. Balancing Developmental with Environmental Concerns

1. Public Participation and Environmental Assessments: Democratic and Scientific Elements

The Rio Declaration directs Nation's to incorporate the use of environmental assessments and to provide for broad public participation in environmental decision making processes.[15] These two elements already are commonplace in the environmental laws of the United States. Public participation is a democratic principle that is entrenched in the political tradition of the United States and the CZMA.

The Rio Declaration's requirement that nations utilize environmental assessments was based on United States law, specifically the National Environmental Policy Act. The use of such assessments, often called environmental impact statements (EIS) is therefore no stranger to U.S. environmental policy. The use of environmental assessments promotes pre-development scientific research. The assessment data should then play an important role in weighing the costs and benefits of development on the environment. The use of the best science is also an underlying premise in determining environmental harm under polluter pays and potential environmental harm under the precautionary approach.

2. Polluter Pays: An Economic Element

Polluter pays requires resource developers and users to internalize the costs of development.[16] The goal is to eliminate what economists call "externalities," those costs borne by third parties who neither made nor consumed the goods. Polluter pays is no stranger to environmental laws in the United States. The Clean Water Act and the Comprehensive Environmental Response, Compensation and Liability Act incorporate a version of this principle to prevent future pollution and to recover the costs for cleaning up environmental damage.

One downside of internalizing externalities is that the cost of certain goods may increase. However, arguably it also places the cost where it belongs -- on those who cause pollution, not taxpayers. Under polluter pays, businesses and property owners remain free to develop as long as they pay for or eliminate the harm their actions have on public or private property owners' resources. It also encourages polluters to reduce their costs through development of cleaner production methods. It does not bar development, but it can have that effect if the internalization of costs makes a project economically prohibitive.

3. The Precautionary Approach: A Legal, Burden Shifting Element

The precautionary approach (or precautionary principle) is a "look-before-you-leap" principle that promotes erring on the side of caution when the environmental impacts of new development are uncertain.[17] It requires that potential environmental impacts be adequately addressed before the harmful effects of a given behavior are fully proven.[18] It is not a statement of law, but rather it is a policy around which laws can be constructed. Because it presumes dependence on science to ensure sound decision making, it is a catalyst for infusing the best science into permitting processes Like science itself, it recognizes uncertainty as fact. Legal regimes incorporating the principle must remain flexible enough to change with scientific advances, ensuring that the most useful description of the environmental management problem is utilized.[19]

One primary effects of the principle is to shift the burden of proof from the government and potential victims of pollution to potential polluters. It requires potential polluters to demonstrate no harm will occur before new development begins, thereby helping to prevent future pollution, litigation, and high clean up costs. Rather than requiring the public to demonstrate harm, developers must overcome the legal presumption that development will harm the environment. "Where there are threats of serious or irreversible environmental damage, lack of scientific certainty should not be used as a reason for postponing measures aimed to prevent environmental degradation."[20] Thus, the precautionary approach encourages developers to design projects that reduce environmental threats.

IV. Integrating the Rio Principles into the CZMA

The CZMA provides for a voluntary and cooperative state/federal partnership to address national and local concerns in the coastal zone. Regulation is local not federal, and states are given broad discretion in drafting their coastal management plans (CMPs). State CMPs need federal approval which is in part based on whether the CMPs meet the policies declared in §1452 of the CZMA.[21] Generally, Congress need only add these principles to §1452 in order to have states incorporate them into their CMPs. It is important to note, however, that states need not wait until Congress acts. States can incorporate these principles on their own initiative.

Achieving sustainable development in the coastal zone is a daunting task. Its achievement will take dedication and perseverance on the part of government officials, the public, and industry. Furthermore, in addition to the CZMA, a host of other federal, state, and local laws address coastal concerns and interests. The cooperative approach of the CZMA potentially provides a way to bridge and integrate these various authorities to achieve the higher goal of sustainable development in the coastal zone while giving due regard to local and state interests.

A. Intergenerational Equity

The CZMA directs states to give consideration to the needs of future generations, however, it offers no guidance on how to implement this ethical element. John Rawls, a leading ethicist, proposed that decisionmakers view themselves as a ghost generation that does not know when in time it will exist. They could be the first or a much later generation of resource users. From this perspective, decisionmakers will seek an equitable allocation of resources because if they are a later generation, they would not want to inherit a degraded environment. While interesting on a theoretical level, it is difficult to conceive how decisionmakers can be forced to participate in this sort of abstract reasoning. Perhaps a more practical alternative is to require that all environmental assessments specifically consider impacts on future generations.

B. Public Participation and Environmental Assessments

The CZMA explicitly requires states to provide for, "timely and effective notification of, and opportunities for public and local government participation,..."[22] To be effective, states should, of course, be diligent in implementing public participation. When reviewing state plans, federal administrators should make sure public participation is incorporated in both design and practice.

The CZMA does not explicitly require states to utilize environmental assessments, however, the CZMA's findings instruct states to establish "uniform policies, criteria, standards, methods and processes for dealing with land and water use decisions,..." Furthermore, the policies of the CZMA state that "wise use" of coastal resources means "full consideration" must be given to ecological and other values. [23] Therefore, the CZMA implies that states should utilize environmental assessments as part of sound coastal management. To ensure that states implement the use of environmental assessments in their coastal management plans, §1452 of the CZMA could be amended by adding a provision that states: "To ensure the wise use of coastal resources and that full consideration is given to the environmental impacts of development, states will implement the use of environmental assessments using the best science to evaluate the consequences of past and future development in the coastal zone."

To help defray costs, promote the development of new technologies and scientific understanding, and to integrate government services in the coastal zone, language might also be included encouraging involvement of universities and other federally-funded institutions. Also, direct technical assistance from federal government engineers and scientists, especially NOAA, the Army Corps and EPA, should be made available to help states implement sustainable practices. Some costs for research will also be borne by the private sector under the precautionary approach's requirement that developers carry the burden for demonstrating "no harm."

C. Polluter Pays

The CZMA's policies currently do not require states to incorporate polluter pays into their CMPs. To change this, Congress need only add polluter pays to §1452. The amendment might read: "To ensure that the environmental costs of coastal development are borne by those benefiting most from the development, states will incorporate policies requiring that polluters pay for environmental harms and internalize the environmental costs of development." States would then have discretion as to the specific laws, regulations, voluntary measures, or incentive-based programs necessary to implement the policy.

Implementing polluter pays will present challenges to states. Regarding known high-level sources of pollution, states might implement a system of fines or penalties requiring polluters to either cleanup or pay the costs of cleanup. Regarding day-to-day, low-level pollution, a system of fees might be implemented. For example, motor vessels might pay a "marine pollution" fee or tax on fuel and lubricants. More efficient vessels would, of course, pay less tax, encouraging development of more efficient and sustainable technologies. New development projects might be given tax credits or other incentives if developers can demonstrate the new facility incorporates state-of-the-art technologies designed to reduce pollution and environmental impacts.

The CZMA also discourages development in coastal areas at high risk from storm and other natural disasters.[24] Polluter pays would help discourage such development. Under polluter pays, if a development in a high-risk area is ruined by natural disaster, it will inevitably cause pollution and require clean-up costs which the owner (or the insurer) should pay. Polluter pays also implies that such commercial or residential sites should not be eligible for government disaster assistance to rebuild in high risk areas, in essence making such efforts a strictly at-your-own-risk affair. This could make insurance, and therefore redevelopment, too costly to justify. This does not mean that other emergency assistance need be withheld. At a minimum, parties planning new development in high-risk areas should be advised that they will carry the burden for harm to public resources and be ineligible for disaster relief.[25]

Furthermore, such policies might be an effective way to discourage unsustainable coastal development without requiring compensation to coastal property owners. In recent years, property owners denied certain uses of their property have claimed such regulations violate the Fifth Amendment. Courts, including the U.S. Supreme Court, increasingly have been sympathetic to such claims. Polluter pays does not require regulation prohibiting development. Instead it simply places the entire risk of dubious development on the property owner. Therefore no value is "taken" by the government (and no false value is given either.) In conclusion, polluter pays requires giving due regard to the broader public interest. It is in the public interest to reduce environmental risks to coastal public trust lands and waterways. It is also in the public interest to avoid outlays of public funds to property owners who voluntarily take on the risks of development in high-risk coastal areas.

D. The Precautionary Approach

The CZMA's policies make no mention of the precautionary approach. Congress need only add a provision to §1452 in order to require states to implement it into their CMPs. The amendment might read: "To prevent or reduce future environmental damage from new development in the coastal zone, states will employ the precautionary approach and develop polices requiring use of the best science when evaluating the potential impacts of development. Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty shall not be used as reason for postponing measures to prevent environmental degradation."

Implementing the precautionary approach could reduce pollution by disallowing or postponing potentially environmentally hazardous development. It could also reduce government regulation and expense. By shifting the burden to developers, they, not the government, will bear the primary expense of demonstrating that the potential for serious or irreversible environmental damage is absent or so low as to allow development to proceed. This represents a significant departure from the prevailing use of litigation and government regulation and preparation of impact statements.

For example, rather than detailed regulations, the states need only establish basic guidelines or thresholds that new development must meet. The initial burden for conducting the necessary research, impact statements and options for development would fall upon the would-be developer. In short, the developer would have flexibility regarding the "means" used to reach the state-established "ends." This could reduce some of the burdensome regulations that tend to impose the methods as well as the goals. The developer-produced report would then be subject to public and government scrutiny and review. Instead of a permanent bureaucracy, the government could impanel a group of experts to publicly review the developer's proposal. To avoid local bias, the panel could be convened from a national pool of experts. The panel would consider the costs and benefits of the proposed development, as well as reasonable alternatives to mitigate harmful impacts. The employment of alternative means to resolve areas in dispute, such as fact-finding, negotiation, and mediation, is advisable.

V. Conclusion: Sustainable Development in the Coastal Zone

It is time for sustainable development to move from theory to practice. This abstract represents an initial attempt to examine how that might be achieved within the context of the CZMA.

The employment of intergenerational equity, public participation, environmental assessments, polluter pays and the precautionary approach into the CZMA should promote sustainable development in the coastal zone. Intergenerational equity provides a guiding ethical purpose, *i.e.*, to ensure that the coastal zone is not left degraded for our children, grandchildren and their progeny. The democratic principle of public participation ensures that debate and decision making is done openly and in pursuit of the public interest. The use of environmental assessments in decision making ensures that the best science is utilized in evaluating the environmental costs of development. The polluter pays principle primarily addresses the impacts of past and existing development and places the burden for remedying harms on those who benefited most and caused the harm. The precautionary approach addresses future development, places the burden of demonstrating no harm on developers, requires pre-development review, and disallows development where there are significant environmental risks. In general, development that poses fewer risks will cost less, providing an incentive for the development of more sustainable practices.

Sustainable development implies the promotion of economic activity that can be continued with minimal or no harm to the environment. It concedes that historically unsustainable practices have been the norm and that those practices must be changed. Implementing sustainable development is, of course, no simple task and one would expect resistance from those currently benefiting from the continuation of unsustainable practices. To avoid the expense and delay of litigation, states should employ the mediation and other alternative means of dispute resolution whenever possible.

Glenn Boledovich
3983 Dillard Rd.
Eugene, OR, USA 97405

Ph (541) 683-9296
Email Glenn@law.uoregon.edu

[1] 16 U.S.C.A §1451 et. seq.
[2] 16 U.S.C.A. §1451(c) and (d).
[3] 16 U.S.C.A. §1452(I)
[4] 16 U.S.C.A. §1451(a)(2 & 6), The Findings and Purposes of the Coastal Zone Act Reauthorization Amendments of 1990. In response, Congress amended the Act including providing for enhancement grants and nonpoint source pollution provisions.
[5] Congressional Research Service, Oceans and Coastal Management Issues Team, *Oceans and Coastal Resources: A Briefing Book*, 2, (October 4, 1993).
[6] H.B. 1965 was introduce during the first session of the 104th Congress, and provisions to reauthorize the CZMA were include in S.B. 1142, the National Oceanic and Atmospheric Administration authorization bill. Generally, both bills provide for a straight forward reauthorizaiton with only minor amendments.
[7] Robert W. Hahn, *Toward a New Environmental Paradigm*, 102 Yale Law Journal, 1719, 1747 (May 1993), a critical review of Vice President Al Gore's book, *Earth in the Balance: Ecology and Human Spirit*.
[8] UNEP G.C. Dec. No. 15/2, Annex II, May 1989.
[9] Perry E. Wallace, 192 of 50 Wash. and Lee L. Rev. 1093, 1142, FN 192, (Summer 1993).
[10] 16 U.S.C.A. §1452(1)
[11] 16 U.S.C.A. §1452(2)
[12] 16 U.S.C.A. §1451 (f) & (h).
[13] Edith Brown Weiss, *Environmentally Sustainable Competitiveness: A Comment*, 102 Yale L.J. 2123, 2123, (1993).
[14] James T. McClymonds, *The Human Right to a healthy Environment: An International Legal Perspective*, 37 N.Y. Law School L. Rev., 583, 613 (1993).
[15] Principles 10 of the Rio Declaration mandates that "all concerned citizens" should be able to participate in decision making and Principle 17 provides that environmental impact assessments should in instituted as a national instrument.
[16] Principle 16 of the Rio Declaration.
[17] Principle 15 of the Rio Declaration.
[18] Bernard A. Weintraub, *Science, International Environmental Regulation, and the Precautionary Principle: Setting Standard and Defining Terms*, 1 N.Y.U. Envt'l. L. J. 173 (1992). It is interesting to note that this principle was first applied in the context of addressing the threat of marine pollution. See Weintraub at 188 and U.N. Doc. A/44/25 (1989).
[19] Id. at 205.
[20] From Principle 15 of the Rio Declaration.
[21] 16 U.S.C.A. §1455(d)(1).
[22] 16 U.S.C.A. §1452(2)(I).
[23] 16 U.S.C.A. §1452(2). This section then lists 11 specific concerns that state coastal programs must adequately address.
[24] The federal Coastal Barrier Resource Act, 16 U.S.C.A. §3501 et. seq., also discourages such development. The author is aware that bills granting exemptions from CBRA are commonplace in Congress. It is also a fact that some members of Congress may have a personal stake in this issue.
[25] Politically, some grandfathering of existing structures might be required in implementing polluter pays.

NEW DIRECTIONS IN GLOBAL COASTAL ZONE MANAGEMENT

Jens Sorensen, University of Massachusetts, Boston, and
John Clark, Mote Marine Laboratory

Introduction

Since the beginning of Integrated Coastal Zone Management (ICZM) in the United States in 1972, countries in all parts of the world have tested and/or evaluated such programs. A good many have gone forward with ICZM in one form or another, having worked out the special strategies needed for conservation of their coastal resources. Experience in these countries shows that such programs can add to the economic and social prosperity of coastal communities.

In developing countries, sustained fisheries productivity, increased tourism revenues, sustained mangrove forestry, and protection of lives and property from sea storms are among the practical benefits of coastal zone planning and management. An effective ICZM program can also be a major force for maintaining coastal biodiversity, for resolving conflicting demands over the use of coastal resources, and for guaranteeing the long term economic sustainability of the coastal resource base.

Much of the ICZM progress in developing countries is attributable to the support of the international donor community, assistance funds from individual countries and grants and loans from international banks and other agencies. Because the donors have had relatively good payback interms of program success, we expect them to continue to support ICZM.

This paper serves both to update the reader on global progress in ICZM and to identify current and future needs.

The ICZM Approach

Globally, we define ICZM as a "system" for resource management in the critical zone where land and sea interact. It is a comprehensive program which both manages development and conserves natural resources, and while so doing, integrates the concerns of relevant economic sectors and societal interests.

The key is unitary zone management -- treating the shorelands and coastal waters as a single interacting unit.

The special role of ICZM-type programs for developing countries is that they are centrally supported and apply integrated, area wide, resources planning and management to the distinct landforms and waters of the coast where special knowledge, techniques, and governance methods are essential.

In its planning mode, ICZM for developing countries examines the consequences of various development actions and proposes necessary safeguards, constraints, and development alternatives that will guarantee sustainable development and the sustainable use of coastal natural resources, at the most productive levels possible.

In its management (or "implementation") mode, ICZM assesses the environmental and socio-economic impacts of specific development projects and recommends changes necessary to conserve resources and protect biodiversity. Developing country ICZM coordinates actions of various economic sectors to ensure that advances in one sector do not bring reverses in another; for example, that port development does not unnecessarily diminish local fisheries or tourism.

Global Status

Many countries have seriously explored the potential of ICZM, many have implemented coastal management programs, and more than 10 have initiated full scale integrated nationwide programs, *e.g.*, Sri Lanka, Ecuador, Oman, Brazil, United States.

Three years ago a roster was created of ICZM initiatives around the world which had occurred during the previous twenty years. The criteria used to determine if an ICZM initiative should be included in the roster was essentially the same as posed by this paper. The 1993 roster identified 140 ICZM initiatives in 55 nations and semi-sovereign states.

In the Oceania Region, various states have been experimenting with ICZM for many years. Examples include American Samoa, several Australian states, Micronesia Federation, Guam, New Zealand, and Northern Marianas. Asian countries that have been involved for nearly two decades include Bangladesh, Brunei, China, Indonesia, Japan, Maldives, Malaysia, Philippines, Singapore, Sri Lanka, India, Taiwan, and Thailand.

The few African countries have explored the potential of ICZM include Ivory Coast, Guinea Bissau, Nigeria, South Africa, and Tunisia. In the Near East, Egypt, Israel, Oman, Saudi Arabia, Syria, and Turkey have experimented with various forms of ICZM.

Interested European countries include Spain, Portugal, U.K., Netherlands, France, Italy, Ireland, Greece, Albania, Bulgaria, and Croatia. In North America, Canada, United States (and several of its territories), and Mexico have had experience with ICZM.

Latin America countries with a history of involvement include Argentina, Brazil, Columbia, Ecuador, Venezuela, Belize, Costa Rica, El Salvador, and Honduras. The following Caribbean states have shown interest: British Virgin Islands, Dominica, Trinidad & Tobago, St. Kitts-Nevis, St. Lucia, Turks and Caicos, and British Virgin Islands.

All these trials have generated an extensive pool of knowledge and a large literature on ICZM. But so far there has been little meaningful evaluation of the global experience. But we have come to appreciate the impediments that we face and the professional work that remains to be done to realize the promise of ICZM.

Future Directions

There are many unmet needs in the field of ICZM. Below we point out some of these needs, with the emphasis on information. The rapidly expanding field of integrated coastal zone management (ICZM) is suffering from information overload which is coming from at least two directions. One loading is from the proliferation of ICZM efforts in all parts of the world. The second loading is from the ever increasing amount of information in the many topics directly pertinent to the practice of ICZM.

A Data Base of ICZM Initiatives

A few years ago the proliferation of ICZM initiatives previously described reached the point that it was impossible to keep track of who was doing what or where. New ICZM initiatives were not aware of the success and failures of other programs. The same mistakes were being repeated. There was very little international dissemination of information on successful means for resolving coastal issues or the successful application of management techniques such as impact assessment. A worldwide Data Base of Integrated Coastal Zone Management Efforts can be accessed through the University of Rhode Island's Coastal Resources Center home page (http://brooktrout.gso.uri.edu). At the present time 52 ICZM efforts are profiled in the Data Base. It expected that each ICZM program will make the appropriate corrections and updating of their own entry.

Information Exchange Networks

By definition ICZM is a multi-sectoral, multi-enivronmental, and multi-disciplinary practice. One of the major problems in the practice of ICZM is the broad spectrum of topics as well as the number of topics involved. Essentially, anything that is affected by coastal waters and/or coastal lands is pertinent to the practice of ICZM. A project just getting underway between the University of Massachusetts, Boston, and the NOAA/National Ocean Service's Center for Coastal Services has identified at least 50 topic areas which are relevant to ICZM. Each of the topic areas (such as sommercial fisheries, coastal erosion, coral systems, impact assessment, land use law, GIS, public participation) has at least one international information exchange network; most topics have many. When fully constructed, the data base should enable Internet users with access to World Wide Web to determine the information exchange networks which are most relevant to the issue or issues confronting an ICZM project or program. The data base should also have the side benefit of providing better definition to the practice of ICZM by esttablishing a systematic means of classifying the component topics.

Information on the progress of this data base and other data bases relevant to ICZM can be obtained from the home page of NOAA Coastal Services Center (http://cceh.noaa.gov). NETCoast is another useful home page for a broad range of opportunities to enhance communications among ICZM programs. It was developed by the Netherlands Ministry of Transport, Public Works, and Water Management (http://www.minvenw.nl).

Teaching Cases

The global proliferation of ICZM has created a demand for individuals who are knowledgeable about the practice. Invariably in developing nations, program preparation is constrained by the lack of professionals who have education or training in ICZM. A series of teaching cases is needed to enrich existing training and education programs as well as to serve as a basis to create new programs.

The case approach to teaching has been demonstrated to be both highly effective and efficient. Over the last 15 years, the case approach has been increasingly used to teach environmental planning and management. Use of the case approach in advanced training is usually more effective than lectures. While, many specific cases have been reported over the 30 year history of ICZM, few have been done or adapted for teaching. We believe that standardization of the cases in a teaching series is merited, starting with a systematic listing of existing relevant ICZM case studies. A campaign to build the needed set of cases is just begining.

Roadblocks

There is a great need to evaluate ICZM efforts that have had a sufficient amount of time and resources to produce measurable outcomes. This is particularly true in developing nations where project or program evaluation is not a standard practice.

Donor institutions are prone to initiate new projects and programs and not prone to objective evaluation of the project or porgram upon completion. If an evaluation is conducted it is usually buried in the institution's information system and not readily available to those who could benefit from its findings, conclusions and recommendations.

If we are to substantially improve the state of art in ICZM -- as well as sutainable development in general -- evaluations need to be conducted at arm's length. Neither the individuals involved in the evaluation not the institution supporting the evaluation should be connected to the ICZM program. At the present time there are not arm's length evaluations of ICZM programs in developing nations. One can glean, however, from both case studies and program documents, considerable information about the factors which influence program success and failure.

Review of the literature which assesses environmental planning initiatives indicates too few successes (as measured by a program achieving most or all of its objectives) and this is particularly true in developing nations. The majority of programs are either failures or not to the point in the implementation stage where achievement can be measured. ICZM programs appear to be consistent with this general pattern.

A second way to substantially advance the practice of ICZM is to determine if the success ratio is due to a set of common obstacles. This clearly appears to be the case. Work to date by the authors has identified 6 obstacles to ICZM which are common in both developed and developing nations and 11 additional obstacles which beset developing nations. The identification and analysis of common obstacles permits the assessment of the optional means to overcome each obstacle. The development of a case teaching series should assist in the identification and analysis of the common obstacles as well as the means to overcome them.

Jens Sorensen
Harbor and Coastal Center
University of Massachusetts Boston
100 Morrissey Boulevard
Boston, MA, USA 02125-3393

Ph (617) 287-5578
Fax (617) 287-5599
Email coastctr@umbsky.cc.umb.edu

Session F5, Part III: Transboundary Environmental Cooperation: Inland Marine Waters of British Columbia and Washington State
Session Chair: Andrea Copping, Washington Sea Grant Program

JOINT STRATEGIC PLANNING FOR THE INLAND MARINE WATERS OF BRITISH COLUMBIA AND WASHINGTON

John Dohrmann, Puget Sound Water Quality Authority and
Glen Okrainetz, British Columbia Ministry of Environment, Lands and Parks

Issue

The overlapping nature of the marine resources of British Columbia and Washington and the profusion of government entities with responsibility for aspects of marine environmental protection in the region point toward the need for joint strategic planning for the region's resources.

Steering Committee Process

A joint BC/WA Steering Committee was formed to address the issue of strategic or regional planning for the shared waters. Funding was obtained from Fisheries and Oceans Canada to hold a workshop between the Puget Sound Water Quality Authority Boardmembers and regional planners and managers in British Columbia working on the Strait of Georgia to discuss joint strategic planning.

At the time of this writing, the Steering Committee has finalized the workshop planning process and will conduct this workshop March 28-29th in White Rock, B.C. The workshop is intended to provide thirty selected participants with background material on how current environmental management is being conducted on their opposite side of the border. Case studies in regional planning from both sides of the border will also be presented, with an emphasis on "lessons learned." The second portion of the workshop is being devoted to identifying barriers to joint planning and ways to overcome them as well as identifying short and long-term actions that can be taken to work more closely together on joint planning. A report of the workshop and the next steps for the participants will be available during the conference.

John Dohrmann
Puget Sound Water Quality Authority
P.O. Box 40900
Olympia, WA, USA 98504-0900

Ph (360) 407-7305
Fax (360) 407-7333
Email jddpswqa@wln.com

ARE WE TALKING THE SAME LANGUAGE?: INCREASING COMMUNICATION ACROSS THE BORDER

Holly Schneider Ross, Puget Sound Water Quality Authority
Dan Steinborn, U.S. Environmental Protection Agency

Issue

There is a clear need to manage and preserve the habitat and resources remaining in the region effectively and efficiently, using limited resources available in British Columbia and Washington. In order to achieve this goal, it is imperative that there be strong collaboration between and among U.S. and Canadian government agencies, tribes/First Nations, scientists, NGO's, and other stakeholder groups.

Process

The Liaison Officers for the Task Force maintain communication between Task Force and the Council, between the Task Force and the Work Group Leads, and between the Work Group Leads. This involves extensive use of the internet as well as traditional methods of communication. The Liaison Officers are also responsible for ensuring that the work groups progress on their activities on both sides of the border. This may involve offering support to a work group, fostering communication across the border through conference calls, or helping push grant contracts through agency processes, as examples.

Outreach to the public and stakeholder groups regarding the importance of the shared waters is another important piece to realizing action on these high priority issues. The Liaison Officers conduct outreach in a variety of ways: through a dedicated homepage on the internet, through an e-mail discussion group, through newsletter articles, through development of a Task Force brochure, through presentations at meetings, through direct phone calls. Examples of each of these methods will be demonstrated and suggestions for further outreach will be sought.

Holly Schneider Ross
Puget Sound Water Quality Authority
P.O. Box 40900
Olympia, WA, USA 98504-0900

Ph (360) 407-6453
Fax (360) 407-7333
Email hsrpswqa@wln.com

LINCOLN PARK SHORELINE EROSION CONTROL PROJECT: MONITORING FOR IMPACTS ON EELGRASS, BIVALVES, AND BULL KELP

Liam Antrim, Battelle Marine Sciences Laboratory
Jeff Dillon, U.S. Army Corps of Engineers
Ron Thom, Battelle Marine Sciences Laboratory

In 1936, a seawall was constructed at Lincoln Park's southwest beach, Seattle, Washington, to protect the narrow shoreline below a steep hillside. The seawall protected the nearshore area but eliminated the sediment source that replaced erosion loss at the beach. During the next few decades, finer materials from the beach eroded and produced a beach of coarse and hard materials (*i.e.*, cobble, boulders, and hard-packed clay). The erosion rate for the four decades after seawall construction was estimated at 0.1 ft per year.

Beach erosion has threatened the survival of the seawall at Lincoln Park. After a severe winter storm in 1981, large portions of the seawall were undercut and collapsed. Backfill and toe rock were added as temporary restoration measures, but beach nourishment (*i.e.*, sediment replenishment) was planned as a more durable measure to protect the seawall and pedestrian walkway from further degradation. In the fall of 1988 and 1994, pit run (mixed cobble and sand) was added to the upper intertidal area above +5 ft MLLW over approximately 670 m of beach. Beach nourishment was designed to 1) change beach topography and protect the seawall and walkway, 2) provide substrate more suitable for epibenthic habitat than the hardpan clay that covered much of the intertidal area, 3) limit direct burial of the biologically rich lower intertidal areas, and 4) minimize impacts to juvenile salmonids.

In addition to impacts of direct burial on the upper intertidal beach, changes in substrate distribution resulting from migration of fill material and modifications to the wave energy at the beach had potential to impact the biological community at Lincoln Park. The influence of beach nourishment activities on eelgrass (*Zostera marina*) is of widespread interest because of its recognized value as habitat for a variety of biological resources. Impact assessments of beach nourishment identified eelgrass as a potential indicator of far-field (*i.e.*, adjacent to the fill area) impacts of the beach rehabilitation project.

Bull kelp (*Nereocystis leutkeana*) and intertidal bivalves are other potential indicators of far-field impacts. Kelp distribution at Lincoln Park's southwest beach appears to have changed dramatically since records taken early this century. These kelp beds increased in area following the construction of the seawall at Lincoln Park in 1936. By the mid-1980s, kelp formed a more-or-less continuous forest between Point Williams and the southern park boundary. The seawall may have eliminated the source of sediment materials for the beach, and subsequent shoreline erosion exposed more subtidal rocky substrate for kelp attachment. However, fine materials from recent beach nourishment efforts could migrate to the shallow subtidal zone and affect kelp substrate availability. Bivalves are an important resource, because Lincoln Park's southwest beach is heavily used by recreational clam diggers. Intertidal bivalves could be negatively affected both by direct burial under fill material and subsequent migration of fill material to lower intertidal levels. Post-nourishment surveys identified areas where finer portions of the fill material (*i.e.*, sand) washed out of the substrate and slumped onto lower portions of the beach. Some loss of eelgrass was linked to this slumping of fill materials after beach nourishment in 1988.

To optimize comparability of data from previous surveys of eelgrass and bivalve, surveys between 1993 and 1995 used transects established during baseline surveys of 1985. Bivalves were sampled at standardized stations (+6, +4, +2, 0, -2 ft mean low low water [MLLW]) by excavating a 0.06 m^2 area to a depth of 30 cm. Patches of eelgrass were located and surveyed for the following characteristics: patch shape, size (length, width, or diameter), estimated tidal elevation, shoot (turion) density, substrate characteristics, and location relative to adjacent 0 ft MLLW markers. Shoot or turion density was estimated within a 0.1-m^2 quadrant non-selectively tossed in a patch one or more times. If a patch had obvious areas of low and high shoot density, shoot density counts were made in a randomly chosen quadrant from the low- and high-density areas. Similar methods were used to monitor eelgrass transplant plots created in 1993 and 1994. If individual shoot bundles were discernible, counts of shoot per transplant bundle were made as an alternative to quadrant counts of shoot density. The number of shoot bundles that had survived was also estimated from the 1994 transplant plot.

In 1995, preliminary observations of bull kelp (*N. leutkeana*) distribution offshore from the fill area were made from the shore at the extreme of tidal ebb. The subtidal survey in July 1995 was limited to a single transect parallel to the shore and through the approximate center of the kelp bed. This transect was conducted by two scientists using snorkeling gear, swimming at the surface and occasionally diving to the bottom to observe the substrate. Notes were taken on macrophyte species presence, distribution, and substrate. Shore features were used to identify positions of sightings. In addition, shore-based observations were made on the kelp bed located north of Point Williams, where no beach nourishment has occurred. Aerial photographs of the nearshore area from 1983 to 1995 were obtained from U.S. Army Corps of Engineers, Seattle District, and Washington Department of Natural Resources files.

High inter-station variability in clam density and a relatively low sampling intensity resulted in no statistically detectable change in bivalve density between surveys in 1985, 1990, and 1993. Bivalves were found at fewer than 25% of sampling stations each year. The mean density of clams in the fill area ranged from 22/m^2 (1990) to 47/m^2 (1993). The highest bivalve densities were found at stations at or below +2 ft MLLW. Significant direct impacts to bivalves from fill placement are unlikely since bivalves were not abundant in the fill area (+5 ft MLLW and above), and bivalves could move to the surface if shallow deposits of sediments slumped on top of them. Species composition was stable; littleneck (*Protothaca staminea*) and butter clams (*Saxidomas giganteus*) were the dominant species. Recreational clamming is intensive at the southwest beach. In pleasant weather, it is common for several groups of people to be digging at the beach. Evidence of clam digging (*e.g.*, disturbed substrate and shallow pits) is widespread over the lower intertidal areas of the beach. This activity is likely to have a more significant impact on infaunal bivalves than beach nourishment.

Eelgrass distribution studies were limited to the intertidal area down to approximately -2 ft MLLW. Observations of eelgrass in the subtidal areas at Lincoln Park have been informal. Natural eelgrass beds at Lincoln Park are not extensive. Eelgrass is located primarily in soft sediment found in lower intertidal and shallow subtidal areas. Eelgrass grows in a variety of configurations: a few large, well-defined and dense patches, numerous small isolated patches, and broad areas of sparse colonization. In general, the distribution of intertidal eelgrass at Lincoln Park has remained stable between 1988 and 1995. Most eelgrass off Lincoln Park's southwest beach is located on the northern half of the beach, although suitable substrate occurs in the southern area. It is clear, however, that eelgrass distribution at Lincoln Park is not static. Patches change in size and shape from year to year. Newly established areas of eelgrass growth can be relatively large when first noted in periodic surveys.

Eelgrass showed considerable variability in area coverage between surveys in 1988, 1993, and 1995. Data from 1993 show dramatically reduced eelgrass area coverage (m^2) from all sections of the beach in comparison with 1988 data. This loss of eelgrass may have been the result of a severe storm event(s) preceding the survey by weeks or months, although no obvious storm damage was noted during the 1993 survey. By 1995, eelgrass area coverage had returned to levels closer to those found in 1988. Nevertheless, a comparison of 1988 and 1995 data show a net loss of approximately 20% to 40% of intertidal area covered by eelgrass, excluding eelgrass transplant areas. Eelgrass area coverage was reduced at all portions of the beach that contained significant eelgrass beds. It is unclear whether estimated loss of eelgrass area coverage is the result of natural events or a consequence of beach nourishment.

Significant areas of subtidal eelgrass were noted on a "snorkel" transect off the southwest beach in 1995. Because this effort was not designed as a rigorous survey of the subtidal area, observations were descriptive, not quantitative. The subtidal area within 100 m of the shore forms a relatively shallow shelf, approximately 5 m deep at MLLW. Typically, the boulders and cobble of the lower intertidal area extended to about -2 ft MLLW. Further offshore, the substrate is dominated by sand and shell hash. Eelgrass was noted over a large portion of the subtidal area surveyed. At the northern end of the southwest beach (Point Williams), subtidal eelgrass grew in small, dense patches. Further south, subtidal eelgrass was broadly distributed but very sparse (generally <10 shoots/0.1 m^2). No previous surveys of subtidal substrate or eelgrass distribution at southwest beach could be found in the literature.

Eelgrass transplanting at Lincoln Park has strong potential to be a successful habitat enhancement technique. Preferred habitat or site characteristics for transplanting are areas between 0 to -22 ft MLLW, with low wave energy, and mixed sand substrate on relatively flat areas. Eelgrass colonizes new areas rapidly only when it is very near (<1 m) a healthy patch. An increase in soft substrata will not necessarily result in increased eelgrass because of the slow colonization rate (on the order of decades). Therefore, transplanting new and suitable areas can be the best means of increasing the rate of eelgrass colonization. A slumping of materials, primarily a movement of finer materials (sand) to lower tidal elevations was anticipated as a consequence of beach nourishment. In fact, such processes were thought to be responsible for loss of some eelgrass patches adjacent to the fill area. Although changes in substrate could have buried some eelgrass, it could also have increased the area of suitable eelgrass habitat on the lower portions of the beach. Consequently, transplanting in these areas can serve to mitigate for eelgrass loss as well as to enhance habitat for juvenile salmonids. Large areas of suitable substrate are found on the northern portion of Lincoln Park's southwest beach.

Experimental-scale eelgrass transplant plots were created in 1993 and 1994 in a shallow subtidal area dominated by bare sand to determine whether eelgrass transplanting was a viable tool for habitat enhancement.

The 1994 plot was planted on a regular grid, with each bundle of 10 shoots placed at a 0.5 m interval, to allow better quantification of transplant success than was possible with the 1993 plot.

Two years after planting, the 1993 eelgrass transplant plot was well established. After one year, the majority of the transplant bundles were identified as small patches with diameters of 20 to 60 cm. After two years, the small patches had fused to form three adjacent beds totaling 18.5 m^2 in area. These transplants could no longer be identified as distinct bundles and could not be distinguished from natural eelgrass patches. After one year, the 1994 transplant plot was a clearly defined grid of eelgrass. Shoot bundles at the nearshore end of the plot (approximately -1 ft MLLW) had spread more vigorously than bundles at the deeper end of the plot (approximately -2.5 ft MLLW). The nearshore bundles were partially fused, and many could not be identified as individual shoot bundles. At the deeper end of the plot, shoot bundles were more distinct, with fewer individual shoots and less fusion of separate bundles. Counts of shoot number per distinct bundle ranged from 54 shoots at the nearshore end to 22 shoots at the deeper end. Bundles containing 10 shoots each were originally planted. Approximately 88% of the original transplant bundles had survived the first year. Failed transplant bundles, or bare patches, were distributed throughout the transplant plot, with no apparent pattern to their distribution. Total shoot abundance in the 1994 transplant area increased approximately three-fold in one year, from 1,210 shoots (total number of shoots immediately after planting) to approximately 3,730 shoots.

In July 1995, bull kelp (*N. leutkeana*) was found sparsely distributed over approximately 200 m of the subtidal area off the southwest beach. Floating bulbs were observed from the beach only at maximum tidal ebb (approximately -2 ft MLLW). The plants were completely submerged at approximately 0 ft MLLW and could not be seen from the shore. On close inspection, kelp plants appeared healthy, with strong pigmentation, long blades (up to 3 m), and reproductive patches (sori) on the blades.

Substrate availability could limit the distribution and density of kelp colonization off the southwest beach at Lincoln Park. In July 1995, the dominant surficial substrate in the area was sand and shell hash, with occasional boulders and cobble protruding through the sand. Kelp holdfasts were attached to the larger substrate materials. Aerial photos from the mid 1980s show a continuous kelp bed extending from near Point Williams to beyond the south park boundary (approximately 800 m). A survey in 1989 estimated that kelp beds extended for about 600 m along the southwest beach. One explanation for recent reduction in kelp beds adjacent to the fill area is the burial of suitable substrate for kelp attachment and change of the dominant substrate from cobble/boulders to sand. The distribution of bull kelp in the cove just north of Point Williams appears to have changed little during the past decade.

Liam Antrim
Battelle Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, WA, USA 98382

Ph (360) 681-3655
Fax (360) 681-3681
Email ld_antrim@pnl.gov

RESTORATION OF WASHINGTON STATE PARK BEACHES

Maurice L. Schwartz, Western Washington University

Introduction

At the turn of the century three coast-artillery forts guarded the entrance to Puget Sound: Ft. Worden, near Port Townsend, on the northeast corner of the Olympic Peninsula; Ft. Flagler at the north end of Marrowstone Island; and Ft. Casey on the west side of Whidbey Island (Figure 1). In all the intervening years never was a shot fired in anger, and today all three of these sites are marine-oriented facilities operated by the Washington State Parks and Recreation Commission for the burgeoning population of the greater Puget Sound region.

Concurrent with a growth in popularity and use, ongoing beach erosion or deposition has led to various forms of deterioration at each of the three park sites. As a result, the Parks and Recreation Commission is faced with two major concerns: how to best manage the facilities for the enjoyment of the public and then, if some sort of maintenance is required, how to best implement that maintenance?

The first of these concerns raises the specter of "abandon or retreat" versus some form of "maintenance or restoration." In principle, the natural geomorphic beach processes in operation should not be interfered with. Weighed against this, however, is the need to provide public access, present and future, to the beaches and waters of the region. Therefore, at each beach site the present attributes of aesthetics, access, and infrastructure had to be balanced off against the way in which the site would evolve if no action were taken. These decisions are not taken lightly, the possibilities of abandonment or retreat always being seriously considered as a prelude to investigating alternative approaches.

Considerable restraints accompany any remedial undertaking. The Parks and Recreation Commission, as do most government agencies these days, operates under strict and limited funding controls. Not only is the initial capital investment of any project carefully scrutinized, the subsequent annual and/or long-term maintenance costs are of equal concern. Then too, state and federal fisheries agencies, mandated to protect the marine biota in these waters, require adequate passage for small fry and limit seaward encroachment for most projects to mean-higher-high-water (MHHW), which is +8.5 feet MLLW in most of this region. Finally, stringent review by other permitting agencies and by concerned citizens assures input from all concerned.

With due consideration given to these environmental and pragmatic concerns the prospects at each of the park sites are thoroughly reviewed and a range of options developed. Only after continual discussion and reworking are options chosen and decisions made. The whole process is indeed, and rightly so, a lengthy one. Final approval of each of the projects described in this presentation is still under consideration at the time of this writing.

Fort Worden

Ft. Worden State Park is visited by 1.2 million people each year who come to enjoy the two beaches, scenic trails, campgrounds and hostels, concert and lecture series, coast-artillery museum, and marine science center. The Point Wilson beach, facing north onto the Strait of Juan de Fuca, is subject to the highest wave energy of any of the three sites under discussion here. With a fetch of 32 miles to the NW and 27 miles to the NNW, waves approaching the beach from these directions have a significant wave height of 7 feet with a 6 second period. The bluffs of glacial outwash to the west of Point Wilson supply sediment to the eastward net shore-drift. There is a documented recession rate along one high bluff sector of 2.5 inches per year, with an annual sediment contribution of 4 cubic yards per yard of shore length. Despite the ample sediment supply severe storms have caused considerable erosion along the Point Wilson beach over the years. In 1989 three large groins were built into the foreshore to forestall further erosion, yet an extreme series of northerly storms in December of 1990 lowered the beach profile and cut a scarp into the backing dunes. Park personnel estimate that the front of the dunes have been further eroded at a rate of 4 feet per year since that event.

While the Point Wilson beach as it stands today is a site of rugged and scenic beauty, Park concerns are that ongoing erosion at recent rates would jeopardize the dunes and trails within them, beach access, a parking lot and scenic lookout (the latter being the only accessible area for many people who can not walk down to the beach), and a Coast Guard lighthouse at the end of the Point Wilson spit to the east. With all of these facets in mind, the following options were then put forth for review and consideration: 1. No action, 2. Dune rejuvenation, 3. Major beach nourishment, 4. Submerged breakwater, 5. Rock bulkhead and rejuvenate dunes, 6. Modified beach fill.

With due concern for all of the pros and cons of no action, it was determined that the present infrastructure should be maintained for public use, within the most environmentally sensitive manner possible. Both the major beach nourishment project and submerged breakwater were rejected on the basis of the large financial cost, initial and long-term, and detriment to the nearshore and intertidal biota. It was also felt that the similar options of rejuvenating the dunes or a modified beach fill (from MHHW [+8.5 MLLW] to the top of the dune scarp) would provide initial apparent restoration, but would not offer any protection from erosion in subsequent storm events. The option that is now being pursued through agency and public review is the rock bulkhead. As presently designed this would consist of a low rock wall, on a buried base of ballast and filter cloth, at +15 MLLW; with dune restoration in back and beach fill down to +8.5 MLLW in front. Plantings of salal could soften the visual effect.

Considering the special requirements and difficult circumstances that prevail at the Point Wilson beach, a rock wall or bulkhead, as described above, was deemed to be the most viable alternative.

Fort Flagler

The beach at the Ft. Flagler State Park fronts a low, level campground and faces on Kilisut Harbor. Net shore-drift is from the south along the east side of the embayment; and, extrapolating from what is known of the bluffs of glacial outwash across the bay on Indian Island, erosion rates on Marrowstone Island south of the park are 3.5 inches of bluff retreat per year with an annual sediment contribution of approximately .25 cubic yards per yard of shore length.

Some time in the late 1950s or early 1960s a promontory was constructed at the south end of the park beach to provide a base for a dock and float. As would be expected, the promontory caused accretion of the beach in front of the bluffs immediately to the south and erosion of the park beach to the north. In 1964 a wooden bulkhead was built to stem the loss, but it was subsequently wrecked by a storm and rebuilt in 1966. At present the scarp at the back of the beach is littered with remnants of the wooden bulkhead and pieces of concrete that had been dumped there as well.

Park concern here is that the beach is littered with the remains of former defense efforts and that erosion continues to encroach on the campground area. Options that were put forth for consideration included: 1. No action; 2. Removal of debris and allow natural erosion; 3. Removal of debris and plan-view shaping to equilibrium erosional arc; 4. Low, rock bulkhead with beach nourishment; 5. Artificial beach nourishment; 6. Removal of the promontory, with some beach clean up and initial nourishment.

In reviewing these options it was determined that the loss of campground acreage, and in particular jeopardizing a septic field that underlay the area, were unacceptable alternatives; thus ruling out options 1 and 2, taking no action at all or allowing natural erosion after removal of debris. Option 3, shaping to a natural plan-view erosional arc of equilibrium (with some moderate nourishment above +8.5 MLLW) was recommended as being efficient, but was rejected on the same basis as option 1 and 2. Removal of the promontory and ancillary modification or entering into a large-scale nourishment project were deemed much too expensive under the circumstances, and permitting nourishment below +8.5 would be a fisheries concern. Clearing away the debris, constructing a rock bulkhead, and providing some beach nourishment appears to be the approach that will finally be implemented. Whether the low bulkhead will follow a straight line from south to north or be curved inland slightly to form a more natural curvature to refracting waves is still under discussion.

Fort Casey

The Keystone ferry terminal is located in a small harbor at Ft. Casey. Within the harbor entrance there are two concrete boat- ramps for launching trailered craft, and the ramps are used frequently through most of the year. However, sand and gravel transported past a short timber-pile breakwater on the beach along the side of the harbor accumulate at the lower end of the ramps, causing ongoing maintenance problems. Periodic dredging of the ferry channel does not have any significant effect upon net shore-drift along the shore.

Some of the alternatives that were put forth for consideration were: 1. No action; 2. Relocate the ramps; 3. Extend the existing timber-pile breakwater; 4. Construct a rock or floating breakwater outside the harbor entrance; 5. Cut back (dredge) the shore outside the harbor; 6. Build a baffle-type wall of wood posts and plastic panels along the outer side of the two ramps; 7. Construct raised or elevated ramps. Aside from budgetary limitations, there were also the joint requirements of fish passage and avoidance of interfering with ferry operations.

Continued removal of the accumulating sediment was not considered an option by Parks. As for relocating the ramps, there was no other safe place for launching within the small harbor nor another harbor in the nearby vicinity. Extending the existing timber-pile breakwater or building a new rock or floating breakwater were all rejected by the ferry authority as endangering ferry access to the terminal, and the latter two breakwaters were too expensive for the Park. It was also felt that further dredging near the shore would oversteepen the bottom slope in that area. The design for a small wood/plastic baffle wall along the outer side of the ramps appeared viable, yet questions were raised as to sediment passing and fish restricted, just the opposite of the desired objectives. In the final analysis, the concept of a raised or elevated boat ramp design has been selected for further consideration and likely implementation. A prototype at the central Puget Sound town of Silverdale seems to be meeting with considerable success, facilitating passage of both sediment and small fish.

Conclusion

In each of the three cases outlined here the Washington State Park and Recreation Commission had to make pragmatic and decisive decisions in the face of a multitude of conflicting interests and limitations. Restoration of each site, as described, was deemed to be the best alternative for the public at large.

Maurice L. Schwartz
Western Washington University
Department of Geology
Bellingham, WA, USA 98225-9080

Ph (360) 650-3586
Fax (360) 650-7302
Email geology@henson.cc.wwu.edu

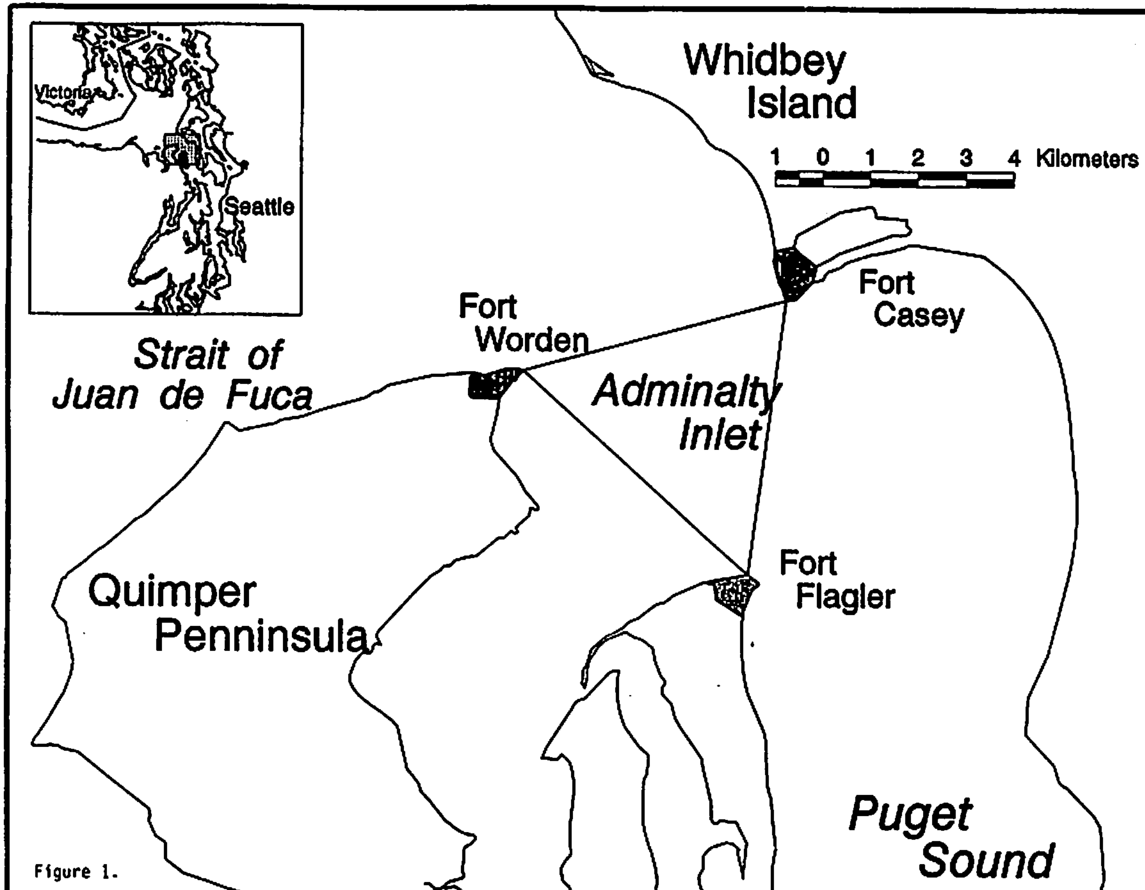
Victoria
Seattle
Whidbey Island
1 0 1 2 3 4 Kilometers
Fort Casey
Fort Worden
Strait of Juan de Fuca
Adminalty Inlet
Fort Flagler
Quimper Penninsula
Puget Sound

Figure 1.

BEACH NOURISHMENT AT BAY VIEW STATE PARK, WASHINGTON

Jim Johannessen, Coastal Geologic Services

Beach processes were determined and management options developed for a 183-m-long artificial beach at Bay View State Park, Washington. The park is adjacent to Padilla Bay National Estuarine Research Reserve, who funded the initial study to determine potential effects on eelgrass (*Zostera marina*) and mud flat resources of the Preserve. The beach was created in 1969 through construction of two rip-rap terminal groins, dredging of nearby mud flat sediment and hydraulic fill of a supra-tidal platform, which was capped with imported sand and gravel. Results include beach profile (cross-section) data, sediment characterization, net shore-drift (long-term result of littoral drift) determination, analysis of erosion and deposition patterns, and initiation of a monitoring program. Remaining nourishment was quantified and a sediment budget was estimated to assess the fate of beach nourishment sediment to date. Slightly more than half of the total known beach nourishment sediment remained at the main park beach in 1993. Most of the nourishment sediment removed from the main park beach was deposited in accretional beaches adjacent to the northern and southern park revetments, or in intertidal bars. It appears that a minimal amount of nourishment sediment was transported to the mud flat, with the exception of an undetermined amount deposited in the dredged depression waterward of the park beach. Incomplete baseline data hampered some aspects of sediment budget. Beach sand and gravel was reduced to a minimum vertical thickness of only 0.3 m by February 1996, nearly exposing underlying mud fill. If mud is exposed, beach erosion rates would increase greatly. Planned renourishment is recommended to preserve the main park beach at minimal expense with minimal disturbance of ecological communities. Specific management recommendations are included.

Park History

Bay View State Park consists of 25.2 a today, including mud flat that is bounded by the much larger Padilla Bay National Estuarine Research Reserve. The park has 407 m of shore along Padilla Bay exposed to low to moderate wave energy (Figure 1). An estimated 262,000 total visitations in occurred in 1990, consisting primarily of daytime beach visits. The 183-m-long beach area at Bay View State Park is artificial; it was created in 1969 of mud flat deposits dredged from the area directly waterward of the beach. Mud flat sediments were placed at the present rectangular area west of Bay View-Edison Road by hydraulic fill, which began by March 1969. Project specifications called for 50,000 m^3 of dredged mud flat sediment to be placed in a 72 by 183 m area, to bring the elevation up to +10 ft NGVD (O ft NGVD corresponds to 4.55 ft MLLW here). During construction of the roadway bridge and access road to the beach an additional 6,100 m^3 of bluff material was placed as a base for the present beach parking area (Johannessen, 1993a).

Hydraulic dredging of the mud flat formed a depression or dredge hole immediately west of the park approximately 150 by 245 m in size. The majority of the hole was dredged 1.8 m, while the remainder of the hole was dredged 0.9 m below the mud flat surface. Following hydraulic fill, pit-run sand was hauled to the site to finish the construction of a "recreational beach". The initial project design called for 2,750 m^3 of sand to be placed as a cap over the mud flat deposits and along the 183 m of newly-constructed shoreline to make a beach at a 5:1 slope.

Rip rap revetments (0.6 m thick light, loose rip rap at a 4:1 slope) were placed around the fill area in an effort to protect it from wave erosion. As a base beneath the rip rap, quarry spalls (0.15 m thick; 4 inch-minus) were to be placed atop fill material. A further "rip rap improvement" drawing was prepared by August 24, 1970, calling for a 23 m-long-terminal groin at both the northern and southern ends of the beach. Design drawings called for each groin to be constructed of 46 m^3 of heavy, loose rip rap to an elevation of +14 to 15 ft NGVD for the center of the groin with sides of decreasing elevation at a 1.5:1 slope.

Beach Erosion and Beach Nourishment

Historical shoreline change of the beach and adjacent areas was examined through a review of available ground photographs and slides, aerial photographs, and interviews of State Parks personnel. A recurring pattern of beach erosion and associated scarping, and subsequent beach nourishment (also called beach fills) has taken place since the beach was created. The artificially steep high-tide beach has been eroded along the entire 183 m of the main park beach, but the most severe erosion repeatedly occurred near the southern end of the beach. Photogrammetry revealed that by April 1971, the southern end of the upper beach was eroded to create a scarp approximately 20 m landward of the 1969 break in slope, while the northern end was eroded to create a scarp 15 m landward of the 1969 break in slope. By July 30, 1972, the beach elevation had dropped 1.3 m at a location near the southern end of the beach, prompting renourishment (Table 1). The pattern of upper beach erosion and scarping was repeated a number of times since 1974, but is not well documented.

State Parks had allocated funding for the same volume of renourishment sand in the 1989-1991 biennium, but Washington Fisheries and Wildlife did not issue a permit until August 1991, after the biennium ended, and renourishment did not occur). State Parks added 460 m^3 (600 cy) of beach nourishment sediment above MHHW in 1994. This was the maximum volume and only placement location that Washington Fisheries and Wildlife would permit.

The total known nourishment of 6,080 m^3 is most likely a low estimate of the total amount of sand added during the last 27 years. During preparation of this report the known volume of nourishment sediment continued to go up as more information was found, literally in the crawl space of a Parks office. Activities such as placement of "beach fill" were treated much more casually in the 1970s.

Beach Characteristics

Beach profiles were sampled on March 12, March 28, and May 9, 1993 (Johannessen, 1993a), and resampled on February 26, 1996. Natural beach sediment is characterized by TR-1 (Figure 2), where the high-tide beach is composed of cobble, with a lesser amount of sand, extending 16 m from the bluff toe. The uppermost 2 m of the high-tide beach contains a narrow band with abundant sand. The vertical thickness of the high-tide beach is as little as 3 cm, below which is a wave-cut platform of Everson glaciomarine drift. Field observations and profile data located the demarcation between the high tide and low-tide terrace at the 7.2 m (relative to TBM-7 = 10.0 m elevation). From 16 to 27 m from the bluff the low-tide terrace consists of silt and sand, with cobbles. Sediment grain size then decreases waterward to silt and clay.

Profile TR-1 also characterizes natural, pre-1969 beach shape in the study area. The profile at TR-1 (Figure 3) shows a narrow high-tide beach meeting the bluff at the location where a berm would otherwise occur. Beach slope along TR-1 decreases first at the beginning of the low-tide terrace, then at 50 m from the bluff base, and than finally becomes almost horizontal at 110 m from the bluff, where the undisturbed mud flat begins. The beach profile at TR-2 is transferred waterward approximately 15 m relative to TR-1 due to the accretion of "north beach."

Profiles TR-3, 4, and 5 sample the main park beach (Figure 3). There is an abrupt drop from the park platform to the upper beach. A scarp was present along TR-4 and 5 here in 1993. Renourishment with granules and coarse sand in September 1994 covered this scarp, however, beachface erosion continued between 1993 and 1996. The low-tide terrace at the main park beach is consistently steeper and narrower than at TR-1. The slope of the low-tide terrace along TR-4 is 3.4 cm/m, while it is only 1.3 cm/m along TR-1. The main park beach profiles drop off at the beginning of the dredged area (beyond 100 m along TR-4), essentially where the lower portion of the profile is "undercut" by the abrupt break in slope at the edge of the dredge hole. The beachface along the main park beach contains mixed sand with pebbles and granules. There is only a minor difference in grain size between the high and low tide portions of the beach at TR-3, 4, and 5. The high tide beach coarse fraction consists of pebbles instead of cobbles, while sand is relatively more abundant than silt in the artificial low-tide terrace. The lower portion of the main park beach is much steeper than it would be under natural conditions, prohibiting deposition of silt and clay.

Net shore-drift refers to the long-term, net result of littoral sediment transport at a particular reach of shore. Geomorphic indicators of northward net shore-drift (Johannessen 1993b) identified include: a slight increase in beach width to the north; an erosional scarp near the southern end of the main park beach as compared to the more stable northern end; small accumulations of beach sediment present on the southern side of the intermediate groins along the main park beach; and finally, angular metamorphic rock fragments from revetments in relatively greater quantity on the northern side of both park revetments, serving as long-term sediment transport tracers. During northwesterly or northerly wind storms, some southward shore drift occurs in the park area, but is overshadowed by northward shore drift, driven by predominant winds from the southeast (Johannessen, 1993a).

Erosion and Accretion Patterns

Erosion of the high-tide unnaturally-shaped beach is caused by a number of factors. End scour in the vicinity of the terminal groins is caused by groins reflecting a portion of incoming wave energy onto the adjacent beach, resulting in enhanced backwash and sediment removal. A shallow rip current trough was observed immediately waterward of the north groin on a number of occasions. Two downcoast shoals or bars (termed Bar 1 and Bar 2) composed of medium and coarse sand occur north of the north groin. These are accretional features formed from sediment derived from the main park beach that has been transported northward. The north groin has deteriorated substantially (from 23-15 m in length). A portion of the original groin rock has been broken into smaller pieces and transported away and some rip rap is out of line with the rest of the groin. The south groin has deteriorated at both ends, but not as severely as the north groin.

An accretional beach has formed adjacent to both cross-shore revetments. North beach extends 95 m north of the northern revetment (Figure 2). It consists of a vegetated backshore area that is fronted by a curved berm. Backshore sediment is almost 100% sand, of the same sizes that are present in the main park beach. North beach was formed primarily from the main park beach sediment that was transported around the northern groin and deposited in the more protected lee of the revetment. South beach is located adjacent to the southern revetment and considerably smaller than north beach. South beach was formed by transport of nourishment sediment around the southern groin and by northward net shore-drift.

Fate of Beach Nourishment Sediment

The volume of nourishment sediment remaining on the main park beach was estimated by measuring the depth of sandy sediment remaining above mud. The minimum thickness sampled was 0.6 m near the southern end of the beach in 1993. Values were as low as 0.3 m in 1996, showing continued erosion despite the small renourishment. A number of potential sediment sinks exist for nourishment sand that was transported away from the main park beach. A sediment budget was estimated (Table 2) from detailed 1993 field measurements (Johannessen, 1993a).

The total nourishment sediment accounted for in this sediment budget is somewhat less than the total known nourishment of 6,080 m^3, although the documented total may be low. This estimate is indeed rough and nourishment sediment not accounted for probably ended up in either the dredge hole, or perhaps alongshore to the north, beyond the northern study area boundary.

The general principle of the equilibrium beach profile affects profile adjustment. When a beach has an artificially steep profile, nourishment sediment will be redistributed waterward and/or alongshore until the beach has a (lesser) slope that approaches its natural equilibrium profile (Bruun, 1985). This process is enhanced by the fact that the initial fill material was removed from the nearshore bottom near MLLW, making the entire main park beach more than 2.5 times steeper than adjacent areas. The 1994 dune placement did not offset the continuing erosion problem.

Medium and coarse sand, that is believed to dominate original nourishment sand, is generally only found on the high-tide beach. Due to limiting depth, moderate energy waves only effect the high tide beach. Northward net shore-drift easily passes around the eroded north groin along the middle and lower foreshore to deposit sediment in north beach and bar 1 and 2. A lesser portion of nourishment sediment passes around the southern end of the main park beach and is deposited primarily on south beach. When shore drift transports nourishment sediment beyond the ends of the main park beach, the large majority remains on the high-tide beach and very little appears to be deposited on the eelgrass-rich mudflat.

Recommendations

Planned renourishment is the recommended alternative. Planned renourishment would preserve the main park beach at minimal expense and disturbance to ecological communities. A possible option would be the repair of the two terminal groins to increase nourishment sediment residence time and reduce the volume needed to maintain the main park beach. An additional outcome of planned renourishment would be a gradual increase in the area of north and south beach, with the rate of increase dependent on the integrity of groins. Additional renourishment is planned for 1997 or 1998. Specific recommendations include:

Planning: The original park beach configuration was not well-planned. Minimum future planning should include assessment of renourishment needs every two years. Renourishment should be carried out when nourishment sediment on the main park beach reaches a critical low level of 0.4 m depth (higher than the spring 1996 level of 0.3 m). Budget for renourishment every six years (loss has averaged 1,000 m^3 in 6 years) and delay if not needed.

Placement: Placement of nourishment sand is limited by the high tide beach/low tide terrace morphology. "Visible beach placement" and "dune placement" often perform poorly (Smith and Jackson, 1990). Renourishment of the entire beach profile would likely last longer but would probably not be permitted now. Reconfiguring the beach could lesson beach slope through landward translation of the high tide beach.

Density: The recent 460 m^3 renourishment volume amounted to 2.61 m^3/m of beach, or only 9.8 cm thick if spread over the high-tide beach evenly. This depth would not have caused a significant change in the main park beach. A larger volume, such as 1,000 m^3, would reduce the frequency of renourishment.

Grain Size: The use of coarse sand to pebbles for renourishment (Terich *et al.*, 1994) would increase residence time on the beach as compared to predominantly sand, and would more closely resemble natural sediment.

Timing: Renourishment should be conducted in late spring. This time precedes the fair weather season and the busy summer season, and would allow for work during low tides during long daylight hours.

Groins: Repair of the existing terminal groins would be the most important action besides renourishment itself for preserving the main park beach. This would increase the residence time of nourishment sediment on the main park beach. Repairing the 23-year-old groins would require realigning existing rock and possibly bringing in additional, more durable (such as granite) rock for the waterward ends.

Vegetation: Remove exotic Scot's broom from main park beach backshore and replace with American dungarees and other native species to aid in holding sediment.

Expectations: Assumptions concerning the stability of renourishment sediment should not be over-optimistic. Storms may remove sediment more suddenly than in the past through net shore-drift and profile adjustment.

Long-term Monitoring: There is a great need for quantitative data from low to moderate energy Puget Sound shores (Macdonald *et al.*, 1994): 1) continue profiling of TR-1, 3, 4, and 5 annually in late spring; 2) repeat beachface cores to determine depth of sand; 3) monitor terminal groin stability with photographs; and 4) document nourishment volume and location, keep samples, photograph placements.

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Jim Johannessen
Coastal Geologic Services
701 Wilson Ave.
Bellingham, WA, USA 98225

Ph (360) 647-1845
Fax (360) 671-6654

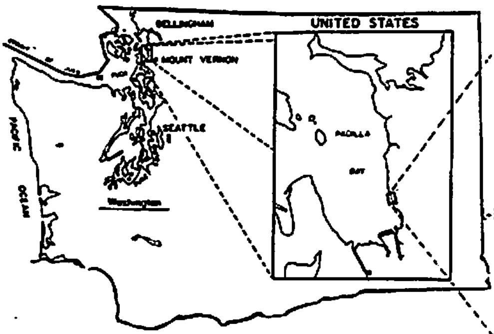

Figure 1. Study Area.

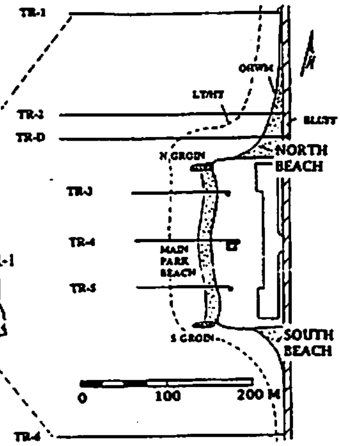

Figure 2. Beach Profile locations.

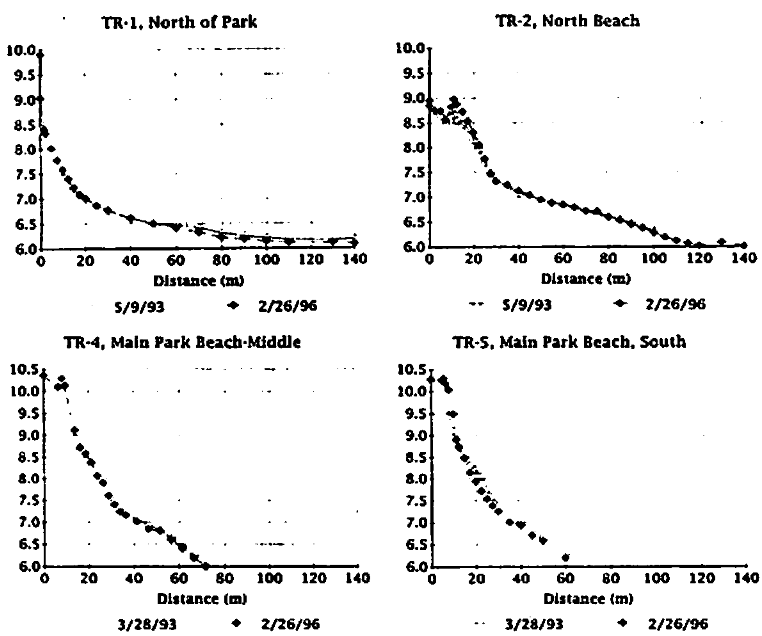

Figure 3. Beach profile selected data (elevation in meters relative to TBM-7=10.0 m).

Table 1. Known beach nourishment history.

DATE	KNOWN BEACH NOURISHMENT	VOLUME (M^3)	VOLUME (CY)
1969	Initial beach fill	2,770	2,600
1975	"Completed" fill (approx.)	770	1,000
late '70s	England pit fill (approx.)	385	500
late '70s	"Private" pit fill (approx.)	155	200
early '82	Pit-run sand	1,540	2,000
9/94	"Buck shot" washed granules and cs. sand	460	600
TOTALS		**6,080**	**7,900**

Table 2. Estimated sediment budget.

SEDIMENT LOCATION/SINK	VOLUME (M^3)	VOLUME (CY)
Main Park Beach	3,290	4,400
North Beach (.75 x total vol.)	1,590	2,070
South Beach (.6 x total vol.)	420	540
Bar 1	170	220
Bar 2	120	150
Dredge Hole, Mud flat, Out of System	???	???
TOTALS	**5,590**	**7,260**

PUGET SOUND BEACH REPLENISHMENT

Hugh Shipman, Washington Department of Ecology

Introduction

Beach nourishment is regarded an effective technique for restoring beaches and protecting shorelines in many parts of the world. Beach nourishment has been widely used on the coast of southern California (Wiegel, 1994), but is generally not documented elsewhere on the west coast of the United States, with the exception of a project at Ediz Hook in Port Angeles, Washington (Galster and Schwartz, 1990). We have found, however, that numerous beach nourishment projects have occurred within Puget Sound, usually in the form of small gravel beaches.

The literature on beach nourishment has focused on sandy, open-ocean coasts where most of the large projects have occurred (Davison *et al.*, 1992). Smaller projects typical of estuarine systems are not well-documented (Nordstrom, 1992). In addition, there is little North American literature on gravel beach restoration and nourishment. Work on Puget Sound sites is confined to conference proceedings, engineering documents, and staff reports, and for many sites even this level of documentation is absent.

In this paper, we review the beach nourishment projects that have occurred in Puget Sound. Our intent is to raise awareness of these projects both inside and outside of our region, as well as to emphasize the similarity of the issues that affect these projects with beach nourishment projects described elsewhere.

Physical Setting of Puget Sound

Puget Sound (including the Strait of Juan de Fuca and the Georgia Strait) includes more than 2,000 miles of shoreline in a geologic region dominated by glacial sediments and glacially-derived topography. The diverse assemblage of shoreline types includes bedrock, shore bluffs of eroding glacial and interglacial sediment, several river deltas, and numerous spits and barrier beaches (Downing, 1983).

Puget Sound is subject to mixed semi-diurnal tides with a range that increases from less than three meters near the mouth of the Strait of Juan de Fuca to almost five meters in Olympia at the south end of the Sound. In most of Puget Sound, fetches are less than 10-20 kilometers and waves rarely exceed two meters in height. On the Strait of Juan de Fuca, fetches are greater and Pacific swell also influences wave conditions.

Beaches are best characterized as mixed sand and gravel, although local variations include sand, cobble, and exposed erosional platforms. The convoluted shoreline is broken into hundreds of discrete littoral cells, ranging from a few tens of meters to tens of kilometers in length (Schwartz *et al.*, 1989). Beach sediment is generally derived from local bluff erosion, although streams and rivers also provide beach sediment in some areas.

Shoreline land use, outside of the large ports, is predominantly single-family residential. Bulkheads are a favored method of erosion protection and are ubiquitous. Concerns about the cumulative impacts of shoreline armoring (Shipman and Canning, 1993) have led agencies to scrutinize applications for hard structures more carefully and to encourage non-structural solutions, including beach nourishment, for erosion problems.

Beach Replenishment in Puget Sound

We have identified almost thirty sites on Puget Sound where some form of beach replenishment has occurred. Most of these projects were built within the last twenty years, reflecting an increased awareness of local planners and the public of beach processes and shoreline environmental values. Interestingly, a large number of these projects were designed by a single consultant, Wolf Bauer, who has been a powerful regional advocate of progressive shoreline management.

The documentation of many of these projects is poor. Records are often unavailable or incomplete. Completed construction often varies significantly from the design drawings that typically survive in files. Post project surveys or monitoring are usually absent. Documentation, including the few published descriptions, describes the design process but often does not provide an analysis of project performance.

Summary of Issues

Sponsor

A majority of the projects occur in public parks where planners and designers wish to enhance recreational use of the beach, restore environmental conditions, and where there is greater willingness and flexibility to experiment with non-traditional shoreline treatments. Private projects are unusual.

Project scale

Projects range in size from pocket beaches less than 50 m in length to the cobble nourishment project at Ediz Hook, a spit over 5 km long. A majority of the projects were less than 200 m in length. Nourishment volumes range from about 1,000 to many tens of thousands of cubic meters, with most less than 5,000 cubic meters.

Physical setting

The projects have generally occurred in two geomorphologic settings. The first common setting is a barrier beach where updrift sediment loss has led to significant erosion. The second is a heavily modified shoreline characterized by eroding artificial fill. Few projects occur where erosion has not been accelerated by human actions.

Sediment size

Although several replenishment projects in the area used sand-size material, most have involved gravel and pebble (a typical specification might be for washed, 1/2 inch to 3 inch gravel, although this varies considerably between projects). Coarser material is used in higher energy settings or where other factors require a steep beach profile. Some projects have utilized different sizes of material in different portions of the project.

Gravel is used for several reasons: most natural Puget Sound beaches consist of gravel or mixed sand and gravel, appropriately-sized gravel tends to move onshore rather than offshore during storms, gravel forms a more stable beach and less material is lost downdrift, gravel reduces the adverse water quality impacts associated with placement of sand and finer sediment, and gravel allows a steeper beach profile to be maintained, reducing encroachment either upland or waterward.

Profile geometry

The natural elevation of the primary berm and the backshore on Puget Sound varies with local tidal range, but generally lies about 0.5 m above Mean Higher High Water (MHHW). Successful beach projects occur where the berm crest is matched well to local conditions. Problems have occurred where incorrect datums were used or where the importance of this design parameter was ignored. Where the crest is built too high, scarping occurs. Where the crest is too low, the protective value of the beach project is reduced, since waves frequently wash over the berm.

Concerns about biological impacts generally restrict the placement of material to the upper foreshore. This prevents direct impacts to benthic organisms and aquatic vegetation on the lower beach. It often requires a much steeper design profile, however, and therefore the use of substantially coarser gravel than may naturally occur on the site.

Backshore width is important to assure a stable beach, to allow the accumulation of drift logs and associated vegetation, and to provide a buffer against the short-term erosion associated with storm events, but it is often limited due to the limited space available between upland improvements and the more productive lower beach.

The slope of the gravel placement is often determined by the competing desires of the landowner to maximize utility of the upland and the resource manager to limit encroachment into intertidal areas. As a result, there is typically pressure to make the beach quite steep, regardless of physical constraints. Typical design profiles for the gravel replenishment projects are between 1:5 and 1:7 (compared to the upper foreshore on natural Puget Sound beaches which generally vary between 1:6 and 1:11).

Planform

For most sites, the configuration of the shoreline is pre-established and the volume of nourishment is sufficiently small to have little impact on the overall geometry of the site. In some cases, existing structures such as jetties or projecting fills have been used to define one or both ends of the project. At Seacrest Park in Seattle, small pocket beaches were carved out of a large industrial fill that was armored with riprap. The remaining riprap serves as a series of artificial headlands. In several projects, requirements for no-net-loss of intertidal habitat have resulted in project designs where small coves were created in one area to offset the waterward placement of beach fill in others.

Secondary structures

Most projects have been built without the use of additional groins or control structures, although in some cases existing structures were used. In some cases, structures were not deemed necessary whereas in other cases the additional cost or regulatory constraints discouraged their use. Shore perpendicular structures are tightly regulated, result in direct impacts to lower intertidal areas, and increase concerns about adverse offsite consequences.

Low rock groins (locally called drift sills) have been added in some cases as a means of controlling the beach profile and elevation and modifying the orientation of the beach. These structures are generally designed to be at grade, allowing continued movement of sediment, although often they become exposed with time.

Sediment source

Gravel for these projects is generally obtained from upland sources, although dredged material has been used in some sites. Barges were used to transport material in at least two of the larger sites, but in most cases, material was trucked to the project. On smaller projects, construction is often carried out by local public works crews.

Monitoring

Systematic or rigorous monitoring is rare. Even where monitoring has been a permit requirement, it is often not carried out effectively. The objective of monitoring is frequently ambiguous, responsibility for monitoring is unclear, and enforcement of provisions is nonexistent. Even if monitoring were carried out systematically, interpretation of results would be hampered by the poor understanding of geological and ecological processes on Puget Sound beaches and in particular, the natural variability (spatial and temporal) of such processes.

Evaluating the success of beach nourishment projects is difficult, largely because of disagreement about the relative importance of multiple objectives. As with nourishment projects elsewhere, even modest changes to the beach following storms are sometimes interpreted as failures by regulators or by the general public.

Renourishment

Renourishment has been carried out at several projects, though rarely as part of a scheduled replenishment program (the exception might be two projects for which dredging dictates the timing and availability of sediment). Most projects were one-time placements, though this may simply reflect the limited history of many of the sites. In some cases, the need for possible future nourishment was noted in the design, but additional material has not been added either because the original project remains healthy or simply because the proponent has not chosen to propose action.

Ecological considerations

As a result of their semi-protected, estuarine nature, Puget Sound beaches provide habitat for a wide variety of aquatic plants, fish, shellfish, and benthic microorganisms. Primary producers such as seagrass and algae concentrate in the lower intertidal and shallow subtidal. Shellfish live as high as the mid-tide level. Several species of fish spawn in sand and gravels on the uppermost beach. Anadromous fish routinely use the shallow nearshore area for migratory passage, feeding, and avoiding larger predators.

Beach nourishment leads to short-term ecological impacts, such as direct burial of habitat, increased turbidity and fine sedimentation, and modifications to beach substrate. Secondary structures such as groins are particularly problematic. Longer term impacts include changes to local substrate, stability regime of bottom sediment, and localized topography and bathymetry that may change the distribution or character of specific habitats.

Policies and regulations

Beach projects are regulated under several authorities, most notably the state's Hydraulic Project Approval (HPA) process and local Shoreline Master Programs, developed under the state's Shoreline Management Act (SMA). The HPA strictly restricts impacts on fish life and may require no-net-loss of intertidal habitat area, prohibit structures below the high water line, and constrain the timing and method of construction. Shoreline Master Programs vary between jurisdictions, but greatly restrict beach fills and shore-perpendicular structures. In some communities, no distinction is made between fills for creating upland and beach nourishment, and therefore replenishment is difficult, if not impossible. In others, beach nourishment is encouraged through specific language.

Conclusions

We identified almost 30 beach replenishment projects in Puget Sound, most of which involved the placement of relatively small volumes of gravel to restore shorelines adversely impacted by chronic erosion. Although they differ significantly from beach nourishment efforts on sandy, open-ocean coasts, we found that they share many of the same design issues and apparently, many of the same regulatory and political issues.

Ironically, while biological and regulatory concerns about shoreline hardening and maintaining beach processes are driving much of the interest in these projects, these same concerns may significantly limit the design options and viability of beach replenishment. We expect that as concerns about the adverse impacts of hard structures increases and as regulators learn more about beach processes, beach replenishment may become more common. We also expect that the current dominant application, in shoreline parks, will broaden to include more applications on private sites, most likely in small beach communities where chronic erosion is forcing consideration of expensive bulkhead or riprap installations.

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Hugh Shipman
Washington Department of Ecology
Shorelands and Water Resources Program
Northwest Regional Office
3190 - 160th Ave SE
Bellevue, WA, USA 98008-5452

Ph (206) 649-7095
Fax (206) 649-7098
Email hshi461@ecy.wa.gov

CUMULATIVE ENVIRONMENTAL CHANGE: A COASTAL CONTEXT

A. O. Gabriel, Department of Geography
University of Wisconsin-Oshkosh and
T.A. Terich, Center for Geography and
Environmental Social Sciences, Western
Washington University

Introduction

Environmental managers are becoming increasingly aware that many serious environmental problems are created by the cumulative nature of impacts from human development activities, including habitat fragmentation, climate change, and degradation of water quality through nonpoint source pollution (Orians, 1995). Such examples of cumulative environmental change are characterized by broad temporal and spatial dimensions, often transcending the scales normally used for planning and policy making. A number of authors have attempted to summarize the wide array of terms and definitions used to describe cumulative environmental change (*e.g.*, Spaling and Smit, 1993), while yet others have examined the methodological shortcomings impeding the assessment of cumulative environmental change (*e.g.*, Stakhiv, 1988). These individual efforts have indicated the inadequacies of conventional environmental impact assessment approaches, which are generally limited to considering single stresses, simple cause-effect relationships, and first order impacts, and limited spatial scopes. Little consideration is given to cumulative effects resulting from multiple stressors, complex causation, indirect impacts, synergistic relationships, time lags, and extended spatial boundaries.

While theoretical and conceptual discussions abound, there has been relatively little concrete application of the growing body of theory. Common concerns regarding the lack of cumulative impact assessment have included complaints of the absence of practical methodologies as well as limited scientific knowledge about causes and effects. The few attempts at developing cumulative assessment methodologies have tended to emphasize biotic systems such as wetlands and forests (*e.g.*, Preston and Bedford, 1988), with little consideration of the geomorphic environment that is often the critical land base for these ecological systems.

One area that has been increasingly identified as being particularly appropriate for cumulative impact assessment is the coastal zone. For example, the U.S. Federal Coastal Zone Act Reauthorization Amendments of 1990 require the development and adoption of procedures to assess, consider and control cumulative and secondary impacts of coastal growth and development, including the collective effect on various individual uses or activities on coastal resources. In response, NOAA recently published Methodologies and Mechanisms for Management of Cumulative Coastal Environmental Impacts (Vestal *et al.*, 1995). In a more regional example, a 1991 survey of 200 coastal managers in Washington State identified addressing cumulative and secondary effects of growth as a high priority issue, with coastal erosion along the Puget Sound being one of the leading concerns (Canning and Shipman, 1993).

Coastal managers in Washington State are particularly concerned about the adverse impacts of shoreline armoring on sediment supply and transport along the Puget Sound, Washington State's inland coast. This region contains approximately 3000 km of coastline, most of which consists of bluff shorelines comprised of poorly consolidated glacial sediments (Downing, 1983). These bluffs are the principal source of sediment for Puget Sound beaches, as well as small accretion landforms (Shipman and Canning, 1993). Reducing bluff recession rates or restricting net sediment transport through shore protection leads to sediment starvation, steeper nearshore profiles, narrower beaches, and increased erosion downdrift (MacDonald *et al.*, 1994). Many shoreline property owners react to incidents of erosion by erecting such erosion control structures. This is particularly evident along the Puget Sound, where the predominant land use is low-density housing often located on top of bluffs protected by some form of shoreline protection (usually concrete bulkheads and rip rap) (Shipman and Canning, 1993).

In response to these concerns, the Washington State Legislature passed Engrossed Senate Bill 6128, which amends the Shoreline Management Act to require county governments to have erosion management standards in their Shoreline Management Programs (Canning and Shipman, 1993). These standards must address both structural (*e.g.*, seawalls) and nonstructural (*e.g.*, shoreline setbacks) methods of erosion management, while preference for permitting erosion protection measures is to be given to those "designed to minimize harm to the shoreline's natural environment."

In an effort to aid this new approach to coastal erosion management, the Washington Department of Ecology's Shorelands and Coastal Zone Management Program initiated a three year (1992-95) Coastal Erosion Management Strategy (CEMS) (Canning and Shipman, 1993). Part of the tasks of this study were to begin to characterize shoreline armoring trends, as well as develop assessment techniques focusing on the cumulative effects of shoreline armoring on physical and ecological systems. The efforts of the CEMS have resulted in several volumes of studies outlining general shoreline armoring effects on physical coastal processes and coastal ecology (*e.g.*, McDonald *et al.*, 1994; Terich *et al.*, 1994; Thom *et al.*, 1994), as well as the various engineering and alternative approaches to erosion management (Cox *et al.*, 1994; McCabe and Wellman, 1994).

To date, no comprehensive examination of the cumulative impacts of shoreline armoring has been completed on specific sites in the Puget Sound Lowland, while little quantitative data exists to demonstrate the relationship between armoring and its potential consequences. Determining the relationship between seawall installation patterns, and how these relate to shoreline characteristics and coastal processes, could aid in understanding what causes beach erosion at adjacent, unprotected sites. There is an obvious need for a methodological framework for analyzing the cumulative environmental change of coastal erosion, as well as a case study application.

Coastal Cumulative Change Typology

Cumulative environmental change and cumulative effects are often used interchangeably to refer to the phenomenon of temporal and spatial accumulation of change in environmental systems in an incremental or interactive manner. Spaling and Smit (1993) note that frameworks of cumulative environmental change are based on general models of causality focusing on three components: 1) source of change; 2) process of change; and 3) the effects. This general model of causality can be further conceptualized as a stress-response framework. Like other stress-response frameworks, conceptual frameworks of cumulative environmental change focus on the type of stress, the structure and processes of the system being impacted, and system response. For example, Cocklin *et al.* (1992) differentiate between sources of cumulative change (*i.e.*, stress types), pathways of accumulation (*i.e.*, process), and impact accumulation (*i.e.*, system response).

The typological distinctions developed by various authors (*e.g.*, Peterson *et al.*, 1987; Sonntag *et al.*, 1987; Cocklin *et al.* 1992) are helpful in describing and distinguishing cumulative impacts on coastal geomorphic systems. Sources of change are typically distinguished on the basis of activity types (single/multiple), spatial dimensions (site, regional, global), and temporal dimensions (short/long term). Cumulative change processes (*i.e.*, pathways of accumulation) are similarly distinguished on the basis of types (additive, aggregative, and indirect) and dimensions (spatial and temporal loading). Additive processes, resulting from single activities may be either incremental (*i.e.*, nibbling), where small additions are made to or deleted from a fixed large storage, or compounding, where each addition has a larger effect than the previous unit. Aggregative processes, resulting from multiple activities, may also be incremental or interactive. Indirect processes result from stresses that set up chain of events that produce responses delayed in time or space (*i.e.*, lack of continuity).

There is a general consensus among researchers that the process of cumulative environmental change can be further characterized on the basis of temporal and spatial dimensions. Spatial loading occurs when the space between stresses is smaller than that required for stress removal or dispersal. This loading can vary in scale, density, and configuration. Temporal accumulation occurs when the interval between stresses is less than the time required for system recovery, and may occur at rates that are continuous, periodic or irregular, long or short-term. These attributes of spatial loading and temporal accumulation are highly dependent.

Lastly, cumulative environmental change may be described according to the type of system response (*i.e.*, accumulative impact). Generally, distinctions are made between linear and nonlinear responses. Linear response is characterized by incremental additions or deletions from a fixed storage along a linear cause-effect relationship. For example, the impact of 100 bulkheads may be equal to 100 times the impact of a single bulkhead (Shipman and Canning, 1993). Nonlinear responses may be either synergistic, logarithmic, or discontinuous (*i.e.*, threshold response). Synergistic responses occur when the total effect of an interaction between two or more processes is greater than the sum of the effects of each individual process. Logarithmic (*i.e.*, exponential) responses occur when incremental additions of stress causing larger effects than earlier additions. Threshold (*i.e.*, discontinuous) responses occur when incremental additions have no apparent effect until crossing threshold boundaries, leading to abrupt to catastrophic changes. Such a cumulative change response includes structural surprises, when the impacts of abrupt, local stresses due to multiple developments are exaggerated by gradual changes in system resiliency, causing long-term changes in future stress-response.

The type of cumulative change response may depend on the type of drift cell and the location of the stress. For example, there may be threshold levels of bulkheading below which the impacts are minor, but above which the impacts are dramatically greater. Thus bulkheading a feeder bluff may result in the breach of a sandy barrier, though the effects of bulkheading may take a while to be felt in the downdrift sink. A much different response might be found within a littoral cell where the entire shoreline has significant potential for contributing sediment. Thus, the elimination of sediment contributions on one part of the shoreline may be readily compensated by minute increases in downdrift erosion.

A number of authors have discussed the conceptual challenges of assessing cumulative environmental change such as spatial and temporal bounding, system response complexities, and threshold issues (*e.g.*, Cocklin *et al.*, 1992). Similar challenges are evident when trying to describe and analyze cumulative environmental change in the coastal zone. In terms of spatial bounding, it is generally accepted that cumulative impacts are usually more evident at a landscape levels. Cocklin *et al.* (1992) have noted that such bounding may be done on the basis of administrative boundaries, ecological/physical characteristics, human activity patterns, or a combination thereof. Spatial bounding may be easier in terms of examining cumulative change of a drift cell, as it is more of a closed system from source to sink, and geomorphic responses may be expected to be spatially linear (*i.e.*, evident downdrift). However, spatial variability in upland characteristics (*e.g.*, slope stability, land use, etc.) may disrupt this linear response.

Temporal bounding may be more problematic. Much coastal bluff erosion is the result of large-scale, low-frequency (*i.e.*, episodic events). Thus cumulative impacts may lie dormant until a big storm hits. Highly episodic erosion rates are particularly true of the Puget Sound shoreline, where even rapidly eroding bluffs remain stable for years and even decades prior to a slope failure, which in turn may provide a large pulse of sediment to help repair down-drift beach/sink (Shipman and Canning, 1993). Average recession rates of feeder bluffs are 10 cm/yr., though annual rates may be much higher during episodic landslide events. Furthermore, complex cumulative effects may not occur for extended periods of time and at locations far downdrift (*i.e.*, the sink). The problem of temporal bounding is further linked to the issue of isolating cause-effect relationships. Erosion rates of the bluffs, as well as the beaches, depend on primarily four factors: wave environment, geology, beach characteristics, and human factors such as development and shore protection (Terich *et al.*, 1994). It may be difficult to isolate specific human activity effects from natural stresses, especially when there are multiple stresses affecting the same system components (*e.g.*, attempting to isolate the effect of bulkheads from storm activity, as each stress has similar effects).

In order to assess cumulative environmental change on the Puget Sound, it is obvious that coastal managers need to have a better understanding of system structure, processes and responses to stresses. As this understanding is partly hampered by a lack of long-term data, part of the solution lies in establishing long-term monitoring programs to establish base-line conditions as well as recognize existing stress-response relationships. The longer the period, the more likely episodic events are captured as well. In addition, a methodology needs to be developed to distinguish between different types of cumulative environmental change, and the causes.

Development of a Case Study Application

This case study will develop and apply analytical techniques to measure possible cumulative impacts by describing and analyzing spatial patterns and controls of bulkhead construction on Puget Sound Lowland shores. This case study will provide coastal managers with background information about actions and processes that are likely to influence cumulative coastal impacts. The case study will synthesize a number of cumulative change principles and existing theoretical frameworks to develop a methodology that identifies the pattern of cumulative impacts of seawall installation, initially differentiating between sequential, clustered, or random patterns. Attempts will be made to explain the pattern of coastal armoring by analyzing differences in a variety of relevant drift cell factors, including direction of nearshore sediment transport, slope stability, vegetative cover, and property-owner motives.

Three potential study sites have been chosen for applying the analytical framework developed by this research. The criteria used to choose potential sites are dependent on two main factors: 1) sites that are complete drift cells representative of Puget Sound geomorphic conditions and land uses; as well as 2) availability of the baseline data required to apply the cumulative impact assessment methodology.

Locations and construction dates of seawalls will be collected on a land parcel basis by accessing a variety of permit records from state and county permit records. As the quality of this information will differ from county to county, aerial photographs will be used to augment the permit information. Use of aerial photographs from several time periods will help determine the location and approximate installation of bulkheads for years missing in the permit records.

In addition, on-site survey information will be gathered for each protected property along the drift cell, including the type of shore protection used, and general backshore conditions (*e.g.*, land use, vegetative cover, evidence of slope failure, etc.) Slope stability information will be augmented using the Coastal Zone Atlas of Washington and county records, while net-shore sediment transport information will be obtained from Washington Department of Ecology (Schwartz *et al.*, 1991). Shoreline property owners along each drift cell will also be surveyed by a mail questionnaire to provide additional information regarding the type and years of seawall installation, as well as the primary motivating factors (*e.g.*, experience of erosion/instability, extension of property, aesthetics, pressure by overzealous contractors or neighbors, etc.).

Dates of installation, as well the direction and distance of protected sites relative to the first protected site within each drift cell will be analyzed using a Spearman Rank correlation coefficient. The spatial and temporal patterns that are revealed are to be classified as sequential, clustered, or random. It is expected that drift cells showing a sequential, downdrift pattern of seawall installation (*i.e.*, high correlation coefficients) may reflect a cumulative loss of sediment to downdrift areas due to increased shore protection. Conversely, random patterns will have very low correlation coefficients, while clustered patterns are expected to have moderate coefficient values. Both sequential and non-sequential patterns will be analyzed relative to the on-site survey information, including general backshore characteristics, and various property-owner motives. The on-site survey information will also be statistically analyzed in order to determine similarities or differences in property characteristics and response patterns between property owners as well as study sites.

A. O. Gabriel
University of Wisconsin-Oshkosh
Department of Geography
800 Algoma Boulevard
Oshkosh, WI, USA 54901-8625

Ph (414) 424-7114
Fax (414) 424-0292
Email gabriel@vaxa.cis.uwosh.edu

ACOUSTIC THERMOMETRY OF OCEAN CLIMATE: A CASE STUDY IN THE EFFECT OF POLITICAL PRESSURES ON SCIENCE

Forsyth P. Kineon, University of Washington

One of the more controversial issues in the environmental community involves anthropogenic sound in the ocean. Sources of anthropogenic sound include: sonar, vessel traffic, seismic exploration, pile driving, military experiments and non-military experiments such as acoustic tomography. Sounds produced by these sources are controversial because there are little data to determine impacts to marine organisms. Regardless of this meager data base, research is hindered by a lack of funding, the general difficulty of studying marine organisms, and the restrictive nature of some United States legislation (*e.g.* ESA and MMPA). Some sources of anthropogenic sound are restricted by statute. The dearth of data, coupled with the lack of an avenue to obtain further information, and regulatory inequity, exemplify the contradictory policies surrounding man-made sources of sound.

Anthropogenic sound in the marine environment has come into the public arena due to a heightened awareness of marine activities and their effects. In 1990, a feasibility test designed to determine whether sound signals could be detected over great distances was announced. This experiment, referred to as the Heard Island Feasibility Test (HIFT), occurred off a remote island in the southern ocean. Some marine mammal experts and special interests, including Greenpeace, raised objections to this experiment where sound would be projected loudly enough presumably to be heard half way around the world. However, since the experiment was taking place a great distance from the United States and the newspapers did not carry the story until the experiment was in progress, there was little public comment on the Heard Island experiment.

A more recent focus of attention on anthropogenic sound involves the Acoustic Thermometry of Ocean Climate (ATOC) experiment, conceived by the same group of principal investigators involved in the Heard Island study. ATOC is a two-year test aimed at establishing the feasibility of measuring temperature change in the oceans to verify current climate change models. Because the signal must travel through thousands of kilometers of ocean to meet the design criteria of the experiment of accounting for local variations in temperature, it was essential that the sound produced be loud enough to serve this requirement. The intensity of the sound, the project description, and the proximity of the California and Hawaii locations to formally designated marine sanctuaries, have caused the present controversy that surrounds not only the validity of the experiment, but also the potential harm to marine fauna.

Beneath the principle of ATOC lies the relatively newly introduced science of acoustic tomography (AT), in which low-frequency sound waves projected over long distances are used to measure variations in the physical properties of the oceans. ATOC will use AT as a powerful tool for studying global climate change. Although such research offers the prospect of better understanding this critical environmental issue, AT has raised a new set of concerns about the effect of human-generated sound on marine animals. Environmentalists have challenged proposed AT experiments, arguing that they pose a threat to whales and other marine mammals. AT researchers have responded that there is no evidence that AT is harmful, and that there are many other natural and human sources of high-energy, low-frequency sound in the marine environment that have not aroused such concerns. Government agencies that are responsible for approving permits to conduct AT experiments are hampered by a dearth of data concerning the effects of such sound on marine animals. Finally, all parties to the controversy are hindered by the lack of a coherent policy framework for evaluating the environmental impacts of AT research. The current case-by-case approach to permitting AT experiments has produced continual challenges in which the same issues are raised, but left unresolved. A growing public discontent has lead to criticism beginning to spread to all forms of anthropogenic sound in the ocean. As controversy increases, the need to create a coherent and equitable policy surrounding anthropogenic ocean sound becomes evident.

The impetus behind this study is the author's experience compiling the Environmental Assessment for HIFT, and participating as a marine mammal observer on the experiment. The politics, misunderstandings of the science, and controversial scientific hypotheses involved with both HIFT, and later intensified through ATOC, prompted my desire to facilitate a more fundamental understanding and structured set of policies in which to explore the ocean realm by means of sound.

This paper seeks to define the controversy surrounding the ATOC experiment as an example of human-generated sound in the ocean and stake holder interactions. This case analysis is instructive because the ATOC study provides an example of the effects of public controversy on a scientific experiment. The first chapter lays the context by describing human-generated sound in the ocean, reviewing the history of sound research in the marine environment, reviewing research results on the effects of sound on marine animals, providing an overview of the applicable environmental laws, and describing the case study, ATOC. The second chapter discusses ramifications of the controversy that surround the study by briefly describing the precursor, Heard Island, addressing why ATOC is so controversial, and the harm this experiment has caused to the individuals involved and society as a whole. Chapter Three examines the causal factors that led to the emerging controversies. Chapter Four consists of a policy analysis focused on decisions made surrounding ATOC, includes alternative solutions, and through criteria, suggests the best plan to follow. Recommendations for avoiding future conflicts will be presented in Chapter Four. This final chapter will advance analysis of contrasting options through specified criteria.

Many are concerned about the health of the ocean and want to learn more about how it functions. Subsequently, there are many stakeholders in the ATOC experiment. Scientists have interests via their discipline. Physical oceanographers are concerned with how sound travels through the oceans. Behaviorists who study marine mammals are interested in what type of response or potential physical damage these projections of sound will create. Fishery biologists and fishermen are interested in the effects of anthropogenic sound on fish. Climatologists are concerned with the question of global warming and what can be learned from sound regarding global warming. The environmental groups want the ocean and its flora and fauna to be preserved for future generations, and are proponents of responsible management of the resources towards that end. Government agencies want already instituted laws to be followed. Finally there is the Strategic Environmental Research Defense Program (SERDP) that funds ATOC. SERDP is a program established by Congress that mandates the Department of Defense to spend money on environmentally relevant issues.[3] Global warming is one of the main interests of SERDP, which administers Department of Defense funds through the Advanced Research Projects Agency.

Conclusions reached through this analysis were derived from current literature, and interviews with many professionals in the marine mammal research realm, environmental organizations, physical oceanographers, acousticians, policy specialists, and academicians. I hope that the broader perspective implicit in this thesis will be considered with necessary future policy surrounding all anthropogenic sound in the ocean. With over fifty years of research and an enhanced effort to understand ocean noise in the past five years[4], it is time to lay the foundations for such a policy.

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[3] Dan Costa, California ATOC Marine Mammal Research Program leader, e-mail message, March 1994

[4]Bob Gisiner, Office of Navel Research, Arlington, VA, personal communication, May, 1995

Forsyth P. Kineon
University of Washington
School of Marine Affairs
3707 Brooklyn Ave., NE
Seattle, WA, USA 98195

Ph (206) 726-9309
Fax (206) 526-6615
Email forsythk@u.washington.edu

THE SAANICH INLET STUDY: SCIENCE BASED DECISION-MAKING MEETS THE PUBLIC

Robert C.H. Wilson,
Department of Fisheries and Oceans, B.C. and
Laurie MacBride, Georgia Strait Alliance, B.C.

Why Was the Saanich Inlet Study Done?

Saanich Inlet is a 28 km long, glacially-formed fjord on the southeast coast of Vancouver Island (Figure 1). Like many inlets in British Columbia (BC), it has a relatively shallow (~75 m) sill at the mouth partially closing off a deeper (~225 m) central basin. The absence of a significant river near the head of the Inlet leads to weak estuarine circulation, and much of the water below the sill depth is naturally anoxic. Despite being close to the city of Victoria, large parts of the shoreline are undeveloped, allowing area residents and tourists to appreciate the natural beauty and "wilderness" feel of the Inlet.

The population of southeast Vancouver Island is growing annually at about 2%. In 1993 the Cowichan Valley Regional District (CVRD) sought to amend local zoning to allow development of a new town of up to 12,500 people at Bamberton (site of a disused cement plant adjacent to the Inlet). The proposal was controversial, and when it was referred to the province, the Minister of Municipal Affairs required three things before the development could proceed: an environmental review of the proposal under BC's new Environmental Assessment legislation; a comprehensive examination of the environmental sensitivity of Saanich Inlet to development; and significant progress on a regional growth management strategy. The latter two were undertaken to provide baseline information for the Bamberton environmental review process (and by extension, for other future land-use decisions around the Inlet). SIS will be completed by late spring of 1996, while the other two processes are still underway.

The Saanich Inlet Study (SIS) was announced in July 1994 and carried out over the next two years. It did not address the town-site proposal directly. Instead, it took a broader view, asking the question: What is the capacity of the Inlet to assimilate contaminants and marine habitat disturbances from urban and rural development without environmental degradation? Yet throughout the study, the Bamberton issue was clearly one of the main driving forces for many of the participants.

Involving the Community - A Multi-Stakeholder Process

Responsibility for SIS was assigned to the BC Ministry of Environment, Lands and Parks (MELP), which established a process of significant public involvement from the start. An Advisory Committee (AC) was appointed, made up of approximately 30 members from non-governmental organizations (including environmental, residents, salmon enhancement and recreational anglers associations), and representatives from each of the First Nations communities and local governments around the Inlet. The AC's job was to provide input and concerns, review and comment on the study's process and findings, and advise on how best to ensure public involvement. In addition, wider public input was sought through four open houses, survey forms distributed at the open houses, and newsletters.

Operating in parallel was the Technical Committee (TC), made up of about 15 scientists from government and universities. The TC's role was to assist with the study design and coordinate related research and studies. AC meetings were usually attended by several TC members and there was considerable exchange between the two committees.

MELP contracted consultants to carry out further studies and write several reports, including one that synthesized the study findings. All eight reports were carefully scrutinized by the TC and AC. Although both committees were purely advisory, MELP was careful to allow an open dialogue and worked hard to incorporate their concerns and recommendations into the various reports. SIS marked the first time in BC that an environmental study had been carried out in this manner.

An important component of SIS was the inclusion of a separate First Nations consultation in addition to involvement in the AC. A consultant was hired to work with the six aboriginal communities and to examine existing archaeological and archival records in order to identify and report on historical and traditional uses of the Inlet, current concerns and values.

Technical Studies

The TC began with a workshop to review existing knowledge. With its unusual environmental features, a major federal government oceanographic institute located on one shore and three universities close by, Saanich Inlet was already one of the most intensively studied bodies of water on the BC coast. The TC's next step was to suggest ways in which scientific knowledge could help answer the question about assimilative capacity and sensitivity. New technical studies had to be completed within 16 months to meet the government's schedule. An overall approach was decided, data gaps were evaluated, and several studies were set in motion to acquire missing information:

1. winter surface currents
2. water quality and criteria for the protection of different uses
3. summer surface currents
4. coliform contamination along the shore and offshore
5. potentially sensitive organisms in the intertidal and subtidal zones

A series of models was developed or adapted to the Inlet:

1. oceanographic box model of water circulation
2. model of nutrient and plankton dynamics
3. sediment transport model
4. ecosystem model of contaminants in sediment and marine life
5. effluent plume model

These models were used to test the sensitivity of the Inlet to altered inputs of water, nutrients and contaminants.

Decision Making with Confidence?

One of the goals of SIS was to assess assimilative capacity. MELP defined assimilative capacity in terms that included dilution, inactivation processes, metabolism and breakdown. The two committees broadened this definition to reflect an ecosystem approach focused on water and sediment contaminants, nutrient enrichment, sensitive biota, critical habitat, public values, and First Nations values. The committees also advised that terrestrial impacts throughout the watershed required consideration in this approach.

Despite there being only one licensed point source discharge to the whole Inlet (a private sewage treatment system of under 105 m^3d^{-1}), the TC quickly established that assimilative capacity had already been exceeded in several ways. Agricultural practices and faulty septic systems had contaminated nearshore water, leading to closure of 12 out of 15 of the inlet's shellfish harvesting areas. Concentrations of some contaminants in sediment in embayments exceeded environmental quality objectives. The extent of eelgrass beds in the subtidal zone had declined compared to historical distribution, and the abundance of several species of fish had decreased. The TC concluded that some of these changes had local causes while others were linked to events outside Saanich Inlet.

The hydrodynamic box model was the foundation for both a contaminants model and a nutrient and plankton dynamics model. A box model was chosen to simulate water circulation partly because it could be supported by existing data and partly because it could be developed within the project budget. In retrospect a three dimensional model would have been better, because the assumption of classical estuarine circulation built into the box model was not supported by one-third of the available data sets.

Running the models highlighted other weakness in the data. The main success was the nutrient and plankton dynamics model, which was seen by most TC members to be the critical component of the study. The hypothesis being tested with the nutrient model was that additional nutrient loading would lead to blooms of macrozooplankton and decreased dissolved oxygen concentrations in the surface layer. This model demonstrated that a significant lowering of dissolved oxygen concentrations was not likely to take place with additional nutrient discharge, and that a model effluent from a town of 13,000 people discharged 50-70m below the surface was unlikely to cause eutrophication. Data coverage for the sediment input functions was weak, however, which increased the margin of error for the fate of particle-reactive substances in the contaminants ecosystem model. Another problem lay in development of the models proceeding at the same time that data gaps were being filled. Some of the new data created scientific knowledge that could not be incorporated into the models before the study ended.

In general, while members of the TC were satisfied that assimilative capacity remained for nutrients discharged at a depth below 50m, the TC was unsuccessful in quantifying the ranges of probability that various model outcomes would accurately reflect future conditions.

A Questioning Future

Open Houses conducted in the first few months of SIS had been extremely well-attended and provided a strong indication of public values and concerns. Citizens value the Inlet highly for its natural beauty, plant and animal life, recreational opportunities and cultural and spiritual qualities. The majority of people see the Inlet as threatened and already degraded by residential development, loss of plant and animal life, loss of fishing opportunities, and a decrease in water quality evidenced by shellfish harvesting closures, seepage from septic systems and red tides. The vast majority of respondents to the Open House questionnaire called for protecting the Inlet through park designation, restricting further development, and improving water quality.

The scientific models used in SIS were developed around conservative or worst case assumptions, a feature more easily accepted by TC than AC members. Some AC members had been skeptical about the process from the beginning because they perceived that local governments would be unwilling to abide by whatever recommendations came from SIS. When lack of certainty in the scientific advice from the TC was added to the mix, it contributed to growing cynicism within the AC.

In the final stages of the process, AC meetings - previously relatively quiet affairs - became lively, occasionally even stormy, with members pushing for stronger conclusions and recommendations that would emphasize that assimilative capacity had been reached for many criteria and that the Inlet did not appear to be able to tolerate much additional human stress without environmental degradation. Several unscheduled meetings were called to deal with the concerns and to propose revisions to the draft findings and recommendations.

SIS's chairperson (from MELP) was always encouraging and mindful of public process. He handled these sessions calmly, stating that he was glad things were not going so well. "The SIS has from the beginning been about making tough choices," he said, "and if this were going well right now it would mean there would be no tough choices to make." As a result of the discussion, MELP staff went back through all the component SIS reports to incorporate AC concerns into the conclusions and recommendations wherever evidence could be found to justify them.

Sewage discharge proved to be the most contentious area. BC public interest groups feel that they lack a range of effective tools to fight major development proposals and have tended to use the sewage issue as a rallying point for environmental concerns, since any new point-source discharge requires a permit from the provincial government. Thus the issue of how to evaluate and describe potential impacts of added sewage effluent on the Inlet became a lightning rod for AC members worried about future development and the possibility of Bamberton's approval. An unwritten moratorium on new point source discharges to Saanich Inlet has been in place over the past few decades, and some AC members were concerned that allowing even one more permitted discharge to the Inlet would open a floodgate of applications whose consequent approval would degrade the Inlet still further.

While AC members were generally willing to buy in to conclusions from the scientific studies, they insisted that the conclusions and recommendations be stated in language that did not compromise their ability to fight future development, including the Bamberton proposal. Some felt that including any consideration of impacts of an additional outfall was dangerous in that developers and the media could distort the findings to say that no harm would result. Others cautioned that pushing for a ban on new point source discharges might be self-defeating, since virtually all of the current pollution in the Inlet came from non-point sources; thus a sewage treatment plant and outfall might prove useful for remediation. Therefore clear, unambiguous wording that could not be taken out of context became paramount to the

AC, which sent the final report's draft conclusions back for a re-write several times.

Conflict Continues

At the time of writing SIS's outcome is still not clear. The last stages of the project (final conclusions and recommendations, wrap-up open houses and AC public response report) are not complete. Nevertheless, in a general sense, we believe that SIS has met the objective of providing a science-based examination of assimilative capacity and a toolbox for analyzing the impacts of future development. In addition, by making a serious effort to gather and incorporate qualitative data that is difficult to "measure" in a traditional scientific sense (*e.g.*, native and non-native uses and values of the Inlet), SIS has succeeded in going well beyond the bounds of traditional environmental assessment models and has attempted to grapple with critical issues of public perception and social values - issues that will plague any public policy maker who relies on objective environmental assessment to provide justification for a difficult decision.

Meaningful aboriginal participation in processes such as this will remain a challenge in BC. One of the native leaders involved in the AC described his people as "reluctant participants" who would be unable to convince scientists of the changes they had seen over their many years of living on the Inlet - that "the bay is dead, the herring are not coming back, the forests above the Inlet are being logged off, the fish are gone, the birds that used to feed on what's there are gone." Having watched the tribes in Saanich Inlet lose their economic base and cultural traditions, he was skeptical that he could convince scientists and government officials to write a document that could not be easily exploited by developers looking for "weak paper." Yet to a much greater degree than we have seen in any previous public process, he and other aboriginal leaders were respectfully listened to and their input was incorporated wherever possible. This was made possible by several factors: SIS's terms of reference and framework which deliberately integrated human values as a key element from the start; the chairperson's skill and careful attention to fairness and public process; the consistent presence of aboriginal representatives at AC meetings; and a genuine openness on the part of the members of both committees.

However, from a scientific perspective, there are still important data gaps in SIS, and a wider problem remains: modelers are not able to quantify uncertainty, both in predictions and in the models themselves, and this leads to their inability to describe their results in a way that is convincing to the public. Yet incomplete data must be taken as the rule in assessments of this nature. Any steps that can be taken, therefore, to increase and improve the dialogue, trust and understanding between scientists and the public can only help to develop better public policy decision-making processes.

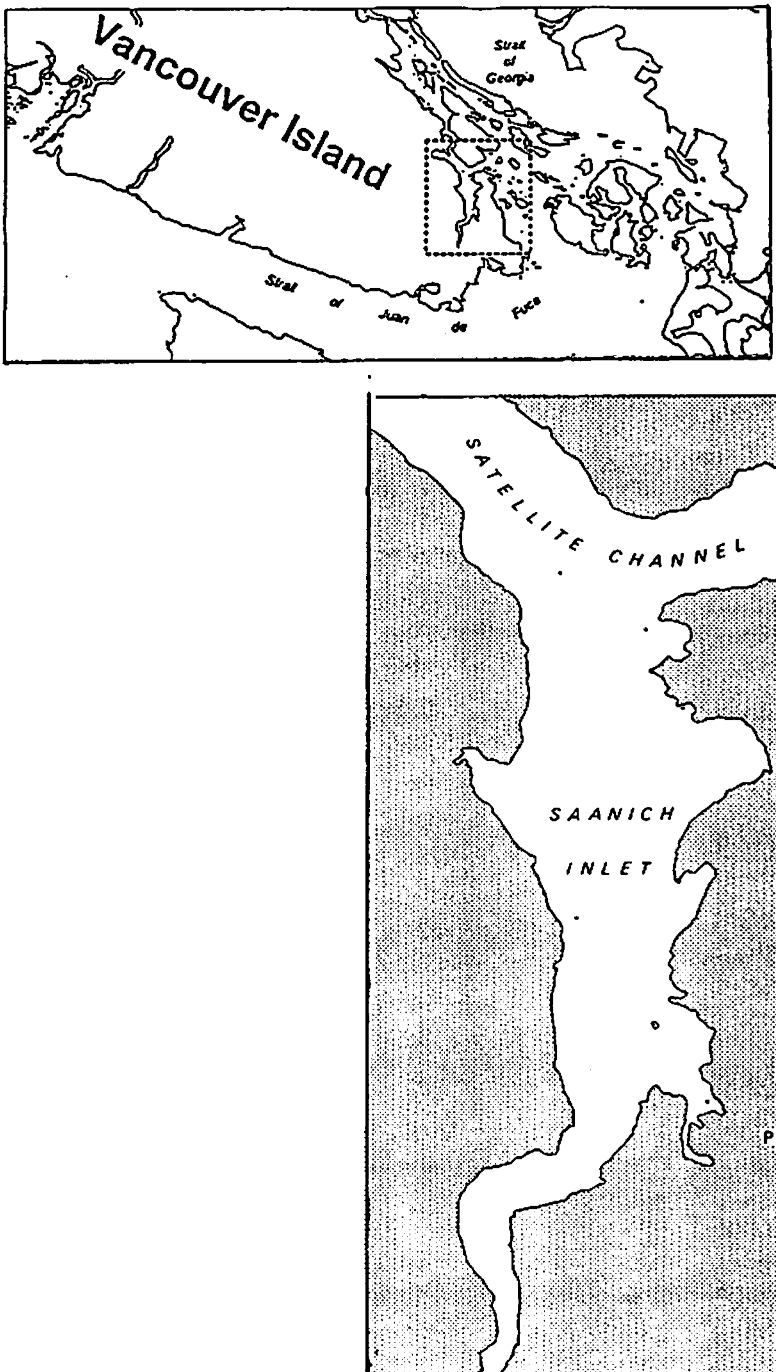
Given the limited number of publicly accessible tools for protecting coastal areas from unwanted development, the issue of point source pollution and approval and siting of outfalls will remain a focus of attention. Any future development proposal for the lands around Saanich Inlet will have to deal with this issue, particularly since traditional septic systems, which lack any monitoring or enforcement requirements, are clearly failing in many coastal areas. Whether innovative sewage treatment technology will be enough to win over a public that is feeling squeezed by rapid growth is questionable, since effective new technology for dealing with human waste might actually pave the way for increased development by enabling areas unsuitable for septic fields to be developed.

Overall, SIS has been a worthwhile exercise in seeking resolution of a difficult public policy issue by drawing on both objective science and the more subjective realms of social values. While it is still too early to assess the final outcome of the process and to know how or when policy-makers might implement any of its recommendations, we believe that SIS has nevertheless provided enough valuable tools and lessons to make it a model worthy of consideration in other coastal management conflicts.

Robert C.H. Wilson
Department of Fisheries and Oceans
PO Box 6000
Sidney, BC, Canada V8L 4B2

Ph (604) 363-6335
Fax (604) 363-6479
Email wilson@ios.bc.ca

Figure 1: Location of the Saanich Inlet Study



Session G3: NOAA's Multiple Use Balancing Act: Protecting Resources While Ensuring Public Access in the National Marine Sanctuaries
Session Chair: Helen Golde, NOAA/National Ocean Service

SPECIAL PANEL – NOAA'S MULTIPLE USE BALANCING ACT: PROTECTING RESOURCES WHILE ENSURING PUBLIC ACCESS IN THE NATIONAL MARINE SANCTUARIES

NOAA/National Ocean Service

Introduction

Charles M. Wahle, NOAA/National Ocean Service

A brief summary of the goals, authorities and structure of the National Marine Sanctuary Program will be presented, highlighting some unique management challenges posed by NOAA's statutory mandate for facilitating multiple compatible uses while ensuring long-term resource protection.

SCIENCE IN THE SANCTUARIES: PROMOTING RESEARCH WHILE MINIMIZING IMPACTS

Charles M. Wahle, NOAA/National Ocean Service
Helen M. Golde, NOAA/National Ocean Service
Dwight D. Trueblood, NOAA/National Ocean Service

Science, both research and monitoring, plays an increasingly important role in NOAA's stewardship of natural and cultural resources within the 12 National Marine Sanctuaries. Like other protected area programs, the sanctuaries must base complex management strategies and decisions on a rigorous understanding of the coastal ecosystems we are entrusted to protect for the public. Moreover, NOAA's statutory mandate to facilitate multiple uses of sanctuary resources poses some interesting challenges to traditional management-driven research and monitoring. Specifically, the program is increasingly compelled to focus limited budgets on complex issues such as user impacts, habitat carrying capacity, secondary and cumulative impacts of stresses originating outside the sanctuary, meaningful monitoring, and injury, recovery and restoration of damaged or degraded habitats. Interestingly, the statutory requirements for resource protection occasionally requires the sanctuary program to deny permits to otherwise valuable but risky projects that are more appropriately conducted in coastal areas not designated for a higher level of resource protection. The Sanctuary Program is currently developing a strategic system-wide research and monitoring plan that will guide budgetary decisions along national, regional and local science priorities.

Charles M. Wahle
Technical Projects Branch
NOAA/NOS, Sanctuaries and Reserves Division
1305 East West Highway, 12th Floor
Silver Spring, MD, USA 20910

Ph (301) 713-3145
Fax (301) 713-0404
Email cwahle@ocean.nos.noaa.gov

TWO IF BY SEA: FEDERAL-STATE PARTNERSHIPS FOR MANAGING COASTAL SANCTUARIES

Sherrard Foster, NOAA/National Ocean Service
Edward Lindelof, NOAA/National Ocean Service
Brady Phillips, NOAA/National Ocean Service
Lisa C. Symons, NOAA/National Ocean Service

Traditionally resource management activities handled by singular agencies were considered "protected turf." The National Marine Sanctuaries Program is a departure from that concept. In an active effort to more effectively protect resources, more partners are being sought. First among these partners are state marine resource management agencies. Cooperatively NOAA and the state agencies are addressing the increasingly pressing issue of marine resource protection found along a portion of America's coastline.

The National Marine Sanctuary program is a national system of 14 sites (until Key Largo and Looe Key are subsumed into the Florida Keys after the FEIS is published). These sites protect over 13,000 square nautical miles of marine resources. Additional approximately 850 square nautical miles are currently under consideration for designation as National Marine Sanctuaries. Of the 14 existing sites, 7 have some state waters within their boundaries. Of these we would like to focus on the 4 sites that have significant state waters within their parameters. Of these, 2 (the Florida Keys National Marine Sanctuary and the Hawaiian Islands Humpback Whale National Marine Sanctuary) have been Congressionally designated, the other 2 (the proposed Northwest Straits (Washington) National Marine Sanctuary and the proposed Thunder Bay National Marine Sanctuary (Michigan)) are going through the administrative designation process. The latter two sites consist entirely of state waters.

The designation process for a National Marine Sanctuary is often long regardless of whether the designation is Administrative or Congressional. For those sites undergoing sanctuary designation, the means by which the site is designated weighs heavily in the public perception of the process. Local citizens want to be involved or at least have the opportunity to be involved in the initial decisions to establish a sanctuary in their community. Congressional designations, by the mere nature of the Federal legislative process, tends to limit the initial degree of public involvement. A Congressional designation often includes regulatory guidance and/or boundary guidelines that may or may not be the most appropriate for the protection of the resources. While there are opportunities for the public to comment on legislation in Washington, D.C., most do not know when issues that affect their community are being considered. More often than not, the public's first knowledge of an action is after a bill has been signed into law.

As a result, feelings of exclusion and anger develop at not being brought into discussions. Congressional designations can delay Administrative designations by causing a reallocation of resources to respond to the Congressional mandate. This can also lead to frustration and anger on the part of the public, as an Administration process is drawn out, expending resources and patience and delaying protection of the resources.

While half of the current sites contain some portion of state waters only 1 other site, Fagatele Bay, American Samoa, is all state or territorial waters. The two sites under evaluation have been slowly working through the administrative process; one that is often buffeted by budget concerns, as well as local and national politics. All of which make an objective and scientifically defensible DEIS/MP a long and often arduous process. Additionally, how best to effect a state-Federal partnership has been a process of experimentation and learning. What may work in one jurisdiction often does not apply elsewhere. Public interest and concern about an alleged increase in the power and intrusiveness of the Federal Government and concern over private property rights has increased dramatically in the last few years and recently has been applied to the marine environment and its resources. The complexity of stewardship and ownership responsibilities can be very confusing and the specter of an additional player is often not well received despite an apparent need or concern for the resources in question. It is in this contentious atmosphere that NOAA is working to determine whether designation is appropriate for both the Proposed Northwest Straits National Marine Sanctuary and the Proposed Thunder Bay National Marine Sanctuary. Both of these sites present somewhat of a departure from the previous "formulas" used for designations. This is not necessarily to be considered good or bad, but rather a symptom of the growth of the program and its responsibilities. Whether or not these two sites will survive the vagaries of the process is yet to be determined. It may be that the determination is made that existing authorities, particularly those of the states in question (Washington and Michigan) may be adequate for protection of the resources, and that further Federal protection is not warranted.

Administrative Versus Congressional Designations: Four Examples

A 630-square nautical mile area surrounding Thunder Bay (Lake Huron), Michigan became an active candidate for sanctuary designation by elevation off of the Site Evaluation List (SEL) in 1992. Originally this site was being examined for comprehensive ecosystem and cultural and history resource protection. Proposed management of Thunder Bay is now so narrowly focused that the pending designation currently causes little controversy. However, that "lack of controversy" was not achieved without significant (and protracted) on-site efforts. Although development activities for Thunder Bay's potential designation have extended over a long period of time, early on in that process a "core group" of persons representing agencies and organizations with commercial, recreational, or management interests was established to provide NOAA with guidance and suggestions regarding the scope of a National Marine Sanctuary at Thunder Bay.

In 1983 the Washington State Nearshore (later called Northern Puget Sound) site was placed on the SEL. In 1988, the site was elevated to active candidacy by Congress during the Reauthorization of Title III of the Marine Protection, Research and Sanctuaries Act (MPRSA). During the Scoping meeting process the study area was expanded to include the Straits of Juan de Fuca and the site is now known as the Northwest Straits. Over 100 public meetings have been held with constituent groups and local government officials over a 6-year period.

Congressional designation sidesteps the administrative Site Evaluation List (SEL) selection process, which can take years for a listed site to become a designated sanctuary as it is heavily dependent upon additional resources being available. Congressionally-designated sites may not be formally evaluated by the SEL process before they are placed as top priority. Congress makes this decision for NOAA. The congressional action automatically requires NOAA, Sanctuaries and Reserves Division to begin the formal National Marine Sanctuary Act (NMSA) and National Environmental Policy Act (NEPA) processes to work with the public, affected state and tribal/native interests in developing a management plan for the site.

Hawaii has a long history in National Marine Sanctuaries Program. In the late 1970s, local researchers in Maui submitted a proposal to establish a Hawaiian Humpback Whale National Marine Sanctuary. Then-Governor Ariyoshi appointed a 15-member advisory group to assist the state in its evaluation of the proposal and to help develop a draft Environmental Impact Statement/Management Plan (DEIS/MP). In 1984, NOAA released the DEIS/MP and held public hearings that with met with strong opposition by some user groups. These interest groups rallied the Governor to withdraw state waters from the Sanctuary in July of that year. NOAA then suspended work on the project. In 1992, Hawaii worked with their delegation to get the Hawaiian Islands Humpback Whale National Marine Sanctuary designated Congressionally. Three and one-half years later, the congressional-designation continues to overshadow the public process. Many citizens feel that the sanctuary was "slipped in" without broad public input or even knowledge that there was such a proposal. People continue to ask, "Why were we never asked if we even wanted a Sanctuary," and think the Sanctuary is a "done deal." As such, many people have developed a mistrust for the designation process and the federal government, and are further discouraged from participating in the development of the site. Their focus remains on undoing the action rather than shaping the sanctuary into something that can benefit their community and better addresses their true resource concerns.

The Florida Keys National Marine Sanctuary and Protection Act of 1990 establishes a National Marine Sanctuary encompassing approximately 2,800 square nautical miles of coastal and oceanic waters and the submerged lands thereunder. Sixty-five percent of the sanctuary is comprised of state waters. The size and diversity of the congressionally designated Florida Keys National Marine Sanctuary (FKNMS) (as well as the legislation itself) mandate development of a comprehensive Management Plan (MP). To accomplish this objective, the FKNMS MP addresses issues outside the "traditional" scope of sanctuary management, such as water quality and land use. Comments received on the recently release DEIS/MP have been numerous.

Regardless of whether a designation is Administrative or congressional, when the FEIS/MP is completed, Congress, the Governor of the affected state, and the Secretary of Commerce all review the project and determine if a sanctuary will be designated in state and federal waters. State governors have the ability to veto all or any portions of the management plan or regulations that are not in the state's interest.

Maintaining the Balance Between State and Federal Interests

The National Marine Sanctuaries Act fosters flexibility to address resource protection needs on a case by case basis -- allowing for achievement of an equitable balance between state and federal authorities. Part of investigating the adequacy of existing state (and other federal) regulatory and other resource protection mechanisms and determining what may be necessary, is an identification of regulatory "gaps" that preclude comprehensive, system protection. This coordinated investigation, with the state (as well as other federal or regional agencies with jurisdiction in the area), should also result in constructive discussions developing reasoned approaches to protecting the proposed sanctuary environment. An obviously significant reason for those discussions is the combined desire to accomplish system protection economically. Over time it is very clear that state governments do not generally want NOAA (or any other federal authority) to supersede regulation of state waters or resources. NOAA does not generally wish to be duplicative, but rather to complement, coordinate and work in partnership.

The designation of the Hawaiian Islands Humpback Whale Sanctuary immediately presented issues of concerns for not only user groups but other federal and state agencies. Humpback whales are already protected under the Endangered Species Act and the Marine Mammal Protection Act, and the whale's habitat is covered by a myriad of other regulations. Throughout the public comment period, NOAA heard repeatedly that there are enough regulations to protect humpback whales and that the existing regulatory processes are already too bureaucratic. After careful analysis and consultations with other experts and agencies, NOAA determined that the existing state and federal regulations to protect the humpback whale and their habitat are sufficient to provide protection, and as such proposed to incorporate those regulations into Sanctuary regulations. As a result the Sanctuary would not contain any provisions for the issuance of independent Sanctuary permits, but work within the existing regulatory and permit processes. The sanctuary would also have direct authority to work with other federal and state agencies to coordinate and enforce permit violations.

In order to interface with the permit processes of other agencies, it became necessary to develop more formalized coordination procedures. As such the Sanctuary worked with the National Marine Fisheries Service, the Corps of Engineers, and the Hawaii Department of Health to develop Memoranda of Understanding as to how the sanctuary would review and comment on their permit applications. Less formalized coordination mechanisms were also initiated with the local sanctuary users and interest areas to ensure the sanctuary was not only listening to their concerns, but not duplicating their efforts. The sanctuary helped sponsor enforcement meetings with boat users, held numerous "town meetings" and small information meetings to solicit public input on issue papers and the DEIS/MP and organized ad-hoc focus groups (*i.e.*, education) to help the Sanctuary and the community focus on that particular issue. Finally, many of these coordination mechanisms have been even more formalized in the creation of a 25-member Sanctuary Advisory Council (SAC) for Hawaii, which gives the representatives the ability to provide advice and recommendation to the actuary on management issues.

Regardless of how and why a proposed site is elevated from NOAA's Site Evaluation List (SEL) to "active candidate" status, there are some initial tasks which must be undertaken by NOAA prior to embarking upon the time-consuming and labor-intensive process of designation. Important among these steps is the establishment of open and continuing communication with the state(s) most directly affected by potential sanctuary designation. Particularly in the case of proposed Sanctuaries incorporating state waters (or even sites whose proposed boundaries would abut state waters), it is imperative that NOAA and the state fully understand the expectations, as well as the limitations, of each other throughout this process.

Memoranda of Understanding or Agreement (MOU/MOA) are often used as a vehicle to set up a formal working relationship between the state and federal partners. This is particularly critical to the development of a DEIS/MP and how resource protection will be dealt with in state waters. Sanctuaries could never function properly absent cooperative, working partnerships with the states upon whose shores they may lap. Before entering into a long-term partnership, however, each state and NOAA party must determine the advantages (or potential advantages) available to each, as well as the possible disadvantages. State governments established long before the National Marine Sanctuaries presumably have some mechanisms for managing uses of coastal waters and resources within their jurisdiction. It is the responsibility of the program to ensure opportunities are made available for active and continuing participation by states in both the sanctuary designation process, and in ongoing sanctuary management following designation. Part of the challenge is to both recognize and take advantage of the existing experience and expertise of state governments in managing coastal marine or Great Lake areas. Beyond ensuring opportunities, it also is the responsibility of the program to secure the long-term commitment of the state to cooperative partnerships before final sanctuary designation occurs.

An additional issue can be how to most effectively address the concerns of native peoples who have traditionally used areas under consideration for designation or that have been designated as NMS. These peoples usually have pre-existing treaty rights to resources within a proposed or designated NMS site and are also active stewards for the resources. The United States Government and the National Marine Sanctuary Program work with these recognized treaty tribes as individual nations and strive to address joint stewardship concerns where appropriate. This is often a complex relationship especially when NOAA is a relatively new player in marine resource protection for a specific area. Native peoples, not unlike state governments are extremely concerned about usurpation of their authorities and their abilities to implement their authorities. There are times when the National Marine Sanctuary Program can provide some benefits in access to expertise and resources as well as serve a catalyst to focus resources from any number of parties to address common resource protection concerns.

Unique Models of Public Involvement

The National Marine Sanctuary program uses a number of models of public involvement in the designation and management process, tailoring them to the needs of each community. These models range from informal to formal and generally change and grow when a site is designated or as a site matures. In the first attempt to designate a sanctuary in Hawaii in the early 1980s, the Governor formed a 15-member Advisory group (non-governmental representatives only) to assist the state in its evaluation of the sanctuary and to provide direct input into the development of the management plan. This group, in concert with interest groups, influenced the Governor's decision to terminate the first proposed sanctuary. Hawaii used a similar advisory structure in 1992 after the Hawaiian Islands Humpback Whale NMS after Congressional designation. The Governor, through the Office of State Planning (OSP), created a State Working Group (SWG) to advise the state and NOAA in developing the DEIS/MP. This SWG initially had over 30 members and was comprised of government (federal, state, and county) representatives and a variety of other user groups. The group primarily functioned to provide comments on management alternatives and issues as needed. Over time the SWG grew to more than 50 members and became too large to be truly effective. In addition, the group never had clear mandate or direction from the state as to what its role should be.

In response to comments requesting greater public involvement following the publication of the DEIS/MP, and to involve the public in on-going management issues, SRD and OSP worked to create a smaller, more workable advisory group patterned after Sanctuary Advisory Councils (SACs) used in Monterey Bay and in Olympic Coast sanctuaries. Numerous modifications were made for Hawaii, including different state and federal government representatives, a native Hawaiian seat and other site-specific user groups. Given that Hawaii has 4 counties, spread out over 8 main Islands, the decision was made to have four county-specific representatives, who each then will chair individual county working groups. This gives individuals in each county a platform and a greater ability to interface with sanctuary management. The main purpose of the SAC is to provide advice and recommendations to the sanctuary manager and SRD on the management issues in the SAC. This will include developing the final EIS/MP and to provide advice on-going management issues after the sanctuary is fully designated and operational.

Following the public scoping meetings for the FKNMS, a series of workshops was conducted to establish the foundation for building the MP. Four working teams were forged to provide the vision and knowledge necessary to achieve FKNMS goals: 1) an Interagency Core Group (composed of federal, state, and local agencies with direct jurisdictional responsibility in the FKNMS) to develop policies and direct and oversee the MP development process; 2) a Strategy Identification Work Group (49 local scientists and management experts) to generate an initial set of strategies and details on implementation requirements; 3) a Sanctuary Advisory Council (representing the dive industry, environmental groups, and commercial and recreational fishermen) to ensure public input into the MP, and to advise and assist NOAA on policy related to a marine zoning plan, activities needing regulation, and recommendations of preferred management alternatives; and 4) a NOAA team (scientists, planners, and attorneys) to develop and implement the process to produce the MP.

NOAA and Washington formed an advisory group in 1989 called the Northern Puget Sound Marine Sanctuary Working Advisory Committee (WAC) to assist in coordinating collection and review of information and identification of marine related issues of concern. The WAC met for the first time in 1990. Membership was composed of representatives from county planning offices, state agencies, federal agencies, commercial fishing interests, environmental organizations, civic organizations, shipping and port interests, recreational boating, academic institutions, and tribal interests. Subcommittees were then established to pursue further more specific information, these were open to anyone interested in participating. The study area was expanded as a result of the work of the WAC and information obtained in a series of 1989 scoping meetings. Additionally in 1989, and again in 1994, Memoranda of Understanding were signed between NOAA and the Department of Ecology affirming and detailing how the two agencies would work together in concert to address the evaluation of the protection of the region's marine resources and whether designation of the National Marine Sanctuary was appropriate.

Although development activities for Thunder Bay's potential designation have extended over a long period of time, early on in that process a "core group" of persons representing agencies and organizations with commercial, recreational, or management interests was established to provide NOAA with guidance and suggestions regarding the scope of a National Marine Sanctuary at Thunder Bay. Core group meetings were combined with public meetings, so that the wider community could also contribute to determining and defining what the program could bring to the state's already-established recognition of Thunder Bay's underwater cultural resources. The resulting proposals at this site comprise a narrowly-focused proposed management regime directed solely at the underwater cultural resources (*i.e.*, shipwrecks) and archeological sites, such as prehistoric settlements.

Integral Partnerships

Progress at all of these sites has been slow. NOAA and the States must recognize the absolute need for each party to any potential partnership to have both a realistic expectations of what designation can accomplish, and an understanding of what each party's specified roles are throughout the designation process, as well as in Sanctuary management. Without this initial understanding, designation of a proposed Sanctuary is certain to be needlessly delayed and controversial.

From the state's perspective, the presence of a National Marine Sanctuary partially or wholly situated within state waters is often viewed as a mixed blessing. It shouldn't and doesn't have to be that way. Initial and continuing frank discussions between NOAA and state governments should lead to mutual understanding and expectations by all parties. There should be no unrealistic expectations by any party as to what NOAA or any state agency is capable of bringing to the partnership. There may be (and likely will be) conflicts of usage, of management initiatives, of research or educational priorities, of resource management philosophies. Resolution of such conflicts is part of the designation process. That is, after all, what a National Marine Sanctuary strives to be: a partnership among stakeholder parties. And the primary message from NOAA to the public regarding Sanctuaries is that we are all stakeholders.

Prominent among the points that each party (NOAA and any state) must make to the other are these: National Marine Sanctuary designation is a Federal designation; implementation of a sanctuary's management plan is a national program. All National Marine Sanctuaries are nationally-recognized treasures whose long-term protection and management are ultimately the responsibility of the federal government.

Lisa C. Symons
Pacific Region
NOAA/NOS, Sanctuaries and Reserves Division
1305 East-West Highway, 12th Floor
Silver Spring, MD, USA 20910

Ph (301) 713-3141 x108
Fax (301) 713-0404
Email lsymons@ocean.nos.noaa.gov

REACHING BEYOND THE GOVERNMENT: SANCTUARY ADVISORY COUNCILS' ROLES IN MANAGING SANCTUARY RESOURCES

Elizabeth Moore, NOAA/National Ocean Service
Edward Lindelof, NOAA/National Ocean Service

Introduction

Though advisory committees in one form or another have long been a staple of various levels of government, the prohibitive requirements of other laws had kept the National Marine Sanctuary Program (NMSP) from venturing too far into this realm. With relief provided by the 1992 legislative reauthorization of the NMSP, this "new" concept was introduced that would allow for far more public participation in sanctuary management than ever before. The NMSP currently has three standing sanctuary Advisory Councils (at Florida Keys National Marine Sanctuary (NMS), Monterey Bay NMS, and Olympic Coast NMS) and two more in development that are expected to begin meeting by summer of 1996 (Hawaiian Islands Humpback Whale NMS and Stellwagen Bank NMS).

Mission and Structure of Councils

Advisory councils are established to generally provide advice on the designation and management of national marine sanctuaries. Their activities for the NMSP may include reviewing documents, proposals, and agreements; informing the NMSP about issues or problems to be addressed; assisting in developing priorities for research, education, and outreach; and advising on use and development of sanctuary facilities. Councils also provide a fundamental link with the local communities.

Sanctuary advisory councils are governed by charters, that provide for, among other things, composition; member selection process; goals and responsibilities; and operation guidelines. Selection processes have differed slightly from site to site, but usually non-government seats are filled by a public process that involves receipt of applications, preliminary review, and selection and confirmation of a final candidate. Government seats are appointed by their respective agencies.

Membership on advisory councils varies from site to site, and is dependent upon the resources, user groups, and issues of that sanctuary. All five permanent or pending councils have representatives from the business sector; the research and education communities; conservation organizations; and the community-at-large. Most of the councils also include government representatives from local, tribal, state, and/or federal agencies. Councils range in size from 15 to 22 members.

Importance and Advantages of Councils

Whether by design or simply fortuitous, sanctuary advisory councils have come at the time they were probably most needed by the NMSP. First, the recent trends in sanctuary designations have been "bigger" and "closer." Most of the newer sanctuaries (*i.e.*, Florida Keys, Monterey, and Olympic) are larger then the NMSP perhaps planned for 10 years ago. These recent sites also come right up to the shoreline and therefore encompass a much broader suite of resource uses and user groups. An advisory council helps bring those voices to the table.

Second, though the NMSP has always had a mandate to facilitate multiple uses of a sanctuary, that were compatible with the primary mandate of resource protection, such a directive has been increasingly harder. The NMSP has seen not only increasing numbers of users of sanctuary resources (partially by moving into coastal waters, but also due to the increasing size of coastal populations) but has also encountered a variety of uses and issues that have never been dealt with at a site. Advisory councils provide a forum for helping resolve or avoid user conflicts.

Third, the NMSP has long recognized that for a sanctuary to be successful, it must become a part of the community to which it lies adjacent. To this end, the numbers of onsite staff members and the autonomy of sanctuary managers have been increased in recent years. However, the establishment of an advisory council composed of members of the community is perhaps a more important step. Members of the council become invested in the proper management of their sanctuary and the protection of their sanctuary resources. Conversely, the council provides a link to the community for the sanctuary staff that would perhaps not otherwise exist.

Finally, though the NMSP has been committed to obtaining strong public input in the management of sanctuary resources, the methods to obtain such input have sometimes been limited to bureaucratic designation and regulatory procedures, or informal and infrequent opportunities through various other channels. Advisory councils provide a "user-friendly," regularly scheduled venue for the public to participate in sanctuary management.

Disadvantages of Councils

In examining the variety of methods available to the NMSP to enhance management of sanctuaries and their resources, advisory councils would never fall under the "easy" category. Advisory councils are labor- and resource-intensive, both during the formation (usually a 12- to 18-month process involving preparing a charter and selecting members) and operation (which involves ongoing preparation of briefings and documents, conducting meetings, and meeting follow-ups). There is also a long learning curve involved, for both members of the council and the staff of the effected sanctuary, when the potential for mis-steps and miscommunication is highest. A very fine line exists between preparing an advisory council to provide the best advice to the sanctuary that it can, and staffing an advisory council as if it were a body of independent authority. Similarly, there is a fine line between providing answers to questions from an advisory council, and just answering to an advisory council. However, given time and patience and open communication, these difficulties can be resolved.

Impacts of Councils on Sanctuary Management

Sanctuary advisory councils have already had profound effects on the way in which sanctuary resources are managed and protected. First, in general, they have provided new voices in helping make management decisions, the direct collective voice of the community. An advisory council, together with its subcommittees and work groups, can provide the expertise, knowledge, experience, and points-of-view of dozens of individuals that live and work beside and in the sanctuary.

Second, and more specifically, advisory councils can assist in making management decisions and resolving issues by providing, for little or no cost, technical and scientific information that would not perhaps be otherwise readily available. As an example, the Research Activity Panel of the Monterey Bay NMS Advisory Council provided a report at NOAA's request that was instrumental in recent rulemaking processes to ban attraction of white sharks in the state waters of that site.

Finally, advisory councils provide a forum for discussion of issues and topics that can lead to resolution of problems without having to resort to more drastic procedures, such as new regulations.

Conclusion

All of the most recently designated sanctuaries have, or will soon have, advisory councils. There has also been some interest by older sites to consider forming advisory councils. Sanctuary advisory councils have, in the first three years of their existence in the NMSP, become a fundamental, even routine, facet of sanctuary management.

Elizabeth Moore
NOAA/NOS, Sanctuaries and Reserves Division
1305 East West Highway, 12th Floor
Silver Spring, MD, USA 20910

Ph (301) 713-3141 x 170
Fax (301) 713-0404
Email emoore@atlantic.nos.noaa.gov

REGULATIONS AND PERMITS: THE FOUNDATIONS OF LONG-TERM RESOURCE PROTECTION

Helen Golde, NOAA/National Ocean Service,
Michael Weiss, NOAA Office of Assistant General Counsel for Ocean Services, and Margo Jackson, NOAA Office of Assistant General Counsel for Ocean Services

Introduction

Each National Marine Sanctuary contains regulations that prohibit a narrow range of activities. These prohibitions were generally developed during the process for designation of the particular sanctuary and were issued primarily to address actual or potential threats to the natural and cultural resources of the sanctuary. Each sanctuary's regulations also provide for the issuance of sanctuary permits to conduct otherwise prohibited activities. Both the regulatory prohibitions and the permitting criteria have evolved as newer sanctuaries have been designated. This paper will explore this evolution, the problems that have resulted, and potential solutions to those problems.

Prohibited Activities and Permitting Criteria

The National Marine Sanctuary Program (NSMP) has matured since the first sanctuary was designated in 1975. Similarly, the regulations regarding prohibited activities and permitting criteria have evolved to reflect lessons learned in administering the NMSP, and changes in the National Marine Sanctuaries Act (NMSA), the statutory authority for the NMSP. In general, regulatory prohibitions have evolved to become more precise to clearly and comprehensively address the concerns for which they were issued. For example, earlier National Marine Sanctuaries prohibit exploring or producing oil, gas or minerals whereas the more recently designated sanctuaries contain absolute prohibitions with express language that no permits may be issued for such activities. This is clearly reflected in the newer Monterey Bay National Marine Sanctuary where such activities are not only absolutely prohibited by regulation, but are also statutorily prohibited.

Sanctuary permitting regulations have also evolved to more clearly describe permitting requirements and criteria, and to reflect changes to the NMSA. All sanctuaries generally allow for the permitting of specific types of activities (*e.g.*, research or education). Further, all sanctuaries contain a list of general criteria which must be considered when deciding whether to issue a permit. Such general criteria include the financial and professional capability of the applicant, the applicability of the proposed methodology, and the expected negative and positive impacts on the sanctuary resources and qualities. Newer sanctuaries (*e.g.*, Monterey Bay and Stellwagen Bank National Marine Sanctuary), however, contain more specific regulatory criteria, including the requirement that activities can be permitted only if they are found to cause "only negligible short-term adverse effects to Sanctuary resources and qualities." This requirement results in a more stringent review of proposed activities to reflect the higher degree of resource protection for these sites.

Although all sanctuaries are limited in the types of activities they can permit (*e.g.*, research, education), more recently designated sites allow the review, conditioning and Authorization of other agency permits thus allowing a broader range of activities than are allowed to be permitted by the Sanctuary. Thus, a non-research or education activity within the Monterey Bay National Marine Sanctuary may be allowed by Authorizing a permit issued by a state agency, such as the California Coastal Commission. The Sanctuary staff will review the Coastal Commission permit and, add appropriate, additional conditions necessary to protect Sanctuary resources, and Authorize the state permit. More types of uses are thereby allowed in the Sanctuary while still protecting its resources. However, if a use is contrary to the resource protection mandate, the Sanctuary may object to the issuance of the State permit.

Effects of Existing Regulatory Structure

The evolution of the regulations has caused some variance between sanctuaries and problems identifying which activities may be prohibited. For example, a fishing exception to the discharge prohibition is worded slightly differently for the three central California sanctuaries and has caused confusion as to whether discharging fish parts, chumming materials, and bait for non-fishing purposes is or is not expressly prohibited.

Because some older sanctuary regulations contain less explicit permitting criteria, they may be more open to interpretation by the sanctuary staff when evaluating a permit application. Contrasted to the requirement in new sanctuaries to find "only negligible short-term adverse effect", the result could be that similar activities subject to similar prohibitions may meet dissimilar results dependent on where they are proposed to be conducted. Although differing results would be consistent with the particular sanctuary's regulations, it can result in confusion among users of the various sanctuaries.

The wider interpretation of regulations in the older sites may foster more uses of an individual sanctuary, while the more explicit newer regulations may be less open for interpretation and thus allow fewer different uses. However, the addition of the Authorization regulation in the newer sites also allows for more uses than are not allowed at older sites. Older sites like

Gray's Reef or the Channel Islands National Marine Sanctuaries allow otherwise prohibited activities only for research and education purposes. With the addition of larger sites that include large amounts of populated shoreline, however, these constraints have been necessarily widened. Authorization of other agency permits allows these other activities to take place once the sanctuary has determined that they are compatible and conditioned them appropriately.

Future Steps

The NMSP is taking several steps to alleviate some of the inconsistencies described above. First of all the permitting system is being overhauled to facilitate more consistent review of permit applications. These changes will incorporate standard application and review forms which will hopefully minimize the potential for differential interpretation of less explicit regulations and permitting criteria.

Secondly, the National Marine Sanctuary Program hopes to undertake a comprehensive evaluation of the existing regulatory structure for each site. The management plan and regulations for each site are to be reviewed every five years to determine whether they are still adequately fulfilling the programs mandate. Fiscal constraints have led to a backlog of sites that are due for this five year review. Hopefully, in the next two years the program will be able to review all of its site regulations to make them as consistent as possible, where appropriate. Administering the National Marine Sanctuary Program is an iterative process and the lessons learned will continue to be applied in the future.

Helen M. Golde
NOAA-Sanctuaries and Reserves Division
1305 East West Highway, 12th Floor
Silver Spring, MD, USA 20910

Ph (301) 713-3145 x 152
Fax (301) 713-0404
Email hgolde@ocean.nos.noaa.gov

THE CUMULATIVE IMPACTS OF MANAGEMENT DECISIONS ON NITROGEN LOADING TO THE RHODE ISLAND SALT POND REGION

Laura M. Ernst, University of Rhode Island
Virginia Lee, University of Rhode Island
Alan Desbonnet, University of Rhode Island

Introduction

Increasingly, non-point source problems in coastal communities require managers at the local, state, and federal levels to determine new methods of evaluation for cumulative impacts. The result of small seemingly harmless decisions about wetland conversion, small lot development, water use, and redirection, sewer extensions and septic system use are apparent in the environmental problems faced by communities today. Resource managers are confronted with a number of human-induced problems including: declines in fishery stocks; endangered and rare species habitat loss; microbial and nutrient pollution in public and private water supplies; and nutrient enrichment from sewer outfalls and non-point source pollution. Although the concept of cumulative impact management became a part of our national environmental policy through the Council on Environmental Quality Guidelines in 1978 (40 C.F.R. §4321 *et seq.*, 1978), under the National Environmental Policy Act (42 U.S.C. §1508.9 *et seq.*, 1969), many coastal management programs need to incorporate initiatives for cumulative impact evaluation.

The Rhode Island Coastal Resources Management Council (CRMC) and four town governments are considering the cumulative impact problem as it relates to nitrogen loading in the salt pond region of Rhode Island. The salt pond region covers 23,473 acres and includes 9 coastal lagoons locally known as "salt ponds." Water quality in the salt ponds is managed by a special area management plan (SAMP). The SAMP utilizes low-density zoning regulations and alternative septic systems to limit the source of nitrogen to the salt ponds. As part of the 1995 revisions to the SAMP, a cumulative and secondary impact study of development was undertaken by the University of Rhode Island Coastal Resources Center. A nitrogen loading budget for each of the salt ponds was calculated based on recent research results (Gold *et al.*, 1990); personal communications with local planners, farmers, and golf course managers; and the Rhode Island Geographic Information System (RIGIS). Total nitrogen loading to each salt pond was determined for 1981, 1992 and full development (buildout) of the watershed based on present zoning regulations.

The Nitrogen Loading Problem for Coastal Ecosystems

In 1968, Garret Hardin wrote that pollution problems in general are a consequence of population (Hardin, 1968). In the case of nitrogen, this is particularly true. Increases in population affect the quantity of nitrogen in the environment because growing populations demand increasing amounts of nitrogen fertilizer to meet basic human nutritional needs (Nixon, 1993). An expanding population also requires more housing and development in cities, towns, and rural areas. Along with new houses there are sewers, sewage treatment systems, and individual sewage disposal systems which load nitrogen to groundwater. Cars emit nitrogen oxides into the atmosphere, which leads to higher concentrations of nitrogen in atmospheric deposition. Increases in impervious areas influence the transmission of nitrogen to receiving waters. Increases of nitrate-nitrogen in private wells, and public water supplies can be a problem if concentrations exceed the ten part per million health limit (U.S. Environmental Protection Agency, 1976). High nitrate-nitrogen levels in drinking water can cause methemoglobinemia (a potentially lethal decreased ability of the blood to transport oxygen) in infants and have been correlated with progeny malformations (National Research Council, 1977; Dorsch *et al.*, 1984). In coastal areas, the potential for nutrient pollution in coastal and estuarine waters poses multiple problems for human, natural and economic health.

Problem Statement and Approach

Although nutrients are important for the productivity of coastal marine ecosystems (Ryther and Dunstan, 1971), excessive amounts of anthropogenic inorganic nitrogen can produce undesirable changes in these systems. The real problem for scientists and managers is that we do not know how much nitrogen coastal marine ecosystems can assimilate before there are serious impacts to habitat and fishery resources. Anthropogenic introduction of nitrate into the salt ponds increases the productivity of phytoplankton and macroalgae. As these species proliferate, mass algal growth blocks sunlight from other plant species like eel grass (*Zostera marina*) and bottom organisms. Increasing nutrient loading leads to the replacement of seagrasses and slow-growing macroalgae by fast-growing macroalgae and phytoplankton (Duarte, 1995). Managers need to understand how these changes disrupt the food chain and the implications for marine species. If managers can associate various quantities of nitrogen loading and the impacts on coastal habitats, then land-use can be managed to limit the source and transmission of nitrogen in coastal watersheds. Human population increases, development pressures on the coastal zone, summer cottage conversion, and seaside tourists all contribute to the amount of anthropogenic nitrogen which can load into coastal waters.

If it is possible to identify changes in the source and transmission of nitrogen over a period of time, managers can use this information to support local and state regulations which limit development in the watersheds of nutrient sensitive water bodies. By identifying significant changes within the salt pond watershed over time, it is possible to show the cumulative impact of past management decisions. Nitrogen is transmitted to the salt ponds by four paths: groundwater, atmospheric deposition, stream flow, and offshore. Since groundwater is the largest source of fresh water to the salt ponds (Olsen and Lee, 1984), loading to groundwater from septic systems, lawn, agriculture, playing field, and golf course fertilizers, and atmospheric deposition is the focus of management policy and actions.

Methods

Loading estimates of dissolved inorganic nitrogen from groundwater were determined for each of the salt ponds. Groundwater loading calculations are based on field experiments of Gold *et al.* (1990) and Koppleman (1978) for nitrate-nitrogen loading from septic systems, fertilizer, domestic pets, and atmospheric deposition to groundwater. Aerial photos from R.I. Statewide Planning (1981) and the R.I. CRMC (1992) were used along with surface watershed maps generated by RIGIS (1995) to determine the number of housing units in each watershed. U.S. Census Bureau data from 1980 and 1990 were used to determine the total number of year-round residents living in each watershed. Seasonal population was calculated from a U.S. Army Corps of Engineers hurricane evacuation study for Misquamicut Beach, Westerly, Rhode Island (1994). Personal communications with local farmers, golf course managers, and town planners established fertilizer application rates. Data for nitrogen loading at buildout was determined from RIGIS and town zoning maps. Nitrogen flux from surface and storm waters were measured for the major streams in each salt pond. Atmospheric deposition was based on field work completed by Fraher (1991) and Nixon *et al.* (1982). The concentration of nitrate-nitrogen in groundwater was measured in 155 private wells, and calculated from available groundwater volumes (l/yr) (Grace and Kelley, 1981) and total nitrate-nitrogen loading (kg/yr), for six of the salt ponds. Total nitrogen loading from groundwater to the coastal ponds, and groundwater concentrations of nitrogen, are summarized in Appendix A.

Results

Changes in land-use in the salt pond region are reflected in the calculated nitrogen loading budget for the salt pond in 1981 and 1992. At buildout, there is the potential for nitrogen concentrations in groundwater to increase between 1 and 5 mg/l in some watersheds. The largest contribution of nitrogen to groundwater in 1981 and 1992 is from septic systems with the exception of Cards Pond in 1981, where agricultural land-uses accounted for 3/4 of the nitrogen budget. Considering the current day zoning for Cards

Pond watershed, residential sources of nitrogen could result in an increase of nitrogen in groundwater from 4 mg/l to 9 mg/l. In Potter Pond, nitrogen loading from residential land-use decreased in 1992 due to little development in the watershed, and a decrease in the median number of people per house between 1980 and 1990 (U.S. Census Bureau). At full development, Potter Pond watershed has the potential for 1,286 more houses which would increase the total loading to the salt pond by 43% (Ernst, 1996). In Point Judith, Trustom, and Green Hill Pond watersheds, nitrogen loading from agriculture in 1981 was replaced by loading from residential land-uses in 1992. As a result, groundwater concentrations of nitrogen decreased from 6 mg/l to 3/mg/l.

Agricultural land-uses changed considerably in the salt pond region between 1981 and 1992. The biggest difference is in Cards Pond watershed where the loading decreased from 17,103 kg/yr of nitrate-nitrogen (NO_3-N) in 1981 to 4,869 kg/NO_3-N/yr in 1992. The change in loading resulted in a decrease of nitrogen in groundwater, from 10 mg/l to 5 mg/l. Nitrogen loading from agricultural land-use in Potter Pond watershed decreased between 1981 and 1992.

Nitrogen loading from undeveloped lands increased between 1981 and 1992 in all of the watersheds due to increases of dissolved inorganic nitrogen (DIN) concentrations in atmospheric wet deposition. The 1981 concentration was .49 mg/l of DIN (Nixon *et al.*, 1982) and the 1992 concentration, .65 mg/DIN/l (Fraher, 1991). The increase of nitrogen in atmospheric deposition in the salt pond region is contrary to the U.S. Environmental Protection Agency (EPA) 1991 emission trends which indicate nitrous oxide (NOx) in the atmosphere decreased by 25% between 1982 and 1991 (US Department of Transportation and EPA, 1993). Decreases in NOx emissions are attributed to improved automobile technology, despite increases in vehicle traffic (US Department of Transportation and EPA, 1993). Based on data existing for southern Rhode Island, the decrease in NOx emissions is not evident from wet deposition of DIN between 1981 and 1992. Nitrogen loading to groundwater and coastal waters from atmospheric deposition poses interesting policy implications because communities trying to control nutrient fluxes within watershed landscapes are reliant on federal regulation of air quality emissions.

Conclusions

Nitrogen is a good indicator of the cumulative impacts of management decisions because changes in the quantity and transmission of nitrogen in the landscape can be quantified. Groundwater sources of nitrogen loading to the salt ponds have increased and will continue to increase because of current zoning regulations and land-use planning decisions made by the four towns in the region. The largest contribution of nitrogen to groundwater in the salt pond watersheds is from septic systems. Septic systems account for 92% of the nitrate-nitrogen loading from residential development (Ernst, 1996), based on loading from septic systems, lawn fertilizers (Gold *et al.*, 1990) and domestic pet loading (Koppleman, 1978). The contribution of residential nitrogen sources is an obvious target for management by local and state governments. The 1984 SAMP attempted to control nitrogen loading through recommended zoning changes in each of the towns. Yet, changes between 1981 and 1992 indicate that septic systems, domestic pets and lawn fertilizers increased the amount of groundwater nitrogen loading. Under current zoning regulations, sources of nitrogen will continue to increase and Potter, Cards, Trustom and Green Hill Ponds could approach or exceed 5 mg/NO_3-N/l at full development.

Management decisions at the local, state, and federal level have resulted in increases of nitrogen loading to the salt ponds. In order to manage salt pond water quality and to protect private and public water supplies, state standards should be adopted for nitrogen concentrations in groundwater. The Cape Cod Planning and Economic Development Commission (CCPEDC) adopted a 5 mg/NO_3-N/l standard for planning purposes to protect water supply areas, private wells and small volume community wells, and to provide some protection for coastal resources (CCPEDC and EPA, 1978). The CRMC and local communities also need to consider the impacts a groundwater concentration of 5 mg/NO_3-N/l could have on private wells and the salt ponds; and include a standard groundwater nitrogen concentration as part of the SAMP and local comprehensive plans.

The management framework of the SAMP provides a useful mechanism for evaluating cumulative impacts because nitrogen sources in the watershed are identified on a watershed basis, land-use data is available through RIGIS, and there are data sets available to compare changes in nitrogen loading. The SAMP is also a useful framework for measuring cumulative impacts to coastal water quality because loading calculations indicate the changes in land-use which may have a negative impact on water quality in the salt ponds and coastal habitats over a period of time. Finally, the SAMP is a cooperative effort between the CRMC and the local town communities. This relationship allows the state to impact local land-use management without removing control from the local authorities.

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Laura M. Ernst
University of Rhode Island
Coastal Resources Center and
Department of Marine Affairs
Narragansett, RI, USA 02882

Ph (301) 713-2325
Fax (301) 713-1043
Email Laura_Ernst@ccgate.ssp.nmfs.gov

Appendix A
Nitrogen Loading (kg/yr) to Groundwater in the Rhode Island Salt Pond Region 1981, 1992, and Buildout

Salt Pond	Point Judith			Potter			Cards		
	1981	1992	Buildout	1981	1992	Buildout	1981	1992	Buildout
Residential									
Septics	17705	23773	37429	13467	13078	25300	4282	4514	13334
Lawns	776	1342	1968	594	600	1161	189	207	612
Pets	1051	1743	2554	800	776	1502	254	268	792
Total Residential	**19532**	**26858**	**41951**	**14861**	**14454**	**27963**	**4725**	**4989**	**14738**
Agriculture	3040	223	223	13242	1620	1620	17103	4860	4860
Undeveloped	382	1089	151	311	884	91	199	566	1
Playing Fields	163	163	163	41	41	41	0	0	0
Total Loading	**23117**	**28333**	**42488**	**28455**	**16999**	**29715**	**22027**	**10415**	**19599**
Groundwater Concentration (Mg/NO3-N/l)	0.91	1.12	1.67	5.68	3.39	5.92	10.20	4.82	9.07

Appendix A Cont.

Salt Pond		Trustom			Green Hill			Ninigret	
	1981	1992	Buildout	1981	1992	Buildout	1981	1992	Buildout
Residential									
Septics	603	1264	2081	15465	22467	28664	12560	17606	22759
Lawns	27	58	96	682	1031	1315	440	647	836
Pets	36	75	124	918	1334	1702	746	1045	1351
Total Residential	**666**	**1397**	**2301**	**17065**	**24832**	**31681**	**13746**	**19298**	**24946**
Agriculture	5167	2025	2025	3740	0	0	8637	8637	8637
Undeveloped	63	178	127	258	733	8	560	1593	432
Playing Fields	0	0	0	70	70	70	67	67	67
Total Loading	**5896**	**3600**	**4453**	**21133**	**25635**	**31759**	**23010**	**29595**	**34082**
Groundwater Concentration (Mg/NO3 N/l)	5.36	3.27	4.05	3.10	3.76	4.65	1.54	1.98	2.00

Appendix A Cont.

Salt Pond		Quonochontaug			Winnapaug			Maschaug	
	1981	1992	Buildout	1981	1992	Buildout	1981	1992	Buildout
Residential									
Septics	8847	10613	20886	11046	15139	27151	1217	3127	3870
Lawns	357	449	884	526	773	1373	58	156	193
Pets	525	630	1240	656	919	1632	72	186	230
Total Residential	**9729**	**11692**	**23010**	**12228**	**16831**	**30156**	**1347**	**3469**	**4293**
Agriculture	961	961	961	2853	2853	2853	0	0	0
Undeveloped	215	613	30	187	532	0	20	56	0
Golf Course	0	0	0	598	598	598	399	399	399
Playing Fields	134	134	134	7	7	7	0	0	0
Total Loading	**11039**	**13400**	**24135**	**15873**	**20821**	**33614**	**1766**	**3924**	**4692**

FACTORS CONTROLLING THE DISTRIBUTION OF DISSOLVED OXYGEN IN AN ESTUARINE SLOUGH

Elizabeth S. Housel, School of Oceanography,
University of Washington

Introduction

Studies performed by the Washington State Department of Ecology (DOE) in 1992 and 1993 indicated low levels of dissolved oxygen in the Snohomish River and its distributaries (Thornburgh, 1993; Cusimano, 1994). Cusimano (1994) suggested that during the August, 1993 survey, oxidation of organic material in the sediments and water column was the cause of oxygen depletion, but the relative impact of tidal flushing and biological oxygen demand (BOD) on dissolved oxygen (DO) levels was uncertain. Quantitative determination of the DO distribution in an estuarine slough is difficult because it is influenced by physical processes (river flow, tidal flow, and gas exchange) and biological processes (photosynthesis and respiration). A first step in assessing how these processes influence DO levels in the slough is to measure DO concentration and to gauge river and tidal flow. A better understanding of the biological processes affecting DO levels can be obtained by measurement of dissolved inorganic carbon (DIC) in addition to DO, because CO2 and O2 are inversely related through photosynthesis and respiration. The 13C:12C of the DIC, expressed using the notation (DIC 13C), is also a tracer of biological processes because an increase in DIC concentration during respiration is accompanied by a depletion of the DIC 13C.

In this study, an attempt was made to assess the relative influence of river and tidal flow, reaeration, and biological processes on the DO levels of Steamboat Slough, a distributary of the Snohomish River, Everett, Washington (Figure 1), on April 5-6, 1995. The observed relationship between DO, DIC, and DIC 13C versus salinity was compared to the conservative expectation of each tracer, which is the predicted relationship if mixing of the fresh water and marine endmembers was masking biological effects in the slough. If the observed trend of each tracer matched its conservative expectation, mixing primarily influenced DO levels. If, on the other hand, photosynthesis, respiration, or reaeration were controlling DO levels in the slough, a deviation from the conservative relationship would be found.

Concentrations of DO and DIC, and the DIC 13C, together with volume transport data, were used to assess the effect of river and tidal flow on DO levels. The effect of reaeration was estimated from measured DO concentration and the calculated oxygen saturation value (Garcia and

Gordon, 1992). Finally, biological processes were assessed by measuring the downstream distributions and diurnal changes of DO, DIC, and DIC 13C. Table 1 summarizes the methods that were used to analyze each sample.

Results and Discussion

Both DIC and DIC 13C were directly correlated with salinity, indicating that Puget Sound was a source of high DIC and DIC 13C to the slough during high tide. This was confirmed by the downstream distribution of DIC and DIC 13C: both tracers increased from the head to the mouth of the slough during high tide (Figure 2). DO, on the other hand, showed an inverse correlation with salinity, suggesting that DO levels in Puget Sound were generally lower than DO levels in the river water. The downstream distribution of DO further suggested this relationship because DO decreased from the head to the mouth of the slough during high tide (Figure 2).

The measured values of DO, DIC, and DIC 13C, with respect to salinity, were compared with the conservative expectation of each tracer (Figure 3). The fresh water endmember had a DIC concentration of 380.0 mol/kg, a DIC 13C of -9.40 o/oo, a DO concentration of 365.0 mol/kg, and a salinity of 0.045 o/oo. The marine endmember, a 10m-deep sample from Puget Sound, had a DIC concentration of 1678.6 mol/kg, DIC 13C of 0.26 o/oo, and was assigned a salinity of 28.500 o/oo because the salinity at 10m in Puget Sound at this time did not vary significantly from 28.5 o/oo (M. Edie, University of Washington, pers. comm., 1995). A marine endmember was not collected for DO, so the endmember was chosen from a six-station average of DO concentrations that were measured in Port Gardner, Washington (Figure 1) on April 12, 1995 (Ocean 201, University of Washington, 1995) to yield a DO concentration of 298.53 mol/kg and a salinity of 28.450 o/oo. This value may be representative of the DO concentration of the marine endmember, but there exists some uncertainty in the value because DO concentration varies widely in the Port Gardner area.

The close fit of both the DIC and DIC 13C, with respect to salinity, to conservative expectations indicates that mixing between the fresh and marine endmembers controlled DIC concentration and DIC 13C in the slough during April 5-6, 1995. DO, on the other hand, showed a positive deviation from linearity. The deviation was likely due to reaeration because the DO concentrations appeared to be approaching the average saturation value in the slough (Figure 3). Photosynthesis was ruled out as the cause of elevated DO levels because no corresponding decrease in DIC or increase in DIC 13C was observed. An unquestionable conclusion could not be made, however, due to the poorly defined marine endmember for DO.

Diurnal trends of DIC, DO, DIC 13C, and salinity were compared to further investigate the factors controlling DO levels in Steamboat Slough.

The diurnal trend of DO mirrored that of salinity, a tracer of tidal mixing in the slough, suggesting that DO was primarily influenced by mixing of the fresh and marine endmembers rather than by biological processes. Inverse relationships existed between DIC and DO, while DIC and DIC 13C were directly correlated such that an increase in DIC corresponded to an increase in DIC 13C. If respiration had been the cause of the diurnal DO decrease, there would have been a corresponding increase in DIC and depletion in DIC 13C. Instead, the DIC 13C increased with the observed increase in DIC, indicating that respiration was not the cause of the DO decrease. The results of this study thus indicate that mixing and reaeration, rather than BOD, primarily influenced DO levels in Steamboat Slough under April flow conditions. If this study had been performed during August flow conditions, the results may have resembled those of Cusimano (1994).

Table 1. Summary of analytical procedures that were used for this study.

Analyte	Method of Determination
DO	Carpenter's modification of the Winkler titration (Carpenter, 1965)
DIC	Manometer (Quay et al., 1992)
DIC 13C	Finnigan MAT 251 mass spectrometer (Craig, 1957)
Salinity	Salinometer

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Elizabeth S. Housel
University of Washington, School of Oceanography
Box 357940
Seattle, WA, USA 98195-7940

Ph (206) 543-6790
Email liz@ocean.washington.edu

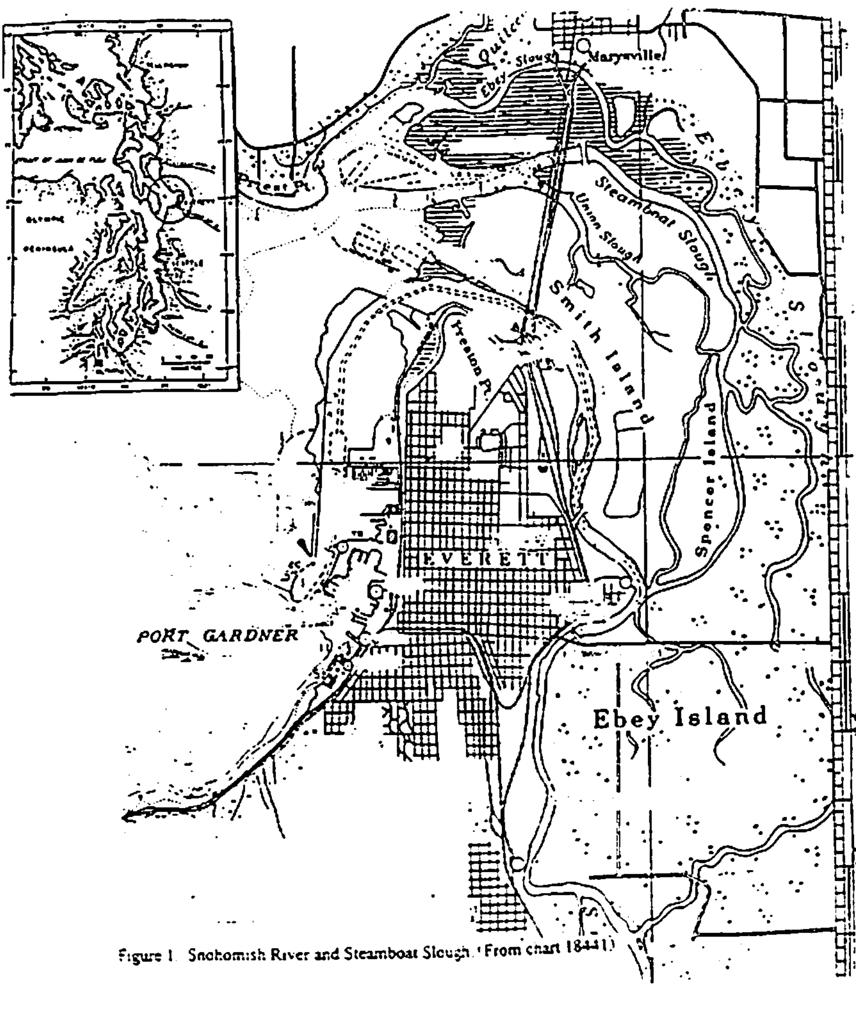

Figure 1. Snohomish River and Steamboat Slough. (From chart 18441)

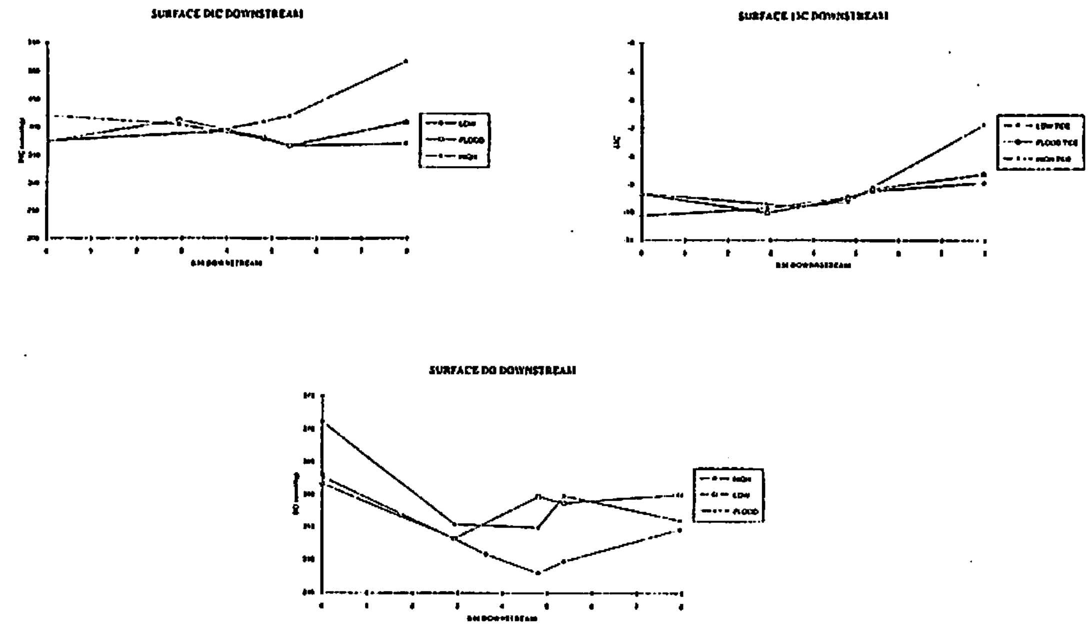

Figure 2. DIC, DIC $\delta^{13}C$, and DO from the head to the mouth of the slough. DIC and DIC $\delta^{13}C$ increase downstream during high tide, while DO decreases downstream during high tide.

NOAA'S NATIONAL SURVEY OF ESTUARINE EUTROPHICATION: AN ASSESSMENT WITH IMPLICATIONS FOR DEVELOPING AN INDICATOR OF COASTAL ECOSYSTEM HEALTH

Suzanne Bricker, John Klein, Charles Alexander, Chris Clement,
Scot Frew, Michelle Harmon, and Doug Pirhalla,
NOAA/National Ocean Service

Introduction

The National Oceanic and Atmospheric Administration's Office of Ocean Resources Conservation and Assessment (ORCA) within the National Ocean Service began development of the National Estuarine Eutrophication Survey in October 1992. The objectives are to: (1) assess the existing conditions and trends for the base period of 1970-present, in estuarine eutrophication in 126 estuaries of the contiguous United States; (2) publish results in a series of regional reports and a national report; (3) formulate a national response to identified problems; and (4) develop a national "indicator" of estuarine health from survey results.

The Problem

Coastal and estuarine waters are now among the most heavily fertilized environments in the world. Discharges of nutrients from point (e.g., wastewater treatment plants) and nonpoint (*e.g.*, agriculture, lawns, gardens) sources are known to have direct effects on water quality through increases in the production of phytoplankton and subsequent increased turbidity and decreased dissolved oxygen, as well as indirect effects on commercial fisheries, recreation, and even public health.

The apparent nationwide increase in estuarine nutrient inputs and eutrophication symptoms in recent years has resulted in numerous local and regional investigations into the location and severity of nutrient problems and into the specific causes. However, evaluating this problem on a national scale and formulating a meaningful strategy for improvements requires a different approach.

Methods

Numerous reports and papers from workshops, panels, and commissions have consistently identified nutrient enrichment and eutrophication as a critical problem in our nation's estuaries (*e.g.*, NAS, 1969; Likens, 1972; NOAA, 1991). These conclusions are based upon results of scientific research and water quality monitoring within many individual estuaries. The operative question becomes - how to accurately determine the nature of this problem for the estuaries of the contiguous United States? Given the limited resources of this project, it was not practical to try to gather and consolidate the many thousands of existing data records. Even if it were possible to do this, the results would be next to impossible to interpret due to incompatible data types, formats, time periods, and methods, not to mention the endless hours attempting to merge disparate data into a comprehensible whole.

Alternatively, ORCA has elected to acquire systematically consistent and detailed sets of qualitative data from the existing expert knowledge base (*i.e.*, coastal and estuarine scientists) through a series of surveys, interviews, and regional workshops. The goal is to determine the status and recent trends of selected parameters for a limited set of national estuaries.

Designing the Survey Form

Collecting a comparable and consistent data set from many different sources requires a carefully constructed data collection format. For this exercise, ORCA developed a questionnaire format. The first step was to identify the parameters of interest through a series of meetings and workshops with estuarine scientists. To be included, a parameter had to be: (1) essential for accurate characterization of nutrient enrichment; (2) generally available for most estuaries; (3) comparable among estuaries; and (4) based upon existing data and/or knowledge (*i.e.*, no new monitoring or analysis required). Sixteen parameters were selected (Table 1).

The next step was to establish response ranges to ensure discrete gradients among responses. For example, the survey asks whether total dissolved nitrogen (TDN) is high, medium, or low based upon specific thresholds (*e.g.*, high exceeds 1 mg/l, medium between 0.1-1.0 mg/l, low less than 0.1 mg/l, or unknown). For each parameter, information is requested for existing conditions and recent trends. Existing conditions were defined as a typical 12- month period (*i.e.*, normal freshwater inflow, average temperatures, etc.). Trends include the direction, magnitude, and time period of change over the past 20 to 25 years.

A consistently applied spatial framework was also required. ORCA's National Estuarine Inventory (NEI) was used (NOAA, 1985). The NEI establishes a rigorous spatial framework for the consistent synthesis and depiction of physical, chemical, and biological attributes (*e.g.*, salinity, land use, wetlands, distribution and abundance of fishes and invertebrates, pollution sources, pesticide use, population, and several others) for 126 estuaries of the contiguous United States (Table 2). The survey requests characterization of each parameter in the three salinity zones as defined in the NEI (tidal fresh 0-0.5 ppt, mixing 0.5-25.0 ppt, and seawater exceeding 25.0 ppt). This model provides a consistent basis for comparisons among these highly variable estuarine systems.

Finally, a section was included in the survey where respondents could rank the reliability of their responses for each parameter as either highly certain, moderately certain, reasonable inference, or speculative inference. This was especially important given that responses are based upon a range of information sources from statistically tested monitoring data to general observations. The objective is to exploit all available information that can provide insight into the existing and historic conditions in each estuary and to understand its limitations.

The survey forms were tested and revised prior to initiating the national survey. Salinity maps, based upon the NEI salinity zones, were distributed with the survey forms for orientation. Respondents were requested to update and/or revise these maps as necessary and return them with the survey forms to ORCA.

Collecting the Data

The target population of experts identified to participate in the survey included at least one expert per estuary. By the summer of 1993, more than 400 persons had agreed to participate in the survey. Survey forms were mailed to the experts who then mailed back their responses. The response rate was approximately 25% with at least 1 response for 112 of the 126 NEI estuaries surveyed.

The initial survey methods and results were evaluated in May 1994 by a panel of NOAA, state, and academic eutrophication experts. The panel recommended that ORCA adopt a regional approach for data collection involving site visits to selected experts to fill data gaps and revise salinity maps, regional workshops to finalize and reach consensus on the responses to each question (including salinity maps), and regional reports on the results.

The revised strategy was implemented in the summer of 1994 starting with the 22 estuaries of the Mid-Atlantic region (Table 2). The Mid-Atlantic regional workshop was held in January 1995 and a draft regional report has been completed. The South Atlantic regional workshop was held in February 1996 and a regional report will be prepared. Regional workshops are currently scheduled for the Gulf of Mexico (June 1996), North Atlantic (July 1996), and the West Coast (August 1996). Depending upon the success of this schedule, a workshop to review national results may be held in the fall of 1996.

Results To Date

Mid-Atlantic

For existing conditions, on average among the 16 parameters, problem conditions are reported for 40% (3,148 sq. miles) of the regional estuarine surface area (includes tidal fresh, mixing, and seawater zones (Bricker *et al.*, in prep). The mixing zone is most highly affected by percent (47%) and area (1,613 sq. miles). Problem conditions occur almost exclusively during the summer months. Four parameters are observed at problem levels in more than half of all three salinity zones; Chl-a, turbidity, TDN, and total dissolved phosphorus (TDP). All 22 estuaries within the Mid-Atlantic region have observed at least 5 of the 16 parameters at problem levels some time during the year. Almost half of the Mid-Atlantic estuaries report occurrences of anoxia and hypoxia, although only for small areas. The estuaries that appear to be most highly affected are Long Island Sound, Hudson River/Raritan Bay, Choptank River, Narragansett Bay, and Potomac River.

For trends, changes in the magnitude of parameter values suggest the largest area of worsening conditions is the mixing zone (although this is almost equally balanced by areas of improvement). Changes in frequency, duration, and spatial coverage of events suggest that the largest area of worsening conditions is the seawater zone. On average, the areas exhibiting degradation are about equal to areas showing improvement, although together these areas account for only 25% of the regional estuarine surface area with the balance being either unknown or showing no trend in conditions. Estuaries showing the most improvement were Potomac River, Delaware Bay, Narragansett Bay, Patuxent River, and Choptank River. Those showing the most degradation were Long Island Sound, Chesapeake Bay, central Buzzards Bay, and Rappahannock River.

South Atlantic

The South Atlantic workshop was completed in February 1996. Workshop results were mailed to participants on March 1, 1996 for final review prior to publication in a regional report. Several regional issues were discussed at the workshop including dissolved oxygen (not typically measured in many South Atlantic estuaries because it is not a problem), benthic community dominance (typically annelids though this does not indicate degradation), turbidity (some regional estuaries are "blackwater" systems with unique characteristics), TDN (some regional estuaries carry 60-90% of nitrogen in organic form, not readily available for primary production), and wetlands (dominant primary producer in many South Atlantic estuaries). In general, most of the South Atlantic estuaries are not heavily influenced by nutrient enrichment and eutrophication problems. A more complete assessment will be included in the regional report which is expected to be final by June 1996.

Next Steps

Site visits, regional workshops, and regional reports will be completed for the Gulf of Mexico, North Atlantic, and West Coast in the next six to eight months. A national assessment report of the status and health of the nation's estuaries will be developed from the survey results. In addition, an "indicator" of ecosystem health will also be published. Both national products will require one or more workshops to discuss and reach consensus on the methods proposed for conducting these analyses. ORCA also expects to recommend a series of follow-up activities that may include additional and/or improved water quality monitoring, and case studies in specific estuaries for further characterization and analysis.

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Charles Alexander
NOAA/National Ocean Service
Office of Resource Conservation and Assessment
1305 East West Highway
Silver Spring, MD, USA 20910

Ph (301) 713-3000
Email calexander@seamail.nos.noaa.gov

Table 1. National Estuarine Eutrophication Survey indicators and response ranges.

Part 1: Algal Conditions	Part 2: Nutrients and Dissolved Oxygen	Part 3: Ecosystem/Community Response
• Chlorophyl-a Hypereutrophic >60 µg/l High >20, ≤ 60 Med. >5, ≤ 20 Low >0, ≤ 5 • Nuisance Algae (Impacts on resources or resource use) Problem No Problem • Toxic Algae (Impacts on resources or resource use) Problem No Problem • Macroalgal Abundance (Impacts on resources or resource use) Problem No Problem • Epiphyte Abundance (Impacts on resources or resource use) Problem No Problem • Turbidity High = <1m Med. = >1m, <3m Low = >3m • Suspended Solids (Impacts on resources or resource use) Problem No Problem	• Total Dissolved Nitrogen (TDN) High ≥ 1mg/l Med. ≥ 0.1, <1 mg/l Low >0, < 0.1 mg/l • Total Dissolved Phosphorus (TDP) High ≥ 0.1mg/l Med. ≥ 0.01, <0.1 mg/l Low >0, <0.01 mg/l • Anoxia (0 mg/l) Observed No Occurrence • Hypoxia (>0, ≤ 2 mg/l) Observed No Occurrence • Biologically Stressful Dissolved Oxygen (>2, ≤ 5 mg/l) Observed No Occurrence	• Benthic Community Diverse Mixture Crustaceans Molluscs Annelids Other • Phytoplankton Community Diverse Mixture Diatoms Flagellates Blue-green Algae Other • System Productivity Mixed Pelagic Benthic • Submerged Aquatic Vegetation (SAV) (as % of surface area) Very Low >0, ≤10 Low >10, ≤ 25 Med. >25, ≤ 50 High >50, ≤ 100

Existing Conditions	Trends
• Information collected by salinity zone • Probable months of occurrence • Duration of event • Episodic or periodic occurrence	• Information collected by salinity zone • Direction of observed change • Magnitude of observed change • Contributing factors

Table 2. NOAA's National Estuarine Inventory (NEI) regions and estuaries.

North Atlantic (14)

Passamaquoddy Bay
Englishman Bay
Narraguagus Bay
Blue Hill Bay
Penobscot Bay
Muscongus Bay
Sheepscot Bay
Casco Bay
Saco Bay
Great Bay
Merrimack River
Massachusetts Bay
Boston Bay
Cape Cod Bay

Mid Atlantic (22)

Buzzards Bay
Narragansett Bay
Gardiners Bay
Long Island Sound
Connecticut River
Great South Bay
Hudson River/Raritan Bay
Barnegat Bay
New Jersey Inland Bays
Delaware Bay
Delaware Inland Bays
Maryland Inland Bays
Chincoteague Bay
Chesapeake Bay
Patuxent River
Potomac River
Rappahannock River
York River
James River
Chester River
Choptank River
Tangier/Pocomoke Sounds

South Atlantic (20)

Albemarle/Pamlico Sounds
Pamlico/Pungo Rivers
Neuse River
Bouge Sound
New River
Cape Fear River
Winyah Bay
N. Santee/S. Santee Rivers
Charleston Harbor
St. Helena Sound
Broad River
Savannah River
Ossabaw Sound
St. Catherines/Sapelo Sounds
Altamaha River
St. Andrew/St. Simons Sounds
St. Marys River/Cumberland Sounds
St. Johns River
Indian River
Biscayne Bay

Gulf of Mexico (36)

Florida Bay
South Ten Thousand Islands
North Ten Thousand Islands
Rookery Bay
Charlotte Harbor
Caloosahatchee River
Sarasota Bay
Tampa Bay
Suwanee River
Apalachee Bay
Apalachicola Bay
St. Andrew Bay
Choctawhatchee Bay
Pensacola Bay
Perdido Bay
Mobile Bay
Mississippi Sound
Lake Borgne
Lake Ponchartrain
Breton/Chandeleur Sounds
Mississippi River
Barataria Bay
Terrebone/Timbalier Bays
Atchafalaya/Vermilion Bays
Mermentau River
Calcasieu Lake
Sabine Lake
Galveston Bay
Brazos River
Matagorda Bay
San Antonio Bay
Aransas Bay
Corpus Christi Bay
Upper Laguna Madre
Baffin Bay
Lower Laguna Madre

West Coast (34)

Tijuana Estuary
San Diego Bay
Mission Bay
Newport Bay
San Pedro Bay
Alamitos Bay
Anaheim Bay
Santa Monica Bay
Morro Bay
Monterey Bay
Elkhorn Slough
San Francisco Bay
Central San Fran/San Pablo/
Suisun Bays
Drakes Estero
Tomales Bay
Eel River
Humbolt Bay
Klamath River
Rogue River
Coos Bay
Umpqua River
Siuslaw River
Alsea River
Yaquina Bay
Siletz Bay
Netarts Bay
Tillamook Bay
Nehalem River
Columbia River
Willapa Bay
Grays Harbor
Puget Sound
Hood Canal
Skagit Bay

CONSIDERING SEA LEVEL RISE IN PLANNING FISHERIES HABITAT RESTORATION IN COASTAL LOUISIANA

Gregory Blaine Miller, NOAA/National Marine Fisheries Service[1]

Introduction

The commercial fishing industry in Louisiana annually lands more than one billion pounds of finfish and shellfish with a dockside value exceeding $250 million (USDOC, 1995). This sustainable coastal industry is dependent upon Louisiana's 1.9 million acres of estuarine marshes (Hefner *et al.*, 1994). However, these activities are threatened because the state's coastal wetlands are disappearing at a rate of more than 25 square miles per year (Britsch and Dunbar, 1993). These coastal wetland losses are caused by natural processes (delta decay and land subsidence) and human activities (flood protection and minerals extraction). A combination of stronger wetlands protection programs and a coastwide restoration effort have been implemented to counteract the state's wetlands loss crisis. This paper analyzes sea level rise as a planning factor for long-term habitat restoration efforts in the Louisiana coastal zone.

Protecting and Restoring the Coast

Coastal erosion and wetland losses in Louisiana were documented by scientists beginning in the 1930s and were eventually quantified at alarming rates (Russel, 1936; Gagliano, Meyer-Arendt, and Wicker, 1981). It took several decades for the public sector to recognize the magnitude of the problem and begin a policy debate on appropriate responses (Templet, 1987; Silva and Meo, 1985). Eventually, the state's academic and environmental communities succeeded in convincing government entities of the severity of the problem and its consequences (Klarin and Hershman, 1990). The protection of wetland resources was a major focus of the state's initial efforts to develop a federally approved coastal zone management program (LACCMR, 1973). Activities in wetlands are now regulated through a state coastal zone permit program that has effectively reduced wetlands destruction through a strategy of impact avoidance, minimization and mitigation (Forman, 1980; LDNR, 1991).

DISCLAIMER: The views presented in this article represent those of the author and not necessarily those of the National Marine Fisheries Service or the U.S. Government.

In 1989, Louisiana's citizens voted to amend the state constitution to establish a Wetlands Conservation and Restoration Fund that receives up to $25 million annually from state oil and gas royalties (LDNR, 1991). Establishment of this dedicated funding source spurred federal enactment of a coastal restoration law primarily intended to address the loss of coastal wetlands in Louisiana (Miller, 1995). The Coastal Wetlands Planning, Protection and Restoration Act of 1990 (CWPPRA) has served as the funding and organizational tool for the development of a comprehensive, watershed-based, coastal restoration program in Louisiana (Miller, 1995). CWPPRA established a Federal/State task force to develop the restoration plan and to foster the cooperative implementation of projects (Zobrist *et al.*, 1993). The National Marine Fisheries Service (NMFS) is a member of the CWPPRA Task Force and has been awarded $20.25 million to protect and restore more than 42,000 acres of coastal wetlands through barrier island rebuilding, salt marsh restoration, experimental shoreline protection, and conservation property acquisition.

The initial CWPPRA projects are viewed by many coastal managers, scientists, environmental groups, and policy makers as merely emergency actions to reduce the immediate loss of wetlands (Boesch *et al.*, 1994). A long-term, comprehensive strategy is being developed to address the Nation's most significant coastal habitat loss problem. The essential components of a long-term strategy will be the restoration of barrier island systems and the re-introduction of Mississippi River water and sediments into wetlands (Boesch *et al.*, 1994). NMFS is participating in a barrier island restoration feasibility study designed to evaluate the potential for the large scale restoration of islands along the Louisiana coast.

Incorporating Sea Level Rise Into Restoration Planning

A major consideration in planning long-term coastal restoration projects must be the current and predicted rates of sea level rise. The combination of land subsidence and rising water result in an annual relative sea level increase of 0.4 inches along portions of the Louisiana coast. Predictive models indicate that sea level may rise between 25 inches and 126 inches above current levels by the year 2100 resulting in additional annual coastal wetland losses of 19,000 acres in the state (Titus, 1988). Therefore, it is not only important to recognize sea level rise as a factor in the loss of wetlands, but also as a planning consideration for efforts to protect and restore coastal resources (Day and Templet, 1989). The expected rise in sea level is especially significant for barrier island restoration planning because of the associated expense and the importance of these systems in the protection of estuarine wetlands. Agencies can incorporate sea level rise predictions into restoration plans by either increasing existing island heights or choosing to move project sites inshore to the predicted Gulf of Mexico coastline (Titus, 1990). A third option, the use of hard structures to protect barrier shorelines, is not being considered by planners because it has already proven ineffective and even detrimental on East Timbalier Island (Suter, Penland, and Ramsey, 1991).

Increasing the heights of uninhabited barrier islands in their present locations will require the use of large amounts of dredged sediments to counteract expected increases in sea level. Studies indicate that sufficient sediment resources for island restoration exist in nearshore shoals and inner-shelf deposits (Suter, Penland, and Ramsey, 1991). NMFS is planning a $7.7 million CWPPRA project on East Timbalier Island that will use 890,000 cubic yards of sediment to restore 87 acres of back-barrier wetlands (Miller et al., 1995). Incorporating sea level rise predictions into this project by raising the island 2.25 feet (i.e., above the predicted minimum sea level in the year 2100), would require an additional 315,810 cubic yards of sediment at an estimated total project cost of $10.4 million. To incorporate the maximum predicted sea level rise would require a total of 2,358,867 cubic yards of sediment at a cost of $20.4 million. These efforts would have to be implemented through periodic dredged material placements to allow for tidal wetland establishment and to avoid the subsidence problems created by a single large-scale increase in island elevation.

If adopted, the onsite restoration option should also involve coastal use planning to allow islands to migrate naturally with increasing sea levels. Even if barrier islands can be restored to historic sizes and shapes, continuing sea level rise will overcome islands if they are not allowed to migrate inland. Efforts to incorporate island migration into restoration projects can be hampered by existing human uses of the coast such as oil exploration and commercial fishing. Coastal use planning for island migration would have to involve the removal, relocation or upgrading of the extensive back-barrier oil and gas infrastructure in areas such as Timbalier Bay. However, coastal industries have been supportive of some restoration efforts to date because of the storm protection and natural resource nursery benefits provided by coastal wetlands (Miller, 1994).

Movement of project sites from existing barrier island locations to the predicted Gulf of Mexico coastline may be preferable because it would offer the additional benefit of the natural incorporation of existing island sediments into the created islands through transgression. However, this option will require the construction of entirely new barrier islands as opposed to the restoration of back-barrier wetlands and frontal dunes on existing island platforms. The process of building new islands would involve more extensive engineering and design preparation resulting in elevated costs over periodic in situ restoration efforts.

Some considerations for analyzing the predicted coastline option are: 1) is there suitable construction depth inland of the existing barrier island, 2) is a sufficient sediment source available within hydraulic pumping distance of the site, and 3) can an island be constructed inland that will function like a natural barrier island? Using comparable water-bottom acreage with depths of seven feet or less as a site selection criteria, suitable inshore creation sites are available for the Grand Terre, Timbalier, East Timbalier, and Isle Derniere barrier island systems. Analyses of sediment deposits indicate that appropriate grain sizes for island building exist for each of these island systems (Suter, Penland and Ramsey, 1991). However, the technical feasibility, environmental impacts, and expense of the sediment acquisition is potentially problematic for the Timbalier and Isle Derniere barrier island systems.

Conclusions

The combined effects of human activities, geologic processes and sea level rise have produced dramatic impacts in coastal Louisiana. Coastal environments are dynamic settings that will continue to change because of sea level rise and other factors. Relative and predicted rates of sea level rise along the Louisiana coast preclude managers from viewing the region as a static set of lines on a map. A public policy decision has been made to address the coastal erosion problem through restoration rather than retreating and relocating coastal development inland.

Consideration of anticipated sea level rise must be a major component of coastal habitat restoration planning. Large public expenditures to address coastal wetland losses must be guided by effective planning to optimize the long-term contribution of each restoration project to a comprehensive coastal restoration strategy. Planning should involve the immediate incorporation of sea level rise estimates into the design of the initial "band-aid" CWPPRA projects and into the components of a long-term coastal preservation plan. Sea level rise predictions can be incorporated into restoration planning by increasing the elevation of restored areas or by locating project sites at predicted coastlines. Increasing island heights must consider the elevations required for tidal wetlands, possible increased subsidence, and existing adjacent coastal uses. Building islands at anticipated shorelines most consider the available sediment resources and construction depths.

A significant consequence of inshore island creation would be the abandonment of the extensive wetland complexes between the expected coastline and the current position of the barrier islands. The result would be an estimated net loss of one million acres of wetlands unless an equivalent area could be set aside behind the created islands for natural wetland establishment. This set aside is unlikely because these areas are currently occupied by farms, industry, and population centers.

Drawbacks associated with increasing island heights will arise if these projects are not implemented in conjunction with river diversions. If instituted solely, coastal managers would have to establish recurring maintenance programs for barrier islands. Tandem implementation of barrier island restoration and river diversion would allow for the natural delivery of sediments through distributaries providing for "natural" re-nourishment of the islands (Ruebsamen, 1996).

Sea level rise is a growing concern for fisheries and coastal managers throughout the United States (Bigford, 1991). Because sea level rise has already begun to affect Louisiana's marine fisheries habitats, the restoration response in the state is serving as a proving ground for coastal management and restoration practices applicable to subsequent sea level rise in other areas of the United States (Day and Templet, 1989).

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Gregory Miller
National Marine Fisheries Service
Office of Protected Resources
1315 East West Highway
Silver Spring, MD, USA 20910

Ph (301) 713-1401
Fax (301) 713-0376
Email Gregory_Miller@ssp.nmfs.gov

EVALUATION OF A WATERSHED-BASED WETLAND RESTORATION INITIATIVE FOR WASHINGTON'S PUGET SOUND BASIN

Richard Gersib, Washington Department of Ecology

To date, attempts at restoring aquatic resources have largely been compensatory in nature or oriented to fish/waterfowl and restricted in scope to individual sites. This paper summarizes the field testing and evaluation of a fledgling, non-regulatory initiative within Washington's Puget Sound Trough which addresses the restoration of aquatic resources in a larger watershed context.

Background

In 1987, the first Puget Sound Water Quality Management Plan was developed to restore and protect the biological health and diversity of Puget Sound. A new directive was added in 1991 which called on the Washington Department of Ecology (Ecology), US Environmental Protection Agency (EPA), US Fish and Wildlife Service (FWS), and US Army Corps of Engineers (COE) to develop and implement a program to restore Puget Sound wetlands that assist in achieving the overall plan goal. Budget limitations restricted significant action until 1993 when a program coordinator was hired and an interagency work team of technical experts from Ecology, EPA, FWS, COE, Washington Departments of Fisheries and Wildlife, the Northwest Indian Fisheries Commission and the Puget Sound Water Quality Authority was formed. This technical work team developed the process framework for watershed-based wetland restoration planning and implementation. In 1994, a Puget Sound Advisory Group representing local jurisdictions, tribes, agriculture, timber, conservation, community groups, and state and federal agencies was convened to develop a working draft plan for the Puget Sound Wetland Restoration Program. Program goals identified in the working draft plan are:

1. Restore and maintain wetlands of sufficient quantity and quality to assist in meeting the Puget Sound Water Quality Management Plan purpose of restoring and protecting the biological health and diversity of Puget Sound.
2. Identify ecological problems within watersheds and, where wetlands restoration can address problems, reestablish lost or degraded natural functions.
3. Identify community needs within watersheds and restore natural wetland functions which contribute to meeting human health, safety, and quality of life needs of residents.
4. Support state and federal policy goals of no net loss and a long-term net gain in acreage and function of wetlands.

Program Description

The cornerstone of this program is a coordinated public/private approach to restoring wetlands which can help solve ecological problems and meet community needs within a watershed. We know that wetland restoration can increase watershed functions such as water quality improvement, flood storage and desynchronization, and fish and wildlife habitat. The dilemma has been finding a common sense method which uses public input and existing technical information to analyze the watershed and identify wetland restoration sites which can contribute to solving problems and meeting needs. Through continued testing and refinement, we believe this program can fill this need for many non-regulatory applications.

Two major products are anticipated from this watershed-based effort. The first is a "menu" of wetland restoration sites with anticipated functions each could provide if restored. Functions identified are those which are capable of positively impacting specific ecological problems and community needs identified for that basin. This information, along with technical assistance and training, will be provided to all individuals, organizations, local jurisdictions, and tribes interested in restoring wetlands. The second major product is the on-the-ground restoration of wetlands. This program considers planning and technical method development as two critical components of program success. However, planning must not be the end product. We believe the success of this program must be measured by how effective we are at restoring or facilitating the restoration of wetlands which help solve ecological problems and meet community needs.

Cooperating landowners having wetland restoration sites identified in the "menu" will be matched with available funding sources to restore wetlands in a non-regulatory manner. The keys to success lie in our ability to establish credibility with landowners and develop a diverse funding base for restoration activities. Credibility takes time and trust, while a diversified funding base requires the matching of funding sources with functions to be gained through restoration. The development of this large "menu" of sites with anticipated gains in wetland function is the critical link to matching sites with funding sources. For example, using technically sound watershed analysis techniques, sites having the greatest potential to provide flood flow storage/desynchronization can be identified and targeted for restoration with floodplain management monies. Likewise, sites having the greatest potential to provide non-point water quality improvement can be targeted for restoration using State Section 319(h) grant funds. Similar funding opportunities exist to restore migratory bird habitat using Pacific Coast Joint Venture and Washington Duck Stamp monies and important off-channel rearing habitat for juvenile coho salmon using state and federal fish habitat enhancement dollars. The information gained through watershed analysis efforts can also serve as an important screening tool used to improve predictability and effectiveness of wetland restoration in a regulatory context.

Planning activities consist of watershed analysis techniques which characterize surface and subsurface water flow through the watershed, classify existing wetlands into hydrogeomorphically similar classes, identify potential restoration sites, and characterize the potential functions to be gained at each site. This work will result in the development of the "menu" described above. Then, work is done on-the-ground with landowners to develop specific wetland restoration site plans and ultimately restore wetlands.

Implementation in Stillaguamish Basin

In 1995, this program framework was applied in the 180,000 hectare Stillaguamish River basin in Washington State. The purpose was to begin moving the plan from a conceptual framework to a field-proven method for identifying and analyzing wetland restoration sites and characterizing the functions each is capable of providing. The Stillaguamish basin serves as the pilot watershed for the development, testing, and evaluation of all methods.

The following steps define the framework for reaching program goals within the Stillaguamish basin:

1. Develop partnerships with agencies, local jurisdictions, and river basin residents to direct program activities. Considerable time was spent developing working partnerships with local jurisdictions, watershed advisory groups, tribes, and other interest groups.

2. Identify ecological problems and community needs that wetland restoration can address using public input and existing data. A survey form was developed and distributed to watershed residents to help identify ecological problems and community needs of concern. All available water quality technical studies were then used to identify the know location and extent of water quality/quantity problems.

3. Identify key wetland functions that contribute to the resolution of problems/needs. This step consisted of identifying wetland functions capable of addressing problems and needs important to watershed residents. For example, the wetland function of flood flow storage and desynchronization was identified as a tool to help solve flooding problems on the Stillaguamish River.

4. Identify wetland restoration sites within each hydrogeomorphic wetland class. Using GIS, soils data sets were merged and overlaid with existing

wetlands data. Maps were produced which identified and classified potential wetland restoration sites.

5. Conduct watershed analysis which characterizes the watershed, classifies wetland systems, and characterizes individual site functions. Prescriptions were developed which use GIS technology to evaluate the entire Stillaguamish basin and identify wetlands having the greatest potential for providing targeted wetland functions. Methods were developed and tested for seventeen wetland functions in the Stillaguamish basin.

6. Create a "menu" of potential restoration sites with each site's anticipated contributions to system function. Watershed analysis was used to create individual lists of potential restoration sites for each targeted wetland function. These lists were then combined to create the menu.

7. Compile information on individual wetland restoration sites to verify GIS assumptions, assess restoration potential, and evaluate project complexity. Field inspections are completed on a priority basis to confirm hydrogeomorphic classification and assess restoration potential.

8. Restore or facilitate the restoration of wetlands. Using the menu, different funding sources are used to restore wetlands capable of provided the function or functions targeted by the funding agency. Contacted are then made and working relationships established with cooperating private and public landowners. Wetland restoration plans are developed and executed.

9. Monitor and evaluate both individual sites and program successes/failures.

Future Direction

There is an urgent need for watershed analysis techniques which identify and characterize the potential functions of wetland restoration sites at a basin-wide scale. After all methods are finalized in the Stillaguamish River basin, watershed analysis methods will be refined further in the Snohomish and Nooksack River basins of Puget Sound. We seek to demonstrate that watershed analysis can be completed in a four- to six-month period per basin, results are applicable for many non-regulatory and regulatory applications, and that government can work cooperatively with public and private landowners to restore wetlands in a cost effective, time efficient manner.

Richard A. Gersib
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA, USA 98504-7600

Ph (360) 407-7259
Fax (360) 407-6535
Email rger461@ecy.wa.gov

DANCING THE CHARLESTON SLOUGH: CONSTRAINTS AND COMPETING INTERESTS FOR TIDAL MARSH RESTORATION AT CHARLESTON SLOUGH, MOUNTAIN VIEW, SANTA CLARA COUNTY, CALIFORNIA

Jonathan T. Smith, San Francisco Bay
Conservation and Development Commission and
Robert J. Batha, San Francisco Bay
Conservation and Development Commission

Background

Charleston Slough is located in the City of Mountain View and is bounded on the north by San Francisco Bay, on the east by Cargill Salt Division's salt pond A1, on the south by uplands, on the southeast by the City's shoreline park, and on the west by the Palo Alto flood control basin, also known as the Palo Alto Baylands. One levee ("the slough levee") separates inner Charleston Slough from outer Charleston Slough and southern San Francisco Bay. A second levee ("the salt pond levee") separates the inner slough from salt pond A1, and a third levee ("the baylands levee") separates the inner slough from the Palo Alto Baylands. A water control structure is located with the slough levee and controls tidal exchange between the inner slough and the outer slough and southern San Francisco Bay.

Prior to 1975, Cargill's predecessor, the Leslie Salt Company, owned the inner slough, which was then connected to the outer slough and the Bay by a pipe that was 60 inches in diameter. This pile allowed sufficient tidal exchange to maintain within the inner slough approximately 40 to 60 acres of healthy tidal marsh. In 1975, Leslie replaced the pipe with a pipe that was only 42 inches in diameter and appeared to have been placed at a higher elevation. This change in the size and possible change in the elevation of the pipe prevented proper tidal drainage on the outgoing tide. Thus, the inner slough became a kind of tidal "lake" and almost all of the tidal marsh located in the inner slough died. Leslie did not obtain a permit from the San Francisco Bay Conservation and Development Commission, as required by the McAteer-Petris Act, which the Commission enforces, when Leslie replaced the pipe.

Thereafter, Leslie conveyed the slough property to the City of Mountain View, which also uses the inner slough as a source of water for the recreational lake that the City maintains in its adjacent park. The City obtained the inner slough property with knowledge of the violation and the need to restore the tidal marsh that had previously existed in the inner slough. In 1980, the City applied for and the Commission granted an amendment to an existing permit to authorize a new water control structure to control tidal exchange between the inner and outer sloughs. The permit required an average daily tidal fluctuation of one foot and that the City restore at least 30 acres of tidal marsh by July 1, 1987. The permit also contained monitoring and reporting requirements.

The new water control structure never functioned as intended, and average daily tidal fluctuation ranges from 1-2 inches rather than one foot. Virtually no tidal marsh has been restored, and the inner slough remains a vast salt water lake. However, the inner slough supports a large population of shorebirds and ducks, including the California least tern, which is listed by both the federal government and California as an endangered species. The relatively protected nature of the inner slough, the large area of water-covered land, and the shallow depth of the "lake" make the inner slough very attractive to bird life.

When the City failed to meet the reporting, tidal fluctuation, and restoration conditions of its permit, the Commission commenced enforcement action. However, after some early discussions, the City and the Commission decided that it would be a more efficient use of public resources, more likely to meet the Commission's objective of restoring the inner slough, and more likely to meet the City's objective of ensuring a high-quality permanent source of water for its shoreline recreational lake if both the City and the Commission tried to work to a consensus resolution of this matter rather than litigating the alleged violations.

Goal, Constraints, and Competing Interests

The goal of the Charleston Slough restoration project is to create conditions that will promote the restoration of approximately 53 acres of tidal marsh within the inner slough as quickly as possible consistent with the many constraints that exist. These constraints include the need to avoid any possible flooding either of the Palo Alto baylands and nearby upland property that drains into the bayland or of salt pond A1, the need to avoid and to mitigate possible adverse impacts on the continued use of the inner slough by the California least tern, and the need to keep the total cost of the project within the budget of the City of Mountain View, which would pay for the entire project. These constraints caused the involvement of many interested parties, including the Commission, the cities of Mountain View and Palo Alto, the Santa Clara Valley Flood Control District, which operates the Palo Alto flood control basin for the City of Palo Alto, the Cargill Salt Division, the California Department of Fish and Game, the U. S. Fish and Wildlife Service, and the U. S. Army Corps of Engineers. In addition, several local environmental organizations and interested individuals were extensively involved in the negotiations that surrounded the resolution of this matter.

Alternatives and Limitations

The interested parties considered several alternative approaches to resolving this matter. Those alternatives included (1) the full breach alternative, which would have consisted of removing approximately 200 feet of the slough levee and thus would have allowed full tidal action within the inner slough, (2) a "large culverts alternative," which would have involved the renovation of the existing water control structure and the installation of between 5-6 culverts, each with a 60-inch diameter and some of which would have been open to tidal action at all times and some of which would have been fitted with slide flap gates to limit tidal action under specified conditions, (3) a "small culverts" alternative, which would have been similar to the large culverts alternative except the diameter of the culverts would have been smaller but also would have involved more culverts, (4) the relocation of the slough levee further inland to protect against tidal flooding but create two smaller areas, one of which would have been subject to full tidal action and one of which would have remained much the same as the current inner slough conditions, (5) the dredging of the outer slough, the renovation of the existing tidal control structure, or a combination of both of these approaches, (6) a "no-action" alternative, and (7) some form of off-site mitigation, either in a different but nearby location or simply the payment of cash to an appropriate fund in lieu of any actual mitigation.

Each of these alternative had positive aspects and negative aspects, based on the major goal of restoring 53 acres of tidal marsh while simultaneously avoiding any significant flooding to nearby property, avoiding or minimizing any adverse impacts on the California least tern and other bird life that currently use the inner slough, and not exceeding the financial ability of the City of Mountain View to pay for the project and all mitigation requirements.

The "full breach" alternative would provide that highest probability of restoring the most tidal marsh in the shortest period of time but also would involve the highest probability of flooding nearby property. Each of the "culverts" alternatives would reduce the probability of flooding, but would also reduce the probability of successful restoration and still involve some substantial risk of flooding under certain circumstances. Relocating the slough levee inland would create some area with "full" tidal action and thereby the best chance of restoration of this area while protecting upland areas from flooding but would also be extremely expensive and disruptive to existing resources. Dredging the outer slough would also be very expensive, and even in combination with a renovation of the existing water control structure would not offer a sufficiently high chance of a successful restoration effort. No reasonable off-site mitigation site could be located, and the simple payment of money into some unspecified fund was unacceptable. Similarly, the "no-action" alternative was clearly unacceptable.

Finally, the City of Mountain View maintained as its fall-back legal position that the amended permit only required the City to expend up to $50,000 to resolve this alleged violation. Although the Commission disagreed with this legal position and maintained that the City's financial liability was unlimited because it had not met all of the conditions contained in the amended permit and although the City had agreed to reserve any attempt to enforce its legal position pending attempts to resolve this matter by consensus, this knowledge provided a backdrop to all efforts to resolve this matter.

Compromises

Many of the involved parties agreed to a number of compromises that made the adoption of a final project design possible. First, and perhaps foremost, despite the City's legal position, the City eventually agreed to a final compromise project that will eventually result in the City's spending approximately $1.4 million when the project is complete. Second, the California Department of Fish and Game and the U. S. Fish and Wildlife Service initially sought approximately 2.5 acres of habitat islands located within both the inner slough and salt pond A1. However, they ultimately agreed to two habitat islands in the inner slough totaling one-half acre to offset possible adverse impacts on the California least tern. Also, ultimately, the Cargill Salt Division, which owns most of the salt pond levee, the City of Palo Alto, which owns most of the flood basin levee, and the Water District, which operates the baylands for the City of Palo Alto, all agreed to allow the City access over its levees for construction purposes and access to the levees to raise them to prevent flooding at very high tides.

Final Project CEQA Compliance

The adopted alternative includes the following elements: (1) dredge approximately 700 cubic yards from the tidal area that is outboard of the slough levee and approximately 600 cubic yards from the slough levee, (2) remove the existing water control structure and replace it with 6 5-foot diameter culverts, all fitted with a Nekton self-regulating tide gate set to allow as much as 4 feet of daily tidal exchange, (3) raise the slough levee and the Cargill salt pond levee to an appropriate elevation to prevent flooding, (4) create two habitat islands in the inner slough with a total area of 0.5 acre to mitigate possible impacts on the California least tern, (5) restore the north end of the salt pond levee to maintain characteristics attractive to least tern roosting, and (6) conduct appropriate monitoring.

Compliance with the California Environmental Quality Act (CEQA) was accomplished when the Commission prepared and circulated an environmental assessment under the Commission's functional equivalency regulations. Under the Commission's regulations, an environmental assessment is the equivalent of a full environmental impact report. The assessment was prepared with the significant help of the City of Mountain View staff and consultants.

Mitigation for possible adverse impacts on the California least tern and other bird life that currently use the inner slough consists of the construction of two habitat islands in the inner slough totaling approximately 0.5 acre, a prohibition against any work from June 1 through September 15 of each year, when the least tern uses the inner slough for roosting and foraging purposes, and the use of appropriate materials to raise the salt pond levee and to finish it with light-colored, shell-like material attractive to the least tern.

The project also includes extensive monitoring to track the evolution of changes in the inner slough and to provide information that could serve as a basis for minor adjustments, such as altering the operation of the Nekton gates or dredging to achieve the stated restoration goals of creating 53 acres of tidal marsh vegetation. Every two years, for a 10-year period, or until the restoration goals have been achieved, the City shall report to the Commission and public interest organizations, on whether the project is proceeding as expected toward the goal of restoring marsh vegetation in Charleston Slough. The monitoring requirements are based on a detailed plan prepared in advance of the settlement and require the City to develop and to provide information concerning each of the following elements: (1) the average daily tidal fluctuation in Charleston Slough; (2) a brief analysis of the composition, diversity, and density of plant and wildlife populations in the slough, specifically including a list of the plant species present, the number of acres in Charleston Slough supporting marsh vegetation, and annual bird counts of Charleston Slough; (3) a comparison with measurements taken in previous years; (4) an assessment of the water quality in the small boat lake, comparing water quality measurements with Regional Water Quality Control Board standards; (5) measurements of sedimentation rates and a comparison of measured rates with predicted values; (6) a description of the use of the slough and habitat islands by the California least tern; and (7) acts of vandalism to the control facility and measures implemented to thwart such acts.

Technology and Uncertainty

Technology has played a prominent role during the Commission's involvement in this matter. Starting in the late 1970s with the first attempt to restore tidal marsh in the slough, the City proposed and the Commission agreed that the installation of a relatively untested inlet/outlet structure ("the Allston Gate") would allow approximately one foot of tidal action within the slough, which was thought at the time to provide sufficient periods of tidal inundation and emergence to support marsh restoration. For reasons that are still debated, this first inlet/outlet structure failed to achieve more than a two inch tidal fluctuation and virtually no tidal marsh restoration occurred. Moreover, it now appears that providing an average daily tidal fluctuation of only 1 foot would not have been sufficient to provide the designated goal of restoring 53 acres of tidal marsh.

During the early stages of the review process in the late 1980s to develop an appropriate alternative project design, the various interested parties considered and then rejected various alternatives to restore tidal marsh to inner Charleston Slough. When they considered dredging the outer slough to increase tidal flows to the inner slough, the lack of nearby dredged material disposal sites doomed this alternative. An agitation dredge that simply churned up the Bay muds and required no disposal appeared to breathe life into this alternative, but was ultimately rejected because of the uncertain nature of the technology and concerns that stirring up that much mud might have unanticipated adverse environmental impacts. In evaluating raising the levees encompassing the inner slough to accommodate increased tidal action, the use of new levee construction methods that permitted the raising of the levees without significantly increasing the levee footprint was also considered but was ultimately rejected for cost reasons. As the levees were surrounded on both sides by wetlands, minimization of such impacts was critical to favorable review of such proposals. However, the use of this technology became unnecessary after the decision to use the Nekton gates was reached.

Use of Modeling

The City of Mountain View's hydrologic consultant used tidal information and modeling for several purposes. First, it used this information to predict maximum tidal elevations, tidal ranges, and tidal stage duration curves. This data was used, in turn, to predict the probability of success for the various proposed alternatives and the period of time that it could take to attain success and therefore for which monitoring would be appropriate. The consultant also used this data to determine the risk of flooding that each alternative entailed. Finally, this information was used in combination with the characteristics of the tidal mud located in the outer slough to determine the probability that natural scouring would occur in the outer slough. Without natural scouring, insufficient tidal exchange would occur in the inner slough to allow sufficient natural siltation to provide the necessary substrate for subsequent marsh restoration.

The Nekton Tide Gates

Early in project planning, it became apparent that the full breach alternative and the two culverts alternatives were not acceptable because of flooding risks. Similarly, by using fewer and smaller culverts, the risk of flooding could be reduced sufficiently, but this approach also reduced to an unacceptable level the probability of a successful restoration effort and stretched out to an unacceptable length of time the monitoring period necessary to determine if sufficient siltation would occur to create an elevation needed to support the growth and maintenance of appropriate marsh vegetation. Thus, some combination of a sufficiently large number of culverts of sufficient size was necessary to allow enough tidal action into the inner slough to increase the likelihood of success over a reasonably short period of time. And to allow adjustments to the tidal exchange as conditions changed over time, some ability to further mute or even eliminate tidal action during incidence of very high water and storm conditions would be necessary to eliminate or minimize chances of flooding.

Initially, the use of slide flap gates was considered on some or all of the culverts. The gates could be kept open at all times except when a significant threat of flooding existed. However, all parties were concerned that relying on humans to guarantee that a slide flap gate could always be closed in time to prevent flooding at times of very high tides and storm conditions was not acceptable.

In an almost serendipitous fashion, the possibility of using the Nekton self-regulating tide gate came about through reading the annual report of a nonprofit organization located in the east that had faced a similar restoration problem. This information was passed on to the staff of the City of Mountain View, which investigated the gate and its use and determined that it would allow all culverts to remain fully open during most conditions and also allow them to close automatically at a preselected tidal elevation, which could be set initially and then modified as necessary based on actual data after the culverts have been in operation. The use of this type of gate still requires electric power with an appropriate back up power source, but reduces the chance of flooding to an acceptable level

Summary and Conclusion

The restoration of approximately 53 acres of tidal marsh within inner Charleston Slough presented many conflicting constraints and limitations, all of which in combination require a project design that is truly a compromise. The selected alternative has a good, but not perfect, probability of successful marsh restoration while significantly reducing the risk of flooding. The selected alternative also will probably have some significant impact on the California least tern and will definitely affect the continued attraction of the inner slough to shorebirds and ducks in general. On the other hand, those impacts will be mitigated to some extent by the creation of the two habitat islands and other limitations on construction activities and will also create tidal marsh habitat that is in shorter supply than the shallow open water habitat that the marsh restoration project will replace. Moreover, the selected alternative represents the product of almost seven years of discussions and a continuous process of incremental compromises to reach the current status. Finally, although the Commission has now issued a permit to authorize the selected project, only construction, monitoring, and time will eventually determine whether this cooperation results in the desired marsh restoration. The awareness of technological advances have proved both a boon to crafting acceptable solutions for this complex project, while instilling a degree of wariness that implementing new technology is not without risk.

Jonathan T. Smith
San Francisco Bay Conservation and Development Commission
30 Van Ness Avenue, Suite 2011
San Francisco, CA, USA 94904

Ph (415) 557-8772
Fax (415) 557-3767

DESIGN OF A STRATEGIC MANAGEMENT PLAN FOR COASTAL WETLANDS IN SOUTHERN SONORA, MEXICO

Irene Gamio, ITESM-Guaymas,
Alberto Oriza, ITESM-Guaymas,
Carlos Valdes-Casillas, ITESM-Guaymas, and
James R. Pease, Oregon State University

Background

Coastal wetlands in southern Sonora includes coastal lagoons, estuaries, inlets, creeks, salt marshes, and mudflats. They are important feeding and nursing grounds for a variety of migratory and resident water birds, mammals, fish, and shellfish, which represent important economic support for the region. Coastal wetlands of southern Sonora are closely related to agricultural activities; they receive water discharges with agrochemicals, playing an important role in water quality control.

The study area is located in a narrow coastal plain bordered on the north by El Soldado Estuary in Guaymas, stretching south to the coastal lagoon system of Agiabampo, located on the Sonora-Sinaloa state border (Figure 1). This area extends over 540,000 ha and varies between 7 and 32 km wide. The region is important because it contains the lower portions of the Matape, Yaqui, Mayo, and Fuerte River basins. These rivers constitute 98.8% of total water storage for the state of Sonora. The study area also includes six municipalities in Sonora. Located within this zone are 375 cities, towns, and rural settlements.

The majority of the study area is rural in nature, with 79% of the communities having a total population of fewer than 1,000 inhabitants, and only 4 settlements with more than 5,000. Most of the economically-active population works in resource-based sectors.

These coastal human settlements as well as the cities nearby use wetlands for fishing, aquaculture, cattle ranching, hunting, mining, tourism, and outdoor recreation. These activities constitute the main source of income for local towns and some outside investors.

Lacking an integrated national coastal management strategy, federal and state governments have participated on isolated initiatives for regulation and control. Management activities for the coastal zone consist mainly of fishery regulations, applied to seasons and gear types; other important regulations have been applied to water use and discharges. More recently, in the early 1990s, a state-level effort for a preliminary land-use plan has been developing. Results so far are at the level of a classification of land-use capability.

The Project

To develop an integrated management effort, a resource evaluation and inventory was still missing. In 1993 and 1994, the Biogeographic Information Unit (UIB) at ITESM-Guaymas developed an assessment of coastal wetlands, including the integration of databases for wetland resources and human activities into a GIS, and the design of a public involvement and environmental education program, as the first step toward the management of coastal resources. In August of 1995, the UIB initiated the development of a strategic management plan for the Southern Sonora coast, by using a modified methodology based upon C.S. Holling's "Adaptive Environmental Assessment and Management" (AEAM; see Figure 2). This will is to be finished in August 1996.

According to AEAM, the planning process would include three workshops in which key scientists, government decision-makers, and community leaders would interact to identify problems, alternative management strategies, and alternative time scenarios. Workshop attendees would also work to develop management guidelines for plan implementation. Information exchange from diverse sources was expected to reduce uncertainty as well as gain true commitment from decision makers and community leaders, since they are to be directly involved in elaborating the plan.

Previous to the first workshop a comprehensive review of government structure and community sectors that are related to southern Sonora's coastal zone was carried out, in order to identify and select those officials most suited to participate in the workshop. A small number of participants was required to ensure proper interaction among them. The selection was difficult because of the similar structure and overlapping functions of the three government levels (federal, state, and municipality).

The final list included 21 participants: 6 municipal representatives, National Water Commission, Mexican navy, federal and state environmental, health and education agencies, private and public organizations from the aquaculture and agriculture sectors, two coastal zone specialists, and the independent government of the Yaqui Tribe. Formal invitations for the three-day workshop were issued by the State Agency of Ecology.

From the 21 institutions and organizations invited, 18 were able to participate in the initial activities of the workshop, but only 8 remained the following days. A brief discussions of potential causes for this lack of participation, which are probably applicable to most management efforts in Mexico, follows:

Lack of interest - Particularly since 1994, the economic crisis and general political instability have resulted in looking at unemployment, foreign investors opportunities, and poverty issues as far more important priorities for public concern than the conservation and management of natural resources.

Lack of commitment - Although an agreement with the State Agency of Ecology (SIUE) for project design and development was achieved, work overload and budget constraints within the agency have resulted in failure to attend the whole workshop. This diminished project support from other agencies. In addition, some municipal governments showed relaxed responses regarding the arrangements and the manner in which the workshop was conducted.

Political instability - The state governor had agreed to inaugurate the first workshop, with the corresponding media coverage, but due to an unexpected out-of-state trip he was unable to do so. He committed some of his second-level officials to cover alternative events, dissipating the attention to other areas. Another factor affecting the participation was that the Yaqui Tribe had internal government rivalries, which prevented them from attending the workshop.

Poor background - Society in southern Sonora have had poor contact with environmental education and management. Lacking a tradition of public participation, people perceive management as the sole responsibility of government. Also many of them do not understand yet the role of wetlands on natural and productive processes.

Poor economic resources - Some of the invited institutions, including some municipal governments, claimed they were not financially able to attend these events.

Given the results of the first workshop, a detailed revision of the planning process was needed (Figure 3). Because of their rural nature and poor environmental background, it was evident that this approach would not be effective in involving the local governments and coastal communities in the management effort. In order to have a comprehensive approach that could support environmentally sound policies, we had to consider both the people who have the information and that can help in identifying feasible means and those people who have experienced the problems. The gap between them is significant, so a new structure was adjusted to broaden the contact with communities.

The series of local workshops are taking place in each municipality with one day of duration. General public involved directly or indirectly with wetland use express their concerns, and after discussing alternative strategies for alleviating those concerns and promoting sustainable use. At the same time personal interviews take place with government agencies and specialists to discuss and improve information.

A final regional workshop will follow in which decision makers and specialists as well as key leaders in the communities will meet again to outline management guidelines and, if possible, to compromise their participation. It is expected that an involved community will promote the continuity of the management effort, even given the upcoming changes in state and municipal governments.

Methodology and results for the planning workshops are expected to provide discussion among coastal managers and planners for the potential application of this methodology in other Mexican states and Latin-American countries.

Irene Gamio-Roffe'
ITESM Campus Guaymas
Unidad de Informacion Biogeografica
Bahia de Bacochibampo S/N, Apdo.P. 484
Guaymas, Sonora, Mexico 85400

Ph 52(622) 1-0364; 52(622)1-0136
Fax 52(622)1-0243
Email igr@uib.gym.itesm.mx

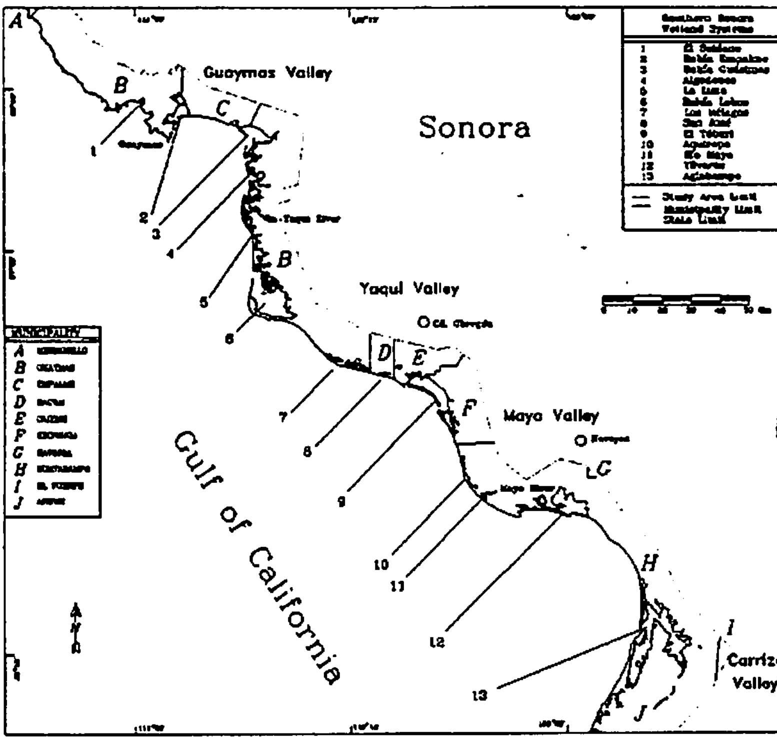

Figure 1. Map of the Area for the Design of the Strategic Management Plan.

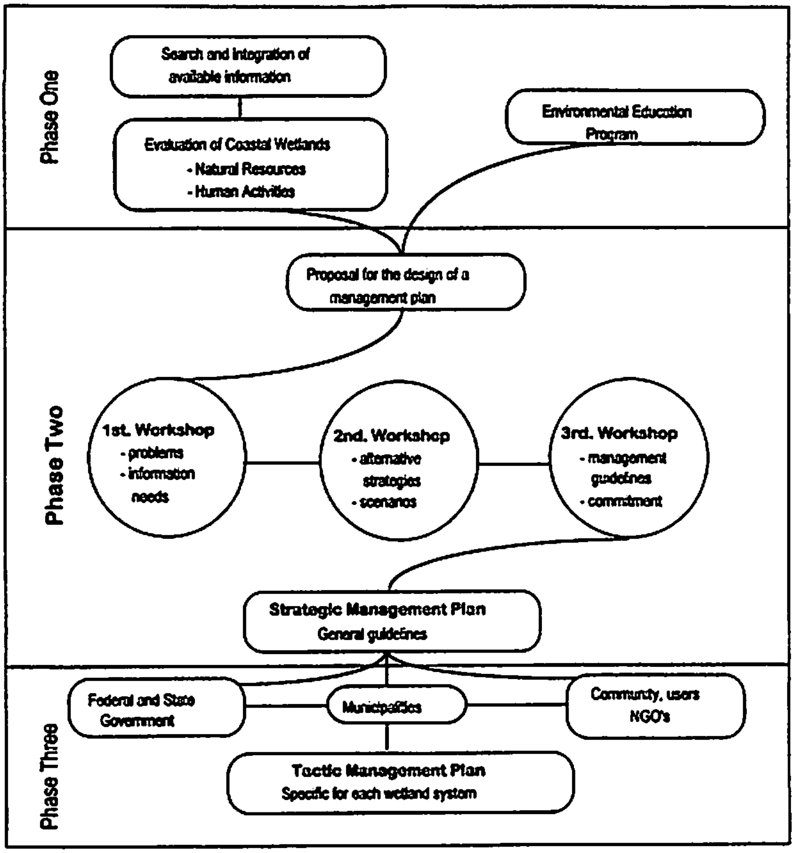

Figure 1 Proposed Project Procedures based on C.S. Holling's "Adaptive Environmental Assessment and Management (AEAM)" *

*Holling, C.S., 1978. Adaptive Environmental Assessment and Management. John Wiley and Sons.

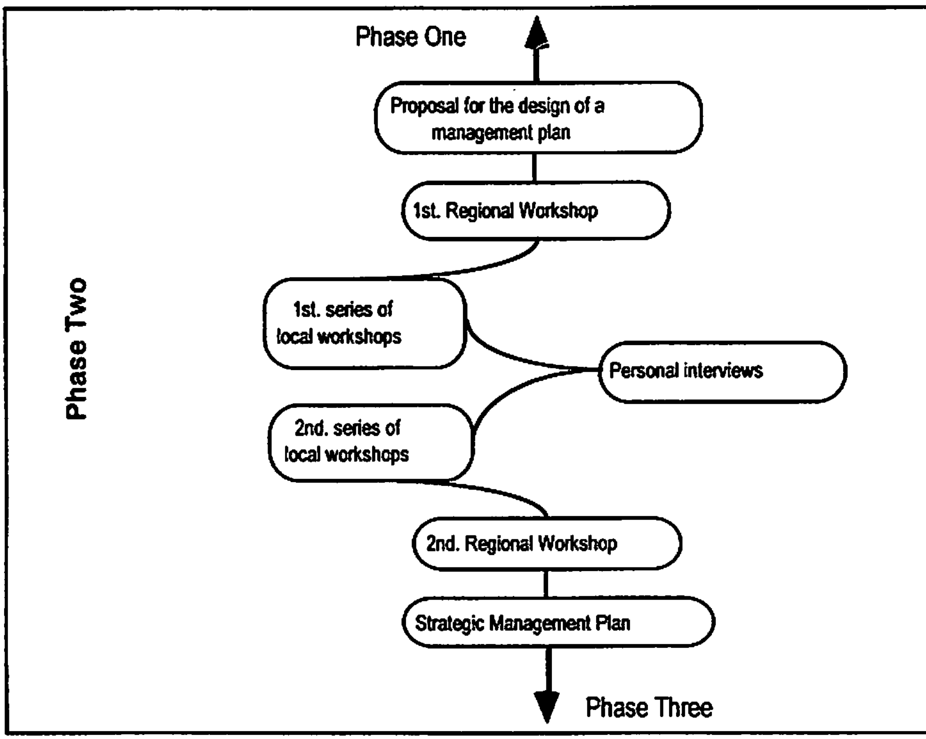

Figure 2. Adjusted Procedures to Increase Governmental and Community Participation.

Session H1, Part I: The National Effectiveness Study: How Does it All Add Up?
Session Chair: Tina Bernd-Cohen, Project Coordinator

THE NATIONAL CZM EFFECTIVENESS STUDY– HOW DOES IT ALL ADD UP?

Marc Hershman, University of Washington,
Tina Bernd-Cohen, Coastal Consultant,
James W. Good, Oregon State University,
Robert F. Goodwin, University of Washington,
Virginia Lee, University of Rhode Island, and
Pamela Pogue, University of Rhode Island

The principal purpose of the National CZM Effectiveness Study is to determine the effectiveness of the CZM program, as developed and implemented by the states, in addressing certain core objectives of the CZMA. The research project is designed to document the management tools and on-the-ground results of state CZM programs in addressing the following four national objectives of the CZMA: 1) protection of natural resources-beaches, dunes, bluffs, rocky shores; 2) protection of natural resources-wetlands and estuaries; 3) provision of public access to the coast; and 4) promotion of water-dependent uses. The study seeks to identify state and local management tools that work particularly well in achieving these objectives, as well as recommend ways to improve the national program.

The study will assess the individual and collective contributions of the 29 state, territory and commonwealth coastal zone management programs in achieving the four priority core objectives of the CZMA. This will include a description of the management programs, tools or techniques (process indicators) that have been developed and/or refined as a result of coastal zone management, as well as on-the-ground results (outcome indicators) of program implementation.

Case examples will be provided that illustrate on-the-ground effectiveness of management tools, showing how individual state actions add up to achieve national goals. Case examples will also show the balance among competing issues such as development and preservation, innovative ways of resolving issues, and lessons learned from failures.

The Team will identify and recommend improvements to the national CZM program that will improve its effectiveness in addressing the core objectives of the CZMA. Examples include: establishing clear, consistent monitoring guidelines and performance measures relative to core objectives; providing new funding mechanisms or categories to provide for monitoring and improved performance; and changing the technical and/or information services available to the states.

It is hoped that the results of the study may provide a new kind and level of national program accounting with respect to mandated Congressional goals, as well as demonstrate areas of needed improvement leading to Congressional, administrative or state-level action. The results may be used to guide federal technical assistance to states or promote the use of especially effective management strategies or tools. It is also intended to be used to improve future assessment of CZM efforts.

The project is a year-long effort beginning in October 1995 and ending in September 1996. In addition to an Executive Summary, two other reports will be produced. One report will provide a national summary of overall effectiveness of the CZM program based on cross-state aggregation, comparison and analysis of state-level data; case examples of illustrative or innovative management tools used by states; and conclusions and recommendations for national level program improvements. The other report will contain state-by-state survey profiles documenting management tools (process indicators) and on-the-ground results (outcome indicators).

Beaches, Dunes, Bluffs, and Rocky Shores and National Context for CZM

As early as the late 1800s, recreational tourism began along our nation's beaches. With the advent of the automobile, seasonal seaside resorts evolved. The summer homes and fishing villages of the 1940s and 1950s were transformed by the 1970s into "cities on the beach." Today, due to population and economic pressures, over half of our nation's population lives within 50 miles of the coast and our nation's coastal zone is over four times more densely populated than the national average. In addition to the retirees who migrated to the coast and other year round residents, tourists and conventioneers are demanding beachfront coastal resorts. This is most pronounced along our coastal barriers at high risk due to coastal flooding, hurricanes and erosion. Billions of dollars in private development and pubic recreation and infrastructure is invested on these unstable coastal barriers. The demand for coastal waterfront property has lead to increased residential development pressures along our nation's coastal bluffs and rocky shores.

The persistent development along our nation's coastline had lead to destruction of coastal dunes systems and placement of structures in jeopardy from both short and long-term erosion. Shoreline development prior to the 1970s were frequently armored with seawalls, revetments, bulkheads or other shoreline stabilization structure to protect upland private and public investments from erosion. Such stabilization structures accelerated the loss of sandy beaches. A whole host of human interferences have adversely affected the natural sand transport system, destroyed or caused dune instability, and increased erosion. These include sand-trapping structures such as groins and breakwaters; sand mining for development and sand scraping practices; dredged navigational channels with jetties for shipping and dredged tidal inlets for commercial fishing and recreational boating; the placement of dredged spoil and beach quality sand offshore beyond the littoral sand transfer system; and the damming of coastal rivers. Efforts to recreate natural beach/dune systems include sand fencing and dune revegetation, beach nourishment, and inlet sand transfer.

At least 7% of our nation's coastal shoreline is critically eroding where properties are in imminent danger of collapse and 25% is experiencing significant erosion. Most barrier islands along the east coast and gulf coast are retreating landward by 1 to 10 feet per year -- rates of up to 20 feet are not uncommon for specific locations. In addition to long-term erosion, many coastal states have experienced shoreline loss and property destruction through periodic storm events. Bluff recession is also a problem along the Great Lakes States.

Seventy percent of our nation's shoreline is in private ownership (excluding Alaska where 99% is publicly owned). Rights of upland owners, above mean high water or line of vegetation where state jurisdiction begins, has limited states' authority to regulate activities. As of 1970, three-fifths of the shoreline was undeveloped (excluding Alaska). Development pressures vary depending on geography and climate issues. Inaccessible and hard to develop shorelines, such as rocky shores, are less prone to development than accessible sandy beach areas.

Several federal agencies have a long history of involvement with our nation's coastlines, all pre-dating the Federal CZM Act of 1972. The US Army Corps of Engineers (COE) administers federal shore protection projects, authorized navigation channel dredging, and federal permits for dredge and fill affecting navigable waters. COE published the National Shoreline Study in 1971, and is working on analysis of Federal shore protection program for Congress. The Federal Emergency Management Agency (FEMA) administers the federal Flood Insurance Program that produces rate insurance maps and insures properties within 100 flood zone for local community participating in the program. Under the Upton/Jones Program 1988-1995, FEMA allowed for payment of flood insurance claims to demolish or relocate buildings imminently threatened by erosion. FEMA is currently conducting an evaluation of economic impact of mapping erosion hazard areas for Congress. The US Department of the Interior(DOI), National Parks Service (NPS) created and manages 10 National Seashores covering 592,627 acres and 4 National Lakeshores covering 228,716 acres. DOI Fish and Wildlife Service (FWS) manages the National Wildlife Refuges, several located along the coast. DOI also administers the Coastal Barrier Resources Act of 1982 which prohibits federal incentives to development on designated coastal barriers along the Atlantic and Gulf coast that are not publicly owned or otherwise protected.

The inappropriate siting of structures on coastal barriers, in coastal flood zones and on erodable bluffs is a problem which state CZM programs inherited. Thus when the state CZM programs began in the 1970s, certain portions of our nation's coastline were already committed to intense development and other areas already zoned and platted for development. Shoreline erosion was a recognized problem, but land use controls were not well developed. State CZM programs would provide the testing grounds for land and water management to balance competing demands along our shoreline and minimize adverse impacts on valued natural coastal resources. State CZM programs would be at the forefront of the "quiet revolution in land use controls" and "integrated coastal management."

This project will explore the CZM management tools developed, refined and employed to protect beaches, dunes, bluffs and rocky shores and the effectiveness of the management tools in achieving national objectives. Included will be documentation of regulatory controls such as setbacks from beaches/bluffs, controls over shoreline stabilizations and the policy shift towards beach nourishment and shoreline retreat. Also include will be direct land management of beachfront parks, acquisition of beaches and coastal resource areas, and the use of planning and research tools such as beachfront management plans.

Estuaries and Coastal Wetlands in the National Context for CZM

It is widely recognized today that estuaries and coastal wetlands are among the most environmentally and economically important natural resources in the United States. These resources -- salt marshes, seagrass beds, tidal flats, freshwater marshes, forested wetlands, and open water function -- perform a variety of ecological functions that translate into valuable societal services. They provide habitat for a vast array of fish and wildlife resources, including many endangered or threatened species. On the east and Gulf coasts, for example, 60-90% of the fish species caught commercially are dependent on estuaries or wetlands for some portion of their life cycle. Estuaries and wetlands help control water pollution by transforming nutrients and other chemicals, and by removing sediments from the water column. Wetlands anchor the shoreline against erosion, buffer storms, and in some areas, serve as temporary flood storage areas.

This widespread recognition of the values of estuaries and coastal wetlands is relatively new. In the past, estuaries and coastal wetlands were places to be dredged and filled for port and harbor development, industry, and expansion of cities for a growing nation. They were diked and drained for agriculture, their waters diverted for other uses, and generally abused as dumps for much of the waste of a rapidly growing nation. This all changed relatively dramatically in the 1960s and early 1970s. One national study after another chronicled the abuses of estuaries and wetlands and the mounting costs. Among the most important were the National Estuary Study in 1968, the National Estuarine Pollution Study in 1970, and the Stratton Commission report, Our Nation and the Sea in 1969. The landmark Stratton Commission report called for the establishment of a national coastal zone management program that would, among other things, help reverse the decline and abuses of estuaries and coastal wetlands. These and other state-level initiatives, in turn, led to two laws very important to estuary and wetland protection: the 1972 amendments to the Federal Water Pollution Control Act (now called the Clean Water Act), which established the federal Section 404 wetland permit program; and the 1972 Coastal Zone Management Act (CZMA), which led to the establishment of a variety of estuary and wetland protection programs at the state level.

It is these state coastal zone management (CZM) programs and their contributions to the protection of estuaries and coastal wetlands that is one of the focus areas of this project. As with the other parts of this study, the emphasis is on identifying on-the-ground outcomes of CZM processes and tools that result in real protection of these vital resources. Some preliminary observations are offered here. For virtually every state coastal program, estuary and wetland protection has been and remains an important issue and, in some areas, a vital one. A wide array of management processes and tools that contribute to estuary and wetland protection have been developed and implemented by states as part of their CZM programs. Wetland permit programs similar to the federal Section 404 process are among the most common; compensatory mitigation requirements and mitigation banking were among the innovations first initiated in the US at the state level through CZM; harbor planning and special area management planning (SAMP) are other unique creations of CZM that have been mimicked worldwide; modest estuary and wetland acquisition programs and major restoration efforts are parts of other state programs, while creative education programs are the emphasis elsewhere. The late 1980s and 1990s has seen a shift in emphasis in coastal wetland protection emphasis as states establish nontidal freshwater wetland protection elements in their programs. Lessons learned along salt water shores are being applied to the inland tiers of coastal zones and beyond, illustrating the important diffusion effect of CZM institutions and policies.

This project is documenting the use of the array of CZM management policies, programs, processes, and tools states use to protect estuaries and coastal wetlands. Preliminary results suggest that systematic documentation of on-the-ground outcomes is the various states is difficult because of uneven

record keeping, different program issues and focuses, and utilization of different strategies and tools. However, it is expected that much will be learned by collecting and analyzing what data is available. Improvements may result in CZM generally and in the documentation of outcomes with respect to national CZMA objectives for state programs.

Public Access and National Context for CZM

Public access to the nation's extensive coastal shoreline has historically been through national, state, and local parks, as well as street ends, boat ramps, and public piers and boardwalks. View corridors, rights-of-way, and redeveloped urban waterfronts are examples of public access resulting from CZM permit conditions. Commercial, residential, and industrial use of the coastal zone has often limited or eliminated the public's access to the nation's shores. Private ownership of coastal uplands has prevented the public from reaching intertidal zones and waters along the U.S. shores -- an area to which legal access is protected through the public trust doctrine.

Increased permanent and seasonal coastal population has led to a greater demand for coastal recreational opportunities. In 1990 more than 44% of the nation's population lived in the country's 451 coastal counties, yet those counties account for only 11% of the U.S. land area (excluding Alaska). The coastal population is expected to increase at least 20% in the next 15 years. Most of the coastal land in the U.S. is privately held (68%). Rapid coastal development and competing private and public use have reduced the amount of coastal land that is open to the public. Public funds to acquire public access sites are scarce, as coastal property values skyrocket, and other resource protection priorities vie for limited dollars. State regulatory methods for acquiring access through permit conditions for easements have been limited due to taking concerns and the lack of state legal authority.

Key coastal uses which have intensified and are dependent upon public access to the coast include: fishing, boating, port operations, coastal energy production, and recreation. Of these activities, coastal recreation and tourism is the largest coastal user, and increasing as a sector of state coastal economies. With the exception of the early 1980, federal and state parks have experienced a dramatic increase in attendance over the 1960 level. Between 1972 and 1984, public recreation land in coastal and estuarine areas increased 27% to meet these needs, despite federal cut-backs in outdoor recreation acquisition funds. A 1988 NOAA study estimates 25,000 public coastal recreation facilities in U.S (excluding the Great Lake States), with private recreation facilities at over 20,000. Despite these numbers, coastal facilities are inadequate to meet public recreation needs. Beachfront parks, during peak seasons, experience severe overcrowding. The demand for public recreation facilities in most coastal areas exceed the supply.

Individual states define public rights of access to coastal areas in varying ways. Perpendicular access to the nation's coasts pose different problems than lateral access. Private must often be crossed to reach coastal waters. Once at the shoreline, the amount of land available to public use may vary according to state rules. Some states claim the high tide line as the line of demarcation between private land and public trust areas, others the vegetation line, and some have sold off public rights below the mean high water line to private interests in portions of their coasts.

The acquisition of easements and rights-of-way is a complex and often expensive process. Once on the shore and off private land, lateral access may become a problem as fencing or groins frequently prohibit walking along the beach. The lack of parking is also an issue. Industrial and port development may be dangerous, inappropriate areas for public access, though they command a large section of urban waterfronts.

Certain federal agencies been involved in providing public access to the coast. Of note are the National Park Service through the Land and Water Conservation Fund and US Fish and Wildlife Service through the Angler Access program, Wildlife/Conservation Lands program, and Dingle/Johnson funding for boating and fishing ramps.

State CZM efforts have involved the use of Section 306A funds, beginning in 1980, and renewed interest through the Coastal Zone Enhancement Grants Program beginning in 1990. This project will explore the CZM management tools developed, refined, and employed to promote public access to the coast and the effectiveness of the management tools in achieving this national objectives. Included will be documentation of the following tools: planning, management, inventories, site improvements, acquisition funding, regulatory exaction, legal jurisdiction, and public awareness.

Waterfront Revitalization and National Context for CZM

Waterfront revitalization was already well underway in the nation's larger seaport cities (Baltimore, New York, San Francisco, Boston, etc.) before the 1980 CZMA amendments focused states' CZM programs' attention on deteriorated and underutilized port areas. These run down waterfronts were artifacts of several national trends having their origins in the 1950s and 1960s: The shrinkage of some ports as a result of containerization of cargoes and load centering; port abandonment of downtown piers, wharves and transit sheds in favor of new container terminals constructed on flat, less-developed industrial shorelines; the demise of ocean going passenger liners as the airlines' international reach expanded with the advent of jet transports; the suburbanization of downtown manufacturing establishments, including water-dependent and water-related industries, as a result of efficient truck transportation; urban renewal and downtown revitalization; improvements in water quality and growth in tourism/recreation, especially boating and other water-based activities.

Municipal governments, ports, and public development corporations have teamed with private sector interests to take on large city waterfront projects. Federal urban renewal and community development agencies have helped fund planning studies, site acquisition, site clearance and cleanup, and new infrastructure along the waterfront. Because of CZM's late start and the magnitude of financial resources required to revitalize waterfront areas, CZM agencies have been forced to be "niche players." CZM has provided a forum for resolving contentious waterfront development issues, and its policies have kept on the urban waterfront agenda those affirmative national coastal goals of expanding public access, restoring degraded environments, preserving cultural and historic buildings and sites, and giving preference to coastal dependent industries -- the "working waterfront" issue. This last goal has proven to be the most contentious and illusive. Competition from non-water dependent development -- restaurants, housing, hotels, offices -- and water dependent development of a purely recreational nature -- marinas, yacht brokers, etc. -- displaces industrial water dependent businesses that support commercial fishing fleets and other maritime enterprises.

CZM agencies have produced guidance documents, and provided technical assistance, educational programs, and planning grants, particularly to smaller and middle-sized coastal cities, to help achieve these multiple CZM goals. Local coastal programs developed under state oversight -- including those adopted by some ports -- have proven to be effective vehicles with which to implement balanced urban waterfront redevelopment plans.

This project will explore CZM management approaches for encouraging waterfront revitalization including: policies and performance standards for public access, priority for water-dependent uses, environmental restoration; CZM reports/technical publications; CZM funding for planning studies and 306A projects, and the leveraging for funds such as California Coastal Conservancy grants and loans; Washington DNR ALEA grants CZM linkages to other agencies involved in waterfront revitalization (local governments, ports, economic development councils/districts).

Boating Facilities and National Context for CZM

There has been a more than threefold increase in the US recreational boating fleet since 1962 (USCG, 1994). This growth, fueled by rising incomes, shorter work weeks and longer and healthier retirement years, has placed great demand on the nation's coasts for expanded boater access to the water. For trailerable motorboats -- generally fewer than 26 feet in length --boat launch ramps provide adequate access; but a marina is the preferred facility for the non-trailerable cabin cruiser and most auxiliary-powered sailboats.

A marina is a coastal dependent business which, in turn, supports or complements a suite of other marine businesses (boat sales, marine electronics, repair yards, sailmakers, etc.). As such, it is a preferred use of the coastal zone. Nonetheless, marinas produce impacts affecting coastal environments. Intertidal and subtidal habitats are altered by dredging; docks, piers and the boats moored to them limit the amount of sunlight penetrating the water column; breakwaters and jetties affect water circulation and mixing; chronic and episodic fuel and oil spills, and heavy metals leaching from anti-fouling paint on hulls cause water quality deterioration; and even the risk of boaters discharging sewage while berthed in a marina causes health departments to close or limit shellfish harvesting from nearby beds. EPA, USF&WS, NMFS and state fish and wildlife, and water quality programs play significant roles in regulating the siting, design and mitigation of docks and marinas.

CZM programs must balance the social and economic benefits of enhanced boater access to coastal waters against the CZMA's coastal resource protection and conservation policies. In states where urban development and other uses have already caused significant wetland loss and beach disturbance, policies may favor resource conservation over marina development, and require a showing that alternatives to in-water moorage -- boat ramps, hoists, upland dry storage yards -- will not satisfy the unmet demand for boating access; and that new marina development, where demonstrable need exists, fully mitigates unavoidable resource losses and provides benefits such as fishing piers or picnic areas for the non-boating public. CZM has had a major role in studying regional boating access needs and developing strategies to accommodate a mix of new boating facilities while minimizing damage to coastal resources and water quality.

This project will explore CZM management approaches including the use of regional demand analyses and siting studies, CZM funding for technical assistance for planning studies, permit requirements for assessing (unmet) demand and alternatives to in-water structures; state-level policies and performance standards for design and mitigation of marinas boater sanitation and water quality habitat (fisheries, aquatic vegetation, substrate, etc.) and shellfish protection (no anchorage areas cumulative impact assessment). It will also explore CZM efforts to rationalize water space use conflicts

Seaports and National Context for CZM

In the post World War II era the US has become increasingly dependent on international trade for its goods and services. This has put great demand on the transportation infrastructure of the country and has spurred enormous growth. Seaports, harbors and waterways have been a crucial part of this growth. Waterborne commerce has grown and today constitutes almost 25% of GDP.

This growth has been in kind as well as size. Ships have gotten much bigger, and require larger berths and deeper channels. And because the ships and maritime labor are expensive there has been a movement toward "local centering" and containerization which increase economies of scale, reduce the turn-around time for ships and mechanize the movement of cargo on and off the vessel. The face of the seaport has changed from one of many small piers and wharves handling scores of smaller ships to fewer huge terminals that require considerable back-up space on land, large berths, efficient sea and land access. etc. The smaller piers were abandoned and became available for redevelopment for no-port purposes.

The transformation of the urban waterfront has come about because of powerful institutional forces as well as market forces. The planning by the US Army Corps of Engineers (COE) and the financing by Congress of so many harbor improvements and maintenance projects has hastened the remake of harbors. At the local level the public port authorities have used municipal bond financing to underwrite enormous investment in landside facilities to compete for cargo-related business.

Thus when the CZM program began development in the mid-1970s the revolution in ship size and port infrastructure was well underway. Channels were being deepened and widened and new lands for port terminals were being created. Obsolete port facilities were beginning to be re-used for various purposes. The partnership between local port agencies, the COE and Congressional delegations was powerful.

The CZM programs (along with federal and state wildlife and environmental agencies) sought during the early to mid-1970s to broaden the perspective of these agencies with respect to seaport development. Issues introduced by CZM programs relate to reducing impacts from dredged material disposal, providing access to the public; avoiding the development of redundant port facilities; taking responsibility for the reuse of abandoned facilities; defining and operationalizing environmental mitigation; and other issues. The OCRM, AAPA, and MARAD worked together in the early years to help ports and the COE understand and plan for some of these new requirements. A number of CZM funded studies identified these new issues. Today, CZM programs are playing an important role in redefining "harbor management" from a concept of serving only more efficient waterborne commerce to the contemporary philosophy of multi use. This study will document the management tools states have used as players in seaport activities.

TCS Session

This session on the National CZM Effectiveness Study, at The Coastal Society Conference, will provide: 1) an overview of the national study; (2) findings of state CZM program achievements over the past 20 years by key issues area showing both process and outcome indicators; and (3) a summary of the national picture of CZM -- how it all adds up. This will also a "working session" with invited state CZM program Managers for sharing perceived strengths and weaknesses of CZM and identifying needed improvements to state CZM accounting and OCRM administration.

Tina Bernd-Cohen
Coastal Consultant
729 Power Street
Helena, MT, USA 59601

Ph (406) 442-4002
Fax (406) 442-4114
Email tinacoast@aol.com

HUMAN IMPACTS ON FLORIDA'S ESTUARINE RESOURCES: THE ROLES OF ACADEMIC RESEARCH IN THE DEVELOPMENT OF MANAGEMENT STRATEGIES FOR CONSERVATION AND SUSTAINABLE GROWTH

G.S. Kleppel, South Carolina
Department of Environmental Health Sciences
and Nova Southeastern University
Oceanographic Center and
Lee Houchin, Nova Southeastern University
Oceanographic Center

More than 75% of the Gulf and Atlantic coasts of Florida are bordered by estuaries and most of the Florida land mass occurs in watersheds that empty into estuaries. As such, Florida's estuaries are extremely important natural and economic resources. Some 30 years ago, when exponential population growth and intensive development of Florida's coastal and estuarine resources began, with little regard for the sensitivity of these ecosystems, severe loss of habitat and estuarine functional integrity ensued. Between 1970 and 1980, through combined federal, state, and local efforts, a measure of control was achieved over estuarine resource exploitation. Several systems have already responded positively to restorative and remediative measures (Tampa Bay NEP, 1995). However, pressure on these systems remains high and continued population growth accompanied by changing demographic trends and a relaxation of regulation ensure that enormous challenges lie ahead for the continued development of sound habitat protection practices and sustainable resource utilization in Florida's estuaries.

The Florida Sea Grant College Program has a long history of funding estuarine research. However, it is considered that a defined research theme area focused on problems associated with future challenges in the estuarine resource management will permit academic scientists to more efficiently target these problems. Such a response will facilitate research by government agencies and address society's needs for both access to and quality of estuarine resources. The first step toward the development of this estuarine research theme area has been a study of the state of Florida's estuaries and of future needs in estuarine research. This paper summarizes the findings and conclusions of that study.

Approach

Ten estuaries were considered in this study: the Lower St. Johns River (SJR), the Indian River Lagoon (IRL), Biscayne Bay (BB), Florida Bay (FB), Rookery Bay (RB), Charlotte Harbor (CH), Tampa Bay (TB), the Suwannee River Estuary (SRE), Apalachicola Bay (AB), and Pensacola Bay (PB). Several methods were used to collect data and to examine concepts pertinent to the development of the estuarine research theme area. These included:

Literature searches: The 10 estuaries studied were chosen because they: (a) reflect the range of environmental, demographic and socioeconomic variability characteristic of Florida and (b) have been the focus of previous study such that a data base of information was available. Our efforts centered on summary documents, but we also examined data reports, journal articles and other published materials.

Interviews and meetings: Telephone conversations and face-to-face meeting were conducted with personnel at management agencies (*e.g.*, water management districts, NEP's) and outreach organizations (*e.g.*, Sea Grant Extension Program). Visits were made to various institutions (*e.g.*, Office of Ocean Resources Conservation and Assessment, Florida Department of Environmental Protection) to discuss concept development, technology issues, and data product availability. The interview process augmented our literature searches, providing insights into the literature.

Meetings with university faculties: Because Sea Grant is an academic research program, the involvement of academics in the process of developing a research theme area was considered crucial. Meetings were conducted with the faculties of several state universities to solicit their perspectives on needs in estuarine research and on the ability of Sea Grant to address these needs.

Formation of an estuarine theme area panel: Because of the broad scope of this project, we convened a multidisciplinary panel of academics with expertise that encompassed the breadth of issues to which Sea Grant's estuarine research program might respond. The panel was composed of physical and biological scientists, a resource economist, an academic attorney, and a professor of urban and regional planning. The purpose of the panel was to advise on issues and to provide perspective on the interpretation of information and production of reports. Several members of the panel prepared white papers on key issues that were identified during panel deliberations. These dealt with: the importance of understanding hydrodynamics when attempting to manage estuarine resources; the definition of a functional estuary; and, the potential for incentives-based, rather than regulation-based, management in future estuary policy development.

Our actual goal in this project transcended the objective of simply summarizing the existing literature and locating information gaps. Instead, we sought to identify a product that was uniquely academic, which could contribute in real ways to efforts at the agency research and managerial levels to enhance the sustainable use of estuarine resources and to promote enlightened development in watersheds. We also sought a synthesis, *i.e.*, a set of overarching principles pointing toward some general directions along which a research program could be developed.

Findings

The state of Florida extends through six degrees of latitude, encompassing subtropical to temperate climates. Florida's estuaries reflect a multitude of geomorphologies and ecosystem and habitat types. They are subject to human impacts ranging from minimal to extreme. There is no single "typical" estuary in Florida. However, certain generalities are possible. From these generalities, one can identify classes of issues that reflect concern within the management community. Prioritization of these issues by their relative importance across the field of estuaries that was studied (*i.e.*, by summing the priority weights for each issue across all estuaries) provides a rough ranking that identifies the issues of broadest concern within the state. We consider both the general characteristics of Florida's estuaries and the issues of concern below.

Attributes that characterize Florida's estuaries -- Florida's estuaries tend to be lagoonal or cuspate lagoonal in geomorphology, and they are frequently shallow, except where dredged. In general, they are small to moderate in size (usually <500 square miles) but they have moderate to large watersheds (*ca.* an order of magnitude greater surface area than the estuary). Riverine estuaries are more abundant in the north and on the west coast and panhandle than in the south and southeast. Frequently, tributary rivers cross state boundaries. The estuaries encompass numerous habitats which, south of *ca.* 28°N latitude, tend to be characterized by clear water, sea grass dominated benthic communities (that may, through both natural and human perturbation, periodically become more turbid, plankton-dominated systems) and mangrove-dominated emergent vegetation. To the north, the estuaries are turbid salt marshes, typical of the estuaries of Georgia and the Carolinas. Virtually all of the estuaries in the state exhibit some evidence of human impact. However, estuaries in the Big Bend area, on the northwest coast and eastern panhandle (Suwannee River, Apalachicola Bay) tend to be less impacted than those in the south and southeast. Frequently, certain segments of the estuaries are heavily impacted, while other segments that are more pristine (*e.g.*, SJR, IRL, and PB).

Priority issues in estuarine management -- Table 1 summarizes the concerns of the management community on key issues that are recurrent in the literature. Although the priority weightings are somewhat subjective, they permit one to roughly characterize the environmental concerns of managers. It is important to note, however, that priorities may be quite different at the local level. Table 1, while useful for identifying issues, is not appropriate for setting management priorities.

The three issues most consistently considered as problems of significant concern were: (1) non-point source contamination; (2) habitat loss; and (3) modification of flows (hydrology). Specific communities view these problems in different ways but in most cases they relate to changes occurring in the watershed (which affect the estuary). They reflect the impact of changing land use practices coupled with the management or non-management of freshwater flows (see for example, SWFWMD 1993). And finally, they point to the difficulties of ameliorating the impacts of non-point source contamination and the lack of necessary information for discriminating between natural and anthropogenic forcing of environmental variability in estuaries.

Conclusions

Ultimately two factors, hydrology and cyclic environmental variability, are key to understanding estuarine functional integrity. We suggest that they represent fundamental themes for future research on Florida's estuaries.

There is evidence that the role of freshwater in the maintenance of ecosystem function has not been carefully considered in many estuaries (*e.g.*, RBI, CHI). The estuaries are not mentioned in the state's water policy. Research is needed to describe the hydrology in relation to the ecosystem and to identify the links between the movement of water (including groundwater), the changing landscape and estuary function (Smith, 1996).

Estuaries are now recognized as "pulsing" ecosystems that are constantly variable (Odum *et al.*, 1993). Although variability can be chaotic or cyclic, it is the latter which is predictable. Many of the biological indicators used in management exhibit cyclic variability on time scales of 10 to 100 years. Interpretation of environmental data is greatly facilitated by an appreciation of cyclic variability on these scales. And the risk of misinterpretation of data may increase substantially when cyclic variability in the data is not accounted for.

The development of an estuarine research theme area by Sea Grant may be coupled to the organization of research consortia with government agencies. These will ally scientists from the academic and public sectors and focus research on specific and complimentary problems in selected estuaries. Such an approach will allow Sea Grant to achieve a more significant research product than if it works alone and it will avail agencies of unique and diverse academic capabilities. The consortial approach should extend further, to efforts at standardizing research protocols, and developing and disseminating GIS products.

It has been predicted that in the near future the classical legislative approach to estuarine regulation may be obsolete. In the absence of regulation, it is suggested that management may be possible through incentive (Christie, 1996). Incentive-based policies can only succeed, however, when the public is aware of the issues and recognizes the value of the resource. Perhaps the greatest challenge to the Sea Grant Program will be on its outreach network. It will be the function of education and extension services to develop that sense of public awareness that is necessary to support incentives-based management policies for Florida's estuaries.

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Table 1. Environmental quality issues (problems) identified in the literature and the priority of each issue in each of the estuaries studied. Values in () are the ranks of each issue relative to the others.

	Estuary									
Problem	SJR	IRL	BB	FB	RB	CH	TB	SRE	AB	PB
Non-Point Sources(1)	3	3	3	3	0	3	3*	0	3	3
Habitat Loss(2)	2	3*	3*	3	3	3	3*	0	0	3
Flow Mods(3)	0	3	3	3	3	3	3	0	0	2
Septic Syst.(4)	3	3	0	2	0	3	0	2	3	2
Eutroph-ication(5)	1	3*	3	3	0	3	3*	0	0	2*
Turbid-ity(6)	0	2	1	3	2	2	3*	0	0	2
Wet-lands Loss(6)	2*	3	3*	0	0	3	3	3*	0	0
Fisheries Biodiv.(7)	0	2*	2	3	0	2	2	0	0	3
Toxics(7)	1	1	2	1	0	2	2	0	2	3
Point Srcs/STP's[1](8)	2	2*	2	0	0	1	2*	0	0	3*
DO/BOD(9)	3	2	2	0	0	0	0	0	1	3*
Dredg-ing(10)	2	2	1	0	0	0	3*	0	0	2
Bact/ Pathogens(10)	3	2	0	0	0	2	0	0	1	2
Industr. 1 Wastes(11)	0	2	0	0	3	0	0	0	3*	

Priority: 0=minimal or not mentioned; 1=localized problem or low priority; 2= moderate priority or of general concern; 3=significant problem, great concern

[1]STP's = sewage treatment plants. *A remediative program is currently in place.

INLAND MARINE WATERS OF BRITISH COLUMBIA AND WASHINGTON: WHAT HAPPENS WHEN SCIENTISTS STEP OUT OF THEIR ACCUSTOMED ROLES?

Andrea E. Copping, Washington Sea Grant Program, University of Washington

Introduction

In 1993 six scientists from British Columbia (Canada) and Washington were appointed to examine environmental conditions in the shared inland marine waters of BC and WA. The BC/WA Marine Science Panel (MSP) included scientists from three universities, two federal agencies, and a private consulting firm. Panel members were trained in physical, chemical and biological oceanography, fisheries biology, and microbiology/toxicology; most had worked in scientific-management related questions in the shared marine waters.

Under the terms of an Environmental Cooperation Agreement signed between the state of Washington and the Province of British Columbia in 1992, several transboundary environmental issues are to be jointly addressed by the two jurisdictions, including the status of the shared inland marine waters. Under the agreement, the Environmental Cooperation Council (ECC) was formed to provide oversight for planning and implementation of BC/WA activities. The Council is headed by environmental agency directors from WA and BC; federal environmental agency representatives sit on the ECC as observers.

Canada and the US share a common estuarine resource which encompasses the inland seas of Puget Sound (all US waters), the Straits of Georgia, (largely Canadian waters) and the Straits of Juan de Fuca (shared between the two nations). The inland waters communicate to the Pacific Ocean via the Straits of Juan de Fuca to the west and to the north through the Strait of Georgia, northwest of Vancouver Island. The state and province charged the MSP with answering nine specific questions (Table 1), dealing with the importance of transboundary pollution, the threatened condition of living marine resources, and the projected impacts of rapid growth on habitats and marine resources of the shared marine waters.

The MSP members undertook their charge, agreeing to report back in one year. The MSP process included: a data gathering phase; development of an analytical framework; delineating the present status of the shared marine waters and resources; projecting the status of the waters and resources 20 years in the future; and developing recommendations for improved environmental management.

Panel Activities

During the data gathering phase, the MSP sponsored a two-day symposium in Vancouver, BC, inviting 13 papers, each focusing on a different aspect of the science and management of the shared marine waters and each co-authored by regional experts from British Columbia and Washington. The papers were subsequently published in a volume entitled "Review of the Marine Environment and Biota of Strait of Georgia, Puget Sound, and Juan de Fuca Strait" (Wilson *et al.*, 1994). Following the workshop, the MSP met with individuals and organizations with special knowledge of the science, management needs, and future prospects for the shared inland waters, including university and agency scientists, resource managers, and nongovernmental organizations. Written briefs were also submitted by a number of individuals and organizations, at the request of the panel.

The MSP members studied the workshop papers and associated discussions, considered the written and oral briefing notes, referenced pertinent literature, and consulted with numerous colleagues. With this material as background, the MSP members developed a framework for viewing the status of the shared waters; constructed tables of the present status of the waters and resources; projected the status of the waters and resources to the year 2014 under current environmental management regimes and trends (Business as Usual Scenario); projected the status of the waters and resources to the year 2014 under ideal management conditions (Future Optimum Scenario); and developed recommendations for the use of management resources to maximize protection and enhancement of the marine environment. The MSP prepared a report, "The Shared Marine Waters of British Columbia and Washington" (Copping *et al.*, 1994) which was presented to the Governor of Washington and the Premier of British Columbia in September 1994. Panel members worked with the local and regional media to call attention to the status of the shared marine waters and predictions for future health of the waters. The MSP was also instrumental in preparing a public release version of their report entitled, "Shared Waters: The Vulnerable Inland Sea of British Columbia and Washington." Both reports were produced by the Washington Sea Grant Program.

The analytical framework developed by the MSP was guided by three principles: to advocate the use of science in environmental management decisions; to encourage resource agencies to take a long-term perspective in environmental management; and to involve the public in making decisions critical to the future marine resources of the area. As part of that framework, the MSP members invoked the precautionary principle: that irrevocable changes not be made to the environment until all the consequences of such actions are understood.

The MSP evaluated change to the environment in terms of the time it would take the ecosystem to rebound from an environmental assault, once that assault has been stopped (recovery time). The MSP framework depends heavily on affording the greatest protection to portions of environment that would require a long (greater than 30 years) or irreversible (greater than 100 years) recovery time. Less attention and fewer management resources would be devoted to environmental problems with short (less than 3 years) or medium (10-30 years) recovery times.

Conclusions

Based on their findings, the MSP members set out 12 recommendations (Table 2) for better environmental management of the shared marine waters. Seven recommendations outline specific activities that could be addressed by the state and province; the remaining five involve planning and outreach activities that would benefit the management of natural resources in the region. The state and province have chosen to implement four of the recommendations as ECC priorities (as noted in Table 2), with some activity on an additional four (also noted in Table 2).

The four recommendations that are receiving action are the purview of a task force of agency staff from both sides of the border. The Task Force has appointed a working group of agency staff, scientists, and others to address each issue. The working groups were formed in early 1995 and began implementation plans for the MSPs recommendations. Progress has been slow and continues into 1996.

In 1996 the role of the MSP has evolved into one of cheerleader, critic and political persuader. Panel members have attended Task Force and Environmental Cooperation Council meetings to voice support for the ECCs intentions towards progress, and criticism for the slow pace of activity. Individual MSP members sit on workgroups in both WA and BC and attempt to move activities forward. They seek to redirect activities that stray widely from the courses set out by the MSP and endorsed by the ECC. In addition, MSP members have met with agency directors and program leaders in state and provincial agencies to help focus the attention of agency management on the importance of the shared resources, and to encourage agency staff to take seriously the responsibility of working towards joint environmental management systems.

The MSP members continue to call attention to the accelerated pace of change due to human activities in the inland marine waters. They also see a continuing need to encourage natural resource managers to view their responsibilities from a new perspective: by taking an ecosystem approach to environmental management, and by considering harm to the environment as the primary criterion for allocating management resources.

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Andrea Copping
Washington Sea Grant College Program
University of Washington HG-30
3716 Brooklyn Avenue N.E.
Seattle, WA, USA 98105-6716

Ph (206) 685-8209
Fax (206) 685-0380
Email ACOPPING@U.WASHINGTON.EDU

Table 1

Questions Posed to the BC/WA Marine Science Panel by the State of Washington and the Province of British Columbia

1. What transport mechanisms exist for transboundary exchange of human-caused contamination between the Strait of Georgia, Puget Sound, and Juan de Fuca Strait? To what extent can spills or discharges to these waters be transported across the international border and cause harm?

2. What do we know about the status of the transboundary population of invertebrates, finfish, birds, and mammals of Strait of Georgia, Puget Sound, and Juan de Fuca Strait? Are there long term trends in the populations, and if so, what are the likely causes?

3. To what degree do the biological resources of the Strait of Georgia, Puget Sound, and Juan de Fuca Strait move across the international border? Biological resources include invertebrates, finfish, birds, and marine mammals.

4. What evidence is there for harm from transboundary pollution and other anthropogenic influences to the habitats, aquatic biota, human uses, or public health of the Strait of Georgia, Puget Sound, and Juan de Fuca Strait? As compared to five or ten years ago, is the severity of harm greater, less, or the same?

5. Given forecasts of human population increases for the lands that drain to the Strait of Georgia, Puget Sound and Juan de Fuca Strait, and assuming little or no change to the current level of pollution control, harvest management and land use management activities, will the amount or severity of harm from transboundary pollution to the habitats, aquatic biota, human health, or public health be greater, less or the same in 20 years? Are the transboundary populations of biological resources associated with the Strait of Georgia, Puget Sound and Juan de Fuca Strait anticipated to increase, decrease or stay the same in 20 years?

6. What components of the transboundary marine ecosystem appear to be the most sensitive to harm from human activities?

7. What types of harm appear to be most serious and should be the focus of monitoring, research and management activities over the next ten years?

8. What indicators are recommended for future state of the environment reporting for the transboundary marine ecosystem?

9. Which types of human activities (for example, discharges or spills of toxic compounds, nutrients, pathogens, physical land modification) need the most management attention?

Table 2

BC/WA Marine Science Panel Recommendations
(ranked in order of priority)

Additional Actions Activity	ECC Priority
1) Minimize Estuarine Wetland Habitat Losses	X
2) Establish Marine Protected Areas	X
3) Protect Marine Animals and Plants	X
4) Minimize Large Fresh Water Diversions	
5) Minimize Introduction of Exotic Species	X
6) Control Toxic Wastes	X
7) Prevent Large Oil Spills	
Effective Management Tools	
1) Strategic Planning	X
2) Comprehensive Program Review	
3) Monitoring/Research/ Management Framework	X
4) Increased Public and Scientific Communication	X
5) Freedom of Scientific Discussion	

COASTAL NORTH CAROLINA WATER QUALITY: POLLUTION, POLICY AND POLITICS

B.J. Copeland, North Carolina Sea Grant College and
Walter F. Clark, North Carolina Sea Grant College

Introduction

Coastal waters are one of North Carolina's most important natural resources. Miles of marshes, estuaries and barrier islands provide critical habitat and nurseries for important plants and animals. Rivers, sounds and ocean teem with fish that support the state's economy through recreational and commercial fishing. Long beaches and vast expanses of water draw millions to the coast each year.

But today, reports of algal blooms, fish kills and dead water have become frequent. Enrichment of North Carolina coastal waters with nutrients threatens the coast's sublime beauty and teeming wildlife. Coastal water quality problems did not arise overnight. Signals of ecosystem stress have been occurring for more than a decade. However, it has been difficult to draw everyone -- resource managers, scientists, politicians, and the public -- together to see the problem from the same perspective.

During recent decades, North Carolina's rivers, estuaries, and ocean waters have been inundated with nutrients. Nitrogen and phosphorus pour from waste treatment plants and industries; drain from farmlands, forests and city streets; trickle through groundwater from animal waste lagoons and other land-use activities; and rain from clouds seeded by factory, agricultural uses, and fossil fuel emissions. This deluge of nutrients into ecosystems already rich in their own natural supply causes eutrophication -- too many nutrients -- which is responsible for algal blooms, hypoxia, fish kills, decline in valuable seagrasses, and other problems. These problems have been difficult to solve because:

- The linkages and interactions among nutrient sources, fates and impact are extremely complex and not entirely understood by scientists, even less by the public, and difficult to identify by resource managers.
- Population and activities in the watershed continue to increase, and mostly outpace the implementation of mechanisms to reduce the generation and release of nutrients.
- Coastal North Carolina is a unique and complex coastal environment, consisting of large, slow-moving, wind-mixed, shallow lagoons that flush very slowly through narrow inlets to the sea.

People see the problems, but they do not see the causes. Dissolved nutrients are undetectable to the naked eye, which makes the problem of too many nutrients a hard concept for the public to grasp and embrace. Consequently, many people do not understand that eutrophication and its consequences are directly related to human activities. Natural resources are finite and in the public domain, but there are infinite desires to use them. The many, and often conflicting, demands are simply increasing pressures on our resources and the people who manage them.

Scientific Inquiry

During the past decade, teams of scientists have examined the coastal sounds and estuaries and their watersheds. Multidisciplinary studies were conducted in the following areas:

1. Circulation and Mixing -- Coastal ecological systems receive input from upstream point sources, watershed non-point sources, rainfall, exchange among water bodies and the ocean, etc. It is fundamentally important to understand how and when circulation and mixing occurs.

2. Nutrient Inputs -- Coastal ecological systems receive nutrient inputs exceeding the assimilative capacity, leading to nuisance algal blooms and fish kills. Linkages between nutrient loading and water quality are fundamental to the understanding of fate and impacts. Recent discoveries of nutrient-driven, toxic dinoflagellates indicate specific fish kills in some waters.

3. Fisheries -- Secondary productivity is the connection to public and private user groups and serves as a base for large economic returns. Fish kills, diseases, and reductions in yields must be understood in the context of the entire ecosystem.

4. Land/Water Interactions -- A majority of loading in North Carolina coastal waters has been attributed to non-point sources. In order to effectively manage land-use, we must identify those sources and relate the inputs to specific land-use activities.

5. Socio-Economic Impacts -- Coastal economy, in large part, involves the natural resources provided in public trust waters. Whatever changes that may be exacted to improve water quality will need to be evaluated in its socio-economic context and the relative costs, both economically and socially, must be evaluated.

6. Sediments -- The great storehouse of material inputs to the estuary lies in and attached to the sediments. Sediment movement, distribution, and interaction with the water must be understood to evaluate estuarine responses to changes in loading.

7. Wetlands -- Natural functions of wetlands offer natural buffers to non-point source loading. The relative value of different types of wetlands, their variability and use, must be understood to be used as reductions to loading and to protect estuarine water quality.

Policy Development

In response to public interest due to deteriorating water quality in one of the state's major estuarine systems, the state senate appointed a "Select Committee on River Water Quality and Fish Kills" to develop new state policy on coastal water quality. The Senate Select Committee, in recognition of creditable research, called on the Sea Grant College Program to provide scientific expertise to advise the committee. Based on questions raised by the Senate Select Committee and scientific focus group discussions, a workshop, composed of university scientists, management agencies, industry scientists, and citizens groups, was convened by Sea Grant to suggest measures necessary to reduce nutrients and improve water quality. A series of recommendations were proposed:

1. Restoration of Water Quality in the Estuary: Adopt a minimum goal to create a detectable improvement in water quality by capping loading at 70% of the 1990-1995 average load. Based on current knowledge, this reduction will produce a detectable improvement within five years. Immediate action will require development of a "basinwide" water quality model.

2. Identification and Characterization of Nutrient Sources: Based on current technology, initiate an isotope ratio study to identify nutrient sources. This action will improve the ability to categorize sources among sewage, animal wastes, fertilizers, atmosphere, runoff, etc.

3. Improved Data System: Establish a centralized data bank that includes all historical and current water quality and fisheries data properly catalogued and retrievable. This would include information from citizens monitoring groups and would be available to all interests.

4. Wetlands Utilization: Move immediately to establish mandatory buffers of riparian wetlands. Effectiveness depends on developing site specific, quantitative guidelines for riparian buffers, hydrologic reconstructions, and best management practices for land use.

5. Nutrient Reduction Cost/Benefit Identification: Convene a workshop to identify the state of knowledge regarding social and economic costs and benefits of pollution reduction alternatives. Ascertain public and stakeholder perceptions concerning water quality conditions and the willingness to pay for and participate in changes and improvements.

6. Improved Water Quality Monitoring Program: Design a comprehensive monitoring program under the oversight of a scientific advisory board, including a well-organized volunteer monitoring network.

7. Establish a Scientific Advisory Board: Establish a formal Scientific Advisory Board to oversee planning and implementation of effective water quality management. The board would appoint Task Groups to consider specific, technical issues as needed.

8. Environmental Education: A strong environmental education and communications program will be needed to undergird whatever technical and managerial actions that may be implemented. All segments of society and user interests of coastal resources will need a better understanding of the environment and the effects of human activities in order to bring about the changes required to improve current environmental quality.

All of the above recommendations were incorporated in new state policies proposed by the Governor, the General Assembly and many user groups.

Politics

Several bills were introduced in the 1996 session of the state General Assembly, where tremendous public debate considered the recommendations and policy declarations. Coastal water quality and fisheries issues have become campaign issues and stands for or against environmental quality are influencing elections and the passage of legislation. Some specific legislation and/or state initiatives:

1. Wetlands Trust Fund: An Act to establish a Trust Fund of $30 million per year to purchase designated riparian wetlands, natural areas and critical non-point reductions is pending. The legislation has the support of the Governor, both houses of the General Assembly, agriculture and forestry organizations, developers, and environmental groups.

2. Capping Nutrient Loading: It is now the intention of the state's environmental management commission to cap nitrogen loading to coastal waters at 70% of the 1990-1995 average.

3. Characterization of Nutrient Sources: A study has been initiated to use isotope ratios to categorize sewage, animal waste, fertilizer, and atmospheric and urban runoff source contributions. Funds were obtained from industry, grants, and state appropriations.

4. Data System: Plans are being formulated under the auspices of the state Board of Science and Technology to develop, catalogue, and quality check a centralized data bank that is user friendly and available to all interests.

5. Wetland Buffers: A group of scientists and managers have been identified to develop site specific, quantitative guidelines for riparian buffers. This document will also contain the use of best management practices to reduce nutrient runoff and recommendations for reconstructing hydrologic integrity around sensitive waters. Funding comes from state appropriations.

6. Improved Water Quality Monitoring Program: Legislation has been introduced to increase and improve water quality monitoring ($1.6 million per year) and to develop basin-wide water quality modeling ($720,000). A widespread, organized citizens volunteer water quality monitoring program will be initiated.

7. Establishment of a Scientific Advisory Board: The department of Environment, Health and Natural Resources will have a formal scientific advisory board to oversee water quality and fisheries monitoring, studies, and management planning.

8. Agricultural Management Cost Sharing: The state will cost share with farmers for the introduction of practices deemed applicable for reducing runoff and nutrient flows. These will be applied in concert with the recommendations contained in the guidelines developed in 5, above.

9. Environmental Education: A bold, new environmental education program developed through the Department of Environment, Health and Natural Resources will be implemented. The plan is being formulated with the input of university scientists and educators.

Many of these initiatives are still pending and will be subject to political will. However, prospects are very promising due to the support of an interested and concerned public, and the availability of creditable scientific information.

B. J. Copeland
North Carolina Sea Grant College Program
Box 8605
N. C. State University
Raleigh, NC, USA 27695-8605

Ph (919) 515-2454
Fax (919) 515-7095
Email BJ_COPELAND@NCSU.EDU

RHODE ISLAND SALT PONDS, AN EXAMPLE OF INTEGRATED COASTAL ECOSYSTEM MANAGEMENT

Virginia Lee, University of Rhode Island, Coastal Resources Center
Stephen Olsen, University of Rhode Island, Coastal Resources Center
Scott Nixon, Rhode Island Sea Grant Program

Introduction

An integrated management plan for Rhode Island's Salt Pond lagoon ecosystems underwent a complex policy process prior to formal adoption in 1984 and is now being revised after a decade of implementation. The principal issues -- deteriorating water quality, rapid sedimentation, overfishing, increased vulnerability to hurricane damage, and mounting user conflicts -- are all closely interrelated and driven by rapid residential development in the watershed. The complexity of the resource management issues is matched by the complexity of governmental authority fragmented among agencies of municipal, state, and federal governments. The plan required four years of scientific research to estimate the causes, linkages, and significance of selected expressions of lost environmental quality and two years of collaborative planning and negotiation with many agencies of government. During the ten years following its formal adoption as an element of the Rhode Island Coastal Management Program, the plan has achieved many of its objectives; it halted, but did not reverse, the gradual erosion of environmental quality in this beautiful and productive coastal region. A string of sandy barrier beaches and scenically beautiful coastal lagoons (known locally as "salt ponds") that have been extremely bountiful in fish, shellfish, and waterfowl, stretch along Rhode Island's Atlantic coast. This area is important for lucrative summer tourism and contains a large proportion of the state's most valuable residential property. The state's biggest commercial fishing port is at the mouth of Point Judith Pond. In a series of public hearings that accompanied the adoption of the statewide coastal management plan, local residents forcefully requested that government pay greater attention to the region, align contradictory policies and manage environmental changes in the region more effectively, so that the quality of life and the economy of the area could be sustained.

Issue Identification

Threats to a sustainable economy and quality of life for the citizens of the region included:

- Declines in fish and shellfish stocks;
- Stabilized inlets causing rapid siltation in the lagoons: shoaling inlets no longer provide boats with safe access to the ocean and are changing water circulation patterns;
- Nonpoint source water pollution becoming more severe and widespread: bacterial contamination threatens to close shellfishing grounds and eutrophic conditions are degrading fishing habitats and the quality of the lagoons for swimming and boating;
- Unmanaged growth overwhelming the ecosystem's capacity to assimilate waste and sustain potable drinking water: the farmland and woodland that give the area much of its character, beauty, and sense of community are being lost;
- Building in highly hazardous coastal flood zones where property destruction and loss of life have been severe in past hurricanes;
- User conflicts accelerating: competition between aquaculture, recreational and commercial fisheries, residents and commercial interests are mounting as the number of people using the lagoons and their environs increases; and
- Agency decision-making was viewed as cumbersome, contradictory, time-consuming, and ineffectual.

Water quality problems proved to be the best integrator among all the problems affecting the region. The water quality problems in the salt pond region range from bacterial contamination, which closed shellfishing areas, to contamination of drinking water supplies and symptoms of eutrophication. Concern for eutrophication called for a major Sea Grant-funded research effort to develop nutrient input budgets for the lagoons. This work has shown that by far the largest nitrogen loading to the lagoons was the nitrate in groundwater. A synthesis of the research on nutrient sources in the salt pond region combined with research conducted elsewhere, particularly on Long Island, New York, led to the conclusion that residential development, specifically on-site sewage disposal and fertilizers, was the principal source of this anthropogenically derived nitrogen. Field experiments demonstrated that additions of nitrogen in the form of nitrate and ammonia trigger massive blooms of nuisance algae (*Enteromorpha* spp., *Ulva* spp.). An analysis of existing municipal zoning plans and ordinances that determine the density and distribution of development had shown that the development process was less than half complete and that under existing regulations the numbers of houses in the watersheds of the lagoons could be expected to double and the resident population to increase fourfold. Additional deterioration is unavoidable. For instance, the research on the enrichment of groundwater with nitrate raised the additional public health issue of nonpotable drinking water supplies. In the United States the limit for potable water is 10 mg/l of nitrate nitrogen. This level has already been attained in some areas of the Salt Pond Region, and such concentrations are expected to extend over much larger areas at saturation development.

A common response to problems such as these is to build, at great expense, public water supply and sewage systems. A small public water supply system already exists to service older communities where wells are contaminated by bacteria. A region wide water system, however, will pose the enormous problems of securing an adequate source of unpolluted supply and in altering freshwater inputs to the individual salt ponds. A public sewer system will effectively eliminate major sources of nitrate and bacteria to groundwater. However, experience in neighboring states has shown that such services encourage dense development. A large number of users is needed to defray the costs of building and maintaining such services and as the area becomes increasingly urban in character the nutrients and bacteria carried by surface runoff become more significant. The likely end result would be eutrophic salt ponds with large areas closed by bacterial contamination -- a similar condition to that produced by smaller populations without these amenities. A better strategy is, if possible, to reduce the ultimate density of development and to implement a variety of measures to reduce the flow of nutrients and bacteria into both groundwater and the lagoons.

The implications of water pollution on recreational as well as commercial fisheries are enormous. State law requires that areas be closed to shellfishing when coliform bacteria concentrations attain prescribed levels. The studies suggested that if the development trends were to continue unchecked, areas that still support intensive shellfishing would eventually have to be closed. In certain coves, episodes of low oxygen limit the few remaining oyster populations to near surface waters. This has greatly reduced the potential for a promising small-scale oyster aquaculture industry. Eutrophic conditions also are increasing areas of soft, highly organic bottom sediments that were formerly productive sandy bottoms. The effects of eutrophication on finfish stocks are less obvious but may be equally significant. Localized fish kills that may be attributed to low oxygen and high temperatures are known to occur and, if they become more common and widespread, could have a significant impact on the juvenile flounder that are abundant in the lagoons during the summer.

One of the biggest threats of increasing water pollution to fisheries, however, is indirect. If the lagoons become more polluted by high levels of bacterial contamination and eutrophic waters, there will be mounting pressure to increase water circulation and flushing. This could be readily accomplished by dredging out channels and inlets and by cutting new connections between adjoining lagoons and to the ocean. Research relating the hydrography of the salt ponds to their value for fisheries showed, however, that such modifications have profound implications on the conservative qualities of the lagoons as nursery areas for finfish and can have major impacts on the productivity of shellfish stocks as well. Such modifications would also, in many instances, accelerate the already severe problem of rapid siltation of the lagoons by sand carried in the inlets by fast-flowing tidal currents. Thus, eutrophication, bacterial contamination, and strategies to address their water quality problems have major implications for fisheries management.

Declines in habitat quality, however, are only one reason for the remarkable decline in the fisheries of the salt ponds in this century. Equally important is the chronic overfishing by commercial and recreational fishermen.

There were two distinct forms of negotiation and collaborative thinking required to formulate the plan. The first was internal, among those concerned with the policy and planning implications of the work and the researchers. The second was the more formal and structured process of negotiation among public interest groups and among governmental agencies.

Policy Development Process

It was no simple matter to create and maintain the sense of a collaborative effort among the many principal researchers. It was also a major challenge to keep track of the research findings and the initial interpretations thereof, and apply them to the management questions as the components of a management strategy gradually evolved. The need for a considerable number of mid-course corrections in the research priorities also surfaced and were incorporated into the research plans of the investigators. Collaborative field studies and interpretation of research results for management strategies also helped build an appreciation for the many interrelationships among the research findings.

Another major challenge was to convince municipal officials that they did have the power and the ability to influence how the land was developed. A series of topical workshops were held so that a critical mass of the local officials were convinced that problems could indeed be overcome and that exciting new approaches to old problems were being successfully tested elsewhere. They helped create a sense of common purpose and trust among the larger community and each of their municipalities.

To assure support of the management plan by key interest groups, an advisory committee worked intensively over two years to adopt policies and regulations and, equally important, a set of nonregulatory initiatives for managing the region. Once the draft plan had been approved in principle by the Committee, it was released to the press and again became the subject of in-depth and supportive newspaper articles. At the same time, the Plan was presented at a series of public workshops, which built further support.

The Plan was then subject to the formal hearing process required by the Rhode Island Administrative Procedures Act. This is an often contentious and awkward process that does not easily promote negotiation among parties in conflict. It is a testament to the enormous amount of work that preceded the formal hearing process that all conflicts had been worked out well in advance and the formal hearing consisted almost entirely of strong statements in support of the strategy from a broad cross-section of government officials at the municipal, state, and federal level, and many citizens. The Plan was formally adopted by the Management Council in November 1984, approximately one year after formal adoption of the new statewide regulatory coastal program.

Conclusions

The Special Area Management Plan has now been in effect for 10 years. It is being revised in 1996 for three reasons: (1) to update the technical findings; (2) to incorporate GIS maps for improved implementation; and (3) to align changes in local zoning with the policies of the state coastal management program for land use in the watersheds of the salt pond ecosystems.

With the benefit of hindsight, the major features of the strategy and its relative success appears to be as follows:

- The Plan has succeeded in providing three levels of government (municipalities, state agencies and federal agencies) with a common, formally adopted set of objectives and strategies for managing the saltpond ecosystems. The sense of isolation and working at cross purposes between municipal and state regulatory agencies has been largely overcome. The coordinated review of major development proposals that is a major feature of the Plan does not occur with the formality originally envisioned, but the town requests a review by state agency staff at the initial stages of formulating a proposal so that the local planning boards can benefit from technical review and may assume that proposals meet state standards from the beginning of the development process.

- The municipalities have adopted modifications to their zoning plans and ordinances that have significantly reduced the ultimate density of development within the watersheds of the lagoons. Opposition to some of these modifications was intense and well-organized, but the Plan and concern for protecting environmental quality persuaded the majority of voters to support the changes.

- The Rhode Island Department of Environmental Management has extensively reviewed the criteria by which it evaluates the potential impacts of on-site sewage disposal systems. State codes have been changed to provide for more stringent siting and construction standards for septic systems in the salt pond region. Legislation has been passed to allow towns to establish wastewater management districts for non-sewered areas.

- No large-scale proposals have been made to invest in infrastructure such as sewer systems and public water supply systems that would ultimately increase the density of development. Moreover, public infrastructure has been prohibited from storm hazard areas and in, one case, public water lines have been removed from a hazardous barrier beach area.

- Non-point source pollution loadings are reduced by buffer strips, building setbacks, limiting the number of docks, and requiring grassy swales to treat road runoff.

- The Special Area Management Plan has served as the model for similar linked research and planning initiatives elsewhere in Rhode Island and in other coastal states. The major features of the Plan have been adopted by planners for the watersheds abutting the original Salt Pond region to the north and west.

Virginia Lee
Rhode Island Sea Grant College Program
University of Rhode Island
Graduate School of Oceanography
South Ferry Road
Narragansett, RI, USA 02881-0804

Ph (401) 874-6224
Fax (401) 789-4670
Email VLEE@GSOSUN1.GSO.URI.EDU

Session H3, Part I: Networking of North American Marine and Coastal Protected Areas: First Steps Toward Regional Implementation
Session Chair: Jeffrey Benoit, NOAA/National Ocean Service

No abstracts submitted for this session.

Session H4, Part I: Decision Support Tools for Coastal Management
Session Chair: Mark Evans, NOAA/National Ocean Service

DECISION ANALYSIS, DPL, AND COASTAL MANAGEMENT

Adam B. Borison,
Applied Decision Analysis, Inc.

Coastal management decisions are difficult in part because of the uncertain impacts they generate, such as enhanced biodiversity, and the competing objectives they are intended to achieve, such as economic growth and environmental quality. This presentation describes an approach (decision analysis) and a commercially available PC software product (DPL) designed to address these two difficulties and improve the quality of coastal management decisions.

Adam Borison
ADA Inc.

INFORMATION SOURCES AND USES IN THE DEVELOPMENT OF A COASTAL ECOSYSTEM MANAGEMENT PLAN

Holly Greening, Tampa Bay National Estuary Program

The Tampa Bay National Estuary Program (TBNEP) is a four year program charged with development and initiation of a "Masterplan" for long-term management of Tampa Bay. Partners in TBNEP include the U.S. Environmental Protection Agency, Florida Department of Environmental Protection, Southwest Florida Water Management District, the counties of Hillsborough, Pinellas and Manatee, and the cities of St. Petersburg, Tampa and Clearwater.

Since initiation of TBNEP, participants have agreed that the final goal for the program is the restoration, enhancement, and protection of the bay's critical living resources. This includes both the physical structure of important habitats and the animal communities which inhabit them. Tampa Bay NEP participants have focused on developing measurable goals and associated strategies to restore and protect water quality and bay habitats, as the foundation for healthy and diverse populations of fish and wildlife. The relative richness of historic data and information sources available for the Tampa Bay watershed has proven to be a critical element to the success of the program, without which setting specific measurable goals would have been much more difficult.

Furthermore, Tampa Bay resource managers have continuing requirements for data collection and interpretation to enable the measurement of progress (or lack of) toward meeting those goals, emphasizing the need for a long-term monitoring program. An effective monitoring and data interpretation program provides the information necessary to assess the status and trends in the health and abundance of the bay's wildlife and habitats. This information allows local governments and agencies to evaluate progress made in the restoration and protection of Tampa Bay. The data also provide insights into the effectiveness of current management strategies, indicating when goals have been met, if actions should continue, or whether more stringent efforts are warranted.

Setting TBNEP Goals and Targets - Information Sources and Uses

Seagrass and Water Quality Goals

In 1993, the Tampa Bay NEP established a long-term seagrass restoration target of 14,000 acres. That goal was based on restoring seagrasses to 1950s levels, excluding areas that have been permanently altered. Subsequent studies by TBNEP indicate that as many as 12,000 acres of seagrass can be recovered over time by maintaining existing water quality conditions. That would require local communities to reduce their nitrogen loadings to the bay by about 10% by the year 2010 to compensate for increases in nitrogen loadings associated with population growth. Models developed for the program estimate increases in nitrogen loadings of about 30 tons per year from all sources, an amount that represents less than 1% of present-day levels.

The TBNEP, in cooperation with the Southwest Florida Water Management District (SWFWMD), is using a two-pronged modeling approach to define the relationships among the environmental requirements of the target resource (seagrass), water quality conditions necessary to support restoration of the target resource, and nutrient loadings which drive changes in water quality conditions. These two approaches, an empirical regression modeling approach and a mechanistic "box model" approach, both require considerable data and information.

Several types of data sources were necessary to develop the models, and ultimately to define measurable restoration goals: historical and existing seagrass extent (acreage), historical and existing ambient water quality data, river flow, and information used to develop nutrient loading estimates.

Seagrass Trends: Data Sources

Seagrass coverage trends were developed using GIS maps generated from photointerpretation of aerial photographs taken in 1950, 1982, 1988, 1990, and 1992. By overlaying areal coverage maps from these years, temporal trends of extent and location were generated. GIS coverages of permanently altered areas of the bay (*i.e.*, dredged and filled, new causeways, shoreline alterations) were generated from historical aerial photographs and NOAA navigational charts. A final "seagrass restoration target" map was produced by layering 1950 seagrass extent, 1990 extent, and subtracting those areas which were permanently altered between those years. The final seagrass restoration target map (Figure 1) shows those areas which were seagrass in 1950 but were not in 1990, taking into account permanently altered areas.

The definition of seagrass light requirements in Tampa Bay was also a critical element of the process, and obtained through implementation of a study designed to measure average light at deep edges of seagrass beds.

Water Quality Trends: Data Sources

Monthly ambient water quality has been monitored by the Environmental Protection Commission of Hillsborough County throughout the bay since the early 1970s. This continuous record of nutrient concentrations, Secchi disk depth, color, turbidity, chlorophyll, salinity, temperature, and other parameters has been invaluable in the development of statistical and mechanistic model relationships between seagrass light requirements, ambient water clarity, and chlorophyll, and turbidity levels.

Nutrient Loading: Data Sources

Nutrient loading information used in the development of both models was the most eclectic and variable element of the goal-setting process. Data types and sources included the following:

Nonpoint sources (stormwater runoff)
- drainage basin boundaries (US Geological Survey)
- stream flow (USGS)
- rainfall records (National Weather Service)
- land use/land cover (GIS format) (SWFWMD)
- land use-specific runoff coefficients (literature)
- soils (GIS format) Soil Conservation Service

Point sources (domestic and industrial wastewater)
- point source permitted operating records (state and federal)
- land application of effluent (calculated attenuation)
- springs (USGS for flow volume; SWFWMD for water quality)

Atmospheric deposition
- rainfall records (USGS)
- wetfall nutrient concentrations (National Atmospheric Deposition Program)

Groundwater
- aquifer flow estimates (SWFWMD)
- groundwater nutrient concentrations (USGS and SWFMWD)

The nutrient loading element of the Tampa Bay models was collated using ARC/Info GIS and SAS databases.

Goals for Estuarine Wetlands

TBNEP participants have also agreed to a watershed strategy for coastal habitat restoration and protection that goes further and will accomplish more for Tampa Bay than existing "no net loss" goals for wetlands. More than 20% of the bay's saltwater wetlands have been lost to development since the 1950s. Development has exacted an especially heavy toll on the oligohaline (low-salinity) portions of the bay's tributaries: almost 40% of the 1950s acreage have been lost. Oligohaline areas provide critical nursery habitat for numerous species of fish and invertebrates in the Tampa Bay estuary.

A strategy to "restore the historic balance" of the key emergent wetland plant communities focuses bay-wide efforts on two elements: 1) bay tidal stream habitat are given restoration priority; and 2) all remaining emergent marine and estuarine wetlands not currently under protection from development are identified as priority acquisition or conservation easement areas.

An overall minimum goal is to restore roughly 100 acres of low-salinity tidal marsh habitat every five years, while maintaining and enhancing salt marshes and mangroves at existing levels. The long-term aim is to recover more than 1,600 acres of these habitats over time, either through habitat restoration or enhancement of existing areas that have been severely degraded. The strategy effectively targets one of the major causes of bay wildlife declines--the accelerated decline of a few unique and crucial habitats whose losses place a "biological bottleneck" on bay productivity.

Coastal Habitats Areal Trends: Data Sources

Historical and current aerial photographs were used to develop GIS coverages of habitat type. As with the seagrass target mapping process, 1950 historical coverage and 1990 coverage was layered to produce a map and database of acreage of loss or gain of each habitat type. Data sources for this effort were:

- SWFWMD land use/land cover (GIS)
- National Wetland Survey maps

Monitoring Progress Toward Meeting Goals
The Tampa Bay Monitoring Program

A critical element of the final Master Plan for Tampa Bay is the establishment and maintenance of a monitoring program capable of measuring status and trends of environmental variables which may be affected by actions designated in the Plan. Local governments implementing actions need the ability to evaluate whether funds and effort spent on pollution abatement in the watershed is reflected in improvements in bay quality. An effective monitoring program can provide data to assess the effectiveness of current management strategies and indicate progress (or lack of) toward goals.

One of the first elements of the TBNEP in Tampa, therefore, was to initiate a multi-year effort, in cooperation with local governments and agencies, to establish a coordinated monitoring program capable of reliably measuring changes in bay quality. The bay-wide monitoring plan builds on a significant foundation of existing water quality and fisheries monitoring programs. Existing programs have been standardized and expanded in some areas and new components have been added.

Defining and Meeting Objectives

Through a series of workshops, two major objectives for the bay-wide program were defined by local governments, agencies and university participants. These were to:

- detect temporal changes of environmental variables (*i.e.*, water quality parameters, seagrass coverage, fish abundances) for each of the major bay segments; and
- estimate areal extent of conditions and detect differences between the bay segments.

An inventory and assessment of existing programs indicated that the first objective, to detect temporal changes by bay segment, was being met for water quality, fisheries and seagrass coverage. However, the existing water quality sampling network required additional sample site locations (particularly in shallow water) to estimate areal extent of conditions. Sediment chemistry and benthic communities were not being monitored under existing programs.

After examining several options, the stratified random statistical design developed by the U.S. EPA Environmental Monitoring and Assessment Program for Estuaries (EMAP-E) was used to provide a framework for estimating the areal extent of water quality and benthic conditions in the bay. Unlike many monitoring designs, this probability-based sampling approach allows the status and trends of environmental quality indicators to be estimated with statistical rigor and known confidence.

The bay-wide monitoring program for Tampa Bay currently encompasses these components:

- Water quality
- Benthos and sediment quality
- Seagrass coverage and quality
- Fisheries

Tampa Bay benefits from several existing water quality, habitat and fisheries monitoring programs, including an ambient water quality monitoring program operated by the Environmental Protection Commission (EPC) of Hillsborough County since 1974. These programs have contributed significantly to the wealth of knowledge available on the Tampa Bay estuary.

The monitoring design devised by the Tampa Bay NEP builds on this existing foundation. Existing monitoring programs have been standardized and expanded in some areas and new components (to measure atmospheric deposition, bay sediment chemistry, and the health of benthic communities) have been added.

A series of workshops with local government and agency partners helped to define five general monitoring objectives for the water quality, fisheries, benthic and habitat components of the program. These objectives are to:

- estimate the areal extent of the bay that does not provide adequate water quality conditions to support seagrasses and other living resources
- assess the abundance and health of bay fish populations over time
- estimate the areal extent of degraded benthic habitat in the bay and within each bay segment
- estimate the areal extent and quality of seagrasses, mangroves and emergent bay wetlands
- estimate the areal extent of oligohaline (low-salinity) habitat in the bay and its tributaries.

Another new element in the monitoring program for Tampa Bay is an increased emphasis on communicating information in a standard and more meaningful format. Prior to standardization, monitoring programs used various methods to communicate their results. The monitoring framework has been specifically designed to provide a forum and format for compiling and synthesizing results from major monitoring programs in a single comprehensive document.

Monitoring workshops will be held regularly, every second or third year, allowing environmental professionals from various programs to meet and review findings. A separate report will be written for decision-makers at government agencies responsible for the management of the Tampa Bay estuary.

Implementing a Coordinated Program

The Tampa Bay Monitoring Program is unique among estuaries and coastal areas across the country in that implementation is being accomplished by many individual governments and agencies, rather than one centralized agency. Successful implementation of the program will require strong commitment for continued coordination from the participating entities.

The Tampa Bay NEP has initiated several avenues for continuing coordination, including the following:

- Regularly scheduled standardized quality assurance checks between participants conducting water quality and benthic community analyses.
- Development of a coordinated sampling design and procedures. TBNEP participants have joined other county governments from Tampa Bay to Charlotte Harbor and the Sarasota Bay NEP to form the Florida West

Coast Regional Ambient Monitoring Program, to implement standardized procedures.
- Reporting and integration of monitoring results in a regularly compiled Environmental Monitoring Report.

Information and Data Sharing in Tampa Bay

In 1992, TBNEP and local agencies and governments developed a Data Management Plan for data and information sharing in the Tampa Bay region. The participants recommended keeping data in the control of individual agencies as an advantage that doesn't require the development and maintenance of a central repository, but which keeps the data sets closely linked to people who are experts on their contents and structure. The Data Management Plan also called for the development of a central subject directory, designed for the specific purpose of directing users to data stored in the individual agencies. In a 1992 survey of agencies by TBNEP 39% indicated that they required access to maps/ maps-data and 78% indicated that they had worked on a project using GIS in the last year, with 77% indicating that they expected access to GIS to be "extremely important" to their work in the next five years, a prediction that has proven to be true.

To reach the objectives of the Data Management Plan, TBNEP has been working with the state of Florida's Growth Management Data Coordinating Council's (FGMDCC) Florida Spatial Directory to develop a Central Subject Directory as well as their quality and accuracy protocols as useful to NEP. The FGMDCC is using the Tampa Bay area as pilot for implementation statewide.

Summary

Development of a comprehensive management plan for Tampa Bay was strongly dependent on existing data sources to define long-term goals for the bay. Implementation of the baywide plan will rely on data collected with the specific objective of tracking progress towards agreed-upon goals for the restoration and protection of Tampa Bay's living resources. Critical elements include the following:

1. Conduct habitat mapping in GIS format to track status and trends of long-term living resource restoration goals
2. Implement a statistically valid water quality monitoring program to track short-term indicators of bay quality
3. Develop coordination and standardization between local monitoring programs to "share the cost" of monitoring while maintaining quality
4. Provide timely assimilation of monitoring information into management decisions and actions

5. Facilitate data sharing between programs through a Central Subject Directory while maintaining individual data management systems

Supporting Documents

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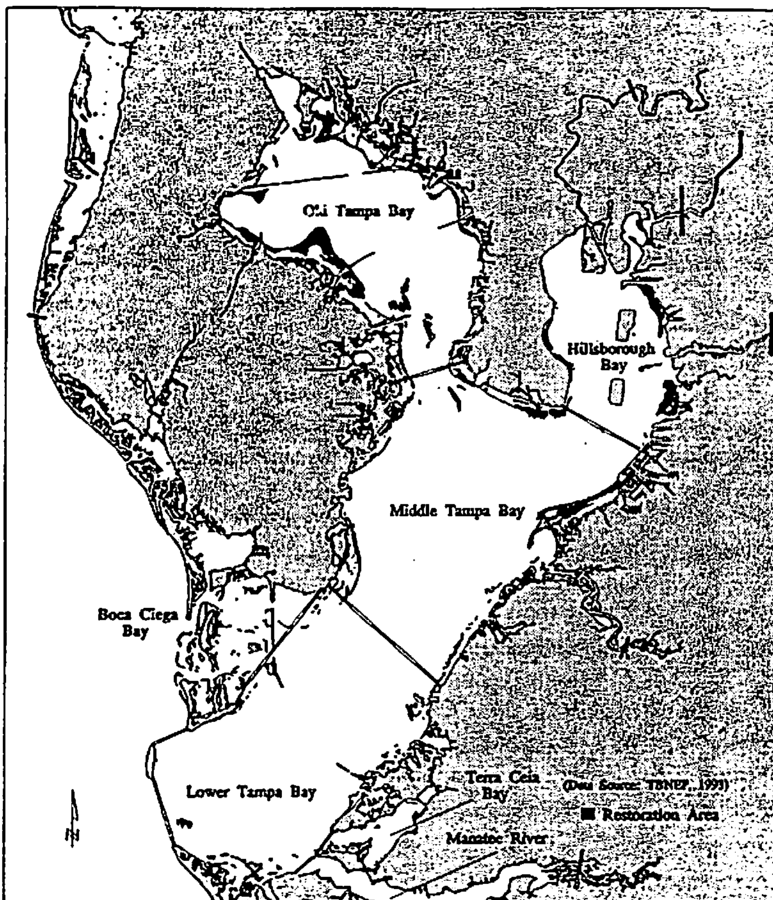
Holly Greening
Tampa Bay National Estuary Program
111 7th Avenue South
St. Petersburg, FL, USA 33701



Map Prepared by Coastal Environmental, Inc.

Figure 1. Seagrass restoration targets for Tampa Bay.

PORT RISK ASSESSMENT AND RESPONSE PLANNING FOR OIL SPILLS

Ivan M. Lissauer,
U.S. Coast Guard R&D Center,
Roberto V. Desimone, SRI International, and
D. John Mark Agosta, SRI International

The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Commandant or the Coast Guard at large.

In May 1993, the U. S. Coast Guard Research and Development Center (R&D Center) began research to determine the feasibility of developing a "Configuration System" for use prior to and during oil spill responses. The configuration model would use equipment databases, capabilities databases, personnel databases, and risk assessment scenarios to develop responses to questions concerning equipment quantities, equipment location, new sites for equipment storage, and equipment mixes at different sites for use in training, analyzing the credibility of response plans and as a decision-making tool for actual response.

In order to insure that the Federal Government is adequately prepared to execute a rapid, coordinated, and effective response to a major pollution incident a thorough, usable contingency plan is vital. The effectiveness of a contingency plan depends on the depth of evaluations and considerations of different types of events that could occur and the nature, type and level of response that have been taken into consideration during the development process. Contingency plans developed by different groups vary in both quality and considerations of various quantitative aspects of a potential release of oil or hazardous material, which makes it difficult to assess, a priori, the effectiveness of a plan prior to its actual use in a real emergency. The development of a method for analyzing the level of risk for an oil spill and the use of that information within a configuration system provides an initial method of creating a uniform guidance methodology for use in the development and assessment of contingency plans, and as a tool to facilitate the use of artificial intelligence and decision-making systems for spill response training and during actual events.

A methodology used to develop a generic oil spill risk assessment model applicable to all ports, was constructed and then exercised with data from several U.S. ports to illustrate the nature of the results and their dependence on important traffic and hydrographic parameters. Using the model, several U.S. ports were rank ordered in the descending order of risk (*i.e.*, susceptibility to experiencing oil spills equal to or greater than a certain volume). This information is then used to develop scenarios for the configuration model which provides an analysis of the dynamics of one or even two major oil spills in proximity to each other or widely separated. The configuration system will be able to present the evaluation of its decisions in terms of quantitative measures of increased response effectiveness.

The prototype configuration system comprised advanced artificial intelligence (AI) planning technology, together with color map display capabilities, and modules for spill trajectory modeling and response plan evaluation implemented with the aid of commercial software. Advanced technology was leveraged from Department of Defense (DoD)-funded projects on military operations crisis planning.

The specification for the system capabilities included the following:

- Highlighting the consequences of shortfalls in the spill response equipment
- Modeling two major spill scenarios concurrently, using replanning techniques
- Generating multiple response plans for the same scenario
- Displaying response plans on a PERT chart and on a map-based display
- Presenting choices of spill response operations and equipment for spill scenarios
- Highlighting resource conflicts and response-plan inconsistencies
- Simulating the effectiveness of equipment by modeling its interaction with the transport of oil among sectors
- Summarizing and displaying in charts the environmental damages to shores and sea sectors due to the consequence of the oil spreading

The underlying AI planning techniques provide a powerful representation and automated reasoning mechanisms that permit the user to explore a greater number of spill scenarios than is practical with manual methods. These mechanisms also keep track of all the decisions made and notify the user when they contradict or are inconsistent with each other. The use of a commercial spreadsheet tool for the evaluation module permits the user to access the evaluation model more easily. The spreadsheet tool also provides an excellent array of tabular displays and charts for representing environment damage and equipment shortfalls.

The overall design, comprised four main modules:

- Equipment and Logistics Planner
- Trajectory and Oil Disposition Model
- Evaluation Module
- Color Map Display

To explore a configuration planning problem, the end user must first provide relevant information about the spill scenarios to be examined and the equipment available for responding to the spill. This information, provides the main inputs for the equipment and logistics planner. The user can modify the scenario, the locations of spill response resources, or the choices of response operations within the RESPONSE PLAN that is generated. The response plan provides an input for updating the trajectory and oil disposition model, for evaluating the environmental and cost impacts, and for presenting the plan to the user on a map display.

The main capabilities of the equipment and logistics planner are provided by state-of-the-art advanced AI planning technology, embodied within the System for Interactive Planning and Execution (SIPE-2). This technology meets the four main design criteria of flexibility, ease of use, extensibility, and interactiveness. SIPE-2 was developed during the early 1980s and has been demonstrated on a variety of planning problems.

The underlying AI planning technology provides good plan representation capabilities, as well as mechanisms for interactive and automated reasoning. SIPE-2 provides traditional PERT and Gantt-chart representations of the plans it produces. PERT charts, or partially ordered graphs provide a standard description of the plan as a set of actions ordered by links showing which action should come before another. Most systems that assist in project planning represent plans as PERT charts.
However, this form of representation is insufficient to capture or represent the rationale between the choices for certain actions in a plan. SIPE-2 is able to record the intentions and justification for specific actions, as well as their effects, and utilizes this knowledge to build a more complex dependence network that captures plan rationale. This knowledge is an essential component of the planning system because it helps to model the process of how plans are developed within specific domains such as spill response.

SIPE-2 is also able to represent spill response procedures and operations at multiple levels of detail. A high-level representation may be useful for identifying that no major parts of the overall response plan are missing, whereas lower-level plans show exactly which resources are being utilized within the plan. The number of planning levels can be increased or decreased as needed. At each level different pieces of information are brought to bear about the current situation, the applicability of specific response operations, or their duration and effectiveness. Thus, SIPE-2 manages the integration of the relevant information hierarchically without confusion.

During the planning process, SIPE-2 keeps track of a great deal of information, and presents choices to the user concerning the selection of procedures or operations, resources, locations, or times. Where there is a choice of any of these, SIPE-2 will present a list to the user. The list is not prioritized, but all members of the list have been checked for consistency.

For instance, in presenting choices of operations, SIPE-2 will have already checked that they achieve the necessary effects, and meet the applicability conditions for the current problem. In choosing appropriate response equipment, SIPE-2 checks whether the equipment can withstand the operating environment. In this way, SIPE-2 guides the selection of planning choices, but requires the user to make the final choice.

At the end of each planning level, SIPE-2 checks that the plan is consistent. This involves ensuring that no actions undo the effects of others, and checking that there are no temporal or resource conflicts among concurrent branches of the plan. Examples of these conflicts are the placing of a boom across a harbor to prevent access to the harbor for offloading skimmed oil, the arrival of a specific piece of response equipment too late for it to be effective, or plans for an item of equipment to be used at the same time in different locations. SIPE-2 is able to identify these situations and suggest remedies either by choosing different resources, locations, and times, or by ordering the actions such that the conflict is avoided.

As the situation changes, SIPE-2 checks to see that operations within the plan are still applicable and consistent with each other. If not, then SIPE-2 identifies those parts of the plans that are affected by the changes and presents choices to the user to remedy the situation change. For instance, the severity of the weather conditions might affect the effectiveness of specific booms and, as a result, additional booms may be required. Weather conditions might also affect the spill trajectory, resulting in the possibility of using dispersants offshore to break up the spill.

The replanning capability within SIPE-2 permits the user to explore how changes in the situations affect existing planned choices. It also allows the user to explore the what-if questions which are essential for configuration planning.

The underlying knowledge and database that SIPE-2 utilizes during the planning process comprises information about the following:

- Spill response resources, such as their location, type, quantity, and other more detailed information about their operating conditions and capabilities.
- Spill response operations, such as the use of booms, skimmers, and vacuum trucks.
- Geographic information about the surrounding shores and sea-sectors, such as the location of sensitive areas, equipment storage sites and sea and ground transports, but also water temperature, wind and tidal data.
- Spill incident data, such as discharge rates and quantities, location and time of the initial spill.

The Configuration system provides a multifunctional tool. It can be used to:

1. Ascertain the adequacy of response and contingency plans.
2. Assist in developing scenarios for response drills and determining whether the response was as efficient as it could be.
3. Develop response strategies for actual spill response.

Ivan M. Lissauer,
U.S. Coast Guard R&D Center
1082 Shennecossett Road
Groton, CT, USA 06340-6096

Ph (860) 441-2742
Fax (860) 441-2792
Email I.Lissauer/RDC03@cgsmtp.uscg.mil

INFORMATION SYSTEMS DEVELOPMENT BY THE CALIFORNIA COASTAL COMMISSION

Helmut Gieben, California Coastal Commission
and Marty Frum, California Coastal Commission

The California Coastal Commission is catching up. Following a 10-year hiatus of development in its information systems -- brought on by drastic budget cuts in the early 1980s -- the Commission is now gradually acquiring desktop PCs, and is in the process of developing a number of tools to assist its analysts in managing the impacts of development along the state's shoreline. Development of these tools has been almost entirely dependent on CZMA Section 309 program improvement grants, EPA grants, and a $150,000 grant from the NOAA/National Ocean Service's Coastal Services Center (CSC). The Commission has focused its efforts in two areas: databases and mapping tools, including Geographic Information Systems (GIS).

Databases

The Commission has just completed, and is currently installing, a permit tracking system designed in-house using Microsoft's Access database software. The system took a little more than one year to develop -- about three times as long as any of us anticipated -- but we now have a very user-friendly system that conforms to the quirks and idiosyncrasies of our unique permitting process. The commercially available tracking software simply didn't fit our needs, and, based on a prior failed attempt, hiring a consultant to design a custom system for us seemed prohibitively expensive. In looking back now, it might have been more cost-effective to hire outside consultants, but by developing our own system, we have greatly increased our in-house expertise and can be much more responsive to the suggestions of our analysts and clerical staff for system improvements.

The database has allowed more efficient tracking of permit applications. It prints out standardized notices and letters, and has a fairly sophisticated search mechanism that allows our analysts and clerical staff to respond quickly to information requests from the public. Our analysts are particularly happy with the way the system has increased their access to historic permit records as they review currently pending applications.
Previously they had to rely on 3x5 card files, hand-written logs and institutional memory. One improvement slated for this coming year is the ability to track compliance with permit conditions, such as long-term monitoring, that tend to slip between the cracks if institutional memory does not catch them.

We are also currently developing a wetland mitigation tracking database. Funded through an EPA grant and designed in-house using MS Access, the database will enhance our ability to track the effectiveness of wetland restoration projects that were required by Commission permits. Over time, this will enable us to come up with more informed acreage ratios for compensatory wetland mitigation and better evaluate mitigation plans to assure successful mitigation of impacts to wetlands.

Geographic Information Systems (GIS)

Our GIS capability is also expanding, thanks in part to a recent grant from the Coastal Services Center. With CSC's support, and with the cooperation of a number of federal, state, and local agencies, we are spearheading the development of a prototype regional GIS for the Monterey Bay area in central California. The system will incorporate GIS data sets, aerial photos, satellite images and tabular data from about a half dozen agencies in the region, and will make this information accessible in graphic form over the Internet's World Wide Web. The goal is to allow the region's resource managers to come together and make decisions based on a common understanding of the region's resources, problems, and potentials. We hope the system will encourage the evolution of multi-jurisdictional watershed and ecosystem-based management approaches, and are convinced that data sharing is the way of the future.

The project ties management and academic communities together as well. Under the CSC grant, we have contracted with the University of California at Berkeley's Center for Environmental Design Research (CEDR) to develop translation and rectification engines that will enable the data transfer across jurisdictions, currently impossible because of data structure and platform incompatibilities. CEDR will also develop the user interface for making the GIS accessible via the World Wide Web to schools, libraries, park visitor centers and property owners, creating an unprecedented opportunity for public education. In addition, the new California State University at Monterey Bay (CSUMB) has agreed to serve as the regional data repository and home for the regional GIS and the translation engines at the end of our grant period.

The translation and rectification engines will be the key to keeping the regional GIS full of current data without imposing a burden on source agencies. Source agencies won't be asked to change their native data structures or platforms to conform with a regional standard. Instead, they will be asked to submit updates in their own native formats to CSUMB, who will use the translation engines to integrate the new data into the GIS. Students and faculty at CSUMB will benefit from having direct access to regional resource data, and the region's resource managers will benefit from the case studies, computer models, and other tools that may be developed at CSUMB as a result of this arrangement. Talk about win-win!

Pre-GIS Mapping Tools

Although we are very excited about the progress we are making with our prototype GIS in Monterey Bay, we know it will be a while before all of our district offices are outfitted with GIS capability. So we have also been researching the usefulness and applicability of low-cost, user-friendly, CD-ROM-based mapping products -- the kind that can be purchased off the shelf at computer software stores. Created for home and business use, some have powerful features that our analysts can use in their day-to-day work.

MapExpert 2.0 ($320 from DeLorme) can be used to create very professional-looking site-location maps and exhibits for staff reports. In addition, the program displays the latitude and longitude of wherever the cross-hair cursor is pointed. We tested the accuracy of the program using a set of sample points on USGS quad maps, and found the program was accurate to within about 50 feet, and much less prone to operator error than hand-mapping. Our analysts can use the program to quickly and easily geo-code permit locations, water quality sampling stations, septic tanks, etc. for future use in a GIS. An $80 version of the program (Street Atlas USA, also from DeLorme) does not have all the features for creating display-quality maps that the more expensive version has, but does provide latitude and longitude.

Some programs allow you to import street addresses from a database and map them directly. Rand McNally's StreetFinder ($50) did this easily and accurately for about 65% of the street addresses in our database, even though they do not have zip codes. Select Street Atlas ($100 from ProCD) requires the zip+4 code before mapping imported addresses, but a utility program (ZipFix, $20, also from ProCD) provides the ability to assign zip codes to street addresses. Unfortunately, the program could not find zip codes for about half of the street addresses in our database, and the multi-step process makes it more cumbersome to use than Rand McNally's product. Neither of these products provide latitude/longitude, but they are very useful for evaluating the potential for cumulative impacts. For example, while reviewing an individual permit application, our analysts can query the permit database and then map the results to get a feel for the level of permit activity in the area.

Thomas Brothers makes a CD-ROM mapping product (cost is $400 for the state of California) that also allows you to import addresses from a database, and it is the only product we tested that allows you to export the latitude/longitude in a database format, ready for input to a GIS. Unfortunately, the program is difficult to use and it requires all addresses to have zip codes. As this abstract went to press, we have not tested the accuracy of the latitude/longitude coordinates, though we expect it to be comparable to the other programs tested.

Conclusion

Ironically, while tight budgets continue to constrain the Commission's efforts to update and improve its analytical tools, they have also reduced the risk of investing in technological white elephants. We have benefitted from the learning curves of other agencies; many weak technologies and systems have been weeded out by trial and error; state and federal data standards are beginning to emerge; and certain trends have crystallized -- such as the omnipresence of the Windows PC platform and the dominance of the World Wide Web on the Internet. This has enabled us to skip several generations of the evolutionary process and perhaps make better choices as a result. Nonetheless, we continue to innovate, learn, and make mistakes. Driven largely by motivated PC users in our staff, we continue to explore ways of making the most of our limited resources. Although we have far to go, we are catching up.

Helmut Gieben
California Coastal Commission
45 Fremont, Suite 2000
San Francisco, CA, USA 94105

Ph (415) 904-5284
Email hgieben@slip.net

CONDUCTING AND PUBLISHING ECOLOGICAL CHARACTERIZATIONS IN THE INFORMATION AGE

Eugene J. Olmi, South Carolina Department of Natural Resources and
Anne Hale Miglarese, NOAA/National Ocean Service

Ecological characterizations provide important baseline information on natural resources and ecosystem interactions. When coupled with the human dimension (*e.g.*, land use, infrastructure, socioeconomic linkages, anthropogenic inputs), characterizations are important tools for resource management decision making. While characterizations provide an important "snapshot" of the ecosystem of interest (usually at a regional level), they have generally been static, *i.e.*, non interactive and difficult to update. Incorporation of Geographical Information Systems (GIS) technology into ecological characterizations greatly enhances their utility by providing capabilities for efficient detection of changes in landscape features over time.

The Otter Island Characterization Project is a collaborative effort among NOAA/National Ocean Service's Coastal Services Center, NOAA National Geophysical Data Center, and the Marine Resources Division of the South Carolina Department of Natural Resources. The goal of the project is to provide a demonstration product for a desktop PC that allows menu-driven interactive access to electronic characterization information. The focus of the product is Otter Island, South Carolina.

Fronting St. Helena Sound on the lower South Carolina Coast, Otter Island is an 845 ha (2,088 acres) marsh and barrier island that was recently purchased by South Carolina for inclusion in the "core area" of ACE Basin National Estuarine Research Reserve (NERR). Named for the Ashepoo, Combahee, and Edisto Rivers, the ACE Basin Project Area is an area of approximately 350,000 acres that is rich in wildlife and cultural heritage. Conservation organizations, local land owners and government agencies have worked together to conserve these important resources. As part of the ACE Basin NERR, Otter Island will serve as a site for research and education as well as wildlife protection.

Otter Island consists of 185 ha (456 a) of high ground, 602 ha (1,489 a) of regularly flooded salt marsh and intertidal creeks, 23 ha (58 a) of sand beach, and 35 ha (86 a) of continuously flooded estuarine creeks. Of the high ground area, 127 ha (313 a) are maritime forest. The tract includes one barrier island (the original Otter Island) of approximately 149 ha (367 a) in size and approximately 20 hummocks (areas of high ground surrounded by marsh). The three largest of these are 4.5, 13, and 19 ha (11, 32, and 47 a, respectively); the rest are less than 1.6 ha (4 acres) in size. These hummocks are scattered throughout the salt marsh which is also traversed by many creeks which drain the marsh. The primary island (Otter island proper) fronts St. Helena Sound with a sand beach 2.9 km (1.8 mi) long and contains several freshwater inter-dune ponds.

Humans have infrequently occupied Otter Island in the past (no dwellings are on the island) and the tract is in near pristine condition. According to The Nature Conservancy's "ACE Basin Biological Inventory Report, 1990-1992," 10 natural plant communities and/or rare plant species are on Otter Island: Atlantic maritime dry grassland, barrier island pond complex, maritime dune shrub thicket, piedmont flatsedge, salt flat, salt marsh, salt shrub thicket, shell-mound buckthorn, south Atlantic barrier forest, and temperate shell midden woodland.

Otter Island is an active nesting area for the federally threatened loggerhead sea turtle. The island also provides roosting and feeding areas for the federally endangered piping plover, peregrine falcon, wood stork, and southern bald eagle and is a refuge for other species such as the eastern diamondback rattlesnake. The interior ponds harbor alligators and freshwater wetland vegetation, and the beach and mud flats at the southeast end of the island are a major feeding and resting area for migrating shorebirds.

Beyond its ecological significance, Otter Island also contains the remains of Native American shell middens and a Civil War Fort. The fort on Otter Island was built by the Confederate Army in 1861, along with similar forts on nearby islands, to protect local plantations. The forts were abandoned in November 1861 after Hilton Head Island fell to Union forces. The Union Army occupied the Otter Island fort and later built a signal tower there as part of a communications network along the South Carolina coast. A community of escaped slaves was on the island when the Union troops arrived and remained there throughout the war.

Because of the island's significance for rare plants, threatened and endangered species, and as an historic site, the South Carolina Heritage Trust Advisory Board gave Otter Island a high priority for acquisition in 1986. In 1993 The Nature Conservancy purchased the island. The South Carolina Department of Natural Resources then purchased the property and the Island became a Heritage Trust Preserve, known as the St. Helena Heritage Preserve.

Otter Island is managed by the South Carolina Department of Natural Resources. The Management Plan for Otter Island strives to preserve the unique and valuable resources of the island. In addition the management plan promotes use of the island for education and research and allows public access for "traditional uses" such as beach activities, bird watching, fishing, and archery hunting. The characterization of Otter Island is intended to serve as a tool to aid management of the island by classifying its resources and providing scenarios to guide management decision making, all in an interactive digital format. The characterization relies almost entirely on information already available for the area.

The CD-ROM publication includes a hypertext viewer (such as Mosaic) which accesses characterization information presented as hypertext-linked text, tables, graphs, photographs, and spatial coverages (GIS) for Otter Island and the surrounding region.

Descriptions of Otter Island and its surrounding area include physical setting (geologic history, physiography, soils, and climate), human history and current socioeconomic setting, ecological communities and their interactions, and management considerations. Other text components include an introduction to ecological characterizations, overviews of Otter Island and the ACE Basin NERR, life history of the loggerhead sea turtle, and the Otter Island Management Plan. Digital images of vegetation communities and selected species accompany the text and may be viewed as a group in a photo gallery.

Spatial features include population density, land use, shoreline changes, hydrography, vegetation, shellfish, endangered species, historic sites, research stations, and human use regulations (*e.g.*, trails, restricted areas). These coverages may be queried or simply viewed in a digital atlas. Users with ArcView II may download files for more complex analyses and updating. Metadata documentation adheres to federal standards.

The product also demonstrates application of the information in making management decisions through interactive scenarios, such as placement of access points. Also included in the product are an extensive bibliography of coastal resource information and an interactive educational component that describes the "Life in a Salt Marsh."

An important goal in the development of the product was to maintain "easy access" to the information, thereby enhancing its usability. This demonstration product will be reviewed by the coastal management community and the concept will be refined for application to other ecological characterizations.

Eugene J. Olmi
South Carolina Dept. of Natural Resources
Marine Resources Division
P.O. Box 12559
Charleston, SC, USA 29422-2559

Ph (803) 762 5657
Fax (803) 762-5412
Email olmie@cofc.edu

Session H5: Private Property Legislation: An Overview of Federal and State Statutory Takings Laws
Session Chair: John Duff, University of Mississippi Law Center

A WORKINGMAN'S GUIDE TO SECTION 404 REGULATORY TAKINGS

Barry Gale, U.S. Army Corps of Engineers

Introduction

The development of wetlands in the United States is regulated at the federal level by the U.S. Army Corps of Engineers ("Corps") under the authority of Section 404 of the Clean Water Act. The Corps evaluates permit applications to fill or alter wetlands based on stringent guidelines (40 CFR part 230) developed by the U.S. Environmental Protection Agency. These Guidelines make it nearly impossible for the Corps to issue Section 404 permits that would allow for the destruction of wetlands unless the proposed project needs to be located in or adjacent to a waterway (*e.g.*, marina) or there is no alternative upland location available. Consequently, property owners often allege that they are stymied by the Corps in their efforts to transform their privately held wetlands into financially viable projects such as large-scale residential or commercial developments.

In response to "property-rights" advocates, Congress is considering whether some form of legislation is necessary to compensate property owners for the devaluation of their property resulting from environmental regulation. The Section 404 program is often cited as a prime example of why such legislation is warranted.

Often overlooked in this debate, however, is the fact that the United States Court of Federal Claims ("Claims Court"), with increasing regularity, has already been compensating property owners who have suffered property devaluations resulting from Section 404 permit denials. Property owners have utilized the Fifth Amendment restriction against property "takings" as a basis to support their claims. While the number of federal cases that have had to decide whether a Section 404 permit denial is a "regulatory taking" is still relatively small, there are a number of prevailing issues that have emerged as critical in the Claims Courts' evaluation of these cases. This paper will identify these issues, and focus upon the criteria used by the Claims Court in resolving these issues.

Is the Case Ripe for Review?

The threshold issue in any Section 404 regulatory takings case is whether the permit applicant has sufficiently exhausted all realistic efforts to obtain a permit that would allow successful development of his property. If he has not, the Courts are reluctant to move forward with the case.

For example, assume a developer owns 10 acres of wetlands. He applies to the Corps for a permit to fill all 10 acres. The Corps indicates during the permitting process that it is unlikely that the applicant will obtain a permit to fill all 10 acres, but offers that an application to fill something fewer than 10 acres "may" be more favorably viewed. The applicant insists that he wants to fill 10 acres and refuses to modify his application. Consequently, the permit is denied and the developer seeks compensation for the devaluation of 10 acres in the Claims Court. Undoubtedly, the Government's first defense would be that the applicant did not pursue alternative proposals that may have proven to be acceptable to the Corps. Therefore, in the Government's view, it is premature to declare the denial of a single development scenario to be a taking. Of course, from the developer's perspective, if the Corps denied a permit to fill 10 acres of wetlands, the likelihood is that a permit to develop a lesser acreage of wetlands would also be denied. Thus, in the property owner's view, further applications are ultimately futile.

It is up to the Court to decide factually, whether it would be futile for the developer to seek an alternative permit. The difficulty, from the Court's perspective, is attempting to discern what the Corps would do with an alternative application when the Corps, itself, can only make that determination after going through a formal permit process. Adding to this dilemma is the fact that the Corps regulations on processing permits do not require the Corps to generate an acceptable alternative project in lieu of simply rejecting an applicant's proposal. Thus, in theory, the Corps could simply deny multiple proposals from an applicant while at the same maintaining in the Claims Court that it would not be futile for the applicant to reapply one more time for a slightly different, more environmentally benign project. Of course, it is unlikely that the Court would tolerate this type of gamesmanship from the Corps. More likely, the Claims Court, at best, will allow the Corps one opportunity after an initial denial to issue a permit. A second denial, for an alternative project, would almost certainly lead to the conclusion that further applications would be futile.

Did the Property Owner Have a Reasonable Investment-Backed Expectation?

Once the applicant convinces the Court that he has exhausted all efforts to obtain a Section 404 permit, the next issue that the Claims Court must address is whether the applicant had a reasonable, investment-backed expectation to develop the wetland property when it was purchased. Without that expectation, the Claims Court has declined to rule that a taking has occurred. Clearly, if the applicant purchased wetland property prior to the passage of the Clean Water Act, it would be reasonable to assume that it could be developed free from federal regulatory interference. Conversely, there would be no reasonable expectation for developing wetland property purchased within the last 10 years, when the Corps regulatory program and the impediments inherent in obtaining permits were generally well understood. Furthermore, it is generally the case that the cost of wetland property purchased in the last 10 years would have already been discounted to reflect the more intensive and restrictive regulatory environment.

The gray area in analyzing this issue is the period of time after the Clean Water Act was enacted in 1972 but prior to the time when the regulatory restrictions related to wetland development were in place and understood by the public. For example, assume a developer bought 10 acres of wetlands in 1978. The government would argue that the passage of the Clean Water Act in 1972, its amendment in 1976, and the promulgation of regulations by the Corps in 1974, 1975, and 1977 all would have placed the developer on notice that the development of his wetland property required a Corps permit. The inherent possibility that a permit may not be issued, in the government's view, should preclude any reasonable expectation that the property could be developed. The developer would argue that in 1978 the mere existence of a regulatory framework was not enough to undue the expectation that his property could be developed. The developer might support his argument with an assortment of allegations: 1) in 1978 the Corps had not fully implemented its regulatory program; 2) to the extent that a regulatory program existed - the Corps was not generally denying permits to fill wetlands; and 3) it was not even understood by the development community what property constituted wetlands in 1978. Further, in order to make factual determinations on these allegations the Court would need to know the type and location of the wetland that was purchased. For example, in a particular Corps District, it might have been unreasonable to have an expectation that a tidal wetland could be developed in 1978 - although the reasonable expectation concerning an isolated freshwater wetlands at that time might have been entirely different. Finally, because permit decisions are typically made at the District level, the Court's inquiry concerning "reasonable expectations" might extend to the overall permitting record of the particular Corps District responsible for the decision. Because of the Corps' regional diversity, reasonable expectations might vary significantly based on what Corps District was involved.

Is the Devaluation in the Property Caused by the Permit Denial Sufficient to Constitute a Taking?

The cornerstone of the Supreme Court's analysis of regulatory takings is the principle that some property devaluation is inevitable as a result of government regulation. Regulatory action that adversely affects property only becomes compensable, however, when the devaluation results in a severe economic impact. In making this determination in the context of

Section 404 denials, the Claims Court compares the value of the affected property prior to the permit denial with the diminished value resulting from the adverse permit decision.

Perhaps the single most difficult issue in Section 404 takings litigation focuses on what property should be considered in making the devaluation determination. For example, assume a developer purchased 250 acres of wetlands in 1950. Prior to enactment of the Clean Water Act he successfully developed 200 acres into a residential housing development. In 1980, the applicant, now in need of a Corps permit to continue his development, applies to the Corps to develop 12 more acres of wetlands. The Corps denies the permit. The government's defense against a taking is that the Corp's denial only affected 12 out of 250 acres - 200 of which have already been filled and developed. In the government's view, this is hardly the type of severe economic impact that could constitute a taking. The developer, on the other hand, frames the economic impact issue differently. The only property he wants to discuss is the 12 acres that were the subject of his permit denial. The other 238 acres are irrelevant. Because many property owners hold a combination of uplands and wetlands, how the Court resolves this issue often drives the resolution of the economic impact determination. To the extent that the Claims Court looks at the entirety of a claimant's property holdings, including uplands or wetlands that were previously developed, the likelihood of a taking diminishes. To the extent that the Court considers only the property subject to the permit denial, the likelihood of a taking increases dramatically.

Which is the right approach? The narrow view of looking at only the property subject to the permit denial appears to be inconsistent with the way communities regulate land use. Land use or zoning regulations often require a developer to set aside open space in some form as a trade-off in exchange for the ability to develop. Viewed narrowly, a developer might argue that his inability to develop the open space was a taking. Yet, the Supreme Court has never viewed this type of land use regulation as violative of the Fifth Amendment based on the theory that the government action must be viewed in a broader context. Obviously, the open space requirement is only part of the overall development picture. Similarly, in the above example, looking narrowly at only the permit denial for 12 acres ignores the broader context of development that was either previously permitted or not regulated.

Once the Court decides what property is to be evaluated, it then must resolve the underlying issue - is the devaluation resulting from the permit denial sufficient to constitute a taking. The few Courts that have squarely faced this issue have yet to latch on to any exact percentage devaluation that signals a taking. Instead, the Courts fall back on meaningless catch phrases to rationalize their actions. In *Formanek v. U.S.* (26 Cl. Ct. 332, 1992) the fair market value of the property before the permit denial was $933,921. After the permit was denied the property was valued at $112,000. In finding that a taking had occurred the Court stated: "This change [88% devaluation] clearly exceeds the 'mere diminution in value' which our society must tolerate in order for government to effectively operate." In *Bowles v. United States* (31 Fed. Cl. 37, 1994) the devaluation was from $55,000 to $4,500 [91.8%]. This was held to be a taking. At the other end of the spectrum, at least one case, *Ciampitti v. U.S.* (22 Cl. Ct. 310, 1991), has suggested that a devaluation of only 25% is insufficient to result in a taking.

An additional factor that has been noted by some Courts in addressing the devaluation issue is the comparison between the fair market value of the property after the permit denial and the property owner's cost basis. Presumably, even if a permit denial results in a severe devaluation in comparison with the pre-denial value, if the post-denial value still greatly exceeds the property's owner's cost basis, a Court may be reluctant to find that a taking has occurred.

Is the Section 404 Permit Denial Solely Responsible for the Property Devaluation?

The Section 404 program is not the only governmental program that regulates wetlands. Many states, particularly those in proximity to a coastline, have established their own regulatory programs with jurisdiction over tidal and/or freshwater wetlands. In many cases these programs operate concurrently with the Section 404 program, so that, for example, in Delaware an applicant who wants to develop tidal wetlands must obtain both a federal Section 404 permit and a state wetlands permit. In addition, the federal Section 404 permit requires an applicant to obtain a Water Quality Certification (WQC) from the state and a determination that his proposed project is consistent with that state's coastal zone management plan (CZMP). The Section 404 permit is not operative without both of these state approvals.

A question that has yet to be fully resolved by the Courts that have heard regulatory takings cases is to what extent a state denial of either its own wetlands permit or a WQC or CZMP denial relieves the federal government of responsibility for the alleged taking.

The easiest case to resolve is the situation where an applicant applies to both the state and the Corps for their respective permits. Prior to the Corps making a decision the state denies its permit. The Corps, as allowed by its regulations, denies the Section 404 permit without prejudice, indicating that if and when the state permit is obtained it will then make a merits-based decision. In this example, since it was the state alone that affected use of the property, without any substantive decision by the Corps, the federal government should not be subject to a takings claim.

A more difficult case arises when the state denies its permit and the Corps also denies the Section 404 permit based on a substantive decision, *i.e.*, with prejudice. Since the property owner cannot join the state and federal governments together in one legal action, he is left to file his state takings claim in state court and his federal claim in federal court. Of course each governmental entity will argue that it was the other that "caused" the taking. The situation grows even murkier when state and federal geographic jurisdiction is not identical.

In a third scenario the Corps denies the Section 404 permit based strictly on the state decision not to issue the WQC or CZMP approvals. In this case, although there may be no question that the property devaluation resulted from the Section 404 permit denial, the permit denial itself was predicated strictly upon a state decision. If, as several Claims Court cases have suggested, the federal government must pay for the taking under these circumstances, the states, knowing that it is the federal government that will ultimately pay for the state denial, will have little incentive to approve any project that adversely affects the environment.

Conclusion

The above analysis provides a thumbnail sketch of the primary issues that arise during regulatory takings litigation resulting from Section 404 permit denials. As the Courts take great pains to point out, the ultimate decision in any Section 404 takings case is driven by the facts of the particular case. Because of the wide variation in factual circumstances that arise it is difficult to generalize about the outcome of Section 404 takings cases. Perhaps, in light of the current frenzy to address the takings issue through legislation, it is enough to understand that of the thousands of permit applications that the Corps entertains every year, only a handful result in takings claims. If a court - the Claims Court, and a remedy - the Fifth Amendment, already exists to address these claims, it is difficult to understand the need for legislation that will ultimately duplicate administratively what already exists judicially.

RECENT DEVELOPMENTS IN TAKINGS LEGISLATION IN THE GULF STATES

John Alton Duff,
Mississippi-Alabama Sea Grant Legal Program

Introduction

The coastal areas of the United States, including the Gulf of Mexico, constitute myriad valuable resources. They serve as important commerce points with major ports, offer aesthetic relief to wary humans who are drawn to its waters to vacation or live, serve as valuable habitat to many endangered and threatened species, and maintain important sources of seafood. However, it is this importance, popularity, and wide range of benefits which may ultimately lead to the coasts' demise. Overdevelopment, overfishing, and increased traffic contribute to the decline.

Public and private use of the shoreline and coastal areas often overlap. Federal, state, and municipal entities apply laws, regulations and ordinances to protect the public interest in these areas. These measures may constrain the rights of private property owners and in some instances reduce those rights so as to deprive the property owner of any reasonable use of the land. Historically, the federal and state constitutions have provided the primary, if not exclusive, means of seeking redress in these situations. The fifth amendment to the U.S. Constitution provides, in pertinent part, "nor shall private property be taken for public use, without just compensation," which has been deemed to mean that regulations amounting to a "taking" of all reasonable use, requires that the government compensate the land owner. Most state constitutions mirror this wording and accordingly, state courts apply the same standard.

During the last 10 years, the United States Supreme Court has paid particular attention to regulatory takings claims regarding shoreline areas.[2] While some commentators see a trend in affording property owners heightened protection against regulatory impact on the use of their land, a finding of a constitutional regulatory "taking" sufficient to mandate compensation still requires a high burden of proof on the part of a claimant.

[2]Nollan v. California Coastal Commission, 483 U.S. 825 (1987); Lucas v. South Carolina Coastal Council, 112 S. Ct. 2886 (1992), Stevens v. City of Cannon Beach, 317 Or. 131, 854 P.2d 449 (1993), cert denied 114 S. Ct. 1332 (1994), Scalia dissenting.

Private property owners of both coastal and non-coastal property have deemed these rulings ineffective (too little, too late) in addressing the more widespread affects of federal, state, and municipal regulations on private property. They have urged federal and state lawmakers to adopt "legislative takings" measures which would provide compensation for claimed diminutions in value that do not amount to total loss or "constitutional taking." This paper touches on some of the aspects of this movement in the states bordering the Gulf of Mexico. It sets out the legislative takings measures that have been enacted in Florida, Texas, and Louisiana. It also reviews the efforts to enact such measures in Mississippi and Alabama. It concludes that some states have enacted more specific mechanisms to address the issue, complete with a well articulated process for resolving claims. It also notes that in certain areas, important questions have been left unanswered.

Florida

In 1995, Florida enacted the Private Property Rights Protection Act (Florida Act).[3] In doing so, the state reasoned, "that some laws, regulations, and ordinances . . . may inordinately burden, restrict, or limit private property rights without amounting to a [state or federal] constitutional taking . . . [and therefore the state should] provide[] for relief, or payment of compensation, when a new law, rule, regulation, or ordinance . . . as applied, unfairly affects real property."[4]

A claimant under the Florida Act must present the governmental entity involved with a claim, an appraisal supporting the claim that sets forth the resulting diminution in value, and compensation sought. The government has a six-month period within which to offer a settlement to the claim. The settlement may come in an array of forms from removing or reducing the regulatory impact at issue to paying compensation.

In signing the law, Governor Chiles hailed the measure as a compromise, in that it protects pre-existing regulations while it affords claimants a mediation process, or in the alternative, quick access to courts where new regulations impact property value. The adversaries on the issue were not as satisfied. Opponents of the Florida Act argue that it will have a chilling effect on future environmental and growth management plans and that the effect of the law remains uncertain. Some proponents of the Act maintain that it does not go far enough.

Property rights advocates are calling for an even stronger state constitutional amendment. In February 1996, a proposed House Joint

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[3] Fla. Stat. § 70.001 et seq. (1995)
[4] <u>Id.</u>

Resolution was filed in the Florida House of Representatives.[5] The measure calls for the creation of an amendment which would, *inter alia*, provide property owners with a legal means to seek compensation for claims of diminished value resulting from existing as well as future regulation. It would also entitle a claimant to judicial review and a jury trial on the issues without requiring the claimant to first exhaust administrative remedies available. Upon gaining the requisite votes in the legislature, the proposed constitutional amendment would be submitted to the electorate for approval or rejection in the November general election.

Texas

In 1995, Texas enacted its Private Real Property Rights Preservation Act.[6] As in other states, opponents of the Act argued that it would have a chilling effect on state regulation. Proponents concede, but term the Act a "preventive" measure to ensure that the state does not mirror the actions of federal agencies perceived as intrusive, such as the U.S. Fish and Wildlife Service.[7]

Under the law, a legislative taking will be deemed to have occurred where a regulation diminishes the value of private property by at least 25%. It applies only to actions taken after September 1, 1997. The Act does not apply to regulatory actions taken pursuant to obligations mandated by federal law, law enforcement seizures or forfeitures, actions protecting against nuisance, formal exercise of the power of eminent domain, and certain rules regarding water safety, hunting, and fishing. Additionally, it does not apply to certain provisions of the Natural Resources Code.

The Act waives state sovereign immunity and calls for attempts to be made to settle any claim by alternative dispute resolution prior to litigation.[8] Similar to standard administrative procedure review, a claimant under the Act must exhaust all administrative remedies before seeking judicial review. If and when such review is granted, the facts and issues are heard de novo.[9] Any suit brought pursuant to the Act must be filed within 180 days after the date the "property owner knew, or should have known, that the governmental action restricted or limited the owner's right in the private property."[10]

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[5] 1996 FL H.J.R. 1281.
[6] Texas Governmental Code §2007.
[7] Taking the Property Rights Plunge, Texas Lawyer, p.4 (July 31, 1995) (citing statement of state senator T. Bivins).
[8] §2007.004, §2007.005.
[9] §2007.005.
[10] §2007.21(b).

If suit is taken and a trier of fact determines that a legislative taking has occurred, the governmental action may be deemed invalid in that instance or compensation may be ordered. The prevailing party in an action brought pursuant to the Act is awarded attorney's fees and court costs.[11]

The Act calls on the Texas Attorney General's office to develop guidelines for the legislation in the form of Takings Impact Assessments. It also requires that a state agency proposing an action that might constitute a legislative taking must give 30 days notice by newspaper publication and/or notice in the Texas Register.

Louisiana

The Louisiana legislature addressed the regulatory takings issue on a somewhat more limited basis in enacting the Right to Farm and Right to Forest laws.[12] In doing so, the state created a right of action in owners of private agricultural and forest lands. Where owners of such property suffer a diminution in value of 20% or more resulting from new regulations, they are entitled to a jury trial to determine what compensation may be recovered from the state regulatory authority.

Upon a finding of 20% diminution, the private property owner may opt to transfer title to the property to the state in exchange for compensation equal to the fair market value of the land. Alternatively, if the private owner prevails on the merits of the case, the governmental entity may choose to rescind or repeal the impacting rule or regulation.

Mississippi

In recent years, Mississippi has addressed the "legislative takings" issue but has not advanced the concept beyond legislative debate. In 1994, the Mississippi House of Representatives reviewed a bill which would have, if enacted, required the assessment of governmental actions impacting private property; authorized a cause of action for the recovery of diminished property value resulting from government regulations; and, allowed recovery of the full fair market value of the property if the diminution in value was deemed to be 40% or more.[13] The Mississippi Senate considered a similar bill.[14] Neither of the bills was enacted.

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[11] §2007.026.
[12] 1995 La. Acts 302.
[13] 1994 H.B. 1099.
[14] 1994 S.B. 2005.

In 1995, the state did pass a law which addressed some of the concerns expressed by property rights advocates.[15] The Act requires all state rule-making and regulatory agencies to prepare "economic impact assessments" for the adoption of new regulations where the "total aggregate cost to all persons required to comply with that rule exceeds One Hundred Thousand Dollars."[16] The Act is not a legislative takings measure *per se*. However it does require state agencies to consider alternative and less intrusive means to effect agency goals. It also provides individuals limited standing to challenge new rules and regulations where a state agency has failed to apply the required economic impact analysis.

Alabama

In February of 1996, the Alabama state legislature began reviewing a bill, which if enacted, would create the Alabama Private Property Protection Act.[17] The stated intent of the bill is to provide private property owners with a means to institute a special cause of action to recover lost real property value resulting from state regulation. The bill provides a right to an inverse condemnation proceeding that would, upon proof, provide a landowner with either "monetary damages equal to the amount of the alleged Diminution in Value," or "the amount of the entire fair market value when the Diminution in Value is determined to exceed 50 percent."[18]

Attorneys fees would not be recoverable by any party in such proceedings. However, other costs (experts, etc.) could be charged to the governmental unit if a landowner is successful in an inverse condemnation claim. Pursuant to the bill, a claimant would need to set forth the particular affected parcel of real property, or portion thereof; the nature of the interest of the owner; and, the estimated amount of the diminution in value and whether the owner will seek to transfer the title to the property if the diminution in value is determined to exceed 50%.

The bill would restrict claims on a number of levels. It would apply specifically to laws and regulations regarding zoning, land use planning, environmental protection, land use permitting, and certain required dedications or exactions; but would apply only to the aforementioned class of laws and regulations enacted subsequent to the passage of the bill. It would not apply to those laws and regulations applicable pursuant to federal laws and regulations.

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[15] 1995 Miss. Laws 499.
[16] Id. at §1.
[17] 1996 AL S.B. 436
[18] Id.

Further the bill specifically notes that the special cause of action is not available where the affected use or proposed use amounts to a public nuisance; the restriction is a result of the exercise of the Power of Environment Domain; the governmental action is a result of law enforcement property seizure or forfeiture; or, the repeal of the regulatory restriction reduces or removes the effect of the restriction

The bill would further require every state regulatory entity to develop guidelines identifying actions that might result in inverse condemnation liability pursuant to the Act. The guidelines would also be required to set out alternatives to the proposed rule or regulatory program in an effort to reduce the impact on private property owners. The guidelines and estimated inverse condemnation costs would be forwarded to the Joint Committee on Regulatory Review.[19] The bill, as drafted, leaves open a number of important questions, such as the level of impact necessary to trigger a cause of action.

Conclusion

In addressing the legislative regulatory takings issue, some of the Gulf states profess to have drafted an equitable solution to the public interest-private interest conflict. Florida and Texas have set out concepts, definitions and processes which may seem at first glance to "solve" the problem. However, in these and the remaining states, ambiguities and questions remain which will require ad hoc judicial construction of the laws. At the time of this writing the author is unaware of any current or pending claim under these acts. The issues that will need to be addressed to determine if these laws can be applied effectively and fairly include: how baseline property values will be determined; how impacts will be valued; what offsetting regulatory benefits may be incorporated into regulatory loss calculations; and, whether administrative procedure acts have been legally circumvented.

Additionally, the codification of regulatory compensation claims may support the corollary argument that government actions which result in a benefit to the property owner ought to be taxable to him. The property rights movement and the resulting takings legislative activities may be more successful in their ability to prompt regulators to use heightened scrutiny when contemplating regulations which may have economic impact on property owners. They may also be sending a message to the judiciary that restrictive regulations ought not to be presumed valid, requiring the government to articulate a clearer, more rational and more closely related need for governmental interference with private property.

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[19] The Joint Committee on Regulatory Review was established pursuant to Section 41-22-22, Code of Alabama 1975.

John Alton Duff
Mississippi-Alabama Sea Grant Legal Program
Law Center, Room 518
University, MS, USA 38677

Ph (601) 232-7775
Fax (601) 232-5267
Email jduff@sunset.backbone.olemiss.edu

Session I1, Part II: The National Effectiveness Study: How Does it All Add Up?
Session Chair: Tina Bernd-Cohen, Project Coordinator

See abstracts under Session H1, Part I.

Session I2, Part II: Coastal Water Quality: Science, Policy and Politics
Session Chair: B.J. Copeland, North Carolina Sea Grant Program

See abstracts under Session H2, Part 1.

Session I3, Part II: Networking of North American Marine and Coastal Protected Areas: First Steps Toward Regional Implementation
Session Chair: Jeffrey Benoit, NOAA/National Ocean Service

See abstracts under Session H3, Part 1.

DEVELOPMENT OF AN INFORMATION SYSTEM TO DETERMINE THE FEASIBILITY OF WETLAND ENHANCEMENT THROUGH THE APPLICATION OF SECONDARILY TREATED WASTEWATER IN THE LOUISIANA COASTAL ZONE

John Day, Louisiana State University,
Enrique Reyes, Louisiana State University,
Joel Lindsey, Southern University, and
Terry Howey,
Louisiana Department of Natural Resources

This project seeks to transfer successful industry pollution prevention technology experiences with wetland applications of wastewater effluents to targeted industries. The project involves defining criteria for selecting acceptable waste, identification of suitable wetlands, and understanding economic factors that lead to cost effective methods of waste treatment while protecting and enhancing valuable wetland ecosystems.

This project is unique in the experience, knowledge, and interest the partners bring to the project. The hands-on experience in water quality management and wetland enhancement through application of wastewater effluents of our business and municipal partners, is a winning combination of features to ensure successful transfer of this important pollution prevention technology.

The project team brings 20 years of applied research, management skills, and technology transfer expertise to this project. Completed research projects enhancing wetlands through application of suitable wastewater effluent provides the foundation for this partnership. This foundation is coupled with a strong policy analysis capability demonstrated by the project experiences of Southern University's Institute for Environmental Issues and Policy Assessment. Extensive work with a fast food processor and municipalities to evaluate application of secondarily treated industrial effluent demonstrates continuous involvement with industry groups.

The budget is structured to support an in-depth technology transfer effort. It focuses on building and developing an analysis tool for potential users of innovative technology of wetland enhancement through application of wastewater effluent.

Project Description

The project team seeks to transfer pollution prevention technology which has been developed for the food processing industry, to municipalities and the sea food process industry and core user groups. In addition, the team will develop a mechanism to evaluate applicability for other potential users. The overall objective of this project is to expand the types of industries using this technology by its application in two key areas and developing a mechanism for evaluating further use. The aim of the project is to design an information tool for use by small businesses and municipalities to analyze the potential for water quality management and wetland enhancement through application of wastewater effluents. This information system will assist industry in evaluating cost effective strategies for treatment of wastewater effluents.

One member of our team [J. Day] is nationally recognized for research achievements and competitiveness in ecology and management of wetland systems. With the inclusion of Southern University's (SU) Institute for Environmental Issues and Policy Assessment, we have the expertise to integrate the research findings on wetland enhancement through application of wastewater effluents with a coherent water management policy. The Institute at Southern University has put in place the infrastructure whose goal is to achieve excellence in the area of policy development and technology transfer aimed at real world problems. In addition our project builds on over twenty years of extensive wetland research (LSU) and work with industry and municipalities in treating waste.

What is the management methodology? In this project, we will take industry experience gained by research and development of successful wetland enhancements through application of secondarily treated wastewater and expand the system to two additional user industries/municipalities and construct a mechanism to determine the suitability for individual businesses and municipalities.

The project has these strategically designed steps to achieve the program objectives:

1. Implement wetland enhancement through application of secondarily treated wastewater.

2. Develop a user friendly information decision-making system which incorporates the basic understanding of wetland functions within a sociological, legal, regulatory and economic framework. This system will be on the Internet World Wide Web (HTML).

3. Use this information system for selected case studies.

4. Design an information system that incorporates the concept of environmental sustainability with wastewater treatment systems for appropriate municipal and small business users.

5. Build a conceptual understanding of the process and functioning of wetland systems receiving wastewater flows.

6. Conduct a technology transfer conference for potential users of the analysis software tool - a conference targeting municipal managers, small food processors and seafood processors will provide hands-on experience using the analysis tool in a real world situation. In addition, regulatory procedures will be explained.

How will this project advance the state of knowledge or practice? This project involves application of cost effective technology to additional industries to handle waste and preserve wetlands in Louisiana. Our existing industrial technology is based on that developed for Zapp's CHIPS in Gramercy, Louisiana. This plant releases treated secondary effluent into forested wetlands that have been hydrologically altered, resulting in confinement by canals, spoil banks, highways, oil and gas access roads, or railroad lines. Data collected at the Zapp's receiving wetland during 1991-92 indicated that the 140,000 l/wk of secondarily treated effluent (15 mg/l BOD and 20 mg/l TSS) discharged from the factory to the receiving forested wetland stimulated vegetative growth and improved water quality (Breaux, 1992). Data were gathered from two bottomland hardwood zones, one of which has experienced high mortality rates due to elevated water levels resulting from impoundment since the 1950s. Measurements included plant productivity (litterfall and stem growth), soil redox potential, accretion rates, and water quality.

Extensive research defined criteria to select acceptable waste, identify suitable wetlands, and understand economic factors that lead to cost effective methods of waste treatment and protection and enhancement of valuable wetland ecosystems.

For this project we will expand this application to two targeted dischargers and develop a mechanism to evaluate and identify applicable industry use.

What will be produced? We will construct a computer-based conceptual framework that will assist us in developing an information system for potential users who will apply wastewater to wetlands. Potential users will be identified from food processors, seafood processors, and municipalities that are in close proximity to wetlands.

Project Objectives:

1. Manage project and coordinate duties,

2. Develop and refine criteria for selecting suitable wetlands and acceptable wastewater,

3. Evaluate economic factors associated with adoption of different treatment approaches,

4. Pinpoint roadblocks to regulatory approval,

5. Examine selected sample users - small municipalities, farmers, agricultural processors, food processors and seafood processors in a case study approach,

6. Develop an analysis package that is a user friendly Web page, that allows the user to input information in a specific project and get an analysis of the feasibility of wastewater application and store information - words, charts, pictures, digitized photographs - about any subject that suits the user,

7. Conduct a technology transfer conference for users who could benefit from the information system. The information system and preliminary applications will be presented at the conference.

The thesis of this project is that businesses and organizations with hands-on experience in pollution prevention can be effective partners in transferring essential knowledge and expertise to small businesses facing similar challenges. This project is a partnership of a fast food processor with a seafood processor and a municipality to adopt Zapp's innovative approach for effectively discharging secondarily treated wastewater to wetlands. These three experienced operations will serve as models for small businesses looking for cost-effective approaches to treating wastewater effluent. We will test the thesis; that this information sharing between large and small businesses can be an effective means of transferring pollution prevention experience and expertise.

This partnership of businesses, municipalities, state coastal management, and universities is designed to facilitate transfer of pollution prevention technology. The businesses and municipal partners in this project will assist the management team in collecting data, securing cost estimates for construction, documenting case study histories, identifying obstacles to adopting innovative approaches and evaluation of the information tool.

What specific management problem will be addressed? This partnership with businesses, a municipality, state government, and universities addresses two major environmental problems currently affecting the Louisiana coastal zone - a high rate of wetland loss and high levels of surface water pollution. The application of secondarily treated wastewater to wetlands is proposed as a means of dealing with these problems. The benefits of wetland wastewater treatment include improved surface water quality, increased accretion rates to balance a high relative water level rise due mainly to subsidence, improved plant productivity and habitat quality, and decreased capital outlays for conventional engineering treatment systems (Breaux and Day, 1994). Wetland treatment systems can, therefore, be designed and operated to restore deteriorating wetlands. Hydrological altered wetlands, which are common in the Louisiana coastal zone, are appropriate for receiving municipal and some types of industrial effluent (Day *et al.*, 1990).

What other work has been done in this area? Researchers have demonstrated in recent studies that wetland plants perform valuable services in treating different waste. Many types of wetlands in the Louisiana coastal zone have proven effective to varying degrees in removing organic matter, nutrients, pathogens, or heavy metals. Studies include investigations of salt marsh plants such as *Spartina alterniflora* (DeLaune *et al.*, 1981 and 1983; Nixon and Lee, 1986), *Spartina patens* (Payonk, 1972; Turner *et al.*, 1976), and *Juncus roemerianus* (EPA, 1986); brackish marsh plants such as *Scirpus* spp. (Payonk, 1972; Turner *et al.*, 1976; Gersberg *et al.*, 1987; DeBusk *et al.*, 1990; Batchelor *et al.*, 1990); intermediate marsh plants such as *Phragmites* spp. (Meo *et al.*, 1975; Gersberg *et al.*, 1987; Batchelor *et al.*, 1990; Davies *et al.*, 1990; Finlayson *et al.*, 1990) and *Sagittaria falcata* (Payonk, 1972; Turner *et al.*, 1976; DeBusk *et al.*, 1990); fresh marsh plants such as *Typha* spp. (Finlayson *et al.*, 1990), and freshwater forested wetlands (Gosselink and Gosselink, 1974; Conner *et al.*, 1989; Odum and Ewel, 1978; Breaux and Day, 1994). We (LSU) will use this body of knowledge in constructing our conceptual framework and information system.

How will the technical information be transferred to potential users? We will use different avenues to transfer the technology. These include the following: publication of results in the scientific literature for coastal and environmental management, preparation of a technical report for NOAA on the general approach, construction of a Web home page on the Internet and, conducting a technology transfer conference.

The technology transfer conference for potential users of the information system is an essential step in reaching out to small municipalities and businesses. Announcements for the conference will be sent out to an extensive mailing.list derived from EPA Region 6 and LDEQ, SU's and

LSU's Cooperative Extension Services, Louisiana Department of Natural Resources/CMD and the Louisiana Department of Economic Development.

Participants at the conference will learn about individual case studies of wetland wastewater treatment applications and see a demonstration of the Internet Web home page information system. Of particular interest to attendees of the conference will be a panel discussion on comparative cost of different approaches to wastewater treatment.

How will public awareness be improved? The information system will make available decision making tools for this new technology to a wide audience. For the first time managers of small municipalities and owners of small businesses that discharge wastewater will have access to an easy to use, economical method to evaluate alternative technologies.

Partners and Their Contribution

Coastal Ecology Institute, Louisiana State University (LSU) - Will establish criteria for selecting acceptable waste, identify suitable wetlands and evaluate cost effective approaches to non-point source pollution reduction.

Institute for Environmental Issues and Policy Assessment, Southern University (SU) - Will pinpoint roadblocks to regulatory process, identify the audience and the scope of the hypertext stack, determine potential users knowledge of computers and hypertext stacks and prepare progress and final report.

Zapp's CHIPPS - Will share data gathered from recent work completed on their site, and participate in a case study and the technology transfer conference.

City of Thibodaux - Will provide data from their site for the development of the information system and participate in the technology transfer conference, so other potential users of this approach can benefit.

Louisiana Cooperative Extension Service, Louisiana State University - Will assist the project team by: (1) identifying potential users of the system; (2) provide a mailing list of potential attendees for the technology transfer conference; (3) and announce the conference in the Cooperative Extension newsletter.

Office of Water Quality, Louisiana Department of Environmental Quality (LDEQ) - Will review and comment on the regulatory information included in the information system and participate in planing the technology transfer conference.

John Day
Coastal Ecology Institute
Louisiana State University
Baton Rouge, LA, USA 70803

Ph (504) 388-6508
Fax (504) 388-6331
Email ceiday@lsuvm.sncc.lsu.edu

COMPAS DELAWARE AN INTEGRATED NONPOINT SOURCE INFORMATION SYSTEM

Betsy Archer, NOAA/National Ocean Service,
Dave Carter,
Delaware Department of Natural Resources and
Environmental Control, and
Rick McCorkle, DOI/U.S. Fish and Wildlife Service

Development of the Coastal Ocean Management, Planning and Assessment System (COMPAS) for Delaware is being conducted in four phases. During Phase I a COMPAS Working Group comprised of state and federal participants chose nonpoint source pollution and nutrient overenrichment as the themes to be addressed in a prototype desktop mapping system. After developing a prototype for two of the topics, the group decided to expand the prototype to include three other tasks. Two workshops were held during Phase II to design the next phase of the project. Data collection, data processing, and modeling will be conducted in Phase III. During Phase IV the data will either be included in the desktop system or will be used by the project partners for other ongoing work in advanced spatial analyses. This paper describes each of the phases.

Phase 1: Priority Coastal Management Problems

The COMPAS Working Group established a hierarchy of theme, issue, and problem or cause, and identified resource management questions as the structure for deciding the information content of the COMPAS prototype. The theme of water resources was chosen over five others (habitats, land use, coastal hazards, resource utilization, and air quality). Within that theme, five major issues were listed for consideration (nutrient overenrichment, toxics, insufficient water supplies, habitat modifications, and recreational use). Of these, nutrient overenrichment was selected because it is a significant issue statewide.

Major causes of nutrient overenrichment were listed by the Working Group, followed by resource management questions they would like answered. The group decided to create a prototype for the system using two initial topics: best management practices (BMP) and well permitting. The BMP module was to address problems associated with livestock operations. Nonpoint source management programs are one tool to help control sources of groundwater pollution. Well permits would be prototyped to demonstrate the application of COMPAS in evaluating state permit applications.

The project now integrates four tasks: 1) Adding two more watersheds (the Appoquinimink and Blackbird Creek) to the St. Jones BMP module to assess agricultural BMPs; 2) Developing data sets to extend the hydrodynamic modeling done in the Dover/Silver Lake Watershed contained in the headwaters of the St. Jones River Basin throughout the entire Basin; 3) Collecting data to conduct a comparative study of the effects of currents and wetlands on eutrophication in the tidal portions of the Appoquinimink, Blackbird Creek, and St. Jones basins; and 4) Determining the status and trends of terrestrial wildlife communities within the Blackbird Creek National Estuarine Research Reserve, and mapping vegetative and wildlife species distributions for the other two watersheds.

Phase II: Task Characterization

Two workshops were held to design the project and to allow participants to reach consensus regarding each stage of the project. Four basic steps were used. Step 1 was to complete preliminary systems design, including characterize all information requirements, identify system capabilities required to access and manage the information, define the relationship between project elements; and define the final products. Step 2 was to identify task elements. Based on the conclusions from Step 1, the tasks necessary to develop or improve information requirements and system capabilities were identified. Step 3 was to refine and evaluate the tasks. The level of time and effort required for the tasks was estimated in more detail and potential problems were noted. Step 4 was to develop the implementation plan. Given the tasks identified in Steps 2 and 3, the roles of project participants were clarified. The result is an operational implementation plan that prioritizes and schedules tasks and identifies responsible individuals and organizations.

The first workshop was held in June, 1995 in Silver Spring, Maryland. During this workshop, the Work Group reached consensus on the major task elements. For each task the group determined the geographic area covered and specified the activities, products, steps, and time to completion. The tasks were prioritized. The second day of the workshop was used to characterize the data requirements. For each task element participants defined the scale, source, parameters, time period, level of effort, completion date, and person responsible. A matrix of data requirements by tasks was developed. The group identified criteria for prioritizing data requirements.

The second workshop was held in August in Smyrna, Delaware. That workshop began by identifying potential problems associated with the tasks. Taking this information into account, the work groups proceeded to review, evaluate, and schedule tasks and data requirements. The scale and projection to be used for the preliminary system design were agreed to.

For each module, the work group identified a list of resource management questions to be addressed in the desktop system. Based on these questions, they defined example queries for every data base to ensure that all relevant parameters were included.

Phase III: Module Development

Task 1: Best Management Practices,

The purpose of the Agricultural Best Management Practices module is to examine the effectiveness of BMPs on water quality. The module will organize BMP data into a user-friendly, integrated database and provide program managers with a means to plan, focus, educate, and determine success. It is intended to complement and support ongoing nonpoint source efforts.

Resource Management Requirements

Examples of questions identified at the workshop include:

- Identify confined animal feed lots located within areas of highly permeable soils or groundwater recharge areas;
- Compare concentrations of confined animal feed operations (CAFOs) or manure production to acres of available agricultural land;
- Map those areas that have CAFOs within a given number of meters of a water body;
- Break out the classes of agricultural BMPs within a watershed;
- Show all locations of a certain category of BMP (e.g., sediment/erosion controls) and then delineate whether they are no-till, conservation-till or grassed waterways;
- Break out the acreage of conservation tillage, integrated pest management plans, or nutrient management plans;
- Data to be collected and synthesized include information on agricultural BMPs, livestock inventories, soils, NPDES data, and land use.

A list of data sets, parameters, level of effort required, and the responsible program was developed.

Products

This work will result in:

1) A menu driven desktop system that maps and analyzes BMPs in three Delaware watersheds (St. Jones, Blackbird, and Appoquinimink).
2) A microcomputer desktop system that runs ArcView software on IBM compatibles, UNIX and Macintosh computers.
3) Customized query, analysis and display capabilities.
4) A database with thematic digital maps and associated data files.

5) Attributes maintained as a relational data base (allowing data files to be related to the original data using common attributes and allowing multiple files to be accessed simultaneously).

Task 2: Hydrodynamic Modeling

Cause-and-effect data related to nonpoint source pollution and predictive hydrodynamic modeling can strengthen decisions and improve decision-makers' ability to protect natural resources.

This work will result in an analysis of alternative land-use scenarios for the watershed to aid local land-use decision-makers in their efforts to:

1) Implement stormwater management controls on individual new development sites.
2) Consider the impacts of existing industrial discharges to the watershed.
3) Retrofit stormwater management practices where possible.

Resource Management Requirements

This task is primarily a data collection and modeling effort. DNREC staff will eventually synthesize a subset of this data and make it available in COMPAS to others. Questions that could be addressed include:

1) Determine where stormwater retrofits are needed based on water quality data.
2) Compare 1984 and 1992 land-use data to a given water quality parameter to determine the effects of different levels of development.
3) What land areas, if changed due to development, are most likely to exacerbate or improve downstream water quality?

Data Requirements

Data developed will include soils coverage, a digital elevation model, major conduits and water control structures, drainage systems, precipitation and land use, and land cover. The major data needs for the U.S. Environmental Protection Agency's Storm Water Management Model are: slope (digital elevation model - DEM), land use, land cover, soils, drainage network, rainfall, and flow-weighted stormwater data.

One of the most difficult problems faced by the modelers is that much of the needed data is unorganized, out of date, hard to locate, inaccurate, and difficult to input to the modeling software. COMPAS will aid in building and maintaining easy-to-access data sets. Through past experience Delaware has found that getting the necessary and appropriate data into the model constitutes the bulk of the effort. COMPAS will be used as a platform for viewing the results of the modeling.

Products

This work will primarily result in data sets developed for the hydrodynamic modeling. Some of these data sets will be synthesized for use in COMPAS.

Task 3: Eutrophication in Delaware Bay Tidal Creeks

This task will look at natural versus human-induced eutrophication problems in the tidal creeks of the three basins. Vigorous tidal creeks and wetlands appear to exert a major influence on eutrophication dynamics in Delaware tidal creeks because the current velocities are sufficient to keep fine-grained material in a constant state of suspension. The creeks are turbid even during extended dry periods. All three creeks are bordered by expansive dry marshes that flood twice a day. Substantial dissolved oxygen (DO) reductions could occur in the marshes due to solar heating and the biological oxygen demand. The transport of DO-reduced waters back into the creeks on ebb tides could result in lowered concentrations within the creeks.

Resource Management Requirements

In addition to identifying questions that this task is trying to answer, the Work Group attempted to identify management actions, where known, that would result from the answers to those questions. Should an industrial facility be permitted to discharge into a given water body? What is the variability of water quality parameters at various tide levels? Show all ambient water quality sampling stations where dissolved oxygen is less than 4.0 mg/l or greater than 15.0 mg/l (these would be violations of the states water quality standards). Add site name, date of sampling, time of sampling, text description of site, last precipitation, latitude, longitude, and basin to the results. Show all sampling points where sediment samples have total phosphorus greater than zero. Add site name, basin, and time of sampling to result. Graph results, sort by station, sort by time. Show all ambient water quality sampling stations where dissolved oxygen is less than 4.0 mg/l or greater than 15.0 mg/l (these would be violations of the state's water quality standards) and where it hasn't rained for at least a week.

Products

This task will result in a database containing geo-referenced sampling data that will be accessible through the desktop mapping system. Those data will allow resource managers to analyze the effects of currents and wetlands on eutrophication in three tidal creeks.

Task 4: Habitat Modeling

This task will integrate wildlife habitat restoration priorities with nonpoint source pollution control strategies by making spatial and temporal land cover/habitat data available to decision-makers through COMPAS. Vegetation and wildlife species distributions will also be mapped for the other two watersheds.

Resource Management Requirements

Topics that can be addressed by this task include the following, listed in order of priority. Examples of system questions include: Where are the individual species, *e.g.*, deer, quail; rare, threatened, or endangered species, *e.g.*, bald eagle, tiger salamander; guilds/groups, *e.g.*, forest interior dwelling species, waterfowl; and habitats/land-use types, *e.g.*, pine forests, wetlands, agricultural lands? Should restoration efforts be focused where a certain habitat type has been lost or where restoration will benefit a species that is in trouble? How can restoration be integrated with BMPs to optimize wildlife benefits, *e.g.*, declining species? Which species will be affected by land use changes/activities, *e.g.*, deforestation, reforestation, spray irrigation? When is the species present, *e.g.*, a species of migratory bird, and/or what is its behavior, *e.g.*, breeding, overwintering, staging during migration?

Data Requirements

This module will include information on data from field inventories, distributions of terrestrial vertebrates, and land cover/land use.

Products

This task will result in maps of vegetation, land use, and the distributions of all terrestrial vertebrates within the project area. Estimated losses or gains of habitats that have changed will be determined. Status and trends of wildlife habitats and associated wildlife populations will be provided. Detailed vegetation mapping and habitat improvement strategies can then be integrated with NPS pollution control strategies.

Phase IV: Information Management

Desktop System

COMPAS integrates knowledge engineering, electronic maps and data, and the desktop computer environment, providing a user-friendly means to access data and, in many instances, to translate the data into map form to more easily illustrate resource management issues. COMPAS is designed for resource planners and managers who are not computer professionals, but who need a wide range of information at their fingertips to make program-level decisions.

Data Synthesis

To be effective in resource management, information must be simple and easily understood. Raw data is of little use in most contexts. Creating this sort of fundamental information requires considerable investment in a deliberate process that includes identifying priority issues, inventorying data sets, establishing data set priorities, determining relevant spatial aggregates, winnowing and consolidating data to its most salient features, and controlling data quality.

Data Integration

The individual data sets will be structured into a relational database design framework. The structure of the data tables will be normalized, which simplifies the table structure and, consequently, the queries. This allows data sets to be related to each other. In a relational data base, additional attribute data files can be created and related to the original attribute data file using common or shared attributes such as the unique feature identifier. This provides considerable flexibility because multiple data files can be accessed simultaneously.

Other Management Uses

Developing and disseminating new targeted synthesis products begins to fill certain information gaps, but the problem of getting state and local analysts and managers to use this information (as well as their own) effectively still remains. A major barrier to get the most of the information and knowledge base available is the lack of tools with which to simply and easily bring about what is known about a problem or management decision in a timely fashion. Many state and local institutions have neither the resources nor experience to develop these tools and, in many cases, are simply too busy with their existing workloads.

Trying to fill these gaps requires much more than software; therefore, COMPAS is first and foremost a process in which the SEA Division staff works closely with state and local resource managers to identify resource management questions and to provide the available information to help answer them. This often requires tedious work sessions to specify management questions and engineer available data into useful information. In the first application of COMPAS in Texas, regular and often intensive work sessions resulted in 14 thematic modules, including pollutant sources, streamflow, water quality monitoring, water rights permits and coastal tracts management. In Florida, information for over 30 themes were incorporated into COMPAS. Oregon contained about 15 themes for

nonpoint source pollution. Coastal resource managers in these areas are applying their new perspective on engineering information to further evolve the information content and apply them to state coastal management problems.

COMPAS Delaware will enable resource managers to view the relationships between selected nonpoint pollution sources, land use activities, habitat trends, and the species associated with those habitats. The information will assist the state in identifying critical areas within the watershed to reduce the flow of nonpoint source pollution and in integrating habitat restoration priorities with pollution control strategies.

THE COASTAL DATA DIRECTORY
TOWARDS A SHARED INFORMATION INFRASTRUCTURE

Anne O'Donnell, NOAA/National Ocean Service

The Coastal Data Directory is an initiative by the NOAA/National Ocean Service's Coastal Services Center (CSC) to provide coastal data and information to coastal zone managers and the community at large. The directory is designed to respond to the requirements placed on CSC by the federal government as well as the needs of a diverse user community. The directory is required to follow federal government regulations regarding storing and providing metadata. The directory is searchable by other information query systems. The directory is designed with the needs of coastal zone managers in mind, but also addresses the need for easy access of coastal environment information by scientists, resource managers, and the general public. By meeting all these requirements, CSC takes a step forward in furthering goals for sharing information within diverse user communities having an interest in the types of data and information available through the CSC.

Coastal zone managers require diverse types of data and information to help formulate solutions to issues in their communities. Traditional methods of searching for information requires users to find databases of interest, learn how to query each database, run a query and obtain results before moving on to the next database. This linear method of searching is time consuming and repetitive. What users need is a way to search many databases at one time and view the output from these searches in an integrated manner.

The Coastal Data Directory gives users this capability via a World Wide Web Home Page interface to distributed Wide Area Information Servers (WAIS) databases. These databases may be located at CSC or offsite at other federal, state, and local government offices or educational institutions. Users can go to the Coastal Data Directory Home Page and fill in a search criteria form which will then query all the databases that are part of the directory. Users can also select a subset of these databases to search if not all the databases are of interest. Users can search entire metadata records for particular words, or can search for items in particular fields. Standard fields include start and end dates, latitude/longitude pairs, and topical keywords. Users can also search metadata about electronic data holdings and at the same time search library catalogs and environmental legislation databases.

Another important feature of the Coastal Data Directory is that it supports multiple metadata formats (such as MARC and FGDC), and converts them on the fly to a more human readable form or to other metadata formats. As such, a user can request to see all the output of his or her search in a specific format independent of the format in which the data is stored. A popular output format is HTML (HyperText Markup Language -- the format used to write Home Pages on the World Wide Web). Links to related information are added on the fly. For example, wherever a specific term exists in the metadata, a link to a definition of that term can be added automatically.

The singular most important feature of the Coastal Data Directory is that it is interoperable with other search systems. These systems can search the CSC data holdings and convert the standard records to whatever format is needed by their user community. The Coastal Data Directory is searchable by NOAAServer, a NOAA-wide integrated search system. It is also compatible with the Department of Defense Master Environmental Library (MEL) system and the National Environmental Data Index (NEDI). The latitude/longitude fields are searchable by the Spatial Data Clearinghouse at the USGS.

To be compatible with these other systems, the Coastal Services Center simply had to make databases available in WAIS. To make fields searchable by other systems, the databases were indexed using field names agreed upon by NOAAServer, MEL, the Spatial Data Clearinghouse, and NEDI. As long as the metadata is stored in a standard format, each search system can write software to convert it on the fly to whatever output format their user community desires. This means that other groups can include those databases from the Coastal Data Directory that are of interest to their user community and make them available for searching. These same groups can then convert the Coastal Data Directory metadata to an output format that fits the needs of their users.

PROVIDING INFORMATION TO COASTAL MANAGERS: RESULTS OF A SURVEY

Catherine McCrary, NOAA/National Ocean Service

The Coastal Information Management customer survey will be distributed in the spring of 1996. The results will be presented at the conference.

Coastal Information Management Customer Survey

This survey will be used by the NOAA/NOS Coastal Services Center to obtain feedback and information from its customers to make quality improvements to products and services. The respondents will be from the coastal information management community.

The purpose of the survey is to identify the services and products the CSC's users want and expect, as well as their satisfaction with existing services. In addition, the CSC must collect brief information about its customers' hardware and software capabilities so it can provide information in an efficient and useful manner.

The CSC has identified a group of approximately 200 coastal information managers from the following programs and agencies: coastal zone management programs; national estuarine research reserve sites, national marine sanctuaries, sea grant institutions, and natural resource management agencies. The CSC will send a hard copy of the survey to managers in those categories.

In addition, CSC will make the questionnaire available to selected individuals electronically through the Internet. CSC expects to receive approximately 400 responses through that method. The results of the two methods will be tabulated separately to avoid bias.

The information collected will be used by CSC's Coastal Information Management Division to better satisfy its customers' needs in the coastal information management community.

The questionnaire includes the following sections:

1. Coastal information management, problems, and opportunities - This section will target the most appropriate individual or office that deals specifically with coastal information and data to be identified.

2. Problem solving tools and techniques - The computing resources section requests information about the users' hardware and software capabilities, including Geographic Information Systems and remote sensing. This is

extremely important in designing products and services that meet the Center's customers' needs.

3. Communication pathways and data/information exchange - This section will provide the CSC with information on how best to format future products. It will also enable the CSC to interact with the coastal management community more efficiently.

4. Current and planned activities and products - The last section of the survey gives CSC customers an opportunity to specify their interest in specific CSC-proposed projects. This will allow the Center to prioritize projects according to customer needs. The CSC will use this information in developing training programs, competitive grants programs, educational forums, and other products and services. Lastly, the questionnaire will give the user an opportunity to describe other needs or programs they would like the CSC to foster.

Catherine McCrary
NOAA/National Ocean Service
Coastal Services Center
1990 South Hobson Avenue
Charleston, SC, USA 29405-2409

DOCUMENTATION AND CATALOGUING OF COASTAL MANAGEMENT INFORMATION SYSTEMS

Mark W. Evans, NOAA/National Ocean Service
and Milt Rhodes, South Carolina Office of
Ocean and Coastal Resource Management

Introduction

Coastal management is the process of allocating limited coastal resources among a variety of potential users and uses. Management decisions are made in the context of a wide variety of laws and regulations that determine the private and public use of coastal resources. Examples of management decisions with coastal resource implications include dredge and fill permits, fishery and shellfish harvest quotas, freshwater withdrawals and allocations, stormwater control, pollutant discharge regulation, flood and hazard mitigation, road construction and maintenance. The effects of these and many other decisions on coastal ecosystems are difficult to predict and quantify. In order to improve decisions which impact coastal resources, many resource management agencies are developing decision support and information management systems that allow disparate data types to viewed and analyzed in some sort of GIS or analytical format.

In order to facilitate the development and promote the use of these information management systems, the Coastal Services Center is cataloguing these tools with specific information about the capabilities, access, and limitations of each tool. CSC will distribute the catalogue via the Center's INTERNET homepage and maintain and expand the decision tool catalogue as part of ongoing efforts of CSC's Coastal Management Services Program. Examples of the type of information system CSC is examining include NOAA's Coastal Ocean Management, Planning and Assessment System (COMPAS), North Carolina's Coastal Region Evaluation of Wetland Significance (NC-CREWS), Florida's Marine Resources Geographic Information System and Automated Survey and Directory. Site or effect specific models that are used to predict specific parameters are not included in this definition of information systems, rather CSC is interested in larger, ecosystem wide information systems.

The specific objectives of this project are to compile and maintain a list of coastal resource information management tools, develop the appropriate metadata fields to describe the capabilities and limitations of the different systems, and to facilitate communication among system developers and users by creating an INTERNET accessible catalogue of coastal information systems.

Methods

Table 1 contains the initial data fields for the types of information to be collected for each of the coastal information systems. These data fields are compliant with the metadata standards of the Federal Geographic Data Committee (FGDC). This table structure contains the metadata to describe the decision support and information systems and will be amended and modified in order to support the system definitions and queries about the systems.

Information about these systems has been collected through email, phone calls and site visits from coastal planning and management agencies around the country. Information from local, regional, state, and federal agencies has been obtained in order to provide a comprehensive catalogue of information systems. Information about the information systems has been collected in a structured format so that the system catalogue can support data and keyword query tools and allows for the comparison of uses and system specifications.

Summary

Developing and maintaining the coastal information system catalogue is a long term process of data collection, interpretation and distribution. Although we have only begun the formal process of querying system developers, it is clear that a proliferation of local, regional, state, and national coastal information systems are in various stages of development and testing. It is also apparent that, although many systems use the same software and underlying datasets, there has been too little communication between developers.

Most of the tools currently in use or development are directed towards visualization of geospatial information within a GIS environment. None of the currently catalogued tools can be interpreted as a decision system which incorporates information about uncertainties of underlying environmental information or offers predictions as to the environmental effects of a coastal management decision. Also, the underlying environmental information in most of the existing systems is heavily weighted towards distribution of natural resources with little use of human resource information such as land use, demographic data, or economic evaluation. Hopefully, expansion of the information management system catalogue will provide examples of systems that do incorporate these features into the process of coastal management.

In light of the recent hardware and software improvements that form the backbone of these information systems, the proliferation of coastal information systems is rapid and has led to the development of a great diversity of systems. Five years from now, many of these systems may be

obsolete and no longer be supported by the original developer. These systems are currently at a seminal state where enhanced communication among system developers will lead to the development of more robust and compatible systems.

Milt Rhodes
South Carolina Office of Ocean
and Coastal Resource Management
Charleston, SC, USA 29405-2623

MetaData Field Names (from FGDC)	Data Format
System Identification	
Acronym-Abbreviation	Text
Full Text Description	Text
Resource Identification	*Choice*
Information System Type	*Choice*
Lead/Developing Agency	Text
Contact Person	Text
Address	Text
State	*Choice*
Phone Number	Number
Email	Text
FTP/HTTP address	Text
System Components/Structure	
System Description	Text
Hardware Requirements	Text
Software Requirements	Text
Technical Training Requirements	Text
Proposed Applications	Text
Data Quality	
Data Description	Text
Analytical Operations/Processes	*Choice*
Output/Format	*Choice*
Date of Publication	Date
Data Scale	*Choice*
Data Collection Units	Text
Data Collection Method	Text
Data Labels/Headings	Text
Data Update schedule	*Choice*
Distribution	
Access/Availability	*Choice*
Hardware Requirements	*Choice*
Distributor (if different from contact person)	Text
Distribution Format	Text
Ordering Information	Text
Cost	Number
Citation Information	
Originator (if different from contact person)	Text
Series/Version Information (version info)	Text
Publisher Name (if different from contact person)	
Publication Address (if different from contact)	Text
Publisher State (if different from contact)	Text

Items in italics will be treated as keywords

Session I5: Environmental Justice: Community and Inclusion
Session Chair: Mark Poirier, Seton Hall University

ENVIRONMENTAL EQUITY IN WATER POLLUTION CONTROL: AN ANALYSIS OF THE CONSTRUCTION GRANTS PROGRAM

Mark T. Imperial,
School of Public and Environmental Affairs,
Indiana University

Introduction

On February 11, 1994, President Clinton directed the United States Environmental Protection Agency (EPA) to make "environmental justice" part of its mission. Environmental justice can be defined as "the distribution of environmental benefits and harms. It asks whether the procedures and impacts of decision making are fair to the people they affect (Goldman 1994, 1)." President Clinton's Executive Order directed the EPA to identify and address disproportionately high and adverse human health or environmental effects on its programs, policies, and activities on minority populations and low income populations in the United States (§ 1-1-101, E.O. 12898, February 11, 1994). In accordance with these requirements, the EPA's Office of Water released its "Environmental Justice Strategy" on November 8, 1994 (hereafter referred to as the EPA's "Strategy").

Three goals form the basis of the EPA's Strategy: 1) provide equal environmental protection for all citizens; 2) enhance access of disadvantaged citizens to environmental decision makers; and, 3) provide equal access to environmental infrastructure for all citizens including those who live in disadvantaged communities (EPA, 1994a). Many of the Strategy's recommended actions focus on enhancing data collection efforts and conducting pilot projects to assess whether disproportionate human health or environmental effects exist (e.g., contaminated drinking water supplies, contaminated fish, contaminated sediments, etc.). The Strategy also recommends "process oriented" actions which focus on incorporating environmental justice issues into appropriate EPA Office of Water programs.

This project focuses on the Strategy's third goal; ensuring that disadvantaged communities have comparable infrastructure such as sewage treatment plants as more advantaged communities. Disadvantaged communities include those which are small, rural, low income, or have high percentage of minority residents. In the past, one of the primary sources of financial assistance was the Construction Grants Program which provided grants to construct owned treatment works (POTWs). This program was phased out in 1992 and replaced by the State Revolving Loan (SRL)

Program. One mechanism for ensuring equal access to environmental infrastructure is to ensure that federal water pollution control funding was distributed in an equitable fashion. However, it is unclear whether this has been the case. This paper examines the distribution of construction grants during the last ten years of the program in order to determine whether disadvantaged communities had equal access to this important infrastructure funding source.

There are several reasons why this is an important area for inquiry. First, point sources of pollution adversely affect many disadvantaged communities, particularly in urbanized watersheds. As a result, residents in disadvantaged communities may lack the same opportunities for fishing and recreation present in communities with good water quality. Residents in disadvantaged communities may also be subject to elevated risks as a result of the consumption of contaminated fish and shellfish. Moreover, communities which are not served by POTWs are likely served by on-site sewage disposal systems (OSDSs). This can lead to contaminated surface and groundwater or lead to the contamination of and public drinking water supplies. Second, the results of this research have important implications for federal and state water quality officials. The analysis helps determine the extent to which disadvantaged communities had difficulty obtaining funding for water pollution control efforts. This is particularly important given the fact that the EPA has already invested over $56 billion in municipal sewage treatment plants. If disadvantaged communities had trouble obtaining grants Construction Grants Program it is likely that they are having difficulties obtaining SRL Funds. Finally, this analysis makes important contributions to the burgeoning research on environmental justice because previous empirical research has generally neglected water pollution control issues as well as issues related to public expenditures on pollution control efforts.

While disadvantaged communities may have a greater need for federal grants and loans in order to finance water pollution control improvements, they also tend to be in a poor position to utilize these funding sources. Therefore, it is reasonable to expect some inequities associated with the distribution of these federal water pollution control funds. However, if these funds were not distributed equitably, disadvantaged communities may be impacted adversely because water quality is often a function of capital investment. The remainder of the paper examines the distribution of construction grants during the final ten years of the program. If the construction grants have been awarded in an equitable fashion, the distribution of the grants should not be a function of a municipality's population size, population density, change in population, minority composition, or community wealth. Before discussing the research design in greater detail, it is appropriate to review previous environmental justice research in order to understand how this study will contribute to the existing knowledge base in this area. It is also appropriate to briefly discuss the administration of the Construction Grants Program.

Review of the Environmental Justice Literature

Environmental justice is a relatively new field of academic inquiry which focuses on examining the distribution of environmental benefits and harms within the population. It also examines whether the procedures used to distribute environmental benefits and harms are fair with respect to those affected by decisions (Goldman, 1994:1). A great deal of research on environmental justice has been conducted in recent years (e.g., Hamilton, 1995; Hird, 1993; Kohlhase, 1991; UCC and PDA, 1987). The nature of this research varies considerably and consists of case studies, comparative analyses, economic analyses, and legal analyses. A recent review of 64 studies conducted by Goldman (1994) found that 63 of the studies identified disparities either by race or income regardless of the level of geographic specificity or type of environmental concern examined. Goldman (1994) also observed that racial disparities tend to be identified more frequently than income disparities. Despite addressing a diverse set of environmental concerns and utilizing a variety of measures, previous environmental justice research has primarily been directed at four distinct areas of inquiry: 1) distributions (or siting) of noxious facilities and toxic releases and their impacts on surrounding communities; 2) distributions or levels of ambient pollution in the environment; 3) human exposures and health effects; and, 4) economic impacts associated with environmental disparities (Goldman, 1994). Only a few studies have examined environmental justice issues associated with water quality. These studies have primarily focused on toxic fish consumption and predicting the regulatory costs associated with implementation of the Clean Water Act's requirements. No empirical study has examined whether the EPA's distribution of water pollution control funds and infrastructure investment is equitable.

Construction Grants Program

Since 1972, state and local efforts to address point source pollution (e.g., sewage treatment plants, industrial discharges, combined sewer overflows) have been guided by the requirements of the federal Clean Water Act (CWA). Among other things, the CWA required municipal treatment plants to achieve "secondary treatment" by July 1, 1988. To help municipalities meet the CWA's July 1, 1988 deadline, Congress established a program to provide construction grants to assist municipalities with the costs associated improving the capacity and efficiency of sewage treatment plants. Projects eligible for grant assistance included wastewater treatment facilities that provide secondary or advanced treatment, interceptor sewers, and corrections to inflow/infiltration problems. Grants were allocated according to a ranking of potential projects based upon a state priority system which considered issues related to improved water quality and protecting public health. Federal construction grants covered up to 75% of the eligible project costs until October 1, 1984 after which time the federal share of project costs was lowered to 55%. The rest of the funds typically came from state grants (typically 15%) and a local share to cover the difference. However, it is important to note that many communities were unable to afford the local share of project costs and did not make use of federal construction grant funding (EPA, 1991).

Through fiscal year 1992, $56 billion in federal funds have been invested in municipal wastewater treatment facilities (EPA, 1991). These expenditures, have contributed to significant water quality improvements nationwide (EPA, 1994b). Of the 3,731 major POTWs, 1,478 facilities were identified as requiring construction to meet the 1988 deadline. Only 423 facilities failed to meet the July 1, 1988 deadline. Currently, there are approximately 235 facilities which remain in noncompliance and all but 50 of these have been placed on enforceable compliance schedules (EPA, 1994b). However, the most recent EPA estimate of the financial needs associated with improving sewage treatment plant capacity and efficiency is approximately $127.1 billion. These funds are necessary to ensure future compliance with the CWA's requirements. In addition, given increased urbanization and population growth, additional public expenditures will be needed to service the growing populations in order to maintain existing water quality.

Examining the Distribution of Federal Construction Grants

This study focuses on determining whether federal construction grants have been distributed equitably. "Equity" is defined here as the impartial distribution of environmental benefits and costs to individuals, groups, or communities regardless of race, ethnicity, or economic status. The concept is narrow and tends to neglect many of the process oriented aspects of the environmental justice concept. Two concepts are useful to consider when examining environmental equity: 1) horizontal equity; and, 2) vertical equity (Berne and Stiefel, 1984). Horizontal equity can be defined as the equal treatment of equals. In other words, all communities are assumed to have an equal opportunity of receive federal construction grants and observed differences should not be a function of characteristics considered to be illegitimate by the EPA (e.g., wealth, size, or racial characteristics, etc.). Horizontal equity is typically examined using measures which capture the dispersion within a distribution (e.g., correlations, regressions, etc.). Perfect equity would be when federal funding was dispersed randomly among communities with similar characteristics (Berne and Stiefel, 1984:18). No previous environmental justice studies have examined the horizontal equity of the EPA's Construction Grants Program.

Vertical equity can be defined as the unequal treatment of unequals. In other words, the relative degree of progressivity or regressivity associated with a distributional policy. For example, it might be desirable to target federal funds to communities with greater infrastructure needs, low income communities which can not afford direct financing of infrastructure, or communities with greater environmental problems. A central feature of vertical equity is deciding who is "unequal" and how the treatment should be applied unequally to different groups (Berne and Stiefel, 1984). These decisions are primarily based on value judgments. The concept of vertical equity will be used to reexamine the third goal of the EPA's Strategy and its characterization of disadvantaged communities. This will help to identify those community characteristics that should be considered when determining whether future state revolving loan funds have been allocated equitably.

Data and Methods

This project consists of an analysis of the distribution of federal construction grants pursuant to the Clean Water Act. The study population consist of all counties in the 48 contiguous states during the period 1983-1992 (N = 3110). While environmental justice researchers often focus on smaller units (*e.g.*, census blocks, zip codes, etc.), county level data was determined to more appropriate since many POTWs are regional and serve multiple communities. Given the exploratory nature of this research, multiple measures of the dependent and independent variables were used whenever possible to improve the reliability of the findings.

The total amount of federal construction grant awards to a county during the period 1983-1992 constitute the dependent variable in this analysis. A fundamental assumption surrounding this analysis is that there was at least one municipality in every county that desired to obtain at least one construction grant during this period. It is important to note that these are grant awards, not expenditures. In some cases, a community may have received a grant but never spent the money. They may also have spent less or more then the amount of a grant award. It is also possible that the EPA withdrew the initial award. Accordingly, a second assumption surrounding this analysis is that these minor adjustments in grant awards occurred randomly.

Data on individual grant awards was obtained from the Consolidated Federal Funds data system. Approximately 66.8% of the counties received at least 1 grant during this time period. Three measures of the dependent variable were used in the analysis. The first measure is simply the total amount of grants a county received during this time period. The second measure divides the first measure by the state's total grant awards during this period to give a measure of the county's share of state funding. Both of these measures were used in the ordinary least squares regression (OLS) analysis. Since it is likely that some minimum thresholds (*e.g.*, population, and density) exist in order to be eligible for funding, a tobit analysis was employed using these two dependent variables as well. The third measure is a dummy variable coded as 1 if a county received a grant award during this time period and a 0 if it did not. This measure of the dependent variable was used in a logit analysis which examined the extent to which the independent variables influenced the probability of obtaining a construction grant during this time period.

The independent variables used in the analysis are a county's: 1) population; 2) population change; 3) population density; 4) minority population; and, 5) income characteristics. In each case, data for these measures was obtained from the 1990 Census data contained in Landview II. The study then tests the following hypothesis:

> H_0: It is hypothesized that there was an equitable distribution of federal construction grants between all counties during this time period regardless of population size, population density, population change, minority composition, or income characteristics.

Previous research indicates that there are often significant differences associated with state environmental policy implementation (Goggin, *et al.*, 1990). Therefore, differences may exist with respect to the process used to prioritize and select grant awards. There are also differences across states in terms of the total amount of construction grant funding that is allocated to a state. A dummy variable for each state was included in the analyses to control for these differences. Any systematic differences across states will also be examined in the analysis.

Preliminary Results and Conclusions

The results of the preliminary OLS regressions and Logit analyses indicate that all five variables had statistically significant ($p < .05$) effects on both the amount of grant awards and the probability of receiving at least one grant award. Accordingly, the null hypothesis should be rejected. Four of the five relationships were in the direction suggested by the EPA's Strategy. Both the amount of grant awards and the probability of receiving a grant increased as the county's population and density increased. Counties with large positive changes in population also received larger grant awards and had a higher probability of receiving a grant award. The results also confirm the EPA's suspicions that low income communities (e.g., low per capita incomes, low median home values, high percentage of the population at or below the poverty level or high unemployment) received less funding pursuant to the construction grant program. Low income communities also had a lower probability of receiving construction grant awards. However, the results do not confirm the EPA's suspicions that minority communities would have had greater difficulties in obtaining construction grant awards. In fact, the opposite is true. Communities with large minority populations were more likely to receive construction grants and received larger funding awards. One explanation for this result is that minority populations are often centered in large urbanized areas which competed well for construction grant funds.

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Mark T. Imperial
School of Public and Environmental Affairs
Indiana University
Bloomington, IN, USA 47405

Ph (812) 330-9523
Fax (812) 855-7802
Email mimperia@indiana.edu

STRUCTURAL RESTORATION OF TWO CORAL REEFS IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY

Tim Osborn,
NOAA/National Marine Fisheries Service,
Kevin Bodge, Olsen Associates, Inc.,
Miles Croom, NOAA/National Marine Fisheries Service,
Mark Schroeder, Continental Shelf Associates, and
Charles M. Wahle, NOAA/National Ocean Service

In two separate incidents in 1989, the 40-m M/V Alec Owen Maitland and the 142-m M/V Elpis went aground upon living coral reefs in the Key Largo National Marine Sanctuary in the Florida Keys. The grounding incidents fractured the underlying coral substrate, and the ships' screws created deep craters in the coralline seabed. Large amounts of coral rubble were created from the fractures and ejected from the craters. Through the actions of the U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration (NOAA) Damage Assessment and Restoration Program, monetary damages were collected from the vessels' owners under the auspices of the National Marine Sanctuaries Act for the purposes of site rehabilitation.

Restoration Planning and engineering efforts to quantitatively assess the sites' structural damage, and to design and supervise the construction efforts to structurally restore the damaged reefs, were initiated in June, 1993. Restoration and engineering design alternatives for the structural restoration and construction plans and specifications were subsequently prepared in accordance with the sites' environmental conditions and limitations, and in accordance with preferences of the sites' trustees. Construction of the structural restoration project was completed on September 1, 1995, in accordance with the plans and specifications, within budget and within the anticipated construction schedule, and with minimal environmental impacts -- despite the area's most active tropical storm season on record.

In terms of its complexity and the environmental sensitivity of the work, the project represented an experimental attempt to structurally restore damaged coral substrate on an unprecedented scale[5]. Central to the project's ultimate success was the benefit of careful planning, detailed bid documents and plans, hallmark cooperation between federal and private agencies, insistence upon compliance with the project's specifications through vigilant construction review, selection of a competent construction Contractor through thoughtfully prepared evaluation criteria, and direct involvement of the engineering design professional from the initial site survey through construction review.

The restoration planning and engineering approach to the work followed that of a traditional civil works project, the protocol for which is well established. This approach involves, in order, (1) preliminary site assessment to formulate survey requirements, (2) site survey and data analysis, (3) formulation of conceptual design alternatives, (4) selection of a preferred alternative, (5) design-development of the preferred alternative (6) acquisition of regulatory permits and concurrent development of construction plans and specifications, (7) preparation of bid documents and construction Contractor selection criteria, (8) Contractor solicitation, selection, and award, (9) issuance of notice-to-proceed, (10) construction by the Contractor and construction review by the Engineer, and (11) acceptance. The traditional process involves three distinct parties with specific responsibilities: the Owner, the Engineer, and the Construction Contractor. In the present case, lacking a viable contracting mechanism by which to solicit and manage the construction contract, NOAA elected to construct the project through the U. S. Army Corps of Engineers via interagency agreement between the two parties.

[5] Engineering restoration efforts focused upon the stabilization of coral rubble and large craters which resulted from the vessel groundings. The intent of the project was to re-create a stable foundation which closely emulates the adjacent natural seabed and which would foster future recruitment of local biota. Work at the *Elpis* site (10 m depth) included mechanical transfer of 25 m^3 of coral rubble as well as back-filling of two craters with 400 tons of limerock boulders and 60 m^3 of carbonate sand. Work at the *Maitland* site (2.5 m depth) included excavation of coral rubble, precision placement of 40 pre-cast, 10-ton reef-replicating armor units and an underwater pour of 45 m^3 of a specially designed non-separable underwater concrete. Engineering design was complicated by the sites' shallow depths and proximity to environmentally sensitive coral.

The total elapsed time between the initial restoration planning and the construction Contractor's Notice-to-Proceed was 20 months. Future efforts between NOAA and the Corps will enjoy the benefit of reduced timelines in engineering and construction schedules because of the development of standard agreements in jointly implementing projects and the coordination built between the two agencies during this project. After receipt of notice-to-proceed, Contractor preparation and off-site fabrication took about 2-1/2 months. Site work involved another 2-1/2 months, including weather delays.

It is important for the design and construction of engineering restorative works that the scope of the site survey work be developed to meet a project's engineering requirements. In the present case, the detailed seabed survey data conducted by NOAA personnel and academic interests (while of value to those groups) were of little value to the engineering design and subsequent formulation of project plans. High-resolution electronically-collected survey data were collected as part of this project, but diver measurement was also necessary to discriminate the limits of the injury and to collect smaller-scale data suitable for ultimate engineering design. The requisite, intensive underwater survey work offered the added, invaluable benefit of allowing the design professionals to significantly increase their understanding of the site's characteristics and limitations -- and also lent an unambiguous understanding of the collected data's physical significance, precision and accuracy. Such an understanding is best realized when trustees and design contracting staff are directly involved in the underwater data collection effort together: it cannot be gained from remote observation or after-the-fact discussion. The ability to manipulate the survey data digitally (*i.e.*, through AutoCAD) was essential to the production of useful survey documents and greatly expedited the formulation of conceptual design alternatives.

Selection of a preferred design alternative was supported (and documented) by a multi-attribute decision analysis. Final engineering design of the selected alternative involved stability computations for a nominal 50-yr return period storm event, and required novel applications of structural steel reinforcement and experimental, non-separable underwater concrete. Peer review of the plans was performed.

Florida permits were not required because the projects were outside state waters. A federal permit was required and took 8 months to secure. A Marine Sanctuaries Permit was issued to the Construction Contractor subsequent to approval of key plan submittals (methods statements) noted above.

The restoration/construction plans and specifications were comprehensive and detailed. Structural elements of the work and provisions for construction tolerance were described in detail. Construction methods deemed unacceptable (primarily because of environmental concerns) were clearly specified; but otherwise, the Contractor was free to propose construction methods -- subject to the approval of the Engineer and Owner. Developing an outline for the Contractor to complete in regard to his submittal of construction methods (methods statements), and observation of strict timetables, would have better facilitated preparation and review of the submitted plans. Construction tolerances were found by the Corps to be sufficiently precise; however, their practical interpretation would have been made easier if permanent, horizontally- and vertically-controlled monuments had been established at each work site during the initial engineering survey. As is typical in most construction projects, proper specification of tolerances was of great importance and value during field discussions between the Owner, Engineer, and the Contractor.

Assessment of pre-construction site conditions by the Engineer (and environmental specialists) prior to award of the construction contract award is important in order to determine whether conditions have changed relative to those indicated in the construction plans. It also serves to establish a pre-construction baseline -- which may be different than that determined by the initial injury assessment. In the present case, no change in conditions was observed. Contingencies for re-survey and modest plan modification had been identified in the event that site changes occurred over the winter prior to construction.

The construction contract was awarded on the basis of "best overall value" and involved concurrent submittal of a separate technical proposal and cost proposal. Payment was based upon a combination of lump sum and unit cost. The technical basis for award (*i.e.*, a set of pre-established evaluation criteria for which offerors must submit specific information) was carefully formulated with the direct participation of the design engineer. Without careful thought to the award's evaluation criteria (including a definition of what constitutes compliance with each criterion, and including appropriate assignation of the relative weighting factors for each criterion) it was entirely possible that the outcome of the contractor-selection process would have resulted in an unexpectedly poor choice; or, that the award will be subject to protest from unsuccessful offerors and significant delays. Specific forms were designed to focus potential Contractors' attention upon the requisite submittal information, and to facilitate the evaluators' review of the technical (bid) proposals. The process performed well in this case, resulting in the selection of a highly qualified, competent and motivated construction contractor.

In the field, the Contractor was proved very sensitive and responsive to the protection of coral resources within the Marine Sanctuary. At the ELPIS site, two large craters that had been created from the ship's propellers were filled to grade with quarried boulders and sand to resemble the surrounding environment. At the Maitland site, the shallow depth and unstable reef structure had resulted in the two blowholes (also created from the ship's propellers) to expand into one large crater that was susceptible to continued erosion. At this site, 40 concrete artificial reef modules were placed into the crater to prevent additional erosion of the crater and to recreate a three dimensional reef structure which resembled the surround coral reef environment and to facilitate later biological restoration efforts.

Construction review was practically implemented through a partnering effort of the project's many players. On-site review, in particular, was accomplished through three principal parties, each with a specific responsibility and expertise. Technical review of the work was principally undertaken by the project's design engineer (subcontracted to NOAA) -- both directly by the engineer and also indirectly via a full-time, on-site field representative. Environmental review was undertaken by NOAA Sanctuary biologists. Final review, authority for acceptance, and construction management was the responsibility of the Corps of Engineers. Such team-oriented review can work only when it is understood that (1) there can be only one chief authority from whom the Contractor receives direction, and (2) the one chief authority is prepared to share and receive the recommendations of the other members of the review team. This level of understanding was mostly achieved on this project, and was greatly facilitated by a 1-1/2 day pre-construction partnering meeting. Partnering in this case was particularly effective because of an excellent facilitator and the spirit of cooperation -- and general level of technical sophistication -- of the project's diverse parties.

The on-site audio- and image-communication capabilities and the photographic documentation provided by the Engineer's field representative provided unanticipated value to the project. The Owner and the design engineer were able to view high-quality, color images of the underwater work-in-progress via cellular phone, the Internet and office computer -- in almost real-time. This enabled the Engineer to monitor compliance with the design intent between site-visits, and to offer recommendations for re-direction in a timely, cost-effective manner.

An innovative concept of monitoring for "cumulative turbidity" impact was introduced for the purposes of this project, but could not be tested because individual measurements were of little meaning (attributed to the nature of the sediments). Adverse impacts due to construction-related turbidity were not observed; nonetheless, this aspect of the work requires further research.

The bid cost for project construction was $1,047,000; or about 15% less than the engineer's pre-project opinion of probable cost-to-construct. This cost does not include construction review activities. Change orders over the project life amounted to a net increase in cost of $19,600 -- a very low percentage (<2%) for an experimental project of this nature.

In summary, the integration of trustee staff with the design/engineering contracting staff from the early stages of restoration planning through construction resulted in a restoration that complies with the goals of the trustees with compliance to engineering/design criteria to provide for a long lived, stable reef restoration.

Tim Osborn
NOAA/National Marine Fisheries Service
Office of Habitat Conservation/
Restoration Division
1315 East-West Highway, F/HC, Rm 12600
Silver Spring, MD, USA 20910

Ph (301) 713-0174
Fax (301) 713-0184
Email Tim_Osborn@ccgate.ssp.nmfs.gov

UTILIZING ECONOMIC IMPACT ASSESSMENTS TO COMPARE ALTERNATIVE NATIONAL MARINE SANCTUARY DEVELOPMENT SCENARIOS

Edward Mahoney, Department of Park,
Recreation and Tourism Resources,
Michigan State University,
Michele J. Malarney,
NOAA Thunder Bay National Marine Sanctuary
(Proposed), and
Daniel Stynes, Department of Park,
Recreation and Tourism Resources,
Michigan State University

Introduction

This paper describes a method for Economic Impact Analysis (EIA) being incorporated as part of the Draft Environmental Impact Assessment (DEIS/DMP) for a proposed National Marine Sanctuary in Thunder Bay, Michigan. The method recognizes and addresses some of the problems and limitations of EIAs, especially EIAs for proposed recreation areas, facilities and programs. The method generates estimates of the direct, indirect and induced economic impacts associated with alternative mixes and scales of facilities and programs. It utilizes an input-output model to estimate the economic impacts associated with alternative development-use scenarios.

Thunder Bay was activated as a candidate for National Marine Sanctuary designation by the National Oceanic and Atmospheric Administration (NOAA) in 1991. If designated, Thunder Bay will be the first Great Lakes and first freshwater sanctuary, and the first sanctuary designated entirely within state waters. Since activation, NOAA has been working with local, state, federal, and tribal agencies and organizations to determine the feasibility of the sanctuary, including the sanctuary's scope and size, and priorities for management, education and research activities. A Core Group, representing regional governments and agencies, was formed to assist NOAA in the feasibility process. The Core Group, with input from other sanctuary publics, has provided the following recommendations: (1) the sanctuary should focus on underwater cultural resources (e.g., shipwrecks, piers, wharves, and prehistoric sites), and (2) sanctuary recreation, education, and research programs should focus on and highlight the maritime heritage of the area.

To that end, NOAA proposes to partner with Michigan to manage Thunder Bay underwater cultural resources by adopting as federal regulations the substance of state legislation protecting those resources (P.A. 173 of 1929, as amended; P.A. 247 of 1955, as amended). No other sanctuary regulations are proposed. Additionally, NOAA will work cooperatively with regional communities to supplement and complement education and research activities rather than duplicate them. Given this scope, sanctuary designation should have no negative economic impacts because no new regulations or limitations on existing activities are being proposed (*e.g.*, commercial fishing, charter operations, shipping, etc.).

According to the National Environmental Policy Act and the National Marine Sanctuaries Act, as amended, NOAA is obligated to assess the environmental, social and economic impacts related to sanctuary designation, and incorporate findings into an Environmental Impact Statement/Management Plan. Despite these legislative obligations, the National Marine Sanctuary Program (NMSP) has in the past devoted minimal attention to the economic impacts of proposed sanctuaries during the designation process and throughout their existence. However, given the increasing scrutiny of federal programs, particularly those that could appear duplicative of state programs, and decreasing Congressional appropriations, it is necessary to clearly describe the added value of sanctuary designation, including economic impacts. In this case, local sanctuary publics were particularly interested in the economic development potential of the sanctuary.

Economic Impact Assessments: Problems and Limitations

Reliable and timely estimates of the economic impacts associated with proposed coastal zone reserves and parks, and their facilities, programs, policies, and regulations are important in decisions effecting the management and protection of coastal areas. EIAs range from relatively naive estimates or projections of new direct spending (*e.g.*, spending by recreational users) or revenue/sales reductions (*e.g.*, reduced harvesting), to sophisticated regional economic models that estimate the direct, indirect, and induced income and employment impacts likely to result from a new facility, action or regulation. However, the majority of EIAs consist primarily, or only, of estimates of the likely direct spending or cost impacts from a proposed development or action. These relatively simple estimates often fail to provide a true or valid measure of economic impact, or the information needed to manage and evaluate actual impact. Because of this, debate about future economic consequences often centers on short-term direct spending or sales impacts (*e.g.*, new spending by tourists, loss of revenues associated with regulations) rather than long-term "net impacts" on economic systems, or on strategies to maximize positive economic impacts and limit negative effects.

According to Stynes and Propst (1994)

[1], EIAs are useful if they: (1) derive impacts for both "with" and "without project" conditions to anticipate the consequences of a proposed project, (2) show the effects of alternative development-use scenarios, and (3) project the impacts on different economic sectors. While these more comprehensive EIAs provide a better basis for decision making, they are often difficult to complete given the usual time and budget constraints. As a result, EIAs frequently consist of a collection of different measures of current economic activity (tourist spending, sales, employment) collected by different organizations during different time periods. It is often difficult to utilize this disparate data to draw conclusions about the likely impacts of proposals, or to assess trade-offs between alternative developments (*e.g.*, scope, capacities), programs or regulations. Seldom does this type of assessment provide an understandable picture of direct, indirect, and induced positive and negative economic impacts.

Agencies and organizations required to complete economic impact assessments of proposed projects or actions confront a number of obstacles and limitations including time and budgetary constraints, lack of current and reliable economic data, and short comings with some methods available to assess economic impacts. This sometimes results in problems with the way EIAs are designed, conducted, reported, and/or utilized.

EIAs, whether they are simple estimates of direct spending, sales or employment, or input-output analyses, require spending and/or sales data, including spending by visitors/users, durable goods purchased by users and households in the area, and spending by organizations for construction, operations, and maintenance, to estimate direct and indirect economic impacts (Stynes *et al.*, 1992). Although more attention is being focused on the economic consequences of public investments and regulations, the availability and quality of data needed to estimate economic impacts is frequently inadequate. This is especially true for different recreation activities and tourism. There is often no data (participation/use rates or production levels) available for specific geographic areas, proposed activities under consideration (*e.g.*, new marine park or sanctuary), or current activities that may be impacted either positively or negatively by the proposed action. In many situations, planners and economists are forced to utilize data that are outdated, adopted from other locations with very different economic structures, or data about closely associated activities, but not those actually being considered or impacted. For example, no data is currently available on spending associated with sea kayaking in Michigan with which to estimate the potential economic impacts of a National Marine Sanctuary that provides or enhances opportunities for sea kayaking. Time and budget restrictions prohibit conducting a special spending study to collect this data. The most similar available data are estimates of spending by canoeists and river rafters in other states. The problem is the activities are not really comparable, and the other locations have different economies, service capacities (*e.g.*, hotels, restaurants, guides), and, therefore, different economic multipliers. It is even more difficult to obtain economic data that can be used to generate estimates of the economic impacts of a proposed new area, facility, or activity currently not found in the impact area, or not found anywhere else. For example, what are the economic impacts of a proposed "land-water-underwater" interpretive trail?

Even when existing secondary data is available, it must be carefully evaluated with special attention to the organization that collected it, the purpose for which the data was collected, collection methods (*e.g.*, questionnaire design), and types of data editing and analyses performed. Organizations such as industry and environmental groups regularly collect and distribute economic data in support of their positions and agendas (*e.g.*, the economic benefits from a cleaner environment, spending by recreational anglers). Often this is the only secondary data that is available to use in EIAs. However, it is rare for one of these organizations to publish or distribute information that does not support their positions or agendas. The focus is often on producing the "largest possible estimates" of the positive or negative economic impacts associated with existing or proposed programs, policies, and regulations. Sometimes economic data that is collected and/or analyzed uses methods that may not be valid, reliable, or comparable. In other cases, the data may be reliable, but valid for certain types of economies (*e.g.*, urban systems, undeveloped rural areas).

A variety of direct and indirect methods are used to collect economic impact data, each with its own advantages and disadvantages in terms of sampling, survey questions, and biases (Lipton *et al.*, 1995; Walsh, 1986). Even subtle variations in sampling methods and data collection instruments can significantly influence different economic impact data. Differences in collection methods, units of analysis, and reporting formats make it difficult to combine data collected by different organizations and studies. The problem is that a certain degree of sophistication and experience with economic data collection methods is necessary to evaluate applicability, validity, and reliability of secondary data, and the results of economic impact studies. Frequently persons conducting these analyses have limited experiences with these methods.

Another common problem, especially when estimating the economic impacts of proposed recreation and tourism developments that positively or negatively effect recreational opportunities or capacities, is the inability to bridge spending data to input-output models. Bridging is necessary to utilize input-output models to estimate the total impact (direct, indirect, and induced effects) of proposed projects and impacts on economic sectors (Stynes *et al.*, 1994 and Stynes *et al.*, 1992. Often organizations do not have access to bridging methods or tables. This is one reason why many EIAs are limited to only providing estimates of direct economic impacts. Direct impacts include spending for gasoline, food, lodging, and equipment, while indirect impacts are those which amass to local, state, and national communities in terms of added income, employment, retail sales, taxes and revenues, and linked industries (Propst et al, 1987). Assessment of secondary impacts requires additional analysis such as that associated with an input-output model.

An input-output model traces the flows of economic activity between different sectors in the economy (Stynes *et al.*, 1995). According to Fletcher (1989), the benefits of using input-output models include: (1) providing decision-makers with a comprehensive view of the economy; (2) an emphasis on the links and interdependencies within the economy; (3) flexibility within the model to suit the purpose at hand; (4) providing consistent accounting structures for all sectors of the economy and (5) assessing the direct, indirect, and induced impacts of the project. A bridging method (*e.g.*, system of spread sheets) developed for Michigan and an input-output model was incorporated into the EIA method for the proposed Thunder Bay Sanctuary.

It is complicated to estimate the economic impacts of current facilities and programs, never mind generate reliable estimates of the future stream of different economic impacts associated with the scope and investment of alternative facilities, programs, or regulations. Many published EIAs provide information on current economic activity (*e.g.*, current spending by recreational boaters), not projections of likely economic impacts associated with a range of alternative future developments. EIAs of proposed facilities or programs tend to measure the impacts as with and without the project, rather than providing information to evaluate trade-offs between alternative types and levels of development or use. Estimating future economic impacts of different alternatives requires projections of: (1) both the expected amounts of recreational use or production (*e.g.*, number of visitors, reduced commodity production) associated with different alternatives, and (2) estimates of the amount of visitor spending or sales revenues/losses that can be expected. Generating estimates of the economic impact for different alternatives provides better information and rationale for decisions. It also clarifies the trade-offs and returns-on-investment associated with different alternatives, and provides a more comprehensive assessment of the benefits and costs of different alternatives. This can also provide a more efficient and effective framework for focusing debate and public comment.

EIAs also tend to focus on providing a "one-time" estimate of current or expected economic impact. The results are generally not presented in a fashion to encourage post development comparison of projected economic impacts with actual impacts, although this is changing for some agencies (Perales, 1994). Additionally, the results of EIAs are commonly presented in terms of total or average spending rather than describing the actual or expected distribution and categories of spending throughout the area under consideration. Estimates of total or average spending fails to provide important information for managing and marketing facilities and programs.

Thunder Bay Proposed National Marine Sanctuary: A Case Study

Providing decision relevant estimates of the economic impact for different proposals for the Thunder Bay Sanctuary posed a challenging mix of problems and limitations. The challenges included: (1) alternative sanctuary proposals consisted of a mix of existing and proposed recreation and educational facilities and programs; (2) little or no spending data was available for proposed recreation and education activities and facilities; (3) data that was available was not current, or was collected in other locations; (4) no time and money was available for primary data collection; and (5) there was skepticism among local and state publics that sanctuary proposals would generate the type and amount of economic impact they expected in 1991 when the site was activated as a National Marine Sanctuary candidate. However, the case provided an opportunity to design and implement a feasible EIA that addressed these problems and limitations. It also provided an opportunity to educate decision-makers about the importance and complexities of EIAs.

The method for estimating economic impacts of alternative "sanctuary development-use scenarios" consisted of four primary steps, a variety of different analyses, and data from a variety of sources:

1. An inventory was conducted to identify existing recreation and education facilities, programs, and activities occurring within the proposed boundaries that were relevant and compatible with the proposed sanctuary's purpose of protecting underwater cultural resources and highlighting maritime heritage. The inventory included an effort to identify recreational use/visitation information and recent economic (spending) studies.

2. Information on existing uses/activities was used along with public input and recommendations of the Core Group to develop the alternative sanctuary development-use scenarios. The scenarios were an important component of the EIA. They included different mixes of recreational and educational programs and facilities, different levels of capital investment and anticipated operating expenditures, and different phases of development (Table 1). The amount of investment, operating spending, and levels of use increased from low (start-up) to high. All uses, activities, and facilities comprising the scenarios were compatible with the sanctuary's draft management plan and consistent with the maritime heritage theme recommended by the Core Group. The scenarios also included projections of likely use/visitation and estimates of visitor/user spending (*e.g.*, average spending x total visits). The scenarios were structured with clearly identified assumptions allowing decision-makers to modify the assumptions, or the levels of investment, and estimates of use/spending.

Identifying relevant and ongoing activities in the Thunder Bay area was straight forward given the clearly defined scope for the proposed "shipwreck sanctuary." The types of activities identified included scuba diving, museum visitorship, lighthouse visitorship, kayaking/canoeing, etc. Difficulties occurred, however, in trying to identify and prioritize activities proposed to occur. Proposed activities could only be described generally because the goals of sanctuary management, education and research were still under development as part of the DEIS/DMP. Additionally, proposed activities were not entirely new activities, but rather expansions of, and partnerships between, existing activities. For example, promoting recreational opportunities for the non-diving family members of divers, or providing maritime heritage learning experiences on Thunder Bay Island through existing boat charters or kayak/canoe tours.

Also, NOAA would not provide all the funding to develop or support the different development alternatives. The different recreational and educational facilities and programs may be developed by a single entity, or through partnerships between local, state, federal, and tribal agencies, organizations, and businesses.

3. Spending associated with different scenarios was estimated using information from a variety of different sources including national and state studies and secondary information on spending by recreational users and tourists; estimates of capital expenditures for facilities and programs; and operating expenditures for similar types of facilities and recreational use levels. Deriving spending estimates for the recreation and educational activities was particularly difficult and time consuming because almost no specific spending data was available for the Thunder Bay region, and minimal spending data was available for identified activities (*e.g.*, scuba diving, kayaking, museum visitorship, interpretation), or comparable activities any where in the country. Further, there were no applicable studies available regarding the economic impacts of National Marine Sanctuaries or Great Lakes underwater parks in general.

The spending estimates from different sources were made comparable (*e.g.*, visitation units). The Consumer Price Index was used to convert all spending estimates to 1996 dollars.

4. The spending-investment estimates for the different development-use scenarios were used in input-output (Micro-IMPLAN) models to estimate the direct, indirect and induced economic impacts. The MI-REC system was employed to facilitate the use of IMPLAN by providing spreadsheets for bridging the estimates of recreation spending. The spreadsheets produce spending estimates that are compatible with requirements of IMPLAN. The MI-REC/IMPLAN system is tailored for recreational applications and allows for the use of different spending data. Default spending data is provided as well as procedures for estimating spending changes. The

advantage of MI-REC is that in situations like Thunder Bay, when recreational spending data is limited, it can generalize and apply spending patterns from regional and national surveys/data (Stynes *et al.*, 1994).

The results of MI-REC/ IMPLAN analysis include multipliers for the multi-county (impact) region; direct, indirect, and induced effects; and impacts reported in sales and employment in total and for individual sectors.

Conclusion

The Thunder Bay EIA and corresponding results have many uses. The methods implemented in this assessment demonstrate the use of creative approaches for overcoming some of the problems and limitations typically associated with EIAs. The EIA not only fulfills the legislative requirements of the NMSP, but it provides a model by which other sanctuaries and related coastal parks can begin to assess the economic impacts associated with proposed programs, facilities and services. Further, it empowers decision-makers to become involved in the analysis and usefulness of EIAs, allowing them to challenge the EIA's assumptions, and modify the levels of investment and the estimates of spending according to their own experiences. Most importantly, for Thunder Bay, it reinforces the idea that a sanctuary can have positive impacts for northeast Michigan, but only through the active cooperation and involvement of different publics comprising the sanctuary community.

The results of this analysis will be incorporated into the Thunder Bay DEIS/DMP scheduled for publication in 1996. A separate report will be available in July 1996.

Michele Malarney
NOAA Thunder Bay National Marine Sanctuary (Proposed)
Natural Resources Bldg, Rm 131
Michigan State University
East Lansing, MI, USA 48824

Ph (517) 432-3142
Fax (517) 432-3597
Email mmalarney@ocean.nos.noaa.gov

[1] Technically, economic values can be expressed as compensation demanded for loss of salmon fishing rather than willingness to pay to obtain salmon or salmon fishing. The compensation-type value can be pertinent where reductions in salmon or salmon habitat are being considered. For simplicity and because I am considering cases in which prior rights to

salmon harvest are ambiguous, I limit my discussion to values associated with positive payment for salmon fishing.

[2] "Economic Impacts and Net Economic Values Associated with Non-Indian Salmon and Sturgeon Fisheries". ICF Technology Incorporated, Redmond, WA (1988).

[3] The variable fishing cost estimate leaves out capital costs of vessels and gear.

[4] All these figures are contained in Tables 11-16, pp A-12 through A-17of ICF Technology Inc. (1988).

[5] Information distributed by Salmon for Washington - No on 640. Seattle, WA. Economic projections are from "Economic Activity Associated with Fisheries Products in the United States". Report for the US Department of Commerce by the Kearney/Centaur Division of A. T. Kearney, Inc., Washington, D.C.

[6] See Kearney/Centaur Report, p. 7-48.

[1] 16 U.S.C.A §1451 et. seq.

[2] 16 U.S.C.A. §1451(c) and (d).

[3] 16 U.S.C.A. §1452(l)

[4] 16 U.S.C.A. §1451(a)(2 & 6), The Findings and Purposes of the Coastal Zone Act Reauthorization Amendments of 1990. In response, Congress amended the Act including providing for enhancement grants and nonpoint source pollution provisions.

[5] Congressional Research Service, Oceans and Coastal Management Issues Team, *Oceans and Coastal Resources: A Briefing Book*, 2, (October 4, 1993).

[6] H.B. 1965 was introduce during the first session of the 104th Congress, and provisions to reauthorize the CZMA were include in S.B. 1142, the National Oceanic and Atmospheric Administration authorization bill. Generally, both bills provide for a straight forward reauthorizaiton with only minor amendments.

[7] Robert W. Hahn, *Toward a New Environmental Paradigm*, 102 Yale Law Journal, 1719, 1747 (May 1993), a critical review of Vice President Al Gore's book, *Earth in the Balance: Ecology and Human Spirit.*

[8] UNEP G.C. Dec. No. 15/2, Annex II, May 1989.

[9] Perry E. Wallace, 192 of 50 Wash. and Lee L. Rev. 1093, 1142, FN 192, (Summer 1993).

[10] 16 U.S.C.A. §1452(1)

[11] 16 U.S.C.A. §1452(2)

[12] 16 U.S.C.A. §1451 (f) & (h).

[13] Edith Brown Weiss, *Environmentally Sustainable Competitiveness: A Comment*, 102 Yale L.J. 2123, 2123, (1993).

[14] James T. McClymonds, *The Human Right to a healthy Environment: An International Legal Perspective*, 37 N.Y. Law School L. Rev., 583, 613 (1993).
[15] Principles 10 of the Rio Declaration mandates that "all concerned citizens" should be able to participate in decision making and Principle 17 provides that environmental impact assessments should in instituted as a national instrument.
[16] Principle 16 of the Rio Declaration.
[17] Principle 15 of the Rio Declaration.
[18] Bernard A. Weintraub, *Science, International Environmental Regulation, and the Precautionary Principle: Setting Standard and Defining Terms*, 1 N.Y.U. Envt'l. L. J. 173 (1992). It is interesting to note that this principle was first applied in the context of addressing the threat of marine pollution. See Weintraub at 188 and U.N. Doc. A/44/25 (1989).
[19] Id. at 205.
[20] From Principle 15 of the Rio Declaration.
[21] 16 U.S.C.A. §1455(d)(1).
[22] 16 U.S.C.A. §1452(2)(I).
[23] 16 U.S.C.A. §1452(2). This section then lists 11 specific concerns that state coastal programs must adequately address.
[24] The federal Coastal Barrier Resource Act, 16 U.S.C.A. §3501 et. seq., also discourages such development. The author is aware that bills granting exemptions from CBRA are commonplace in Congress. It is also a fact that some members of Congress may have a personal stake in this issue.
[25] Politically, some grandfathering of existing structures might be required in implementing polluter pays.

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TABLE 1. DEVELOPMENT-USE SCENARIOS FOR THE THUNDER BAY PROPOSED NATIONAL MARINE SANCTUARY.

Mixes of Uses, Facilities and Programs	Developing and Operating Partners	Level of Investment, Operating Expenditures and Visitation/Use Levels	Project Implementation after Designation	Economic Impacts
Awareness of Thunder Bay National Marine Sanctuary		Low	1-3 Years	
Integrated education program to encourage understanding of the Thunder Bay Cultural Landscape.		Moderate	3-5 Years	
Development of a Great Lakes Maritime Education Center.		High	5+ Years	

COMMERCIAL FISHERMEN AND THE FLORIDA KEYS NATIONAL MARINE SANCTUARY

Daniel Suman, University of Miami and
Manoj Shivlani, University of Miami

Our research evaluates the acceptance of marine reserves by local populations. We have tested a number of hypotheses concerning whether acceptance/opposition to marine reserves: 1) varies among different user groups; 2) is related to the group's economic interest in the marine resources; and 3) correlates with the extent to which group members have participated in public participation mechanisms.

Our efforts focus on Monroe County, Florida, the site of the Florida Keys National Marine Sanctuary (FKNMS) that is administered by the National Oceanic and Atmospheric Administration (NOAA). Congress designated the 2,800 square mile FKNMS by statute in 1990. NOAA released the Sanctuary's Draft Management Plan to the public in March 1995. The Sanctuary Plan proposed three Replenishment Reserves and 19 smaller Sanctuary Preservation Areas in which consumption of marine resources would be restricted. The Plan also proposed four small Special Use Areas in which no human activities would be allowed. Together these areas account for about 5% of the FKNMS.

Our research focuses on commercial fishermen in Monroe County, Florida. We have developed an attitudes and perceptions survey instrument that includes more than 50 questions that test our research hypotheses. We elicit responses from 1 to 5 that indicate degrees of support or opposition to the statements. When we report support for a statement, we are summing Responses 1 and 2 (Strongly Agree and Moderately Agree). Similarly, opposition to a statement sums Responses 5 and 4 (Strongly Disagree and Moderately Disagree). We have conducted our surveys via personal interviews with approximately 15% of the commercial fishermen in Monroe County (350 of 2,400). Our survey strategy attempts to obtain sampling ratios of full time: part time fishermen; Anglo: Cuban fishermen; and Upper Keys: Middle Keys: Lower Keys fishermen that approximate the ratios in the actual population.

More than three-fourths (79%) of the fishermen surveyed generally oppose the establishment of the Sanctuary. Only about 12% of those surveyed generally support the establishment of the FKNMS. Regarding the sanctuary zones (which include the Replenishment Reserves and the Sanctuary Preservation Areas), 26% of the fishermen surveyed supported the establishment of such areas somewhere in the Florida Keys, and 64% opposed establishment. However, when asked if they supported the establishment of sanctuary zones in the exact locations described in the

FKNMS Comprehensive Management Plan, fishermen's support declined to fewer than 5%, with more than 87% opposed. This disparity in support may suggest two separate, potential motivations. First, commercial fishermen show some support for protected zones but are dissatisfied with the proposed zones due to the perceived impact on their personal interests (the "not-in-my-back-yard" factor). Alternatively, commercial fishermen, although somewhat in favor of protective zoning in the Florida Keys, believe that the size or location of the actual zones may have been improperly designated.

An overwhelming majority of the commercial fishermen surveyed (94%) did not agree that their group would be the primary beneficiary of the sanctuary zones. More than 72% did not believe that the long-term effects of the sanctuary zones on the economy of the Florida Keys would be positive. More fishermen (60%) perceived that NOAA's principal purpose for creating the zones was to protect and conserve living marine resources, rather than to augment stocks either within or outside the zones (40% and 22%, respectively).

Responses regarding the public participation process indicated that the most successful vehicles have been FKNMS-related NOAA literature; the three-volume FKNMS Comprehensive Management Plan; and public hearings, workshops, and meetings. More than half (52%) of the fishermen surveyed read some FKNMS-related NOAA literature, 48% read parts of the Draft Management Plan, and more than 48% attended at least one hearing, workshop, or meeting. The least successful participatory component was the Info Expos which were attended by only 12% of fishermen surveyed. Also, Spanish-speaking fishermen have been greatly under-represented in the public participation process. Due to a variety of reasons, only 50% of Hispanic fishermen surveyed obtained information on the sanctuary zones from sources apart from rumors; 25% of Hispanic fishermen surveyed never even heard of the Sanctuary zones.

When asked if the public participatory process utilized by NOAA to develop regulations for the FKNMS had been "open and fair," almost 24% of respondents agreed, while more than 48% disagreed. However, when asked whether the process utilized to develop boundaries and regulations for the sanctuary zones had been open and fair, only 8% agreed while 64% disagreed. Thus, it appears that a sector of commercial fishermen surveyed believed that although they had the opportunity to participate in the general FKNMS process, they were excluded from the zoning designation process. Fishermen generally perceived themselves to be alienated from the process used to develop Sanctuary regulations; just under 65% of those surveyed considered that participation in the Sanctuary process was futile because the average person could not influence the final decisions. More than 75% believed that NOAA had failed to give sufficient consideration to their concerns in developing regulations for the FKNMS, while only 4% felt that the agency had addressed their concerns adequately.

We find that the commercial fishermen surveyed thus far have voiced strong opposition to the sanctuary zones. However, a third of those surveyed actually supported some type of zoning in the region, although not that currently proposed in the FKNMS plan. Most of the fishermen surveyed perceived that the main purpose of these zones was the protection of living marine resources, rather than the augmentation of commercial stocks. Therefore, most of them did not believe that their group would benefit from the zones. A majority of the fishermen surveyed did not predict a growth in the Florida Keys economy as a result of the marine zoning. With respect to participation, many fishermen sensed the process to be pre-determined and considered that their input could not influence the final decisions. Widespread belief also existed that NOAA's process had not addressed their concerns and that the zones had been developed in an arbitrary fashion. Our results suggest that Sanctuary managers must develop new strategies to involve fishermen in the Sanctuary planning process.

Daniel Suman
Division of Marine Affairs and Policy
Rosenstiel School of Marine and Atmospheric Science
4600 Rickenbacker Causeway
Miami, FL, USA 33149

Ph (305) 361-4685
Fax (305) 361-4675
Email dsuman@rsmas.miami.edu

Session J2: Incentives for Non-Regulatory Compliance
Session Chair: Roger Griffis, NOAA/Office of Policy and Strategic Planning

NEW APPROACHES TO HABITAT CONSERVATION FOR ENDANGERED SPECIES

Susan E. Essig, DOI/Fish and Wildlife Service

Introduction

The Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq.*) was last reauthorized in 1988 as Public Law 100-478. Authority to conduct activities pursuant to this statute expired at the close of FY 1992. Since that time, a period of great uncertainty regarding the future of the statute and the outcome of its reauthorization has been a dominant subject in Congress. With the start of the 104th Congress, themes dominating the conservative view of the statute have dealt with the issues of: extensive scientific peer review; diminution in economic value of private lands providing habitat for federally-listed species and the associated "takings" debate; and cost-benefit analyses for any associated rulemaking activity. To date, approximately eight bills to overhaul the basic tenets of the original statute have been introduced this session. Although the original Congressional momentum on this subject has been in "abeyance," the debate will continue.

At the heart of the debate has the issue of endangered species habitat. From an ecological perspective, habitat essential to maintain declining, yet unlisted species, and habitat essential for the recovery of listed species has been the central issue. From a private landowner's perspective, the question of limitations on property uses due to the habitat needs of declining and listed species has been the most contentious factor and has spearheaded the "takings" debate expressed in legislative proposals such as S. 605, the Omnibus Property Rights Act of 1995.

This abstract describes the ideological views which have lead to a polarized view on habitat needs for Federally-listed endangered and threatened species. More importantly, it highlights the actions undertaken by the U.S. Department of the Interior to adopt a more "user-friendly" approach to meeting the needs of both listed species and private property owners.

Review of Habitat Issues

Approximately, two-thirds of the lower 48 conterminous states are privately owned. As of August, 1995, 956 species (526 plant species and 430 species of animals) have been designated as "threatened" or "endangered" under the Endangered Species Act and now protected by the prohibitions on "take" as defined by this statute. "Critical habitat" has been designated for a total of 114 of these species under the jurisdiction of the U.S. Fish and Wildlife Service. A total of 411 recovery plans have been developed and published, many of which are multi-species in nature. Most listed animal species fall into the category of: mammals; birds; reptiles; and fishes.

The habitat needs for these species assumes a more controversial aspect given that an estimated 40% of listed species are wetland-dependent for all or part of their life cycle. As wetland losses continue at a rate of over 200,000 acres per year in the lower 48 states, the correlation between this decline, the need to list additional species which are declining, and the ability to implement effective recovery strategies becomes more evident. It is rare that an approved recovery plan lacks provisions for improved habitat protection for a listed species, in particular, plant species.

Three sections of the ESA are particularly germane to habitat issues: (1) Section 4 -- Designation of "Critical habitat"; (2) Section 9 which prohibits the private take of listed animal species (the prohibition on take for plants applies only to Federal lands); and (3) Section 10 which authorizes a permit process for "incidental take" ("take" resulting from the conduct of an otherwise lawful activity) via the development of a Habitat Conservation Plan (HCP).

Although adverse modifications to "critical habitat" have been upheld as violating the ESA [*Sweethome vs. Babbitt*], a developing trend has been to refrain from the designation of critical habitat when a species is listed. In turn, the emphasis has been placed on such designation, only when necessary, during the phase of recovering a listed species. Section 9 and Section 10 are intertwined with respect to private landowners. Since Section 9 places a virtual prohibition on "take" of listed animal species on private lands, a Section 10 permit for "incidental take" is essential. As a result, the development of Habitat Conservation Plans for this purpose have been a more recent undertaking under the ESA, with more than 150 plans approved or underway nationally.

Moving from the "Punitive" to the "Partnership" Approach

Secretary Babbitt has made numerous overtures during the last several years to adapt the ESA to what may be termed a more "user-friendly" approach. The following examples are illustrative of the Secretarial initiatives and reflect a trend which is likely to permeate throughout the process of reauthorizing the statute.

Habitat Conservation Plans -- As noted previously, a major emphasis has been placed during the past four years in working with the private sector and private landowners to develop Habitat Conservation Plans as a basis for a lawful Federally-permitted "incidental take" of a listed species. The word "habitat" is key to plan development since the basis for incidental take is premised on either a net gain in habitat for the target species or no net loss of habitat. Essentially, the permittee agrees to abide by stipulated provisions for lawful "incidental take" which seek to provide habitat gain (or no net loss) for a species or group of species as a "quid-pro-quo" for the potential take.

An upper limit on "take" may be stipulated thus requiring monitoring by the permittee and the U.S. Fish and Wildlife Service. Stipulated provisions are permit-specific but seek to minimize "incidental take" by factoring in provisions related to the foraging and seasonal habitat needs of the species. HCP's are not authorized if it is concluded by the Service that a level of take could constitute "jeopardy" to the future existence of the species.

Although 150 HCP's are under development (with many already approved), it will be necessary to evaluate their effectiveness in the future. Development of such agreements and subsequent monitoring can be labor-intensive for both the permittee and the reviewing federal agency. Increasingly, the scale of effort involved in the development of plans will be proportionate to the likely impact to the species and its habitat.

A related policy development by Secretary Babbitt has been the promulgation of a "No Surprises" policy during the fall of 1994. The policy statement issued indicated that the requirements of an HCP would not be altered in the event that actual "incidental take" exceeds that agreed to in the approved agreement. In essence, the permittee has been promised that additional habitat protection will not be needed beyond that previously agreed if impacts actually exceeded those anticipated.

Guideposts for Reform -- Secretary Babbitt continued the theme of more cooperative relationships with the private sector and private landowners with his March 6, 1995, announcement of "Guideposts for Reform" -- principles to be followed both by the Administration in implementing the ESA and to be given strong consideration during reauthorization of the statute. The 10 principles are:

(1) Base ESA decisions on sound and objective science.

(2) Minimize social and economic impacts.

(3) Provide quick, responsive answers and certainty to landowners.

(4) Treat landowners fairly and with consideration.

(5) Create incentives for landowners to conserve species.

(6) Make effective use of limited public and private resources by focusing on groups of species dependent on the same habitat.

(7) Prevent species from becoming endangered or threatened.

(8) Promptly recover and de-list threatened and endangered species.

(9) Promote efficiency and consistency.

(10) Provide state, tribal, and local governments with opportunities to play a greater role in carrying out the ESA.

These 10 principles may be self-explanatory. However, a brief explanation will provide the linkages between the basic principles:

(1) Sound and Objective Science -- the standard for the use of "best scientific information available" is codified in the ESA. Although this principle reiterates the need for reinforcing this point to the public, the term "objective" will permeate the question of the necessity for and the extent of peer review for listing activities and development of recovery plans in particular.

(2) Minimize Social and Economic Impacts -- unfortunately, the ESA has been portrayed too often as a statute which is incompatible with economic development. However, statistics do not substantiate this point. Annual studies of consultation activities between federal agencies and the U.S. Fish and Wildlife Service (Section 7 of the ESA) indicate that, between 1987-1992, a total of 54 federally-authorized, permitted or licensed projects were withdrawn or terminated due to the ESA consultation process. This is the cumulative number from a total of greater than 96,000 consultations conducted under the ESA with more than 94,000 of these consultations conducted at the "informal" level based on the standards in the statute.

The Administration has recognized that the small landowner should not be subjected to onerous economic impacts. Accordingly, the Secretary has also issued a policy which essentially waives liability for incidental take of animal species on residential landowners whose property does not exceed five acres.

(3) Quick, Responsive Answers and Certainty to Landowners -- the statistics on expeditious informal consultations; the "No Surprises" Policy for Section 10 permits; and the recognition of minimizing economic impacts on small landowners are all indicative of this principle.

(4) Treat Landowners Fairly and with Consideration -- this principle follows the general tenets expressed in the Administration policies noted in the previous principle.

(5) Create Incentives for Landowners to Conserve Species -- this philosophy embraces an incentives-based approach for the landowner and recognizes the landowner as an "asset" rather than a "cost" in administering the

statute. Under the auspices of the Services' Partners for Wildlife Program, a trend has been witnessed nationwide in agreements (ranging from 10-25 years) whereby the Service works with the landowner to enhance property occupied by both listed species and plants. Many aspects of this program are still in the maturation phase; however, the concept has been embraced as a future direction for this program which, until recently, has largely focused on restoration or enhancement of wetlands on private property under a stipulated time frame and subject to a cost-sharing agreement with the private landowner.

(6) Focusing on Groups of Species Dependent on the Same Habitat -- the attributes of this principle are significant and myriad. By definition, this approach is more cost-effective if a singular action (*e.g.*, development of a recovery plan) is applicable to conserving or recovering several listed species. In addition, it promotes a positive ecological concept since it is consistent with the concept of biodiversity. Most ecologists will argue that an ecosystem (defined at the spatial, landscape, or temporal dimension) is more resilient to adverse impacts when characterized by a diversity of biota endemic to the ecosystem.

(7) Prevent Species from Becoming Endangered or Threatened -- this tenet is consistent with the increased attention in the Service to its Candidate Species Conservation Program (previously known as the Service's pre-listing program). This focus has been on-going, cost-effective, and is aimed at meeting what essentially is the singular goal of the ESA -- prevent species from declining to the point where listing is essential to prevent extinction of a species.

(8) Recover and de-list threatened and endangered species -- this principle is evident in the intent of the ESA; however, on-going activities within the Service, particularly with respect to delisting, are not frequently noted. One of the most recent success stories nationally has been the declassification of the American bald eagle from "endangered" to "threatened" status. Within the northeast, plans have been developed to both "de-list" and "declassify" both plant and animal species -- a continuum of activities already conducted for several plant species during previous years.

(9) Promote Efficiency and Consistency -- this principle permeates the entire program. However, it is essential to recognize that the program nationally has had a relatively small budget. The FY 1991 appropriation of $32 million for the entire program (including those aspects implemented by the U.S. Departments of Commerce and Agriculture) has been estimated as less than the sum of money necessary to build one mile of an urban highway.

(10) More Opportunities for Intergovernmental Involvement in Implementing the ESA -- this last principle has been a characteristic of the program as it has evolved. Since its enactment in 1973, grant monies have been provided to States pursuant to Section 6 of the Act to aid pre-listing and recovery actions. This program has also been important in promoting biodiversity since actions to protect habitat for listed species often benefit resident species for which the States retain management jurisdiction. In addition, more than 500 Indian tribes have been accorded "tribal" status by the U.S. Bureau of Indian Affairs. Such recognition usually is accompanied by a national recognition of indigenous rights for a tribe to be held "in trust" by the federal Government. Tribal needs with respect to retaining rights to terrestrial and aquatic biota will continue to increase in implementing the ESA.

Conclusion

The Endangered Species Act is now 24 years old. As with any other national conservation statute, its maturation has not been without controversy. The ESA has a record of both noteworthy successes and ancillary controversies. The regulatory aspects of the statute are important to its success yet success cannot be achieved without the support of the public. This Administration's attempts to integrate the needs of the private sector and landowner -- minimizing cost and maximizing predictability are at the basis of the policies promulgated during the last four years. Sufficient recognition must be accorded to these attempts to find "common ground" between the need to prevent the decline of species and conserve listed species while sustaining a healthy level of economic development.

Susan E. Essig
U.S. Fish and Wildlife Service
DARD/Ecological Services
Northeast Regional Office
300 Westgate Center Drive
Hadley, MA, USA 01035-9589

Ph (413) 253-8611
Fax (413) 253-8482

DEEPVIEW SUBSURFACE MAPPING SURVEY: THE PRIVATE SECTOR PRACTICES INTEGRATED COASTAL MANAGEMENT

Eugenia Laychak, California Center for Public Dispute Resolution and
Noel Davis, Chambers Group, Inc.

Introduction

Integrated Coastal Management (ICM) concepts call for achieving natural resource sustainability to safeguard the ability of future generations of people and other species to meet their needs. Putting this theory into practice, especially on a project level, can be challenging to project proponents, agency regulators, resource managers, affected communities and other interested parties. One of the biggest challenges is implementing a project in an environmentally sustainable manner while adhering to very real budget and time constraints and ensuring a profitable result.
This abstract describes how THUMS Long Beach Company (THUMS) prepared for and conducted a month long three-dimensional (3-D) geophysical survey in and just outside Long Beach Harbor, California while addressing environmental, community, and public policy concerns (Figure 1). THUMS is in charge of overseeing day-to-day operations of four oil and gas producing islands in the harbor on behalf of the field operator, the City of Long Beach, who was granted title to the tidelands in trust through California legislation. More than 1,700 wells have been drilled since THUMS began operations in 1964.

Survey Description

The survey used compressed air sources (airguns) and seafloor receivers to map multiple subsurface geologic horizons and faults. The survey area extended from the beach offshore to about 60 ft of water depth. Survey operations were conducted daily between January 10 and February 1, 1995. The operations consisted of the deployment of several hundred small transmitter buoys, to each of which were attached several receivers that lay on the sea floor, over an area or patch covering up to 2 square miles. A 56-foot source vessel towing an array of 12 compressed airguns criss-crossed the receiver lines while emitting a signal that was reflected from subsurface geological formations back up to the receivers. When the source vessel completed the transit of one patch, the buoys were collected and redeployed to another patch. Four patches were required to cover the 8-square mile survey area (Figure 2).

This survey was the first offshore oil related 3-D survey permitted in California waters since October 1988. Several major reasons account for this lack of oil related geophysical activity. The first is that due to the drop in oil prices in the 1980's, the oil underlying the California Outer Continental Shelf (OCS) has become less economically attractive on the world oil market. Second, public opinion and California's regulatory climate have driven oil companies to more receptive areas and less restrictive governments. Related to this second point was the California State Lands Commission's (SLC) decision in 1987 to require an Environmental Impact Report (EIR) for any future 2-D or 3-D offshore oil related surveys. The survey in 1988 had been permitted in a permit issued prior to SLC's decision.

The environmental and fisheries communities in California are very active and vocal on ocean issues. For example, the American Oceans Campaign, headquartered in Los Angeles, California, and the Pacific Coast Federation of Fishermen's Associations, headquartered in San Francisco, have both objected strenuously to expansion of offshore oil and gas development outside of existing developed areas. In addition, the environmental and fisheries communities have joined with local governments and state and federal elected officials to object to increased oil and gas development within developed areas that they believe are burdened with unmitigated cumulative environmental and social impacts.

Purpose of Survey

The purpose of THUMS' survey was to more accurately delineate oil-bearing strata and fault traps in order to maximize recovery of remaining oil reserves. An overriding concern for the local oil company, however, was their positive image in the Long Beach community, which they established in 1964 and maintained ever since. Another concern was cost, in terms of time and money, of pursuing regulatory permits from a host of public agencies. THUMS' primary objective was to conduct a safe, environmentally sound, cost effective survey while addressing the concerns of the Long Beach Harbor community and agencies. Part of that objective was to address environmental and social impacts with the affected agencies in a way that minimized permitting delays, with as few permits as possible.

Issues/Concerns/Mitigation

Regulatory Agency Concerns

Locally, the City of Long Beach Harbor Department, Marine Bureau and Recreation Department were concerned the survey could adversely affect normal harbor area activities. On the State level, the SLC, California Coastal Commission, and Department of Fish and Game were concerned about environmental impacts and conflicts with fishing activities. The U.S. National Marine Fisheries Service (NMFS) was most concerned with potential effects on marine mammals.

Environmental Concerns

Long Beach Harbor is a valuable habitat for marine life. The calm waters support abundant and diverse fish populations. The breakwaters and harbor waters are used by many species of birds. Sea lions haul out on the breakwaters and buoys.

Early in the planning process, THUMS contracted with Chambers Group Inc. and E J L & Associates to analyze the potential impacts of the seismic survey on marine life. This report was not required by any regulatory agency, but was commissioned by THUMS to help plan the survey to minimize impacts on marine life and to use in discussions with the agencies. The environmental study described marine life in the survey area and reviewed literature on the impacts of sounds from airguns on different kinds of marine organisms. The literature review acknowledged that only a few studies have documented effects of airguns on marine life. The short and long term effects on most species of fish, mammals and birds, especially those in shallow water environments, are largely unknown. Reviewed studies recommended that 1) field measurements to determine the zone of critical concern (area within which marine animals would be disturbed by airgun sounds) be conducted in shallow water environments and 2) further study on different types of shallow water species was necessary to fully understand the impact of geophysical surveys in shallow and nearshore environments.

For logistical reasons, THUMS did not attempt to place hydrophones in the water column to delineate the zone of critical concern. THUMS also believed the short length of the survey and low estimate of impacts did not justify the effort and expense of a field study on impacts on shallow-water species. Timing was critical because impacts on birds, fish and marine mammals were far less in winter than they would be in spring, summer or fall.

The authors were tasked to assess the potential impacts on Long Beach Harbor marine life, based on a reasonable review of the literature and their professional judgement. Evidence from the literature review suggested that physical damage to marine animals from compressed air sources is localized to within a few meters of the sound source. However, behavioral effects could occur over a much larger area. The study concluded that the seismic survey was unlikely to have significant adverse effects on fishes or invertebrate populations in the harbor area. However, any marine mammals or diving birds near the operating airguns might be severely disoriented or disturbed.

Mitigation

In keeping with THUMS' goal of incorporating environmental protection into the survey design, prior to completion of the environmental report the plan specified that the minimum size airgun array be used. Survey designers incorporated airguns which focus the energy down into the water column to limit the spread of sound in the horizontal plane. THUMS and NMFS agreed to a site monitoring observation program, based on the conclusions and recommendations of the environmental report. Program guidelines included 1) presenting a marine mammal awareness training program to all survey personnel, 2) having a marine mammal observer on board while the airguns were operating to warn the source boat to stop operations if a marine mammal came within 50 meters of the array (1.2 kilometers for gray whale), and 3) conducting the survey only during daylight hours.

Potential Conflicts with Harbor Traffic

The ports of Los Angeles and Long Beach immediately west of the survey area are major shipping areas, in fact, Long Beach Harbor is the busiest harbor in the United States, based on tonnage. In addition, the waters in the survey area are used extensively by Catalina Island passenger carriers, several tug and barge companies, sail boat races and other recreational boaters.

Interactions with Fishermen and Other Harbor Users

A live bait fishery for northern anchovy occurs within the breakwater. Crab and lobster are fished by trap just outside the breakwater. Recreational fishing from shore and by small boats occurs within the survey area. The shoreline within the survey area includes a pier, a heavily used beach and the tourist attractions of the Queen Mary and Shoreline Village. Harbor marinas are home to many who live aboard their boats. The survey area is visible from a number of high rise residences along the coast.

Mitigation

To address social concerns and clarify survey objectives and procedures, THUMS put as much effort into its community relations planning and implementation as it did its environmental program. It notified the agencies in advance of the survey and provided the environmental report for their review. The CCC ruled a permit was not required, based on the mitigation measures previously agreed to by THUMS, and SLC was comfortable with the survey design and did not raise concerns. The local agencies concurred that the survey could be run and the survey would not adversely affect normal harbor area activities.

A crucial aspect of the survey project was cooperating with the Port of Long Beach and Los Angeles/Long Beach Harbor Marine Exchange to coordinate operations with arrivals, departures and anchorage's of large tankers and freighters. This was no easy task and required direct communications between THUMS and port operators. In addition, THUMS contracted with the Long Beach Marine Patrol for a Lifeguard boat and crew to patrol the waters around the source boat during airgun operations.

Public officials, harbor businesses, and residents were also given plenty of advance notice. Thousands of informational letters were mailed to boat owners who berthed their boats in one of the Long Beach marinas. Special attention was given to those that lived aboard their boats. A survey notice was run in the Long Beach area sailing newsletter. THUMS mailed letters to about 75 harbor-area businesses involved in boating, skiing and other water activities, in an effort to reach many other people who engage in recreational activities in the harbor.

Political leaders, including U.S. Senators from California and those Congressional and State representatives from local districts received letters. In fact, oil field managers met personally with City of Long Beach council members and the mayor to explain the survey and measures taken to ensure minimal impacts. About 500 informational letters were mailed to Long Beach area public opinion leaders, as well.

Special consideration was given to commercial crab and lobster fishing activities. Accepted State and federal procedures were followed to notify key fishing and agency representatives locally and throughout the State of the impending survey. This notification requested comments from the notice recipients and was in addition to noticing the survey in the U.S. Coast Guard Local Notice to Mariners. No comments were received.

Results/Conclusion

THUMS' foresight and extensive planning ensured successful completion of the survey with minimal interactions with marine life and other harbor users. THUMS is to be credited for its environmental awareness and community outreach efforts, because without its proactive attitude and support the consultants which helped THUMS implement its program would have been less effective in fulfilling their responsibilities. THUMS encouraged the consultants to work as a team to help them meet the purpose of the survey.

Environmental Program Results. THUMS conducted its survey with minimal disruption to the natural environment. Survey operators adhered strictly to all measures designed to protect marine mammals. Dr. Davis, the marine mammal observer, spotted three marine mammal sightings, two California sea lions and one rare sighting of a northern fur seal during the survey. One sea lion approached the air gun array when the guns were operating. The source boat immediately shut down operation of the airguns until the sea lion left the area.

The question left unanswered was whether the survey actually caused harm to marine life. Because no field measurements or studies were conducted we still do not know the extent of the zone of critical concern nor do we know how shallow water fish are affected, if at all, by sounds from airguns. Although we are no closer to knowing the answers to those questions, we have a little more information on the effects of surveys on birds. Dr. Davis observed that a Brandt's cormorant, western gull, loon, and western grebes, whether sitting on the water or diving, showed no visible reaction to the operating airguns. The birds were anywhere from about 35 feet to 350 feet from the array.

Community Coordination Program Results

Very little conflict between the survey operations and other harbor users occurred. Most boaters were extremely cooperative and lifeguards chased a boat out of the survey area on only one occasion. Not once during the survey was normal shipping activity interrupted.

The only serious conflict during the survey was a shouting match between a lobster fisherman and survey operators. In spite of the notices, the area just outside the breakwater was peppered with lobster traps. THUMS knew the survey was being conducted during lobster season and had prepared for potential conflicts. It instructed the survey crews to avoid the traps as much as possible. Apparently, judging from the fisherman's reaction, one or more traps were possibly fouled by a survey boat. However, this fisherman did not follow up with THUMS to seek compensation for his losses.

THUMS immediate response to the incident was to have Ms. Laychak present on the marine mammal observer boat while the crew completed the portion of the survey outside the breakwater. No other on-site encounters occurred during the survey.

Another fisherman contacted the survey project manager, George Otott (Chief Geologist, THUMS) and requested compensation for a few traps. He claimed the crew moved some of his traps and cut the lines on one or two others. Otott followed up by questioning the crew chief and lifeguards. Their response was that no traps were moved nor were lines cut. Because he was faced with choosing between opposing positions, Otott decided to pay for the alleged losses, rather than risk future ill will with the fishing fleet.

In conclusion, THUMS spent a lot of time, money and effort to conduct the seismic survey. Without this extensive effort many serious conflicts would have undoubtedly occurred. If for instance, the public was not adequately notified, the survey could have been protested to such an extent, that THUMS may have stopped the survey. If the survey was not conducted during winter, impacts on marine life would have been far greater. If the agencies had not had the opportunity to review the environmental report the CCC may have required a permit or NMFS may have stopped the survey.

Along with the negative incentives to coordinate and plan with the other interested parties, an important positive incentive, from THUMS' perspective, was that Otott and others implemented the program, from planning to implementation, the way they thought was best for their operations. They hired consultants who had thorough knowledge of the local environment, literature and agency processes. This way they addressed the concerns head on and early in the process so that the project was revised in the planning stage and was completed on time and within the budget.

Eugenia Laychak
California Center for Public Dispute Resolution
P.O. Box 162696
Sacramento, CA, USA 95816

Ph (916) 444-2161
Fax (916) 444-2162
Email 73130.3271@compuserve.com

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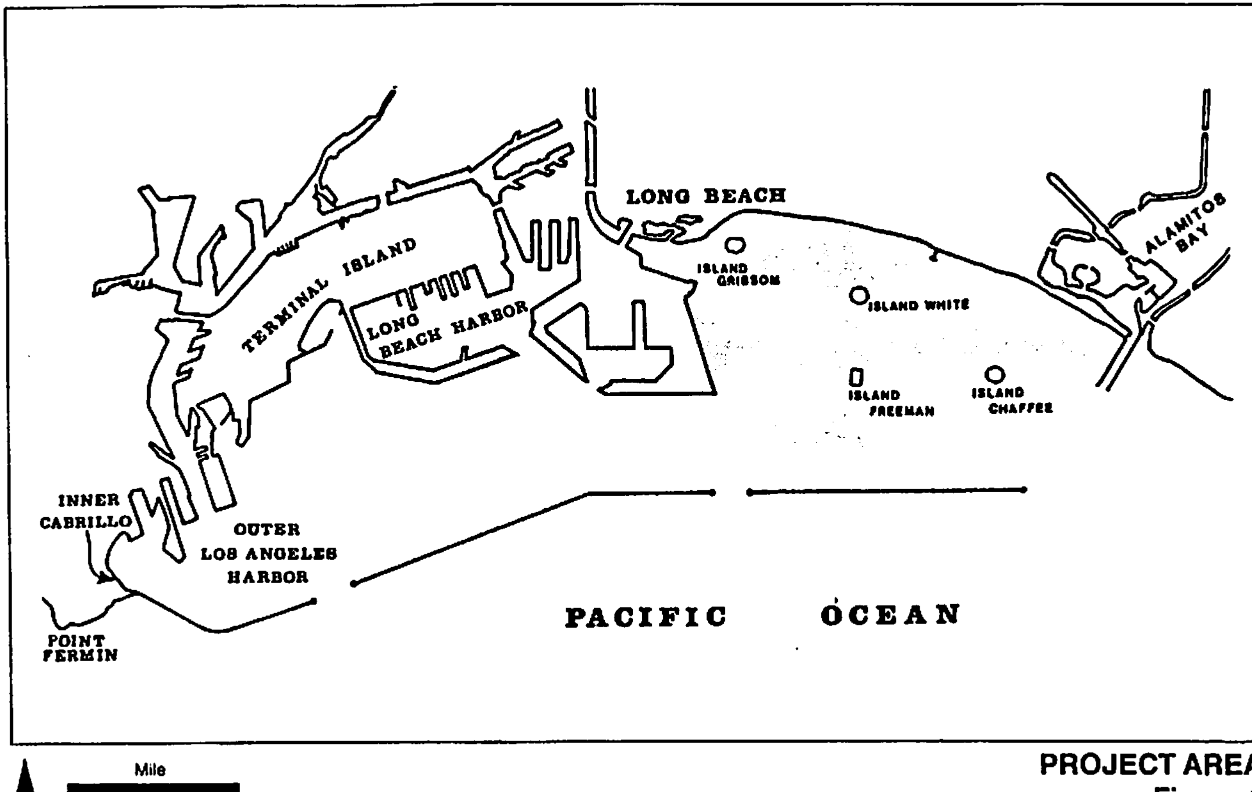
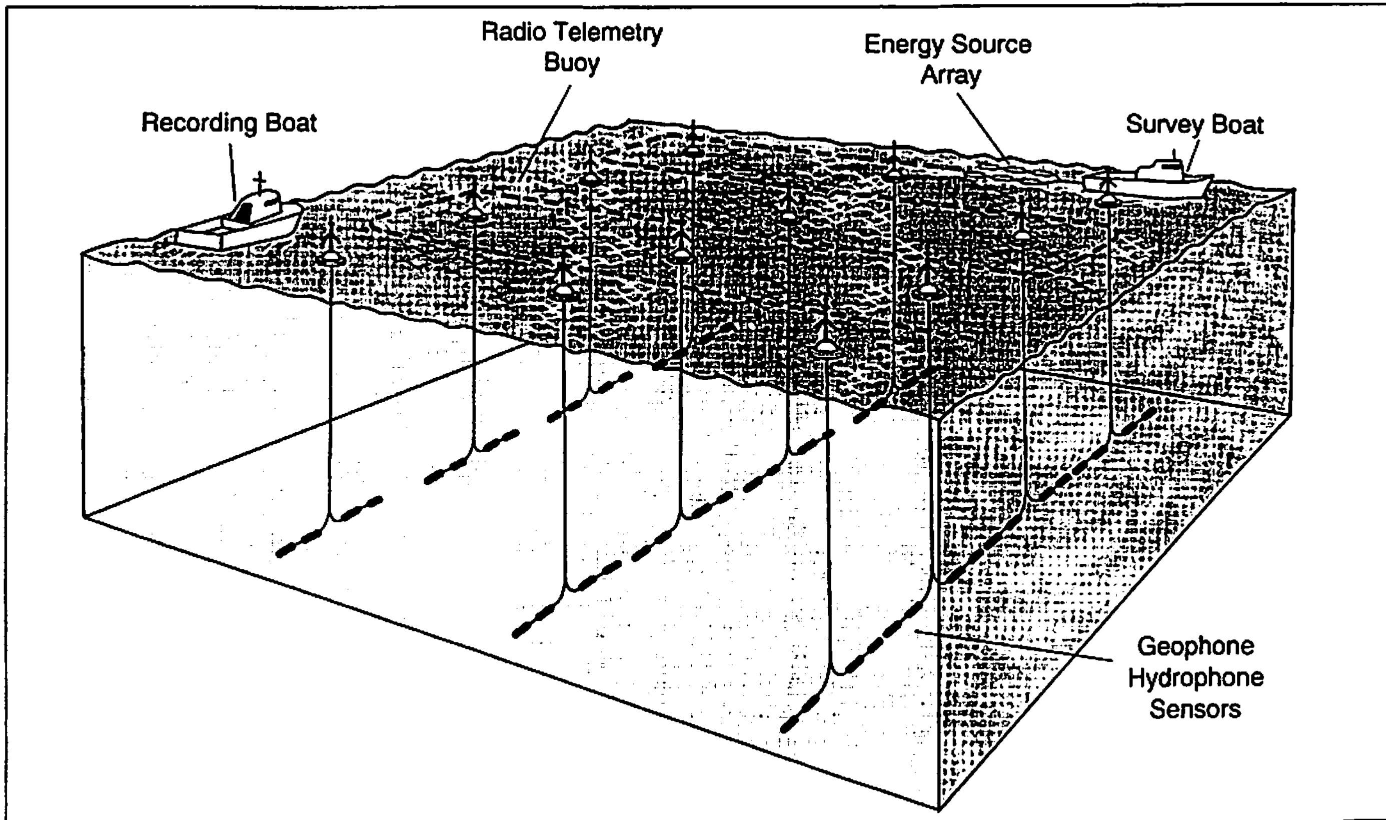


Base Map Source: Straughan and Patterson, 1975

PROJECT AREA
Figure 1



SURVEY ARRAY
Figure 2

PRESENT USE VALUE TAXATION: A POSSIBLE MECHANISM TO IMPLEMENT THE AGRICULTURAL MANAGEMENT MEASURES REQUIRED BY THE COASTAL NONPOINT POLLUTION CONTROL PROGRAM[1]

Bonnie Nobori, University of North Carolina at Chapel Hill and
Lisa C. Huff, North Carolina Division of Coastal Management

Introduction

As a result of the 1990 Coastal Zone Act Reauthorization Amendments (CZARA), coastal states now bear the responsibility of controlling nonpoint sources of pollution through a combination of enforceable policies and voluntary programs. In North Carolina (N.C.), agriculture is the second largest land use by area. Agriculture produces a substantial amount of nonpoint pollution in the form of nutrients and sediments -- two pollutants that require control under the Coastal Nonpoint Pollution Control Program (CZARA, Section 6217), and the two most troublesome pollutants in fresh and estuarine waters in N.C. Agriculture is exempted from the requirements of the N.C. Sedimentation Pollution Control Act, and no requirement exists for nutrient management on farms engaged in row crop production. For most confined animal facilities, nutrient management requirements are limited to applying animal waste at agronomic rates. Commercially supplied nutrients thus evade scrutiny on row crop farms and at confined animal facilities.

Given a tradition of unwillingness to impose regulation on the agricultural community, the Division of Coastal Management is seeking means to modify existing programs and mechanisms to significantly reduce runoff of sediments and nutrients from agricultural land. One possible mechanism is the state's Use Value Assessment program.

Use Value Assessment (UVA) is a form of preferential tax treatment of land engaged in agricultural, horticultural, and/or forestry activities. It allows eligible private property to be assessed and taxed according to the value of its current use, rather than at the market value of the same land in alternative, more profitable uses. This paper examines the feasibility of modifying North Carolina's UVA program to provide an economic and quasi-regulatory incentive for the implementation of agricultural best

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management practices (BMPs). The mechanism examined is the use value requirement that qualifying property must be under a "sound management program." Since many states have similar preferential tax treatment programs for farm and forest land, this mechanism may be of broad interest. Discussion will be limited to agricultural land.

Use Value - What It Is?

The UVA program was passed by the North Carolina General Assembly in 1973 as the Farmland Taxation Act and codified at Chapter 105, Section 277.2 through 277.7 of the North Carolina General Statutes. To be eligible for UVA, private property must be engaged in agriculture, horticulture, and/or forestry uses. Eligibility for UVA also includes specific, but lenient, requirements regarding ownership and residency, minimum acreage in productive use, and minimum annual income from the land use. For example, agricultural land parcels meeting ownership requirements may consist of one or more tracts. At least one tract must have ten acres in active production and the average gross income must have been at least $1,000 per year for the preceding three years. Additionally, "each tract must be under a sound management program" (G.S. 105-277.2(1)-(3)) such that the "greatest net return from the land is consistent with its conservation and its long term improvement" (G.S. 105-277.2(7)). When one tract receives UVA status, the same landowner can include other properties that would not otherwise qualify. That is, the initial determination of UVA for the first tract is based upon eligibility of the land and the landowner, whereas the eligibility of all subsequent tracts is based upon the landowner's UVA status. It is acceptable for a landowner to receive UVA if the qualifying tract is under production by a tenant farmer or someone else.

Once a tract of farm land is formally on the UVA rolls, the land owner is taxed at the assessed value of the land's estimated present farm uses. This assessment will be less than an assessment derived through market valuation of the same land. Present use value is not, however, determined from a calculation of actual income from farming activities on that land. Instead, it is typically calculated using a recommended rate schedule that is based upon estimates of soil productivity. The soil productivity rating for a given UVA tract is assigned according to the soil type and the corresponding estimate of net income that would be derived from that soil if soybeans and corn were grown on it. Since future commodities prices cannot be known, a price-per-acre estimate is taken by averaging the net income from soybeans and corn for the last ten years. A new recommended use value schedule based upon soil type has been published every year pursuant to the requirements of G.S. 105-277.4 and 105-317. The schedule is produced by a Use Value Advisory Board (UVAB) and is provided to all county tax assessors. It serves as an attempt to standardize farm use valuation methods throughout the one hundred counties in North Carolina.

For each parcel of land eligible for use value assessment, the county tax assessor must identify the underlying soil type, then cross-reference it to the corresponding per-acre income estimate for that soil type throughout that county. That estimate is divided by the legislated capitalization rate of nine percent. The result is the present use value (see Equation 1). Present use value is then multiplied by the current county property tax rate (usually less than $1.00 of tax assessed per $1,000.00 of property value) in order to determine the amount of taxes due from a use value parcel. For each year that the land remains under UVA, the difference between the UVA and a market value assessment equals the amount of tax deferred (see Equations 2 and 3). Deferred tax is due only if the landowner takes the UVA-qualifying land out of farm uses. In addition, if the landowner keeps the same farm parcel under use value for four or more years, some of the deferred taxes are forgiven entirely and are no longer subject to eventual repayment.

EQUATION 1: Present Use Value Tax = [Use Value Assessment / Capitalization Rate at 0.09] x [County Tax Rate (i.e., tax per $1,000 of value)]

EQUATION 2: Total Tax Due = [Market Value Assessment] x [County Tax Rate]

EQUATION 3: Deferred Tax = [Total Tax Due] - [Present Use Value Tax]

For each consecutive year a property qualifies for UVA, a farmer can defer a portion of the property tax. As soon as the farmer sells that land for non-farm uses, or removes the land from the UVA tax roll, the deferred tax becomes due immediately. In tax terms, the tax ledgers are "rolled back" to recapture the deferred taxes resulting from the land's former use value status. If the property received UVA deferrals for no more than three full years plus a portion of the current calendar year, then the entire deferred amount is due, in addition to a ten percent interest penalty. However, if the property was assessed under UVA for four or more consecutive years, the landowner owes taxes for only the last three full years, plus a portion of the current year. All back taxes prior to that period are forgiven and handled as a pure tax exemption. For example, if a landowner sold UVA land for non-farm use on January 31, 1996 after receiving continuous UVA tax deferrals since January 1, 1989, the difference between the market value assessment and the UVA for each year from 1989 through 1992 is the amount of tax forgiven.

Tax Advantages of the Use Value Assessment

The tax advantages of UVA come in two forms: tax deferral and outright tax exemption. The benefits from deferral versus exemption are a function of: the difference between use value and market value each year; the length of time the property has received UVA; and the total number of acres receiving UVA. Since each county is required by law to undergo a complete revaluation (an update in appraisal of market values) of properties only once every eight years, the time period immediately following a revaluation will tend to coincide with the greatest MV/UV ratio for a given eight-year period. Thus, application for and benefits from UVA will likely occur during the same time period. In general, the more acres of land a farmer can get under use value, the greater the tax benefits he/she accrues. In addition, anything that decreases UV and/or increases MV relative to the other will increase the tax deferral advantages to farmers who have land enrolled in UVA. As the time period over which a farm receives UVA increases, the ratio of tax exemptions to tax deferral also increases. Both tax deferrals and tax exemptions can represent a significant amount in actual savings to an individual farmer.

Role of UVA in Determining County Tax Rates

Property taxes represent a major source of funding for counties. Each year the commissioners from each county approve a budget for the coming fiscal year. The county tax assessor is responsible for financing that estimated budget. First the assessor determines the value of all property that is assessed at market value. To that he/she adds the assessed use values of all UVA-eligible properties plus revenues from other tax sources. The assessor divides the projected annual county budget by the assessed values of all properties within the county to get the county-wide property tax rate for that year. Since a county's yearly budgetary requirements are usually just a fraction of the property value base, a county's tax rate is represented as the tax (usually less than $1.00 per $1,000) of property value. For example:

County Tax Rate (i.e., tax per $1,000 value) = Projected Budget for 1996 / [(Value of land assessed at market value) + ((Value of lands assessed at use value) x $1,000) + (other tax sources)]

Changing the Use Value Assessment to Provide Economic Incentives for Best Management Practices

Modifying the UVA program in order to provide incentives for farmers to implement BMPs must be done with care. A primary reason for enacting the UVA program was to provide farmers with an incentive to keep their land in farm uses. Many argue that a preferential tax treatment is justified, because the income from traditional types of farming is generally modest compared to the income that can be derived from urban, commercial, and industrial uses of land. Any change to the UVA program must ensure that farmers will continue to take advantage of the preferential tax and not transfer their farm land to other market uses.

Several potential changes to the UVA are under examination, but most of them are quite complicated. Some would involve legislative amendments to the act, decreasing the likelihood of a favorable outcome. Yet, another póssibility for meaningful changes exists based on the UVA requirement that qualifying land must be under a "sound management program."

According to Chapter 105, Section 277.2(7) of the N.C. General Statutes, a "sound management program" consists of "a program of production designed to obtain the greatest net return from the land consistent with its conservation and long-term improvement." Although "conservation" and "long-term improvement" may seem consistent with environmental protection goals, they traditionally have been interpreted by the agricultural community to relate to agricultural productivity. Productivity-based definitions of conservation are rooted in the "Progressive Conservation" movement popular during President Theodore Roosevelt's administration. This movement emphasized the exploitation of natural resources to maximize economic efficiency and "conserve" waste. A contrasting philosophy was "preservationism" championed by John Muir, which recognized that natural resources possessed non-market values and deserved preservation in perpetuity.

These philosophies indicate that a farmer typically approaches erosion control with a goal of optimizing income (i.e., maximizing productivity (assuming no subsidies) to produce at less-than-maximum yield). However, the environmental manager approaches erosion control with the goals of decreasing sedimentation, nutrient loading, and pesticide runoff, in order to mitigate the effects of overall surface water impairment, in particular, algal blooms, fish kills, increased treatment of drinking water, destruction of commercial finfish and shellfish nurseries in adjoining estuaries, etc.

To modify the UVA to encourage management practices that protect off-farm resources in addition to short-term farm yields, the UVA tax incentive should be based as much upon environmental protection as upon agricultural productivity. This could be accomplished by interpreting the existing "sound management program" provision as the long term conservation of all natural resources. The key, however, is to expand the definition of natural resources conservation in the minds and practices of the farming community, to include a scientifically and ecologically meaningful method of environmental accounting. This accounting for farm management practices would promote the conservation of off-farm private resources and public trust resources, in addition to resource uses and values of short-term agricultural productivity. Sound management based on ecological concerns would also sustain the long-term viability of the farm system. Including environmental considerations as part of the UVA sound management program would also provide a pollution prevention approach.

Why Off-Farm Environmental Impacts Should Be Included in an Environmental Accounting System

A large portion of the annual budgetary requirements of each county is met through revenue collected, and property taxes are a major source of revenue. When one class of landowners is accorded property tax benefits through a preferential property assessment program, the unpaid portion of the total tax bill must be made up by the remaining landowners. The tax burden shifts away from the farming community onto the non-farming taxpayers within each county. Although the tax shift takes the form of a relatively higher tax rate imposed upon everyone, including farmers, it results in a disproportionately higher tax bill upon those property owners whose land is not under UVA. The following are offered as reasons for modifying the UVA sound management program requirements:

1) Internalizing costs is legitimate in terms of social equity (tax shift). It is important to account for environmental effects of farming beyond the farm, and to integrate these effects into farm subsidy programs like the UVA. It is also essential to recognize the impacts of farming on both public trust resources and private interests. When farming activities generate pollution downstream, someone other than the farmer will likely suffer the negative effects (e.g., in the form of reduced commercial income or recreational opportunities resulting from water quality impairment). This loss, though real to society as a whole, is external to what the individual farmer incurs directly in farm production costs. The externalized costs of natural resource damage from sedimentation, pesticides, and nutrient loading, underrepresent the true costs to society in comparison to the social benefits of farming.

The theory behind tax relief to certain activities assumes that the tax exempt class somehow provides a net social benefit warranting special tax treatment. This is also the rationale for giving exclusive tax exemptions to churches, charities and public service organizations. The existence of the UVA implies that agriculture produces a net benefit to society beyond that provided by other non-exempt activities. Therefore, the non-exempt (non-farming) community accepts the additional tax burden to subsidize this activity, in the amount of the tax shift. Without internalizing and quantifying the costs of pollution and other social costs of farming, the non-farming community must absorb an additional tax burden from UVA and other farm subsidy programs. As a result a net social benefit is assumed while simultaneously paying the real, tangible costs of pollution generated by farms.

2) Increasing farmer responsibility for the externalities caused by their pollution will allow the state to develop pollution mitigation strategies. The utility of internalizing the net environmental costs of farming has bearing beyond the issue of tax policy. Accounting for environmental externalities

holds the promise of creating effective pollution abatement strategies for nonpoint sources in general. Without accounting for off-farm environmental impacts and overall social costs, it would be impossible to determine whether targeting pollution prevention programs at farms would provide a cost-effective method for mitigating common pollutants. Inefficient or ineffective pollution controls could result without a method to quantify the relative effect farms have on water quality impairment in coastal North Carolina. Without an accurate accounting system to measure pollution control strategies, there would be no way to appeal to government regulators for more efficient solutions.

3) If environmental effects are not internalized, it is impossible to justify additional tax exemptions based on the argument of social benefits and economic efficiency. Policy-makers must have a legitimate basis to evaluate whether existing tax subsidies are sufficient to provide adequate incentives to farmers and to maximize social benefits. This basis will become more important in March, 1996, when a new state statute requiring cost-benefit analysis of new regulations or changes to existing regulations takes effect. An ideal sound management program should include the otherwise externalized costs of pollution generated as a byproduct of the farming process. By internalizing costs, the farmer, the tax assessor, the environmental manager, the non-farm community, and everyone downstream of the farm will get a realistic estimate of the present use value of farming. Subsequently, the farmer can manage for "the greatest net return from the land consistent with its conservation and long-term improvement." By definition, "greatest net return" includes total social returns and not solely individual return or profit.

Sound Management Program Requirement - No Compliance Oversight

Presently, no standard method exists between counties, or within one county from year to year, to evaluate the validity of a farmer's "sound management program." As the UVA program currently operates, the farmer, once meeting all other eligibility requirements, must only declare that the farm is under sound management. It is the responsibility of the county tax assessor's office to review the UVA application and determine if the tract qualifies for UVA. Whereas some county assessors require a written proposal for management of the land, others rely on mere affirmation by the applicant that a sound management program has been developed and implemented. This method leaves the interpretation of a sound management plan to the individual farmer who, in the absence of anyone to review the plan or monitor its implementation, has little incentive to spend time or money on a plan, as long as he or she can still qualify for UVA. Even if the tax assessor has the time to review a management plan, the assessor cannot be expected to have the background and expertise necessary to evaluate a management plan for agriculture. Furthermore, no motivation or requirement exists to monitor the landowner after enrollment in the UVA program to determine whether the management plan has been implemented and carried out correctly.

Some Recommendations On What the Sound Management Program Should Contain

Catastrophic events were highly visible in North Carolina river basins in 1995, including: waste spills, fish kills, algal blooms, outbreaks of toxic dinoflagellates, and large regions of hypoxia and anoxia. As a result, great attention is being given to finding solutions to nutrient loading resulting from nonpoint sources. Currently, several commissions appointed by the governor are studying means to increase the state's oversight of agricultural nutrient sources.

The following is a proposal of how the current "sound management plan" definition could be implemented with the objective of protecting natural resources and providing for the long-term improvement and conservation of farmland. State environmental managers - particularly for the coastal counties - would require a formal plan containing specific elements, including a comprehensive, integrated program of BMPs on all tracts for which UVA is requested. The specifications of the implementation and maintenance of appropriate BMPs within the plan would include (but not be limited to) the following. They would have as their priority the reduction of high priority pollutants within the watershed where the land is located. Specifications should be site-specific for each tract within a farm parcel. After a new parcel has been admitted into UVA and a designated minimum time period has elapsed, continuation of use value benefits would be contingent upon the progress made in implementing the list of BMPs proposed in the sound management program.

Currently, local Agricultural Extension Service agents, district soil and water conservationists, and North Carolina Agricultural Cost Share Program (ACSP) technicians are charged with providing technical assistance for accepted agricultural best management practices. Although these individuals are familiar with the technical issues relating to implementation and maintenance of BMPs, additional personnel and funding would be needed to certify, monitor, and enforce the implementation of sound management plans. However, it is not beyond their current list of job responsibilities to assist a farmer in developing a sound management program to qualify for UVA. In fact, UVA sound management planning might be accomplished through the certification of some other already-required farm plan which currently falls under the purview of these technical specialists. Furthermore, in 1997, after all large confined animal facilities have met requirements for registration and certification of their operations, many technical specialists will have more time to focus on general issues of farm conservation and pollution prevention.

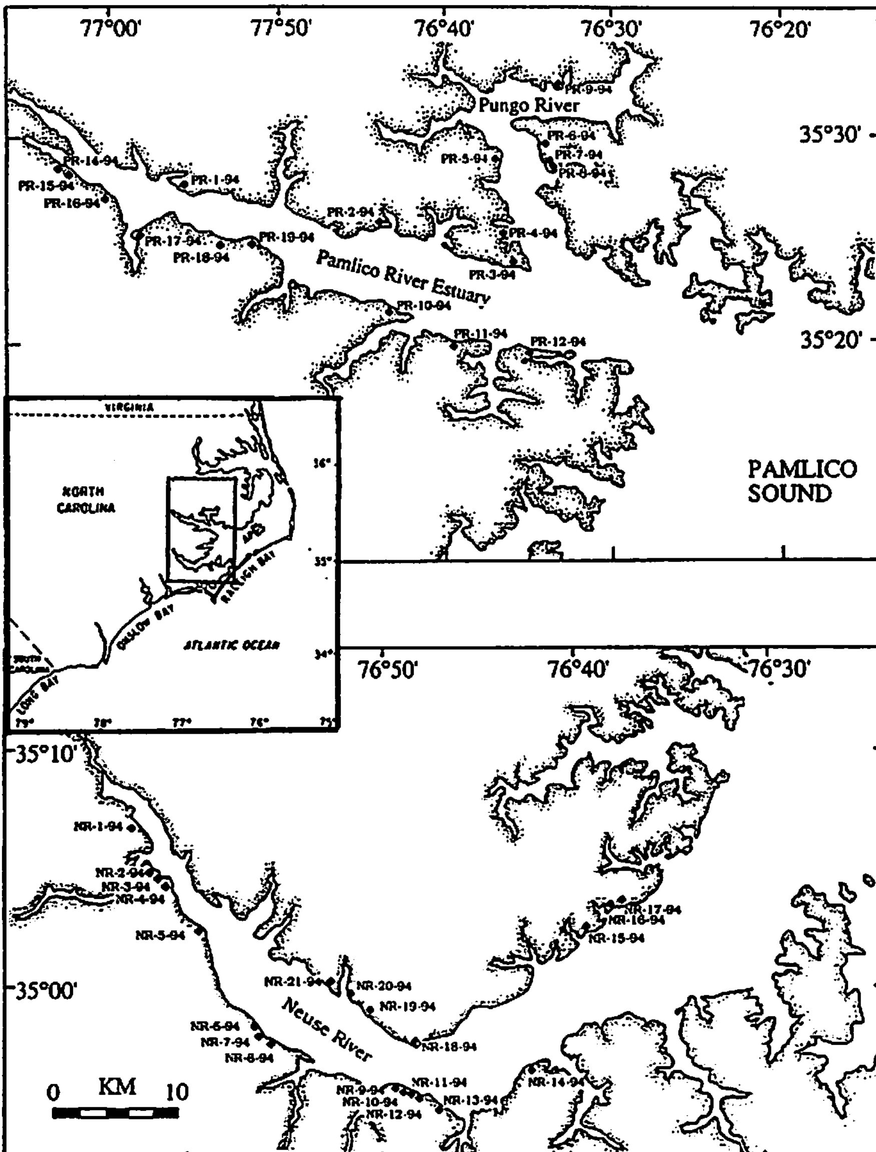
One alternative to the incorporation of UVA sound management plans into an existing farm planning/oversight program, would be to allow private, certified consultants to develop the sound management plans. The State's technical responsibility would consist of: (1) providing the basic criteria required in a sound management plan, and providing spot-check monitoring of the certified planners and plan implementation to ensure responsible conduct, technical expertise, and quality control, and (2) certifying the qualifications of the individuals who develop the plans.

Enforcement of plan implementation could be handled in a tiered approach, similar to current pollution control programs. Currently, technical specialists do everything possible to encourage a farmer to comply with requirements or recommendations. If sound management programs were a requirement and a farmer was found out of compliance with a the program, the technical specialist would exhaust all means of gaining compliance before reporting the farmer to state water quality officials. The water quality officials would then try to get the farmer to comply with the sound management requirements. If the farmer continued to resist, the state water agency would report the farmer to the county tax assessor's office and the farmer would lose UVA benefits and pay deferred taxes.

The proposed modification of the UVA program would remove the evaluation of both pollution control strategies and agricultural productivity from the county tax assessor's list of responsibilities. Furthermore, consistency in following the "sound management program" requirement would be increased. From a public policy perspective, this proposal has the potential to be an effective and relatively cost-effective way to improve the administration of the UVA program. It further provides a way to reduce the effects of agricultural runoff on the fresh and estuarine waters of North Carolina, while placing the true costs pollution in the hands of those responsible for it.

Lisa C. Huff
Coastal Nonpoint Pollution Control Program
N.C. Division of Coastal Management
P.O. Box 27687
Raleigh, NC, USA 27611-7687

Ph (919) 733-2293
Fax (919) 733-1495



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Pungo River
Pamlico River Estuary
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ONSLOW BAY
RALEIGH BAY
LONG BAY
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Session J4: Conflict Resolution
Session Chair: Michael Eng, Mediator/Facilitator/Trainer

CREATING A BETTER PROCESS TO RESOLVE ENVIRONMENTAL DISPUTES: ALTERNATIVE DISPUTE RESOLUTION

Cotton Harness,
Ogletree, Deakins, Nash, Smoak & Stewart, L.L.P.

We all have a common desire to protect the environment, but it has become increasingly apparent that the command and control approach to environmental regulation is too expensive, too time consuming and too divisive. This is not to say that the reams of regulations have not brought conclusion to our air quality, water quality and land management, but as Phillip Howard, the author of the "Death of Common Sense" so eloquently points out:

> Increasingly, law makes us feel like victims. We direct our energies into defensive measures designed solely to avoid tripping over rules that seem to exist only because someone put them there. [Our environmental regulatory] law has fostered a culture of resistance.[1]

The fallout of current regulatory methods has rendered the most inventive country in the world paralyzed in more creatively dealing with environmental protection. Instead of fostering cooperation, our laws have left us in an adversarial mode that does not efficiently lead to a cleaner environment, but surely has created disrespect for law. Most recently, it has shown up in the form of the Wise Use Movement and political efforts to derail environmental laws passed during the 1970s and 1980s.

While Alternative Dispute Resolution (ADR) cannot be looked to as a cure to this unhealthy state of affairs, there is no question that the use of a more cooperative means of resolving public/private conflict would go a long way to change the culture of resistance. That is not to say that standards of environmental protection would be sacrificed, but that we could, in a more open productive dialogue, determine how we, as a culture, can more efficiently and creatively deal with clean up and preservation.

Recognizing the inefficiency of our agencies and courts to deal with environmental conflict, and also cognizant of the psychological fallout from the "Just Say No" approach to regulation, both the federal and state governments are beginning to turn to ADR as a way to deal with disputes. Beginning in 1986, Congress provided for use of environmental ADR with the amendment of CERCLA. EPA has since then followed with various pilot project programs to employ the use of ADR together with policy changes that increase the opportunity of avoiding court.[2]

Before 1990, disputing parties who reached settlement faced uncertainty about the constitutionality of ADR settlements and enforcement, since these settlements were reached outside of the court system.[3] In 1990, the uncertainty was remedied by the passage of the Administrative Dispute Resolution Act which expressly authorized and encouraged the use of ADR by federal agencies.[4]

Even though the passage of the Alternative Dispute Resolution Act authorized the application of such dispute resolution techniques as mediation and arbitration, it has still remained under-utilized. Thus, despite the fact that mediation, arbitration and other dispute resolution techniques have been employed in a variety of complex legal matters with an astounding settlement rate and a high degree of party satisfaction, it appears that there are certain institutional biases working against a process that is more cooperative.

Environmental Dispute Resolution Methods

There are a variety of approaches to allow parties to reach mutually acceptable resolution of issues in environmental disputes, including policy dialogues, regulatory negotiation, facilitation, mediation, fact finding, mini trial, and arbitration. These methods may be described as follows:

1. Policy Dialogues: In this process, a neutral third party facilitates meetings with individuals and/or groups representing different perspectives. The group debates technical and scientific information and attempts to identify areas of common ground on policy issues. This is typically done by government agencies prior to formulating policies.

2. Regulatory Negotiation: This is generally a facilitated process begun by a regulatory agency seeking to reach consensus among affected interests on major elements of a proposed rule. Typically, it is open to the public and it can be conducted within the administrative procedures framework.

3. Facilitation: In this process, a neutral third party assists in a collaborative process in which individuals seek to reach consensus to solve a problem. The neutral third party helps set agendas, assists in productive communication, encourages participation and keeps a record of the proceedings.

4. Mediation: In this process, a third neutral party facilitates communication between the parties to resolve a dispute. It is a confidential structured negotiation process that helps parties identify issues and problem solve.

5. Fact Finding: In this process, there is a formal proceeding where a third party evaluates factual matters presented by parties and files a non-binding report establishing the facts. This may be the basis for negotiation or assistance in development of policy.

6. Mini Trial: In this process, a third party or parties preside over an abbreviated summary of the case given by the disputing parties. The neutral third party or parties make a non-binding decision or give an advisory opinion.

7. Arbitration: In this process, a neutral third party or parties hear the presentation of facts and arguments by the parties and then review the evidence and render a decision. The decision can be binding or non-binding. This is similar to a court process, except that it is more flexible, less formal, and allows the parties more control over the method of trial and confidentiality.

8. Collaborative Community Process: This process is aimed at building consensus through structured negotiation or to develop shared vision and solve discreet problems. This is typically a large group process that draws upon the facilitator that uses techniques such as focus groups, strategic planning, facilitated community meetings and special task force groups.[5]

Examples of ADR Methods in Environmental Matters

The Sheridan Mediation

The City of Sheridan, Wyoming, was cited for violating the Safe Drinking Water Act by supplying 110 households with untreated water. The City challenged the health impact of the violation and EPA had no success in coming to resolving enforcement matters with the City. After seven years of negation, mediation was applied to the situation. Through this process, the City resolved the original issue of contaminated water and the larger problem of providing cleaning and adequate water supply for the County. A further byproduct of the mediation was the issue of a joint powers board to help the city and county developers manage a new water supply project.

Forest Services Negotiated Appeals Process

Despite the Forest Services' best efforts, by the late 1980's, it found itself faced with an escalating number of forest plan appeals. Virtually every plan in the country was appealed and by the end of the fiscal year 1988, there were 830 unresolved cases pending. By way of Executive Order, the Agency was mandated to review its appeals regulations and, as a result, a new regulation 36 C.F.R. 217.12 was implemented giving the deciding officer authority to encourage negotiations between the parties. Contrary to many theories, including those of the Forest Service personnel, the

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Florida Growth Management Conflict Resolution Consortium

This organization is funded partly by the Florida legislature and has acted as a catalyst for use of alternative dispute resolution in a variety of environmental and land use matters. Among other successfully mediated matters, the organization helped resolve an environmental dispute regarding a resources recovery facility in a southeastern urban Florida county. The facility was originally designed, constructed and operated by a company the same nay saying that occurred in the late 1970's and early 1980's when ADR began to gain acceptance in other areas of conflict.

Alternative dispute resolution is coming of age, but will require continued education and insistence upon the part of the public and private entities faced with environmental regulation to make use of it. However, in order to proceed in an organized fashion, rather than relying upon ad hoc application of ADR methods to individual cases, the following steps should be taken by governmental entities to systematically employ ADR. There are ten identified steps to creating successful ADR programs in the governmental sector. These steps are as follows:

1. Policy Commitment: Management must commit itself to employing ADR where it is useful. Organizations such as the Coastal Society that provide support for regulators should make concerted efforts to educate upper governmental management about the value of ADR. Once managers are convinced of its value and understand that it does not mean that they will divest themselves of control over management, the road is then paved for implementation of a program.

2. Needs Assessment: The government entity should complete a needs assessment to determine the reasons, if any, for implementing an ADR program. There should be a determination of where ADR can save cost and time, where current conflict is affecting the management process, and finally, whether the government entity is prepared to invest the time and energy toward shared responsibility for problem solving and thus, alter the old command and control approach to management.

3. Program Design: If the survey develops a justified need for implementation of alternative dispute resolution mechanisms, the government entity must then decide how a program should be designed. The ADR program could range from an educational process that fosters awareness of ADR procedures to a full scale ADR program that includes the use of mediation, arbitration, etc. There must be a careful examination and weighing of the advantages of each dispute resolution mechanism and thereby supporting a choice of the nature of the program.

4. Education and Training: Once a design is chosen, the most critical element of implementation of a program is education of the manager/regulators in-house as well as a public education of program to support a buy-in by the regulated community. Like any new system, ADR cannot be effectively employed without a thorough understanding of its value and how it works.

5. Identity of Neutrals: Identify the neutrals that will assist in implementation of the program, determine how they will be paid and coordinate this with the private sector. Some of the agencies have selected

to employ voluntary neutrals. An example of this is the current effort on the part of the EEOC to employ voluntary mediators in their efforts to reduce the enormous backlog of discrimination charges. However, the better way in which to implement a program is to develop a shared cost program similar to what is used by the Florida consortium.

6. Maximize the Incentives to Use ADR: An entity implementing ADR should consider what behavior that the Agency wishes to reward. The Agency should create in-house incentives and provide incentives for the private sector to use ADR.

7. Begin Small: The entity launching an ADR program should begin with a pilot project. EPA has used pilot projects with great success and this allowed more control over the methods applied. Equally important, a small, focused program is far more likely to result in success than a project that is too large to manage.

8. Keep a Record of Results. It is very important to determine whether or not the ADR program is succeeding. Among those measures to review would be efficiency, effectiveness and customer satisfaction.

9. Remain Patient. ADR represents a significant change in consciousness. As such, it takes a program director who is committed to changing the agency culture. This represents giving up control for a more cooperative model of dispute resolution. Given that ADR remains relatively new and is an unknown commodity, the agency should be very patient in its implementation and application.

10. Continue to Educate: ADR requires continuous vigilance during its incubation and start-up. Unless employees and the potential users are regularly reminded of the value of ADR, it will not be used.[9]

Conclusion

ADR is coming of age in America and there is no question that it will be applied in environmental disputes. It offers both the regulator and regulated an opportunity where applicable to join together in a more cooperative way of dealing with environmental matters. In the final analysis, it is not a matter of whether it will be used by government but when it will be used.

C. C. Harness, III
Ogletree, Deakins, Nash, Smoak & Stewart, L.L.P.
P.O. Box 1808
Charleston, SC, USA 29402

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DUELING WITH BOAT OARS, DRAGGING THROUGH MOORING LINES: TIME FOR MORE FORMAL RESOLUTION OF USE CONFLICTS IN STATE COASTAL WATERS?

Barbara A. Vestal,
University of Maine School of Law

Growing Marine Use Conflicts

Many states are experiencing greatly increased demand for use of their coastal waters. Not only are more people engaging in traditional recreational and commercial activities like boating and fishing, but emerging variations are posing new challenges. Sea kayakers, operators of high-speed personal watercraft, oil tankers, and live-aboard boaters all assert their right to use public waters. Aquaculture, based on state-granted rights of exclusive control over particular waters and marine resources, is a fast-growing industry in some areas. Concurrently, environmentalists, resource harvesters, and others make a strong case for the need to maintain coastal water quality and habitat values.

The increased demand to use coastal waters has spawned many conflicts over space allocation, resource allocation, and allowable resource degradation. The popular press is replete with reports of resource users attempting to settle disputes by dueling with boat oars, dragging through aquaculture mooring lines, or using other "self help" methods.

In the past, coastal waters were generally available to private users on a first-come basis, without state or local policies on use priorities. However, as conflicts escalate and it is increasingly clear that not all demand can be accommodated, that approach is increasingly untenable.

Justification for Increased State Involvement

State governments should take the lead in developing comprehensive conflict resolution strategies for application in coastal waters for at least four reasons:

(1) Coastal waters are a public resource of the state; the state has a fiduciary responsibility to hold and manage these lands for the benefit of the public.

(2) Not all uses can be accommodated; hard choices have to be made to minimize the costs of continued, unresolved conflict.

(3) There are inherent difficulties in managing common property resources, particularly where there are ongoing disputes among user groups who value

disparate resource functions and values. While self-regulation by stakeholders or privatization may eventually play a role, the critical first step requires strengthened governmental leadership in coastal waters to adopt and implement a comprehensive management program.

(4) The multiple single-focus agencies and narrow purpose laws which currently regulate marine waters are not designed to resolve conflicts among uses. The focus has to be shifted from the details of managing a particular resource to a broader ecosystem perspective. State governments may have greater flexibility to embrace this new focus.

In developing a marine conflict resolution strategy, policy makers will have to consider: (1) whether the state already has a policy designating marine use priorities, (2) how the state/local division of authority will affect decision making for coastal waters, and (3) whether state mechanisms and institutions exist which are capable of resolving conflicts and implementing decisions about use priorities for coastal waters.

Use Conflict Resolution Mechanisms for State Coastal Waters

Many states are at the point where they have identified the need for increased planning and management of their coastal waters, but have not yet taken concrete steps to address the problem. In these states, decisions about use of coastal waters are too frequently made by using less than optimal methods: by default to the first user, by litigation of narrow questions, or by *ad hoc* legislative actions supported by those with the greatest financial stake in a particular resource. The public trustees have no comprehensive plan, goals, or priorities for the marine environment, so there is no overarching context for decision making.

Maine is probably typical of these states. A 1991 study concluded Maine has no comprehensive planning and no comprehensive policy for the use of its coastal waters. It is hampered in resolving conflicts because it lacks priority-setting criteria. There is little coordination among local, state and federal agencies, each responsible for managing discrete aspects affecting the use of marine waters (Catena, 1991). The state/local division of authority over coastal waters is unclear.

However, several states have begun the process of formulating more detailed plans and priority systems to manage their coastal waters. Some of the more promising mechanisms include: (1) clarification of authority between state and local governments; (2) promotion of collaborative decision-making and implementation; and (3) development of space and resource allocation systems.

Clarification of State/local Authority

Municipalities in some states are reluctant to manage coastal waters within their boundaries because they are uncertain about the extent of local control over harbors and adjacent waters. At the same time, states are often concerned that giving control to local governments may result in decisions inconsistent with the state-wide public trust interest. Some states have successfully clarified local authority while maintaining state oversight.

For example, Connecticut's Harbor Management Act allows municipalities to establish a local harbor management commission to prepare a detailed management plan for the most desirable use of the harbor; the plan is to encompass the water area and land-side uses that will impact the water. The Act clarifies the relationship of the commission to other state and local entities, and requires U.S. Army Corps review of proposed plans. The plan must be approved by the state and must be in compliance with state-wide resource goals.

Similarly, New York amended its waterfront revitalization program to expand and standardize the authority of local governments to regulate the use of surface waters and underwater lands. Local governments have the authority to adopt comprehensive harbor management plans and implementing ordinances. The plans must address problems of conflict, congestion and competition for space in the use of harbors, surface waters and underwater lands. The plan and ordinances must be approved by the state; once approved, all state agency actions must be consistent with the approved local plan to the maximum extent practicable, and the municipality may regulate everything "abounding" the municipality to a distance of 1,500 feet from its shore, even if that exceeds the town's historic legal boundaries.

Important innovations include: a state approval process to ensure consistency with state-wide goals and priorities for public trust lands, integrated federal review for early identification of obvious conflicts, incentives for local planning to gain consistency of state agency action, and equal local authority with simplified geographic boundaries regardless of historic town boundaries.

Collaborative Decision-making and Implementation

As many agencies in different levels of government currently each have some jurisdiction over the use of coastal waters, the state's capacity to manage its coastal waters should be enhanced by improving the capacity for multiple-agency collaboration on cross-cutting decisions. These efforts can include informal collaboration, formal intergovernmental agreements, and creation of special districts, authorities, or management entities.

Most states engaged in planning for coastal and ocean waters have identified the need to create coordinating councils which are, at a minimum, composed of representatives from all state agencies with some marine authority. Some councils, such as Oregon's Policy Advisory Council, are more broadly representative. California and Oregon have also made use of multi-agency, coordinated project review panels to review and make recommendations on specific project applications.

If the goals of federal agencies with concurrent regulatory jurisdiction are compatible with state goals, state-initiated informal collaboration may include federal agencies as well. States may also benefit from participating in federally established processes. While currently focused primarily on water quality, the National Estuary Program is a model of a collaborative approach which could become a vehicle for use conflict resolution. Similarly, regional fishery management councils may expand their focus to address foreseeable use conflicts, particularly between capture and aquaculture fisheries.

Occasionally this state/federal collaboration may extend to a more formal sharing of authority between federal and state entities to further integrated management of coastal waters. For example, the U.S. Fish and Wildlife Service (USFWS), administrator of uplands composing four National Wildlife Refuges in the Florida Keys, and various Florida agencies which own the surrounding submerged lands, troubled by conflicting water uses of the Lower Florida Keys, developed an innovative Management Agreement to overcome jurisdictional constraints. The parties negotiated a Management Agreement, effective in 1993, which uses state authority to limit public use of particular waters and allows USFWS enforcement officers to patrol state waters (Cuthbert and Suman, 1995).

Space and Resource Allocation Systems

Among the more promising allocation techniques are submerged lands leasing programs, marine zoning, special area management plans, performance standards, and ocean management plans.

Submerged Lands Leasing Programs: Submerged lands leasing programs can help minimize use conflicts in coastal waters by requiring users who propose permanent occupancy of state coastal waters to first obtain a lease or other conveyance from the state. However, these programs typically control only built infrastructure or physical changes in, on or over submerged lands such as structures or dredging, and are not designed to control temporary or transient uses such as seasonal docks, recreational use, or capture fisheries. If the state has not engaged in comprehensive planning, the decisions may be ad hoc, based purely on space allocation criteria.

Comprehensive Marine Zoning: Some states utilize traditional comprehensive zoning applied to the marine environment. Rhode Island, has successfully used marine zoning as a component of its comprehensive land and water management system since 1971. In a state-administered system, it divides all coastal waters of the state into water use categories which determine permissible uses. Similarly, Washington's shoreline management program, also adopted in 1971, utilizes similar water classification techniques but allocates more responsibility to local government. A more recent variation, recommended for adoption in North Carolina recommends employing water use zoning maps, which while not regulatory per se, would illustrate where particular use policies should be considered (Clark, 1993).

These examples illustrate that zoning can be used to comprehensively divide coastal waters into use and intensity classifications. However, as with traditional land-based zoning, this tool regulates major new developments and major changes in use. It can minimize future use conflicts through geographic separation and redirection to least sensitive areas, but it is not designed to facilitate resolution of conflicts among temporary or transient uses.

Special Management Areas: Special area management plans generally allow for more detailed regulation; they can control temporary or transient uses in addition to permanent development. However, due to the intensive effort and cost of developing such a plan, SAMPs are likely to be used only in the most intensely used or particularly sensitive areas. A comprehensive special area management plan is under development for the Florida Keys National Marine Sanctuary. The draft management plan, developed by NOAA in partnership with Florida, identifies 98 "strategies" that together form an integrated management plan. As one strategy, the plan includes the creation of four new marine zoning categories within the special management area to regulate temporary user activities by controlling type and amount of access.

Performance Standards: Performance standards allow states to establish advanced criteria to guide decision makers. For example, in 1991, Hawaii developed guidelines for private marina development to protect public interests and allocate valuable ocean space in a fair and equitable manner. Similarly, through its Coastal Management Act (CCMA), Connecticut established extensive goals and policies for coastal lands and resources. Local actions must be in accordance with the CCMA, and the statutory policies of the CCMA override any less restrictive state or local regulatory standards. These very detailed performance standards allow the state to establish policies for local implementation without the state itself engaging in zoning or other specific space allocation decisions.

Ocean Management Plans: In the last ten years, more comprehensive ocean management planning has emerged which has begun to shift the focus from mere physical space allocation systems to more comprehensive resource allocation systems. They embrace a more holistic, integrated, ecosystem perspective. Examples include the NOAA-led Florida Keys National Marine Sanctuary stewardship strategy and state-initiated ocean management studies or plans in states such as Oregon, California, North Carolina, Mississippi, and Florida. State ocean plans typically study an area out to the 200-mile exclusive economic zone limit and tend to be developed to prepare the state to defend itself against outside development interests in federal waters. In theory, multiple-use ocean management should advance use conflict resolution throughout the stewardship area by establishing priorities for valued uses and establishing a framework within which to make decisions about space and resource allocation. However, in actuality, the geographic scope and activity emphases of most first generation ocean plans are not intended to address competition for space and resources on a scale relevant to resolving coastal use conflicts. However, Oregon's Territorial Sea Plan, a component of its Ocean Plan, suggests that refinement of successive components of ocean plans may eventually produce concrete guidance on conflict resolution in coastal waters.

Conclusion

Conflict resolution strategies for use in states' coastal waters are still in the initial stages of development. More empirical evidence will be required to determine if these particular approaches will successfully protect the public interest and reduce use conflicts. It is clear, however, that as conflicts escalate, states must more forcefully assert their role as public trustee by developing a comprehensive plan, establishing priorities and mediating among user groups. In the absence of state leadership, resource allocation may be made by self-help appropriation, citizen-initiated referenda, special interest legislation, or other *ad hoc* methods which offer less than optimal protection for the broad public interest in this valuable resource.

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Barbara A. Vestal
Marine Law Institute
University of Maine School of Law
246 Deering Avenue,
Portland, ME, USA 04102

Ph (207) 780-4474
Fax (207) 780-4913
E-mail bvestal@payson.usm.maine.edu

A CASE STUDY OF REGULATORY COLLISION ON THE URBAN COAST: UPGRADING A LEVEE ON THE SAN FRANCISCO BAY

Darcey C. Rosenblatt, Environmental Science Associates and
Nona Dennis, Environmental Science Associates

This presentation describes an increasingly common land use conflict between the preservation of natural resources -- in this case seasonal and tidal wetlands -- and urban development. The project at issue is the upgrading of a long-established levee. The real story behind this project is one of impasse, followed by challenge, negotiation, and compromise. Five years have gone by since the project was first conceived; a solution appears to be imminent.

The project levee is part of a five-mile levee system that generally surrounds on three sides the Redwood Shores Peninsula, an area of about 1,500 acres located in Redwood City, San Mateo County, California (Figure 1). The levee separates the peninsula from the tidal waters of San Francisco Bay itself and from two wide, shallow tidal sloughs that enter the Bay on either side of the peninsula. Redwood Shores is primarily a low- to medium-density residential area. A population of 6,000 currently occupies a series of waterfront residential communities that front either directly on the Bay or on a system of internal lagoons. The Peninsula also contains 2.5 million square feet of low- to mid-rise office and commercial space.

The Redwood Shores Peninsula was created as a land form in the early 1900s by diking about 1,500 acres of San Francisco Bay tidelands to create shallow ponds for the production of salt. From the early 1960s, the ponds were drained and/or filled with bay mud dredged to create internal lagoons; additional soil was imported to surcharge the semiconsolidated substrate, and the area was gradually prepared for development. Two-thirds of the peninsula are now fully developed, and the City General Plan calls for developing much of the remaining land.

The remaining undeveloped areas of Redwood Shores have been diked and partially filled but are not yet developed; other diked areas have never been filled. Especially these latter areas, which are of low elevation and frequently pond throughout the rainy season, retain many of the characteristics of the Bay shoreline except for tides that are excluded by the levee. The meanders of former small sloughs are still evident, and salt marsh vegetation covers in varying degree most of these unfilled lands. The combination of tidal salt marsh and mudflats outside the levee, seasonal wetlands and salt flats in unfilled areas inside the levee, and ruderal/upland vegetation on higher, filled lands of the peninsula, creates a complex of habitats that support a variety of wildlife species. At a minimum these include numerous waterfowl and wading birds, shorebirds, raptors and passerines, as well as populations of small mammals and larger mammals such as red fox, raccoon, striped skunk and ground squirrel. Two federal and state-listed endangered animal species also share some of these habitats, both inboard and outboard of the levee.

Although most of the undeveloped lands of the peninsula are owned by one land owner (slated for eventual development), several parcels around the periphery of the peninsula are owned by others. A wastewater treatment plant is situated in one small corner of the peninsula Both inboard and outboard of the levee are several parcels owned by California. Much of this public land, including waters bayward of the state-owned intertidal areas, could someday become part of the San Francisco Bay National Wildlife Refuge (SFBNWR). Bayward of the peninsula are tidal areas indicated on a 1990 map of the SFBNWR as "Approved Areas," that is, approved by Congress for acquisition. Within the peninsula is a privately-owned, unfilled 120-acre parcel that is on the SFBNWR "wish list."

The Levee Project

Approximately five miles of levee surround the bayward and slough sides of the peninsula. In addition to providing flood control for the entire Redwood Shores community, the levee is used for incidental recreational purposes -- walking, jogging, biking -- by residents of Redwood Shores and others. Four miles of the existing levee are of insufficient height and cross-section to meet current federal (U. S. Corps of Engineers [Corps] and Federal Emergency Management Agency [FEMA]) and local (City) flood-control and flood hazard insurance standards. In 1991, to protect present and future development on the peninsula, the City proposed to upgrade the levee system to meet the standards that they felt were appropriate. They explored a number of design concepts for rehabilitating and strengthening the levee, including constructing a partial floodwall. The City was sensitive to the need to avoid wetlands on the peninsula and thus modified their preferred design, which called for a relatively massive cross section and conservative free-board elevation, to accommodate a three-foot seawall in several places. While more expensive than a standard levee, the seawall (floodwall) theoretically would result in a much smaller levee base "footprint" and thus have less impact on wetlands. The seawall concept later proved to create its own unacceptable impacts (see below).

Permits

The City was aware that the levee upgrade project would require a permit to place fill in wetlands under the Corps Section 404 Permit Program (Clean Water Act), and a permit to build within the 100-foot shoreline jurisdiction of the San Francisco Bay Conservation and Development Commission (BCDC). BCDC is the equivalent state coastal zone management agency for

San Francisco Bay. As such, it has two primary goals: to prevent the unnecessary filling of San Francisco Bay, including wetlands, and to increase public access to and along the Bay shoreline.

Initially, the City expected that regulatory compliance would be relatively uncomplicated and that it could be completed under streamlined permit options at both the Corps and BCDC. Initial consultation with the key agencies revealed that this would not be possible. That position was confirmed by the discovery by consultants (ESA) in 1992 that the levee project area provided habitat for the endangered salt marsh harvest mouse (SMHM), and that tidal marshes external and adjacent to the levee were inhabited by both the SMHM and the endangered California clapper rail (CCR). The presence of SMHM (*Reithrodontomys raviventris*) in the project areas was determined through live trappings conducted as part of a biological assessment (ESA, 1992). It could be readily assumed that the SMHM also inhabited the undisturbed, unfilled, diked marshlands in the project area. The CCR (*Rallus longirostrus obsoletus*) is listed as endangered by both federal and state governments, is known to inhabit offshore islands near the peninsula, and has been reported in tidal marshes along the Bay shoreline and sloughs bordering Redwood Shores. The presence of these two species in the project area guaranteed that the U. S. Fish and Wildlife Service (USFWS) would be a key player in the permit process.

The City had approached the activity as routine maintenance of an existing facility (the levee) that was necessary to maintain protection of private lands and the safety and welfare of existing City residents from flooding. The regulatory agencies, including those that normally comment on Corps and/or BCDC permit actions (USFWS, Environmental Protection Agency [EPA], California Department of Fish and Game [CDFG], Regional Water Quality Control Board [RWQCB], among others), took a fundamentally different view of the project: they looked at the levee upgrade as enabling private development investment on the remaining undeveloped lands behind the levee, and as a major threat to the continued existence of the two endangered species. Thus the process of designing, mitigating impacts, and gaining regulatory approval for this levee upgrade project has involved almost five years, consultation under Section 7 of the federal Endangered Species Act, a draft "Jeopardy Opinion," and considerable efforts in creative engineering and compromise to find alternatives that would achieve the goals of both the City and the relevant regulatory agencies.

Issues of Public and Agency Concern

An EIR produced by City consultants under the California Environmental Quality Act (CEQA) brought to the surface the principal issues of public, resource agency, City, and property-owner concern. These were later expanded or supplemented through the Corps' permit process and endangered species consultation. The issues fall into four main categories. These are summarized below.

1. Levee alignment - The City assumed that the existing levee following the shoreline would dictate the alignment of the rehabilitated structure. An underlying position of the resource agencies turned the alignment into a controversial issue. At issue was the 120-acre parcel immediately within the levee, which has never been filled, supports salt marsh vegetation; and is presumed to be habitat for the SMHM. It was the agencies' position that, in the long-term, the upgraded levee would not only enable planned development in areas of the peninsula that currently serve as open space and wildlife habitat, but that it would preclude future opportunities to restore this particular parcel to tidal action, notwithstanding its private ownership status. As part of the 404(b)(1) alternatives analysis required for Corps permit, the agencies requested that the City analyze the feasibility of converting a temporary berm along an interior alignment into the primary levee; that would effectively place the 120-acre parcel outside the peninsula's primary flood control system.

The City took an opposite position. They maintained, first, that this alternative constituted a new levee, not a maintenance project. The new project would not be practicable due to costs of construction and land acquisition, and also due to impacts associated with importing the required fill material. Second, the City contended that an interior levee would not meet the project purposes of upgrading an existing facility whose basic purpose was the protection of private property. Third, the City cited the risk of severing private lands and nullifying existing landowner development entitlements, general plan designations and zoning classifications. Basically, the City contended that an upgrade project along the existing levee alignment would not in itself encourage further residential development nor preclude restoration of lands in the future, were they to be acquired eventually as part of the SFBNWR. After considerable negotiation, the City and agencies agreed to a compromise: the City would make only minor improvements to that segment of the levee that bordered the 120-acre parcel, and would not construct a new levee along the interior alignment. This had the effect of removing that levee segment from the project.

One other resource issue was more easily solved. Between the wastewater treatment plant and the Bay is a row of trees used throughout the spring and summer as a rookery. Snowy egret, black-crowned night heron, great blue heron, and great egret nest in the trees and forage in the nearby freshwater marsh, shallow Bay waters, and mudflats. To avoid the rookery, the City was able to realign and redesign this segment of the levee as a narrow sheetpile floodwall, skirting the rookery inland and removed from areas of potential habitat fragmentation.

2. Levee design - Initially the levee was conceived as a conservative, "over-engineered" earthfill structure. The design was subsequently modified to reduce the cross-section and amount of fill in wetlands by replacing the top three feet with a block floodwall to reach the desired finished elevation. From a biological perspective, the wall posed several problems. It would fragment the saltmarsh habitat, interfering with SMHM movements between the inboard and outboard sides of the levee. It would prevent dispersal of SMHM populations and impede gene flow between inboard and outboard populations. It also would interfere with access to higher levee vegetation used by both SMHM and CCR as refuge during extreme high tides. From a human perspective, local residents whose homes fronted on the Bay and sloughs felt that the proposed flood wall would obstruct their waterfront views, that it would be visually unattractive, and furthermore would attract graffiti; in this manner, the wall would diminish property values.

On this issue, the biological and human perspectives were in general agreement, and the wall was removed from consideration except at the wastewater treatment plant. During subsequent negotiations, the City redesigned the levee, reducing the top elevation by one foot and narrowing the cross-section, apparently without losing the necessary security of flood protection.

3. Development behind the levee - The most critical issue was not the physical presence of the levee itself but the impacts associated with development planned for lands behind the levee (in most instances already entitled by the City). In the long-term, the agencies believed that the levee upgrade would indirectly enable planned residential development in areas of the peninsula that currently serve as open space and wildlife habitat. In turn, the new residential areas would generate greater human activity along the levee, introduce domestic dogs and cats as predators and disturbers of wildlife habitat, and threaten the small resident population of CCR inhabiting the tidal marshes immediately outside the levee. Of particular concern was a filled area adjacent to the 120-acre parcel: Lido Homes. This development was already fully approved by the City for development and would place new homes within 100 feet of the high tide line outside the levee, and, in so doing, bring human activity within close range of CCR habitat. During Section 7 consultation (which produced a draft Biological Opinion, stating that the project as proposed would jeopardize the continued existence of the CCR and SMHM -- the equivalent of a "double jeopardy"), the USFWS recommended that an average 300-foot buffer be required by the City, between the outboard tidal marshes and any new residential development. This would severely reduce the number of homes that could be built within a project that had been approved for some time. The City countered that a 100-foot buffer was already included in the Lido development plans. A final buffer width of 150 feet was finally accepted by the City and landowner.

4. Cumulative impacts on endangered species - Consistent with their view that the levee would enable development, the agencies also viewed the levee as growth-inducing and, therefore, as contributing to cumulative impacts of development and population growth. During the course of negotiations, various recommendations and City concessions involving alignment, redesign, buffers, and controls (see below) were considered to reduce the significance of cumulative impacts to an acceptable level. The final details are still in process.

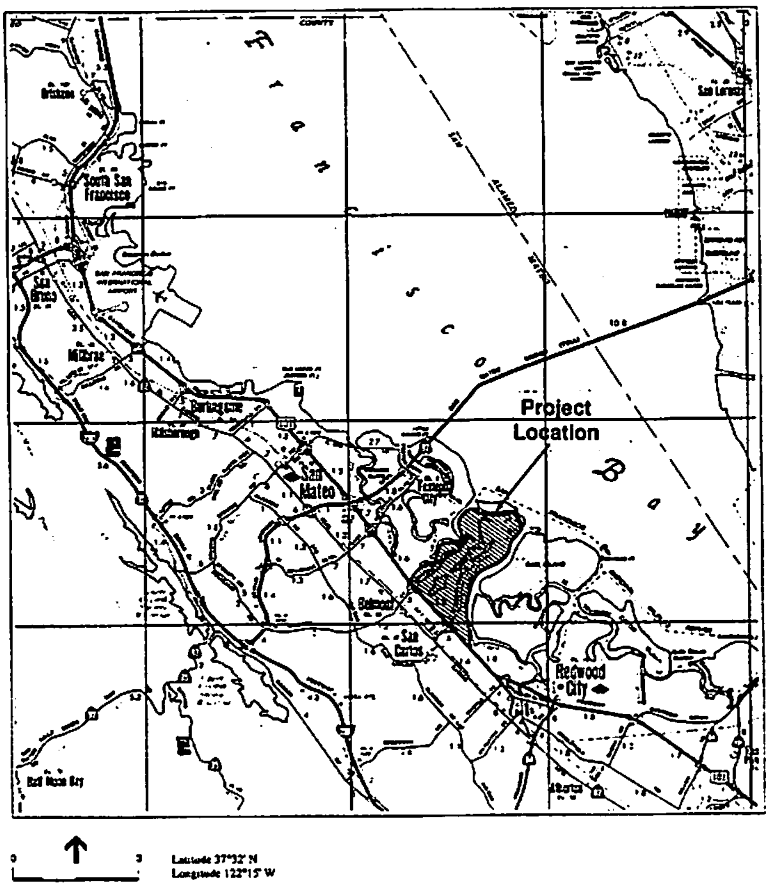
Summary

A final decision on this project has not been reached. However, at this point resolution seems more possible than it has since project initiation. Over the last few years, the Corps permit public notice generated extensive comment and the permit application was revised several times. After struggling to reach a compromise that would satisfy the resource agencies and fulfill the needs of the project (as viewed by the City), the City redesigned the overall project. Removing the levee segment surrounding the 120-acre parcel from the project also removed a major point of decision blockage. The compromise buffer zone of 150 feet was agreed upon along the Lido Homes shoreline (which reduced the development by a number of houses), and the City has made agreements with BCDC for special provisions for access along the levee to avoid compromising endangered species habitat.

How could this project have been accomplished in a more timely and less costly manner? It is generally impossible to foresee how a project such as this will proceed before the discovery and assessment process has begun. In this instance the discovery of endangered species in the area proved to be critical. A levee sounded innocent enough, but the resource agencies required that the future disposition of the area behind the levee be a decision factor in the project. Hindsight, they say is 20-20: Perhaps after studying alternatives and fully exploring the agencies' legal responsibilities and specific concerns (both of which the City did), the approach might have been one of immediate mediation rather than confrontation and challenge through the regulatory process. Several lessons could be learned from this process. Resource agencies must appreciate a City's immediate accountability to its constituents and its vulnerability to legal challenge. It is essential for a public agency such as a City to fulfill its responsibilities for protecting public health, safety, and welfare. However, how that obligation is implemented, requires creative study and solutions to accommodate important natural resources.

Darcey C. Rosenblatt
Environmental Science Associates
301 Brannan Street, Suite 200
San Francisco, CA, USA 94107

Ph (415) 896-5900
Fax (415) 896-0332
Email darceycr@aol.com



Redwood Shores Levee Project

SOURCE: CSAA, Environmental Science Associates Inc.

Figure 1
Project Location

THE OSU FISHING FAMILIES PROJECT: HELPING FISHING FAMILIES, BUSINESSES, AND COMMUNITIES ADAPT TO CHANGE

Flaxen D.L. Conway,
Oregon State University Extension Service
Ginny Goblirsch, Jim Bergeron,
and R.C. Hinman, OSU Extension Sea Grant

Context, History, and the Initial Response

Global, national, and local forces have been causing dramatic changes in the lives of fishing businesses and families and in the economic and social fabric of coastal communities. Increased competition for limited fisheries resources, restrictive management decisions, new federal laws, endangered species, changing markets, and unusual ocean conditions have combined to create a particularly stressful and uncertain climate in the commercial fishing industry in the Pacific Northwest. Many of these challenges, however, are not limited to the Pacific Northwest. In their description of Galilee, Rhode Island, Poggie and Gersuny (1974) could have easily been describing many fishing communities in the Pacific Northwest: proud, independent fishing operations made up of owners, skippers, crew, gear and service suppliers, and processing plant workers who deal with a wide variety of harvest, handling, and processing methods and species in a setting of suburban-rural communities. And when Snow (1990) describes the constantly changing environment that the commercial fishing industry in the Northeast has and will be operating in during the 1990s, many of his comments are hauntingly familiar.

Natural resource-based industries, such as fishing and timber, are an important source of income for coastal communities in the Pacific Northwest. A study in 1989 estimated that about 36% of the personal income received by residents in Oregon's coastal communities was generated by natural resource-based industries. In some areas, such as Newport and Astoria, Oregon, commercial fishing generates about 17% of the total personal income and about 26% of the earned income (Radke, 1993). What has happened in the salmon fishery is an example of the challenges facing fishing businesses, families, and communities. Personal income received from the salmon fisheries (sport and recreational) averaged around $42 million between 1976 and 1992 in Oregon. This declined to around $3 million in 1994. There were 2,061 vessels delivering salmon in 1988. There were 611 in 1993. The 90% decline in economic impacts and 70% decline in vessel effort for salmon has meant changes for all involved: vessel owners, skippers and crew, workers and owners of related businesses (fish processing plants, gear stores), and, of course, family members.

The fishing industry, as with other natural resource-based industries, normally experiences cycles of good and bad years. Yet despite this, many have documented the personal commitment expressed by fishing businesses and families to the occupation (Poggie and Gersuny, 1974; Danowski, 1980; and Mederer, 1993). Terms like "it's in their blood" and "it's a way of life" are commonly heard and chronicled. However, in the Pacific Northwest, many segments of the industry have been in a general decline since 1990. The current decline is expected to be prolonged, with many businesses unable to survive economically.

This is particularly stressful to the families who are the backbone of these fishing businesses. Fishing families possess some unique qualities. Because the fisherman (most often the male) is frequently at sea, the responsibility of maintaining a comfortable and safe home life falls largely on the spouse's (most often the female) shoulders (Mederer, 1993). Its hard to have routine schedules or regular plans. Hobbies or social interactions that the spouse participates in when the fishermen is at sea often stop when he comes home (Danowski, 1980). And family members often comment about the danger involved in commercial fishing and the additional stress this can put on a family.

All in the industry agree that the entire industry is being confronted with enormous change and a painful period of transition. This situation is similar to the economic uncertainty that faced farm families in the 1980s, and timber families in the late 1980s and early 1990s (Conway and Wells, 1993). Those who make it through the current crisis will find themselves part of a much smaller and more restricted fishing fleet. Many will not make it through the transition and their families will be in financial crisis. Four factors often contribute to financial pressure: low family income, unstable work, income loss, and high debt-to-asset ratio. Boat owners certainly are facing income loss and the resulting high debt-to-asset ratio. Skippers, crew, processing workers, gear and service suppliers, and family members are facing all or part of the factors listed above. Anger, frustration, fear, and stress resulting from visions of an uncertain future are challenging the stability and security of fishing businesses, families, and communities.

In November 1993, it seemed timely to develop an experimental outreach program for fishing families in Oregon. Acting as a team, the authors developed a proposal for National Sea Grant funding for a pilot-scale educational outreach program. In January 1994, the team received notice that they had received a small grant for an 18-month effort. They began immediately establishing a project steering committee for guidance and networking support. The next 18 months were filled with needs assessment, networking, and educational outreach activities to meet project objectives and ultimately the needs of the audience: fishermen and their families, workers of processing plants, equipment suppliers and service providers living or working in coastal communities. Our methodology was to assess their needs and then to provide appropriate educational resources to help families cope with the ups and downs of a natural resource-based industry in transition. We would furnish practical information on techniques and attitudes effective in managing community and personal change, tools and methods on surviving transition periods, diversifying employment/income options, and family stress precipitated by economic and social pressures.

The pilot project was an experimental outreach effort; a practical attempt at empowering fishing businesses and families to manage change and maneuver the subsequent transition in a way that provides the most business security and family stability. Through conducting close-to-the-industry needs assessment, we identified some of the unique personal and business challenges facing fishing businesses and families. We also assessed the existing "networks;" the communication/support links that exist within the industry (between fishing businesses or families) and between the industry and community and business agencies. Danowski (1980) reported the importance of networks such as Fishermen's Wives Organizations in helping family members to cope with the fishing marriage. Fishermen have historically operated in the margins of society, and are feeling marginalized and disenfranchised from society in general and the communities where they live (Hall-Arber, 1993). Networks between the industry and community and business agencies will be critical in addressing this issue. During our pilot project, we asked, and encouraged them to ask themselves and each other, "What is your ability to respond to the fishing industry crisis?" We began to recognize the number of community and business agencies that are ill-prepared to respond or lack the understanding of how they might better serve fishing businesses and families in transition. We became aware of the research opportunities that matched these needs and issues. And we learned how an effective community-based outreach project could help fishing businesses and families in transition. In short, on a small scale, we learned about the real needs and issues facing fishing businesses and families and how outreach education can make a difference on these issues.

Improving on Success with Expanded Outreach and Increased Networking

The strategy we are using in the 1995-97 program, what we now call the OSU Fishing Families Project (FFP), is to actualize a vision of "fishing business and family support centers without walls" in each of three regions of the Pacific Northwest coastline:

1) The north coast (serving the ports of Lower Columbia River [Astoria, Hammond, Warrenton, Ilwaco], Tillamook Bay [Garibaldi, Bay City], Pacific City, Willapa Bay [Tokeland, South Bend, Raymond], and Gray's Harbor [Westport, Hoquiam])

2) The central coast (serving the ports of Lincoln City, Depoe Bay, Newport, Florence, Reedsport, Winchester Bay, and Coos Bay)

3) The south coast (serving the ports of Bandon, Port Orford, Gold Beach, Brookings, and Crescent City).

Our objectives are:

1) To implement successful educational outreach programs that help fishing businesses and families manage change.

2) To create or strengthen industry/community/agency networks to support this industry's transition.

3) To regionalize the effort by extending it to fishing businesses and families to the south (northern California) and the north (southwest Washington).

4) To compare and share our research and outreach experience with other areas of the U.S. where similar challenges are being faced.

To do this we deliver, on a regional basis, locally-tailored, community-based, educational outreach activities. We use the support of regional- and port-based advisory groups in the design and delivery of effective educational materials and outreach activities, and in the creation or strengthening of networks. Our challenge is to work with the audience in implementing strategies and networks that make a significant difference in the lives of individuals, businesses, and community organizations.

But How? What Are the Nuts and Bolts/Hooks and Lines?

We take a 3-pronged approach to educational outreach and networking:

1) Personalized, community-based contact

2) Practical, educational materials and activities

3) Encouraging network creation or strengthening

The key to reaching this independent and proud audience is through the personalized contact of peers and we're doing this via Fishing Family Coordinators (FFCs). FFCs are members of fishing families or businesses managing a major transition, and, like their peers, they are working to make ends meet and keep their families strong. They are often "rich" with connections and credibility with the audience, and "poor" with spare time and cash. In the pilot project, the FFCs served as volunteers, receiving a small stipend plus travel and communication expenses. Unfortunately, the pilot experience showed this funding level to be inadequate. In the FFP we provide adequate time, communication, and travel support to the FFCs, assuring that they'll be able to:

1) Reach more peers within Oregon and throughout their region in a high-quality, timely way, and

2) increase their ability to serve as the center of the link between fishing businesses and families, and between these families and businesses and the industry/community/agency networks in the region.

The educational materials and activities that we provide are community-based and address identified needs and issues. For example, we offer workshops focusing on family and business financial management, industry trends and forecasts, business diversification (within the industry and to transition to other industries), individual and group communication/coping methods related to dealing with stress and change, how to access resources, develop and maintain effective networks, etc. One example of a successful educational outreach activity were the "Staying Afloat/Getting Ahead" workshops. Designed to assist fishing families manage their business and family finances, these workshops provided an interactive, educational forum where participants learned from presenters and each other practical strategies to keep records, do some financial planning, and prepare for tax time. Participants evaluated that these workshops were helpful and got many of them "back on track." In fact, a shrimper who attended one of the sessions said that his participation in this workshop "saved my family a very significant amount of money." What also resulted from these workshops were two new publications ("Tax Information for Crewmen on Commercial Fishing Boats" and "Family and Business Records Checklist for Fishing Families") and innovative ways to get them into the hands of those in need. Other examples of educational materials available through the FFP are the "Fishing Family & Business Resource Kit," "Helping Persons Cope With Change, Crisis, and Loss," and "Getting Unhooked From Anger and Conflict."

We create local and regional networking activities that bring all interested parties together, for example through regional conferences for local industry-related groups such as the Fishermen Wives Organizations, or through the regionally-based "Marine Fisheries Resource Fairs." The idea with these networking opportunities is to provide a "one-stop shop" for fishing families and businesses. At these fairs individuals and families access information related to industry- and family-related agencies/organizations, and become connected with opportunities for support, information, and future possibilities. One of the most important aspects of these fairs are the interactive symposiums on topics such as fisheries management, family support networks, etc. Another example of community-based, networking efforts is the Fishermen's Referral Service program in the central coast region. This effort was created in cooperation with the Newport Fishermen's Wives Group and links available crewmen with boat owners/skippers in need of skilled crew. Although it is still young in its process, this may end up being a model for other regions.

Lessons Learned So Far

As OSU Forest Ecologist Steve Radosevich says, "Many of today's natural resource problems are 'wicked problems' — problems so complex and with so many interactions that no solution seems possible, only resolution." And, it could probably be argued that these "wicked problems" are not just related to natural resources. Issues facing families — parenting challenges, the lack of family-wage job opportunities for rural youth, increasing costs and lack of security in income, etc. — are "wicked problems" as well. Combine this with declining agency budgets and increasing impacts of resource management/policy decisions on communities, it obvious why a collaborative approach to resource issues has become so popular. However, most family, business, community, and agency partners have not had the experience or the skills to address these complex situations effectively and collaboratively. That is why we have, and continue to, put so much effort into creating or strengthening networks, both within the fishing industry and between the fishing industry and the community/agency support agencies. Workshops such as the "Fishing Families Networking" appear to be helpful with this. Through these and other workshops, fishing business and family members have and will learn how to build empathy for the kinds of emotional problems that people in changing natural resource-dependent communities face, and how to develop assessment and analytical skills and recognition of opportunities others have taken in similar situations.

We're learning that certain parts of the audience are especially hard to reach. Examples of this are charterboats (some differences of opinion on "if and how" these folks are really part of the commercial fishing industry), crewmen (due to their apparent lack of interest or trust in education, and their mobile lifestyle), and processing plant workers (often due to a language barrier and/or mobile lifestyle). One-on-one visits are hard on the FFCs; phone visits seem to be a more effective and efficient tool. Possibly more workshops like Coping with Loss, and Getting Unhooked from Anger and Conflict, as well as dealing with other types of skills related to change would be helpful. Through an increased awareness of educational materials and other resources, they begin to understand the stages of individual change and build skill in recognizing emotional states during individual change, and develop skills used to manage during transition periods.

We've learned that try as we might to "get the word out," we must be more creative and effective at marketing the FFP and the related materials and activities. There appears to be no "good time of year" or only short squatches of time to reach this audience, so we'll have to be more flexible and increase our ability to respond to needs on shorter notice. And, regardless of the form the materials or activities take, we recognize that fishing businesses and families are made up of independent, busy people with no tolerance for abstract information. We must continue to capture their attention with high interest, practically-oriented educational materials and activities.

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Flaxen Conway, Extension Community Outreach Specialist
OSU Extension Service
Ballard Extension Hall 213
Corvallis, OR, USA 97331-3601

Ph (541) 737-1418
Fax (541) 737-2563
Email conwayf@oes.orst.edu

INVOLVING URBAN YOUTH IN MARINE AND AQUATIC ENVIRONMENTAL ISSUES, SCIENCE AND CAREERS

Norman Bender, University of Connecticut,
Heather Crawford, University of Connecticut,
Carol Kasper, Schooner, Inc., and
Wanda Little, University of Connecticut

Urban youth and community youth leaders have been involved in a three-year pilot program in the New Haven, Connecticut metropolitan area which utilizes a collaborative community-based experiential learning approach to:

a) involving urban youth in learning how they are connected to marine and aquatic environments (natural and those created by society),

b) using scientific-based techniques and knowledge to assist youth in understanding and protecting those environments, and

c) exposing them to related employment and career opportunities available to those with appropriate educational backgrounds.

The program focuses on the ecosystem and geographic area of the Quinnipiac River watershed in Southern Connecticut. A marine and aquatic environmental issues curriculum was developed to be completed by middle-school-aged urban youth and community youth leaders. Included are: field trips to key watershed, river and harbor sites; scientific and management demonstrations and hands-on activities; and community outreach opportunities for youth to share their new knowledge and perspectives.

Cooperative Extension educators at the University of Connecticut identified a need for urban youth to develop an understanding of their relationships to nearby environments and how they can use science to understand and protect these environments. The project addresses Extension education priorities in the areas of youth-at-risk, environmental education, water quality, and marine resources.

Overview

The urban youth and the environment program was initiated in 1993 by Cooperative Extension System educators working in the 4-H Youth-at-Risk programs and Sea Grant Marine Advisory Programs.

Educational activities for 4-H youth and leaders in Connecticut have included an annual one-day 4-H Marine Science Day. Up to 150 youth and leaders have increased their awareness of marine environmental issues and the use of scientific research methods to under-stand aquatic ecosystems. Youth from the City of New Haven have participated in annual Marine Science Days as well as other educational experiences aboard Project Oceanology's educational vessel studying the marine environment at the eastern end of Long Island Sound. Participation in these activities establishes interest in marine and aquatic environmental issues and related science activities. However, one-day educational events provide limited opportunities to develop their knowledge base and skills levels to a point where they can become involved in on-going marine and aquatic programs.

The Fund of the Community Foundation for Greater New Haven was established as part of a lawsuit settlement addressing water pollution from an Upjohn Company plant in North Haven, Connecticut. The lawsuit resulted in establishment of the Quinnipiac River Fund to be used "to improve the environmental quality of the Quinnipiac River and the New Haven Harbor and the watersheds of these water bodies, and otherwise to benefit the environment of these resources."

Among the purposes of grants from the fund are: "a) studying the ecology of the Quinnipiac River and the New Haven Harbor; b) studying pollution of these water bodies; ... and c)providing public education about these water bodies ..."

A proposal submitted to the Quinnipiac River Fund was approved for funding during 1993-94 and subsequent proposals have been funded during 1994-95 and 1995-96. Objectives for these proposals are:

1995-96 and 1994-95

a. To increase awareness of 30 middle-school-age, inner-city youth and 10 youth leaders about the aquatic and estuarine ecosystem and its relationship to their community including causes and impacts of water pollution.

b. To continue developing an integrated program relating science to life in urban communities using the Quinnipiac River Watershed as a focus involving a variety of pre-existing educational programs; and have students explore the possibility of careers in science, education, and industry relating to the aquatic environment.

1993-94

a. To increase awareness of 120 middle-school-age, inner-city youth leaders about the estuarine ecosystem and its relationship to their community; causes and impacts of water pollution.

b. To initiate an integrated program relating science to life in urban communities using the Quinnipiac River Watershed as a focus. Involve a variety of pre-existing educational programs and have the students explore the possibility of careers in science, education and industry relating to the aquatic environment.

c. To identify 10 4-H leaders who will work with project coordinators and instructors in identifying marine environmental topics appropriate for on-going projects carried out by 4-H leaders and middle-school-age, 4-H youth.

Educational Activities

1995-96

A five-day series of educational activities occurred during July 1995. The first day involved studying fish population dynamics in Long Island Sound. Biologists at the National Marine Fisheries Service Laboratory in Milford covered: identifying common fish species, research methods, and a winter flounder study.

Thirty-three youth and leaders participated in hands-on activities measuring fish lengths, recording data, and plotting size distribution data on graphs. This was an opportunity for youth to become "immersed" in their work while also having fun.

Day two involved a tour of coastal sites and activities along New Haven Harbor. Twenty-five youth explored shore-side sites including: Tallmadge Brothers Oyster Company's Mill River facility where thousands of tons of oyster shells are loaded aboard large shell-fishing vessels for transport to oyster beds in Long Island Sound, the U.S. Coast Guard Long Island Sound Station (Search and Rescue Unit), and Fort Nathan Hale and Black Rock Fort (restored historical sites).

Participants learned about oyster production (aquaculture) in nearby waters and the need for clean, unpolluted waters, Coast Guard activities relating to safe use of coastal waters for maritime transportation and recreational boating, and historical activities like harbor defense and shell fishing.

The third day involved a three-hour cruise aboard the educational sailing vessel Quinnipiak which included scientific demonstrations related to water quality, analyzing bottom sediments. identifying marine life, and sail training. Youth utilized fish identification information and size distribution analysis techniques learned at the Milford laboratory.

On the fourth day, participants explored harbor and shoreline habitats at Lighthouse Point Park. Marine scientists led a series of activities exploring a natural rocky shore area, a rock groin extending into the Sound, a sandy beach, and a tidal river.

The final session involved educational activities at two locations. A professor from the University of New Haven demonstrated how a geographic information system (G.I.S.) computer program is used to study the Quinnipiac River Watershed. Participants were able to identify where they live and its proximity to areas of environmental concern.

The second location offered activities covering: seafood safety and human health (including preparation of and sampling flounder), Long Island Sound public issues, and vocational aquaculture education opportunities available at the Sound School (a marine oriented high school).

Ten young people also participated in a week-long summer marine camp which provided additional opportunities to learn about the Quinnipiac River and have fun.

1994-95

The first day involved all participants learning about water safety, handling a canoe, and the water cycle and pollution.
Participants discussed how water moves through the water cycle and a watershed, using the different parts of the Quinnipiac River Watershed as examples. They also discussed different uses of water within the watershed and ways water gets polluted. The session finished with a brief training period on how to test water quality using a simple field kit.

A cruise aboard the Quinnipiak allowed participants to: observe human activities within New Haven Harbor, use scientific instruments to examine bottom sediments and measure dissolved oxygen, water salinity and pH, and collect marine life. On-board activities also covered sail training and navigational principles and skills.

Canoes were used to explore a fresh-water section of the river where they were tested for dissolved oxygen, water salinity, and pH. They observed the upper river's topography, vegetation and aquatic animals and compared these to the conditions in the river's marshes in North Haven. Experiencing and navigating the upper river's rocks, fallen trees and shallow water areas provided opportunities to learn about these areas as well as to develop canoeing skills.

Canoeing the estuarine North Haven marshes provided opportunities to conduct water tests and compare findings with those of the river's fresh-water section. Strong winds and a change in the tidal flow allowed youth and leaders to test their new knowledge navigating canoes.

There were two activities at Lighthouse Point Park. In the first, the park ranger conducted a workshop on compasses and navigating by compass bearings. The second was an exploration of a tidal creek.

There was discussion of the different sections of the Quinnipiac River Watershed that were visited during the project. Youth and leaders agreed that the upland canoe trip was their favorite activity.

1993-94

Two days of training were held for community program youth staff and volunteers. Topics covered were: 1) goals and requirements; 2) description of the boat trip, laboratory work, field trips, use of aquaria, and youth community projects; 3) orientation to the environment, Long Island Sound, Quinnipiac River Watershed and New Haven Harbor, and pollution; and 4) discussion of resource materials.

An educational vessel was utilized to explore New Haven Harbor focusing upon water quality, harbor sediments, and marine life. A field tour of the watershed provided opportunities to observe and learn about a variety of resources and human activities including food production (oystering, lobstering and fin fishing), waste disposal, power generation, a wildlife refuge, transportation facilities, and residential areas. There were also discussions about these activities' impacts upon the watershed and marine ecosystems.

The four community youth programs participating in the project were each provided with an aquarium representing the New Haven Harbor ecosystem. Youth at the community centers were able to observe estuarine animals and conduct several water-quality tests with their on-site aquaria.

Multi-agency Collaboration

Like many successful educational programs, the Quinnipiac River Urban Youth and the Environment project involves partnerships. The basic approach has been to develop collaborative educational efforts involving educational organizations, neighborhood youth centers, marine firms, and public agencies.

Three years of funding have been obtained from the Quinnipiac River Fund of the Community Foundation for Greater New Haven. Continuing support has been provided by the University of Connecticut Cooperative Extension System and Schooner, Inc. (a marine education program) while Sea Grant provided development fund support during the project's first year.

Instructional activities have been contributed by Cooperative Extension, Schooner, Sea Grant, Tallmadge Brothers Oyster Company, Sound School Vocational Aquaculture Center, National Marine Fisheries Service, Fort Nathan Hale/Black Rock Fort Association, New Haven Parks and Recreation, University of New Haven, Environmental Science Program, and Project Oceanology.

A major partner in the continuing effort has been the 4-H SPACES Initiative and community youth programs. Seven youth programs which have involved youth staff and volunteers are: Newhallville Family Support Center, Students United for the Rebirth of Excellence, Farnum Neighborhood House, Church Street South Youth Diversion Program, The Natural Guard, Hill Cooperative Youth Service, and LEAP (Leadership, Education, and Athletics in Partnership). Several programs have participated for three years while others were involved for one to two years.

Summary

Multi-agency collaboration has been viewed as a major strength. Each cooperator continued a unique educational component to the project and most activities have been carried out by the respective programs as part of their on-going educational efforts.

Youth participants benefitted from exposure to different activities and perspectives provided by marine and aquatic educators, public agency researchers, marine and aquaculture firm representatives, high school teachers, Extension educators, and Coast Guard personnel. A combination of field exploration and experimentation, classroom instruction, and shore, canoe and boat trips contributed to achieving project objectives.

The multi-agency effort required a significant project coordination effort to ensure that all the activities were occurring on schedule. The number of participants per year was reduced to allow increased interaction with each participant. This resulted in a more effective educational situation.

The Quinnipiac River Urban Youth Project continues to develop through collaborative activities involving community youth pro-grams, Schooner, Cooperative Extension, and Sea Grant. A Summer Science Camp with SPACES and Schooner will be implemented during 1996, funded by a National Science Foundation grant. Program collaborators are reviewing funding sources that could support a broader program providing continuing opportunities for urban youth to explore nearby environment, science and related careers.

Norman K. Bender
University of Connecticut
Cooperative Extension System
562 New London Turnpike
Norwich, CT, USA 06360

Ph (860) 887-1608
Fax (860) 886-1164
Email nbender@canr1.cag.uconn.edu

NATURE-BASED TOURISM DEVELOPMENT IN SOUTH CAROLINA

Robert H. Bacon, South Carolina Sea Grant Extension Program and
Tamela Kibler, S.C. Sea Grant Extension Program

Tourism is now a $13 billion industry in South Carolina, with about $7 billion of that total generated in three of the state's eight coastal counties. The industry's growth represents both opportunities and challenges for natural resource conservation and rural economic development on the coast.

Tourism development on the South Carolina coast is clustered in three areas: Myrtle Beach on the north coast, Charleston on the central coast, and Hilton Head in the south. Between Myrtle Beach and Charleston lies the Santee River delta and the Francis Marion National Forest. Just south of Charleston, along U.S. Highway 17, is the ACE Basin, a 350,000 acre expanse defined by the basins of Ashepoo, Combahee, and Edisto Rivers.

A thriving tourism industry combined with abundant and relatively undeveloped natural resources and the state's location within a day's drive of almost half the population of the U.S., to make South Carolina an ideal domestic nature-based tourism destination. But for all its potential, nature-based tourism, if not carefully planned for and managed, could harm the resources it depends on. Therefore, the challenge is to engage all stakeholders in the development of a nature-based tourism industry to integrate, or balance, the need for economic development in rural coastal areas with the need to conserve our natural resources. This is a strategy of inclusion, consensus and optimization.

"Nature-based tourism is responsible travel to natural areas which conserves the environment and improves the welfare of people." This is the Ecotourism Society's definition of "ecotourism" and also the definition adopted in S.C. by the S.C. Nature-based Tourism Association (SCNBTA) for "nature-based tourism." Why is this kind of tourism variously called ecotourism or nature-based tourism? Perception is reality. In South Carolina, nature-based tourism organizers feared that an "eco" label might cause the concept to be misperceived as a sign of exclusivity by more conservative or traditional natural resource users such as campers, hunters, and fishermen. Organizers also reasoned that because the key element of the definition of both eco- and nature-based tourism is conservation, then hunting and fishing (both well managed, and thus non-consumptive of total resources) could be considered a subset of nature-based tourism. Organizers decided to include the broad spectrum of activities under the umbrella of nature-based tourism so that it would not seem to be exclusive or elitist in concept or practice, believing that the place from which to educate is from within the organization.

Achieving a balance of economic development and natural resource conservation through nature-based tourism requires good planning involving all stakeholders, including rural residents, public and private natural resource managers, tourism businesses, and tourists. The key to good planning for nature-based tourism lies in matching activities with the most appropriate natural resource areas. More sensitive natural resource areas might be appropriate for very low impact activities of small numbers of wilderness campers, for example. Less sensitive areas might be developed into nature and visitor centers with interpretative programs able to accommodate large groups, the disabled, elderly, and others requiring more infrastructure (parking lots, ramps, walk ways, etc.).

Ross Dowling outlined a process for such matching [Journal of Sustainable Tourism Vol. 1(1), 1993] in "An Environmentally-based Planning Model for Regional Tourism Development." Dowling's model is now being examined for its potential as the basis for a joint effort by the S.C. Department of Natural Resources, the S.C. Department of Parks, Recreation and Tourism, and the S.C. Sea Grant Consortium to create a nature-based tourism plan for the ACE Basin region.

Nature-based tourism became a focus of attention in South Carolina in 1990 when Margaret Davidson, S.C. Sea Grant Consortium director, and Robert Becker, director of the Strom Thurmond Institute at Clemson University, began to look at the changing fabric of the state's rural coastal communities. Davidson and Becker began to consider rural development alternatives which tended both to conserve cultural and natural resources and offer opportunities for economic growth. Nature-based tourism is one such alternative.

In partnership with the National Coastal Resources Research Institute (NCRI), Davidson and Becker began to explore nature-based tourism as a tool for rural economic development on South Carolina's coast. In their initial work investigators began to identify nature-based tourism businesses already in existence. They interviewed the operators and began to understand something of both the challenges they faced in operating their businesses and the things which made them successful. Investigators also attempted to draw a socio-economic profile of nature-based tourists with an interest in nature photography. The goal was to identify a segment of the nature travel market and help operators target that group in their marketing efforts.

Continuing the partnership with NCRI in 1992, Robert Bacon and Lorin Toepper, then director of Clemson University's Recreation, Travel and Tourism Institute created an outreach mechanism for previous and future nature-based tourism information in South Carolina. Bacon and Toepper established a pilot Grand Strand nature-based tourism organization using the concept of "satellite" nature-based tourism development. The concept of satellite nature-based tourism development uses the existing tourism base in the Myrtle Beach area to draw visitors into adjacent rural areas for, at least, part of their visit. Nature-based tourism, as a niche market, enhances the existing tourism industry by expanding the available product mix, diversifying the kinds of activities offered and offering a product which is viable in the off-peak fall and winter seasons. Nature-based tourism benefits rural areas by providing a flow of visitors to local shops and restaurants, and creates business opportunities for residents with knowledge of local natural resources. Such nature-based tourism entrepreneurs, who may be the sons and daughters of farmers or fishermen, could use their familiarity with local streams, rivers, and marshes to start a canoe livery or wildlife guide service. Entrepreneurs might also establish bed and breakfast inns or "eco-lodge" accommodations.

Day-visits by nature tourists provides an initial flow of visitors into rural areas, stimulating an increased demand for products and services which can lead to the development, or expansion, of a variety of small local businesses. The emphasis on local businesses is important, because nature-based tourists enjoy experiencing both natural and cultural resources with the local flavor which helps to make these resources unique.

The success of the Grand Strand task force stimulated interest in creating a statewide organization. Bacon, Toepper, Kibler, and the members of the Grand Strand task force organized the state's first nature-based tourism conference in March 1993. The conference speakers addressed the potential impact of nature-based tourism on local businesses and communities, and extended much of the information gathered through Davidson and Becker's earlier project, including a socio-economic characterization of the nature-based tourist. The conference provided a first opportunity for existing nature-based business operators to meet and exchange ideas. It also drew participants from the established tourism industry, providing an opportunity for them to become acquainted with the potential benefits to them of nature-based tourism. The conference received wide press coverage in local newspapers and appeared in "USA Today's" Around the Nation section.

The S.C. Nature-Based Tourism Association (SCNBTA) was formally established at the second statewide nature-based tourism conference in March 1994. Officers were elected, and a constitution and by-laws adopted. The association was formed as primarily an educational organization to encourage and plan for sustainable nature-based tourism. Organizational objectives include the establishment of voluntary standards and practices; the development of interpretative quality control mechanisms; the development of in-service training for natural interpreters; the provision of business assistance to members; the planned development of a nature-based tourism industry in S.C. including all stakeholders in the planning process; and enhanced industry impact through collective marketing and promotion activities.

Prior to the election of association officers, much of the leadership for nature-based tourism organization was undertaken by Bacon, Toepper, and Kibler in conjunction with their NCRI grant. Between the first and second conferences, Bacon, Toepper, and Kibler identified leaders to form the slate of nominees to head the association. The nominees included: for president, Charlie Sweat, the chair of the Edisto Canoe and Kayak Trail Commission; for vice president, Jim Koenig, the director of Camp St. Christopher, a barrier island environmental education program; for secretary, Tim Todd, the president of the S.C. Association of Tourism Regions; and for treasurer, Vicki Scott, an interpreter/guide from Capt'n Dick's Explorer Cruises, a nature tour operator in Murrell's Inlet. The slate of nominees became the association's first elected officers in March 1994. Bacon, Kibler, and Norman, Toepper's successor at RTTI, all now serve on an advisory board appointed by the president.

In 1994, based on the interest generated by the first nature-based tourism conference, Bacon and Toepper were able to secure a place for nature-based tourism on the program of the S.C. Governor's Conference on Travel and Tourism, the industry's largest and most prestigious event. Bacon and Toepper assembled an international panel from business and academia to address the audience on the nature-based tourism market and the issue of sustainability in tourism development.

Meanwhile, in 1993 Davidson and Bacon convened a group including academics, business people, and public and private agency representatives to consider how to plan for and manage sustainable nature-based tourism in South Carolina. The outcome of a series of meetings which took place over a year's time was "Guidelines and Recommendations for Nature-Based Tourism Planning and Practice in South Carolina." The guidelines were developed to address the roles of communities, resource managers, tourism businesses and tourists in contributing to a sustainable nature tourism industry.

The SCNBTA membership formally adopted the guidelines at the third nature-based tourism conference in 1995. The guidelines constitute the association's official set of standards and practices to guide the industry's planning activities and the member's sustainable business practices. The guidelines were published by the association with the assistance of NCRI and the S.C. Sea Grant Consortium and distributed to the membership, in response to mailed requests from around the country and at tourism industry gatherings, such as the 1996 S.C. Governor's Conference on Travel and Tourism. South Carolina's fourth nature-based tourism conference will be held in November 1996 in Myrtle Beach.

In 1996, NCRI has again funded a joint two-year project of the SCNBTA, S.C. Sea Grant Extension and Clemson's RTTI. The project is designed to create, market, and evaluate nature-based vacation packages and itineraries. Susan Reid, the S.C. Sea Grant Extension Community and Business Development Specialist, joined the project staff in planning this project. The goal of the project is to transform an unrelated series of nature-based tourism activities into coordinated nature vacations.

In order to enhance the attractiveness of S.C. to nature tourists and establish South Carolina as a nature tourism destination, the project planners reasoned that it was necessary to promote the entire industry and provide easy access to its individual businesses. The creation of a S.C. Nature-Based Tourism Business and Resource Directory will provide nature tourism businesses and nature travelers with the same benefits. In addition, the directory will serve as a membership tool for the SCNBTA. Again, the project is modeled after another successful publication, the "Bed and Breakfasts of South Carolina." This guide was published by the S.C. Bed and Breakfast Association with grant support from the S.C. Parks, Recreation and Tourism Department. Because it was produced with state money, the guide must list all bed and breakfast inns, not just association members. Members, however, receive enhanced listings which include promotional tag lines, the association logo and a designation of association approval. Non-members are simply listed by name address and phone. Nature-based project organizers are working with the staff person at SCPRT who assisted the bed and breakfast association with its guide.

Bacon, representing the SCNBTA, has applied for a 50/50 matching grant from SCPRT under its Tourism marketing Partnership Program to help support the development and marketing of the nature-based tourism guide. The guide will be produced in a standard rack compatible 4 x 9 inch format. The guide will also be created on-line for worldwide web access and facilitate updated listings between hard copy revisions. Norman is directing the data collection effort for the guide and is now supervising a pilot project to create a guide for the Grand Strand region. Kibler, working with a student from Coastal Carolina University, is testing data collection formats and methods in preparation for the statewide effort scheduled to begin this summer. The anticipated publication date for the guide is November 15, 1996, in conjunction with the annual SCNBTA conference. The back-up date is in early February 1997, in conjunction with the S.C. Governor's Conference on Travel and Tourism.

The "SC Nature-Based Tourism Business and Resource Guide" will be distributed by the Association and SCPRT at travel industry trade shows; at S.C. Welcome Centers; by mail in response to individual inquiries; at individual businesses; in state parks; and via the world-wide web through the linked home pages of the S.C. Sea Grant Consortium, the S.C. Parks, Recreation and Tourism Department and the State of South Carolina. The guide is also designed to be used by travel agents and receptive tour operators in assisting them and their clients with vacation and tour planning.

Finally, the SCNBTA has begun to address issues of quality control in the interpretation of natural resources through a series of educational seminars. These seminars are being conducted under the direction of SCNBTA Vice President Jim Koenig, director of Camp St. Christopher and environmental learning center on Seabrook Island, in collaboration with the education program staff of the SC Department of Natural Resources' Marine Division. At these seminars, natural resource scientists from the department and the state's universities will provide the state's public and private resource interpreters with in-service training to help ensure the accuracy of information provided to the traveling public. Eventually, the association would like to offer a certification program for interpreters, perhaps modeled after the one required by the City of Charleston for its historic tour guides.

In conclusion, over the past five years while many have contributed to setting the stage for the development of a sustainable nature-based tourism industry in South Carolina, much still remains to be done. Little has been done to address the issues of natural resource carrying capacity for nature travel. Although now being discussed by S.C. Sea Grant, the S.C. Parks, Recreation and Tourism Department, and the S.C. Department of Natural Resources, no regional planning process has yet begun. The SCNBTA is still a young, fragile organization which must engage and maintain the interest and participation of many more members to ensure its continued success. It must produce meaningful outcomes for its members and maintain an active voice within the tourism industry as a whole.

Today in South Carolina, economic development is paramount. The ultimate challenge in nature-based tourism development is, however, is to find and maintain a generally accepted and workable balance between economic development and the conservation of natural and cultural resources. If we can do that, we will have gone a long way toward preserving the things which have made our state an attractive and unique place in which to live, work visit and play.

Robert H. Bacon
S.C. Sea Grant Extension Program
287 Meeting St.
Charleston, SC, USA 29401

Ph (803) 727-2075
Fax (803) 727-2080
Email baconrh@musc.edu

WETLAND BUFFERS IN THE MONTEREY BAY REGION: A FIELD STUDY OF FUNCTION AND EFFECTIVENESS

Rosemary Dyste

Introduction

Wetland buffers are one way to protect wetlands from the potentially negative impact of introducing development adjacent to wetlands. In this study, wetland buffers are defined as a regulated strip of land or setback that provides open space between a development and a wetland.

Functions that buffers can provide include maintaining wetland water quality by reducing erosion and runoff and filtering toxics, a space for wildlife habitat, and a way to discourage easy human access to the wetland. The purpose of this study was to analyze the extent that buffer zones protect wetlands and to begin an investigation of the effectiveness of recommended buffer widths in the study region. This was accomplished by collecting data on buffer function indicators on 15 regulated wetland buffers in the Monterey Bay region.

The Monterey Bay region is located south of the San Francisco Bay area along California's central coast. The region, including both Santa Cruz and Monterey Counties, is an ideal geographic area in which to study the effectiveness of and impacts to wetland buffers. The diversity and natural beauty of the landscape of both counties makes them a desirable place to live, leading to extensive development and regional growth. The Bay itself supports a large population of marine species and has the largest submarine canyon in North America. The national significance of the area was formally acknowledged in 1992 when the Monterey Bay area became a federally protected marine sanctuary (California Coastal Commission, 1994). While management plans and restoration projects have been prepared or are being prepared for many of the area's diverse range of wetlands they are under the continuous pressure of development and human population growth. This combination of a desirable natural setting, development pressure, and the fairly high level of commitment that local governments show towards preserving their wetland resources makes the region ideal for studying the use and effectiveness of wetland buffer zones.

Most of the wetland buffer study sites were mostly chosen from a database of coastal zone wetland permits developed by the Santa Cruz office of the California Coastal Commission (CCC) for their 1995 Regional Cumulative Assessment Project (ReCAP). The remaining study sites were chosen from outside the coastal zone. Criteria for site selection included access to development permit information and site accessibility. The study sites research was guided by two types of questions: those relating to buffer function effectiveness and those relating to effective buffer permitting.

The specific buffer function questions were: (1) how well do current buffers prevent human impacts from adjacent development, as measured by human presence, wildlife, vegetation, and erosion indicators; and (2) what features of buffers seem to limit human impacts?

Permitting questions included: (1) do buffer widths meet the regulatory requirements; (2) are wetland buffer goals established for each buffer; and (3) has the buffer changed over time and do the permits require monitoring or a postdevelopment analysis of success?

Methods

The data for this study were collected and evaluated in 1995. The parameters selected to assess the function and effectiveness of wetland buffer zones included the level and quantity of human use including both human caused disturbances and controlled public access features, wildlife habitat features, evidence of erosion, evidence of water ponding in the buffer, and buffer vegetation characteristics. Each site was walked and thoroughly examined in the months of January, February, and July. Indicators of the selected parameters were counted, measured, and recorded. Special features were noted on a map and the sites were photographed. When possible, a linear measurement was made at each site to determine if the measurements in the field match the regulated setback stated in the permit file.

Additional information was compiled for each site by reviewing permit files and other available reports to collect wetland area history, permit conditions and history, existing wetland evaluation results, and buffer goals. Aerial photographs were reviewed to determine the size of the buffer area in acres. After the field data was collected, statistical tests were conducted to determine if the width of the buffer and the level of human intrusion were correlated and to find if the average level of human intrusion was significantly different in fenced buffer sites versus unfenced ones.

Results and Evaluation

The primary objective of the field component of the study was to assess the characteristics of selected wetland buffers in the Monterey Bay area to determine the effectiveness of wetland buffer zones in protecting the wetland from disturbance. The results of the field study show that the buffers are generally effective in protecting the wetland from disturbance; however, there is a distinct lack of maintenance and control of human access.

Erosion indicators were found at 33% of the buffer sites. Erosion appeared to be associated with either incomplete or newly completed restoration efforts or stormwater outlets in the buffer. One site showed water ponding in the buffer area and no sites showed flooding of adjacent development which may indicate that the buffers are functioning to moderate water level fluctuations. Most sites had good cover for wildlife and many had snags and cavities available. The survey of vegetation characteristics showed that the buffers were dominated by herbaceous vegetation at 66% followed by 13% scrub-shrub, 1% forest, 9% plant litter, 9% bare earth, and 2% paved surface. Nine sites have been maintained in a natural condition (native or non-native vegetation unchanged since development took place), and six have been restored or will be restored with native species.

All of the buffer sites showed some level of human caused disturbances demonstrated by the amount of garbage deposited in the buffer or the wetland and other aspects such as unauthorized trails and vegetation trampling. A Pearson's Product-moment correlation was used to determine if the width of the buffer and the level of human intrusion were related. However, the coefficient of correlation ($r = -0.25$) implied that there was little or no linear relationship between the two factors. Very few of the wetlands in the study area had planned aesthetic development in the buffer that allows limited accessibility to the wetland. One site had plans for interpretive signs and a loop trail while two other sites had observation decks or benches facing the wetland. A Student's t-test was used to find if limiting access to the buffer with a fence had an impact on the average level of human intrusion. The results showed that the sample evidence was insufficient to indicate a statistically significant difference in intrusion levels at the $a = .05$ level of significance. Although the data in this sample did not provide sufficient evidence that the width and/or fencing of the buffer influenced the level of human intrusion, further studies are warranted.

While the field study portion of the thesis was designed to assess buffer function, the research was also guided by several questions to determine if the buffers met the regulations outlined for them in the permits. It was found that there were some discrepancies between the regulated setback requirements and the observed results. While 100 feet was the standard regulatory requirement for most of the buffers, the average width was 78.5 feet. Twelve out of 15 sites were fewer than 100 feet, 1 site was 100 feet, and 2 sites were over 100 feet. It was also found that accurate width measurements were difficult to make due to lack of standard maps in the permit file, ill-defined statements about where the buffer begins and ends, and physical barriers to making measurements.

The permit files, management plans, and restoration reports were searched to determine if wetland buffer goals statements were established for the buffer area. Clear, measurable goals were mostly lacking. Two sites had erosion prevention as a specific goal, enhancement or protection of natural areas was a goal for seven sites, and controlling access was a goal for five sites. No goals were found for four sites. In addition to goal statements, the permits were examined to determine if monitoring or a postdevelopment analysis of success was required. It was found that monitoring and maintenance is not required at most of the study sites. Where monitoring is required (two sites) or recommended (two other sites) it is in conjunction with restoration efforts. One monitoring report contained measurable criteria for success of restoration of the buffer. Several sites are maintained by public works departments that mainly are responsible for clearing storm drains or detention ponds.

Conclusions

The conclusions based on the field study (Table 1) suggest that the wetland buffers in the study region are generally effective in preventing erosion, moderating water level fluctuations, and providing wildlife habitat. On the other hand, the wetland buffers are not preventing human intrusion and the opportunities for education, recreation, and aesthetic enjoyment of the wetlands are limited or not used to their best advantage. The regulatory process needs to be improved and more data is needed to make better judgments on buffer function and effectiveness. Direct observation showed that there was little evidence of erosion in the buffers that would lead to excess sedimentation in the wetlands. The vegetative cover at most of the sites is good and effective at preventing erosion. The buffers are used by birds, reptiles, and small mammals. Habitat features such as snags, cavities, brush, and cover are available. Due to the degree of urbanization surrounding these wetlands, they may be providing important wildlife habitat. Unfortunately, the important habitat features may be compromised by the lack of maintenance and control in these sites leading to garbage and yard waste dumping and unregulated trails. In addition, there was a lack of improvements that would channel human access and enhance human use.

Results from the permit evaluation showed that the permit files and the regulatory process by which buffer size is determined could be improved. Based on the permit file examination portion of the study, the research showed that there is not enough data in the files on baseline conditions and location maps are either missing or insufficient. The lack of predevelopment site information made it difficult to determine if introducing development adjacent to the wetland had a detrimental effect. Without a standard map demarcating the buffer it was difficult to determine the location and actual size of the buffer. In addition, the regulatory requirements for buffers are not explicit enough. There is no standard way of measuring buffers and the terms used to demarcate the buffers are not defined. Goals are not clearly stated and postdevelopment maintenance or monitoring is not required unless the buffer has been restored.

Recommendations

The following recommendations are suggestions to improve the effectiveness of wetland buffers in the Monterey Bay area. Responsibility for the suggested procedures can be divided among developers, regulators, the public, and the academic community. Implementation of the suggested recommendations is not exclusively the responsibility of one particular group; responsibility is best shared between the different stakeholders. The property developers can become responsible for improving water quality protection and wildlife habitat, and controlling human use. Regulators can improve the regulatory program, guide the developer's projects, and help educate the public. The public can become involved in education and maintenance through volunteer efforts and interest in their natural surroundings. Lastly, the academic community can educate the public and conduct further research to expand our knowledge of wetlands and their surrounding uplands.

Recommendations associated with the data findings include channeling human access, removing or improving the stormwater drain outlets in buffers, and improving the permitting procedure. Human access can be channeled with fences, carefully planned pathways, and observation platforms. Access features should be inspected periodically to ensure that the area is not damaged by public contact. Stormwater drain outlets can be improved with structural means to mitigate impacts such as sediment traps or in nonstructural manner such as planning the development to minimize runoff. The permitting procedures for wetland buffers could be improved with standard maps, statements of measurable goals, and more explicit definitions. Additional recommendations include encouraging restoration with native species, educating the public on the resource quality of wetlands and related uplands buffer area, maintaining the wetland buffers with a volunteer clean-up program, implementing variable buffer zones based on a minimum fixed width with the variability based on specific criteria, and improving practices in the watershed.

In summary, this study provided a portion of the information that is needed about wetland buffers. Effective, functional buffers are needed to protect environmentally sensitive areas. While size is an important criteria when designing wetland buffers, it is also important to consider impacts to the wetlands from beyond the buffer boundary. Goals for the buffer must be clearly stated with measurable criteria for success. Lastly, buffers themselves need to be valued for the functions they provide and as habitat for wetland-dependent species.

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Rosemary Dyste
509 Buena Vista
Santa Cruz, CA, USA 95062

Ph (408) 423-2188
Email Rosiedy@aol.com

Table 1—Data Findings Summary

Function	Indicator Methods	Results	Conclusions
Erosion prevention	Count and measurement of rills and gullies	33% of sites showed some sign of erosion	-poor revegetation effort -stormwater outlets in buffer
	Average vegetation cover estimation	Average cover for all sites is 89%	+good vegetative cover
Wildlife Habitat	Wildlife habitat features noted, single direct observation of species	Brush or cover present at 93% of sites, snags or cavities at 67%, burrows in 20%, and animal trails in 27%	+good habitat indicators -too much non-native vegetation
Human use (uncontrolled)	Indicators of human use counted	Garbage found in 80% of sites, yard waste in 27%, and human trails in 60%. No campfires found	-lack of maintenance and controls -lack of improvements
Human use (controlled)	Human access control features counted	Two sites have controlled access paths, 2 have signs, 5 sites are fenced and 5 have observation decks or benches	+good when present -could be improved
Moderation of water level fluctuation	Indicators of ponding or flooding observed	One site had water ponded in the buffer, no flooding observed	+occurs but not enough data available

BACTERIOLOGICAL SURVEY OF THE SNOHOMISH RIVER ESTUARY AND ADJOINING STEAMBOAT SLOUGH

Adrienne Huston, University of Washington

Past studies have shown that the quality of some water bodies in the Snohomish River Watershed have violated water use standards. Bacteria, which are found in the intestinal tracts of certain warm-blooded species, have been identified as pollutants. Four river stations and five slough stations in the Snohomish River and adjoining Steamboat Slough were surveyed for existing levels of bacteria. Levels of total coliforms, fecal coliforms, and fecal streptococci were significantly higher in Steamboat Slough than in the Snohomish River. Fecal coliform levels in both water bodies were much lower than water quality standards. The data suggest that Ebey Slough may be a source of fecal coliform contamination to Steamboat Slough.

Introduction

In 1992, the Washington State Department of Ecology (DOE) assessed the existing water quality of various waterbodies (Washington State Department of Ecology, 1992), and concluded that the Snohomish River did not have sufficient water quality to support its designated uses of primary and secondary recreation or fish spawning, rearing, harvesting, or migration. Pollutants identified by DOE were bacteria, sediment, low oxygen, and metals. The bacterial standards state that the geometric mean value of fecal coliforms shall not exceed 100 org/100ml for class A waters, and that more than 10% of the samples shall not exceed 200 org/100ml (METRO, 1989).

Fecal coliform bacteria are found in the gut or feces of warm-blooded animals. Their presence in the environment is used as an indicator of recent contamination by sanitary wastes. While most species of the fecal coliform group are not pathogenic themselves, as the number of fecal coliforms increases, the probability of pathogenic organisms occurring also increases (Cirone-Storm, 1983). Point sources of bacteria to the Snohomish River, according to Cirone-Storm (1983), may include sewage treatment plans and combined sewer overflows (which collect urban storm runoff as well as sewage overflows). Non-point sources may include runoff from agricultural and urban lands, as well as industrial effluents.

Microbiological testing of water assesses the processes that regulate the distribution of bacteria in a water body. Standardized tests as described by the American Public Health Association (1975) have been created for this purpose. In the present study, the concentrations of Most Probable Numbers (MPNs) of fecal coliforms, total coliforms, and fecal streptococci are given for sampling stations along the Snohomish River Estuary as well as Steamboat Slough. The ratios of fecal coliforms to fecal streptococci (FC/FS) were determined in order to indicate the source of the bacteria (they live in the intestinal tract of different warm-blooded animals in different concentrations). For example, the following FC/FS ratios are given by American Public Health Association (1975): humans 4.4; ducks 0.6; sheep, chicken, and pigs 0.4; cows 0.2; and turkeys 0.1. The obtained ratios will be interpreted loosely, however, because the American Public Health Association (1989) found that the method may not be reliable in determining fecal bacterial origin.

The study hypothesized that because total coliform, fecal coliform, and fecal streptococci distributions are primarily influenced by the hydrography as well as point and nonpoint sources, levels of these bacteria will be higher in the sloughs than in the Snohomish River Estuary (due to the surrounding land uses as well as extensive diking of the Snohomish River Estuary which inhibits nonpoint source contamination). Due to purposes of simplicity, the Snohomish River Estuary will be referred to as the mainstem in the remainder of the document. Furthermore, the FC/FS ratios were expected to be lower in Steamboat Slough due to the surrounding agricultural lands.

Methods

Surface water samples were taken at four stations along the mainstem of The Snohomish River on April 4, 1995, as well as five stations along Steamboat Slough on April 5, 1995. Sampling sites on the mainstem were chosen so as to sample through the salt wedge and obtain a survey of the river from a freshwater end-member (Station MI) to a station adjacent to the mouth of the Snohomish River Estuary (Station MIV). The sampling sites on Steamboat Slough were placed adjacent to strategic waterway junctions as well as other potential contamination sources. Duplicate samples were taken at each station.

Selective media for growing total coliforms, fecal coliforms, and fecal streptococci were purchased from Difco and diluted according to standards as described in American Public Health Association (1975). To determine the levels of total coliform, fecal coliform, and fecal streptococci bacteria, the Most Probable Number's were determined by the Multiple Tube Fermentation Test (American Public Health Association, 1975). Confirmed MPN's per 100 ml were calculated using tables found in American Public Health Association (1975). It is important to note that MPN's are an estimate based on probability formulas, and are not an actual enumeration of bacteria cells (Murphy, 1991).

Analysis of Variance was performed on log transformed bacterial data to determine if significant differences exist between bacterial levels: within the mainstem, within the slough, and between the mainstem and slough.

Results

Surface salinity in the mainstem ranged from 0.043 0/00 at station MI to 6.859 0/00 at station MIV. These measurements were taken during high tide. The surface water was well-mixed at stations MI-MIII because the surface water of these stations lay above the effects of the salt wedge during high tide (Figure 1). Station MIV had a higher salinity because it was situated in the salt wedge. Assuming no tidal influence, the average flow rate of water through the area sampled was approximately 404.3 m3/s during the time of sampling in the area sampled (M. Cook, pers. comm., 1995). This corresponds to a residence time estimate of around four hours for water in the area sampled between stations MI and MIV (Figure 1). The residence time of this water body including tidal influence could not be calculated due to a lack of data, however, it is thought to be on the order of less than one day, regardless of stage in the tidal cycle (M. Swapp, pers. comm, 1995).

The surface salinity values in Steamboat Slough ranged from 0 o/oo at station SII to 2.442 o/oo at station SV. The water between stations SI and SII remained fresh throughout the depth profile and appears unaffected by the tides. The circulation patterns between stations SII and SV are more complex. During ebb tides, a layer of fresh water flows seaward on the surface throughout the area sampled, but during flood tides, effects of the salt wedge travel up past station SIII into Ebey slough (M. Swapp, pers. comm., 1995). The residence time of water in Steamboat Slough between stations SII and SV ranges from 2-13 hours depending on the stage of the tide. The residence time between stations SI and SII is approximately 3-4 hours, independent of tidal effects (M. Swapp, pers. comm., 1995).

Levels of total coliforms, fecal coliforms, and fecal streptococci in MPNs/100 ml from the mainstem and Steamboat Slough can be seen in Figure 2. Results of Analysis of variance tests can be seen in Table 2.

Discussion

The lower stem of the Snohomish River is characterized by a strong salt wedge characteristic of a partially-mixed estuary which reaches up to 10 km upstream of the mouth of the river. The salt wedge affects surface circulation patterns which determine where impacts of fresh water runoff (potential bacteria sources) will occur. Stations MI-MIII lie in an area where the surface water is unaffected by the salt wedge even during high tide (Figure 1). Therefore, during high tide and low tide, bacteria found in the surface water at stations MI-MIII are most likely to have originated from sources either adjacent to the sampling sites, or upstream of the sampling sites. Bacteria levels at station MIV, however, may be affected by the tidal influence. Therefore, bacteria levels found at this station may originate from sources downstream in addition to the sources previously mentioned. During low tide, of course, all of the stations remain unaffected by the salt water intrusion. The area sampled flushes quickly (the residence time is thought to be less than one day) and may not allow a build-up of bacterial contaminants.

The circulation and hydrography of Steamboat Slough is more complex. The depth profiles of uniform salinity between stations SI and SII suggest that there is no tidal influence in this part of Steamboat Slough (Figure 1). Instead, during flood tides, the tidal influence appears to divert away from Steamboat Slough just downstream of station SII and travel up Ebey Slough (M. Swapp, pers. comm., 1995). Therefore, surface bacteria concentrations in the section between stations SI and SII are affected by surrounding land uses as well as sources upstream, regardless of the tidal cycle. Surface bacteria concentrations at stations SIII-SV are influenced by sources along the upper parts of Steamboat and Ebey sloughs during ebb tides, and depending upon mixing, may be affected by sources near the mouth of Steamboat Slough during flood tides.

The geometric mean of fecal coliforms in the mainstem was 1.52 MPN/100 ml, which is well below the water quality standard of 100 org/100 ml for class A waters. Because there existed no significant differences within total coliform or fecal coliform MPN's between the mainstem stations, there appear to be no point sources of these bacterial contaminants to the mainstem in the area sampled. Curiously, levels of fecal streptococci were significantly higher ($p=.05$) at station MIV, the most saline downstream location. The viability of fecal bacteria generally decreases with increasing salinity. Assuming that the bacterial growth rate is matched by the rate of grazing on bacteria (Skinner, 1992), the bacteria are expected to act conservatively once they are in the river. The slightly higher levels of total coliforms, and significantly higher levels of fecal streptococci at station MIV, may be a result of concentrated man-made surface runoff features as well as industrial sites on the shore adjacent to station MIV (Tetra Tech, 1988). The mean FC/FS ratios in the mainstem ranged from 0.78 to 2.25. This range of values makes it difficult to pinpoint the biological sources of contamination. The existing FC/FS ratios are may be a result of a mixture of contaminant sources including livestock, water fowl, and humans.

The levels of total coliforms, fecal coliforms, and fecal streptococci were all significantly higher in Steamboat Slough than in the mainstem. This suggests that either sources of contamination to Steamboat slough are more prevalent or that the slough is more susceptible to contamination due to less effective diking. Much of Steamboat Slough is surrounded by agricultural land where livestock graze; surface runoff from these areas may provide significant non-point contamination to the slough. The mainstem, on the other hand, is bordered by the City of Everett, where chances of bacterial contamination are lower. Furthermore, weather may play a role in affecting the bacterial levels measured. It rained all day during April 4th, which may have significantly increased the surface runoff on April 5th, which corresponds to the sampling date of Steamboat Slough. Therefore, the relatively higher levels of bacteria in Steamboat Slough may be attributed to relatively higher levels of surface runoff during the sampling time of Steamboat Slough. The FC/FS ratios in the slough were not significantly different than those in the river. Therefore, as in the mainstem, the bacteria are likely due to a mixture of biological contaminant sources.

There were no significant differences within total coliforms and fecal coliforms between the stations in the slough. This suggests that these bacteria stem from non-point sources. However, station SIII had significantly higher levels of fecal coliforms ($p=.10$), than did any of the other slough stations which suggests a more concentrated source that was not sampled. Station SIII is situated adjacent to an inlet connecting Ebey and Steamboat sloughs (Figure 1). Ebey Slough may be the source of high fecal coliform levels at this station. Ebey Slough is surrounded by agricultural land, and has been known in the past to violate water quality standards. Furthermore, both Quilceda and Allen creeks flow into Ebey Slough, and both of these water bodies have bacteria levels which consistently violate water quality standards (Kathy Thornburgh, pers. comm. 1995). The geometric mean of fecal coliforms in Steamboat Slough was 17 MPN/100 ml, well below the water quality standard of 100 org/100 ml. The mean FC/FS ratio of the replicates at this station was 17.9, which suggests that human waste may be somehow responsible for the contamination at station SIII.

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Adrienne Huston
University of Washington
Department of Oceanography
5032 21st Ave NE
Seattle, WA, USA 98105

Ph (206) 524-0104
Email alhuston@u.washington.edu

	Total Coliforms		Fecal Coliforms		Fecal Streptococci		FC/FS	
station	MEAN	STERROR	MEAN	STERROR	MEAN	STERROR	MEAN	STERROR
MI	41	8	4.5	2.5	2	0	2.25	1.77
MII	38	5	3.5	1.5	2	0	1.75	1.06
MIII	31	18	2	0	2	0	1	0
MIV	64	15	4.5	2.5	9	4	0.78	0.88
SI	73.5	56.5	7.5	5.5	14.5	7.5	0.44	0.21
SII	175	65	6.5	4.5	5	3	2.88	3.71
SIII	335	205	105	59.5	6.5	1.5	17.9	11.4
SIV	90	20	56	23	12	1	4.55	2.19
SV	133	107	13.5	8.5	8	0	1.69	1.5

Table 1. Mean and standard error of Total Coliforms, Fecal Coliforms, Fecal Streptococci (MPN/100 ml), and FC/FS ratios.

STATION	F CALCULATED	F TABLE (?,?).05	F TABLE (?,?).10
MAINSTEM: TOTAL COLIFORM	0.987	F(3,4) 6.59	F(3,4) 5.34
MAINSTEM: FECAL COLIFORM	0.352	F(3,4) 6.59	F(3,4) 5.34
MAINSTEM: FECAL STREPTOCOCCI	8.515	F(3,4) 6.59 *	F(3,4) 5.34 *
MAINSTEM FC/FS	0.855	F(3,4) 6.59	F(3,4) 5.34
SLOUGH: TOTAL COLIFORM	0.757	F(4,5) 5.19	F(4,5) 3.52
SLOUGH: FECAL COLIFORM	4.023	F(4,5) 5.19	F(4,5) 3.52 *
SLOUGH: FECAL COLIFORM W/OUT SIII	2.094	F(3,4) 6.59	F(4,5) 5.34
SLOUGH: FECAL STREPTOCOCCI	1.276	F(4,5) 5.19	F(4,5) 3.52
SLOUGH FC/FS	2.861	F(4,5) 5.19	F(4,5) 3.52
M VS S: TOTAL COLIFORM	6.214	F(1,16) 4.49 *	F(1,16) 3.05 *
M VS S: FECAL COLIFORM	8.956	F(1,16) 4.49 *	F(1,16) 3.05 *
M VS S: TOTAL COLIFORM W/OUT SIII	5.955	F(1,14) 4.60 *	F(1,14) 3.1 *
M VS S: FECAL STREPTOCCI	10.746	F(1,16) 4.49 *	F(1,16) 3.05 *
M VS S: FC/FS	1.41	F(1,16) 4.49	F(1,16) 3.05
M VS S: FC/FS W/OUT SIII	0.092	F(1,14) 4.6	F(1,14) 3.1

Table 2. Summary of ANOVA Values: MAINSTEM: TOTAL COLIFORM = ANOVA of total coliform levels within the mainstem; SLOUGH: TOTAL COLIFORM = ANOVA of total coliform levels within Steamboat Slough; M VS S: TOTAL COLIFORM = ANOVA of total coliform levels between the mainstem and Steamboat Slough; * = a significant difference exists at this confidence interval (p = .05 or p = .10).

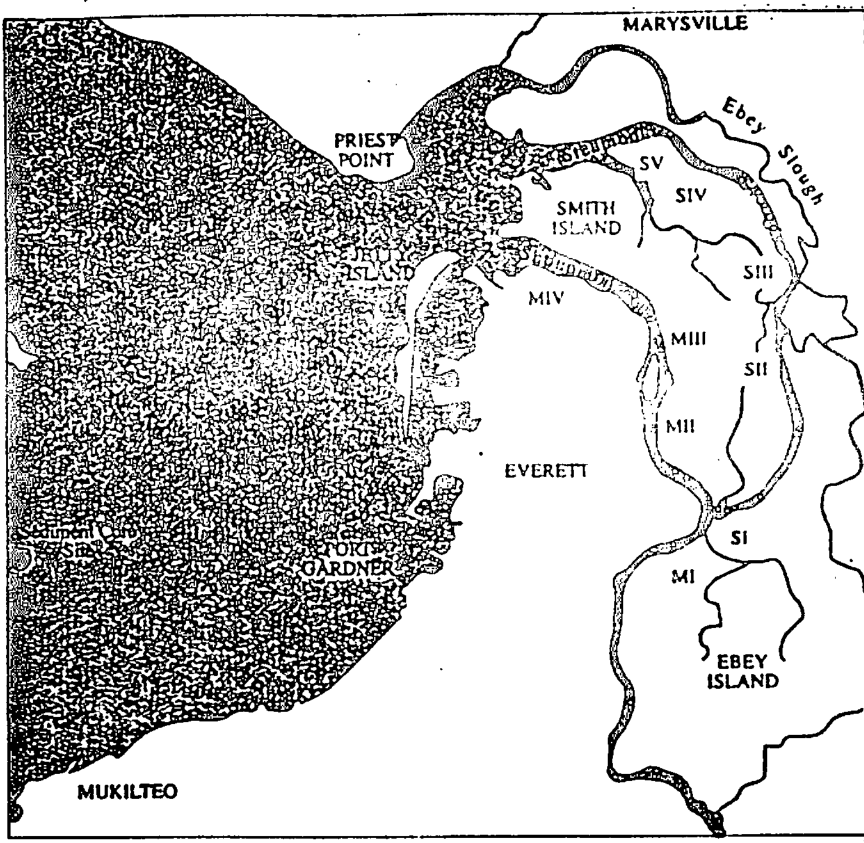


Figure 1. Sampling stations for Snohomish River and Steamboat Slough (after Shen, G.T.,1995)

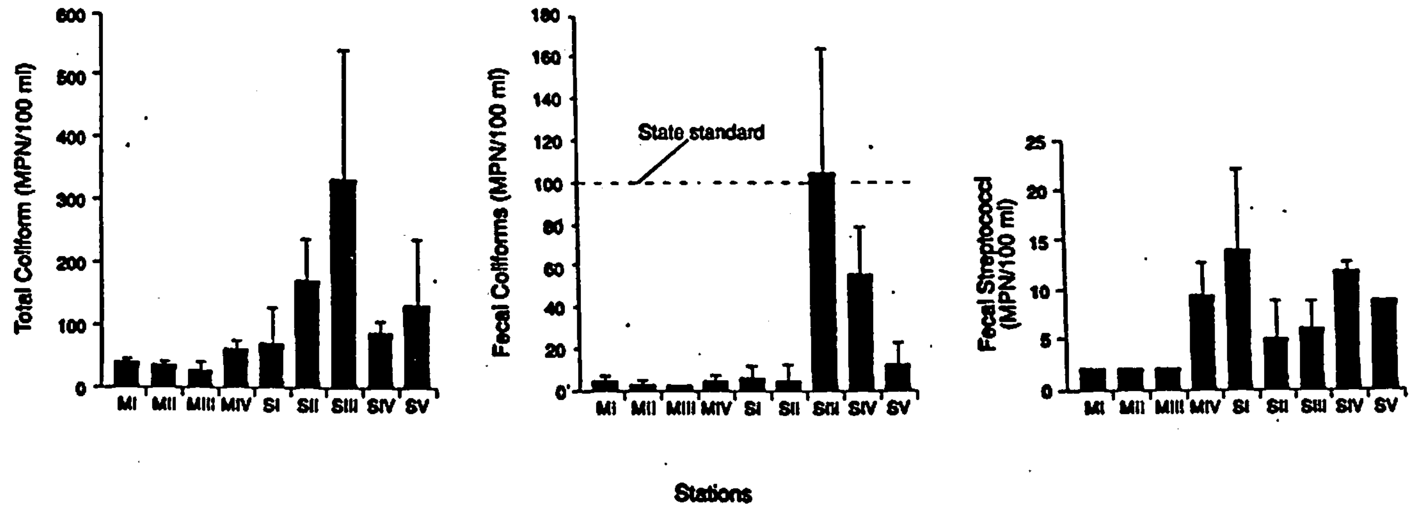


Figure 2. Mean levels of bacteria (MPN/100ml) +/- one standard deviation for total coliform, fecal coliform, and fecal streptococci. Dashed line on fecal coliform plot represents the Washington State water quality standard of 100 organisms/100 ml (geometric mean value) for Class A waters (from Shen, G.T., 1995).

THE OCRM HOMEPAGE: USING THE WORLD WIDE WEB AS A COASTAL COMMUNICATION TOOL

Joshua Lott, NOAA/National Ocean Service

Introduction

NOAA's Office of Ocean and Coastal Resource Management (OCRM) administers the U.S. Coastal Zone Management (CZM), National Estuarine Research Reserve, and National Marine Sanctuary Programs. OCRM has established a site on the World Wide Web to disseminate information to coastal managers, academics, and the public throughout the world on these programs. This poster outlines the goals and objectives of the OCRM Web site, explains its design and features, summarizes its structure, and offers conclusions on the development of the site.

Background

The Internet is a worldwide network of computer networks that communicates using Transmission Control Protocol/Internet Protocol (TCP/IP). The Internet offers electronic mail, file transfer, and access to remote servers and files. The World Wide Web (or "Web") provides "point and click" access to text files, photographs, graphics, audio and video, data, and other files on the Internet, and allows users to easily jump between remote servers and files using hypertext links. A homepage on the Web is the starting point for users to navigate the full suite of data that an organization or individual has made available on its server, or Web site. The World Wide Web has grown tremendously in recent years as universities, government institutions, private companies, and individuals have established Web sites to disseminate information, provide entertainment, promote causes, and sell products.

NOAA's National Ocean Service (NOS) established a Web site in 1994 to make available basic information on NOS and its line offices, including OCRM. Subsequently, OCRM decided to develop its own, more comprehensive site on the NOS server. OCRM began developing the Web site in 1995, and it is still a work in progress. The OCRM Web site can be reached at:

<http://www.nos.noaa.gov/ocrm>

Goals and Objectives of the OCRM Web Site

The goal of the OCRM web site is to provide information on OCRM, its programs, and coastal management issues generally, to coastal management professionals - particularly U.S. state coastal zone management program, National Estuarine Research Reserve, and National Marine Sanctuary managers and staff - and the general public. The site also allows users to interact with OCRM and it will provide recipients of OCRM funding a mechanism for on-line administration of their financial awards.

Specific objectives of the Web site are:

1) to make available relevant information in an easily understood fashion;
2) to allow users with both high and low end Web browsers to easily navigate the site;
3) to create a "common look" throughout the site to remind users of OCRM's role in the highlighted programs and to allow users to easily return to the homepage;
4) to provide a focus on OCRM's programs and activities while also providing information on each state coastal management program and National Estuarine Research Reserve site;
5) to establish a communication network between OCRM and its program partners, and among the partners;
6) to streamline OCRM's financial award processing by providing on-line administration of the awards;
7) to be a source of information on recent OCRM activities; and
8) to be a clearinghouse for coastal management information by providing links to other coastal agencies and organizations.

Design and Features of the Web Site

The design of the OCRM Web site is based on the principles articulated in the goals and objectives. To ensure that all Web users have equal access to the OCRM site, the site was designed simply. The effectiveness of a Web site depends greatly on the type of Internet connection, Web browser, and computer of the users. For example, large color photographs and complex images do not show up well on many monitors and the images may take up to several minutes to load. Also, some Web browsers cannot read certain Hypertext Markup Language (HTML) codes. Therefore, the OCRM Web site generally avoids large color photographs in favor of clip art images and icons. And, the text was encoded using a version of HTML compatible with most browsers.

A standard design format was used throughout the site. It consists of a simple header identifying OCRM and a footer containing a link back to the OCRM homepage. Each page also contains the date of the most recent update and an e-mail link to the page's author for user comments. The

Web site consists of many pages of information on diverse coastal and ocean-related topics. The standard design format reminds users that they are within the OCRM site, and illustrates OCRM's comprehensive management focus.

When completed, the Web site will contain a summary page for all 29 state coastal zone management programs and 21 National Estuarine Research Reserve sites. The standard design format will be used on these pages also to illustrate that the individual state programs/reserves are elements of the national coastal zone management program. These pages will provide an overview of the individual programs/reserves and are intended to be updated infrequently. Where a state or reserve has established its own Web site, the OCRM page will include a link to that site. The OCRM site contains summary pages for all Sanctuaries, also. Several National Marine Sanctuaries have established homepages, which are linked to the OCRM site.

OCRM works closely with other government agencies and outside organizations to administer its programs. The Web site reflects this coordination by providing links to these organizations. For example, OCRM has collaborated with NOS's Office of Ocean Resources Conservation and Assessment (ORCA) on an interactive homepage which allows recipients of OCRM funding to administer their financial awards via a Web-based reporting form. The form is located on ORCA's server and accessible through the OCRM Web site. This is a pilot project now under development. Also, OCRM's coastal hazards initiatives involve interaction with the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers, and other agencies. So, the coastal hazards description on the OCRM Web site provides links to these agencies and discusses the collaborative efforts.

Structure of the Web Site

Users of the OCRM Web site arrive first at the homepage. The homepage must contain enough information to entice users to continue through the site, but not too much text to appear boring. The homepage is composed of a mix of text, consisting largely of links to the rest of the site, and coastal-related images. The "What's New" link, a common element on many homepages, allows users to quickly find out the latest news and activities from OCRM.

Figure 1 illustrates the structure of the OCRM Web site. From the homepage users may select items that interest them, from information on coastal conservation, to OCRM's programs, to a state-by-state summary of coastal related activities.

Most of the Web site's information is devoted to OCRM's programs: the national coastal zone management, Estuarine Research Reserve, and Marine Sanctuary programs. Figure 2 shows how the Web site presents information on the coastal zone management program.

The first page in the coastal zone management section provides an overview of the program and offers links to information on individual program elements. For example, users may view and download the text of the Coastal Zone Management Act, keep informed on current federal consistency issues and send an e-mail message to OCRM's Federal Consistency Coordinator, and read a summary of individual state coastal zone management programs. Information on issues such as coastal hazards and nonpoint source pollution is also available.

Conclusions

Thus far, OCRM's experience has been limited to the development of the Web site. The site has not been operational for long enough to measure its success. To develop a worthwhile Web site, the site must have clear goals and objectives and be designed with them in mind. Also, user feedback during development is essential: OCRM gathered opinions periodically from staff and outside users of the Web site, including a presentation at a meeting of the coastal zone management program, National Estuarine Research Reserve, and National Marine Sanctuary managers last March.

To ensure that the site is useful to coastal management professionals, OCRM must focus on making the site truly interactive. That is, to enable OCRM's partners in the state coastal zone management programs, Estuarine Research Reserves, and Marine Sanctuaries to share financial award applications, performance reports, and other information with OCRM via the Web site. Currently the site is primarily a one-way street, with OCRM presenting information to the outside world. For long-term utility of the site, it must become more interactive.

Finally, OCRM must devote sufficient resources to the project to keep the site current. The site was designed to require minimal maintenance, since OCRM has limited resources. Nevertheless, regular updates are needed, particularly the "What's New" feature. Ultimately, it will be the accuracy and timeliness of information, as well as the site's potential for streamlining program administration - not the pictures and logos - that will make the site a success.

Joshua Lott
NOAA/National Ocean Service/ORCA
1305 East West Hwy.
Silver Spring, MD, USA 20910

Ph (301) 713-3117, ext. 178
Fax (301) 713-4367
Email jlott@coasts.nos.noaa.gov
http://www.nos.noaa.gov/ocrm

Figure 1: Overview of OCRM Web Site

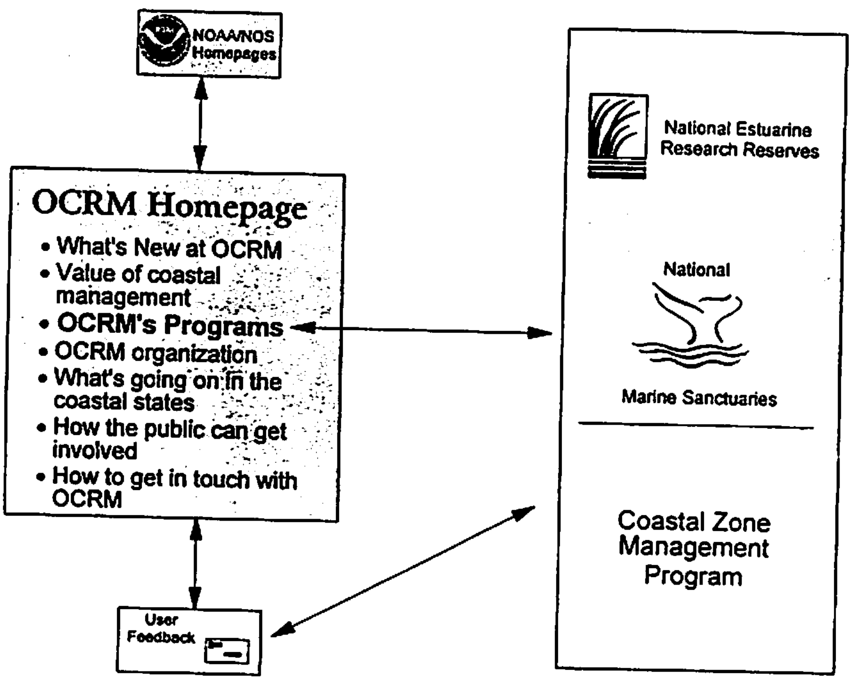
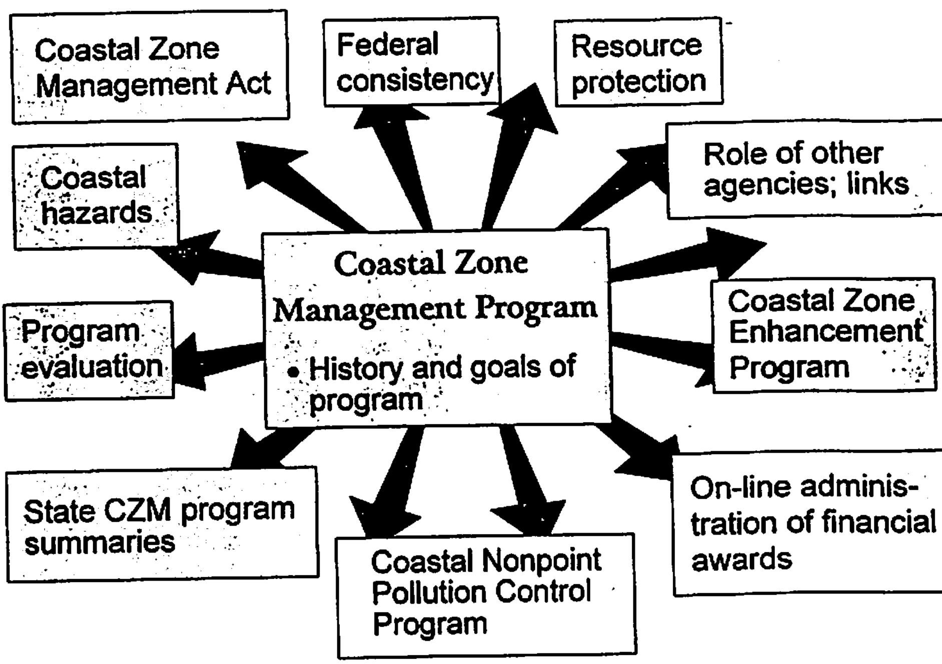


Figure 2: Coastal Zone Management Program



SURF AS A NATURAL RESOURCE: CAN IT BE REPLACED?

Chad Nelsen, Duke University and
Peter Howd, Duke University

Over the last 40 years countless surf breaks have been altered or destroyed by coastal development in California. One of the most famous cases was the destruction of a renown Southern California surfing locale, "Killer Dana," by a large system of jetties that were constructed to create Dana Point Harbor. Historically, efforts to stabilize the coast and ward off erosion hazards have ignored surfers and surf breaks. However, with increased numbers and organizations such as the Surfrider Foundation, the surfers are making their argument heard.

After 10 years of controversy over the construction of a groin in El Segundo and the degradation of surfing conditions, Surfrider Foundation, the California Coastal Commission and Chevron Corporation-El Segundo announced a collaboration to enhance surfing near the El Segundo groin (Figure 1). Through the installation of an artificial surfing reef the triumvirate intends to restore quality surfing in the area. This case marks a number of firsts. By agreeing that restoration of the surf is a compensatory resolution for construction of the groin, the California Coastal Commission is recognizing recreational surf as a natural resource worth preserving. In El Segundo the degraded surf is to be enhanced by the installation of an artificial surfing reef. Enhancement or creation of "surfable" waves by an artificial reef is an untested science so the outcome of the project is unpredictable. The success or failure of the project may set an interesting precedent for coastal management.

Thousands of shoreline engineering structures have been installed along the coasts of the world in an attempt to interrupt the littoral flow of sand, thereby slowing erosion of the "upstream" side of the structure or allowing safe entry into a harbor. By the very nature of their construction objective, shoreline engineering structures alter the nearshore beach face. As waves propagate shoreward their breaking shape and geometry are related to the shallow water bathymetry (Denny, 1988), thus alterations of the beach will affect the waves breaking on that beach. In many cases engineering structures can have a positive effect on surfing near these structures. A good example of a surfing area enhanced by an engineering structure is the Wedge, in Newport Beach, CA. Owing to wave reflection off the Newport Harbor jetty, waves at the Wedge double in height and provide a spectacular setting for body surfing. However, these structures can also have negative effects on surfing conditions, as seen in Dana Point and El Segundo. The El Segundo situation is unique because another shoreline engineering structure, the artificial reef, will be installed to enhance the surf altered by the groin.

The artificial reef will be approximately 600 cubic meters in volume and approximately 50 meters long. The reef will be comprised of large geotextile bags filled with clean sand. Depending on deployment method the size of the bags will range from about 3 cubic yards (4 tons) to 10 cubic yards (15 tons). The geotextile bags are advantageous because the reef can easily be expanded or removed dependent on the success of the project. Although the reef will be very similar to a submerged breakwater, which has a long design history, the intended surfing effects are a new objective. Because no other engineering structures have been created to enhance or create surfing in a natural setting, modeling may help predict import design parameters. In order to design an artificial reef that will enhance the surf in El Segundo and create "surfable" waves, preliminary computer modeling will investigate reef designs and locations. Modeling reef designs under differing wave climates will help test the sensitivity of the parameters involved in creating a "surfable" wave. The model includes the following nearshore wave parameters: wave height, wave period, wave direction, and beach steepness. The reef design parameters are volume, reef height, the angle of the nose, the toe steepness, and the inshore location (Figure 2). By investigating the "typical" wave climates that should produce "ridable" surf in El Segundo and modeling these conditions with multiple reef designs important parameters will be investigated.

Many of the physical processes that define a high quality surfing waves are not well understood by the scientific community. This creates an extra challenge for the engineer and emphasizes the difficulty in creating a successful surfing reef. Certain physical parameters that describe breaking type and breaking geometry in the science community may not translate to what a surfer considers a high quality surfing wave. Because of the gap in methodologies between nearshore physical scientists and the surfing community, it will be important to clearly define the criteria for success of the surfing reef. It will be necessary for both groups to come to a consensus on how to evaluate the success of the reef.

The success or failure of the artificial reef has interesting implications to coastal management and the preservation of surf "spots" as a natural resource. If the artificial reef is considered a success, will it imply that any area that known for its surfing may be altered as long as an artificial reef is installed near by to "re-enhance" the altered area. Will artificial surfing reefs be built to create surf in areas that have never had surfing? Will surf "spots" destroyed in the past be reclaimed through construction of artificial reefs? If the artificial reef is considered a failure, will that imply that "surfable" waves cannot be recreated through engineering and therefore surf "spots" must be protected as any other fragile and irreplaceable natural resource? The future of surf as a natural resource may be foreshadowed by the creation of the first artificial surfing reef.

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Chad Nelsen
Duke University
Nicholas School of the Environment
135 Marine Lab Road
Beaufort, NC, USA 28516

Ph (919) 504-7631
Fax (919) 504-4786
Email cen4@metolius.ml.duke.edu

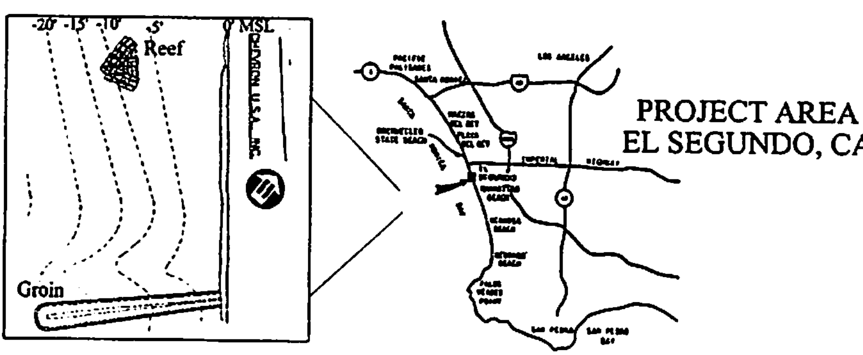
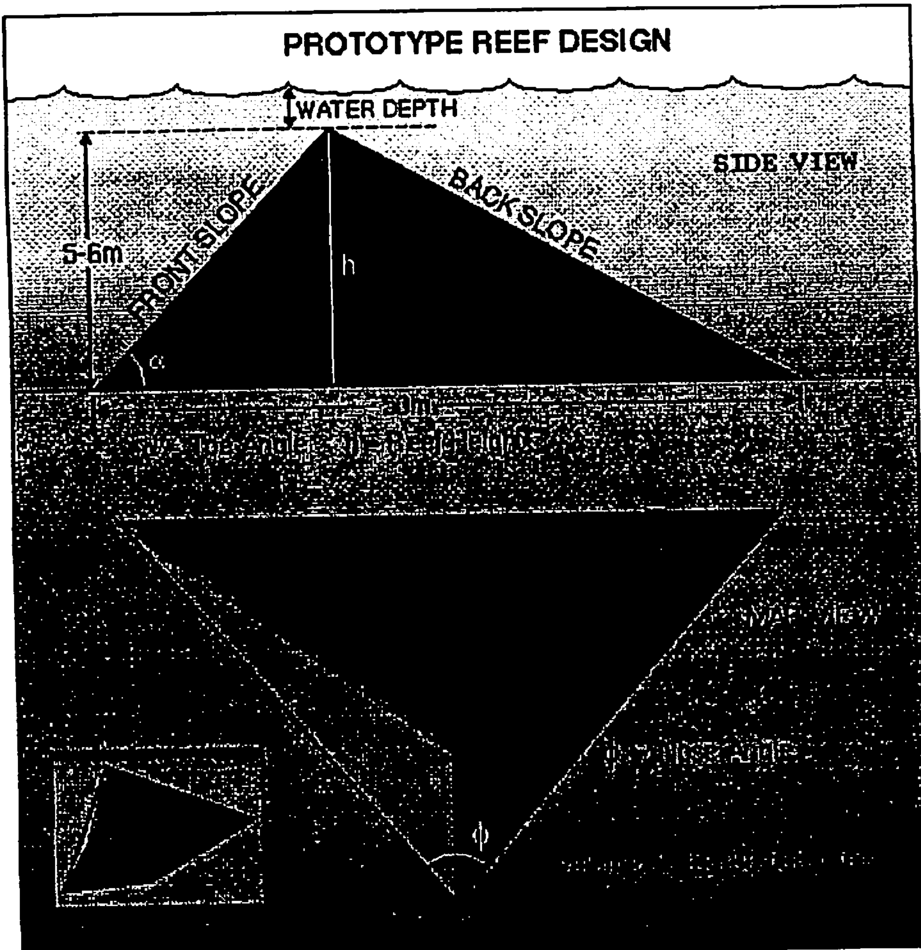


Figure 1.


PROTOTYPE REEF DESIGN
WATER DEPTH
SIDE VIEW
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BACK SLOPE
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Figure 2.

IMPACTS OF ELEVATED INORGANIC CARBON CONCENTRATIONS ON THE AUTOTROPHIC COMPONENTS OF COASTAL SUBMERSED MACROPHYTE COMMUNITIES

William M. Rizzo,
Hilary A. Neckles, Ronald G. Boustany,
DOI/National Biological Service
David R. Meaux and Martha R. Griffis,
Johnson Controls World Services

As concentrations of atmospheric carbon dioxide (CO_2) increase, water column concentrations of dissolved inorganic carbon (DIC = CO_2 + HCO_3 + CO_3) will rise. Higher DIC concentrations may increase rates of photosynthesis and primary production. Submersed aquatic vegetation (SAV) supports an abundant and diverse fauna which would be affected by changes in primary productivity. In this study we assess the photosynthetic responses of SAV, phytoplankton, and benthic microalgae from freshwater, brackish, and marine environments. *Halodule wrightii* was collected from Galveston Bay, Texas (20-30 ppt), *Ruppia maritima* from Rockefeller Wildlife Refuge, Louisiana (0-5 ppt), and *Vallisneria americana* from Cameron Parish, Louisiana (0 ppt).

Phytoplankton bioassays were conducted at all sites, while benthic microalgal bioassays were conducted at sites 1 and 3. Quarterly sampling began in May 1993 at sites 1 and 3 and May, 1994 at site 2. No winter sample was conducted at site 2 because there was no aboveground vegetation. Sampling was conducted twice each season, except for winter, at site 3 in 1994.

Methods

All incubations were carried out within 2 C of the ambient temperature at the time of collection, and under saturating light conditions (>500 uE m^{-2} s^{-1}). Five replicates were used in all experiments. Incubation times were 24 h for phytoplankton, 4 h for benthic microalgae and 1-2 h for macrophytes.

Additions of 300 uM CO_2 or HCO_3, were made to phytoplankton and benthic microalgal communities, except in 1994 when 1 mM HCO_3 additions were made. Water for the sediment incubations was pre-filtered through 0.45-um membrane filters.

Macrophytes were acclimated in filtered ambient water for 2 days prior to the experiment. Plants were maintained in natural orientations during acclimation. Healthy, whole plants were incubated in 3.54 l stirred chambers, except for *Halodule*, which was incubated in 100 ml chambers because of its small size. The smaller chambers were shaken by hand every five minutes during the course of an experiment. Roots of *Vallisneria* and *Ruppia* were enclosed in 125 ml Erlenmeyer flasks during incubation. CO_2 was added at concentrations of 50, 100, 400, and 600 uM, and HCO_3 at either 0.3 mM (1993) or 1 mM (1994).

During 1993, we conducted a growth experiment with *Halodule* and *Vallisneria*. Intact sods were collected to a depth of 17 cm. *Halodule* was collected from upper Laguna Madre, TX, and *Vallisneria* from Site 3. The sods were planted in 120-cm diameter fiberglass tanks within 48 h of collection. Eight tanks of each species were planted. Tanks containing *Halodule* were filled with artificial seawater at 20 ppt to a depth of 30 cm. Tanks containing *Vallisneria* were filled with a freshwater culture solution (Smart and Barko, 1985) to a depth of 50 cm. Low densities of snails were added to the tanks as microalgal grazers, and 3 minnows were added to freshwater tanks to control macroalgal growth.

Water within each tank was aerated continuously and circulated through heat exchangers to maintain ambient field temperatures. Tanks were illuminated by natural sunlight. Plants were acclimated for 8 weeks (*Halodule*) or 5 weeks (*Vallisneria*). Treatments were applied from September 3 to October 12, 1993, by enriching the airstream to 3X ambient. Each treatment was applied to four replicate tanks.

Shoot density, canopy height, and epiphyte biomass were measured pre- and post-treatment on replicate subsamples within each tank. Macrophyte biomass was measured by destructive harvest at the end of the experiment. Differences between treatments were assessed using analysis of covariance with initial conditions as covariates (density, height, epiphyte biomass) or analysis of variance (ANOVA; biomass). Pre- and post-treatment CO2 enrichment bioassays were carried out as above, to evaluate the potential for photosynthetic acclimation in each species.

Results

Results of ANOVA showed no significant effect of CO_2 or HCO_3 additions on benthic microalgal photosynthesis. There were also no significant treatment effects for phytoplankton at either the marine (site 1) or brackish (site 2) sites (Table 1). However, photosynthesis was enhanced by CO_2 addition in 4 of 9 experiments at site 2, while addition of HCO_3 enhanced and suppressed net production in 3 experiments each (Table 1). In experiments where enhancement occurred, CO_2 increased production 1.7X ambient rates. HCO_3 increased production by 4.3X ambient rates in one experiment, while in two others, ambient rates were negative while rates with bicarbonate addition were positive.

The results of the macrophyte experiments are shown in Table 2. *Vallisneria* photosynthesis increased with CO_2 addition in all experiments, while *Ruppia* photosynthesis did not respond to CO_2 addition. *Halodule* photosynthesis increased in response to CO_2 addition in half the experiments. No species responded to additions of HCO_3. Photosynthesis was enhanced to a maximum of 8.3X ambient rates.

The results of the growth experiment are shown in Table 3. There was no difference in final shoot density or total macrophyte biomass between treatments for either species. The final ratio of shoot:root + rhizome biomass decreased significantly with CO_2 enrichment for *Halodule*, while *Vallisneria* showed a similar trend. Epiphyte biomass increased with CO_2 enrichment for *Halodule*, but not for *Vallisneria* which had little epiphyte accumulation. The enhancement of photosynthesis by CO_2 addition at the end of the experiment was greater for plants grown under enriched conditions than for plants grown under ambient conditions for both species.

Discussion

The lack of photosynthetic response to DIC additions of the benthic microalgae and phytoplankton communities from Galveston Bay and the phytoplankton communities of Rockefeller Refuge are probably due to use of HCO_3, which is present in high concentrations. DIC concentrations at the Rockefeller site were actually higher than concentrations in Galveston Bay despite lower salinities, probably as a result of decomposition processes in these very organic-rich sediments. At the Cameron Parish site, sediment heterotrophic metabolism exceeded autotrophic demand, so that CO_2 was probably never limiting to benthic microalgal photosynthesis. However, DIC can apparently limit photosynthesis by the plankton communities at the Cameron Parish site, even though DIC concentrations exceeded 1 mM. On dates with significant response to CO_2 additions, calculated free CO_2 concentrations averaged only 0.10 mM, compared to 0.32 for dates when no significant differences were found. Also, the negative values for most of 1994 indicate little ambient phytoplankton, suggesting that there is probably a threshold biomass value for phytoplankton which must be exceeded before CO_2 limitation ensues for a given ambient concentration.

On a number of occasions, the magnitude of the response of the SAV species in our study was substantially greater than the two fold response generally predicted for submersed species (Wetzel and Grace, 1983). The lack of response by *Ruppia* may result from both extremely high DIC concentrations (>3 mM) at the site, and from efficient use of HCO_3, as for the phytoplankton. In contrast, *Halodule* responded strongly to CO_2 additions during spring and summer, despite a HCO_3 rich environment. Thus it is unlikely that photosynthesis in *Halodule* is saturated by HCO_3 as has often been presumed for seagrasses, agreeing with similar recent findings for Thalassia (Durako, 1993). The lack of response of *Vallisneria* to HCO_3 addition suggests that if HCO_3 is used by this species, uptake is already occurring at maximum rates under ambient conditions.

The increased biomass allocation to below- ground tissue for plants grown under CO_2 enrichment in our experiment is consistent with a large body of research on other systems. The lack of growth response in our experiment contradicts previous research and suggests that additional factors such as soil fertility were also limiting. The potential for increased epiphyte accumulation with CO_2 enrichment suggests shifts in the balance between epiphytes and macrophytes with the continued rise in atmospheric CO_2. If epiphyte growth becomes excessive, a decline in SAV production and survival could result. The photosynthetic response after growth in a CO_2 rich environment showed an enhanced capacity for photosynthesis, rather than acclimation.

Ecosystem studies over longer time scales are necessary to evaluate the interaction of CO_2 enrichment with other environmental controls and to predict the consequences of rising atmospheric CO_2 for natural submerged macrophyte communities.

William M. Rizzo
National Biological Service
Southern Science Center
700 Cajundome Blvd.
Lafayette, LA, USA 70506

Ph (318) 266-8633
Fax (318) 266-8592
Email rizzob@nwrc.gov

Table 1. Results of additions of dissolved inorganic carbon on the net production of the phytoplankton communities of beds of submersed aquatic vegetation. Mean rates + standard deviations (mg O_2/l/h) are shown. Each "*" indicates significant enhancement, while "**" indicates significant suppression at P>0.05.

Site	Date	Ambient	CO2	HCO3
1	5/93	0.279 + 0.037	0.274 + 0.020	0.293 + 0.019
	8/93	0.269 + 0.035	0.246 + 0.007	0.268 + 0.019
	10/93	0.006 + 0.006	0.000 + 0.007	0.013 + 0.007
	2/94	0.112 + 0.019	0.116 + 0.012	0.114 + 0.009
2	5/94	0.497 + 0.023	0.506 + 0.028	0.512 + 0.023
	8/94	1.073 + 0.039	1.023 + 0.074	1.063 + 0.125
	10/94	0.902 + 0.038	0.994 + 0.083	0.949 + 0.079
3	5/93	0.081 + 0.014	*0.110 + 0.018	**0.053 + 0.008
	8/93	0.118 + 0.005	*0.169 + 0.006	**0.097 + 0.012
	10/93	0.034 + 0.006	*0.062 + 0.009	*0.148 + 0.005
	2/94	-0.052 + 0.005	-0.045 + 0.005	-0.046 + 0.002
	3/94	-0.016 + 0.008	-0.008 + 0.005	*0.000 + 0.000
	5/94	-0.048 + 0.009	*-0.030 + 0.008	*-0.024 + 0.004
	6/94	-0.067 + 0.008	-0.043 + 0.002	**-0.131 + 0.011
	9/94	-0.019 + 0.030	-0.011 + 0.022	-0.026 + 0.018
	10/94	0.115 + 0.047	0.094 + 0.023	0.090 + 0.011

Table 2. Mean + standard deviation for photosynthesis (mg O_2/[g dry wt. leaves]/h) for three species of submersed vegetation. P_a represents ambient photosynthetic rates, P_{max} represents the maximum photosynthethic rate achieved by addition of CO_2, and the photosynthetic rate with bicarbonate addition is given under P_{hco}. Each "*" indicates a significant difference from the ambient rate at P>0.05.

Site	Date	Ambient	CO2	HCO3
1	5/93	2.88 + 2.72	*23.87 + 2.97	-1.87 + 5.33
	8/93	-7.17 + 6.15	*5.55 + 2.06	-4.33 + 4.69
	10/93	3.36 + 0.70	5.01 + 2.08	3.35 + 0.88
	2/94	2.93 + 1.22	4.68 + 1.09	4.31 + 1.05
2	5/94	8.72 + 3.34	13.99 + 7.54	11.11 + 4.09
	8/94	2.22 + 0.19	2.47 + 0.46	1.90 + 0.32
	10/94	31.74 + 3.32	35.96 + 3.81	32.33 + 4.43
3	5/93	1.47 + 0.44	* 8.89 + 1.14	2.51 + 1.32
	8/93	2.33 + 0.60	* 9.38 + 1.46	2.97 + 1.53
	10/93	2.00 + 0.40	* 6.73 + 0.86	2.26 + 0.75
	2/94	1.81 + 0.85	* 4.11 + 1.75	-0.67 + 1.25
	3/94	9.11 + 1.71	*13.44 + 1.89	6.28 + 0.85
	5/94	6.51 + 0.61	* 9.30 + 1.50	5.80 + 1.24
	6/94	4.42 + 0.34	*10.35 + 9.24	2.87 + 2.29
	9/94	3.09 + 1.02	* 7.62 + 1.69	3.10 + 1.24
	10/94	2.57 + 1.36	* 7.61 + 2.38	0.78 + 0.50

Table 3. Growth variables for two species of submersed vegetation grown under ambient or three-fold CO_2 concentrations. Probabilities from analyses of covariance are shown.

Variable	Species	Ambient	Enriched	Prob.
Shoot Density (No. m-2)	Vallisneria	360	400	0.17
	Halodule	1940	1860	0.74
Macrophyte Biomass (g m-2)	Vallisneria	132	156	0.34
	Halodule	40	39	0.88
Shoot:Root + Rhizome	Vallisneria	1.94	1.66	0.14
	Halodule	0.68	0.46	0.03
Epiphyte Biomass (mg DW cm-2)	Vallisneria	0.4	0.4	0.88
	Halodule	0.6	1.0	0.07
Enhancement of Photosynthesis with CO2 addition	Vallisneria	2.0	2.8	
	Halodule	1.4	1.9	

NATIONAL CZM EFFECTIVENESS STUDY: WETLANDS AND ESTUARY PROTECTION CASE EXAMPLES

John Weber, Oregon State University
Jay Charland, Oregon State University
John Olson, Oregon State University
Kelly Chapin, Oregon State University

Introduction

Past evaluations of coastal zone management at the national level have tended to focus on procedural and qualitative assessments of state programs, and their progress toward national goals. This study is a first attempt to look at on-the-ground outcomes of implementation of CZM programs designed by states approved at the national level. The federal Coastal Zone Management Act (CZMA) has established several objectives for state programs, four of which are the focus of this outcome oriented evaluation:

- Protecting natural resources, including estuaries and coastal wetlands, and beaches, dunes, bluffs, and rocky shores
- Providing for public access
- Providing for coastal dependent uses and water front revitalization
- Improving governmental coordination and consistency

This poster illustrates a few of the contributions that state CZM programs make to the protection of estuaries and coastal wetlands. Case examples of particularly effective or innovative approaches with demonstrated success are presented.

An Overview of Estuaries and Wetlands

It is widely recognized today that estuaries and coastal wetlands are among the most environmentally and economically important natural resources in the United States. These resources -- salt marshes, seagrass beds, tidal flats, freshwater marshes, forested wetlands, and open water function -- perform a variety of ecological functions that translate into valuable societal services. They provide habitat for a vast array of fish and wildlife resources, including many endangered or threatened species. On the East and Gulf coasts, for example, 60-90% of the fish species caught commercially are dependent on estuaries or wetlands for some portion of their life cycle. Estuaries and wetlands help control water pollution by transforming nutrients and other chemicals, and by removing sediments from the water column. Wetlands anchor the shoreline against erosion, buffer storms, and in some areas, serve as temporary flood storage areas.

This widespread recognition of the values of estuaries and coastal wetlands is relatively new. In the past, estuaries and coastal wetlands were places to be dredged and filled for port and harbor development, industry, and expansion of cities for a growing nation. They were diked and drained for agriculture, their waters diverted for other uses, and generally abused as dumps for much of the waste of a rapidly growing nation. This all changed relatively dramatically in the 1960s and early 1970s. One national study after another chronicled the abuses of estuaries and wetlands and the mounting costs. Among the most important was the 1969 Stratton Commission report, "Our Nation and the Sea," which called for the establishment of a national coastal zone management program that would, among other things, help reverse the decline and abuses of estuaries and coastal wetlands. This and other state-level initiatives led to the 1972 Coastal Zone Management Act (CZMA), which resulted in the establishment and enhancement of a variety of estuary and wetland protection programs at the state level.

Estuary and Wetland Portion of the CZM Effectiveness Study

State coastal zone management programs and their contributions to the protection of estuaries and coastal wetlands is one of the focus areas of the nationwide CZM Effectiveness project. As with the other parts of this study, the emphasis is on identifying on-the-ground outcomes of CZM processes and tools that result in real protection of these vital resources. For virtually every state coastal program, estuary and wetland protection has been and remains an important issue and, in some areas, a vital one. A wide array of management processes and tools that contribute to estuary and wetland protection have been developed and implemented by states as part of their CZM programs.

To obtain the level of detail and accuracy necessary for such a study, a format for data collection has been developed. Heavy interaction with the state CZM agencies themselves is a key, for although some states may have a substantial list of publications, changing and fine-tuning of policies and regulations (and sometimes even agencies) is an ongoing process. A data collection form (DCF) has been constructed which attempts to capture and describe these various management tools. In that regard, the following data collection processes and tools are utilized:
1. National-level data collected - sources such as Coastal Wetlands of the US (NOAA), National Estuarine Inventory (NOAA).
2. State-level data collected - Sources include those available or easily compiled. Onus is on research team, not state, to collect and analyze information from:
- Program documents/products/evaluations
- Published literature
- Existing databases and Geographic
- Information System (GIS) information

interviews with state agency personnel
3. DCF completed using standard protocol.
4. DCF sent to state for review and comments.
5. State program profile developed from state-reviewed DCF.

To characterize a state CZM program's protection of estuaries and wetlands as accurately as possible requires interaction with the state agency people who are, after all, the experts for that state. Additional background information, often anecdotal, from phone interviews provides key current contextual information for operation of a state CZM program. While the burden of the data collection aspect of the study lies on the research team, the interaction with personnel in the state programs is important for information collection and review.

To document the use of the array of CZM management policies, programs, processes, and tools states use to protect estuaries and coastal wetlands, six broad categories of possible management processes and tools have been examined:

1. Information and Research Tools - inventories, mapping efforts, ecosystem functional assessments, ecosystem change monitoring, databases, Geographic Information Systems.
2. Regulatory Tools - state and/ or local permits, application of federal and state consistency, CWA 401 certification, tideland leasing regulations, EIA requirements, mitigation and mitigation banks, compliance monitoring, development setbacks and buffers, other land or water use exclusion/ limitation
policies.
3. Planning Tools - land use planning, zoning, utilization of SAMPs, planning/management for areas of environmental concern, Advanced Identification planning with EPA.
4. Acquisition Tools - direct and/ or indirect land acquisition utilizing either fee simple or less-than-fee methods.
5. Nonregulatory Tools - non-regulatory wetland restoration and enhancement, education and awareness.
6. Coordination Tools - joint state-federal (USACOE) permit applications/ notices, interagency coordination forums, Memoranda of agreement.

Four of these six categories have on-the-ground outcome indicators which we attempt to evaluate. For example, in the Regulatory Tools category, permitting data are examined for trends in numbers of permits issued, denied, permit violations, land area affected by permitting decisions, etc. Zoning area, land/water area in local or regional land use plans, land/water area delineated as areas of environmental concern (or similarly categorized), and/or area of existing SAMPs is determined for the Planning category. Area of acquired land with CZM involvement is compiled for the Acquisition category, and Nonregulatory Tool outcome data can consist of amount of habitat restored and/or enhanced. (Additionally, for the Information and Research Tools category, state databases, digitized map sources, and GIS systems are listed which are utilized for estuary/ wetland protection.) It should be pointed out that the availability of data for these four outcome indicators is in many cases scattered, and that data which is retrievable is sometimes of questionable quality.

The broad range of issues facing individual states is almost as large as the number of innovative management techniques states have developed in response. Particulars of a state such as geography, amount of wetland or estuarine habitat, development pressure on such habitats, population and population growth (both seasonally and year-round), climate, economy, political atmosphere, and others all factor in to the details of state CZM programs. Any overview of state programs should contain documentation wherever possible of these factors.

State CZM Estuary and Wetland Protection Cast Examples

Because of the latitude given to states in developing CZM plans, and the wide variety of factors involved in the protection of estuaries and wetlands, states have arrived at a variety of means for approaching the estuary and wetland protection issue. An important aspect of this study's documentation effort is the highlighting of particularly innovative methods states utilize in balancing the difficult issues involved in estuary and wetland habitat protection. Case examples have been prepared for these management techniques. One case example for each of the four categories of management tools with on-the-ground outcome indicators will be presented:

1. Regulatory Tools - South Carolina's tidal wetlands regulatory program and the use of federal consistency to manage non-tidal wetlands.

2. Planning Tools - Oregon's estuary zoning program.

3. Acquisition Tools - North Carolina's Coastal Reserve System.

4. Nonregulatory Tools - Connecticut's tidal wetlands restoration program.

Conclusion

The CZM Effectiveness Study hopes is highlighting specific state management techniques that may be of interest nationwide. Estuary and wetland protection is an area of natural resource management continually evolving in importance and practice, from the "fill wetlands to get usable land" approach historically, to the current inclination toward balancing of conservation and development. Management techniques such as mitigation banking, special area management planning, and other examples of innovative approaches taken by states illustrate the important roles of these programs in protecting estuaries and wetlands.

John Weber
Oregon State University
Industrial Building #124
Corvallis, OR, USA 97331

Ph (503) 737-2967

CONTROLLING AN INVASIVE PLANT IN THE COASTAL ZONE: THE LESSONS OF *SPARTINA* spp. IN WASHINGTON STATE

Kate Wing, School of Marine Affairs
University of Washington

Washington's coast currently hosts three exotic species of cordgrass: *Spartina alterniflora*, *S. anglica*, and *S. patens*. These three species are most often collectively referred to by the genus name, *Spartina*, but have also been called "Demon Grass" and "the evil weed". In the past ten years *Spartina* has reportedly increased its rate of spread along the Pacific Coast and in Puget Sound; accompanying this botanical growth has been a growth in funding and legislative activity supporting eradication of the plants. This rapid rise in natural resource agency activity, coupled with a public information effort, have created controversy over how to best control the plant or even whether, in some areas, to attempt any control at all. As the demand for eradication grows louder, parties involved in *Spartina* efforts are caught between gathering the best information possible and making immediate decisions. In particular, this analysis targets the difficulties of merging a political timeline with that of a scientific research program.

This study focuses on the players involved in *Spartina* control, with attention given to individuals as well as organizations. The following factors were identified as significant in contributing to the efficiency of the management plan:

1. How decisions were made, and who was held accountable for the results.
2. Who was invited to be part of the decision-making process.
3. How information was transferred among the parties.
4. How the different agencies interacted, both formally and informally.
5. How long-term goals were established, and what attempt was made to correlate the tools used to achieve these goals with the desired outcome.

An analysis of the current state of affairs was made based on interviews and discussions at both official and unofficial meetings, during the period from August 1995 until May 1996. Interviews were conducted in person, when possible, and included persons who had identified themselves as having worked with or currently working with *Spartina*; thus, meeting participants, private landowners who had contacted the State Noxious Weed Board, volunteers with monitoring and surveying agencies, and consultants who had done removals were, among others, included in the sample. Historical information about *Spartina* was gathered from these sources, as well as from a periodical review including academic and non-academic publications. An attempt was made to contact other areas where *Spartina* spp. are invasive in order to compare management strategies, but these results are currently inconclusive.

The complex web of Washington state agencies has, from time to time, taken advantage of the local scientific community and non-governmental agencies (NGOs). Public citizens, many of whom fund and fuel the NGOs, have been instrumental in persuading legislators to appropriate funds for control; and the agencies rely on these same property owners for survey data and manpower for removals. This creates a two-tiered system of state and local individuals trying to craft a comprehensive management plan, with occasional input from researchers and federal agencies. Such a comprehensive management plan is now required by the legislature, and its structure has been largely left up to the members of the *Spartina* Working Group -- a loose coalition with representatives from most of the aforementioned groups. The working group is chaired by the Department of Agriculture (DOA), which has taken over the job of lead agency for *Spartina* from the Department of Natural Resources (DNR). The working group has had two impacts on the community of people working with *Spartina*: it has facilitated management decisions and it has formalized information exchange among interested parties. Is unclear, at this point, how well the working group will be able to adapt their plan to changes in the system, and if even the finest plan developed could achieve the goal of eradicating *Spartina* from the state.

Washington State's natural resource agencies overlap in their jurisdictions, but each retains unique permit granting powers, allowing them to essentially veto a management decision. This separation of powers often forces agencies to find consensus on an issue before a single player can take any action. In addition, DOA, DNR, the Washington Department of Fish and Wildlife (WADFW), and the Department of Ecology (DOE) all have scientists on staff to evaluate the status of a resource. In the past, data collection and interpretation have not always been coordinated or made available to the public. The passage of SSB 5633 in 1995 provided a streamlined permitting process for *Spartina* control, in particular, chemical control using glyphosate. This was a relief in terms of agency coordination, since DOE could now grant regional permits to DOA, who would in turn monitor local activities. However, since DOE is responsible for water quality monitoring, it removed them from the information cycle, and made DOA a repository for information about specific herbicide applications. This could have negative impacts on a watershed level, as other estuarine chemical applications are not compiled in the same repository as those related to *Spartina* control.

While information flows more freely since the codification of the working group, it may not be true that the working group actually improves the situation. The very personal response of many individuals involved with *Spartina* has led them to seek out others with similar beliefs in concerted eradication efforts. One of the best attended meetings in the past year was organized by a professor at a state university, who acted outside the agency channels to bring together people he knew were interested in the topic. Parties who had not been represented at working group or weed board meetings showed up for an all day session to talk about their experiences. *Spartina* bumper sticker and limerick contests were held, and the meeting concluded with a cheer of "*Spartina* you're toast!". The urgency and devotion of the meeting attendants was apparent in their dedication to removing *Spartina*, and would have propelled them to continue their efforts without the coordination of the working group.

Finally, perhaps the most pressing concern in the development of a management plan is the lack of scientific research supporting control methodology. Monsanto, the company which produces the only approved herbicide, has made claims of chemical control effectiveness which have not been duplicated in the field. Application of herbicide, itself a very controversial subject, has been done in a haphazard method, using a variety of tools and with little or no scientific rigor. Experiments with the three most common removal methods -- mowing, hand-pulling and herbicide application -- are often done without efforts to control for seasonal variation, the impacts of previous efforts or any other independent variables. Additionally, since the emphasis has been on removing the plant as soon as possible, by any means possible, little study has been made of the plants' physiology except when categorizing them as "alive" or "dead." Most of the botanical information has been derived from literature from the east coast, where *S. alterniflora* and *S. patens* are protected species. It is probable that the three plants have adapted to the Pacific Northwest in such a way that this physiological data is inaccurate, and there is little or no funding available to do physiological studies in this area. A study was funded (through the University of Washington's WET team, and UW Cooperative Extension) to look at the ecological impacts of *Spartina*, with a focus on invertebrate communities and impacts on shorebirds and juvenile salmonids; the study concluded in the fall of 1995 and it is unlikely to be re-funded.

Spartina management is in a precarious position in Washington State. The strong community support for removal and high degree of agency cooperation are powerful tools which the Department of Agriculture can use to its advantage. However, without an iterative process for learning more about the ecology of the plant and success of various control methods, it may not be possible to achieve the goals of the working group. And, without better integration of scientific information into the decision-making process, the working group may find itself removing *Spartina* without restoring the ecosystem to their desired condition.

Kate Wing
School of Marine Affairs
University of Washington
3707 Brooklyn Ave. NE
Seattle, WA, USA 98105-6715

Ph (206) 324-7912
Fax (206) 543-1417
Email kwing@u.washington.edu

WISCONSIN SEA GRANT'S "ZEBRA MUSSEL WATCH": A MULTI-INSTITUTIONAL STATE, REGIONAL, AND NATIONAL NONINDIGENOUS SPECIES OUTREACH EFFORT

Stephen Wittman,
University of Wisconsin Sea Grant Institute

Bio-Pollution

The last 100 years has seen the largest introduction of nonnative species to North America since the century following Columbus' arrival in 1492. No region has escaped the invasion. In some instances, invading species have taken over healthy native ecosystems, causing environmental chaos as well as considerable economic loss and, occasionally, public health threats. Many of these invading species are aquatic plants and animals, and the introduction of nonindigenous fishes and other aquatic organisms continues to increase at an alarming rate. To date, an estimated 350 nonindigenous marine and estuarine plants and animals have been introduced to U.S. coastal waters. The Great Lakes alone are home to about 130 foreign species, most of them arriving since the opening of the St. Lawrence Seaway in 1959.

Perhaps the most significant aquatic invader in recent years is the Eurasian zebra mussel (*Dreissena* spp.). This prolific biofouling mussel poses significant social, economic and ecological concerns for the entire nation. A freshwater mollusk whose potential range encompasses much of North America, it tends to attach in huge numbers to any solid submerged object, including docks, locks, boat hulls, navigation aids, and, most notably, water intake pipes. Zebra mussels rapidly colonize water intakes, forming layers up to eight inches thick containing tens of thousands of mussels. This thumbnail-sized mussel thus poses an unprecedented threat, in terms of its nature and scope, to the nation's supplies of drinking, cooling, processing, and irrigation water.

First found in Lake St. Clair near Detroit in 1988, this small but prolific mussel spread rapidly throughout the Great Lakes basin, colonizing and clogging the water intakes of dozens of coastal communities and lakeshore power plants. It is estimated that zebra mussels will cost the Great Lakes region alone nearly $5 billion by the end of the century. The zebra mussel also has been implicated in the local extirpation of commercially valuable native freshwater clams (*Unionid* spp.) in some areas.

Hitchhiking on barges and trailerable boats, zebra mussels have since spread to rivers and lakes in 20 central U.S. states and two Canadian provinces (Figure 1). Virtually every lock and dam and several power plants along the upper Mississippi River is infested; the lower Mississippi is infested from Memphis, Tennessee, to New Orleans, Louisiana. The mussel now inhabits the entire length of the Illinois River, all of the Ohio River below Pennsylvania, the Arkansas River as far upstream as Oklahoma, large stretches of the Hudson and Mohawk rivers in New York, and portions of the Tennessee and Cumberland rivers from Kentucky to Alabama. More than a dozen inland lakes in Wisconsin, Michigan, Ohio, Indiana, and Kentucky are infested.

With control and prevention costs estimated in the billions of dollars, the zebra mussel invasion demonstrates why comprehensive, collaborative and coordinated outreach efforts are needed in affected as well as vulnerable adjacent watersheds to prevent and control the spread of exotic aquatic nuisance species.

Sea Grant's Response

Created in 1967, the National Sea Grant College Program supports a national network of 29 university-based programs of research, outreach and education dedicated to the protection and sustainable use of America's coastal, ocean and Great Lakes resources. These programs are funded via the National Oceanic and Atmospheric Administration and participating coastal states.

The nation's network of Sea Grant programs has been a leading player in zebra mussel outreach at the state, regional, and national levels. The six programs that form the Great Lakes Sea Grant Network were among the first institutions in the region to react to the zebra mussel invasion. Within a month of the first confirmed sighting in Lake Erie, Ohio Sea Grant-funded scientists were studying ways to deal with the mussel. Besides research, the Great Lakes Sea Grant Network also provided the region's first major zebra mussel outreach and education programs.

Since 1991, the National Sea Grant College Program has supported more than 100 scientific studies on the zebra mussel, over half of which were devoted to control strategies and assessing the mussel's environmental and economic impacts. Other research has focused on the mussel's basic biology and ways to predict its spread. Sea Grant also supported a wide range of state and regional outreach efforts to rapidly transfer and disseminate the results of these studies.

Within a year of the mussel's discovery in Lake St. Clair, it was found in Lake Erie. By 1990, the Duluth harbor on Lake Superior and southern tip of Lake Michigan. By this time, all six Great Lakes Sea Grant Network programs (Illinois-Indiana, Michigan, Minnesota, New York, Ohio, and Wisconsin) had launched zebra mussel outreach and public information efforts. In 1989, Ohio Sea Grant organized the first U.S. zebra mussel research conference, and network programs have taken turns hosting such conferences (now cosponsored and alternately hosted in Canada) every year since. With power industry support, New York Sea Grant in 1990 established and today still operates a national zebra mussel research information clearinghouse on behalf of the entire network. In a related effort a few years later, Michigan Sea Grant established a loan library of graphics of zebra mussels and other nonindigenous species in the Great Lakes for journalists and scientists as well as network outreach personnel.

Wisconsin's Zebra Mussel Watch

The first step in launching a successful public information campaign is to generate basic public awareness of the problem or issue. To that end, the University of Wisconsin Sea Grant Institute in 1991 created a wallet-sized "Zebra Mussel Watch" card (Figure 2). This single-fold features a life-size color photo of a single zebra mussel on the cover, and a photo of a typical cluster of mussels on the back. Inside, the card briefly tells why zebra mussels are a problem, and describes how to identify the mussel and report new sightings as a way to help prevent its spread.

About the same time, we initiated a free, statewide "Zebra Mussel Update" newsletter for public officials, power industry, news media, researchers, and other interested individuals. The primary purposes of the ZMU was to serve as a vehicle for disseminating the results of UW Sea Grant's zebra mussel water intake and harbor monitoring program. However, it soon proved very popular and extremely useful as a means of disseminating research results, reporting on the mussel's spread elsewhere, and announcing new zebra mussel-related publications, conferences, and meetings. By 1991, the ZMU had nearly 2,000 subscribers throughout the Great Lakes region, including many in Canada.

Related public information efforts included issuing a dozen news releases and arranging for 69 news media interviews for Sea Grant-funded scientists and outreach staff, including appearances on local television news programs and statewide radio call-in talk shows. This intensive outreach effort also included 86 presentations to a wide range of audiences, such as boaters, anglers, civic and environmental groups, researchers, local and state government officials, utility managers, etc. These efforts earned the UW Sea Grant Institute a Gold Medal for community relations from the National Council for the Advancement and Support of Education in 1991.

In 1992, in partnership with the Wisconsin Broadcasters Association and the Wisconsin Department of Natural Resources, we produced 10-, 15- and 30-second public service announcements about the zebra mussel that were broadcast a total of nearly 3,000 times by 124 radio stations and all 18 television stations in Wisconsin throughout the month of August, the mussel's peak reproduction period.

The Regional Effort

Passage of the federal Nonindigenous Aquatic Nuisance Species Prevention and Control Act of 1990 provided the necessary funding and impetus for the Great Lakes Sea Grant Network to begin coordinating its zebra mussel outreach efforts on a more formal basis. Given a total of only about $1 million annually with which to address a huge regional problem, the network's six programs agreed on a strategy of identifying priority outreach projects and avoiding duplicative efforts, with an emphasis on cooperation and the sharing of information materials, in order to maximize our "bang for the buck."

Given its existing regional readership, Wisconsin Sea Grant's "Zebra Mussel Update" thus became the network's premier regional outreach newsletter. Encouraged to "freely duplicate and distribute this newsletter," the ZMU's 2,000 subscribers indicated in a 1993 survey that they shared their copy of the ZMU with an average of 10 others, indicating a total readership of 20,000. Even more gratifying was that 92% of those responding gave the ZMU an overall rating of very good (55%) to excellent (37%).

Likewise, the contact information on our Zebra Mussel Watch card was customized for local use in each Great Lakes state and the Canadian Province of Ontario. During 1992-93, we printed and sold, at cost, more than 635,000 of these cards in partnership with other Sea Grant programs, concerned state and federal agencies, and other organizations in more than a dozen states and two Canadian provinces. Meanwhile, we purchased and distributed the various zebra mussel facts sheets, videotapes and other information products created by the other Great Lakes Sea Grant programs.

In 1994, it was Wisconsin Sea Grant's turn to organize and host the 4th International Zebra Mussel Conference. Held in Madison, Wisconsin, the conference also served an outreach purpose in drawing the attention of state capital policy-makers and news media attention to the problem.

The National Effort

After the zebra mussel spread beyond the Great Lakes basin, the Sea Grant network expanded the scope of its outreach and began actively transferring its knowledge and informational materials to concerned resource management agencies in affected inland states as well as Sea Grant programs in East Coast and Gulf Coast states. The Zebra Mussel Update is now a collaborative effort involving eight Sea Grant programs and serves as the network's national zebra mussel outreach newsletter. The ZMU is presently printed in Columbus, Ohio, compliments of Mercury Marine, a Brunswick company, and distributed via Ohio Sea Grant. The mailing list for newsletter now totals more than 10,000; if as widely shared as by 1993 subscribers, the ZMU readership now stands at 100,000 nationally. Another readership survey will be conducted in late 1996 to find out.

In addition, we continue to print customized versions of the Zebra Mussel Watch card for use as a first-order public awareness tool in affected or threatened inland and coastal states. To date, Wisconsin Sea Grant has printed more than 1.34 million Zebra Mussel Watch cards on behalf of other Sea Grant programs, state and federal agencies, and private businesses in 21 coastal and inland states, and the Province of Ontario (Table 1).

On behalf of the national Sea Grant network, Wisconsin in 1995 compiled and published "Aquatic Exotic," a catalog of all zebra mussel-related information and outreach tools created by national the Sea Grant network so far. So far, more than 12,000 copies have been distributed via the national Sea Grant network as well as direct-mailed to water resource managers in all affected watersheds in seven inland states. Another 600 copies of the catalog were also provided in March 1996 to all registrants for the Sixth International Zebra Mussel and Other Aquatic Nuisance Species Conference, hosted by Michigan Sea Grant, at Dearborn, Michigan.

During the last two years, the Great Lakes have been invaded by two more exotic aquatic nuisance species -- the Eurasian ruffe and round goby -- and the Great Lakes Sea Grant Network is pursuing a similar collaborative outreach effort. For example, customized versions of a "Ruffe Watch" and "Round Goby Watch" cards have already been produced by Minnesota Sea Grant on behalf of each program in the network. Illinois-Indiana Sea Grant has produced fact sheets about these new exotic fish for the network's use, and Wisconsin Sea Grant, given its two decades of experience producing the "Earthwatch" science and environmental news radio program, has taken on the responsibility of producing public service announcements about these exotics for broadcast in invaded areas.

How effective have this outreach effort been? It's difficult to say, as few formal evaluations of these outreach efforts have been conducted, and the quality and level of outreach effort has varied greatly from state to state. However, research has shown that the primary mechanism of zebra mussel transport to inland lakes is via trailerable boats from infested waters. Wisconsin has nearly 500,000 registered motorboats -- about one for every 10 residents, 41% of whom participate in boating. And while a variety of other factors may be involved, to date -- five years since zebra mussels became residents of the state's Great Lakes coastal waters -- zebra mussel larvae or adults have been discovered in only seven of Wisconsin's 14,000 inland lakes.

Stephen Wittman
University of Wisconsin Sea Grant Institute
1800 University Avenue
Madison, WI, USA 53705-4094

Ph (608) 263-5371
Fax (608) 263-2063
Email swittman@seagrant.wisc.edu

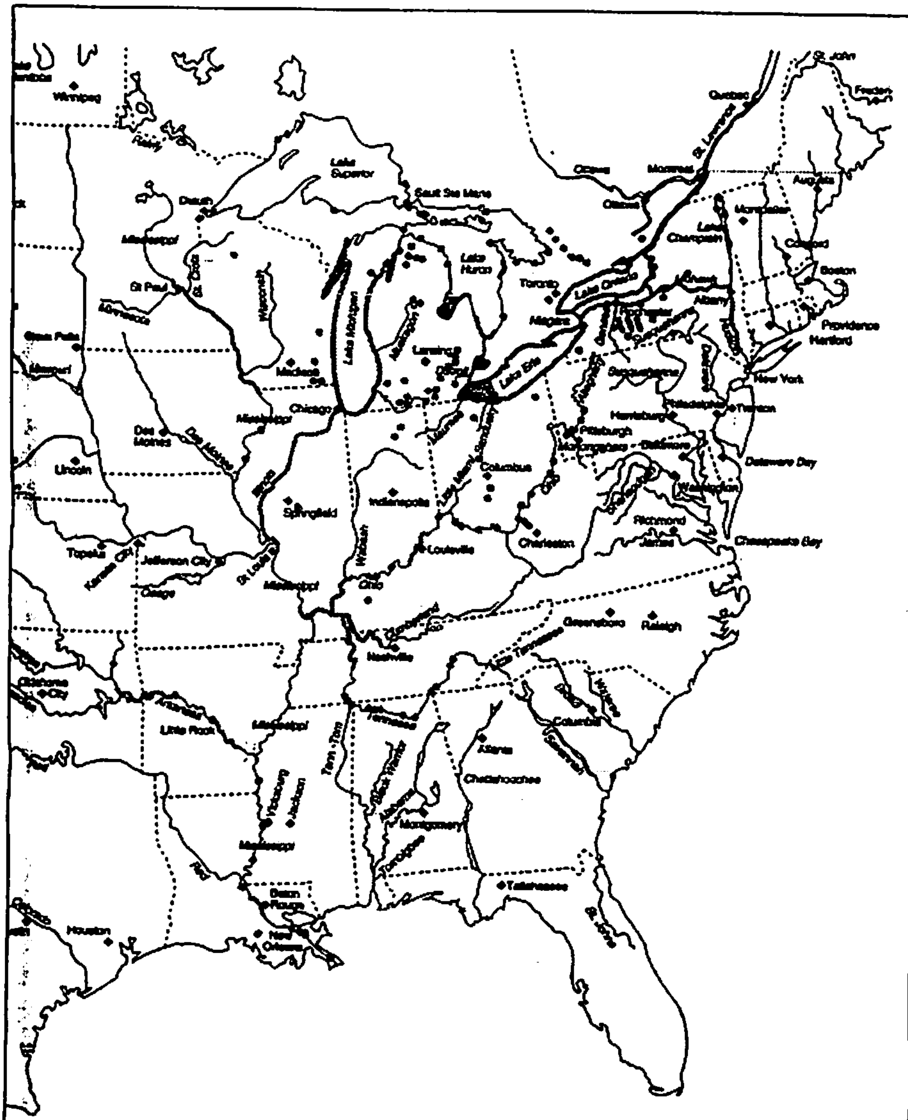

Figure 1: North American Range of the Zebra Mussel • ▬▬▬▬ ©New York Sea Grant

TABLE 1: Customized "Zebra Mussel Watch" Cards Printed (as of February 1996)

VERSION	NUMBER PRINTED
Generic version (1992)	82,550
Arkansas Game & Fish Commission (1992)	15,100
Connecticut Sea Grant (1995)	9,650
Delaware Sea Grant (1992, 1995)	12,300
Illinois-Indiana Sea Grant (1991, 1992, 1993, 1995)	41,690
Illinois Dept of Conservation and City Water Resources Dept.-Springfield (1992)	8,500
Lake Champlain Basin Program-Grand Isle, Vt. (1992, 1993, 1995) Canadian French version (1993)	66,300 19,500
Louisiana Sea Grant and U.S. Fish & Wildlife Service-Baton Rouge (1993, 1995)	10,370
Maryland Sea Grant and Maryland Dept. of Natural Resources (1992, 1994)	229,700
Michigan Sea Grant Extension (1991, 1992, 1995)	46,200
Minnesota Sea Grant and Minnesota Dept of Natural Resources (1991-95)	162,125
MIT Sea Grant/University of Massachusetts-Amherst and U.S. Fish & Wildlife Service (1992)	7,450
Mississippi-Alabama Sea Grant (1995-96)	17,150
New Jersey Sea Grant (1992-95)	34,350
New York Sea Grant Zebra Mussel Information Clearinghouse (1991-93)	84,500
North Carolina Sea Grant (1992, 1994-95)	140,100
Ohio Sea Grant (1991-92)	4,100
Oklahoma Dept. of Wildlife Conservation & U.S. Army Corps of Engineers-Tulsa	20,000 (1993)
Ontario Ministry of Natural Resources (1991, 1995) Canadian French version (1991, 1995)	45,600 6,100
SAMPO-Barneveld, N.Y. (1992)	7,450
South Carolina Sea Grant (1994-95)	23,700
Tennessee Shell Company-Camden (1992)	7,500
U.S. Dept of Interior Bureau of Reclamation-Denver, Colo. (1992, 1995)	13,600
U.S. Army Corps of Engineers-St Paul, Minn. (1991)	52,885
U.S. Army Corps of Engineers-Nashville, Tenn. (1992)	7,650
U.S. Fish & Wildlife Service-Lakewood, Colo. (1995)	20,800
U.S. Fish & Wildlife Service-Winona, Minn. (1991-93)	22,700
U.S. Fish & Wildlife Service-Tishomingo, Okla. (1994)	7,920
Wisconsin Sea Grant, Wisconsin Dept. of Natural Resources and U.S. Fish & Wildlife Service (1991, 1992)	123,800
TOTAL (1991-95)	1,350,840