RESOURCE ALLOCATION ISSUES IN THE COASTAL ENVIRONMENT

PROCEEDINGS of
FIFTH ANNUAL CONFERENCE

Published by

THE COASTAL SOCIETY
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Resource Allocation Issues in the Coastal Environment

Newport, Rhode Island
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Conference Coordinator and Proceedings Editor:

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THE COASTAL SOCIETY is grateful to the Federal Office of Coastal Zone Management for their assistance in publishing this year's proceedings.

Foreword

The 1979 Coastal Society meeting, which was held in Newport, November 6-8, was an important anniversary for the Society. The first five years of any business or organization are critical and although only a small fraction of the coastal clientele are members of the Society, many important contributions have been made to the study and management of the activities and the resources found within this important geographical region.

Unlike past years, it was decided this time to broaden the circulation and emphasis of the meeting; in part a decision which was made for very pragmatic reasons. The Newport meeting was opened to coastal interests of many persuations. Certainly from the point of view of attendance and the number of papers presented, The Coastal Society's Fifth anniversary was a success; attendance by more than 200 made this the largest meeting since the initial one in Washington. Over sixty papers and addresses were given, most of which are presented on the following pages. No less than thirteen sections--a few of which were run concurrently--were offered and while many topics were covered, some noticeable voids were evident, among them sessions dealing with the training and education of coastal professionals. Another important area which could have been included in this year's presentation is the relationship between the coastal scientist, manager and policy maker which appear even more relevant in light of the proposed reauthorization of the Coastal Zone Management Act. These and other possible session topics may be considered in future years.

Like last year, The Coastal Society's Annual Meeting was held jointly with the International Geographical Union-Commission on Coastal Environments. The temporary "marriage" of the two organizations again proved to be a success. The abstracts from both the regular and specialty sessions of the IGU-CCE meeting have been included in this year's Proceedings.

It is probably too early to determine whether this year's format was successful. Undoubtedly there will be members, readers and contributors to The Coastal Society and the Proceedings who would favor the return of the Annual Meeting to something closer to the model of previous years; while others, influenced by tighter travel budgets, might favor the more open program which was tried this year. There are, of course, advantages and disadvantages in either case. The important thing to keep in mind is that The Coastal Society must continue to experiment with respect to the format of its Annual Meeting and in its development of information transfer, because only then will it be able to stay in the forefront of the activities occurring within the coastal zone.

We hope that this year's crop of papers contributed to this end.

Niels West
Editor
Spring, 1980

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Moderator: Elisabeth S. Roy

GRAYS HARBOR - AN EXAMPLE OF REGIONAL PLANNING TO IMPLEMENT COASTAL MANAGEMENT PROGRAMS

Grant Dehart*

I welcome this opportunity to contribute to a discussion of regional planning for Coastal Zone Management. In my view, regional planning has an important place in the implementation of state coastal management programs. It can also help accomplish some emerging national objectives of the Federal program if it leads to more than paper plans -- or more planning, unlike so many regional planning efforts of the past. Effective regional planning should lead to coordinated and simplified government decision-making to assure proper and expedited management of coastal resources. If it does this, regional planning can help assure that the environmental protections put in place over the past decade will remain in place.

I was asked to speak on the Grays Harbor experience, because I was involved in funding the initial planning as Pacific Regional Manager for the Office of Coastal Zone Management. I prepared a case study of the process as Evaluation Officer and I wrote an article on it for the March issue of The Coastal Society Bulletin. This work, and articles by Marc Hershman, David Ortman, Pat Dugan and others, has brought increasing attention to the national implications of the Grays Harbor approach. I won't repeat the background of the Grays Harbor planning, because it has been covered by Marc, Nan Evans, and The Bulletin.

I would like to contribute three things to the continuing dialogue on the Grays Harbor experience:

- First, an explanation of why the process is important nationally;
- Second, corrections to some misunderstandings of OCZM's role in - and attitudes toward - the draft estuary management plan, and
- Third, some lessons learned so far that might guide future planning of this kind.

WHY IS THE GRAYS HARBOR PLANNING NATIONALLY SIGNIFICANT?

A major reason is that it may provide long-term protection for an estuary - and also result in quicker, more predictable permit decisions.

If the processes for reviewing applications for permits cannot be made more expedient and predictable, I believe some of our basic environmental protections are threatened. The present climate for reform of government regulations is so strong that it could seriously undermine environmental programs enacted over the last decade. Even though the

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general public continues to support the basic goals of environmental programs, they have lost patience with the red tape and expense associated with the complex web of regulatory procedures that now exists. A large segment of the public, including many state legislators and Members of Congress, are convinced that environmental regulations are a major cause of inflation, economic stagnation and increased taxes. They believe that these regulations stand in the way of meeting other public needs - such as energy.

One only has to reflect on changes to the Endangered Species Act, expedited processing of crude oil pipelines authorized by Title V of the Public Utilities Regulatory Policies Act, the Tellico Dam outcome and the proposed authority for the Energy Mobilization Board, to understand the present moods of Congress and their constituents. As Senator Dale Bumpers of Arkansas was recently quoted:

> "If there isn't some diminution of the regulatory process -- you don't have to be broke out with brilliance to see that people are mad and are wanting some action. And you can always depend on Congress to overreact."

I think environmental regulatory programs are especially vulnerable to change where the discretion of the regulators is very broad -- that is, when they are unable to tell people what policies guide their decisions, or when they will be able to make their decisions.

Those investing large sums of money in development do not have unreasonable expectations of permit processes, because the effects of regulations on the degree of risk and the timing of investment decisions are critical. Investors deserve to know from government:

- what the requirements are,
- where the requirements apply (geographically),
- what information they need to supply,
- how government makes its decisions, and
- when they will receive answers.

Communities and interested citizens also want to know these things -- and they usually want to influence the answers.

Traditionally, planning and zoning have provided these answers, but now the concept of "performance standards" seems to have taken over the environmental field. I suppose this is because of the fluid nature of local plans and zoning maps in the past, and the recognition of multi-jurisdictional interests in many development problems. The problem with this trend is that performance standard programs are neither prospective nor specific enough, in many cases, to provide the kind of guidance and predictability that most citizens and development interests seem to want.

The Grays Harbor planning process offers a way of combining the expectations and standards of state and Federal agencies with the more traditional planning and zoning concerns of local government into one specific long-range plan for the estuary. Regulatory agencies involved in the planning were expected to include in the plan the performance standards they use to review permit applications -- to the extent that these standards could be applied to planning decisions. They were asked to take a bird's-eye view of what their standards would mean to the estuary in the long-range future.

By having such a plan -- in which the requirements for development in the estuary are clear, specific, and unchanging; permit applications are expected to be processed more quickly, and with generally predictable outcomes. This is not to say that we expect permit decisions to be guaranteed, or the review process to be pro forma as a result of the plan. Since detailed engineering and environmental data may not be available at the planning stage of most projects, developers should not expect approval of a plan to substitute for approval of permits requiring more detailed information.

Most developers and government agencies should be familiar with project reviews involving two or more stages. In local communities, subdivision plans are typically submitted for approval to planning and zoning boards, or local councils, in advance of building permit applications. Few developers would expect a local community to give final building permit approval on the basis of this more general planning and zoning information. Conversely, few local officials would expect to reconsider the zoning or subdivision requirements of an approved project, when a developer submits detailed drawings for a building permit. I give this example to illustrate what the Task Force is trying to accomplish with a regional plan that is tied to permitting.

In Grays Harbor we hope that as many of the legal planning requirements as possible can be embodied in the plan. We also hope that responsible agencies will agree that project proposals can be approved in planning terms, when they are consistent with these requirements -- thus allowing projects to be further developed to meet more detailed legal requirements of building codes and environmental regulations. What the process hopes to avoid is "duplicative or identical determinations at the planning and permit levels of review."[1] In other words, we hope the Grays Harbor process will prevent situations where one set of permit administrators agree in principle to an estuary plan, only to have another group of administrators in two to five years (or in Washington) reconsider the same requirements and planning decisions at the time projects are at the detailed design and permit stage.

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1. EPA Memorandum: "The Interrelationships of the 404 Program and Coastal Zone Management Programs", July 7, 1978.

We are neither expecting agencies to give away their control at the front side of a development proposal, nor are we expecting them to hold all of their decisions to the very end. All we are expecting is that agencies make their requirements known in advance, decide on project proposals as early in the process as information is available to make these judgments and stick to their decisions.

We think the long-term future of this estuary, and others like it, are better protected by a plan which every regulatory agency can agree to and one that would take more than one level of government to change. We also think that if these improvements to the planning and permitting system can be accomplished, it will relieve pressures for incremental erosion or more drastic changes in environmental protection for natural areas like Grays Harbor.

Another reason why Grays Harbor is important is that it may establish precedents and clarify Federal policy regarding wetlands protection, water dependent development on fill, and the relationships between the Coastal Zone Management Program and Section 404 of the Clean Water Act.

In fact, the draft plan has already prompted detailed guidance from both EPA and the Fish and Wildlife Service on how Section 404(b)(1) of the Clean Water Act relates to CZM plans of this kind. These relationships are being defined for the first time, and the revised draft of the Grays Harbor Plan will test these concepts in specific terms. This guidance should provide clear and specific direction to implementing agencies and the public - and result in increased protection for the Nation's wetlands.

Other aspects of the Grays Harbor process that appear to be of interest beyond the State of Washington include:

- The collaboration of all levels of government in preparing a detailed plan for an estuary,
- The use of mediation techniques borrowed from the field of labor-management relations - to arrive at concensus on the plan, and
- The use of the NEPA process to facilitate intergovernmental agreements on a Special Area Management Plan.

<u>NOW, I WOULD LIKE TO CLARIFY SOME MISCONCEPTIONS OF OCZM'S ROLE IN THE GRAYS HARBOR PROCESS - AND OUR PRESENT ATTITUDES ABOUT THE DRAFT PLAN.</u>

<u>First, our office was not a member of the Grays Harbor Planning Task Force, and we have not participated directly in either the design of the process or any substantive proposals in the draft plan.</u> In the past, our role has been limited to funding the planning and conducting periodic evaluations of the activity. Under the direction of Bob Kifer and Ben Mieremet, we are now preparing an environmental impact statement

outlining the options for the Federal actions that may be needed for adoption and implementation of a final plan. As lead agency for the EIS on the Grays Harbor Plan, OCZM has become a facilitator of intergovernmental agreements on a final plan. We expect EPA to assure that the Plan meets the 404(b)(1) guidelines, the Fish and Wildlife Service and the National Marine Fisheries Service to assure consistency with the Endangered Species Act, and other participating agencies to assure that their regulatory requirements are met. Since several people have incorrectly written us requesting that we not designate the Bowerman Basin as a dredge spoil disposal site, it is necessary to correct this erroneous concept of our role.

OCZM has not endorsed the proposals of the Draft Grays Harbor Estuary Management Plan.

We have not taken a position with regard to the proposed fill behind Bowerman Field or any other substantive part of the plan. We will do what we can within the limits of funding and our NEPA and program evaluation responsibilities, to encourage a resolution of the outstanding difficulties; but it is not our role to dictate how these issues should be resolved. We are not intending to influence substantive land and water use policies of the plan - beyond assuring that such a plan will meet the general policies and procedures of the CZMA. Final judgment on the process and the final plan will primarily be based on how it effects the continued approvability of the Washington Program. This judgment cannot be made until the NEPA process is completed. However, it is fair to say that we endorse the concepts of "ecosystem planning" and "balance" between development and conservation and this probably means that trade-offs will be necessary.

Also, OCZM has not attempted to "undermine" or weaken the 404(b)(1) guidelines.

Our office has participated in discussions with EPA, the Fish and Wildlife Service, the National Marine Fisheries Service and other agencies in order to obtain recognition for coastal zone management planning -- where such planning meets the requirements of the Clean Water Act. We are hoping that Grays Harbor and similar efforts can succeed in satisfying some regulatory criteria in the planning document, so that all decisions are not left for the review of permit applications.

Last, OCZM is not proposing "Positive" or "Affirmative" Federal consistency for Grays Harbor or for the national program.

We do not want the CZMA or plans prepared for approved State CZM programs to be seen as a device to waive or undercut Federal permit requirements.

A brief comment in my March 1978 Case Study on Grays Harbor raised the question of "affirmative consistency", in response to comments from those interviewed. This question has now served its purpose: to raise

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the concept of Federal commitments to Federally agreed upon plans -- as a guide for future permitting. The subsequent debate on the subject of affirmative consistency makes it clear that even very specific plans for special areas cannot substitute for the kind of detailed review of proposals involving dredging and filling of wetlands called for in the Clean Water Act.

WHAT HAVE WE LEARNED SO FAR ABOUT THE GRAYS HARBOR PROCESS?

One thing we have not learned is how this kind of planning can be done quickly. The Grays Harbor planning was first funded in July 1976 and, until some difficult problems are resolved, there is no end in sight. Most of the controversy over the Grays Harbor Plan has centered on a draft that was completed over a year and a half ago - in January 1978. This represents a very significant investment of time for the Task Force members and others involved, which we hope can be reclaimed through expeditious processing of permits. It remains to be seen whether a final plan will ever be approved, or whether it will actually speed up the permit process. We think the process can and should be faster, although we recognize it is being held up primarily because it is establishing new precedents.

This point illustrates a second lesson: That proposals for substantial dredging and filling of wetlands will take a long time to be decided on.

It should be clear that Section 404 of the Clean Water Act, the President's Executive Orders on Wetlands and administrative interpretations of these requirements make it tough for anyone proposing to fill the Nation's wetlands. The central issue in the Grays Harbor debate at the present time is whether long-range plans can identify suitable dredge-spoil disposal sites involving wetland fill, in advance of establishing project specific needs, alternatives and impacts.

A third lesson is that all parties that hold a potential veto over the outcome of such a bargaining process, should be recognized and involved in the negotiations.

There is no magic formula for designing a government and citizen participation process that will be guaranteed to work. However, it seems clear that designers of such planning programs need to recognize that citizens and special interest groups often have legal standing and the influence to effectively block concensus on a plan -- whether or not they are directly involved.

Fourth -- Agency representatives in similar planning and bargaining processes should make sure they have the authority and discretion to negotiate on behalf of their agency.

They should thoroughly know, and be able to explain, the policies and standards that apply to their planning commitments. Where broad discretion to interpret general planning principles is provided to administrators, the representative needs to be sure that the interpretations used for negotiations are shared by those of the agency that are expected to approve and implement the plan. This includes permit and EIS reviewers as well as those in Washington that may get involved.

Finally - Designers of such planning efforts should explore other processes for developing concensus on long-range plans, before selecting the bargaining or environmental mediation techniques used in Grays Harbor as a model.

Planners should assess whether the issues are well enough defined and are ready to be mediated, whether those participating in the bargaining process need to reach concensus or find trade-offs, and whether the geographic area has been properly defined to resolve problems.

If there are a variety of complex issues to be resolved, or negotiating parties are not likely to be able to reach concensus within the law, other planning methods might be more appropriate.

In conclusion, the Office of Coastal Zone Management encourages and supports the concepts of the Grays Harbor planning process, reserves judgment on the plan itself, and hopes that others will strive for improvements in the present permitting process. The Grays Harbor experience may or may not be applicable to other areas - depending on the particular circumstances -- but it does hold some promise for the future of Coastal Zone Management. The value of this planning is greater predictability and the trade-off is broad agency discretion. The more specific these plans can become, the more predictable the outcome will be.

RESOURCE MANAGEMENT AND CONFLICTS IN THE
ATCHAFALAYA RIVER BASIN AND DELTA, LOUISIANA

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The 5000 km^2 Atchafalaya River basin has been the focal point of a decade old controversy. A major stumbling block in mandated development of a resource management plan for the area is a polarization of Federal and state agencies and interest groups. The controversy remains fueled by piecemeal planning, implementation of single purpose measures that are in conflict with the executive orders on wetland protection and floodplain management, and the failure to integrate river basin planning with the management needs of the associated coastal area.

Complexity of the problems within the Atchafalaya Basin derives from conflicting pressures for flood control, navigation, oil and gas extraction and agricultural development; the requirements for maintaining the existing, highly productive, aquatic ecosystem and contributing overflow hardwoods; and the need to optimize delta growth to offset present wetland losses. In view of the existing conflicts and continuous deterioration of the resource base, there is an urgent need for implementation of multipurpose management. Feasibility of such management has been established through Federal legislation and demonstrated by a series of studies. These studies focus on operating processes, their susceptibility to management for multiple resource use, and methods of management.

FEDERAL INCONSISTENCY: ADMINISTRATION OF THE CZMA IN THE ABSENCE OF EXPLICIT FEDERAL POLICIES AND STANDARDS

by

Edward T. LaRoe, Ph.D.[1] and Elisabeth Sheiry Roy[2]

ABSTRACT

In 1972, Congress passed the Federal Coastal Zone Management Act (FCZMA) to improve our ability to manage the nation's coastal resources. At that time, the resource management abilities of the coastal states showed wide variation, with significant disparities among the individual states and between the various geographical regions of the nation's shoreline. For example, the West Coast states were well into coastal planning, while areas such as the Gulf Coast had few tools for management of coastal resources.

Progress towards effective coastal resource management under the federal program has been controversial and uneven, with widespread uncertainty regarding both its objectives and its success. At the present time, Congress is reviewing the federal program with an eye towards improving, revamping or abolishing it.

The authors examine the approval and implementation of individual coastal state programs by the federal OCZM. State efforts to improve coastal resource allocation are reviewed in terms of meeting the standards of the federal Act and in comparison to their resource management capabilities at the time of its passage. The substantial differences among state programs in terms of compliance with the federal Act and objectives are described and many variations are ascribed to inconsistent application of standards at the federal and regional levels. Finally, the authors suggest that the federal program as a whole would be enhanced by adoption of more explicit standards for development and implementation of state coastal management programs.

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Since passage of the Federal Coastal Zone Management Act, the federal Office of Coastal Zone Management (OCZM) has struggled with a series of difficult issues regarding administration of the federal program, many of which remain unresolved as we enter the decade of the 80s and the Year of the Coast. The failure to resolve these issues at the federal level has led to inconsistencies in the development, approval, implementation, and funding of state programs, and may have weakened the federal program as a whole. The purpose of this paper is to explore the origin and nature of these inconsistencies, as well as to offer some thoughts regarding ways in which these administrative inconsistencies might be reconciled and thereby strengthen state and federal efforts to effectively manage our coastal resources.

FACTORS CONTRIBUTING TO FEDERAL INCONSISTENCY

Fundamental to the problem of administrative inconsistency is the unresolved issue of whether federal approval of state programs should be based upon procedural or substantive standards. That is, are there substantive standards by which a state's compliance with the requirements of the federal Act should be measured? Are there standards, for example, by which a state's coastal boundary should be established, or is it simply sufficient that some boundary---any boundary---be defined? In addition to the few specific criteria established in Section 305 of the Coastal Zone Management Act (P.L. 92-583, as amended in 1976, hereinafter referred to as CZMA), are there administrative standards which should be used by OCZM to assess compliance with the goals expressed in the Act's hortatory language (CZMA, Sections 302 and 303)?

Complicating this issue still further is OCZM's basic philosophy that program development should be the states' responsibility, and that the federal program should allow the maximum flexibility for coastal states to address those issues which they feel are most important in the manner they deem most appropriate. This philosophy runs counter to the concept of federally defined substantive standards.

When it enacted the Coastal Zone Management Act in 1972, the Congress expressed concern about a number of issues, particularly noting the fragile nature of coastal resources and the rate of loss or damage of these essential resources due to man's activities. As a result, Congress called for a balanced program to manage the Nation's coastal resources. Yet to be resolved, however, is <u>who</u> is to judge that balance. As expressed in the most recent program regulations:

> While the Act emphasizes resource protection, it does not exclude resource use and development <u>where appropriate</u>. The states are given the responsibility in the Act to choose the appropriate mix between

> preservation and development...A major part of OCZM's review involves an assessment of the mix. (15 CFR, Part 923i, emphasis added)

The problem is that OCZM has never published standards for assessing the appropriate mix for achieving the balance between preservation and development.

Because OCZM has never resolved the fundamental issue of whether there should be standards, much less what those standards should be, the review and approval of state programs has continued to be conducted on an ad hoc basis, and has frequently been based upon the opinion of or interpretation by the regional coordinators. As a result of such discretionary action by regional managers and the lack of uniform federal standards, criteria for approval of state programs have differed greatly among the states. Finally, in the absence of clear-cut federal standards, states have often felt subjected to changing standards throughout the program development process, and these uncertainties have further complicated the already difficult task confronting program managers who are struggling to develop programs acceptable to their political constituencies.

The remainder of this paper will be devoted to exploring examples of OCZM's failure to maintain consistent standards for program development, approval, and implementation. We will examine only a few of the federal administrative inconsistencies, but they are illustrative of the nature and extent of the problem which confronts the program as a whole.

INCONSISTENCIES IN PROGRAM DEVELOPMENT AND APPROVAL

One of the best examples of administrative inconsistency in approval of state programs involves the beleaguered Florida Coastal Management Program. During its review of Florida's preliminary draft coastal management program, OCZM cited a mixture of problems and deficiencies which required attention in order to gain federal approval. Some of the problems were editorial or procedural; in addition, three major substantive issues were identified relating to the adequacy and specificity of program policies:

- Florida's standards for approval or denial of dredge and fill permits in submerged lands and wetlands were not adequate or specific enough according to OCZM. In particular, the federal office expressed concern about the definition of the "public interest" test which is an important aspect of Florida's constitution and laws relating to the acceptability of dredge and fill permits.

- OCZM indicated it would require administrative rulemaking regarding standards for public investment in floodplain areas in an effort to avoid or reduce flood hazards and damage.

- OCZM felt that Florida's laws and regulations did not provide special recognition for the needs of water-dependent uses, and indicated it would require a variety of means to ensure that sites particularly suited for water-dependent uses could be protected and reserved for these uses.

These concerns reflect two major problems with the federal program. First, there are no requirements in the Act or regulations relating to some of these issues, and, where they do occur, the requirements are so vague that there is no uniform standard or interpretation. Second, because of the lack of standards, a state's compliance is judged on the basis of extensive negotiation with the federal regional coordinator. As a consequence, the requirements and standards applied to states are inconsistent, with the level of achievement varying greatly among regions and among states. In the absence of adequate standards, the policy of the federal office has been to select programs of certain states to be held up as models for other states to follow. In Florida's case, for example, OCZM pointed to the Massachusetts program in particular.

In order to evaluate the inconsistency of the review process on the part of OCZM, the treatment of the three issues identified above was reviewed in several state programs, including some of those which OCZM suggested as models, as well as programs more recently approved. The latter programs were included for the purpose of examining for possible changes in the administrative review of state programs. Because of OCZM's requirement that only those aspects of state coastal programs that are enforceable are to be included in coastal programs, our review focused exclusively on state coastal management programs and environmental impact statements.

The basic Florida standards for dredge and fill (excluding water quality standards) are summarized in Table I. OCZM did not object to the scope of the standards, nor to the parameters that were reviewed during the determination of whether a permit was approvable. Instead, they focused their concern on the phrase "contrary to the public interest," and required explicit quantitative standards regarding the extent or magnitude of impacts that would be considered contrary to public interest.

TABLE I

SUMMARY OF POLICIES AND STANDARDS FOR DREDGE AND FILL PROJECTS IN FLORIDA

- Private use of sovereignty lands (submerged lands to MHW) may be authorized only when not contrary to the public interest. (Constitution)

- Permits for dredge and fill may only be approved upon an affirmative showing that the proposed action will not:

  i) violate any state or local statute, zoning law, ordinance, or other applicable restriction;

  ii) harmfully obstruct or alter the natural flow of navigable water;

  iii) increase or cause harmful erosion or shoaling or create stagnant water;

  iv) cause material injury or monetary damage to adjoining land;

  v) interfere with the conservation of fish, marine, and wildlife or other natural resources to such an extent as to be contrary to the public interest; and

  vi) destroy oyster beds, clam beds or marine productivity, including destruction of natural marine habitats and grass flats to such an extent as to be contrary to the public interest.

- Water quality permits or certification required, based on numerical standards for several parameters.

- Additional considerations and restrictions for areas in state aquatic preserves

Florida's standards for dredge and fill permits are not unique; rather, they are similar to the standards for most other states. They are more inclusive or rigorous than most, identifying more specifically the factors that are to be considered. Moreover, Florida is not alone in including non-quantifiable subjective standards. As illustrated in Table II, all other state programs which were examined include non-quantifiable, non-defined standards.

The importance of these examples is not that the standards vary from state to state--that is what allows tailoring the federal program to state needs--but that each state's regulations have a certain vagueness, a lack of specificity, where administrative discretion is exercised. Delaware, North Carolina, and Oregon join Florida in referring to the "public interest." North Carolina, Rhode Island, and Massachusetts refer to "significant" effects. California, Delaware, Oregon, and Alabama require a determination of "feasibility" or "reasonableness." Rhode Island and North Carolina both refer to making a "balance." None of these terms are defined; none have predictable limits associated with them. This flexibility is fundamental to the permitting process, which in each state remains at least in part subject to a case-by-case, partially subjective, review.

While it may be desirable to have permitting standards identified in black and white, no state has yet been able to do so basically because it is politically expedient to allow room for negotiation and to avoid clear prohibitions. The inconsistency on the part of OCZM is that it rejected Florida's program for including such discretionary or procedural practices, while several other programs containing the same or greater latitude for discretion were approved.

A review of the other issues identified by OCZM as deficient in Florida's program produced similar results. For example, North Carolina, Alabama, and Massachusetts all have policies relating to public works projects funded by state and federal funds in flood hazard areas. None specify any standards, and some could be interpreted so generally as, for example, to preclude the construction of a state or federally funded bridge over a floodplain area. As in the case of Florida, the states of California, Delaware, Rhode Island, and Oregon have more general policies which speak to the need to minimize risks to life and property from flooding without any special policy explicitly addressing state and federally funded public works projects in the coastal zone. Florida's flood hazards requirements are generally weaker than those of other states examined, but the policies of some states are not enforceable; they are advisory only, and are implemented through such practices as the A-95 Review or Federal Environmental Impact Statement review. Some states only utilized executive order to address the issue, a means denied to Florida, as OCZM

TABLE II

SUBJECTIVE PERMITTING STANDARDS FROM SELECTED APPROVED STATE COASTAL MANAGEMENT PROGRAMS

MASSACHUSETTS:	*Minimize* damage by ensuring that dredging and spoil disposal cause no *significant* adverse change in a variety of identified factors.
CALIFORNIA:	Grant permits only where there is no *feasible* less environmentally destructive alternative.
RHODE ISLAND:	Demonstrate by a fair preponderance of evidence that there will be no *significant* adverse environmental impacts. Benefits must be *balanced* against damage.
DELAWARE:	*Minimize* wetlands destruction. Protect the *public interest*. *Consider* cumulative impacts.
ALABAMA:	Dredging and filling prohibited if it *degrades* the coastal area.
NORTH CAROLINA:	Dredge and fill permits may be denied if *significant* adverse effect. Permits will be evaluated to determine whether they interfere with or negatively affect *public interests*. To be favorably considered, projects should demonstrate a *public or private need*. The *balance* of social, economic and ecological costs and benefits must balance the *public interest*.
OREGON:	Dredging shall not be inconsistent with the protection, conservation and *best uses* of the waters of the state. Fill must not *unreasonably* interfere with the paramount policy of preserving waters for navigation, fishing, and public recreation.

Italicized phrases are not defined.

required administrative rulemaking. More importantly, however, OCZM required a remedy of Florida--a specific requirement regarding public funds and projects--that was not imposed on other states.

Again, our review indicated that states varied greatly in their treatment of water-dependent uses and facilities. Although some states give special recognition to water-dependent uses, fewer provided a commitment to protect certain areas for future use by water-dependent facilities, and only Oregon included a broad requirement that such sites must be sought, identified, and protected from imcompatible uses. Again, OCZM imposed a requirement on Florida that was an exception, not the rule, in approval of other state programs.

In addition to these three requirements, OCZM imposed yet another requirement on Florida: that the state must demonstrate "how the Florida Coastal Management Program will, in fact, specifically alter or augment the administration of...[existing programs] to meet its objectives." Florida's proposed program was based on existing state laws and rules; the Florida Coastal Management Act of 1978 specifically limited the program to only existing laws, policies, rules, or regulations, a requirement that earned the law the reputation as the "No-New-Nothing Act." This restriction was deemed necessary by the political leadership at that time in order to avoid the total loss of the state's coastal management program.

Whereas the draft program submitted to OCZM identified several ways in which program approval would result in improved management of Florida resources (primarily relating to factors such as improved data, coordination, understanding and awareness, and funding of existing efforts), it carefully avoided any implication that the program would change the existing laws, rules, or policies. OCZM rejected this approach, and required a demonstration of more substantive progress, in spite of the fact that nothing in the federal Act or regulations requires states to show an improvement. Florida was attempting to make a case that its existing laws met the existing federal requirements. Regardless of the merits of that argument, even if Florida was correct, OCZM was unwilling to approve the program unless there was a demonstrable alteration or augmentation.

OCZM has been rather blatant in the reasoning behind this requirement: it has candidly commented that it cannot go to OMB or Congress and admit that a state is being funded to do substantially the same thing it was doing before, regardless of how good that was. As a result, it created a new, purely political requirement for approval of Florida's program.

Based on that requirement and its actions, it is apparent that OCZM is willing to approve state programs which are basically very weak (such as Alabama) on the premise that the state has made comparatively great progress since the beginning of the federal program. At the same time, OCZM has rejected Florida's program which was well-developed and functioning prior to the federal program, and is still regarded as containing some of the toughest regulatory and land use laws in the nation, but which has concentrated on refining procedures for administration rather than new substantive changes since entering the federal program. This federal attitude and action may be necessary for continued support of the federal program, but the reaction at state level has been hostile and negative. It is at least partially responsible for the fact that the state's program has been almost totally dismantled by an embittered state legislature.

INCONSISTENCIES IN EVALUATION OF APPROVED STATE PROGRAMS

These examples of inconsistencies in federal administration of the CZMA have focued on Florida, for that is the state with which we are most familiar. However, it is not difficult to find examples of similar problems in other states. In addition, the inconsistencies extend beyond program development and approval into the realm of administration of approved state programs.

For example, during its annual review of approved programs, OCZM has begun to evaluate the progress of state programs toward certain national objectives which are supposedly predicated on the findings and policies of Sections 302 and 303 of the CZMA. Recommendations and grant conditions are then imposed on state programs on the basis of their progress, or lack thereof, towards achieving these objectives.

OCZM is presently using four principal criteria for program evaluation purposes: protection of significant natural resources; more effective management of coastal development; increasing access to the coast; and increasing intergovernmental cooperation and coordination. Although these are indeed worthwhile goals, there are numerous inconsistencies associated with their derivation and application by OCZM. Our review of these inconsistencies is based upon OCZM's most recent evaluation findings for six states: Massachusetts, Rhode Island, North Carolina, Michigan, Oregon, and Washington.

First, these criteria are new, part of the everchanging requirements imposed by OCZM. Such requirements were not a part of the findings surrounding the original approval of these programs, nor, at least in some instances, the first-year program evaluation. Indeed, some states were not even informed that these criteria were to be used until after the evaluations and findings were complete. This is not to connote that newness is necessarily bad. To the extent that it may remedy previous program deficiencies, it may be considered desirable--despite the fact that it represents yet another moving target for the states to hit. To ensure adequate opportunity for review and comment by states, federal agencies, and affected interests, however, these national objectives should be adopted by administrative rule and should not be applied to state program evaluations until after their formal adoption. As Wisconsin has indicated, "The changes and conditions to our program implementation grant represents...an excessive and burdensome amount of federal intervention."

Secondly, OCZM has yet to standardize the criteria by which it is now evaluating state programs. In order to apply criteria in some consistent fashion, the first prerequisite is some standardized language, but as is apparent from Table III, at least two sets of language are currently in use by OCZM. The basic criteria by which programs are to be evaluated, therefore, appear to vary from state to state. Some states are required to protect fisheries; others are not. Some are required to address subsidence and saltwater intrusion (even if these are not problems in the particular state); others are not. Some are required to address revitalization of urban waterfronts; others are not. In essence, for what should be basic, boiler-plate language, the clauses are remarkably inconsistent from state to state. In fact, no pattern--regional or chronological--could be discerned in their application. If these are indeed national objectives, they should apply uniformly to all states; and in order to be applied uniformly, the language should read in some consistent fashion.

The third inconsistency entails the derivation of the four criteria by which OCZM is presently evaluating approved programs. The evaluation findings explicitly cite Sections 302 and 303, the hortatory language of the Act, as the basis of the four areas in which substantive results are expected by OCZM. An examination of the specific objectives and issues in those sections, however, reveals that this is simply not true. Table IV contains a summary of the differences between OCZM's evaluation criteria and the referenced sections of the federal Act. Recreational access, for example, is identified as a planning element in Section 305 (not 302 or 303), but the statutory requirement is to provide a formalized planning process, not necessarily to increase access. Similarly, Section 303 declares that it is the national policy to preserve, protect, develop, and where possible, restore or enhance our coastal resources. OCZM, however, has selectively applied "protection" to certain of these resources, when, in fact, development might be appropriate or necessary. While we personally agree with these objectives, to cite these requirements as derived from Sections 302 or 303, combined with the selectivity in their

TABLE III

INCONSISTENCIES IN OCZM'S

NATIONAL EVALUATION CRITERIA

PROTECTION OF SIGNIFICANT NATURAL COASTAL RESOURCES AND AREAS SUCH AS WETLANDS, FISHERIES, BEACHES, DUNES, AND BARRIER ISLANDS. (NORTH CAROLINA, RHODE ISLAND, MICHIGAN)	PROTECTION OF SIGNIFICANT NATURAL RESOURCES SUCH AS WETLANDS, BEACHES, DUNES, AND BARRIER ISLANDS. (OREGON, MASSACHUSETTS, WASHINGTON)
MANAGEMENT OF COASTAL DEVELOPMENT SO AS TO MINIMIZE LOSS OF LIFE AND PROPERTY DUE TO IMPROPER DEVELOPMENT IN AREAS SUBJECT TO COASTAL HAZARDS; GIVING PRIORITY TO COASTAL DEPENDENT DEVELOPMENT INCLUDING PORTS AND WATER-DEPENDENT ENERGY FACILITIES; AND IDENTIFYING SITES FOR DREDGE SPOIL DISPOSAL. (MICHIGAN, RHODE ISLAND, NORTH CAROLINA)	MORE EFFECTIVE MANAGEMENT OF COASTAL DEVELOPMENT SO AS TO MINIMIZE LOSS OF LIFE AND PROPERTY DUE TO IMPROPER DEVELOPMENT IN FLOODPLAINS, EROSION-PRONE AREAS; AREAS OF SUBSIDENCE AND SALTWATER INTRUSION; TO PROMOTE BETTER MANAGEMENT GENERALLY BY GIVING PRIORITY TO WATER-DEPENDENT DEVELOPMENT; BY DEALING WITH ENERGY FACILITY SITING NEEDS AND BY IDENTIFYING SITES FOR DREDGE SPOIL DISPOSAL. (WASHINGTON, MASSACHUSETTS, OREGON)
INCREASED ACCESS TO THE COAST FOR RECREATION PURPOSES, INCLUDING REVITALIZATION OF URBAN WATERFRONTS, AND PROTECTION AND RESTORATION OF CULTURAL, HISTORIC, AND AESTHETIC COASTAL RESOURCES. (NORTH CAROLINA, RHODE ISLAND, MICHIGAN)	INCREASED ACCESS TO THE COAST FOR RECREATION PURPOSES, AND PROTECTION AND RESTORATION OF HISTORIC, AESTHETIC, AND CULTURAL RESOURCES. (OREGON, MASSACHUSETTS, WASHINGTON)
IMPROVED PREDICTABILITY AND EFFICIENCY IN PUBLIC DECISION-MAKING INCLUDING INCREASED INTERGOVERNMENTAL COOPERATION AND COORDINATION. (RHODE ISLAND, NORTH CAROLINA)	INCREASED GOVERNMENTAL COOPERATION AND COORDINATION RESULTING IN GREATER PREDICTABILITY AND EFFICIENCY IN GOVERNMENTAL DECISION-MAKING. (MASSACHUSETTS, OREGON, MICHIGAN, WASHINGTON)

TABLE IV

DIFFERENCES BETWEEN OCZM'S EVALUATION CRITERIA
AND SECTIONS 302 AND 303 OF THE CZMA

OCZM'S EVALUATION CRITERIA	CZMA, SECTIONS 302 AND 303
1. PROTECTION OF SIGNIFICANT NATURAL COASTAL RESOURCES AND AREAS SUCH AS WETLANDS, FISHERIES, BEACHES, DUNES, AND BARRIER ISLANDS.	1. PRESERVE, PROTECT, DEVELOP, AND WHERE POSSIBLE, TO RESTORE OR ENHANCE THE RESOURCES OF THE NATION'S COASTAL ZONE. (CZMA, Sec. 303(a)).
2. MORE EFFECTIVE MANAGEMENT OF COASTAL DEVELOPMENT SO AS TO MINIMIZE LOSS OF LIFE AND PROPERTY DUE TO IMPROPER DEVELOPMENT IN FLOODPLAINS, EROSION-PRONE AREAS OF SUBSIDENCE AND SALTWATER INTRUSION; TO PROMOTE BETTER MANAGEMENT GENERALLY BY GIVING PRIORITY TO WATER DEPENDENT DEVELOPMENT BY DEALING WITH ENERGY FACILITY SITING NEEDS AND BY IDENTIFYING SITES FOR DREDGE SPOIL DISPOSAL.	2. ...MANAGEMENT PROGRAMS TO ACHIEVE WISE USE OF THE LAND AND WATER RESOURCES OF THE COASTAL ZONE...(CZMA, Sec. 303(b)). ...LAND AND WATER USE PROGRAMS FOR THE COASTAL ZONE, INCLUDING UNIFIED POLICIES, CRITERIA, STANDARDS, METHODS, AND PROCESSES FOR DEALING WITH LAND AND WATER USE DECISIONS OF MORE THAN LOCAL SIGNIFICANCE. (CZMA, Sec. 302(h)). SHORELINE EROSION MENTIONED (CZMA, Sec. 302(c)) ...ATTAINING A GREATER DEGREE OF ENERGY SELF-SUFFICIENCY...TO MEET STATE AND LOCAL NEEDS RESULTING FROM NEW OR EXPANDED ENERGY ACTIVITY IN OR AFFECTING THE COASTAL ZONE (CZMA, Sec. 302(i)).
3. INCREASED ACCESS TO THE COAST FOR RECREATION PURPOSES INCLUDING REVITALIZATION OF URBAN WATERFRONTS AND PROTECTION AND RESTORATION OF CULTURE, HISTORIC, AND AESTHETIC COASTAL RESOURCES.	3. ...DEVELOPMENT AND IMPLEMENTATION OF MANAGEMENT PROGRAMS TO ACHIEVE WISE USE OF THE LAND AND WATER RESOURCES OF THE COASTAL ZONE GIVING FULL CONSIDERATION TO ECOLOGICAL, CULTURAL, HISTORIC, AND AESTHETIC VALUES AS WELL AS NEEDS FOR ECONOMIC DEVELOPMENT (CZMA, Sec. 303(b)). DECREASING OPEN SPACE FOR PUBLIC USE MENTIONED (CZMA, Sec. 302(c)).
4. IMPROVED PREDICTABILITY AND EFFICIENCY IN PUBLIC DECISION-MAKING INCLUDING INCREASED INTERGOVERNMENTAL COOPERATION AND COORDINATION.	4. FOR ALL FEDERAL AGENCIES ENGAGED IN PROGRAMS AFFECTING THE COASTAL ZONE TO COOPERATE AND PARTICIPATE WITH STATE AND LOCAL GOVERNMENTS AND REGIONAL AGENCIES IN EFFECTUATING THE PURPOSES OF THIS TITLE (CZMA, Sec. 303(c)) TO ENCOURAGE THE PARTICIPATION OF THE PUBLIC, OF FEDERAL, STATE, AND LOCAL GOVERNMENTS AND OF REGIONAL AGENCIES IN THE DEVELOPMENT OF COASTAL ZONE MANAGEMENT PROGRAMS (CZMA, Sec. 303(d))

application by OCZM, seems an excessively broad application of administrative discretion.

The extent of administrative discretion becomes even more evident when a close review of the Act itself reveals that nowhere in that statute are such things as dunes, barrier islands, fisheries, loss of life and property, hazards, subsidence, saltwater intrusion, water-dependent development, dredge spoil disposal, revitalization of urban waterfronts, or improved predictability even mentioned (Table V). Some of these objectives can indeed be derived from other federal initiatives such as the Executive Order on Floodplains, the President's Barrier Island Task Force, or the Fisheries Conservation and Management Act of 1976. They are not, however, part of the Coastal Zone Management Act itself, much less Sections 302 or 303.

When these inconsistencies are viewed collectively, therefore, it becomes clear that OCZM has applied inconsistent criteria based upon frequently non-existent objectives.

Yet another example of OCZM inconsistency relates to the mouth of the Columbia River and the Oregon and Washington programs. Recognizing the need for coordinated management for this shared resource, Oregon and Washington initiated a joint planning effort: the Columbia River Estuary Task Force (CREST). After over five years of planning, the CREST plan document is now nearly complete.

During its most recent evaluation of the Oregon program (September, 1979), OCZM unilaterally inserted a new grant condition: Oregon must ensure that the CREST product is incorporated into relevant local government land use programs. This is a remarkable requirement for two reasons. First, no such requirement was placed on Washington, even though both the Washington and Oregon programs are similar in that they are based on local government land use plans developed in compliance with state policies and standards.

Second, at the time the requirement was applied to Oregon, it was not possible to judge whether the CREST results would comply with the Oregon land use and coastal zone policies and standards for the simple reason that the plan was not completed. These standards are based in state law, and form the enforceable basis of Oregon's Coastal Management Program. It is these standards that underwent numerous public and federal reviews, and on which the EIS and federal approval were predicated. If the final CREST plan failed to meet these standards, Oregon would be placed in the position of breaking its own state laws in order to maintain a federally approved program. Moreover, OCZM would have forced an amendment to the state's approved program, one which it required before the actual shape of the CREST plan was known and without the benefit of public, state, or federal review.

TABLE V

LANGUAGE NOT INCLUDED IN THE FEDERAL ACT

OCZM'S EVALUATION CRITERIA

1. PROTECTION OF SIGNIFICANT NATURAL COASTAL RESOURCES AND AREAS SUCH AS WETLANDS, FISHERIES, BEACHES, DUNES, AND BARRIER ISLANDS.

2. MORE EFFECTIVE MANAGEMENT OF COASTAL DEVELOPMENT SO AS TO MINIMIZE LOSS OF LIFE AND PROPERTY DUE TO IMPROPER DEVELOPMENT IN FLOODPLAINS, EROSION-PRONE AREAS, AREAS OF SUBSIDENCE AND SALTWATER INTRUSION; TO PROMOTE BETTER MANAGEMENT GENERALLY BY GIVING PRIORITY TO WATER DEPENDENT DEVELOPMENT BY DEALING WITH ENERGY FACILITY SITING NEEDS AND BY IDENTIFYING SITES FOR DREDGE SPOIL DISPOSAL.

3. INCREASED ACCESS TO THE COAST FOR RECREATION PURPOSES INCLUDING REVITALIZATION OF URBAN WATERFRONTS, AND PROTECTION AND RESTORATION OF CULTURAL, HISTORIC, AND AESTHETIC COASTAL RESOURCES.

4. IMPROVED PREDICTABILITY AND EFFICIENCY IN PUBLIC DECISION-MAKING INCLUDING INCREASED INTERGOVERNMENTAL COOPERATION AND COORDINATION.

SUMMARY AND CONCLUSION

Much of the concern expressed during the past year regarding the reauthorization of the federal Act relates to the lack of specific standards for administration of the federal program. The NACOA report, the CSO Conference, the Coast Alliance, and public and private interest groups have all called for more explicit standards. The ambiguity of the federal standards has allowed states flexibility in addressing their specific needs, but has also caused delay, disputes, and total failure of some state programs. This, in turn, has impeded achievement of the intent of the federal Act.

The examples presented herein are intended to provide some insight into the nature and pervasiveness of the inconsistencies in administration of the federal program. The purpose of this examination of federal inconsistencies is not to criticize OCZM, or to challenge that agency's administrative discretion. Rather, it is to underscore the difficulties this posture creates for states attempting to develop and implement coastal management programs. As the consensus at the January conference of the Coastal States Organization indicated:

> ...changes are needed in the future. These should take the form of more specificity in the national policies and in the state programs....With improved administrative or legislative guidance, these changes can result without dictating the form of the management approach at the state or local level.

In conclusion, let us reiterate that we personally support many of the objectives and criteria which OCZM has applied. Yet, we do not believe that the federal program has developed or applied these criteria consistently, and that this inconsistency has worked to the overall detriment of the program and efforts to achieve the national objective of protecting our vital coastal resources. We hope to continue and expand our efforts to examine the problem of inconsistencies in administration of the federal program, and are actively seeking the assistance of others who are familiar with specific examples of federal inconsistency. We believe that an in-depth analysis of these inconsistencies will provide valuable information which will help define those areas in which federal standards--whether administrative or legislative--are most needed.

THE SEARCH FOR PREDICTABILITY: PLANNING AND CONFLICT RESOLUTION IN GRAYS HARBOR

by
Nan Evans
Marc J. Hershman
George V. Blomberg
William B. Lawrence

ABSTRACT This paper reports on a study in progress of conflict resolution over shoreline development in Grays Harbor, Washington. An interagency Task Force was formed which used bargaining and consensus to develop a multi-use fifty year plan which prescribes long-term policies and resolves specific controversies. The Task Force planning activity is described and lessons identified for other coastal management activities in the nation.

In 1975 an experiment in coastal zone management began in Grays Harbor, Washington. The frequent conflicts which had occurred between government agencies, development interests, and environmental groups over shoreline development projects resulted in costly delays and great uncertainty about the use of the estuary. To resolve these disputes and avoid such conflicts in the future, agencies with decision-making responsibilities in the region formed the Grays Harbor Estuary Planning Task Force. The product of the Task Force effort, the Grays Harbor Estuary Management Plan, was to provide a management system to ensure that future uses of the Grays Harbor shoreline would be predictable. Now, at the end of 1979, although some major agreements have yet to be reached, the Task Force effort is nearing completion.

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The Grays Harbor Estuary Management Program has attracted the attention of a national audience of coastal managers, resource and regulatory agencies, port directors, environmental groups, and elected officials. They are asking major questions about this unique form of estuary management. Would this Task Force of decision makers be able to forge a Plan that would guide development and improve agency coordination for many years to come? Would the Task Force be able to resolve specific conflicts between resource protectors, users, and developers? Would the Plan provide adequate protection for the estuary's biological resources and insure opportunities for economic development in the region? Would the Grays Harbor experience offer the nation a model for coastal zone management that integrates comprehensive planning, intergovernmental coordination, and conflict resolution?

The aim of this study is to begin to answer these questions about the planning process, so that the lessons learned from the Grays Harbor experience can be applied elsewhere. An interdisciplinary team at the Institute for Marine Studies of the University of Washington conducted extensive interviews with members of the Grays Harbor Estuary Planning Task Force and other interested parties. Interviewees were questioned about the problems of resource use and public decision making that made estuarine planning desirable in Grays Harbor, the expectations and objectives of participants in the planning activity, the methods used by the Task Force for estuary planning, and the methods and problems of plan implementation. Information documenting the impetus for the Plan, the collaborative planning process, and the estuary itself was also compiled. This paper is an interim report based on the initial conclusions of a report which is now being circulated to interviewees for review.

Grays Harbor, an estuary on the Pacific coast of the state of Washington, is a major port and industrial center for lumber and wood products, and also supports major commercial fishing and tourism industries. The biological communities and habitats of the estuary and its drainage basin provide the resource base for the primary economic sectors in Grays Harbor county. Grays Harbor is also one of only five major estuaries on the West Coast of the United States, with crucial biological functions such as providing nursery areas for marine animals, wintering grounds for migratory birds, and nutrient supply and regeneration for aquatic ecosystems.

Grays Harbor has a long history of resource use. Disputes over resource allocation and use have been persistent, and have involved a multitude of issues and actors. Specific and heated conflicts in Grays Harbor are similar to those observed nationally, as special interest groups become competitors for scarce and ecologically vulnerable coastal resources. Each of the conflicts involves disputes over what are the most important and valuable uses of the resources, who should determine the character and extent of uses affecting the estuary, and how the resources and their uses are to be managed or controlled. The parties to these conflicts include a wide spectrum of actors: federal resource and regulatory agencies, state resource management agencies, local governments, a port district, private landowners and developers, citizens, and environmental groups.

In recent years, conflict in Grays Harbor has been focused on on shoreline development. The hilly terrain of the region leaves few opportunities for industrial development except in the nearshore flatlands and on filled wetlands. The industrialized portion of the estuary, especially in the inner harbor, provide the necessary infrastructure for further development. The Port of Grays Harbor is the owner of large areas of shoreline, and offers the major opportunity for economic development. Seasonal and high unemployment in Grays Harbor County creates pressure for expansion of existing economic activity and for industrial expansion to provide increased and more stable employment. The shorelands and wetlands, which offer important development opportunities, are, however, also valuable to the maintenance of ecological health and diversity in the estuary. The stage for conflict is thus set between development interests and those concerned with environmental protection and conservation.

Each specific project proposal or permit application for shoreline development encountered a complex set of federal, state, and local administrative procedures. The cumulative outcome of each of these reviews contributed to growing frustration of all parties. Developers were unable to obtain sufficient levels of predictability to secure investments and to provide economic opportunities. In contrast, resource managers feared that they would be unable to predictably protect the long term biological viability of the estuary.

To provide a solution to these persistent and complex conflicts, representatives of the agencies and the governmental entities that had decision making responsibilities and powers in the estuary formed the Grays Harbor Estuary Planning Task Force. The Task Force utilized many basic comprehensive planning techniques. In addition, the Task Force assumed that its composition of actual decision making agencies would provide a more effective coupling between planning and decision making than is often experienced by more traditional comprehensive planning efforts. The Task Force assumed that if all the governmental decision makers could jointly develop a comprehensive plan for estuarine resource use, the plan would be directly implemented by the agencies, using existing management frameworks and regulations. Such a plan was expected to make a real difference in how decisions were coordinated and how resources were used.

A coastal management process designed to integrate conflict resolution with comprehensive planning by a group of decision making agencies and governmental units requires several special components. First, the parties must have realistic expectations and criteria for success. To achieve this the parties must understand the political and ideological nature of the conflict situation and they must accept that complete accomodation of all interests may not be possible. In addition, the parties must expect and be able to compromise. Second, all parties to the conflict which have a stake in the dispute resolution or can impact the implementation of any agreement should be involved in the planning/conflict resolution process. If critical parties are excluded, the political viability of any agreement may be threatened. As a corollary to the inclusion of all parties to a confict in its resolution and in order to maintain a task force at a workable size, parties who have no stake in the conflict, who are unable to compromise, or who are relatively powerless are best used as resource sources rather than as members of the task force. Third, representatives of the parties in a conflict resolution process should be selected who have the authority to speak for their agencies or constituencies. Also, the scope of each party's and its representative's authority must be clearly understood by all participants. Fourth, all representatives should have experience in bargaining and negotiating. Finally, if consultants are used they should be selected on the basis of mediating skills, as well as planning skills, because in conflict resolution a neutral mediator who can facilitate negotiations is necessary.

Despite problems associated with process design and implementation, after nearly four years of hard work a draft of the Grays Harbor Estuary Management Plan does exist. The Draft Plan is a comprehensive plan with general policy statements and resource use objectives, but the Draft Plan also contains several selected and specific agreements on geographic areas subject to the most intense conflict. Elements of the Plan and records of the planning process show that the Task Force was succesful in dealing with a number of trade-offs and in crafting several basic compromises, such as the multiple-use goal, Conditional Use provisions, Split Management Units, and Bankline Straightening and Erosion Control Policies. Also, as a result of the experience of Task Force participants in dealing with the difficult problems of intergovernmental coordination and resource use, the individuals (and perhaps their agencies) have established a firmer basis for future cooperation in the estuary and elsewhere in the region.

The Draft Plan also has provided a basic planning framework enabling small-scale projects to move through the permit review and approval process more predictably than before the Task Force began their work. However, this cannot yet be said of larger scale projects. Confrontation over the filling of 500 acres (200 ha) of wetlands for industrial development on a site called Bowerman Basin must be resolved before the Plan can move ahead to adoption and implementation. This major unresolved issue requires national, state, and local decisions about how negotiated agreements developed during a regional planning effort interface with national environmental policies and decision-making procedures. One of the most significant contributions of the Grays Harbor Estuary Management Program to national coastal zone management has been to force necessary decision on these questions. The predictability sought by all parties is jeopardized until these significant legal problems are resolved.

The original Task Force strategy was to rely on existing agency decision-making systems to implement and use the Plan. The Task Force itself expected to play a minor planning and advisory role. These assumptions are now being reviewed as a fuller range of adoption and implementation alternatives are being explored. Only when these procedures are selected and have a history of use can the conclusions on the success of the search for predictability in Grays Harbor be finalized.

The lessons learned from the experience of the Grays Harbor Estuary Planning Task Force should be applicable to efforts elsewhere. Even more importantly, the Grays Harbor experience has been an invaluable experiment in a form of special area management that is meaningful nationally. Grays Harbor provides a prototype of national coastal zone management issues. The Grays Harbor effort represented and attempted to answer the needs for improved interagency and intergovernmental coordination, for assured and adequate coastal resource protection, for providing development opportunities to protect the economic health of the coastal communities, for considering national interests in state and local coastal management programs, and for close connections between a management plan and the decision making power and mandates of a multidimensional, multijurisdictional, and democratic government.

The Grays Harbor experience in bringing all levels of government into a cooperative planning and management process could not have occurred without the flexible funding philosophy of the federal and state coastal management agencies that allocated funds to flow to areas where problems were clearly defined and where the actors were willing to jointly participate in experimental methods in the attempt to resolve these problems. The administration of the Coastal Zone Management Act should continue to be flexible and responsive to innovations in coastal planning and conflict resolution methods.

PART II

NEARSHORE FISHERIES MANAGEMENT PROBLEMS: OVERVIEW & POTENTIAL SOLUTIONS

Moderator: Lee Anderson

Regional Fishery Management Plan Preparation and a Case Study

Thomas E. Bigford[1], David W. Laist[2], Brian J. O'Sullivan[1] *

Abstract

Pursuant to the Fishery Conservation and Management Act (FCMA) of 1976, eight regional fishery councils were established to prepare and implement fishery management plans (FMPs) for species worthy of special management. This paper addresses the process of preparing an FMP and highlights that process by examining the preparation of one plan -- the coral and coral reef resources FMP for the Gulf of Mexico and South Atlantic Fishery Councils. Though the coral FMP is unique in many respects, it offers instructive insights into the planning process, issue identification, and alternative FMP management approaches. Among the topics discussed are new management strategies for a unique resource, methods of coping with no data base on fishery statistics, and representing the strong contingency of non-consumptive users.

Introduction

The Fishery Conservation and Management Act of 1976 (FCMA) asserted United States' jurisdiction over fishery resources within a new 200-mile fishery conservation zone (FCZ). The major tools for resource management were to be fishery management plans (FMP) drafted

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* The opinions expressed in this paper are those of the authors and not necessarily those of their affiliated organizations or the Fishery Councils.

for each fishery worthy of special management consideration. This paper describes the process of FMP preparation and examines one plan to highlight the problems encountered during the planning effort.

Under the FCMA, eight regional fishery management councils were established throughout the FCZ: New England, Middle Atlantic, South Atlantic, Gulf of Mexico, Caribbean, Pacific, North Pacific, and Western Pacific. These Councils are charged by the FCMA to orchestrate FMP preparation and implementation. Historically, this mandate has been addressed by contracts to consultants, cooperative arrangements with the federal National Marine Fisheries Service (NMFS) and by direct efforts by Council staff. Limited budgets for staff and contracts have somewhat delayed plan preparation; nonetheless, over 70 FMPs are in some stage of preparation or implementation.

As prescribed in the regulations for the FCMA (50 CFR Part 602.3b), each FMP analyzes every conceivable aspect of a particular fishery. In most plans, the outlines are identical, including discussions of biological data (growth, fecundity, distribution, yield, etc.), habitat, relevant legal authorities (federal, state, local; laws, regulations, agreements), trends in the fishery, socioeconomic structure of the fishery participants, business sectors, important cultural data (age, nationality, income, etc.) optimum yield (OY) of the fishery, management measures designed to achieve OY, data needs for effective management, and how the proposed measures relate to the status quo. When supported by catch statistics, ecological data, and other supporting information, each FMP represents a voluminous document describing the entire fishery, its participants, and its management framework.

The FMP Process

FMP preparation review and implementation is a lengthy process with necessary procedures described in the FCMA regulations. As a plan is being drafted, it is closely scrutinized by several review and advisory committees selected by the respective Council for that plan and by federal agencies (Figure 1). When a fishery resource subject to preparation of an FMP occurs over a geographic area spanning two or more Councils, a joint planning effort involving two or more Councils may be undertaken; in those cases (sharks, billfish, coral, and others), the committees include members from the jurisdiction of each participating Council. Typically, a draft plan is first reviewed by an Advisory Panel (AP) and a Management Committee (MC) (Figure 2). The AP represents a hand-picked group of about a dozen people with interests in the subject fishery, a related business sector, an agency involved in management, an environmental group, etc. This Panel is responsible for transmitting opinions and knowledge from these public and private groups. After the AP, the MC reviews the same draft version. The MC is composed of about 10 Council members representing an equally diverse mix of viewpoints. Together, the AP and MC are responsible for shaping much of the early draft. Later in the process, the Scientific and Statistical Committee (S&S) offers its expert knowledge of fisheries and the FMP process to

Figure 1. Hierarchy of organizations involved in the fishery management plan process. Organizations are listed in ascending order of relative importance, e.g., the Management Committees can over-rule the Advisory Panel but can in turn be over-ruled by the full Regional Fishery Council. Refer to text for duties of each group.

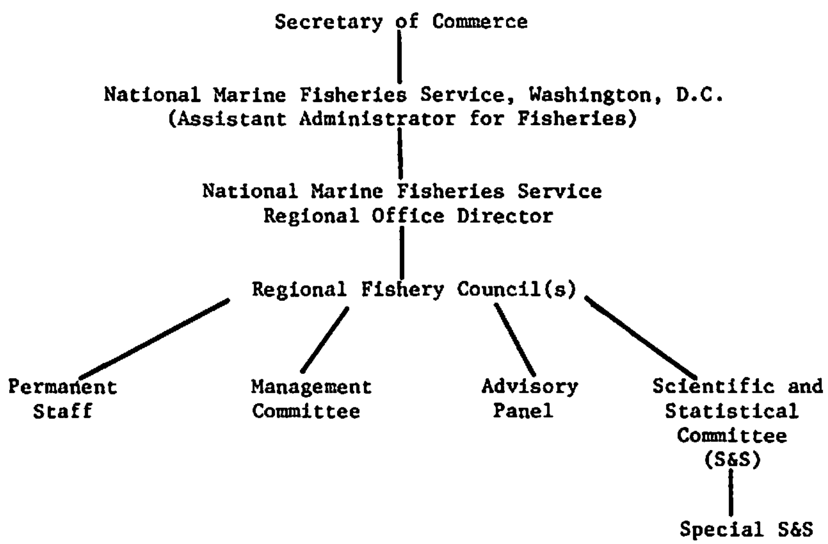
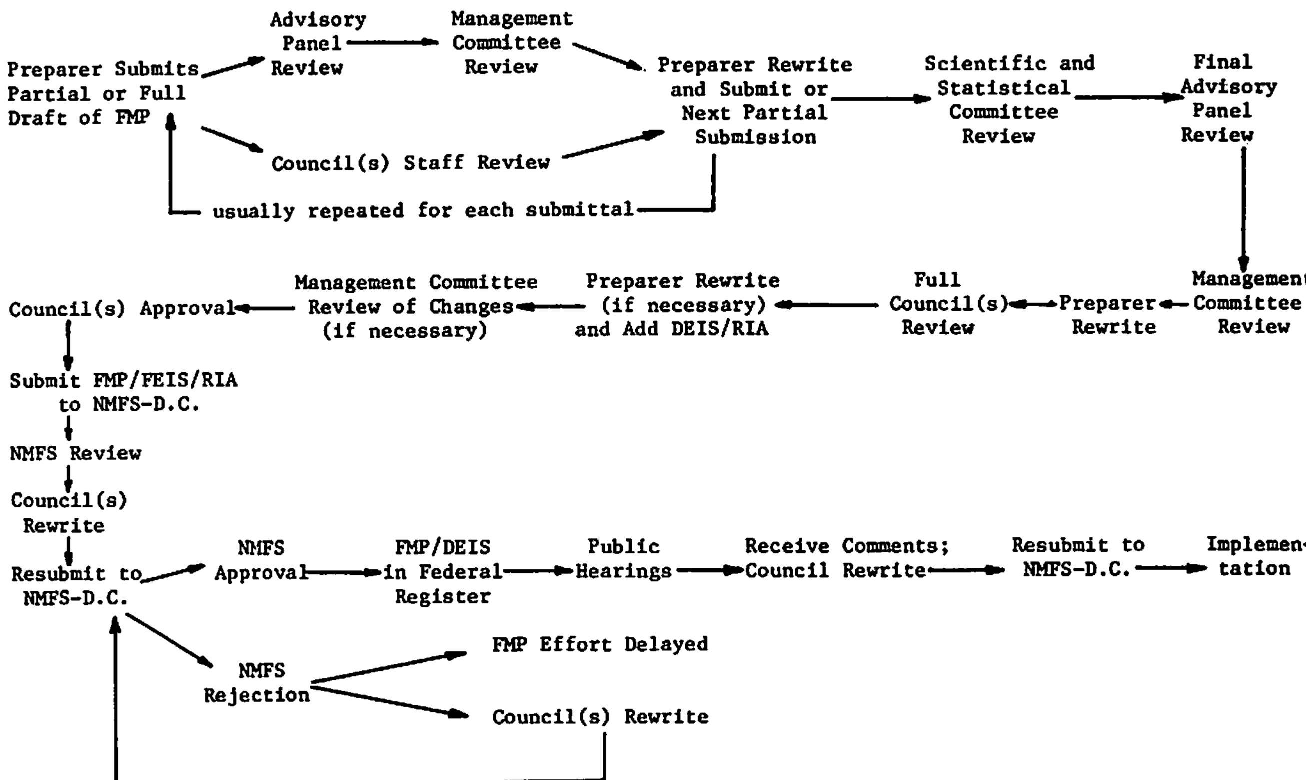


Figure 2. Flow chart of the FMP preparation process. DEIS = draft environmental impact statement; RIA = regulatory impact analysis; NMFS-DC = Washington Office of the National Marine Fisheries Service.



assure that all pertinent facts are considered. For many FMPs, a Special S&S composed of scientists thoroughly knowledgeable in the subject fishery is also named. By the end of the review process, the AP, MC, and S&S will have met several times with the FMP preparer to review changes, add new data, and critique each others' recommendations. Throughout this period, review has been limited to the committees and the states affected by the plan. Only after approval by the MC, whose authority supercedes the AP and S&S, and all involved Councils is the FMP transmitted to the NMFS in Washington, D.C. and eventually the general public.

The time required to prepare an implemented FMP is quite variable. Factors involved include the number of submissions by the preparer (one package including all sections or multiple packages of sections by subject area), the number of reviews required to gain full Council(s) approval, the number of Councils involved, the number of public meetings needed to adequately present the FMP to all sectors, and the reaction of the NMFS in Washington to the FMP and EIS. Regardless of these factors, FMP preparation and review prior to the implementation stage ususally requires well over one year. An important point to remember is that FMP amendments after approval by NMFS require that much of the process be repeated. Hence, if catch statistics imply that the OY was set unacceptably high, for example, the review process must be repeated before OY can be lowered. Emergency, short-term regulations may be implemented relatively quickly through special Council actions but the review process must eventually be repeated. During the amendment review, the initial FMP as approved remains in effect.

As mentioned, over 70 plans are in various stages of the review process nationally. Among those plans are FMPs for finfish (groundfish, mackerels, snapper/groupers) and shellfish (surf clams, crabs, shrimp); heavily-exploited (New England groundfish, surf clam) and under-utilized (squid, butterfish) species; and domestically consumed (lobsters) or exported (squid) species. However, one FMP currently in preparation is quite unique, and is the case study examined in this paper -- the Atlantic and Gulf of Mexico coral plan.

The Coral FMP as a Case Study

The coral and coral reef resources FMP for the Gulf of Mexico and South Atlantic Fishery Management Councils is unique in many aspects. One of the more noticeable features of this plan is that it addresses over 400 different species; most FMPs cover small resource groups of only one or a few species. For example, the Western Pacific Council's coral plan covers four species. Second, and equally unique, is the fact that there is no fishery for any coral in the Councils' FCZ and only a very limited one for soft corals in state waters. Small commercial fisheries existed prior to the mid 1970s but have since been outlawed by federal and state law. The result is a nearly total lack of catch and effort statistics -- a critical absence in developing an FMP. Third, the ecology of corals is inherently different from most finfish and shellfish. Corals are sedentary after a short planktonic larval stage, with juvenile and adult corals often occurring in units known as reefs. In each reef, a course of ecological succession proceeds much like in terrestrial environments. The result is a continually changing resource that requires constant research to enable effective management. Fourth, a large contingency of coral resource users rely upon non-consumptive use. Unlike a pure exploitation fishery as is the case in nearly every other FMP, coral users include the glass bottom, charter dive, and fishing boat groups, fish and specimen collectors, and shellshops that market imported corals. These sectors have been quite vocal throughout the FMP preparation process. Lastly, to complicate the planning effort, corals are subject to a very confusing and overlapping set of laws and regulations. Federal agencies with jurisdiction over coral include the Bureau of Land Management (OCS Lands Act and regulations), the Office of Coastal Zone Management (Coastal Zone Management Act; Marine Protection, Research, and Sanctuaries Act), the Coast Guard (enforcement of the FCMA), NMFS (research for the FCMA), and the Councils. The state of Florida also has a coral law to cover resources within its territorial sea.

The lack of a fishery and the preponderance of non-consumptive users have raised questions of why a coral FMP is being prepared at this time. Three points emphasize the need for a plan. First, although corals are not currently harvested as a "fishery" resource, the living corals in United States' waters are not without significant economic value. Thriving coral reefs are important resources for local scientific, tourist, and recreation industries. Further, demand for imported corals, particularly for jewelry and objets d'art, raise the possibility that a fishery will be developed in the future. Presently, most of the corals marketed domestically appear to be imported illegally from the Philippines and, to a lesser extent, Haiti -- both of whom have laws explicitly prohibiting the export of raw, unprocessed corals. If those laws are ever enforced and the demand continues, domestic corals will probably be subjected to increased exploitation pressures. In any event, the protection and management of living coral resources, perhaps via an exceptionally low optimum yield, represents a viable interpretation of the intent of the FCMA. Second, although corals themselves are not harvested, literally dozens of finfish and shellfish species that utilize corals for food or shelter are caught recreationally or commercially. For example, spiny lobsters, snappers, and groupers inhabit reefs during parts of their life; shrimp, callico scallops, stone crabs, and many tropical fish live in hard bottom areas that often include corals. In many of these fisheries, corals are a very significant component of the species' habitat. Some of the stocks would be displaced or perhaps decimated by reduced coral health. The last and perhaps most important argument centers on the complex jurisdictional morass described above. The many agencies involved have produced a duplicative system for management within federal waters. Memoranda of understanding (MOUs) have been signed in some cases to effectuate a more coordinated and cohesive management system but in many cases each agency proceeds individually. Furthermore, jurisdiction which has for the past several years provided the basis for management authority has become clouded by a September 24, 1979, Fifth Circuit Court of Appeals decision in <u>United States</u> v. <u>Alexander</u> that limited Bureau of Land Management (BLM) regulations from the Outer Continental Shelf Lands Act concerning corals to activities related to OCS mineral activities. This recent court interpretation greatly restricts the breadth and geographic coverage of the BLM authorities. It leaves most of the corals beyond the territorial boundary without any management until an FMP is implemented. These three rationales encompass socio-economic, ecological, and administrative aspects of the coral resource. They validate the need for an FMP immediately, regardless of the status of the coral fishery.

Based on the preceding description of the FMP process and the uniqueness of the resource, it may be useful to analyze how the coral FMP has been developed by the two Councils. Naturally, with the paucity of data and the peculiarities of corals, the Councils have proceeded cautiously toward a rather unconventional plan. Emphasis has been placed on the role of corals as habitat, the diversity of user groups associated with corals, the lack of data to calculate yields and to apportion catch and use, and jurisdictional problems. Brief descriptions of how the joint Council effort has approached these issues are presented below; however, since the FMP has not yet gained Council approval, the following statements are only tentative.

--Coral Habitat

The dependence of so many important commercial and recreational species on coral for habitat presented a problem unlike that addressed in any other FMP. Combined with the historical absence of a fishery, the inclination has been to evaluate coral in light of marine communities' dependence on coral for their existence. The coral FMP has therefore taken a broader ecosystem or habitat management approach then typical FMPs.

One major tool of the coral FMP has been "habitat areas of particular concern" (HAPCs). Although specified in the FCMA regulations (50 CFR Part 602.3b.6.ii) as a component of all plans, not even one FMP had used the HAPC concept previously. For corals, however, the definition of an HAPC as areas "... which are of particular concern because of a requirement in the life cycle of the stock(s), e.g., spawning grounds, nursuries, migratory, etc. ... (and) ... those areas which are currently or potentially threatened with destruction or degradation" seemed an ideal method of management, especially since many corals are subject to negative impacts from pollution, boating activities, other human actions, and many natural occurrences.

To use the concept, the FMP preparer (Center for Natural Areas) and the two Councils had to develop criteria and rationales for HAPCs. A primary consideration of the concept was its use in the FMP. Thus far, the idea has been applied to special ecological areas for the sole purpose of focusing regulatory and enforcement capabilities. The criteria applied to prospective areas were:

1) ecological -- an outstanding or representative example of a coral community; presence of a rare species; or an area with highly unusual coral diversity or other ecologic relationship.

2) research -- an area with an unusual history of research or areas that clearly portray features of corals or coral reef resources.

3) exploitation -- areas where high concentrations of economically valuable corals occur or coral areas subject to impacts from man-made activities.

4) recreation -- areas commonly visited by recreational divers or boaters or areas offering high but underutilized recreational value.

In the FMP process, coral HAPCs have thus far been considered in areas encompassing all four criteria. Some areas are already managed under existing authorities, such as the Key Largo Coral Reef Marine Sanctuary and other areas in the Florida Keys. Other HAPCs might include East and West Flower Garden Banks in the northwestern Gulf of Mexico or a representative Onslow Bay, N.C. hard bottom area. Regardless of the status of existing authority, naming as an HAPC served as Council acknowledgement of a special coral resource assemblage. An effort to incorporate representative coral habitats throughout the geographic area of the plan was also attempted during HAPC consideration.

This HAPC concept appears to be an excellent tool for focusing limited management/enforcement resources. The major use of HAPCs in the coral plan was a first attempt at applying a new approach in the FMP process and represent one plan's solution to the special problems encountered in every FMP.

--User Group Diversity

The coral resource differs from most fisheries, since user groups include a variety of sectors, dominated most obviously by non-consumptive users. During plan preparation, this diversity and dominance was made clear by the Councils' Advisory Panel (AP). In response to their input, the HAPC criteria considered a wide range of users, only one of which involved exploitation. Management measures under consideration for HAPCs and the entire resource area were very cognizant of user group opinions. In fact, it was those opinions that continuously urged preparation of the FMP and shaped its direction toward broad habitat management.

--Lack of Data

The absence of any catch, effort, participation, demand, or other data greatly restricted development of yields, namely maximum sustained yield (MSY) and optimum yield (OY). Since yields are a chief objective of each FMP, the coral plan could not complete the typical yield calculations but had to develop another approach to stock assessment.

With a tendency toward the status quo of no fishery and with no catch or effort data, the Councils have conceived a new approach -- an incaluable MSY. Besides several small portions of the Florida Reef Tract that have been heavily researched, no MSY could be derived without making unsupportable assumptions. This line of thinking again is unique, with no basis in other FMPs.

Following an incaluable MSY, it has also been decided that OY is relatively unquantifiable. The only yield recommended thus far has been for that amount of coral collected by permit from either BLM or the Florida Department of Natural Resources. It may be difficult to defend any OY in light of an incalcuable MSY, but the restricted OY will enable scientific and educational programs to continue.

The lack of data is also clear in the plan's recommendations for future research. Among the research topics suggested are ecological reviews of growth rates, colony weights, densities and distributions. A better understanding of natural versus human impacts on corals is also a crucial data gap.

--Jurisdictional Issues

One major outcome of the coral FMP should be a clarified jurisdiction picture of coral resources. When a plan is implemented, the combination of BLM, NMFS, and OCZM control should be better integrated. This will be a significant advance considering the decision in U.S. v. Alexander on the BLM coral regulations. However, other agency interactions in research, permits, and more will persist. For those cases, additional agreements need to be reached. Each Council has already signed a memorandum of understanding (MOU) with OCZM to provide consultation and coordination of resources over which they both have jurisdiction. Another MOU clarifying the transfer of jurisdiction as the coral plan is implemented or marine sanctuaries are designated has been pending between BLM, OCZM, and NMFS for well over one year.

Another crucial issue in effective implementation of the FMP is coordination with state authorities inside territorial waters. Since the only significant coral stocks in state waters occur in Florida, a cooperative agreement with the Florida Department of Natural Resources is most needed. Supporting agreements with the Florida Department of Natural Resources would be very helpful in gaining state research and enforcement support for the FMP. Cross-deputization of Florida Marine Patrol and U.S. Coast Guard personnel would be an effective approach to manage coral resources that are common on both sides of the territorial sea boundary.

The Future

On the present schedule, the coral FMP should be to the implementation stage by mid to late 1980. As drafted, the plan and its accompanying EIS should form a solid basis on which to formulate an integrated plan for corals and its associated resources. Of crucial importance will be the implementation of the spiny lobster, shrimp, snapper/grouper, reef fish, and other plans in the Councils. These FMPs must be well coordinated to protect the concerns of users in each fishery.

A Model to Estimate the Unrecorded Catch Based on Recorded Landings*

Dr. C. Bruce Austin**, Gregg T. Waugh+ and S. Kenneth Chan++

A model is presented that can be utilized to estimate the magnitude of the unrecorded catch relative to recorded landings. The magnitude of the unrecorded catch relative to recorded landings was theoretically determined by converting a conventional theoretical static fishery production function into a dynamic model. The Florida spiny lobster, Panulirus argus, fishery has conditions similar to those described by the model and was utilized for the preliminary test of the model. The model implies that the unrecorded catch is slightly larger than the recorded catch of approximately 5.5 million pounds. While a percentage of the unrecorded catch can be attributed to the recreational harvest, it is expected (but still not verified) that the poaching of shorts by commercial fishermen while they are harvesting legal size lobsters is the major portion of the unrecorded catch.

This paper describes ongoing work that is sponsored by the Ford Foundation to apply analytical and numerical models to marine resource management problems through the Ford Foundation State Environmental Policy Program. A basic difficulty with calibrating fishery models is that statistical estimations must frequently be done with incomplete landing statistics because a significant amount of the catch is not recorded for various reasons. A model is developed in this paper that can be utilized to estimate the magnitude of the unrecorded catch relative to recorded landings when the fishery has the following characteristics.

(i) There is a specified fishing season which is less than the whole year and during that fishing season the exploitable stock declines, and that decline can be expressed as a ratio of the beginning season exploitable stock.

(ii) There is a specified closed season when the exploitable stock rebuilds to approximately the same level by the beginning of each fishing season.

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(iii) Recruitment that occurs during the closed season can be estimated as a ratio of the beginning season exploitable stock. Furthermore, that the estimate of recruitment during the closed season can provide an estimate of recruitment during the fishing season as a ratio of the beginning season exploitable stock.

These conditions are summarized in Figure 1 which depicts relative abundance of the exploited stock over a period of time that includes consecutive open and closed seasons. This example indicates an eight month fishing season followed by a four month closed season followed by another eight month fishing season.

Given these above conditions then, the magnitude of the unrecorded catch relative to recorded landings can be theoretically determined by converting a conventional theoretical static fishery production function into a dynamic model.

A Static Production Function

A fishery production function specifies the mathematical relationship between economic inputs (fishing effort), the size of the exploitable stock, and the resulting catch. The most widely used static production function is specified to be

(1) $C_t = KE_t N_t$

where C_t is the catch in period (t), E_t is the level of fishing effort, N_t is the exploitable stock, and K is the catchability coefficient that is constant over time, but varies between different fishing gear and exploitable stocks. The reliability of this form is closely related to the ability to aggregate different types of fishing gear that operate in a fishery. This is normally not a weakness of the theoretical form but an applied statistical problem of estimating the form.

An important characteristic of the static production function is its proportionality condition. A percentage reduction in the exploitable stock will result in an equivalent percentage reduction in the catch or catch per unit of effort (CPUE = $^C/E$)*.

*Proof

$C = KEN$	or	$^C/E = KN$
$\ln C = \ln K + \ln E + \ln N$		$\ln(^C/E) = \ln K + \ln N$
$\frac{1}{C}\frac{dC}{dN} = \frac{1}{N}$		$\frac{1}{C/E}\frac{d^C/E}{dN} = \frac{1}{N}$
$\frac{dC}{C} = \frac{dN}{N}$		$\frac{d^C/E}{C/E} = \frac{dN}{N}$

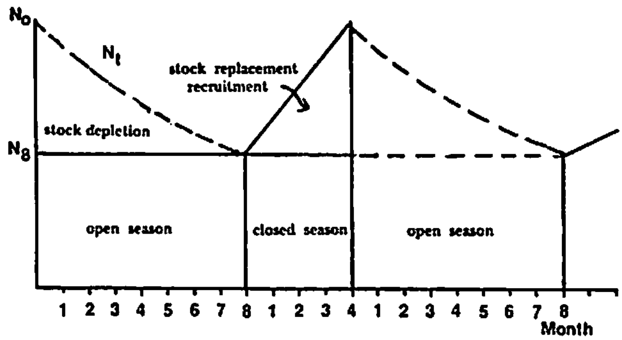

Figure 1. Expected seasonal pattern of the exploited stock required for the model.

A Dynamic Production Function

A dynamic production function can be specified from the static function given three assumptions. First, the fishing effort level is constant in each period of the fishing season. In most seasonal fisheries, the opening months of the season are "busier" than the latter months of the season. If the pattern is known, the model can be adjusted accordingly. Second, there is no recruitment to the exploitable stock during the open season. Third, there is no mortality in the exploitable stock except the fishing mortality indicated by the production function. The second assumption about no recruitment will be dropped, and in doing so, permits a calculation of the unrecorded catch given whatever assumption is made about recruitment. The third assumption can be eliminated with the specification that recruitment is the net growth rate of the exploitable stock which is the difference between the gross recruitment rate and the natural mortality rate.

Given the three assumptions, then the change in the exploitable stock during any period (t) in the fishing season is the catch (C_t).

$$(2) \quad \dot{N}_t = \frac{dN_t}{dt} = -C_t = -KE_tN_t$$

Integrating (2) with respect to time (t) indicates that the exploitable stock at any time during the season is

$$(3) \quad N_t = No\ e^{-KE_tt}$$

where No is the exploitable stock at the beginning of the season*. Substituting (3) into (1) yields the dynamic production function

$$(4) \quad C_t = KE\left[No\ e^{-KE_tt}\right]$$

The dynamic production function (equation 4) could be utilized to estimate the value of the catchability coefficient (K) if landings in each period during the season were avialable. A logarithmic form of equation 4 for the statistical estimations purpose would be

$$(5)\quad \ln C_t = \ln K + \ln E_t + \ln No - KE_t t$$

$$\ln C_t = \alpha - \beta\left(E_t t\right), \text{ where } \alpha = \ln K + \ln E_t + \ln No$$

Integrating (4) with respect to time (t) yields the equation for cumulative seasonal catch[+].

$$(6)\quad \int C_t = No\left(1-e^{-KE_t t}\right)$$

Presumably the percent reduction in the exploitable stock over the fishing season would be known by monitoring the percentage reduction in the catch or sampling the CPUE over the season according to the proportionality assumptions of the static production function (equation 1). Given the known percent reduction (X) then the catchability coefficient could be readily calculated without catch data on each period in the season in the following way:

$$(7)\quad \frac{\int C_t}{No} = \frac{No\left(1-e^{-KE_t t}\right)}{No} = X$$

rearranging (7)

$$(8)\quad K = -\frac{\ln(1-X)}{E_t t}$$

Equations (3), (4) and (6) are illustrated in Figure 2. The exploitable stock N_t is the same as Figure 1. The other variables (C_t, $\int C_t$) are calculated by the dynamic production function.

[*]Proof

$$N_t = No\, e^{-KE_t t}$$

$$\ln Nt = \ln No - KE_t t$$

$$\frac{1}{N}\frac{dNt}{dt} = -KE_t$$

$$\frac{dNt}{dt} = N = -KE_t N_t$$

[+]The constant in the integration of equation 4 is equal to the beginning season exploitable stock (No) according to assumption (ii) that is specified at the beginning of the paper.

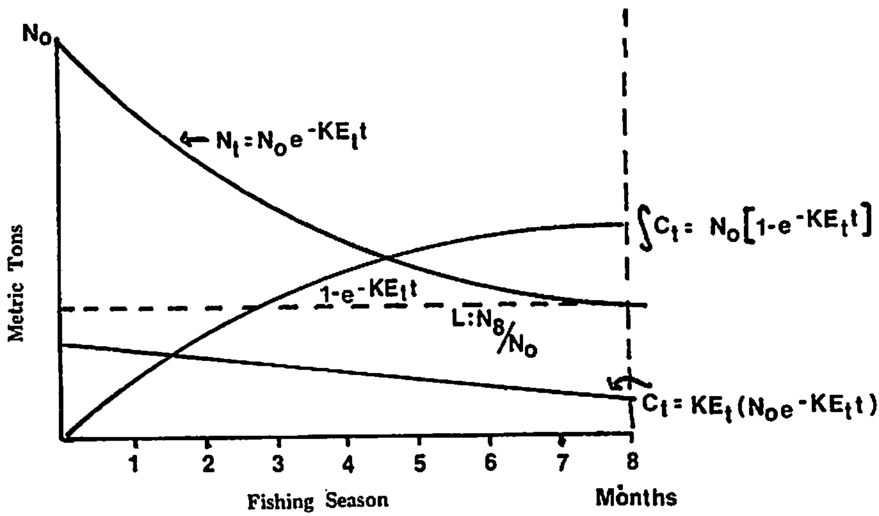

Figure 2. Season pattern of exploitable stock (N_t), monthly catch (C_t) and cumulative seasonal catch (S C_k)

To the extent that there is an unrecorded catch, it does not bias the use of the catch or CPUE over time to estimate the relative size of the exploitable stock (value of X). However, to the extent there is an unrecorded catch, then utilizing equations (5) or (8) to estimate the catchability coefficient (K) will result in an overestimate of the true value of K. In the opposite direction of bias, to the extent there is recruitment to the exploitable stock during the fishing season, the result will be to underestimate the true value of K.

The only time this bias would be obvious is if it violated the basic form of the dynamic production function by resulting in the estimated value of K being zero. This could only occur with an underestimate of K due to recruitment. The necessary condition would be that the catch plus recruitment during the fishing season, both expressed as ratios of the beginning season exploitable stock ($\int C_t$/No ± R/No) to the reduction in the exploitable stock plus the recruitment.*

*Obviously if catch is less than recruitment then the exploitable stock would be increasing rather than decreasing over the fishing season.

That is, the cumulative seasonal catch (equation 6) must be equal to

$$(9)\ \int C_t = No \left(1-e^{-KE_t t}\right) = XNo + R$$

rearranging

$$(10)\quad e^{-KE_t t} = 1-X-{}^{R}/No$$

As long as the reduction in the exploitable stock (X) and recruitment during the fishing season measured as a ratio of the beginning season exploitable stock ($^{R}/No$), are less than one ($X + {}^{R}/No < 1$) then the dynamic production function based on recorded by solving (10) for K

$$(11)\ K = -\left(\frac{\ln\ (1-X-{}^{R}/No)}{E_t t}\right)$$

where $1 > 1-X-{}^{R}/No > 0$

then $K > 0$.

However, if $X + {}^{R}/No > 1$ it implies that the estimated value of the catchability coefficient (K) must be zero which is not possible.

The whole problem can be restated in the following way. With the assumptions that there is no unrecorded catch or recruitment then a dynamic production function, based on a static one, permits the direct estimation of the theoretical catchability coefficient. When the no recruitment assumption is relaxed, the theoretical catchability coefficient is underestimated depending on the amount of recruitment. However, there is a level of recruitment, expressed as a ratio of beginning season exploitable stock ($^{R}/No$) that will result in the estimation of the catchability coefficient (K) being zero which is theoretically impossible. That level is where recruitment during the fishing season ($^{R}/No$) is greater than the exploitable stock at the end of the fishing season ($^{N}t/No$).

If the theoretical static and resulting dynamic production functions are specified to include an unrecorded catch then, given the three general conditions about the fishery that were originally described, the magnitude of the unrecorded compared to the recorded catch can be calculated.

A Static Production Function With an Unrecorded Catch

The simplest and most likely situation is when the unrecorded catch is proportional to the recorded catch. This would be expected to occur when the production function for the unrecorded catch is of the same mathematical form as the recorded catch production function. In this situation the static production function would be the following (the number of the equations that include an unrecorded catch correspond to the previously developed equations without an unrecorded catch, except for the asterisk to distinguish them).

$$(1^*)\ \hat{C}_t = (1 + \emptyset)\ C_t = (1 + \emptyset)\ KE_tN_t$$

$\hat{C}_t$ is the total recorded catch (C_t) plus unrecorded catch ($\emptyset C_t$) in each time period. The variable $\emptyset$ is defined as the unrecorded catch coefficient. The theoretical catchability coefficient (K) and effort level (E) are, of course, always derived solely from recorded data.

Without recruitment (defined as net increase in the exploitable stock such that it incorporates natural mortality), this static production function (1^*) yields a similar dynamic production function as the original static production function (1). The change in the exploitable stock in each time period is the total catch.

$$(2^*)\ N_t = \frac{dN_t}{dt} = -\hat{C}_t = -(1 + \emptyset)\ KE_tN_t$$

Integrating (2^*) with respect to time indicates the exploitable stock at any time during the season.

$$(3^*)\ N_t = No\ e^{-(1 + \emptyset)\ KE_t t}$$

Substituting (3^*) into (1^*) yields the dynamic production function

$$(4^*)\ \hat{C}_t = (1 + \emptyset)\ KE_t\ No\ e^{-(1 + \emptyset)\ KE_t t}$$

Since the only data available is recorded catch $C_t = \hat{C}_t/(1 + \emptyset)$, both sides of equation (4^*) can be divided by $(1 + \emptyset)$ to produce the dynamic production function for the recorded catch (4^{**}) which can be compared with the original recorded catch production function (equation 4).

$$(4^{**})\ C_t = KE_tNo\ e^{-(1 + \emptyset)KE_t t}$$

The dynamic production function (equation 4^{**}), like its counterpart with no unrecorded catch, could be utilized for regression analysis if landing data was available in each time period in the season. The logarithmic form for estimation would be:

$$(5)\quad \ln C_t = \ln K + \ln E_t + \ln No - (1 + \emptyset)KE_t t$$

$$\ln C_t = \alpha - \beta \left\{E_t t\right\} \quad \text{where } \alpha = \ln K + \ln E_t + \ln No$$

$$\beta = (1 + \emptyset)K$$

With an unrecorded catch, the slope of the statistical estimation function (β) cannot be used to estimate K directly. However, $(1 + \emptyset)K$ can be statistically estimated.

Integrating (4^*) with respect to time yields the equation for total recorded and unrecorded catch (6^*). Integrating (4^{**}) with regard to time yields the total recorded catch (6^{**}) (see appendix for a description of integrating 6^* as compared to 6^{**}).

$$(6^*) \quad \int \hat{C}_t = No \left[(1 + \emptyset) - e^{-(1 + \emptyset)KE_t t}\right]$$

$$(6^{**}) \quad \int C_t = No \left[1-(\frac{1}{1 + \emptyset})\, e^{-(1 + \emptyset)KE_t t}\right]$$

What is known from the recorded catch can be specified in a three equation and three unknowns system to solve for the unrecorded catch coefficient.

First, the dynamic production function (equation 5^*) estimates $(1 + \emptyset)K$. That is:

$$\text{I.} \quad (1 + \emptyset)K = \beta$$

Second, equation (6^*) must meet the condition that the total recorded and unrecorded catch is equal to the reduction in the beginning season exploitable stock (XNo) plus recruitment (R) during the fishing season

$$\text{II.} \quad No \quad (1 + \emptyset) - e^{-(1 + \emptyset)KE_t t} = XNo + R$$

$$(1 + \emptyset) - e^{-(1 + \emptyset)KE_t t} = X + {}^{R}/No$$

Third, the equation for recorded catch (equation 6^{**}) must be equal to actual recorded landings (L).

$$\text{III.} \quad No \left[1- \frac{1}{(1 + \emptyset)}\, e^{-(1 + \emptyset)KE_t t}\right] = L$$

Restating the three equations and the three unknowns, the system can be solved for the unrecorded catch coefficient ($\emptyset$), actual unrecorded catch ($\emptyset$L), and the beginning season exploitable stock (No).

<u>Equation System</u>

$$\text{I.} \quad (1 + \emptyset)\ K = \beta$$

$$\text{II.} \quad \left[\ (1 + \emptyset) - e^{-(1 + \emptyset)KE_t t}\right] = X + {}^{R}/No$$

$$\text{III.} \quad No \left[1-\frac{1}{(1 + \emptyset)}\, e^{-(1 + \emptyset)KE_t t}\ \right] = L$$

<u>Unknowns</u>	<u>Knowns</u>
$\emptyset$ = unrecorded catch coefficient	E_t = recorded fishing effort
K = catchablity coefficient	X = reduction in the exploitable stock over the fishing season
No = beginning season exploitable stock	^{R}/No = recruitment to the exploitable stock over the fishing-season as a ratio of the beginning season exploitable stock

L = recorded landings

$(1 + \emptyset)K$ = slope of the statistical regression of catch in each time period

A Preliminary Test of the Model

The Florida spiny lobster (Panulirus argus) fishery has conditions similar to those described by the model. The fishery has consecutive eight month open (August-March) and four month closed seasons (April-July). Over the past fourteen years when the number of traps fished has been recorded on permits (1960-74), the average reduction in the exploitable stock as indicated by the reduction in recorded catch per trap (CPUE) in each season has been 57.6%. Therefore, X in the model is equal to .576.

After the four month closed season the stock has returned to approximately its original beginning season exploitable size each year as indicated by the relative stability of the recorded beginning season (August) catch per trap ($\bar{X}$ CPUE = 7.576, $\sigma_{\bar{x}}$ = 1.6). If this recruitment trend holds over the eight month fishing season it implies that recruitment during the eight month fishing season is approximately 1.20 times the magnitude of the beginning season exploitable stock. Therefore in the model, $^R/No = 1.2^*$.

Total seasonal landings (millions of pounds) have been relatively constant from 1960-74 ($\bar{X}$ = 3.99, $\sigma_{\bar{x}}$ = 1.45) and have been even more stable since 1970 ($\bar{X}$ = 5.5, $\sigma_{\bar{x}}$ = .788). Therefore, in the model, L = 5.5 million pounds.

Finally utilizing a logarithmic form of the dynamic production function (equation 5^{**}) for a statistical ordinary least squares regression on recorded monthly landing data resulted in the following:

$(1 + \emptyset)K = .00000146742$

$F = 120$

$R^2 = .75951$

D.W. = 1.75

n = 40 (8 mos/year: 1970-74).

Substituting the known values into the three equation system yield:

* Note that this fishery meets the condition that $X + {}^R/No = 1.76 > 1$ such that estimating K by equation (11) would result in a theoretically impossible zero value for K unless there is an unrecorded catch.

Known	Calculated Unknowns
E_t = 123,053 traps	ϕ = 1.035849
X = .576	ϕL = 5,698,032 (unrecorded catch)
$^R/No$ = 1.2	K = .000000709612
L= C_t= 5,500,833 (recorded catch)	No = 6,221,592
	R = 1.2 No = 7,465,910
	No = .576 No = 3,583,637

Conclusions

Work is still ongoing to improve the statistical calibration of the model for the Florida spiny lobster fishery. The model implies that the unrecorded catch is slightly larger than the recorded catch. General observations of the recreational (sport diver) catch which is not part of the recorded landings would suggest that this catch is not anywhere near the magnitude of the reported commercial landings (Austin, 1976). Another possibility which has important implications for future policies is the poaching of sub-legal size lobster that would have otherwise grown into the legal size (76.2 mm caparapace length) during the fishing season.

The standard wooden slat trap used in Florida retains lobster from a size of approximately 55 mm carapace length. In heavily fished areas such as the Florida Keys few lobsters grow much beyond the minimum legal size limit (76.2 mm) (Warner et al., 1977). Approximately 66% of the catch is sub-legal size (55 mm - 76.2 m m) that fishermen are supposed to release (Warner et al., 1977). At estimated growth rate of 5 mm per molt and four molts per year (Davis, 1978) sub-legal size lobsters in approximately the 65 - 76.2 mm range would grow into the legal size during the eight month fishing season. This readily exploitable sub-legal "short" population is larger than the legal size population. They are readily available when traps are pulled and there are known black markets for short lobsters. It is expected (but still not verified) that the poaching of shorts by commercial fishermen while they are harvesting legal size lobsters is the major portion of the unrecorded catch.

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Appendix

Given equations (4^*) and 4^{**} as follows:

$$(4^*)\ \hat{C}_t = (1 + \emptyset)\ KE_t\ No\ e^{-(1 + \emptyset)KE_t t}$$

$$(4^{**})\ C_t = KE_t No\ e^{-(1 + \emptyset)KE_t t}$$

Integrating the recorded catch equation (4^{**}) with respect to time yields the cumulative seasonal recorded catch.

$$\int C_t = \frac{-No}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t} + G$$

where G is equal to No, the initial stock, therefore

$$\int C_t = No\ (1 - \frac{1}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t})$$

Integrating (4^*) with respect to time yields the total recorded and unrecorded catch.

$$\begin{aligned}\int \hat{C}_t &= (1 + \emptyset)\ \int KE_t No\ e^{-(1 + \emptyset)KE_t t}\ dt \\ &= (1 + \emptyset)\ \int C_t \\ &= (1 + \emptyset)\ \left(\frac{-No}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t} + G\right) \\ &= -No\ e^{-(1 + \emptyset)KE_t t} + (1 + \emptyset)\ G\end{aligned}$$

Since G is equal to the initial stock (No) we can simplify by isolating G by dividing the equation by ($1 + \emptyset$), then

$$\begin{aligned}\frac{\int \hat{C}_t}{1 + \emptyset} &= \frac{-No}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t} + G \\ &= No\ (1 - \frac{1}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t})\end{aligned}$$

which is the same as the integral of (4^{**}). In other words, these two equations are consistent.

Furthermore, the total catch is simply ($1 + \emptyset$) times the total recorded catch.

$$\begin{aligned}\int \hat{C}_t &= (1 + \emptyset)\ \int C_t \\ &= (1 + \emptyset)\ \left[No\ (1 - \frac{1}{1 + \emptyset}\ e^{-(1 + \emptyset)KE_t t})\right] \\ &= N\ (1 + \emptyset - e^{-(1 + \emptyset)KE_t t})\end{aligned}$$

Austin

MODELING OF FISH POPULATION IN THE COASTAL ZONE: A STUDY IN RESOURCE ALLOCATION

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Among the most important resources of the Coastal Zone are the fish populations, which thrive in the offshore and inshore waters. Many of these fish population are important economically because of commercial and/or recreational fisheries which are dependent on them.

Industrial uses of the waters in Coastal Zone including sewage discharges, withdrawal of cooling water at power plants and releases of toxic chemicals can potentially have serious effects on fish populations in the surrounding regions. In the estimation of the effects of such activities on fish populations, mathematical models play an important role because they permit the evaluation of various mitigating measures, determination of the parameters which influence impact predictions and provide a framework for interpretation of available field data.

The formulation and application of a model of fish populations in the Coastal Zone near the Cape Fear Estuary are presented. The model provides predictions of the impact of the Brunswick Steam Electric Plant (BSEP) on key fish species which use the Cape Fear as a nursery. The fish species of interest are generally ocean-spawned species whose early life stages are transported into the estuary by the ocean's tidal action. Once in the estuary, the ichthyoplankton are perceived to use a number of different devices to move into and remain in preferred nursery areas such as marshes, tidal creeks and upriver regions where their chances of survival are enhanced. Consequently, the model explicitly takes into account the probable influence of hydrodynamic transport of the ichthyoplankton as well as certain behavioral characteristics such as vertical diurnal migration of the larvae of some species.

In the numerical solution of the model equations, the Cape Fear Estuary, including the Coastal Zone near the mouth of the estuary, is divided into seven longitudinal segments. Each of these segments is further subdivided into as many as six control volumes representing the upper and lower layers, tributary creeks, and marshes. The hydrodynamics in the estuary are simulated by tidally-averaged flows in the upper and lower layers. There flows are computed by inputting salinity measurements to a three-dimensional, steady state, hydrodynamic model. Behavioral characteristics, such as vertical diurnal migration and residence of the larvae in the marshes, are simulated by movement of the organisms into and out of the control volumes at the rates computed from field data.

The evaluation of model input parameters and the calibration of the model with data collected during 1976-78 for the spot and croaker populations in the Coastal Zone and in the Cape Fear are presented. Graphical comparisons of field data and model output are included to illustrate the calibration procedure.

After calibration, the model is used to assess the plant impact on the spot and croaker populations. The predicted plant impact is determined by the reduction in the young-of-the-year population from model runs with and without the plant on line.

Environmental Management of Outer Continental Shelf Petroleum Activities and the Protection of Offshore Lobster

Judith Spiller[1]

Abstract. Environmental pollution associated with Outer Continental Shelf (OCS) oil and gas exploration and development on Georges Bank potentially threatens offshore lobster directly through the effects of smothering and of disruptions in breeding behavior and indirectly through reduction of marine water quality. Because a close relation exists between offshore lobster and nearshore populations, damage to offshore groups could reduce population numbers nearshore. Minimization of hazards to offshore lobster rests with detailed knowledge of their distribution, and then the development of stringent controls on OCS petroleum operations in areas of lobster concentration. Previously, information on distributions has been lacking; however, integration of National Marine Fisheries Service (NMFS) commercial data, NMFS survey data and discussions with lobstermen indicate that during the spring and summer, many lobster migrate from the canyonheads bounding the southern edge of Georges Bank into shallower waters coincident with proposed tracts for OCS lease sale #42. During the period of migration, breeding occurs. In light of the effects of hydrocarbons and other drilling discharges on lobster, in areas of high lobster concentration during the critical breeding phase, restrictions on drilling discharges, deck drainage and release of produced waters must be incorporated into OCS lease stipulations, National Pollutant Discharge Elimination System (NPDES) permits, and the Fishery Management Plan for lobster currently under development by the New England Regional Fishery Management Council.

The offshore lobster fishery represents a valuable component of the New England fishery. Landings for 1978 from Georges Bank (ICNAF subdivision 5 Ze) equalled about 8 million dollars (NMFS 1979). Applying the 4.24 economic multiplier used by the Bureau of Land Management (DOI 1977), the value of the fishery is raised to approximately 34 million dollars. Further, offshore populations of lobster appear to supply recruits to the inshore fishery (Cooper and Uzmann 1971; NMFB 1978). Unfortunately, the offshore lobster fishery coincides with lease tracts designated for Outer Continental Shelf petroleum exploration and development (Figure 1). To minimize damage to this fishery, the Bureau of Land Management deleted twelve tracts from those proposed for lease sale #42 (Federal Register, September 28, 1979). These tracts are located around the head of Lydonia Canyon, a rich lobster ground (Figure 2). Tract deletions of this

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sort, however, ignore important biological information about offshore lobster. These lobster migrate extensively across Georges Bank, and at critical times during their life histories, they travel through lease areas. The question raised here then is to what degree do oil and gas activities threaten this valuable resource and in what ways can threats arising from these operations be minimized?

Tagging and recapture studies (Cooper and Uzmann 1971; Uzmann et al. 1977) indicate that 20% to 50% of the population migrates over Georges Bank from around the canyon heads and along the shelf edge to the shallower areas of the Bank. Other studies (Saila and Flowers 1968, 1969; Lund et al. 1971; Russell and Borden 1975) support the extensive migratory powers of offshore lobster. During the winter months, lobster concentrate along the shelf edge in the heads of canyons at depths from 110 to 457 meters (55 to 228 fathoms) (Schroeder 1959). According to Cooper and Uzmann (1971) and Uzmann et al. (1977), populations on the western edge of the shelf begin to migrate up onto the Bank in April, and by June the more easterly populations are moving too. By summer, lobster are distributed across the shoal areas of the Bank. Return to the southern edge of Georges Bank starts in August and is completed by December.

Seasonal movement of lobster appears correlated with the maintenance of populations within a temperature range of approximately 8°C to 14°C (Saila and Flowers 1968; Uzmann et al. 1977). Temperature appears to control the breeding cycle of lobster (Dow 1969, 1976). Movement into warmer waters encourages molting, mating and the extrusion of eggs. Molting generally precedes mating (Hughes and Matthiessen 1962) and mating usually occurs from May until June (NMFB 1978). A year later spawning takes place. Hughes and Matthiessen (1962) observed that hatching begins at 15°C in the hatchery although they note that it probably occurs at lower temperatures in wild populations. Hatching extends from two to fourteen days. The resultant larvae rise to the surface waters, and as weak swimmers, they travel with the plankton from two to five weeks while they undergo a series of four molts (NMFB 1978). When the larvae reach the fifth stage of development, they sink to the bottom.

Breeding occurs from May until June and spawning takes place the next year. These events occur during the time period when lobster are migrating into warmer waters. The timing of the breeding cycle, then, correlates with the time when lobster will be migrating through areas of oil and gas activities.

Commercial data collected by the National Fisheries Service, Statistics Branch, Northeast Region, generally support the view that lobster move around Georges Bank. For example, the largest data base, compiled from commercial landings by weightout, shows the distribution of fishing effort over the region. These data, tabulated here in metric tons, plotted by season (February-April, May through July, August through October, and November through January) for thirty degree squares of latitude and longitude and then averaged for the past four years (1974-1978) indicate that the most intensive lobstering occurs along the southern edge of Georges

Bank and during the time period from May until September (Figure 2). This span coincides with the best weather for fishing and the most active time for lobster (NMFB 1978).

Several factors, however, restrict the usefulness of weightout data in determining areas of intensive fishing. National Marine Fisheries Service agents are located only at major ports. Much lobster is landed at smaller points and is sold directly to the retail market (URI 1977). Thus, neither agents nor the dealers, who fill out the weightout slips, record the landings. Data on the locality of fishing are often missing so that the dealer or the NMFS coder guess at the region (NMFS 1974). Landing data are supplemented by interviews with vessel captains. For the shorter trips characteristic of offshore lobstering, interview coverage includes only 10% to 15% of the vessels fishing (Pierce and Hughes 1979). Thus, interview data designed to provide more detailed information of fishing locale may consist of one vessel captain per month per ten degree square of latitude and longitude and so makes a poor estimator of lobster occurrences or abundances.

Bottom trawl surveys conducted by the National Marine Fisheries Service (Burns and Clark, ms.; Grosslein and Azarovitz, in press) and informal interviews with lobstermen provide an additional data base. It indicates that in the spring and summer concentrations of lobster occur from the shelf edge up onto Little Georges Bank (Figure 1).

The distribution of lobster on Georges Bank, like that of other fin- and shellfish there, appears to be controlled by the persistence of the gyre circulating clockwise around Georges Bank (Bigelow 1927; Bumpus 1976; Butman et al. 1977; Colton and Temple 1961). When the current breaks down or when larvae travelling in it reach the southwestern portion where currents diverge in several directions (Butman et al. 1977), then a mechanism is provided for larvae to disperse to the south of Georges Bank. Another hydrographic feature, circulation in the canyons, influences offshore lobster populations. The parcels of the Georges' gyre break off from the current and move south down the canyons. In the Hudson Canyon, for example, this current lessens at 127 meters to 174 meters, and beyond this point deposition of particulates occurs (Stanley and Freeland 1978). This increase in potential nutrients plus the burrowed structures (Warme et al. 1977) correlate with higher abundances of invertebrates including lobster.

Aside from chance events such as tanker accidents and blow-outs, deck drainage and formation or co-produced waters constitute the major sources of hydrocarbon release from offshore petroleum activities. Current regulation (40 CFR Part 435) prohibits the discharge of free oil from deck drainage, the washings of the drilling platform. The test for such discharge involves determination of a visible sheen, a discoloration on the water surface or a sludge or emulsion deposited beneath the water surface [40 CFR Part 435.41 (d)]; however, given the wind, wave, and current regime of a high energy area such as Georges Bank, obvious difficulties of observation arise. Further, chances of initial dispersion or releases followed by their concentration by the Georges Bank gyre increase.

Formation waters result during development drilling and are composed of heavy brines of hydrocarbons and metals (DOI 1977). Their volume of discharge generally equals the volume of oil produced over the lifetime of an oil field (DOI 1977). Thus, estimates for the Georges Bank field indicate that approximately 123 million barrels of formation water will be discharged. Release of hydrocarbons from co-produced waters is limited to a maximum of 72 mg/l per day [40 CFR Part 435.12 (b)]. Thus, approximately 30,000 barrels of hydrocarbons will be released given the rates estimated by the Department of Interior (1977, 1979) for this region.

Crude oil at relatively low concentrations affects lobsters in several ways, including direct toxicity to larvae and adults and disruption in chemoreception altering feeding and breeding behavior. Standard static bioassays using Venezuelan crude determined a lethal concentration at 0.14 ppm for first stage larval lobster (Wells and Sprague 1976).

Forns (1977) defined a threshold sensitivity for larval lobster at 0.1 to 1.0 ppm using crude oil. As the higher concentrations were reached, behavior became lethargic, feeding was depressed, and often animals appeared dead. Development times were also altered and consistently higher mortalities occurred among the oiled larvae. Further, the normally contracted chromatophores became distended in samples exposed to oil, and at 0.1 ppm the larvae changed color from blue to red. Such color change could make larvae more susceptible to predation during their residence in the plankton. Flow through bioassays with LaRosa crude (Atema and Stein 1974; Atema 1977) determined that exposure to 10 ppm doubled the waiting period of feeding behavior and altered the movements of some chemosensory related appendages, potentially affecting breeding behavior. Effects of these sorts on adult lobster populations may not be seen for several years, and on larvae may not be realized for from five to seven years, corresponding to the amount of time for lobster to mature.

Another potential threat to offshore lobster stems from the discharge of drilling fluids. Over the lifetime of the Georges Bank field, from 45,300 to 90,600 tons of drilling muds will be discharged during exploration, and 29,000 to 79,000 tons during development (DOI 1977). During the exploratory phase, most mud is released in bulk discharges either into the surface waters or shunted to just above the nepheloid layer (DOI 1977). Mud used in development drilling is commonly recycled.

Drilling muds serve several vital functions during the drilling process (OOC 1976). They cool and lubricate the bit. They act as blowout preventitives. Further, they seal formations preventing collapse of the formation and force fluids and cuttings back up to the surface throughout drilling. Over 600 additives are used in drilling muds although the most common constituents are barium sulfate, ferrochrome or chrome lignosulfate, and biocides (Otteman 1976). Concern over muds focuses on these three additives and on the role turbidity plays in reducing photosynthesis in killing eggs and larvae of fin- and shellfish and in increasing biological and chemical oxygen demand when muds are discharged (Rieser and Spiller, ms.).

Years of bioassays (OOC 1976) indicate that drilling muds are harmless; however, these bioassays have been conducted on broadly tolerant species from coastal or estuarine waters, or on freshwater animals, and often these bioassays used whole, fresh drilling. Temperature-pressure changes downhole can change the composition of drilling muds (Carney and Harris 1975). This explanation was offered by Thompson and Bright (1977) to explain high mortalities among corals exposed to drilling effluents. Further, the muds assayed commonly were not analyzed for constituents although the constituents may vary from what the listed composition is (Richards, personal communication). Finally, sublethal effects such as bioaccumulation or behavioral alterations were not recorded.

Recent work on lobster (Oleszko-Szuts et al., ms.; Smith, personal communication) indicates that a 96 hr LC50 of used muds forming a 10-12 mm thick layer resulted in loss of mobility for lobster after four hours of exposure and ultimately in mortality for half of the lobster exposed. The other half were left comatose. A 1-2 mm layer caused alterations in feeding behavior and chemosensory reception. A 10-12 mm layer might be typical of discharges accumulating around a rig while the thinner layer might represent a more distant deposit.

If drilling operations occur from May until July and muds are shunted, the resulting operational discharges will occur on breeding and spawning populations. Further, while fine particulates of the discharged mud will be diluted and disperse rapidly, heavy components such as barium sulfate will sink. Eventually, this material will settle in the depressions characterizing bottom conditions in the lease area (Wigley 1961). Lobster seeking shelter will be attracted to these depressions. Further, the bulldozing method of lobster feeding will result in the constant re-exposure of lobster to these discharges.

The other option for disposal of effluents involves surface release. This method will discharge drilling effluents and hydrocarbons into the gyre circulating around Georges Bank. As noted, this gyre concentrates eggs and larvae of fin- and shellfish. So too, the gyre concentrates pollutants. Thus, lobster larvae will be repeatedly exposed to these discharges. They will also be feeding on plankton who in turn are ingesting these discharges. Ultimately, the overall water quality of the Bank will be reduced.

Other operational options open to minimize the exposure of lobsters to discharges include shunting with seasonal prohibitions on discharging, and zero discharge with transport of wastes to a designated ocean dumping site or to a land-based disposal area. Seasonal discharge limitations would restrict releases during the migration period; however, because the release period corresponds with winter, it represents the least favorable time for drilling. Zero discharge with barging provides the safest alternative until further acute bioassays, behavioral studies on the effects of drilling discharges on lobster, and studies on the uptake of heavy metals by larval and adult lobster are completed.

J. Spiller

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Figure 1

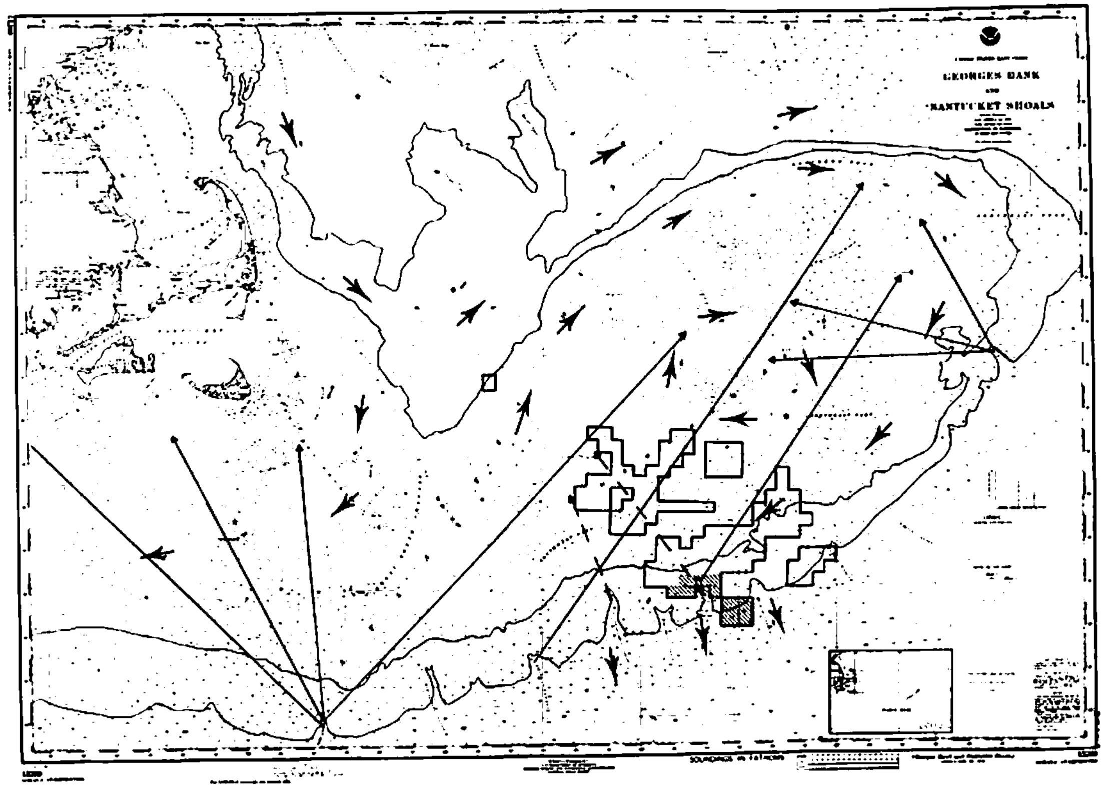

Figure 1 - Mean trajectories of lobster migrations based on recapture studies (solid lines) (Cooper and Uzmann 1971 and Uzmann et al. 1977) and informal interviews with lobstermen (dashed lines). Lease areas are outlined in black and diagonal lines represent recent tract deletions (Federal Register, September 28, 1979)

Figure 2

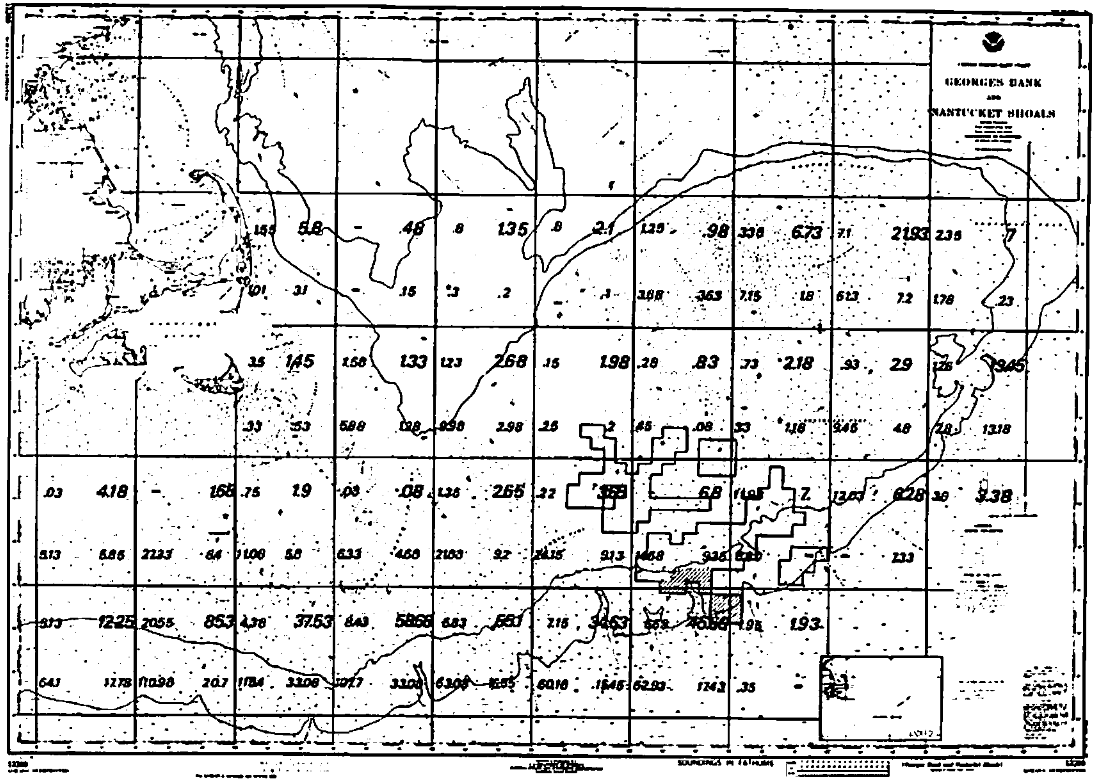

Figure 2 - Average weightouts (1974-1978) plotted in metric tons by season (upper left - February through April; upper right - May through July; lower left - August through October; and lower right - November through January) and by thirty degree squares of latitude and longitude.

INSHORE FISHERIES CONFLICT: Two Cases of Recreational vs. Commercial Interests

H. Arnold Carr[1]

ABSTRACT

Since 1978, recreational and commercial fishermen have confronted each other twice relative to the use of the fishery resources in Nantucket Sound. The first instance was between party boats and pair trawlers as each pursued scup and sea bass in a common area. The second case involved concentrated commercial fishing pressure for squid close to an inlet commonly fished by recreational fishermen. The first case was resolved through hearings and a determination made by the Massachusetts Marine Fisheries Advisory Commission. The second case is pending. Discussion includes traditional utilization of the target species; locally and throughout their range; fishing gear conflict and the evolution of gear that contributed to the conflict; and socio-economic events relating to each case.

Nantucket and Vineyard Sound have considerable pressure from recreational and commercial fishermen. Recreational fishermen - most of whom trailer boats less than 25 feet in length - have convenient access from over 35 ramps on Cape Cod and the islands of Martha's Vineyard and Nantucket. Commercial fishermen also appreciate the advantage of the conveniences of nearby fishery resources for daily trips.

Nantucket and Vineyard Sound is about 70 km long and varies between 35 km and 5 km in width. The Sounds have numerous sand shoals and a few rocky outcrops. Depths rarely exceed 30 meters. Broken bottom and tidal currents up to three knots provide a spawning, nursing and feeding area for over nine commercially important finfish and eight important shellfish. In mid-winter, winter flounder concentrate to spawn near the satellite embayments of the Sounds. In spring, longfin squid, scup, sea bass, tautog, bluefish and striped bass appear and remain until fall. In summer, fluke or summer flounder are common.

Our improved mobility on water and the rising price of fish in the past

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ten years have resulted in additional pressure on the resources in the area from both recreational and commercial fishermen. Concomitant with increased fishing pressure is conflict between the two factions.

During the past five years, the Massachusetts Division of Marine Fisheries has heard two petitions to modify fishing regulations. Two more petitions are imminent. Most of these petitions require further restriction of commercial activity. They originate from recreational interests. The intent has been to restrict the larger over the smaller vessels.

The Director of Marine Fisheries, in concert with the Marine Fisheries Advisory Commission regulate fishing activity in coastal waters under the authority of Chapter 130, General Laws relating to Marine Fish and Fisheries. Any interested party may submit to the Director petitions to manage the fisheries. The Director forwards the petition to the Marine Fisheries Advisory Commission. This body of citizens, appointed by the Governor, has the power to demand management regulations on size, limit, seasons, and numbers. The Commission schedules a formal hearing after receiving a petition and may recommend that the Director take appropriate action.

The northern portion of the Sounds has been the site of two conflicts in the past two years. The first conflict developed in the Hyannis area, between Succonesset Point and Point Gammon (Figure 1). This area is regulated by two statutes. The Acts of 1907, Chapter 301, prohibited the use of seines or nets, mobile or stationary, between the two points of land mentioned above. The only exception to this act is fish traps, which may be used subject to other sections of the General Laws. The Acts of 1932, Chapter 59, regulates the use of otter and beam trawls out to three miles (or more) from shore. Otter or beam trawling is permitted only between 1 November and 30 April.

The target species in the first conflict were scup (<u>Stenotomus chrysops</u>), and sea bass (<u>Centropristis striata</u>). Late April each year, both species return to southern New England. Mature and ripe fish concentrate in these shoal waters to spawn where they remain until late June.

Party boats from Hyannis and other nearby ports direct their effort on these species in May and early June. The boats have a total capacity of 235 persons. Numerous sport craft, less than 25 feet in length, also fish these concentrated stocks.

Prior to 1977, both commercial and recreational boats fished their respective areas without major incident. In May, the recreational boats jigged near shore while the trawlers fished outside the regulated waters, three miles or more from shore.

In 1977, the landed value of scup and sea bass rose to a May-June average of 24¢/lb and 70¢/lb respectively. This resulted in increased fishing pressure on these species and more frequent illegal trawling in the prohibited area. Complaints by the recreational fishermen resulted in additional law enforcement. A new type of fishing gear, pair trawling, commenced operation in this area. Pair trawling uses two fishing vessels rather than otter trawl doors or beams to keep the wings of the net

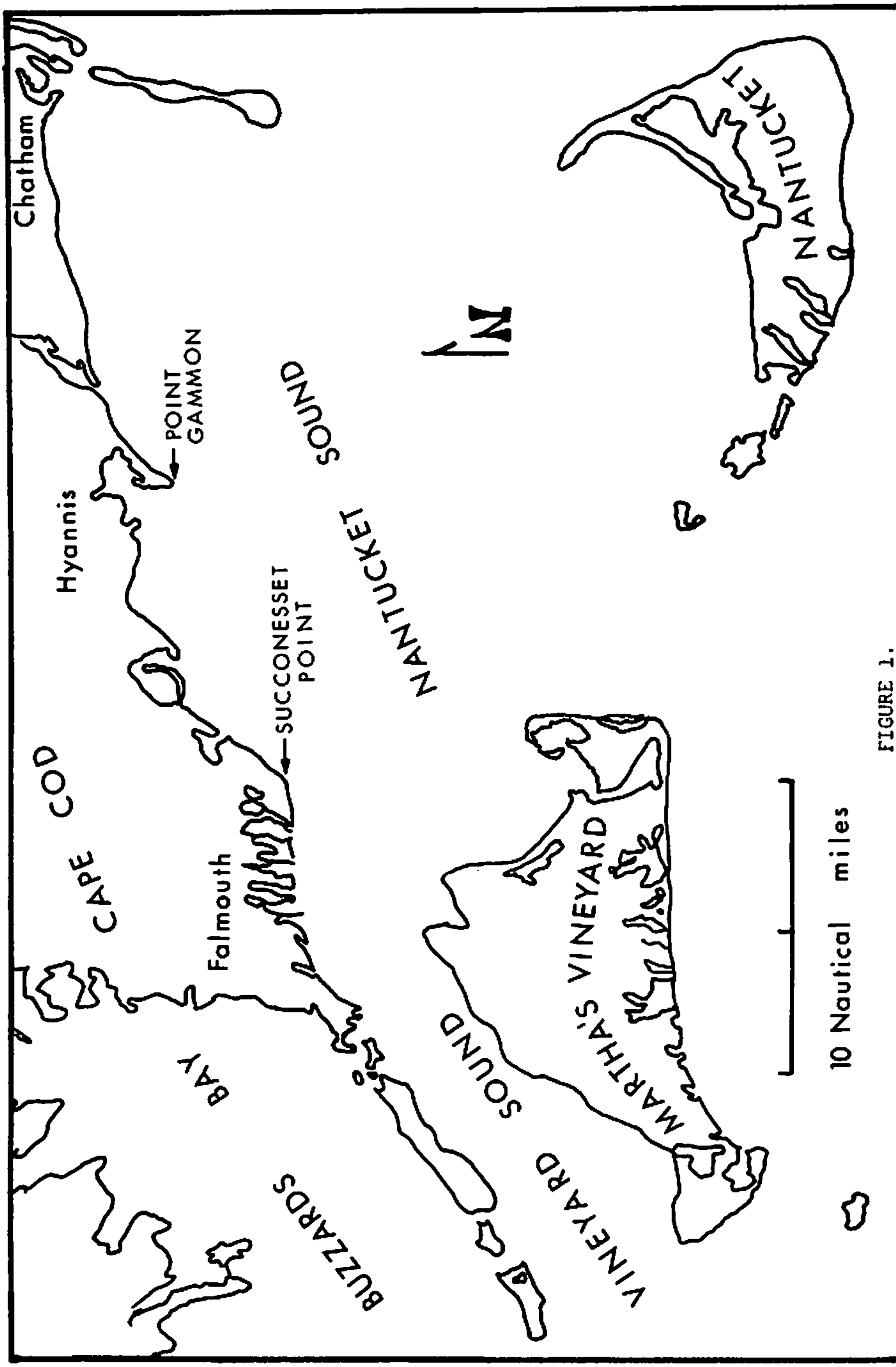

FIGURE 1.

Carr,

spread. This operation was not included in Chapter 59 of the Acts of 1932 and therefore this gear was permitted within three miles.

The landed price for scup and squid remained high into 1978. This and the abundance of the two species attracted three pair trawl operations. These boats initially fished at night and no open conflict between these vessels and the recreational fishermen resulted. However, shortly after the pair trawlers commenced daytime operation, a petition to restrict this fishing method was filed with the Director of Marine Fisheries.

The Marine Fisheries Advisory Commission heard the petition on 6 July 1978. A major concern discussed was whether the scup and sea bass could withstand the increased pressure. The May-June catch in the inshore area between Falmouth and Chatham was 500,000 lbs of scup and 60,000 lbs of sea bass. This catch included the party boats, the pair trawlers and the fish weirs. No data was available from the small recreational craft fishery. Pair trawlers caught between 74-77% of each species. Although the increased pressure on both scup and sea bass was significant on the local level, the catch only amounted to 20-30% of the total east coast harvest. Most of this catch was taken off the mid-Atlantic coast during the winter.

The annual scup harvest has fluctuated dramatically during the past century. This and the high natural mortality of scup suggests that large year classes are not dependent on an abundance of mature fish (Neville and Talbot 1964). Less is known on sea bass.

At the hearing, recreational fishermen charged that the trawlers 1) discarded large amounts of small scup and other unwanted species - all of which were moribund, 2) disrupted schools of scup and sea bass thereby rendering jigging impossible, and 3) took fish that party boats are dependent upon. They further declared that party boats must remain close to port to keep trips short for passenger convenience and because of license restrictions.

Commercial fishermen countercharged 1) that pair trawlers could fish only 25% of the bottom, 2) that scup fishing was self-limiting because large catches depressed market prices, and 3) most of the recreational fishermen sold their catch and should be considered commercial fishermen without exclusive rights to this area.

The Commission recommended that the Director of Marine Fisheries restrict pair trawling in a manner similar to otter and beam trawling. The reason for this action was as follows:

1. A large and intensive recreational fishery for scup and sea bass exists within the three-mile limit in Nantucket Sound in the general vicinity of Hyannis.

2. This fishery evolves around spring concentrations of the two species that occur principally in a depression along the 20-foot contour (MLW) approximately 2 1/2 miles long and 1/4 mile wide.

3. Party boats, by virtue of time constraints imposed by four-hour trips and by operator license restrictions, are heavily dependent upon stocks of fish in this area to satisfy their large clientele.

4. The Division's Stock Assessment Program during three of the last five years shows a preponderance of both species in inshore waters during their respective spawning seasons. Although we are unable to fully evaluate the biological impact of fishing on spawning stocks of scup and sea bass at this time, there are obvious and unacceptable risks associated with the continued use of efficient mobile gear like the pair trawl on spawning concentrations of these fish.

The target species in the second conflict was squid and the fishery off Falmouth, Cape Cod. The longfin squid (*Loligo pealei*) has a migratory pattern similar to the scup and sea bass; it concentrates and spawns in the Sounds during late May and early June. Spawning continues throughout the summer, but with the squid dispersed throughout the Sound.

Historically, squid was fished by fish weirs. Trawlers harvest it only as an incidental catch. In 1974-75, 35 small trawlers directed a fishery for squid and sold their catch to a foreign market.

In 1979, the directed fishery increased as the landing price approached 60¢/lb. At first, twelve inshore vessels fished a small area near the mouth of Waquoit Pond. One week later, 33 vessels 10-24 meters in length fished the same area. The larger vessels seized the opportunity to fish squid while yellowtail flounder, the species they normally direct their efforts toward, was closed (west of 69° W longitude) by the National Marine Fisheries Service. The directed fishery in this small area of water lasted three weeks.

The reaction of recreational and sports fishermen was immediate. A petition was drafted and distributed. The aim of the petition was not to just prohibit commercial fishing for squid, but to sharply curtail the "unlimited fishing" of "30 commercial fishing trawlers and draggers.. operating regularly in both Sounds" (Falmouth Chamber of Commerce, unpublished document). The petition also called for more concern for the ecology of these waters and assurance that recreational and sport fisherman would continue to acquire "their fair share". Other issues cited publically were as follows:

1. The area fished contains an important bay scallop population.

2. This commercial pressure on squid threatens the entire food chain and its relationship in attracting sportfish, bluefish and striped bass, to the area.

3. The heavy pressure of up to 33 vessels is unsightly and can only be compared to "stripmining".

The petition is still being distributed; it has not been filed with the

Director of Marine Fisheries as of 1 November 1979.

The principal issues addressed in the petitions are increased fishing pressure on particular stocks and the ability of the targeted species to maintain optimal abundance under this pressure. Concern is also expressed about the adequacy of the biological information to these areas. Although these are important and legitimate questions, many individuals are using these issues as a disguise for more personal and emotional interests.

Many petitioners who have expressed these concerns declare themselves as recreational fishermen. If we examine these fishermen we would find a large number actually sell their catch. Are these fishermen truly recreational?

The public and officials responsible for fisheries management must appreciate the existence of a third group of fishermen, the commercial sportsfishermen. At public hearings on fisheries regulations, this group should be identified. Too often, public discussion erroneously places recreational fishermen against commercial fishermen. The true parties in conflict are the commercial sportsfishermen and the commercia fishermen.

Notes

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PART III

WETLANDS EVALUATION

Moderator: Jeffrey Zinn

ECONOMIC PERSPECTIVES ON VIRGINIA'S COASTAL WETLANDS MANAGEMENT PROGRAM[1]

Carl C. Mabbs-Zeno and Sandra S. Batie*

ABSTRACT

This paper reports on the conclusions of a three year study addressing public policies for managing Virginia's coastal wetlands. The purposes and performance of institutions which manage wetlands is examined. The paucity of appropriate data with which to impute economic values for public management of wetlands is identified, and the implications of this lack of data for public management is addressed. The public goals which motivate Virginia wetlands boards, the Virginia Marine Resource Commission and the Army Corps of Engineers are identified. It is concluded that these institutions may all be characterized as preservation oriented in their decision on whether to permit wetlands alteration, but justifications for permit decisions vary greatly among these agencies. Finally, a new institution for wetlands management is suggested as an alternative to the current permitting structure.

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The coastal and estuarine marshes of temperate North America have attracted considerable research and public policy attention in recent years. With approximately 200,000 acres of marsh legally defined as tidal wetlands, Virginia has responded to concerns regarding wetlands with a statewide management program for wetlands. The Virginia program presently exists in addition to federal programs and numerous more general land use regulations [Mabbs-Zeno and Batie, forthcoming (a)]. This paper presents an overview of research done at Virginia Tech to investigate the purposes and performance of institutions for managing wetlands in Virginia. The public goals which motivated current institutions are first examined. Performance and impact of those institutions is then evaluated in relation to both explicit and implicit goals of legislators and administrators. Finally a new institution for wetlands management is suggested as an alternative which offers relatively good performance on most parameters of importance.

The research at Virginia Tech has been supported by two consecutive grants from the Federal Sea Grant Office of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce covering the period from July 1, 1976 to January 31, 1980. The topics covered in

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this research effort have been titled "Alternative Management Strategies for Virginia's Coastal Wetlands."

Virginia was selected as a case study which would provide insight for other states' management programs. The project's findings, however, are not intended to substitute for the political determination of the "best" means of managing wetlands. Rather, the project is designed to provide a decision framework and information base from which improved management can be fashioned.

Objectives of Current Management Institutions

Net Benefit Criterion

The Virginia program for wetlands management derives from the 1972 Virginia Wetlands Act which requires that a permit for wetlands alteration be obtained from a local government wetlands board before any development can proceed. The local boards consist of five volunteer citizens who receive technical and scientific advice from state agencies. The Virginia Marine Resources Commission (VMRC) administers the program in cities or counties which have decided not to set up their own board. The VMRC also reviews all local decisions and retains power to reverse local board decisions. The fundamental criterion offered by the Wetlands Act to guide permit allocation is to balance the benefits of preservation with the benefits of development. Specifically the Virginia law states that a permit should be granted only if "...the public and private benefit of the proposed activity exceeds the public and private detriment..." [Va. Code Ann.].

Under Section 404 of the Federal Water Pollution Control Act Amendments of 1972, the Army Corps of Engineers also issues permits for wetlands development. In consultation with the Environmental Protection Agency and the Fish and Wildlife Service, the Corps grants permits if analysis indicates "that the benefits of the proposed alteration outweigh the damage to the wetlands resources and the proposed alteration is necessary to realize those benefits" [42 F.R.].

The major problem which both the state and federal programs purported to address at the time of their initiation was that wetlands were not being used in a manner which took account of all forms of value wetlands provide to society. It had been argued that coastal wetlands can yield numerous valuable ecological services such as provision of fish and bird habitat and assimilation of waste. These same tracts of land, however, might instead be developed as residential, commercial or industrial sites. Before the permit programs were instituted, the decision to develop wetlands was made by private individuals in response to the price incentives of the land market. The appropriate time and place for development was determined by the ability of owners to make a positive return. Because property rights for many natural services were poorly defined, however, there were no markets where wetlands owners could sell ecological services to willing buyers. As a result the market allocations did not consider such services as fish habitat even though they provide value to the public. The land use pattern generated by unconstrained market institutions was thought to lead to more development of wetlands than was socially efficient.

Unfortunately at the time the various laws were enacted, little information was available to quantify the value of nonmarketed services of wetlands. Without this information, it is not uncontestably clear that the state program, the federal permit system or any other government intervention will be more efficient than the preexisting market in allocating wetlands use to provide the greatest net benefit to society. Because there was a lack of knowledge with respect to the magnitude of the nonmarketed services and because such knowledge appeared to be important for informed decision making, one of the objectives of the Virginia Tech study was to identify, quantify and value some nonmarket and market services of natural coastal wetlands.

Valuing Services of Wetlands

The task of quantifying values of the services not valued by ordinary land markets has been approached by a variety of researchers with a variety of methodologies in recent years. Values are typically expressed in terms of the willingness of users to pay for services so that the value of different services may be compared. Where a well functioning market does not exist for a service, willingness to pay is imputed from other forms of evidence. Interviews with users of the wetlands service, market prices of substitute services, market prices of services derived from wetlands services and other data have been used [Sassone and Schaffer, 1978].

Most researchers have sought to express the value of wetlands services through a single parameter, such as dollars, in order to reveal what tradeoffs are produced by land use decisions. If services are so measured, the value of ecological services lost when wetlands are developed can be compared to the development values gained in order to estimate the net benefits of developing a wetlands area. Only limited progress in monetary measurement of the value of nonmarketed services has been made, however, because many, if not most, attempts to measure such values have used inappropriate methodology.

The most typical analytical error appears to be the use of average value of wetlands for decisions on acreage which is clearly not average. When information is available to express the quality of a particular site for providing services, it may have an important effect on the estimate of value. More generally, the value of a unit of wetlands should be expressed as the value lost when that unit of wetlands is destroyed; that is, the marginal value is not equal to the average loss when all wetlands are destroyed. For example, if Virginia develops one acre of wetlands, the number of migrating birds may be unchanged because the birds are limited by some other factor in their environment. The value of that acre of wetlands for migration habitat is zero. If all wetlands in Virginia were destroyed, however, the bird population would be drastically effected. Further, more than a simple multiplication of the value of the first acre times the total number of acres is required to represent total value of all wetlands. At some acreage of wetlands, the value of an additional acre of wetlands destruction for bird habitat becomes positive and the value increases for each acre destroyed thereafter.

Some studies have employed improper economic methodology by failing to attribute value ultimately to the utility of individual people. For example, energy has been treated as a source of value in studies of wetlands even apart from its worth to people [Gosselink, et al., 1974]. The energy embodied in the biota of an ecosystem is not equivalent to energy in a form readily usable to people such as refined gasoline. Similarly, economic value cannot be attributed to wildlife habitat per se, but must be related to the use man derives from wildlife, such as hunting or viewing [Shabman and Batie, 1978].

Conceptual flaws are prevalent in the research attempting to measure the value of wetlands services, but even the most theoretically sound studies do not offer firm estimates of value. The ecological foundations for economic analysis are not established well enough to allow precise statements on value [Shabman and Batie, 1979]. The research at Virginia Tech investigated several forms of value attributed to wetlands and found that these values could not be unambiguously imputed from the existing knowledge base. The role of wetlands in water quality, for example, remains highly controversial [Park and Batie, forthcoming]. The contribution of wetlands productivity to oyster production is not well established [Batie and Wilson]. Whether wetlands provide any more erosion protection than fastlands is debatable [Owens, 1979]. Aesthetic value of wetlands may be positive or negative, depending on the site and the viewer [Mabbs-Zeno and Batie, 1979].

The value of wetlands for development purposes has better documentation because more market information is available. In the Virginia Tech study, separate case studies of an urban and rural site in Virginia indicated that development values for residential lots on wetlands are not remarkably high [Shabman and Bertelsen, 1979; Mabbs-Zeno and Batie, 1979]. The Virginia Tech studies conclude that wetlands-use decisions must be made under conditions dominated by uncertainty on preservation values and that the decision process can be adjusted to reflect such uncertainty [Shabman and Batie, 1979]. It is suggested that the burden of proof in decisions to permit development should be placed on those who wish to develop rather than on those who wish to preserve. Further, a decision strategy based on limited availability of information has been developed for wetlands development [Shabman, Batie and Mabbs-Zeno, forthcoming].

There is a question whether the destruction of wetlands should also be prevented on the basis that a decision to destroy wetlands cannot be reversed in the future in contrast to a decision to preserve which can be reversed. It can be argued that if present information is poor, the irreversible decisions should generally be delayed until better information is found. However, the case for total irreversibility of development decisions may be overstated since substitute inputs may be found for producing some of the services of wetlands. For example, while wetlands appear to contribute to oyster harvest in the Chesapeake Bay, there is a range of output over which changes in harvest technology or property rights for oystering can substitute for lost wetlands acres

[Batie and Wilson, 1978]. Additionally, altered natural wetlands may be replaced by direct construction of new wetlands. In fact, there are several cases where such marsh building activity has been successfully accomplished [Garbisch, 1977]. The costs of building new wetlands or of finding and employing wetlands substitutes are still speculative and may be high. Thus, while the possibility of substitution for wetlands reduces the importance of uncertainty about preservation values, it is not yet been documented well enough to entirely offset the recommendation that preservation should be the basic use for wetlands against which development must be proven worthwhile.

Other Criteria

Although the Virginia Wetlands Act and the directives of the federal management programs cite comparison of preservation and development values as the major decision criterion, several other considerations are relevant and are suggested by law. While no constitutional challenges to the Virginia Wetlands Act have emerged, some permitting practices now being used may in the future be questioned with respect to constitutionality and, specifically, equal treatment of like situations. With local boards reflecting local value systems, different treatments of similar wetlands proposals are common. Officials at VMRC and others have expressed the opinion in interviews with the Virginia Tech researchers that some treatments usurp more private decision making power than the Wetlands Act intends. Perhaps, too, the wide variety of interpretations shown by different wetlands boards attests to excessive vagueness in the Act.

Wetlands board members have indicated a sensitivity to constitutional and other broad legal questions. In interviews and surveys they frequently expressed a desire for clearer decision guidelines [Mabbs-Zeno and Batie, forthcoming (b)]. Before the courts remove all ambiguity in guidelines and before scientific uncertainty about the existence and scope of wetlands services is eliminated, however, society will make permitting decisions with whatever information is available.

Performance of Current Institutions

The predominant characterization of Virginia's wetlands boards, which derives from research on the six years of their existence, presents the boards as highly individualistic in their perceptions of appropriate action under the Wetlands Act. The City of Virginia Beach, for example, has set up a formal procedure with strong technical, legal and clerical support. In contrast, the adjacent City of Norfolk decided to forego the formation of any board and to allow VMRC to handle wetlands permits directly. At least one board has adopted the policy of denying permits for any wetlands destruction over 100 square feet while other boards regard such parcels as too small for public concern [Mabbs-Zeno and Batie, forthcoming (a)]. Retaining the ability of local jurisdictions to express local preferences was a powerful political priority when the Wetlands Act was passed [Carriker, 1976], and the widespread popularity today of the Act owes much to this principle.

The record of permit applications reveals very little of the mechanism through which local boards effect controls. Although only about ten percent of formal permit applications have been denied and even those are subject to VMRC review, most board members felt that the local boards and the Wetlands Act had a major impact on wetlands use. Responses from seven rural counties indicated that between 50 and 80 percent of local board activity is spent with concerns of citizens who never file a permit.

In spite of local differences, a large majority of board members across the state do perceive their responsibility as essentially maximizing net public and private benefit from wetlands use, and they generally do attempt to make judgement within a framework that balances values from preservation with those of development. Their efforts often incorporate subtle insights into the value of proposals, but their overall economic analysis lacks the sophistication necessary for scientifically valid use of all available information [Mabbs-Zeno and Batie, forthcoming (b)]. The state, through the Virginia Institute of Marine Sciences (VIMS), has provided strong guidance on questions of environmental impact, but a lack of comparable technical aid on other questions, such as development values, leaves the boards with information focused mainly on preservation values. These informational shortcomings have resulted in emphasis by local boards on the most conspicuous values, on expert testimony from VIMS, and on local precedent.

Nevertheless, the boards are able to generate and utilize information which would be unavailable at higher levels of organization. They possess relatively detailed knowledge on some aspects of land use value which they obtain from permit applicants, local experience and personal contacts. They also have information on feasible informal alternatives to the denial of a permit.

The outcome of this informational set and, apparently, of the board's desire to avoid unnecessary confrontation is an emphasis on project modification [Mabbs-Zeno and Batie, forthcoming (b)]. Wetlands permit proposals are often changed in negotiation between landowner and wetlands board so that their impact is minimal. This modification process may be the most effective aspect of the Virginia Wetlands Act, and it demonstrates the special abilities of a local board format; however, the amount of modification is difficult to document. Nevertheless it is apparent that wetlands preservation benefits are usually heavily weighted in the process relative to development values.

Impact of Current Institutions

Even though the Wetlands Act and other policies were set up to account for public values which existing land markets did not consider, the permit systems do not provide perfect social efficiency, even in theory [Mabbs-Zeno and Park]. Permitting systems by the state and federal governments represent a compromise among efficiency goals and the considerations of administration and politics.

The preservation orientation of most boards has been shown through interviews and surveys [Mabbs-Zeno and Batie, forthcoming (a,b); Jones and Lynch, 1978]. Substantiating that finding is the record of permits which shows only about 100 acres destroyed by permit since 1972 in the state. There is conflicting evidence, however, indicating that local boards may not be as effective in protecting wetlands as these statistics might suggest. Research which compared actual use of wetlands to what would have occurred without the Wetlands Act suggests that development pressure on wetlands has been light and may not have destroyed substantial acreage after 1972. Extrapolation of historical trends for wetlands destruction to determine future trends is inappropriate because modern development patterns in Virginia reflect changing locational incentives. Most wetlands in the heavily urbanized Virginia Beach area have already been developed so the remaining areas are small tracts with questionable aesthetic value. The vast acreage of Virginia's eastern peninsula, constituting over 60 percent of the state's coastal marsh, remains untouched mainly because better sites on fastlands are available for the slow growth in the area. A large portion of marshes on the barrier islands in that area are owned by a private conservation organization. Publicly owned land, which does not fall within the Wetlands Act, includes at least 30 percent of Virginia's wetlands acreage [Niedzwiedz and Batie, forthcoming].

Aside from the ownership and economic hindrances to development, there are many overlapping land use regulations. Several counties attribute the lack of development pressure on wetlands to state building code requirements. Zoning, erosion ordinances, pollution regulation, public purchase programs, tax incentives for open space and other institutions contribute to a complex array of options and constraints facing wetlands owners. Furthermore, the programs specific to wetlands, as administered by the Army Corps of Engineers and by VMRC, are themselves redundant. Although the decision criteria in these two agencies are consistent, the permitting processes function independently. Either agency can halt wetlands development, a fact which has led to feelings of impotence and frustration on the part of some local boards. Indeed, some boards question why they should spend time and effort in deliberating the costs and merits of a proposal which the Corps or VMRC could reject anyway.

A final consideration in assessing the contribution of current institutions to wetlands management is enforcement power. The support provided by city or county attorneys and local courts varies among boards, but localities can cite a record of strict interpretation of enforcement responsibilities by such institutions. In the prominent example of land development by First Charter Land Corporation, over 100 acres of wetlands were destroyed without any permit. The corporation pled guilty, but were fined only 4,500 dollars. The fine seems like small incentive to obey laws protecting wetlands when quarter-acre lots sold for 10,000 dollars.

A New Management Alternative

As better information for quantifying values of wetlands is compiled, a clearer image of "optimal" wetlands use emerges. The permitting system of state law now in place is not well designed for using such information because it relies on untrained volunteers to make a judgement on the value of each specific proposal [Mabbs-Zeno and Batie, forthcoming (b)]. Similarly, the current institutions may fail to manage wetlands according to their goals if increased development pressure causes a courtroom test which further limits the programs. Even without a court case, the state law may be unable to effectively confront increased development pressure since enforcement power is already dubious. These potential problems with current management institutions, in addition to their high administrative cost, suggest that an alternative management strategy may be able to achieve the recognized goals more effectively. An important component of the research at Virginia Tech has been the search for ways to avoid present and future problems without losing the strengths of current institutions.

Structure of the Alternative

An alternative institution called single-resource transferable development rights has been constructed to offer one possible mechanism for improved allocation of wetlands. The conceptual roots of this institution lie in the idea of transferable development rights (TDR's). TDR schemes involve separating ownership of the right to develop land from ownership of other rights in land. The common notion that a landowner can do anything with his or her land has been challenged by the concept of land as a bundle of use rights or services, each of which may separately be sold or regulated. Development uses, as distinct from such uses as open space or wildlife habitat, are especially important because they involve relatively permanent reductions in the land's capacity for providing other services of social value.

The single-resource TDR restricts transfer of development rights among one type of land--that of wetlands. The program operates by issuing development rights to current wetlands owners in some fixed proportion of acreage owned. The proportion is chosen according to an analysis of current marginal public value of wetlands for development compared to preservation. For example, it may be decided that 180,000 of the current 200,000 acres should be preserved. A ratio of one to ten would then be chosen, such that a landowner with 150 acres of wetlands would have 15 acres of development rights. If that landowner were to develop or destroy more than 15 acres, he or she would have to obtain rights from other holders. Presumably a market for development rights would arise, so that the value of development rights becomes independent of the land from which it originated and is, instead, a reflection of the marginal private value of developing wetlands in the state. Modification of the basic program may be done to allow consideration of regional differences in development value and ecological differences in preservation value [Mabbs-Zeno and Park, 1979].

Performance of New Alternative

In theory the single-resource TDR, like permitting systems, does not provide perfect allocation according to the accepted goals. The reasons for misallocation are different for the two alternatives, but no data base currently exists for empirical comparison.

A potentially important contribution of the single-resource TDR lies in its incentive to create wetlands. Under conventional markets or permitting incentives, wetlands are economically nonrenewable at the range of wetlands acreage likely to exist in the near future. With single-resource TDR's, newly created wetlands have a minimum value of the market price for development rights across the state or region. Artificial enhancement of ecological quality by private landowners is also a possibility.

Speed and efficiency in administering wetlands allocation are both improved by TDR's. The current system takes several months on the average to complete consideration of a permit. The cost of investigating impacts and of holding a hearing can be greater than the value of the wetlands. With TDR's the cost of information-gathering is largely absorbed by the market, instead of the state, so the additional value expected from information is considered in the decision to seek further information. The process costs no more than the participants are willing to pay.

The administrative tasks which remain under a TDR program are relatively simple in design and may be further aided by recent experience with permit programs. A detailed inventory of all wetlands in Virginia is nearly complete. Local building inspectors and other officials are already trained to recognize areas defined legally as wetlands. Extensive public analysis of each site is not required, only an assurance that each development is backed by sufficient rights.

Political acceptance of TDR's is enhanced by the freedom it seems to allow landowners. Market mechanisms are widely used already so their pressures and incentives are commonly accepted. In addition TDR's release landowners from the uncertainty inherent in a permitting system. Any site may be developed if it is profitable enough. The system also appears equitable because it recognizes current property rights, uncertain as they may currently be, by giving development rights initially to landowners. Developers are likely to be supportive of TDR's because their transactions costs are reduced and their planning process is easier without permits. Conservationists may support TDR's because TDR's guarantee the preservation of some minimum amount of acres, TDR's encourage marsh creation and enhancement and because TDR's lower the cost of preserving additional acres to the cost of development rights.

The political weak point of TDR's lies in general inexperience with the TDR concept as a specific program. Numerous proposals have been developed since Gerald Lloyd published the concept in 1961, but the first TDR programs actually instituted are less than ten years old. Political processes in the U.S. are slow to accept a change perceived as nonmarginal, so the existence of precedence is critical to political feasibility. There are, however, several notions similar to TDR's which have been used in Virginia to separate various rights in land, including requirements for marsh creation to offset illegal wetlands destruction or highway construction through wetlands [Hundley].

On balance, TDR's are unfamiliar enough to most people that their initiation and use are hampered. There are no particular enemies to the use of TDR's, but neither is there a strong supporting constituency because the public benefits are spread so widely. If the current system, however, faces stronger pressure in the future and falters, TDR's may emerge as more of a politically viable response.

Conclusions

Numerous land use controls have been instituted in recent years to provide improved allocation of coastal wetlands. The dominant justification for federal and Virginia wetlands programs has been consideration of services not normally traded in markets.

The ability of ecologists and economists to assess the value of nonmarketed services is poor at present, yielding estimates with wide variance and high uncertainty especially for natural services. The search for values has included a full share of methodological errors but a consensus has emerged indicating preservation services of wetlands are generally less often valued than development services by conventional markets.

The local boards set up by the Virginia Wetlands Act, VMRC, and the Army Corps of Engineers may all be characterized as preservation oriented in their decisions on whether to permit wetlands alteration. The justifications for permit decisions vary greatly among these agencies in certain cases and local boards exhibit considerable ability to reflect local values, but the tendency to preserve wetlands remains widespread and is consistent with research prescriptions. In addition, local boards utilize various informal powers to protect wetlands through modification or withdrawal of project proposals.

The various levels of wetlands permitting are substantially redundant and the elimination of any single permit review would probably have little impact on wetlands uses. For most wetlands in Virginia there appears to be little pressure for development today, so current institutions may perform differently if future economic conditions favor wetlands destruction. The current institutions, however, have provided valuable administrative and legal experience with wetlands management and have encouraged scientific research.

A new management institution for wetlands has been suggested to provide greater flexibility for landowners, lower administrative cost and greater enforcement power under conditions of increasing development pressure. This plan, based on transferable development rights, needs further research, but it builds upon recent experience and offers a solution to problems expected to test current institutions soon.

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Regulatory Strategies and the Spatial Distribution of Wetlands

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Abstract

A conceptual model illustrating the relationship between the filling of wetlands and regulation is presented. The model demonstrates that the social costs and environmental quality resulting from several types of regulatory programs can vary due to the spatial distribution of wetlands. The model wetlands vary only in perimeter-area ratio. For the wetland with the larger ratio, environmental quality would suffer from a strategy intended to equalize the social costs of regulation for wetlands with different ratios. A strategy chosen to limit wetland areas losses and to equalize environmental quality, will result in larger social costs of regulation in the larger perimeter-area ratio wetland.

Introduction

Wetlands have long been viewed as wastelands suitable only for conversion to house lots, marinas, roads, or other clearly productive uses when the benefits of conversion were larger than the costs. This rather narrow view led to the rapid disappearance of wetlands in many areas of the United States. (1) The trend toward rapid development of wetland resources is being countered by regulatory programs as well as by purchase of wetland areas for conservation purposes. These regulatory and conservation programs have been heavily supported by the results of scientific studies demonstrating the value of wetlands in their natural state. (2) These programs and supporting studies have been heavily publicized and the publicity has led to a measure of public acceptance of the concepts of natural productivity and value. But, these concepts are not fully embraced by interests wishing to develop wetlands. Consequently, developmental interests are posing a serious challenge to some regulatory programs. The challenge is based on claims that regulatory programs inflate the natural "values" of wetlands and react slowly, unevenly, and uncertainly to development proposals. (3) The charge that regulatory programs inflate the values of wetlands could only be answered after the current controversy over the proper methodology for wetlands valuation has been explored

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more thoroughly. (4) The charge that regulatory programs react slowly, unevenly, and uncertainly to development proposals could probably be more easily substantiated than assessing the monetary values of wetlands. However, it is the intent of this paper to argue that the options for improving the "evenness" and "certainty" of agency decisionmaking would be severely limited given even "perfect" information about the developmental and natural values of wetlands.

This argument can be made more forcefully with reference to simple models of the development process in wetlands and the regulatory programs that could be designed to counter it. The developmental model is based on the progressive filling of a wetland by a number of developers who place a wide range of values on the individual fill projects. The model regulatory program is designed to use either standards or bargaining to counter development in the wetland areas of the jurisdiction. It will be shown that the spatial distribution of the wetland resources has implications for the distributions of the opportunity cost and wetland area loss under a given regulatory strategy.

Wetland Development Model

Consider two wetland areas with many identical characteristics such as natural values and desirability for development. The wetlands have the same area, but one wetland has a perimeter that is twice that of the other. (5) The perimeter of each wetland is bordered by development sites occupying a constant length, e, along the wetland-upland boundary. The number of development sites around the short perimeter wetland can be determined by dividing the perimeter, p, by e or p/e. The number of development sites around the other wetland is 2p/e.

Developers proceed with their plans by filling into the wetland various distances, d, after considering the costs of the project and their affinity for filling wetlands. Each developer placed a certain value, V, on the project and it is assumed that V and d each have rectangular distributions and are linearly related over the range of values, as shown in Figure 1.

The value, V, accruing to each p/e developers can be termed the consumer surplus. (6) If these values are arranged in declining order, as shown in Figure 2, the area under the triangle V0p/e is the total value of development around the wetland of perimeter p. The area under triangle V02p/e is the total value of development around the 2p perimeter wetland and is twice that of the p perimeter wetland, as shown in Table 1.

Since the distance, e, filled along the wetland-upland boundary is constant and the distance d filled into the wetland has a rectangular distribution, the area filled is dp/2 in the p perimeter wetland and dp in the 2p perimeter wetland. Both wetlands have the same area and if the percentage of wetlands filled is an indicator of environmental quality, the long perimeter wetland will have lower environmental quality. The following section of the paper will demonstrate that a regulatory stragegy can be chosen that will promote even environmental quality of the two wetland system or identical percentage losses in consumer surplus. No simple regulatory strategy can accomplish both ends.

Wetland Regulatory Model

Assume that the regulatory agency is charged with preventing a loosely defined amount of wetlands development as well as with the duty to treat each development proposal in an equal and systematic way. The first charge could be carried out more easily by setting a more definite goal, say a specific amount of the total wetland area within the jurisdiction. The second charge, of systematic treatment of development proposals, could be carried out by allowing each developer to alter a standard amount of wetland area or by bargaining systematically with each developer in order to limit wetland area losses. (7) Given the previously described model of development, the regulatory agency will clearly encounter problems in carrying out its charges. If the agency attempts to limit the losses of wetland area to the same percentage in each of the two model wetlands under its jurisdiction, the losses in consumer surplus or developmental value will be quite different. If the agency attempts to limit the losses of consumer surplus to the same amounts in each wetland area, the losses of wetland will be different.

Identical Losses of Wetland Area

With no regulation, development leads to alteration of dp/2 square feet of the p perimeter wetland and dp of the 2p perimeter wetland. Let us assume that the agency, after careful consideration, determines that a loss of only 3pd/8 square feet should be tolerated in either wetland. With the information presented in the model of development in wetlands, the agency could examine the pattern of development and determine that a standard allowing each developer to alter d/2 feet into the wetland would lead to alteration of 3pd/8 square feet in the p perimeter wetland, as shown in Table I. The agency could attempt to use a standard of d/4 feet in the 2p wetland, but since some developers alter less than that, less than 3pd/8 square feet would be altered. A standard of 7d/32 will lead to the alteration of approximately 3pd/8 square feet of wetlands, also shown in Table I.

Another option available to the agency concerns the decision to limit the loss in wetland area by bargaining with each potential developer. In this model, the agency knows that the fill in distances range from zero to d feet and have a rectangular distribution. For simplicity, we will treat bargaining only for the 2p wetland. Since bargaining is to be systematic, it will result in a new, rectangluar, distribution of d values. The mid-point of that distribution will be the average and the average d times the perimeter of the wetland will be the total amount filled in under bargaining. For bargaining leading to loss of 3pd/8 square feet, the maximum d will become 3d/8 and the mid-point will be 3d/16.

The opportunity costs of regulation for each of the two standards and for bargaining are shown in Table 1 and diagrammed in Figures 2, 3, and 4. As expected, the less stringent standard in the short perimeter wetland leads to lower opportunity costs. Approximately one quarter of the unregulated developmental value is lost. The average opportunity cost is also lower in the short perimeter wetland. The more stringent standard in the long perimeter wetland leads to a loss of five eights of the unregulated value and also a higher average opportunity cost. Bargaining in the long perimeter wetland leads to the same total lost opportunity cost as the stringent standard, but the loss is distributed over all of the developers so that the average opportunity cost is lower.

Proportionate Losses of Developmental Value

The regulatory agency may pursue a course that leads to some restriction in both wetlands, but which results in losses of developmental value in the long, 2p, perimeter wetland that are twice the losses in the short, p, perimeter wetland. This goal will lead to the pattern of wetland area and developmental benefit losses shown in Table 1 and diagrammed in Figures 2, 5 and 6.

The regulatory standard in each wetland is d/2 feet. This standard leads to a loss of 3pd/8 square feet in the short perimeter wetland and 6pd/8 square feet in the long perimeter wetland. The total losses of developmental value in the 2p wetland are twice those of the p wetland, but the average losses are the same.

The agency could also bargain systematically to ensure that the losses of developmental value are proportionate. Focussing again on the 2p wetland, a bargaining strategy will have to reduce the maximum distance, d, filled into the wetland to 6d/8 to ensure that the total loss is twice that of the value loss in the p wetland. This level of bargaining results in the same changes in wetland area and developmental value as the d/2 standard in the 2p wetland. However, the bargained losses are spread over all developers and the average loss, in this case, is one half the average loss resulting from the standard.

Conclusions

Only a few of the problems facing the regulatory programs protecting wetlands can be accurately described in so brief a paper. The problems chosen here are the concepts of certainty of outcome and evenness of effect of regulatory decisionmaking. Certainty of outcome implies that there is a systematic and well publicized process for making decisions and that the process is capable of producing identical decisions in identical situations. Evenness of effect implies that the systematic process will produce a desired effect on either environmental quality or on the distribution of costs due to regulation. A decisionmaking system using either standards or systematic bargaining rules has been modelled as a way of promoting certianty of outcome. Set standards or bargaining rules could speed up agency decisionmaking.

However, alteration standards would be difficult to develop for activities that have environmental effects that are difficult to characterize or quantify. Further, neither alteration standards nor bargaining rules can promote even distribution of environmental quality and opportunity costs at the same time. These differences in environmental quality and opportunity cost can most easily be seen by comparing wetlands differing only in perimeter area ration. This comparison shows, for example, that environmental quality would be lower in a wetland with a larger perimeter-area ration if regulation of development were by a constant bulkhead line standard. This type of standard would also promote larger total opportunity costs to be imposed on development around the larger perimeter-area ratio wetland.

Other methods of controlling development in wetlands have been suggested to solve some of the other problems that are related to direct regulation. For instance, development in some wetlands could be prevented by "selling" the rights to develop other wetland units. However, setting the number of development rights required to achieve a given level of environmental quality may prove to be a formidable problem if the spatial characteristics and expected levels of development are not considered. It has also been proposed that property taxes could be lowered for preserved wetlands or raised on developed wetlands to promote preservation. No matter how carefully chosen, a tax differential would exhibit many of the problems of standards, as discussed above. For example, an identical tax for all wetland units would result in those units with larger perimeter-area ratios being developed more intensively.

The main objective of this paper has been reached if the reader is left with a clearer view of how set standards of specific bargaining rules could play a part in removing some of the more commonly voiced objections to the regulatory process. Unfortunately, use of standards or bargaining appears to leave the agency with the difficult choice of promoting even environmental quality or proportionate loss in developmental benefits. The former would tend to set an implicit price for wetlands that varied with the losses of developmental value. The latter would tend to set a constant implicit price, but allow destruction of varying amounts of wetland at that price.

Fig. 1. Development Benefits in Unregulated Wetlands

p Perimeter

2p Perimeter

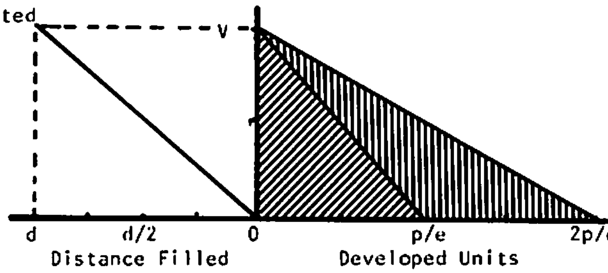

Fig. 2. Loss of Development Benefits with a Regulatory Standard

Loss in p Perimeter

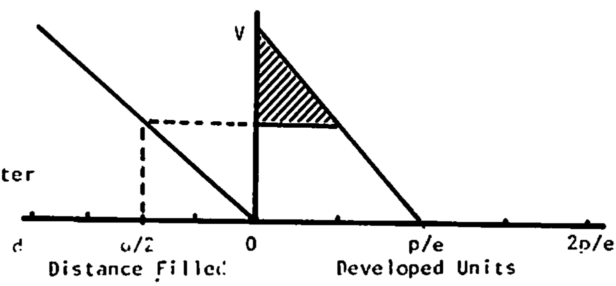

Fig. 3. Loss of Developmental Benefits with a Regulatory Standard of 7d/32

Loss in 2 p Perimeter

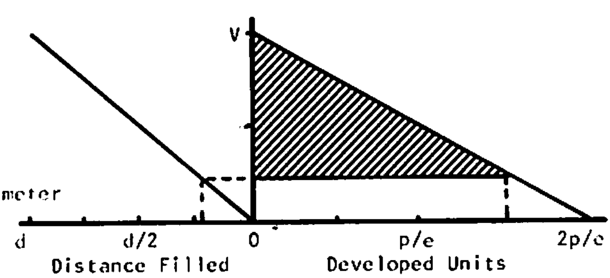

Fig. 4. Loss of Development Benefits with Bargaining

Loss in 2p Perimeter

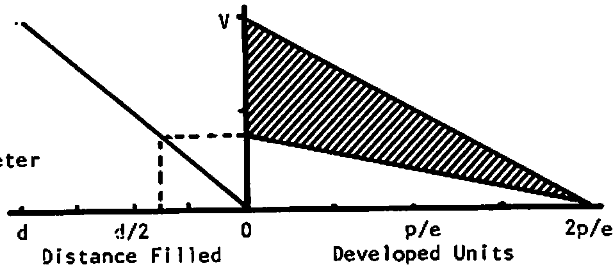

Fig. 5. Loss of Development Benefits with a Regulatory Standard of d/2

Loss in a p Perimeter

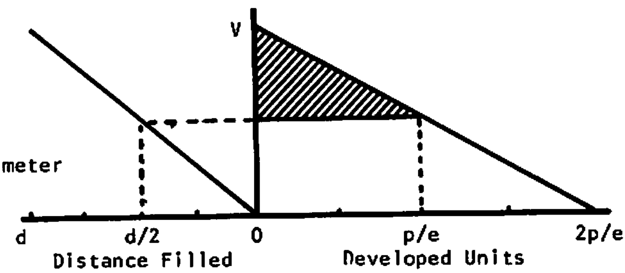

Fig. 6. Loss of Development Benefits with (less stringent) Bargaining

Loss in 2p Perimeter

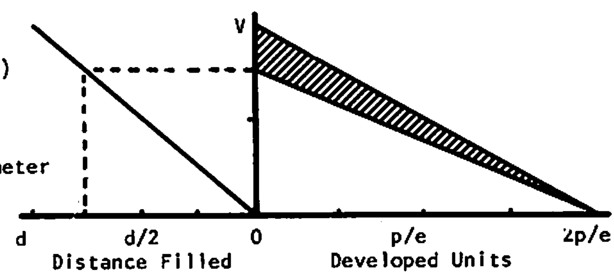

Table 1

Economic and Environmental Implications of Different Regulatory Strategies

Strategy	Regulatory Standard	Wetland Perimeter	Wetland Area Lost	Developmental Values Lost (Retained)	#of Developers Affected by Regulation	Average Loss of Value
NO	NONE	p	pd/2	(pV/2e)	p/e	(8V/16)
REGULATION	NONE	2p	pd	(pV/e)	2p/e	(8V/16)
Identical	d/2	p	3pd/8	2pV/16e	p/2e	4V/16
Losses of	7d/32	2p	3pd/8	10pV/16e	25p/16e	6V/16
Wetland	BARGAINING*	2p	3pd/8	10pV/16e	2p/e	5V/16
Proportionate	d/2	p	3pd/8	2pV/16e	p/2e	4V/16
Losses of	d/2	2p	6pd/8	4pV/16e	p/e	4V/16
Value	BARGAINING**	2p	6pd/8	4pV/16e	2p/e	2V/16

* Reduces the maximum d from d to 3d/8
** Reduces the maximum d from d to 6d/8

Notes

1. See John Teal and Mildred Teal, Life and Death of the Salt Marsh, (New York: Audubon/Ballantine, 1969) and Our Nation's Wetlands - An Interagency Task Force Report, by Elinor Lander Horwitz, (Washington, D.C.: Government Printing Office, 1978) for a detailed treatment of attitudes toward wetlands and a modern update.

2. A few of the controversial views on wetlands valuation are:

   David A. Huettner, "Net Energy Analysis: An Economic Assessment Science, Vol. 192 (1976): 101-104;

   Howard T. Odum. "Principle of Environmental Energy Matching for Estimating Potential Economic Value, A Rebuttal", Coastal Zone Management Journal, Vol. 5, No. 3 (1979): 239-241;

   Leonard A. Shabman, and Sandra S. Batie, "Economic Value of Natural Coastal Wetlands: A Critique." Coastal Zone Management Journal, Vol. 4, No.3 (1978): 231-247; and

   Richard Walker, "Wetlands Preservation and Management on Chesapeake Bay: The Role of Science in Natural Resource Policy", Coastal Zone Management Journal, Vol. 1, No. 1 (1973); 75-102.

3. Fred Bosselman: Duane A. Feurer: and Charles L. Sieman. The Permit Explosion, (Washington: Urban Land Institute, 1976), review the myriad problems besetting regulatory agencies;

   Richard B. Stewart, "The Reformation of American Administrative Law", Harvard Law Review, Vol. 88, No. 8 (1975): 1669-1813, reviews the legal and administrative standing of various agency alternatives for decisionmaking; and

   Dan K. Richardson, "The Cost of Environmental Protection: Regulating Housing Development in the Coastal Zone" (New Brunswick: Rutgers University Center for Urban Policy Research), focusses on the social costs of regulation in the coastal zone.

4. One group of researchers feel that even if valuation or ranking efforts succeed, the results would be used to the detriment of wetlands protection. See:

   Candace A. Oviatt; Scott W. Nixon; and Jonathan Garber. "Variation and Evaluation of Salt Marshes," Environmental Management, Vol. 1, No. 5 (1977): 201-211.

5. The long perimeter wetland has a perimeter-area ratio that is twice that of the short perimeter wetland.

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6. See E.J. Mishan; Cost-Benefit Analysis, Revised Edition, (New York: Praeger Publishers, 1976). Ch. 39 for a similar treatment of consumer surplus, and

   Joseph S. Larson, ed. "Models for Assessment of Freshwater Wetlands," Water Resources Research Center, Publication No. 32, (Amherst: University of Massachusetts, 1976), for the use of historical purchase data for estimating developmental and natural values of wetlands.

7. Many regulatory programs purport to make decisions systematically, but on a case-by-case basis, without documenting the decisionmaking system. It is difficult to imagine a case-by-case, systematic decisionmaking system that would promote both even environmental quality and social cost.

THE COASTAL REGULATIONS OF THE MASSACHUSETTS WETLANDS PROTECTION ACT: WHOM DO THEY AFFECT AND WHY?

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ABSTRACT

The Wetlands Protection Act of Massachusetts (M.G.L.C. 131, s 40) requires permits when anyone wants to dredge, fill, remove or alter a wetland. Regulations promulgated under the Act have the force of law. These regulations clarify the jurisdiction and administration of the statute. In 1978, new regulations which specifically address coastal wetlands were implemented. Projects proposed for the coastal zone must now meet strict performance standards which minimize or have no adverse impact on certain values of the wetland. The result of these regulations has been a consistent and predictable application on all coastal projects of sound technical coastal processes concepts.

INTRODUCTION

The Commonwealth of Massachusetts has been a leader in the protection of wetlands. The existing law, known as the Wetlands Protection Act, was passed in 1972. It is the result and combination of two earlier statutes. The Jones Act of 1963 (M.G.L.C. 426) applied only to coastal wetlands such as beaches, dunes and salt marshes. The law established a review and permit procedure for all projects which would affect a wetland. The Massachusetts Department of Natural Resources (DNR) administered the law and issued the permits. The public could comment and in many instances brought violations of the law to the attention of the agency. A second statute passed in 1965 was known as the Hatch Ace (M.G.L. c. 220). In nearly all respects this law was identical to the Jones Ace except that it protected only freshwater or inland wetlands.

The present Wetlands Protection Act has jurisdiction over both freshwater and coastal wetlands. An important change in this law gives conservation commissions (the mayor or selectmen) local and primary review responsibility. The local commissions issue the permit, called an Order of Conditions. Anyone who wants to fill, dredge, remove or alter a wetland must first obtain an Order of Conditions regulating the project.

The Wetlands Protection Act (The Act) protects seven interests or values wetlands Commonly associated with. They include the protection of public and private water supply, groundwater supply, storm damage prevention and flood control, prevention of pollution, protection of land containing shellfish and the protection of fisheries.

Figure 1 depicts the application/permit procedure under the Act. Anyone who is not sure whether or not he/she is subject to the Act may request a determination of applicability to the law. This is an optional step which if positive leads to the filing of a Notice of Intent (NOI). When a NOI has been filed to do work in a wetland the conservation commission has a maximum of 21 days in which to legally schedule and hold a public hearing. The hearing determines if the project will have a significant impact on the wetland and if the wetland is significant in and of itself to the interests protected by the law.

After the closing of the hearing, the conservation commission decides, based on its' review, whether an Order of Conditions is necessary. Usually this is the case, and the Order must be issued within an additional 21 day period. Ten days after the date of issuance of the Order must elapse before the project may begin. This is the appeal period allowed by the law. The appellant review agency is the Massachusetts Department of Environmental Quality Engineering (DEQE).

An important aspect of the law is the provision that the DEQE may promulgate regulations which assist in clarifying and implementing the law. These regulations will be the subject of the ensuing discussion.

DISCUSSION

The first set of regulations promulgated under the Act passed in 1975. These General Regulations (Part 1) defined administrative procedures and terms found in the body of the statute. Revisions to these regulations have been made when necessary.

A major addition to the regulations, the Coastal Regulations (Part 2) were promulgated on August 10, 1978. The development of Part 2 was the joint responsibility of the DEQE, Division of Wetlands and the Massachusetts Coastal Zone Management Program. The approval of the Massachusetts CZM plan enables major revisions to the Act which would further protect coastal wetlands. The CZM staff utilized the basic framework of the Wetlands Protection Act. Coastal resource areas were identified and categorized. The specific interests of the Act were highlighted with respect to each of the characteristics of the

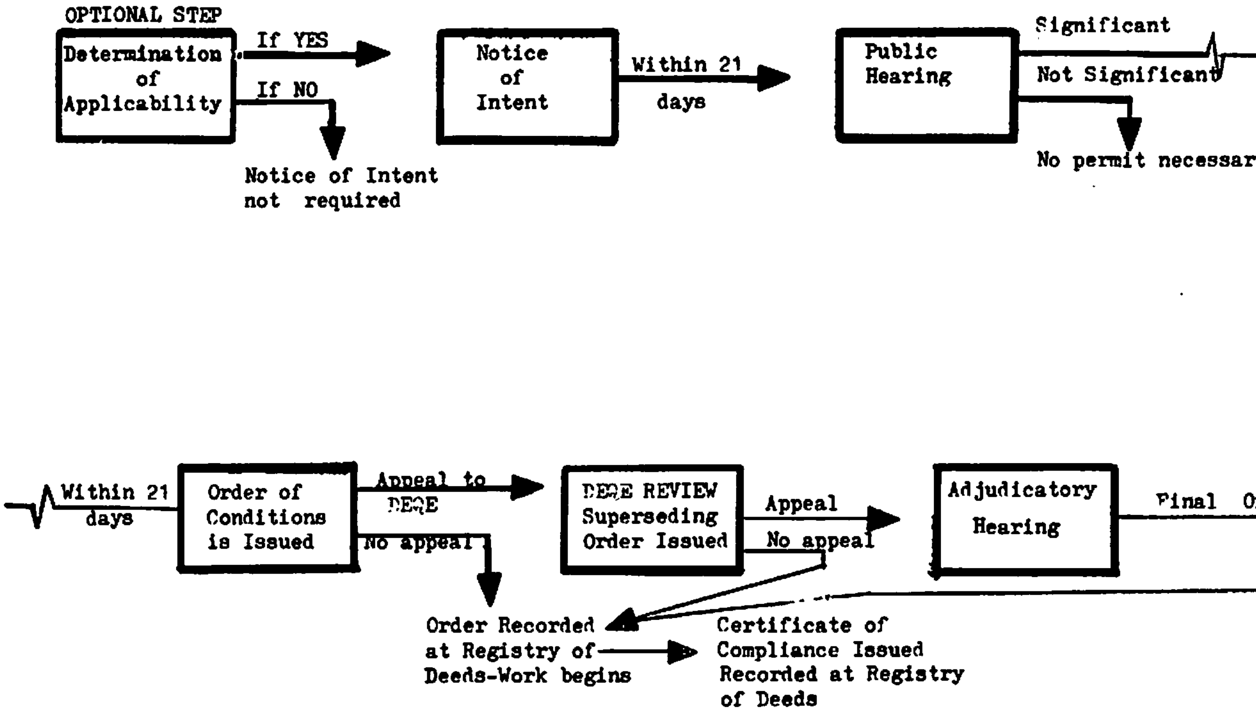

FIG. 1 Application and Permit Process under the Wetlands Protection Act.

particular resource. For example, salt marshes were identified for their value to the protection and importance to land containing shellfish and fisheries as well as storm damage prevention, flood control and water supply. The identified values of salt marshes were then addressed in the regulations. Salt marshes are assumed to be significant to the interests stated above and essentially no salt marshes can be destroyed or altered. Allowable projects in salt marshes include the harvesting of salt hay and the construction over the marsh of an elevated boardwalk.

In addition to salt marshes, coastal beaches, coastal banks, dunes, barrier beaches, land containing shellfish, rocky intertidal shores, anadromous/catadromous fish runs, salt ponds and designated ports are included as coastal resource areas. Each resource area was defined by its physical and/or biological characteristics.[3] Each resource area was then related to the appropriate interest(s) protectable under the law. The relationships were clearly made in the body of the regulations. Establishing prior significance of the coastal resource areas was an important part of the overall concept of the regulations. Each resource area can not be assessed in advance of development.[4]

An individual wanting to construct a home on land within 100 feet of an eroding coastal bank would require and be given an Order of Conditions possibly permitting the project but including the condition;

> "No coastal engineering structure such as a bulkhead, revetment or seawall...will be permitted...in the future to protect the project allowed by this Order."

This language is included on all projects applied for subsequent to the effective date of the regulations. It is an example of the kind of protection being made to the coastal resource. It puts the public on notice that the important sediment suppling function of the coastal bank will be maintained.

CONCLUSIONS

The Coastal Regulations are a significant step toward protecting the remaining coastal wetlands of Massachusetts. They provide a model for other states in assessing their own goals for wetlands protection. Adjudicatory cases presently being litigated are offering a positive enforcement powers the supportive technical interpretation of the law. In establishing the importance of wetlands to the public and clearly explaining those values we are able to promote sound coastal development.

[3] A complete set of the Coastal Regulations can be obtained by writing: Massachusetts State Bookstore, State House Room 116, Boston, MA 02133

[4] A more in-depth analysis and description of the development of the Coastal Regulations can be found in the proceedings authored by Geise and Smith, Physical Processes...., and Clayton, Mayo & Mayo, Biological Processes....

A Profile of Wetlands Regulation in Coastal Massachusetts Towns: Local Regulatory Activity and the Public Perception of Effects

by

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I. Study Format

This study is attempting to look in detail at both the process and effect of wetlands regulation at the community level in Massachusetts. Work carried out during 1979 in two coastal Massachusetts towns involved 1) a survey of the local and state regulatory practices commonly engaged when construction activity impinges on wetlands areas; and 2) a survey of owners of residential property, both developed and undeveloped, in wetlands areas where this suite of regulations and practices is applicable. The survey of regulations has focused on permit-issuing activities that stem from local management of state and local wetlands protection programs, and on the effects local zoning regulations have on development around wetlands. The property owner survey, which has been the major focus of our research efforts thus far, gathered information of several types, as outlined in Table 1 below.

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2. Department of Urban Studies and Planning, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

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Among the survey's areas of inquiry, special attention was paid to open-ended responses which related personal experiences with wetlands regulation, and a series of scaled ratings of the perceived degree of necessity for the regulation of wetlands use, of the value attached to wetlands ownership, and of the effect wetlands regulations have on that value. While this kind of survey primarily measures the perception of regulatory effects, wetlands values, and the effect of regulations on that value, as distinct for the effects and values themselves, we believe the survey has produced interesting insights into how well the total wetlands regulatory system is working in the areas we studied.

Table 1. Survey of wetlands residential property owners: areas of inquiry

- Socio-economic profile
- Past, present, intended future use of wetlands property
- Past, present, intended future modifications of wetlands areas
- Knowledge of, feelings about, wetlands protection measures
- Personal experiences with the wetlands regulatory apparatus
- Concerns related to wetlands property ownership
- Perceptions of wetlands value and the effect of regulations on that value

THE STUDY AREAS

Survey work done during the summer and early fall of 1979 concentrated on the town of Falmouth, on western Cape Cod, and the town of Marshfield, located about 30 miles south of Boston on the Massachusetts South Shore. A related but more limited survey was conducted in Eastham and Orleans on the outer shore of Cape Cod in 1978. This paper focuses on the 1979 work and draws most illustrative material from the Falmouth survey. Results are preliminary at this point.

The developed portions of the shorelines in all these towns are almost entirely devoted to housing. Thus it is the housing industry and present shorefront homeowners who are most likely to make further alterations of the shoreline and wetlands in these areas. Cape Cod towns are all important resort and retirement communities with strong saltwater recreation orientations. Falmouth alone has 55 miles of tidal shoreline. Estimated peak summer populations in Cape Cod towns are nearly three times their winter populations; as an extreme example, nearly two-thirds of the housing stock in Eastham is unoccupied in the winter (2).

Cape Cod has experienced exceptionally rapid population growth over the past 30 years, with annual growth rates ranging as high as 4%. At the same time, 90% of growth in recent years has been from in-migration, heavily weighted in turn toward the 45 and older age categories (1). The pattern of older, well-educated, higher income people moving to Cape Cod retirement homes, or to second homes destined to become retirement homes, suggested by these data is strongly reflected in the socio-economic characteristics of the Cape Cod property owners we interviewed. Almost half of our Falmouth interviewees were retired or semiretired.

Cape Cod has long been regarded as one of the strongest centers for housing construction activity in New England. The 1972 Cape Cod Economic Base Study (1) revealed that while the resort industry directly accounted for 20% of 1970 payrolls, construction and construction related activities accounted for another 25% of these payrolls. The two industries are strongly linked; Cape Cod construction activity has been dominated by housing construction and the housing market has been largely driven in turn by demand for second and retirement homes. It is not surprising that representatives of the building trades voiced the strongest opposition when the state coastal zone management program was being applied to Cape Cod (6).

Marshfield contrasts the Cape Cod towns in the survey in several respects. Its proximity to Boston made it an attractive commuter suburb during the 1950's and 1960's urban exodus. It experienced explosive growth then that resulted in extensive wetland filling for housing construction, particularly in the town's southern end. Yet Marshfield retains considerable open space and wetlands today; about 2700 of its 18,500 acres were fresh or salt water wetlands in 1972, a number only slightly smaller than the combined total fresh and salt water wetlands in the Cape Cod towns we surveyed (4). The North River, which forms the towns northern and western border, is a wetlands resource of particular significance to Eastern Massachusetts. Development and the attendent filling of wetlands have left the river corridor relatively untouched, partly because thick impervious clay beds in the river's catchment make septic system construction difficult. The outstanding natural qualities of this river made it a prime candidate for designation under the Massachusetts Scenic

Rivers Program, and early in 1979 it became the first river to be so designated. Property in the river corridor is subject to restrictions as a result of the scenic river designation, and our survey sample in Marshfield included owners of newly restricted property.

Marshfield wetlands property owners interviewed tended to be younger, and less likely to be retired or semiretired than the people we interviewed in Cape Cod towns. While Marshfield people also enjoy their wetlands and waterfront property, they appear less likely than Cape Cod property owners to regard their present wetlands properties as lifelong properties.

SURVEY METHODS

State and local records were surveyed sufficiently to give us a fairly detailed picture of wetlands protection activity at the local level in the towns we studied. Special attention was paid to records of permit applications and reviews under various wetlands programs, building inspector reports, assessor's maps and records, special local zoning determinations, and state determinations of critical wetlands habitats in private hands. State and local personnel connected with all phases of the governmental process which affects private property development near wetlands were interviewed or consulted, and we attended numerous public hearings and meetings related to wetlands protection activities.

This blend of systematic and informal data collection techniques produced the information about how the total system functions at the local level which is sketched below. It also located areas in the towns of interest where the alteration of wetlands by private property owners was a well established activity. Property owners were then selected for in-person interviews in "clusters" from areas in which recent modification activity either had or should have produced encounters with the regulatory system. The selection of interview subjects within clusters was essentially arbitrary, though all individual property owners in the area who had filed for wetlands alteration permits from a local Conservation Commission were included. One hundred Falmouth property owners were interviewed in person, usually in their homes, and 71 Marshfield property owners were interviewed either in person or by telephone. The survey was not limited to those actually known to have encountered the wetlands protection system in some official way.

II. The Regulatory Climate

While the central piece of legislation regulating the use of wetlands in Massachusetts is the Wetlands Protection Act, a whole suite of regulations, directly and indirectly related to wetlands protection, determines the regulatory climate in which property owners make decisions about how they will use their wetlands.

The Wetlands Protection Act. This act, passed in the 1960's,established local conservation commissions of citizen volunteers to regulate the alteration of wetlands and associated environments such as dunes, beaches and coastal banks. Permits are required from town conservation commissions for all construction activity within 100' of wetlands; permits granted specify performance standards, often in considerable detail. Permission for proposed construction activity can be denied if a commission finds that any of seven specified public benefits of wetlands will be significantly degraded by the activity proposed. Commissions tend to deny permission for projects which involve significant alterations of wetlands *per se*, but to allow development of contiguous uplands, often well within 100' of wetlands. The conditions they impose on single family home construction adjacent to wetlands most often focus on proper placement of septic systems to prevent pollution of wetlands and proper maintenance of the vegetative cover and contour of bordering uplands to prevent erosion.

The Wetlands Restriction Program. Enabling state legislation for this program authorizes the issuance of restrictive orders specifying permitted and prohibited uses of wetlands. Unlike the somewhat diffuse domain regulated by the Wetlands Protection Act, restricted wetlands are mapped from aerial photographs. The restrictive order, along with a copy of the map, is attached to the deed of each property containing a restricted wetland. This program is currently being applied to both inland and coastal wetlands, town-by-town, throughout the coastal zone.

Flood plain zoning bylaws. As towns elect to participate in the National Flood Insurance Program, they pass zoning bylaws which require new construction in flood plains to satisfy the standards authorized by the National Flood Insurance Act and related enactments. With the aid of HUD flood insurance rate maps, building inspectors in participating towns make systematic determinations of whether building permit applications involve construction in the flood plain.

Other town bylaws. Town zoning and other bylaws can affect development around wetlands in a variety of ways. Subdivision and residential cluster development guidelines often require that 80 to 90 percent of the subdivided area (or of individual lots, in some cases) be upland. Though Title V of the State Environmental Code specifies that residential septic systems are to be located a minimum of 50' from wetlands, zoning bylaws may specify a greater minimum distance. Marshfield, like some other coastal towns, has superimposed wetlands zoning districts in which its special wetlands zoning requirements apply. Other towns define the wetlands to which zoning regulations apply in a variety of ways, not always consistent with definitions given in State legislation. Currently many coastal towns are passing non-zoning special bylaws which reaffirm the purposes of the Wetlands Protection Act, often adding additional public benefits of wetlands, such as recreation and esthetics, to the interests protected by the Act.

III. Results and Discussion

While local conservation commissions are perceived as playing the central role in wetlands regulation at the local level by the public, understanding of the nature of the decisions they are empowered to make and the criteria by which they are supposed to render judgements is quite low. We judged 63% of our Falmouth interview sample to have little or no knowledge of the functions conservation commissions have. At the same time, 38% of the sample had had either direct or indirect encounters with the wetlands regulatory system, either as permit applicants, abuttors to applicants, or through other involvement with the cases of friends or neighbors. Many of these people were among these judged to have little or no knowledge of the program, however. While complaints about conservation commission members being biased, inconsistent or inadequately knowledgeable to make proper decisions were fairly frequent, people with complaints often judged the overall system to be fair nonetheless; 63% of those with such experiences judged the system to be a fair one.

The public hearings required for each case which comes before a local conservation commission can become quite charged in controversial cases. It is not uncommon to have lawyers and expert witnesses representing both sides in cases in which there is opposition to proposed development. In such situations conservation commission members do appear to sometimes base their decisions on factors which go beyond their mandate under the Wetlands Protection Act and pertinent local bylaws. On the other hand, the citizen concerns which fuel these debates often go beyond the purely environmental considerations of the Act as well, and wetlands protection can become an excuse used to legitimize a host of other social and economic concerns.

We similarly discerned in our interviews a pattern of respondents confusing social, political and economic concerns with those which specifically relate to the health of the wetlands environment. This was particularly true in the anecdotal accounts we heard of encounters with wetlands regulations. This same kind of juxtaposition of environmental and non-environmental concerns occurred in response to a question in which property owners were asked to identify their chief concerns related to the ownership of wetlands property from a list we presented; shoreline erosion and invasion of privacy were the choices most often selected.

We discovered in our survey of conservation commission activity in Falmouth and Marshfield that the number of cases actually processed by these commissions is surprisingly small when compared to what we perceived the level of building activity around wetlands to be. The Falmouth Conservation Commission had rendered decisions on only 150 permit requests of all kinds from its formation in 1972 through mid 1979; Marshfield had processed less than half as many. It appears to us that systematic evasion of permit requirements for relatively small-scale activity at least (such as dock and rip-rap installation) is widespread in Falmouth, where structures or shoreline modifications related to recreational boating or erosion control abound along the shoreline. We cannot yet judge this situation in Marshfield.

The Falmouth Conservation Commission had issued permits on only seven single-family home constructions through 1977 (followed by a flurry of 28 decisions in the next year and a half). This occurred during a period in which the town was issuing building permits at a rate of from 300 to 350 per year. There appears to be no convenient way of systematically determining whether new construction impinges on the domain covered by the Wetlands Protection Act, however, since the area is not mapped.

The level of awareness of most other state and local wetlands regulations among those we interviewed was extremely low. Only the National Flood Insurance Program evoked an appreciable level of recognition by the interview population at large. A significant minority of respondents who lived in low lying areas and had experienced floods volunteered concern that the program permits development of land lying lower than their own.

On the basis of our preliminary findings we are willing to reject the hypothesis that environmental regulation, and the present administration of the Wetlands Protection and Restriction Acts in particular, is restricting overall growth in the housing industry in the areas we studied. The Cape Cod housing industry especially has shown great strength through most of the 1970's; the trend in housing starts during this period shows fluctuations which seem clearly linked to prevailing market conditions but little else. The only dramatic decline in housing starts during the past decade coincided with the 1974-75 building recession. Growth just prior to the late 1979 round of mortgage interest rate increases was particularly strong (3), and this growth occurred during a period in which the administrative efficiency of wetlands programs was apparently increasing under impetus from Massachusetts Coastal Zone Management program.

Those controls which most affect the density of new development, and ultimately limit local growth, continue to be the ones which have historically performed that function -- local zoning and other manifestations of home rule. While the state legislation we have described has deflected new development out of wetlands, it does not appear to be appreciably affecting development of immediately adjacent uplands. In areas of Falmouth where subdivision plans were approved locally before most of the town's present wetlands-oriented zoning went into effect, the buffer zone along large areas of salt marsh is now rapidly being enclosed by new housing on half acre lots, with Conservation Commission approval. In other areas, however, where such pre-existing commitments were absent (and where neighborhood attitudes appear less receptive to new development), zoning controls and wetlands regulations seem to be working in concert to preserve open space in the buffer zone as well as in the marshes themselves.

It can be very difficult to predict the effect local enforcement of local bylaws will have on wetlands area development. Often the possible effect and ostensible purpose of local bylaws cannot be understood without first understanding the intent which motivated their passage. An apparent motive for some town non-zoning wetlands bylaws, for example, is to use the authority granted towns under their home rule charters to establish local appeal procedures for wetlands matters as alternatives to the State administrative appeals specified in the Wetlands Protection Act. Towns may be more willing to accept restrictive language in zoning ordinances, from which variances can be granted by local boards of appeals, than they are to see the same language in state legislation which has no built-in procedures for granting variances. The vague wording of many local zoning ordinances creates a measure of discretionary power often lacking in other kinds of legislation.

Because Marshfield has a superimposed wetlands zoning district, its town conservation officer is empowered to make delineations of privately owned wetlands, upon request, to determine which portions of lots fall within the wetlands zone. We found that he had issued more than 80 such delineations since 1976, mostly on lots where future building near wetlands areas was being considered. Requests were made by potential buyers as well as by land owners contemplating construction or subdivision. We believe that this local system is succeeding in turning many cases away from conservation commission consideration before building plans ever get under way.

Preliminary analysis of our Falmouth interviews shows a strong preference for local control (45%) versus state (22%), federal (10%), or various combinations of control of wetlands regulation. When asked to choose the 'best' hypothetical system of wetlands ownership from a list of options, 37% of our Falmouth sample chose the present system of private ownership. A surprising 30% chose conservation trusts as the best proprietors, however, possibly indicating an underlying general dissatisfaction with the present state of the wetlands environment they knew best.

While we found a high level of commitment to the general principle of environmental protection consistent with the reported findings of other surveys (5), we found limitations to that commitment as well. While 72% of respondents thought wetlands filling should be prohibited, for example, two thirds of that majority thought exceptions should be made if a public benefit were involved. Likewise, substantial majorities thought wetlands use regulations were necessary and that wetlands enhanced the value of their property. A minority, however, gave answers to questions on wetlands value suggesting they believed their neighbors' wetlands, which contributed to their privacy, sense of open space, and esthetics, were more valuable to them than their own wetlands, which they viewed as inhibiting their access to the water or as presenting the kind of property maintenance problems one usually associates with crabgrass. This statement may in its own way summarize the basic dilemma facing the wetlands program manager who must balance his environmental mandate against the legitimate, but sometimes contradictory and inexplicable perceptions and expectations of the affected public.

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CHARACTERIZATION OF BEACH AND DUNE RESOURCES USED IN THE IMPLEMENTATION OF THE MASSACHUSETTS COASTAL WETLANDS RESTRICTION ACT

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ABSTRACT

Under the Massachusetts Coastal Wetlands Restriction Act (G.L.C. 130, S. 105), the Department of Environmental Management is currently mandated to prohibit certain land uses in specific wetland areas by means of a deed restriction process. With the creation of policy guidelines by the Massachusetts Coastal Zone Management Program, addition of technical and scientific staff, use of orthophoto basemaps, and administrative procedures which include scientific research, implementation of the Act has become more substantial.

Recognition of the legal ramifications centered upon the taking issue has emphasized the need for considering evaluation of wetlands. In general, all restricted wetlands are characterized physically and biologically and their functional value must be determined in relation to one or more of the statutory interests. Depending on the type and amount of existing information and data, field research may be necessary to complete the resource characterization.

INTRODUCTION

Largely due to the fact that wetland protection legislation existed, Massachuasetts had a Coastal Zone Management Program approved in April, 1978. Unlike most other states which had to formulate and adopt legislation before a program could be implemented with federal funds, Massachusetts was ready to procede with a more substantive approach. Utilization of scientific methods and a technical understanding of wetland values is fundamental in this approach.

The purpose of this paper is to emphasize 1) the substantive and procedural changes which have occurred in the Massachusetts Coastal Wetlands Restriction Program, 2) the legal influence on the type of criteria used for restricting wetlands, and 3) the implementation of a scientifically sound method in evaluating beaches and dunes. Elements such as public relations, political awareness, and coordination of public meetings are not discussed. In order to gain a better understanding of the Coastal Wetlands Restriction Act and the manner in which the program has changed, background information is presented regarding legislative

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history, implementation authority and the balance that exists between law and science. A sound approach to characterizing the physical and biological features of beaches and dunes and the use of this characterization in defending the restrictions are discussed. Finally, a simple field methodology is reviewed that is useful for obtaining both short-term data used in the present decision making process and long-term data used as a basic research tool.

BACKGROUND

Legislative History

In the early 1960's, there was a growing concern for the protection of wetlands possessing a functional value related to marine productivity (i.e., shellfish and finfish). Massachusetts chose to protect only salt marshes and land containing shellfish. Over time, it was obvious that removing, filling and dredging of these wetlands had an adverse effect on their value. An estimated 45,000 acres of wetlands were in need of protection, so, to accomplish this, legislation was adopted in 1963 known as the Jones Act [1]. This law gave regulatory authority to a number of institutions including the board of selectmen in a town, the appropriate licensing authority in a city, the state department of public works, and/or the director of marine fisheries.

It was felt that the Jones Act had been effective in curtailing indiscriminate alteration of coastal areas; however, additional legislation could provide for further and more permanent protection of these vital areas through a restriction process as opposed to a regulatory one [2]. In 1965, the first form of the Coastal Wetlands Restriction Act [3] was passed, giving the Commissioner of Natural Resources the authority to regulate and permanently restrict certain uses in wetlands. The statutory interests were broadened to promote the public safety, health and welfare by protecting public and private property, wildlife and marine fisheries. Following the identification of wetlands to be restricted, the assessed owners are given a 21 day notice of a public hearing upon which time the restrictions will be presented. An order listing the permitted and prohibited uses and a plan showing the restriction boundaries is then recorded in the registry of deeds. During a 90 day period after the recording date, an aggrieved landowner may petition the superior court for a taking without just compensation. If the court finds the order to be an unreasonable exercise of police power, the order will not apply to the petitioner's land. However, the state may choose to take the land by eminent domain.

By 1970, the Act was implemented in only five towns, affecting 328 people and including about 4750 acres of wetlands. Since 1970, the Act has been amended three times. It is now implemented in 20 towns, affecting over 3100 people and including about 21,000 acres.

During the ten year period between 1965 and 1975, both the restriction program and the regulatory program also gained strength. In 1972, the Jones Act was incorporated into the Wetland Protection Act[4] which addressed the regulation of both inland and coastal wetlands. Both wetland protection programs (restriction and protection) were operated within one office -- the Department of Natural Resources (DNR).

<u>Implementation Changes</u>

With the advent of a new administration in 1974, a large reorganization occurred which effected the departmental responsibility of implementing the Wetland Protection and Restriction Acts. The Department of Environmental Quality Engineering (DEQE) became responsible for implementing the Protection Act. The Department of Environmental Management (DEM) became responsible for implementing the Restrictions Act. In this way, two separate staffs could concentrate on separate programs and presumably accomplish their respective goals. However, some problems had arisen with the transition and only five coastal towns were restricted in the following four year period. In the spring of 1978, these problems were finally addressed.

Four major changes occurred in the program which substantially improved the implementation procedures and methods for restricting the use of coastal wetlands. Discussion of these changes in relation to the past program will provide a greater understanding of the current program. The changes are briefly summarized below.

1. With the adoption of a management plan developed under Federal guidelines (CZM Act 1972), the Massachusetts Coastal Zone Management Program (MCZMP) set forth a number of environmental policies designed to promote consistent implementation of existing statutes. For the restriction program, policy #1 is the most important because it specifies the type of wetlands of major concern. The wetlands so entitled include coastal beaches and dunes, barrier beaches, salt marshes, salt ponds, and shellfish beds. This development represents an impressive improvement over the general language used in the Restriction Act. In addition, policy #1 clarifies the statutory interests more specifically to include 1) contribution to marine productivity, 2) value as natural habitats and 3) storm buffers.

2. Another improvement to the program centers upon the professional background of that staff. With the addition of a technical and scientific staff now including a coastal geologist, marine biologist, certified registered land surveyor and civil engineer, engineering draftsman, conveyancer, business manager and principal planner, specific responsibilities become better defined. Scientists and engineers are responsible for wetland evaluation and selection, quality control of the mapping products, and transference of restriction lines to individual plot plans. The total planning process, office organization and assessors work comprise some of the other professional responsibilities.

Because of this specific division of responsibility, a team approach is used to implement the restrictions on a town by town priority basis. In the past, one individual was responsible for conducting the entire restriction process in a town. A beneficial aspect of the team approach has been a natural check and balance which occurs during the interaction and coordination between and among the staff.

3. Orthophoto base maps meeting National Map Accuracy Standards and representing the state of the art were introduced. With the use of high altitude vertical aerial photos at a scale of 1:25,000, the orthophotographically corrected product is enlarged to a scale of 1:5000, has an overall size of 36"x24" and supplies a large amount of information to the user. They serve as a 1) work product for field verification of wetlands by the evaluation staff, 2) a map product for locating all wetlands (restricted or not) and identifying jurisdictional boundaries by the town Conservation Commissions, local and state officials implementing the Wetland Protection Act and 3) the recorded document used in the registry of deeds. In the past, a line and symbol map having only the restricted wetlands identified served as the sole recorded document. Expensive, uncorrected 9" x 9" black and white prints served as the work product for the field. Although the line and symbol maps were legally acceptable documents, government officials, engineers, and affected property owners found them extremely difficult to work with because of the lack of physical resource information.

4. The program formally adopted Rules and Regulations. Not required by law, as it is with the Protection Act, it is a publicly accepted document representing an effort to insure greater procedural consistency within the restriction process. It also demonstrates that the State is acting in good faith. The recommendation to promulgate a formal set of administrative guidelines was intiated by the Attorney General's Office amidst an important law suit. The law suit posed a substantial threat to the Inland Wetlands Restriction Act; a law similar enough to the coastal law to have direct ramifications. Later, the entire program was evaluated from a conservative legal standpoint and measures taken to guarantee the continued existence of the Act. That is, limitations within the law had to be recognized and protected without reducing the effectiveness of the law itself.

PROCEDURAL AND SUBSTANTIVE RESPONSIBILITIES

Legal Ramifications

As previously mentioned, an aggrieved landowner can sue the State for a taking without just compensation. Although the decision only affects that property in question, the court process is publicly known and, if the decision supports that of a taking, many other landowners may follow suit and the threat of an unconstitutional ruling becomes pre-eminent. Therefore, steps must be taken to 1) avoid any cases being brought to court and, if they are, 2) insure that policy and procedures are defensible. There have been very few law suits in the past and measures to limit the number have been extremely successful.

However, one should keep in mind that the uses restricted in salt marshes and tidal flats were, for the most part, unintentional in the first place. That is to say, many people were unaware of their high identified value and, therefore, often altered them indiscriminately. The threat of a law suit is much greater now since upland areas such as dunes are being restricted. The principal factor used to determine if there has been a taking is the level and extent of the burden placed on the individual owner. This burden is weighed against the public need and a balancing act must be performed to acknowledge it (personal communication Frank Wright, Assistant Attorney General, 1978). On one hand, the public need is generally assessed using the following criteria: 1) protection from hazardous floods, 2) conservation of wildlife and 3) additional recreation. Impact on the individual could be viewed in light of 1) complete deprivation, 2) expected use and 3) speculative value. The case exemplifying greatest public need and least impact on the individual would occur when protection from hazardous floods on one side is balanced with speculative value on the other. In this case, no taking is likely to be found. Conversely, restriction of land for additional recreation balanced with complete deprivation probably would result in a taking. "The courts are ascribing greater weight to public values, whether expressed as affirmative benefits or prevention of harm, and consequently, imparting lesser weight to the rights of private owners."[6]

A similar type of balancing act has been tested in the courts for zoning. Over a number of years, case law has been established in a manner which supports the use of zoning to protect the public interest. This is not recorded on deeds, however. The similarity with the Restriction Act is that neither government nor another individual gain control and use of private property. The landowner still owns the property; but, certain standards must be met and a conforming use must be exercised. The courts, in general, feel the Fifth Amendment which states in part: "... nor shall private property be taken for public use, without just compensation" has been upheld.

Because there is very little case law to either support or reject the Restrictions Act, there is little guidance as to what limitations exist. A defensible tool must be utilized to demonstrate that the state is protecting needs of the public and not violating the individuals' rights. This tool consists of a rational, systematic and procedurally sound approach to evaluating wetlands, notifying the owner and presenting enough information to the owner for him to understand how he (or she) is affected. Certified mail, mapping by the best available means as constrained by money, time and expertise, and providing on-site inspection services to answer individual questions on the landowner's property, basically protects the rights of the landowners. The approach to evaluating wetlands is the subject of discussion that follows.

Application of Science

Use of the term "wetland evaluation" generally implies that quantitative standards, statistical values and a system of ranking or rating those values are accountable by natural scientists. Interrelationships between the physical, chemical and biological components of wetlands are often better understood through scientific research in the fields of coastal geomorphology, marine biology and oceanography, for example. Scientific knowledge is important as a basis for understanding the general functions of wetlands, but it must be translated in a form which is understood and accepted by the general public. The state of the art in relating wetland value to statutory interest lacks quantitative standards and numerical rating systems. This may reflect a number of limiting factors ranging from the fact that wetland functions are dynamically complex to, perhaps, a general deficiency in basic and applied research. Whatever the reason, those working in the field of applied science and public administration responsible for defending evaluation methods in the courts "should not feel ashamed of being caught with their pants down because there are no pants to wear," as Joseph Larsen of the University of Massachusetts states. As a final note, decisions concerning alterations of wetlands should concur with a general policy and not be made on the basis of an elaborate rating scheme that is, in fact, built on a very shaky intellectual foundation.[7]

For purposes of the current coastal wetlands restriction program, legal recommendations for defending a rational, systematic and procedurally sound approach to evaluating wetlands are paramount. To this end, a system of identification, verification and documentation is being implemented. In short, a physical and biological characterization is used to determine the primary function of the wetland. Then, it must be demonstrated that the wetland function and the interests of the Act are directly protected. For beaches and dunes, the primary functions are storm damage prevention and flood control. The critical characteristics used in recognizing these functions include form, volume and ability to erode. And, the protected statutory interests are public safety, health and welfare. A publication primarily used for understanding the Wetland Protection Act enumerates these values, functions and characteristics.[8]

CHARACTERIZATION OF BEACH AND DUNE RESOURCES

Use of Existing Information

The approach used to identify beaches and dunes for restriction parallels the methodology of that used by the Corps of Engineers for identifying "Coastal High Hazard Zones" in the southeastern and Gulf states.[9] Of three approaches used,the final one is closely followed because of the emphasis placed on exercising judgment. Although application of detailed engineering techniques would achieve the desired results, reliance upon historical information and judgment would achieve substantially the same results and would likely be more acceptable to the general public. The types of information used in this approach are listed below.

a. Historical information: With the use of detailed engineering reports, newspapers, photographs and information provided by local residents, a knowledge of past storms and associated wave damage is acquired. For those coastal areas which lack a great deal of information, records from a comparable area can be used. Two areas having similar physical features, geomorphology, wave approach and basin characteristics provide a case for an equitable application of data. Large differences between two areas make the use of comparable records more difficult. Also, data relating to the erosional and depositional history of specific areas are important for determing long-term shoreline changes not directly related to storms.

b. Storms of record: Since beaches and dunes receive the brunt of impact from storms, it is necessary to identify some acceptable storm surge threshold used in evaluating their function. The most familiar and frequently used record storm is the 100-year storm. Flood elevations established by the Federal Emergency Management Agency (FEMA) and the Federal Insurance Administration (FIA) are used as guidelines.

c. Types of structures: Historical data from developed areas provide a knowledge of the distances from shore in which wooden, concrete and steel framed structures have been destroyed. In turn, a better understanding of the necessity for a buffer zone is acquired. The larger area of dune and beach area that is available for storm damage prevention, the greater the restriction area will be.

d. Sand dunes: Although sometimes very substantial in height and width, the resources have often been swept away in one storm. The effectiveness of a dune as a surge and wave barrier is virtually impossible to quantify, and therefore, no specific criteria is used.

e. Limited field work: Once the existence of available data and information pertaining to the physical and biological characteristics of beach and dunes resources has been determined, the data gaps can be identified. In addition to visual observations that can be made in the field, quantitative data can be collected using a simple profile method. The physical and biological characterization from use of profile data is discussed in detail later in this section.

f. Historical storm accounts: Since both hurricanes and northeasterly storms have impact on the Massachusetts coast, detailed accounts of the wind speed and duration, storm path and speed and other variables associated with a particular storm are important for the purpose of compiling an inventory and determining average storm characteristics on a regional scale. Any information about past storms which can be summarized and applied to other areas is useful.

g. Results of studies: The maximum use of historical data and information will enable better the determination of the location of a restriction zone. The boundary line will be placed on orthophoto base maps at a scale of 1:5000.

Documentation and filing of the existing information is important from a legal standpoint and is an administrative priority. Any information which applies to the entire shoreline of a town is kept in a general file; however, oftentimes information may apply to certain sections of shoreline. Therefore, a town is subdivided into systems. For use as a planning tool, these are selected on an arbitrary basis with the use of the orthophotos by determining easily recognizable areas bounded by permanent features such as roads, bodies of water and different shoreline orientations. They are not identified on the basis of distinct environmental processes or other scientific means.

Following the process of gathering existing information and data, reviewing the orthophoto maps and selecting systems within a town, ground truth verification and limited field work are conducted. The verification process consists of 1) checking the accuracy of the wetland type and boundary location as delineated from aerial photos by a photogrammetrist and 2) completing a "Verification and Documentation Form" in which resource characteristics, boundary descriptions and statutory values are recorded. It is the limited field work, however, which expands on the opportunity to collect resource data from beaches and dunes used to meet both present and future needs.

Limited Field Work

For the purposes of characterizing the physical features of beaches and dunes, establishing a data base and providing for a means of future monitoring, a modified Emery[10] profile method has been employed in the Massachusetts Coastal Wetland Restriction Program. Essentially, changes in elevation are recorded along a limited horizontal distance which, when plotted, represent a cross-sectional view of the landform. From these data, quantitative information including dune widths and heights, beach widths and slopes, and barrier beach configuration can be computed. Approximate dune, beach and/or barrier beach volumes can be determined with use of profile data from adjacent locations. This information does not complete a physical characterization, however. Qualitative observations are also invaluable. Notes pertaining to sediment type and distribution, geomorphology, tide levels, and proximity to coastal engineering structures are recorded along the profile. As far as a biological characterization is concerned, only qualitative observations with regard to major vegetative types, density and distribution are presently recorded.

These are types of data which can be acquired quickly, accurately and systematically for the purpose of verifying and documenting that certain resources on the ground are what they appear to be from the air, as delineated on the orthophotos. Although this quantitative data has short-term or immediate use for the purposes of characterizing resources, it remains in a form useful in the long-term sense as baseline data.

Long-Term Objective

Reoccupation of the profile sites and continued data collection enable the addition of comparative data sets. Not only will a comparison of profiles over time dramatize the dynamic character of beaches and dunes, but it provides data useful for computing erosional and depositional trends along stretches of shoreline. As these changes are evaluated, a better understanding of the hazards in specific areas is gained. With the extended collection of data and a better understanding of wetland function in specific areas, perhaps more quantitative criteria and standards can be formulated. It would then shift the emphasis in wetland evaluation from being legally procedural to technically substantive.

More site specific research and data collection is required if science is to play a more substantive role in management and protection of wetlands. If quantitative criteria are to be formulated, a better understanding of coastal dynamics is necessary - this means more research. If the criteria are established, it must be determined that they are satisfied - this means more research. More research will not solve the conflict between the short amount of time required to make a decision and the long amount of time required to understand the resource. This frustrates both the manager and the scientist, however, additional research would be beneficial.

CONCLUSION

Massachusetts continues to implement a Coastal Wetlands Restriction Act. Many changes in the procedures, policies, staff and administration have occured and will continue to do so. Although most changes have occurred in response to a change in government leaders, other changes can be related to progress made in the state of the art for wetland mapping and evaluation techniques. The latter of which is instrumental for enduring court challenges.

A legally defensible and scientifically sound approach to wetland evaluation is currently implemented. It consists of 1) identifying the wetland location with the use of delineated orthophoto base maps, 2) verifying the fact that the mapped wetland exists on the ground (by noting its physical and biological characteristics) and 3) documenting the information needed to demonstrate that the wetland function is directly related to one or more of the statutory interests. Collection of resource data by a simple profiling method not only addresses the immediate need of wetland evaluation, it also provides baseline information. An objective of the restriction program is to defend the means by which a scientific judgement is made, and at the same time, consider the development of more quantitative criteria to be used in the future.

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PART IV

POSTER SESSION

INSTITUTIONAL ISSUES IN STATE ENVIRONMENTAL AND WATER RESOURCES MANAGEMENT IN THE MASSACHUSETTS COASTAL ZONE

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ABSTRACT

Rapidly urbanizing coastal states have unique environmental problems associated with water resources management. Severe pressures on limited water resources, for urban and industrial demands are one problem. Potential damage of coastal flooding of urban expansion is another. Despite an escalating potential crisis, institutional capacity of the states, despite recent improvement, is severely dificient to copy with problems. State suthority to manage is handicapped by constitutional-statutory rigidity and lags in program reform. State management is further weakened by fragmented and conflicting Federal policies, agencies, rules and standards on one hand and on the other, by local pressures for "home rule" and control over land and water decisions. While improvements have been made in both federal and state programs to encourage planning, environmental analysis and support actions, to date, few efforts have aimed directly at the creation of contemporary management institutions to enable states to mediate serious problems.

This paper assesses problems of institutional development in water resources management by looking at current issues and potential for solution in Massachusetts, with a particular focus on the issue of urbanization on Cape Cod. The paper first looks at the problem setting of Cape Cod and coastal Massachusetts, then looks at the current state water resources and management institutionsl framework. Institutional and program options are then evaluated, addressed to improvement of state capacity to resolve coastal water resources problems in rapidly urbanizing zones.

INNOVATION IN PLANNING WATER RESOURCES IN COASTAL STATES

A quiet but deepening conflict is emerging in water supply issues in the east. In coastal states, in particular, both quantitative and qualitative urban water problems have intensified as older systems have deteriorated and serious water shortages have increased. Federal water policy changes are also exerting pressure to increase local payments for projects long subsidized at the federal level. In response to these complex pressures, eastern states are beginning to develop water supply strategies.

We looked at state water resources agencies to assess how states were responding to new pressures, and for trends in innovation in planning and policy. Evidence suggests that state water policy and planning is still in a developing state. Moreover, there is a need for basic institutional reform and for new programs to carry out policies. There may also be need for Federal policy and program change to provide better incentives for state reform and to coordinate goals carried out separately in NOAA, state programs administered by the Water Resources Council, HUD and EPA, affecting rapidly urbanizing coastal zones.

This assessment of innovation in state water resources planning is divided into three parts. The first reviews evidence on coastal state innovation and draws from a survey undertaken recently on a state water resources planning.* A second part looks at problems at innovation efforts at the community level, drawing on a recent survey of Massachusetts coastal communities. A third part looks briefly at potential for incentives in Federal program.

PROBLEMS AND ISSUES IN STATE WATER PLANNING

Economists and planners have long agreed that water resources decisions are heavily influenced by (1) the collective nature and properties of water itself as a commodity; (2) the problem of visibility and different values places for different uses under different conditions of scarcity. As Helen Ingram recently points out, water is considered "a birthright" by most people and expectations are at will be made available, at no cost and in unlimited quantity (Ingram: 1977). While

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*The survey was undertaken by the author at the University of Maryland and was supported in part by the University. Surveys of Massachusetts municipalities also included here were drawn from studies undertaken by Elizabeth Klein, et.al. as part of the Water Conservation Project, Massachusetts Conservation Service Corporation, Lincoln Filene Center, Tufts University, Medford, MA.

the need for municipal subsidies of water is now long past,[1] the public still expects its supply as a free good and rarely considers its values except in outbreaks of crisis or emergencies. This creates public perception of the problem as dichotomized between (1) the visible collective crisis; and (2) the invisible individual "right." In public policy, a "flood-drought" syndrome is created where public action and policy ebb and flow with crisis.[2] Where there is no crisis, there is little need for policy; the main issues are limited to occasional property rights mediation and quarterly water bills for the average householder.

There is, however, a formally institutionalized water resources politics at the state level which is highly influential in innovation. Three components include: (1) organized special interests and other benefit publics; (2) institutional structure, including technical, administrative staff, budget, program organization and legislative committee; and (3) unwritten roles and rules which distribute power and influence and allocate benefits between a fragmented public jurisdictional structure and private interests.

Organized interests, as Helen Ingram points out, are highly specialized and focus on narrow goals. The institutional structure--legislative, executive and administrative at both state and local levels--have evolved a complex informal decision process, designed to mediate inevitable conflicts which arise in water matters. The process, however, converts most decisions to technical, hardware or capital terms, which acts to narrow the participants to a specialized club, limit debate and exclude the uninitiated. Some results are an over-representation of commercial interests. Commercial needs, for example are usually included into planning municipal water supply expansion and pricing systems may not reflect equity in policies. Rate setting may also reflect the requirements of special larger users; rate structures are frequently tolerated which openly encourage waste as with declining block rates, or ignore sloppy municipal metering practices. States may and frequently do fail to provide an overall water consumption or use standard to local districts or other assistance to encourage efficiency in local water planning, pricing, and use.

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[1]The subsidy was considered legitimate early in the 20th century when public monopolies sought to encourage consumption of pure, standard water for community health and safety considerations. Underpricing currently, however, has no justification on either equity or efficiency grounds.

[2]Floods and droughts represent extreme and catastrophic events. Public perceptions of impacts are erratic; high during the event, dropping sharply after the crisis is past. Such crises, rarely becomes institutionalized in reform. See: Maurice D. Van Arsdol, Jr., Georges Sebaugh and Francesca Alexander, "Reality and the Perception of Environmental Hazards," Journal of Health and Human Behavior, Vol. 1 (1964) pp. 144-153.

Finally, the nature of decision making processes in state water resources, including public participation, lacks interaction of broad interests considered crucial to feedback and democratic representation and perhaps innovation itself. Water resources decision processes typically reflect domination of the specialists in narrowly structured forums, with rigid agendas and limited mechanisms for advertisement and participation by the public. Commission meetings for example, are typica-ly dominated by discussions of capital projects, by detailed but obscure technical expositions of aims goals and implementation questions associated with projects, and an insiders ritual of questions and answers, supporting the contention of existence of a "tyranny of expertise" (Ingram: 1977)[3]. Not surprisingly, few members of the public, including organized consumer groups, participate in water resources decision making in the states.[4]

STATE WATER RESOURCES: ISSUES

Three problems face eastern coastal states in water supply areas:

1. physical-hydrological questions
2. urbanization patterns influencing demand
3. institutional problems, particularly fragmentation

Proglems with supply flow directly from the widely recognized unique, complex and volatile physical and hydrological characteristics of coastal areas. Water supplied for municipal purposes is severely limited in quantity. Surface water in the form of year round streams and impoundments is rare and ground water, while plentiful in the East, is characteristically found close to the surface and is vulnerable to contamination from urban activities and recharge interference from urban use. Sea water intrusion is also a potential problem. Finally, alteration of much of the land-water systems through draining of wetlands, channelization of stream courses, up-stream diversions, manipulation of littoral coast systems, etc., may also have negative consequences in limiting water supply.

Demand, measured in terms of urbanization rates, has increased rapidly recently in coastal areas, if differently. In some cases, coastal growth is outstripping state population and economic growth rates. Underlying these trends are:

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[3]In Massachusetts, for example, examination of the water resources commission meetings held during one year revealed that exactly three structural flood control projects dominated agenda presentations by staff. Attendance by the general public rarely exceeded a handfull.

[4](Exceptions are the League of Women Voters which has been active nationally and through state chapters in water resources matters and faithfully followed state public meetings on policy and projects).

1. redistribution of urban populations to coastal zones, accelerated land development rates, construction rates, particularly for year-round housing.

2. growth in tourism and short term visitation rates

3. Growth in industrial activities of a regional nature, including utilities, port and shipping, energy processing facilities, food processing, etc.

Coastal urbanization as a general trend in the U.S. which includes a redistribution of population towards coastal settlement areas despite overall leveling of growth. Residential shifts have included retirement households, households in search of "life style" advantages and suburban commuters seeking advantages of amenities in coastal zones.

Most of the Northeasters states have experienced growth in coastal suburbs. Where transit or commuter rail systems connect to existing job centers (N.J., Conn., Mass., N.Y.) or where industry is attracted to coastal locations (Conn., Va. Beach-Norfolk), the trend could be expected to continue.

Populations shifts have been accompanied by growth in water use exceeding population growth as well as possible loss of in basin supplies. Households are more affluent, buy larger housing units with more consuming facilities (bathrooms, appliances, swimming pools, lawns, etc.) which results in higher water consumption. Losses in water tables can occur with (1) conflict with recharge areas; (2) loss of recharge through waste water treatment facilities.[5]

Non-residential activities--tourism, industrial and commercial expansions--are also taking place in coastal zones. As the Massachusetts case described below indicates, major conflicts between expanding year round population and seasonal demand, correspond to low flow periods causing emergency problems. Industrial expansion is even more serious as the Massachusetts case below indicates. Coastal locations are preferred by some very large water consumers, including electric power facilities, energy processing facilities, petro-chemicals, food processers and the like.

INSTITUTIONAL AND PROGRAM INNOVATION IN EASTERN COASTAL STATES

In an effort to test recent changes in water resources planning and innovation, a survey was conducted of nine northeast coastal states to assess state policy and programs. Two types of questions were asked,

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[5]In some Cape Cod Communities, estimates are that water tables may lose as much as 20% recharge through installation of upgraded sewage treatment systems.

one related to the framework which addressed changes in law and executive reorganization, resources devoted to water resources and a second set which looked at innovation in planning and programs.

The overall framework, including statutory and constitutional changes have tended to be altered less frequently than administrative structures. State survey results indicate that innovation in the form of executive reorganization has been rapid and universal among states. Most executive reorganizations moreover have addressed environmental resources conservation and pollution control fairly comprehensively. Internal changes directly affecting water resources programs have included: centralizing authority in the executive branch; designating single administrative units and officers responsible for programs; reducing powers of independent boards and commissions; consolidating scattered programs in single agencies; creating special water policy and planning units and providing higher funding levels of technical analysis, inventories, framework planning and technical assistance to localities.

Of the ten coastal states surveyed, all but two underwent environmental reorganization during the recent past. Of those which were reorganized, all involved creation of cabinet level officers reporting directly to the governor and all reported increased authority over water resources programs. In each case, authority of independent boards was drastically reduced, or curtailed altogether.

A second type of reform model included in the survey has been the integration of water resources into pollution abatement agencies. The assumption is that in the long run the two issues must be integrated although there is some concern that the constituents, framework and politics of one are more backward (or less progressive) that the other.[6]

Finally, a number of states have retained older, unreformed independent boards and commissions. These tend to continue to be dominated by special interests and are stratified to include intricate distribution of technical, regional, industry and public agency representation.

Resources and efforts were assessed in 10 different categories of water resources, non-capital outlay, ranging from planning to withdrawal permits. On a per capita basis, the largest overall efforts were made by the more rural states (North Carolina, Maryland, Virginia) while the more urbanized states spent less (Connecticut, Massachusetts and Rhode Island). As Table 1 indicates, this may reflect the likelihood that less state planning is taking place where urban water districts dominate water supply issues, but it also suggests

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[6] Elizabeth H. Haskell and Victoria S. Price, State Environmental Management, Praeger, NY, 1973, the authors are pessimistic about the executive reorganizations influencing water resources and fear that such traditional conservation agencies will tend to "undermine" reform achievements of pollution abatement programs in the same policy units.

that very little statewide resource activities are taking place.

PLANNING AND PROGRAM INNOVATION IN COASTAL STATES

Radical changes in the form of shifts in appropriate planning and administration has not taken place as yet in coastal states. Innovation is taking place in several ways, however:

1. comprehensive programs; integration of land and water planning and management programs into single comprehensive planning programs.

2. development of technical assistance for support of local innovation such as conservation of municipal supply, recycling, etc.

3. research and development to increase safe yields from existing sources

4. increase special districting of critical areas; use of permit programs to manage withdrawals.

Comprehensive planning programs have been initiated in several coastal states. Most aim to integrate land and water conservation planning analysis and decisions and to simplify implementation of such programs as flood protection, food plains management, wildlife protection, recreation programming and new water supply management reservoir site awuisition, etc. An additional aim is to create efficiencies in water administration, eliminate duplication of effort, facilitate communication of similar goals, avoid conflicts, etc.

Technical assistance to localities is receiving increased attention as conservation and demand reduction is seen as an alternative to costly and politically difficult new water supply development to meet future needs. While no state has developed policies as comprehensive as some western states, the increase in incentives for self-held at the local level is visible in states such as Massachusetts, New Jersey and New York. Rather, there is increasing interest in direct state actions such as education, modification of building codes, recycling requirements, and such programs as statewide pricing, and regulatory standard setting. States are also looking at the new problem of local bond issue water utility financing as another means to assert state conservation standards.

The most radical innovation in appropriation administration is underway in the form of special districting in a few states. North Carolina and Virginia have instituted special districting for ground water management areas subject to potential large scale intrusion, other contamination or conflict over rights between small and large interests. In Virginia, two coastal districts have been designated in Southeastern and Eastern Shore areas, where problems have included overpumping, aquifer compaction, surface subsidence, and salt-water instrusion.[7] Under the program, all industrial and commercial users wishing to withdraw more than 50,000 GPD must apply for a permit from the state water control board. The board in turn utilizes the permit system to calculate overall rates of withdrawal, seasonal changes and water table changes to permit safe withdrawals.

PLANNING AND INNOVATION IN MASSACHUSETTS COASTAL COMMUNITIES: A CASE

Coastal communities in Massachusetts, reflect the typical problem of supply limits, limited resources in ground water and rapid shifts in urban populations and accelerated consumption rates.

Massachusetts water problems reflect its past and recent history. One of the most urbanized coastlines in the U.S., 40% of the states' populations currently lives in 97 communities constituting the coastal land mass and about 50% of current development occurs in the same zone. Growth in the coastal communities has increased at a faster rate than in the state as a while. In older communities (Boston, New Bedford), losses are balanced by gains indicating a redistribution of populations to growth areas such as Plymouth county, Ipswich and Cape Cod. In addition, industry also favors coastal locations. Included are port/energy supplies. (3/4 of the energy supplies enter through Mass. coastal ports and electric generating power facilities; 80% are located on the coast, as is the build of food processing and petro-chemicals facilities. Finally, the 1 billion dollar tourism and commercial fishing industries are highly dependent on coastal locations.)[8]

A community sample was undertaken recently to assess voluntary potential for voluntary innovation in water resources in Massachusetts.[9]

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[7] see: --Statutes, Regulations, Policies, State Water Control Board, Commonwealth of Virginia, Richmond, 1978 and Progress Report for Fiscal Years 1977 and 1978.

[8] Massachusetts Coastal Zone Management Review, Executive Office of Environmental Affairs, Office of Coastal Zone Management.

[9] Klein, Elizabeth, et.al, op.cit.

The survey indicated that water problems were compounded by urbanization patterns, physical limits and lack of interjurisdictional cooperation. Growth patterns are divided between high growth communities (exceeding statewide rates) and low growth communities. This is only part of the picture, however, water use tends to exceed population growth where affluent communities are experiencing expansion and larger housing units, more luxuries, appliances, pools, etc. Other older "declining" communities, however, may also experience increases in water consumption if steps are not taken toward conservation; communities such as Gloucester and New Bedford expect population decline but growth in high water consuming industries such as fish processing.

Supply issues are much more critical than one would expect. Resources are extremely limited in the communities surveyed, owing to the (1) high dependency on ground water (63% of the communities); (2) loss in existing water supply through contamination or up-stream diversions. Many communities were instituting measures to increase yield. 18% are now using wells once abandoned and 16% use wells once considered "not economically feasible." Much of the problems of water include contamination from new sources such as road salt, toxic chemicals and oil. This is in contrast to the traditional contaminants of sea water and leachate from dumps. Examples of new contamination cases include Provincetown where town wells have been shift down when contamination by underground oil storage and road salt. Another case that of excessive upstream diversions, is represented by the Northshore coastal community of Imswich. Excessive surface drawdowns during low flow periods have resulted in high concentrations of salts and minerals in the Ipswich river resulting in loss of this wource to downstream Ipswich.[10]

INSTITUTIONAL QUESTIONS: JURISDICTIONAL FRAGMENTATION IN MUNICIPAL WATER SUPPLY

Two types of arrangements characterize Massachusetts coastal communities which are typical of other states (1) old; (2) new. The older systems are large regional districts, developed from an almost total appropriation of stream sources. Boston and Fa-l River are typical. Over the years municipal districts have expanded to become regional suppliers with limits on capacity reached, however few new urbanizing areas can be accomodated in these systems. The newer systems are communities which rely almost exclusively on in basin resources. Common well fields in coastal zones are common but there are few shared arrangements between communities, even where one area is sparsely populated and its neighbors heavily populated. The state has been reluctant to intervene directly and efforts to interest localities in voluntary districting have all met with failure.[11]

[10] Klein, E. et.al. op.cit.

[11] Between 1974 to 1976, a number of studies were undertaken to assess regional districting on the Northshore. Ipswich, an affluent rural community, however, turned down plans for a regional reservoir.

In the absence of mandates for interjurisdictional cooperation in water supply allocation, there has been a small effort to encourage localities to institute conservation and demand-reduction in water use. Part of the impetus emerged with reports of waste in larger systems. The coastal community survey attempted to test the interest and willingness of communities to institute conservation methods as a substitute for new water supply development.

INNOVATION IN WATER SUPPLY AT THE LOCAL LEVEL

Massachusetts communities surveyed illustrate one of the major delemmas in water supply planning. While there are major supply problems in all of the 15 communities surveyed and severe problems in 3/4 of the coastal communities, the current innovation record is not optimistic. Measuring innovation in terms of use of one or more of techniques such as pricing, rate setting, metering and other conservation and protective activities, few communities participated. Only a little over 1/4 used graduated rate structures to encourage conservation and nearly 1/2 have flat rate systems. Many of the remaining 18% moreover, were suspected of having a decreasing rate system, constituting a disincentive to conservation. Metering was more widely practiced (85% had meters) and thus cost recovery is possible.

Innovation techniques are currently being encouraged in special demonstrations in Massachusetts as part of a strong effort to reduce future demand. Both hardware and behavior changes are being considered. Equipment, tools, hardware innovation are being emphasized. Although recycling and reuse are beginning to be talked about. Behavior changes, the more difficult but by far the most effective conservation measure, takes a wide range from total bans on water use, time of day restrictions, out of door restrictions appropriate mainly for emergencies, to conservation remedies are viewed with enthusiasm by some, in the long run, institutional change at the state level will probably be required.

CONCLUSION: FEDERAL POLICY INCENTIVES OF COASTAL STATE WATER RESOURCES INNOVATION

Evidence here suggests there is an increasing recognition of need for planning water resources at the state level in the urbanizing coastal north east. A principle handicap in planning is lack of a coordinating mechanism to consider the complex competition for water in a limited system. The creation of institutional mechanisms which regionalize problems and solutions might be facilitated by such a planning/coordinating mechanism at the state level. One possible base might be the current federal grants in aid for planning and coordination, which separately touch urbanization, coastal resources conservation, land and water protection and public water supply. Requiring that each grantor review planning programs to assure that water resources issues are not overlooked would be an initial step. A second step would be a strong new incentive for assessment of coastal resources, as part of joint program requirements.

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Table 1:

Selected Eastern State Water Resources Expenditures

State	Exp./Bud. (000's dollars):		Staff:	
	Total	Planning	Total	Planning
Delaware	200.0	N.A.	N.A.	0.5
N.C.	850.0	200.0	51	12
Conn.	220.0	40.0	10	2
Maryland	750.0	50.0	32	2
Penn.	890.0	250.0	75	12
Va.	551.5	125.0	N.A.	4
N.Y.	1,045.0	60.0	15	2
MA.	750.0	125.0	30	2

Source: Woody, Bette, "National Survey of State Water Resources Expenditure", University of Maryland, 1979

Table 2

<u>Composition of State Water Administration</u>

	Del.	N.C.	R.I.	Conn.	Md.	Penn.	Va.	N.Y.	Mass.
1) Planning/future supplies	x	x	x	x	x	x	x	x	x
2) Supply inventories, hydrological surveys, etc.	x	x	x	x	x	x	x	x	x
3) Flood abatement planning		*	x	x	x	x	x	x	x
4) Flood control projects planning engineering, contracting (structural)		*		x		x		x	x
5) Ground water drilling permits	x	x	x	/	x		x	x (Long Island Only)	
6) Diversion permits	x	**		x	x	x	x	x	
7) Municipal supply planning, review			x	x	x	x	x	x	
8) Administration/adjudication water rights	x	**		//				x (Public Water Supply) Only	
9) Appropriation administration	x	**		x	x				

*Legislation but no resources

**Only in designated capacity use areas

/ State Well Drilling Board

// State Court System

Table 3: Rates of Change in Population and Water Use 1979-1990

Community	% Change Population	Water Use
Ipswich	20.03	n.a.
Salisbury	108.21	n.a.
Gloucester	4.44	n.a.
+Cohassett	30.00	77.12
Lynn	(3.33)	n.a.
+Reading	21.16	14.29
+Boston	(1.91)	6.90
+Stroughton	31.24	74.52
Bedford	30.79	n.a.
+Fall River	(11.60)	(29.56)
+Taunton	4.39	5.80
+Provincetown	25.15	291.47
New Bedford	(8.72)	n.a.

Source: Klein, Elizabeth, et. al. Water Conservation Project, Massachusetts Conservation Service Corporation, Lincoln Filene Center, Tufts University, Medford, MA, for Executive Office of Environmental Affairs, Commonwealth of MA, February, 1979.

MASSACHUSETTS COASTAL COMMUNITIES--WATER SUPPLY ISSUES

Community:	Population: 1978	1990	Avg. Consump. (Mgd) 1978	P/ Consump.	1990	P/ Consump.	Source	Problems[1/] (code)
1. Ipswich	11,800	14,200	n.a.		1,838		wells, diversion	A,B,C,
2. Salisbury	4,179 +15,000[2/]	8,701	n.a.		.77		wells	
3. Gloucester	28,250	29,500	n.a.		4.34		wells, diversion	
4. Cohasset	7,500	9,750	0.66	.88	1,169	1.20	ponds, wells	
5. Lynn	90,000	89,700	n.a.	n.a.	15.8	1.76	4 ponds, 2 diversions	
6. Reading	24,250	29,500	3.26	1.34	3.726	1.26	wells[3/]	
7. Boston	628,000	616,000	143.4	2.28	153.3	2.49	diversion	
8. Stoughton	25,717	33,750	2.17	84.4	3.787	1.12	wells	
9. Bedford	15,100	19,750	n.a.	n.a.	3.042		wells[3/]	
10. Fall River	100,339	88,700	16.66	1.66	11.735	1.32	ponds	
11. Taunton	42,148	44,000	6.5	1.59	6.877	1.56	4 ponds; Tau'n River; wells	
12. Provincetown	18,432	23,060	0.75 +1.50[2/]		2.936		wells[3/]	
13. New Bedford	100,345	91,600	n.a.		19.08		3 ponds	

1. Code: A= overpumping of aquifer; seasonal shortage, withdrawals exceeding safe yields; B= pollution; sea intrusion, road salt, high soliform count, other toxic materials exceeding safe levels; C= upstream diversions/adjacent community drawdowns reduce local supply below safe yields; D= old didstribution system, leakage; E= land use threats to recharge areas.
2. Summer tourism increases
3. Community wells closed; emergency supply from neighboring communities

Source: Compiled from Klein, Elizabeth, "Water Conservation Project: First Report," Massachusetts Conservation Service Corporation, Lincoln Filene Center, Tufts University, Medford, MA, January 1979

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ILLUSTRATED OVERVIEW OF COASTAL ENVIRONMENTAL ISSUES

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NO ABSTRACT SUBMITTED

THE IMPACTS OF A PROPOSED WATER DIVERSION ON THE ANADROMOUS FISHERIES OF A COASTAL RIVER

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ABSTRACT

The Jones River in Kingston, Massachusetts, is the site of a proposed diversion of peak springtime flows to supplement the City of Brockton's water system. This small coastal river is also utilized by two common anadromous fish, alewives (*Alosa pseudoharengus*) and rainbow smelt (*Osmerus mordax*). Various life stages of these species could be affected by the proposed diversion.

Sufficient river flow is needed to ensure that migrating adult alewives are able to ascend a fish ladder to reach spawning ponds farther upriver. Alteration of river flow may also affect rainbow smelt which spawn in the river channel immediately below the proposed diversion site. Impacts on spawning behavior as well as egg and larval survival of this fish may result from increased levels of predation, dissication or suffocation.

The physical carrying capacity of the rainbow smelt spawning area can be defined in terms of river depth, velocity, substrate and temperature. These flow assessment data allow prediction of the loss or alteration of both optimal and marginal spawning and nursery habitat under various diversion schemes.

Rhode Island Coastal Community Land Use Review: A Study of Resources Allocation in the Coastal Community

by Richard J. Amato and Lee R. Whitaker[1]

ABSTRACT

This project is based on the findings of the federally approved State of Rhode Island Coastal Resources Management Program which identified five broad categories of inconsistensies between local community zoning and state coastal resources policies, plans, and regulations. The initial conclusions of this research, based on the examination of the local regulations and the state permitting process, is that the local land use regulations are the prime determinants of permissibility and priorities of use of the state's coastal resources; that the state's coastal management laws and regulatory functions focus more intensely on the permissibility issue than on the priorities of use of the resource *in toto*; and that the end result of coastal resources management in Rhode Island is a predominately site by site impact mitigation process, rather than a comprehensive management approach utilizing clearly defined benchmarks to implement its legislative charge "to preserve, protect, develop, and where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long-range planning and management designed to produce the maximum benefit for society from such coastal resources..."

PART I: SUMMARY OF PAST STATE ACTIVITY IN THE SHORE REGION[2]

A. EARLY EFFORTS

The Rhode Island Shore, A Regional Guide Plan Study 1955-1970, published by the Rhode Island Development Council in March, 1956, was the first significant study of the state's shore region. The study, prompted by the damage caused by Hurricane Carol in 1954, initially was an effort to determine the measures necessary to minimize damage from

1) Richard J. Amato is a Planning Technician for the Rhode Island Statewide Planning Program and Lee R. Whitaker is a Senior Planner for the Rhode Island Department of Environmental Management.

future storms. This study was enlarged with the aid of matching state and federal funds provided under Section 701 of the Housing Act of 1954. The report recognized the need for a comprehensive master plan for planning, development and regulatory controls concerning the Rhode Island shore region, and recommended the coordination of state, local and federal agencies and private interest groups' efforts to achieve such a plan.

Also, "The Shore Development Act of 1956" was enacted by the General Assembly as a declaration of state policy to protect and promote the health, safety and welfare of the people. The Act declared it to be the intention of the state to assist municipalities in arresting, protecting, and preserving beach areas from erosion and damage by the elements. The Division of Harbors and Rivers which is now the Division of Coastal Resources, in the Department of Environmental Management, was designated as the state agency responsible for this Act.

In January, 1969, the Natural Resources Group, a private citizen interest group, published the Report on Administration of Narragansett Bay. The group emphasized the historic importance of Narragansett Bay to the development of Rhode Island, and stressed its continuing role as the state's "greatest natural resource substantially supporting industrial, commercial, military, recreational and domestic activities". The study identified two distinct, but closely related problems concerning Narragansett Bay: (1) The lack of existing state or local government management policies and goals relative to the bay; and (2) the lack of information necessary to develop goals and policies. The report recommended that immediate action be taken to find the best methods for determining and formulating bay policies and the means of implementing and administering them.

B. GOVERNOR'S TECHNICAL COMMITTEE ON THE COASTAL ZONE

As a result of the Natural Resources Group's effort, and the growing awareness of Rhode Islanders to the proven historical need of a comprehensive coastal resources management program, the Governor appointed a technical committee in March, 1969, as the first step toward drafting future management policies for Narragansett Bay and the entire coastal region. The initial report of the Technical Committee to the Governor was presented in March, 1970. It recommended:

(1) That the state of Rhode Island make a declaration regarding the importance of its Coastal zone and the intention of the state to provide for the proper planning and management of this resource;

(2) that the management mechanism be a Coastal Zone Council created by the General Assembly;

(3) that the University of Rhode Island be designated as the State's Coastal Zone Laboratory, with primary research responsibilities;

(4) that the Coastal Zone Council immediately begin to prepare a comprehensive plan for the coastal zone;

(5) that the Council identify and, if necessary, initiate the actions needed to clarify the state's legal jurisdiction in the coastal zone;

(6) that the Council review statutes relating to the coastal zone and recommend necessary changes;

(7) that the Council review existing programs and projects relating to the coastal zone and make recommendations concerning their direction;

(8) that the Council develop and maintain an inventory of Coastal resources; and

(9) that the General Assembly amend Section 42-1-1 of the General Laws of 1956, as amended, regarding the state's seaward boundary, so as to extend the state's jurisdiction to the maximum extent possible under existing statutes, treaties, and conventions.

Legislation based on these recommendations was submitted to the 1970 session of the Rhode Island General Assembly, but was not reported out of committee and died upon adjournment of that session, because of the unresolved jurisdictional dispute concerning the "inland boundary of the coastal zone". On November 23, 1970, the Governor, by executive order number 19, reconstituted and expanded the Technical Committee and charged it to continue the study of the coastal region and to propose an acceptable, effective and equitable mechanism to insure its proper and orderly development and management.

C. THE COASTAL RESOURCES MANAGEMENT COUNCIL

The recommendation of the expanded committee resulted in a bill enacted in the 1971 session of the General Assembly. Chapter 46-23 of the General Laws established a management mechanism consisting of a Coastal Resources Management Council and staff. The Council is closely related to the former Department of Natural Resources, which is now the Department of Environmental Management. Its staff arm is the Division of Coastal Resources within that Department, formed by the reconstitution of the Division of Harbors and Rivers. The Council has seventeen ex-officio and appointed voting members: two state agency heads, four local government officials, seven public members, two members of the Rhode Island House of Representatives, and two members of the Rhode Island Senate.

The Council's primary responsibility is to direct the planning and management of the Rhode Island Coastal region. All plans and programs adopted by the Council to manage the state's coastal resources must be consistent with water quality standards set by the state Department of Environmental Management and with the State Guide Plan which is a series of functional plans for land use, transportation, water quality management, historic preservation, and others, prepared by the Statewide Planning Program. The Council's authority over water areas (from the mean high water mark to the State's seaward limit of jurisdiction) allows it to formulate policies and plans and to adopt regulations necessary to implement its resources management programs.

The Council has authority to approve, modify, set conditions for, or reject any development proposal for the coastal area, and the "burden of proof" falls on the developer. The 1971 legislation empowered the Council to "approve, modify, set conditions for, or reject the design, location, construction, alteration, and operation of specified activities or land uses when these are related to a water area under the agency's jurisdiction" and where "there is a reasonable probability of conflict with a plan or program for resources management or damage to the coastal environment". The six specified activities and uses are: (1) power generating and desalination plants; (2) chemical or petroleum processing, transfer, or storage; (3) minerals extraction; (4) shoreline protection facilities and physiographical features; (5) intertidal salt marshes, and (6) sewage treatment and disposal and solid waste disposal facilities. With the approval and adoption of the State of Rhode Island Coastal Resources Management Program (RICRMP) the Council's jurisdiction was more clearly defined to cover activities within 200 feet of coastal waters and coastal wetlands, and physiographical features were defined as beaches, barrier beaches, cliffs, bluffs and dunes. The Council also has certain operating powers formerly exercised by the Division of Harbors and Rivers, such as the permit system for construction and filling in public waters.

Enforcement methods of the Council are based on the concept that initial decisions relating to coastal resources should remain with the local government (or, in some cases, a state agency such as the Department of Environmental Management) which now makes the decision. The Council reviews initial affirmative decisions and then acts in accordance with its implementing authority, as described above. To enforce its decisions and regulation, the Council is empowered to issue orders to violators to cease and desist and to remedy the violation. Violators who do not conform to an order may be prosecuted in the district court; violation of an order is considered a misdemeanor. The Council may also obtain relief in equity or by prerogative writ in the superior court. The on ground enforcement of the Council's decisions is primarily the responsibility of the Department of Environmental Management, Division of Enforcement.

PART II: COASTAL COMMUNITY LAND USE

A. Preparation of Rhode Island's Coastal Management Program: Identification of Need

The coastal resources management mechanism for Rhode Island was created with an eye toward the evolving federal Coastal Zone Management Act (CZMA), and was in its first year of operation when the federal legislation was enacted in 1972. This placed the state in an advantageous position to receive CZMA section 305 planning funds, and in March, 1974, Rhode Island became one of the first recipients of the federal program. Over the course of the succeeding four years, Rhode Island was the beneficiary of $1.6 million dollars of section 305 monies and Outer Continental Shelf development impact planning funds to prepare the State of Rhode Island Coastal Management Program (RICRMP), to support administration, research, and documentation, and to prepare the Quonset Point/Davisville Reuse Plan, Environmental Impact Assessment, and socio economic analysis.

The federal Office of Coastal Zone Management approved the Rhode Island program in May, 1978, and awarded the state a $1 million dollar management grant which was matched by $250,000 in state funds. A second million dollar grant was awarded in September, 1979, raising the total federal investment in the state's coastal program to $3.6 million dollars matched by approximately $1 million dollars in state funds and in-kind services.

The state program is organized to reflect the major systems and development concerns in the coastal region. These are covered in six major chapters on 1) natural systems; 2) exploitable natural resources; 3) pollution; 4) culture and recreation; 5) coastal development; and 6) energy, and each establishes the general and specific tests an applicant must meet to obtain a Council assent.

During the preparation of the RICRMP by the University of Rhode Island's Coastal Resources Center, five categories of inconsistencies between state and local policies were identified in general terms:(3

1) Sensitive natural features (i.e., cliffs and bluffs, wetlands, streams) frequently are not recognized by local plans and ordinances;

2) Open space/conservation areas or agricultural lands are not designated by local zoning regulations;

3) Barrier beaches are zoned for residentail development;

4) Flood hazard zones are not given special protection;

and

5) Zoning maps do not recognize well established publicly/privately designated recreation or conservation areas.

The RICRMP conclusion that the major problem in the municipal zoning process is that local communities do not presently have adequate power to protect coastal features,(4 spawned the coastal community land use review to specifically pin point those areas in conflict on a community by community basis.(5

B. Organization and Methodology of the Study

The Chairman of the Coastal Resources Management Council nominated Portsmouth and South Kingstown as the first towns out of 21 coastal communities to be reviewed by the Statewide Planning Program because they are representatives of bay and oceanside communities with typical development problems. In response to the requests of the program managers of the two coastal energy impact program (CEIP) projects evaluating the community and regional impacts of the proposed 2300 MW Charlestown nuclear power plant, the study also placed initial priority on the Washington County Coastal Communities. After preparing preliminary analysis for 12 communities and final reports for two of these, plus an appendix proposing suggested methods of eliminating conflicts, the Statewide Planning Program abandoned the original intention of publishing separate community reports in favor of a single report because the findings became typically repetitious.

Beaches, salt marshes, state, local, and private open space/recreation/conservation areas, agricultural areas, and residential zones at the local level were identified and their zoning verified. The zoned use for the areas examined was then compared to the adopted coastal resource policy, the 208 Water Quality Management Program recommendations, the U. S. Department of Agriculture, Soil Conservation Service Soil Reports, and the National Flood Insurance Program Flood Hazard designations, to reveal the direct conflicts, inconsistencies, and the potential for conflict.

These comparisons are accompanied by additional data on each community's rate of growth, growth patterns, development constraints, overall soil conditions, septic system failures and alteration rates, flood hazard and sensitive natural area maps and photographic illustrations highlighting the issues. Four particular problems for the local communities which exist because enabling legislation is inadequate or nonexistent are: 1) residential zoning of fragile natural area; 2) lot sizes below the minimum set by the draft areawide waste treatment management (208) plan for areas without public water; 3) agricultural land zoned for residential use; and 4) areas subject to soil erosion and sedimentation which are not managed to minimize the problem.

1. Determination of permissibility and priority of use at the local level vs. state policies.

The RICRMP has established maintenance and enhancement as the priorities of use for conservation and management areas, historic preservation places, research areas, coastal wetlands, cliffs and bluffs, freshwater wetlands, and undeveloped beaches and barrier beaches.(6 In the examples studied, the towns clearly have established residential development as the permissible and the priority use for beaches, saltmarshes, open space, conservation and recreation areas, and agricultural land. This type of zoning may preclude the CRMC from evoking its policies and regulations on conservation and development because, unless the area is presently committed to conservation, fisheries or wildlife management purposes by covenant or deed, or the project is to occur on property contiguous to such a designated area, the CRMC conservation regulations do not apply.(7 The non applicability of the conservation regulations appears to hold in the instances where a town's comprehensive plan designates an area for conservation purposes, and the adopted land use element of the State Guide Plan designates an area for conservation and/or recreation use, but the town's zoning ordinance designates the area for residential use. This latter instance is particularly curious because the criteria for decision making by the CRMC include consistency with the State Guide Plan.(8

The local zoning designation has a similar effect on areas designated by the RICRMP for Preservation or Restoration (APR's). Not less than 25 percent of 152 CRMC assents issued between May 16, 1978, the date of section 306 approval, and September 30, 1979, the cut-off date for that phase of the analysis, have been for projects in APR's and while the four denials during the 306 period were also in APR's, they represent less than 3 percent of the total decisions and only 1.5 percent of all applications. A specific example of this relationship between assents and local zoning in APR's can best be illustrated on the Pettaquamscutt River Complex which is designated as a Coastal Natural Area for Protection by Coastal Resources Center Marine Technical Report No. 43.(9 That report stated that "due to the vulnerability of the river to contaminants and recent evidence of increasing coliform bacteria counts, no additional effluent pipes from any source should be permitted to discharge into the river."10

In 1976, another report on the river, "A Plan for the Narrow River Watershed", concluded that although "existing state programs safeguard valuable natural resources, they will not prevent the long term cummulative effects of development in the watershed".(11

Between 1975 and September 30, 1979, the CRMC has issued 14 assents for development along the Pettaquamscutt River.

Not less than nine since the watershed plan was released, and at least six since the area was designated an APR by the RICRMP and the state entered the 306 management phase. There are approximately nine outstanding applications which have received no action. At least five of the assents are for single family dwellings with individual sewage disposal systems, a reflection of local zoning, and five of the assents and one pending application are for storm drain outfalls, a result of increased residential development of the watershed with direct impact on the water quality. In 1979, shellfishing was banned in the Pettaquamscutt River by the Department of Environmental Management because of dangerously high coliform levels in the water, and the river remains out of compliance with state standards.

2. Measurement of Coastal Development through the CRMC Permitting Process

An analysis of the applications and assents was performed to determine the types and frequency of activities occurring in the coastal region by coastal water body and by community. Compilations were prepared for two time frames: from January 1, 1975 to September 30, 1979, and from May 16, 1978 to September 30, 1979. The 1975 starting date was chosen because of the convenience of the assent filing system at the Division of Coastal Resources which was initiated in 1975, and the May 16, 1978 date was chosen because that was the start-up date of the state's first CZMA section 306 grant. Additional data has been collected from applications dating back to 1969.

The Coastal Management Council has received an annual average of slightly less than 150 applications for coastal development projects over the past few years, but the total has jumped to nearly 200 for the most recent fiscal year and climbed to 252 for calendar year 1979.(12 Each project application was examined and broken down into "development activities" (Tables 1,2,3). For example, a typical application is for a single family dwelling unit (SFDU), an individual sewage disposal system (ISDS), a rip rap retaining wall, and a drainage ditch and outfall. This project contains four separate "development activities". The basis of determining the "development activity" categories was formed by reviewing a large number of applications to determine the different types of activities encountered. This approach was used to keep the "other" category at a minimum.

Of the nearly 800 applications filed since 1975, and of the approximately 1100 filed since 1971, the vast majority, approximately 80 percent, received CRMC approval, while only 2 percent were denied. Approximately 3 percent were withdrawn or discharged without prejudice by the CRMC. Fifteen percent of the applications fall into a pending action category, primarily those most recently received and those out to hearing.

Approximately two thirds of all activities by applications and assents fall into three categories: Single family dwelling units and/or individual sewage disposal systems; erosion control, such as retaining walls, seawalls and rip rap; and piers, docks, floats, etc. (Tables 4,5,6). Dredging and drainage projects account for more than 10 percent of the activities, while marina and yacht club projects which usually are for piers, docks and floats, and frequently involve dredging and erosion control activities, account for approximately 5 per cent of the applicants. Publicly funded projects sponsored by the state and local governments, educational institutions, and federal departments account for approximately 10 percent of the applicants.

The increase in applications since May 16, 1978 noted earlier, seems to be directly attributable to a heavy increase in residential development. Over the 57 month period from January 1, 1975 to September 30, 1979, the monthly average application rate for single family dwelling units and/or individual sewage disposal systems was 3.5, but since May 16, 1978, the rate has swelled to nearly 13.5. Erosion control projects have increased from an average rate of three per month to nearly five per month, and for piers, docks and floats, etc., the average monthly rate is approximately 4.5 since May 16, 1978, up slightly from 3.8 over the longer time frame.

The most heavily affected waterbody in terms of absolute numbers of applications and assents for projects is the Narragansett Bay region/drainage basin (Table 7). Nearly 60 percent of the applications and assents occur around the bay, predominately in tidal rivers, coves, and harbors, although nearly 30 percent of the projects along the bay between January 1, 1975 and September 30, 1979, more directly affected open water (East and West Passages and the bay in general).

Approximately 20 percent of the projects affect coastal ponds, with Pt. Judith Pond alone experiencing half of those projects. All of the coastal ponds are identified by the RICRMP as Areas for Preservation and Restoration. Another 20 percent of the projects affect the coastal drainage basins/ Rhode Island and Block Island Sounds. This development frequently involves barrier beaches, but the count for these sensitive natural features is incomplete. The assent file and the application logs do not portray the number of projects on barrier beaches or salt marshes.

In terms of development by community, the Town of Narragansett has experienced the largest number of applications and assents. Since 1975 more than 120 applications have been filed while 58 assents have been issued (Table 9). The apparent lag between applications and assents reflects the large number of outstanding recent applications. It

TABLE 1

CLASSIFICATION BY ACTIVITY DESCRIPTION

APPLICATIONS FOR COASTAL ASSENTS AND ASSENTS ISSUED
DURING SECTION 306 GRANT PERIOD
MAY 16, 1978 TO SEPTEMBER 30, 1979

ACTIVITY	APPLICATIONS(1,3	ASSENTS(3
Marinas/yacht clubs	14	6
Erosion control	44	34
Fill	5	4
Piers, Docks, Floats, etc.	39	33
Transportation related	6	3
Maintenance	4	---
Dredging	14	6
Outfalls/drainage	24	15
Discharges	0	0
Multifamily dwelling	2	1
Commercial building	7	5
Single family dwelling unit (SFDU)	36	36
Indiv.sewage disposal system(ISDS)	13	3
SFDU/ISDS	70	33
Sewage treatment/disposal	14	3
Subdivision	2	2
Recreation	4	1
Access/rights-of-way	5	---
Petroleum related	2	2
Power related	0	---
Barrier beaches(2	8	3
Marshes(2	3	3
Aquaculture	4	7
Solid waste disposal	1	1
Other	4	1
TOTAL	325	202
NON-PRIVATE APPLICANTS	30	

1) adds to more than total project applications for the period because each project frequently involves two or more activities.
2) incomplete totals; the number of project activities affecting barrier beaches and marshes exceed the number shown.
3) a one-to-one relationship cannot be assumed because of difference in sources that reflect clerical differences in classifications, and because decisions made during the period may reflect applications filed prior to the period shown.

SOURCE: Rhode Island Statewide Planning Program(RISPP) Log of Notices of application for CRMC assents, and Department of Environmental Management, Division of Coastal Resources assent file.

TABLE 2

CLASSIFICATION BY ACTIVITY DESCRIPTION

APPLICATIONS FOR COASTAL ASSENTS AND ASSENTS ISSUED FROM 1975 TO SEPTEMBER 30, 1979

ACTIVITY	APPLICATIONS(1,3	ASSENTS(3
Marinas/yacht clubs	50	32
Erosion control	171	107
Fill	33	15
Piers, docks, floats, etc.	218	137
Transportation related	21	16
Maintenance	30	18
Dredging	65	37
Outfalls/drainage	76	44
Discharges	5	2
Multi-family dwelling	2	2
Commercial building	11	8
Single family dwelling unit(SFDU)	26	15
Indiv.sewage disposal system(ISDS)	15	4
SFDU/ISDS	158	80
Sewage treatment/disposal	17	9
Subdivision	4	2
Recreation	13	9
Access/rights-of-way	10	11
Petroleum related	4	8
Power related	4	3
Barrier beaches(2	1	1
Marshes(2	1	1
Aquaculture	20	13
Solid waste disposal	1	1
Other	21	9
TOTAL	989	582
NON-PRIVATE APPLICANTS	120	72

1) adds to more than total project applications for the period because each project frequently involves two or more activities.
2) incomplete totals; the number of project activities affecting barrier beaches and marshes exceed the number shown.
3) a one-to-one relationship cannot be assumed because of difference in sources that reflect clerical differences in classifications, and because decisions made during the period may reflect applications filed prior to the period shown.

SOURCE: Rhode Island Statewide Planning Program(RISPP) Log of Notices of application for CRMC assents, and Department of Environmental Management, Division of Coastal Resources assent file.

TABLE 3

CLASSIFICATION BY ACTIVITY DESCRIPTION

APPLICATIONS FOR COASTAL ASSENTS AND ASSENTS ISSUED FROM 1969 TO SEPTEMBER 30, 1979

ACTIVITY	APPLICATIONS(1,3	ASSENTS(3
Marinas/yacht clubs	78	incom-
Erosion control	257	plete
Fill	59	
Piers, docks, floats, etc.	416	
Transportation related	28	
Maintenance	87	
Dredging	115	
Outfalls/drainage	101	
Discharges	17	
Multi-family dwelling	7	
Commercial building	21	
Single family dwelling unit(SFDU)	37	
Indiv.sewage disposal system(ISDS)	22	
SFDU/ISDS	198	
Sewage treatment/disposal	20	
Subdivision	4	
Recreation	19	
Access/rights-of-way	13	
Petroleum related	20	
Power related	20	
Barrier beaches(2	11	
Marshes(2	8	
Aquaculture	20	
Solid waste disposal	2	
Other	42	
TOTAL	1606	
NON-PRIVATE APPLICANTS	176	

1) adds to more than total project applications for the period because each project frequently involves two or more activities.
2) incomplete totals; the number of project activities affecting barrier beaches and marshes exceed the number shown.
3) a one-to-one relationship cannot be assumed because of difference in sources that reflect clerical differences in classifications, and because decisions made during the period may reflect applications filed prior to the period shown.

SOURCE: Rhode Island Statewide Planning Program (RISPP) Log of Notices of application for CRMC assents, and Department of Environmental Management, Division of Coastal Resources assent file.

TABLE 4

MOST FREQUENTLY OCCURRING COASTAL ACTIVITIES REQUIRING CRMC ASSENT DURING SECTION 306 GRANT PERIOD MAY 16, 1978 TO SEPTEMBER 30, 1979

ACTIVITY TYPE	RATE BY APPLICATION	RATE BY ASSENT
- SFDU; ISDS; SFDU/ISDS	38	36
(SFDU/ISDS	29)	(16)
- Erosion control	14	17
- Piers, docks, floats, etc.	12	16
- Outfalls/drainage	8	7
- Dredging	4	3
- Marinas/yacht clubs	4	3
SUB TOTAL	80	82
- All others	20	18
TOTAL	100	100

NON-PRIVATE APPLICANTS 10%

TABLE 5

MOST FREQUENTLY OCCURRING COASTAL ACTIVITIES REQUIRING CRMC PERMITS January 1, 1975 to September 30, 1979

ACTIVITY TYPE	RATE BY APPLICATION	RATE BY ASSENTS
- Piers, docks, floats, etc.	22	24
- SFDU: ISDS: SFDU/ISDS	20	17
(SFDU/ISDS)	(16)	(14)
- Erosion control	17	18
- Outfalls/drainage	8	8
- Dredging	7	6
- Marinas/yacht clubs	5	5
SUB TOTAL	79	78
- All others	21	22
TOTAL	100	100

NON-PRIVATE APPLICANTS 12%

TABLE 6

MOST FREQUENTLY OCCURRING COASTAL ACTIVITIES
BY APPLICATIONS FOR STATE ASSENTS
1969 TO SEPTEMBER 30, 1979

ACTIVITY TYPE	RATE
- Piers, docks, floats, etc.	26
- Erosion control	16
-ISDS; SFDU; SFDU/ISDS	16
(SFDU/ISDS)	(12)
- Dredging	7
- Outfalls/drainage	6
- Marinas/yacht clubs	5
SUB TOTAL	76
- All Others	24
TOTAL	100

NON-PRIVATE APPLICANTS 11%

also reflects a distortion created by the assent file at the Division of Coastal Resources which apparently does not contain all the assents issued since 1975.(13 South Kingstown, Jamestown, Charlestown, and Warwick are grouped with 80, 70, 66, and 62 applications respectively from 1975 to September 30, 1979. All five communities have experienced rapid residential growth during this period, with the annual average percent gain in residential units as measured by building permits showing the following rates: Narragansett, 3.7; South Kingstown, 3.0; Jamestown, 3.2; Charlestown, 5.7; and Warwick, 2.5, all well above the state rate of 1.7.(14 Other communities experiencing fairly significant rates of coastal development pressure are Newport, Westerly, North Kingstown and Barrington.

PART III: THE ISSUE OF PERMISSIBILITY vs. PRIORITY OF USE OF COASTAL RESOURCES

A. Discussion

The premise of this section, based on the review of local land use regulations and the state assents for development, is that local land use regulations are the prime determinant of both permissibility and priority of use of coastal resources, and that the state regulatory function is focused more intensely on permissibility than on priority of use. Once an applicant has received the local building permit, which by CRMC policy must be obtained before applying for a CRMC assent (although there is evidence of change in the

TABLE 7

CRMC ASSENTS BY COASTAL WATERBODY

	Waterbody/community	1/1/75-9/30/79	5/16/78-9/30/79
I.	Narragansett Bay Region/ Drainage Basin		
1.	Academy Cove, N.K.	3	1
2.	Apponaug Cove, Warwick	2	1
3.	Barrington River, Barrington	16	---
4.	Bissell Cove, N.K.	1	1
5.	Blue Bill Cove, Portsmouth	2	1
6.	Bristol Harbor,Bristol	2	1
7.	Brushneck Cove,Warwick	4	2
8.	Bullocks Cove, East Providence/Barrington	9	---
9.	Cold Spring Cove, N.K.	1	---
10.	Dutch Cove, N.K.	1	---
11.	East Passage, Jamestown, Narragansett	14	14
12.	Fishing Cove, N.K.	2	1
13.	Greenwich Bay, Warwick	4	3
14.	Greenwich Cove, East Greenwich	7	2
15.	Great Creek, Jamestown	1	---
16.	Jamestown Harbor, Jamestown	2	---
17.	Kickemuit River,Bristol	4	2
18.	Mackeral Cove,Jamestown	1	---
19.	Mill Cove, N.K.	1	---
20.	Mill Creek, N.K.	1	1
21.	Mt.Hope Bay, Bristol, Portsmouth	6	2
21a.	Narragansett Bay(General)	52	9
22.	Newport Harbor, Newport	13	4
23.	Palmer River,Barrington	4	1
24.	Pawtuxet Cove, Cranston, Warwick	5	---
25.	Pettaquamscutt River, Narr., S.K., N.K.	14	6
26.	Potowomet River,Warwick	1	---
27.	Providence River, Prov., War.,Crans.,E.Prov.,Barr.	18	6
28.	Sakonnet River,Ports., Tiverton,Middletown, Little Compton	29	9
29.	Seekonk River, Prov., Pawt., E. Prov.	6	2
30.	Smith's Cove,Barrington	3	2
31.	Warren River, Warren	5	3

TABLE 7 (con't)

Waterbody/community	1/1/75-9/30/79	5/16/78-9/30/79
32. Warwick Cove, Warwick	12	3
33. West Passage	10	9
34. Wickford Cove, N.K.	3	1
35. Wickford Harbor, N.K.	7	---
36. Woonasquatucket River, Providence	2	---
SUBTOTAL	269	88
PERCENT OF TOTAL	59%	58%
II. COASTAL PONDS		
1. Charlestown Pond, Charlestown	2	---
2. Galilee Bird Sanctuary, Narragansett	2	---
3. Great Salt Pond, New Shoreham	1	---
4. Green Hill Pond, S.K.	7	3
5. New Harbor, New Shoreham	1	1
6. Ninigret Pond	20	4
7. Potter Pond, Charlestown	6	2
8. Pt.Judith Pond, Narra., S.K.	52	13
9. Quicksand Pond, Little Com.	1	1
10. Quonochontaug Pond, Charlestown, Westerly	2	---
11. Trim Pond, New Shoreham	5	3
12. Weekapaug, Westerly	1	---
SUBTOTAL	100	27
PERCENT OF TOTAL	22%	18%
III. COASTAL DRAINAGE BASINS/SOUNDS		
1. Block Island Sound	36	3
2. Brenton Cove, Newport	2	1
3. Matunuck, S.K.	2	1
4. Old Harbor, New Shoreham	2	---
5. Pawcatuck River, Westerly	11	7
6. Rhode Island Sound	32	24
7. Sachuest Bay, Middletown	1	---
8. Saugatucket River, S.K.	1	---
9. Watch Hill Cove	2	1
SUBTOTAL	89	37
PERCENT OF TOTAL	19%	24%
TOTAL	458	152

SOURCE: DIVISION OF COASTAL RESOURCES ASSENT FILE

TABLE 8

CRMC PROJECT DENIALS BY COASTAL WATERBODY

	YEAR	WATERBODY/COMMUNITY	PROJECT TYPE	APPLICATION NO.
1.	1973	Pt. Judith Pond	SFDU/ISDS	73-7-10
2.	1974	Pt. Judith Pond	SFDU/ISDS	74-3-3
3.	1974	Green Hill Pond	Pier	74-3-11
4.	1974	Warwick Cove,War.	Marina Bulk-head/fill	74-2-6
5.	1974	Pawtuxet Cove,War.	Pier	74-10-10
6.	1974	Green Hill Pond,S.K.	SFDU/ISDS	74-10-9
7.	1975	Winnapaug Pond, Westerly	Fill marsh	75-5-6
8.	1975	B.I.Sound,Westerly	Seawall	75-11-2
9.	1975	Winnapaug Pond, Westerly	SFDU/ISDS	75-5-20
10.	1976	Wickford Harbor,N.K.	Dredge	76-1-7
11.	1977	Newport Harbor, Newport	Floating piers	77-9-4
12.	1977	Tibbets Creek,N.K.	Fill marsh	77-5-19
13.	1977	Charlestown Beach, Charlestown	Rip Rap	77-12-4
14.	1977	Charlestown Beach, Charlestown	Rip Rap	77-12-5
15.	1977	Charlestown Beach, Charlestown	Rip Rap	77-12-6
16.	1978	B.I.Sound,Westerly	SFDU/ISDS	78-4-11
17.	1978	Ninigret Pond	ISDS	78-9-2
18.	1978	Ninigret Pond	Bldg.	78-11-10
19.	1979	Pettaquamscutt River, Narr.	SFDU/ISDS	79-2-1

SOURCE: DIVISION OF COASTAL RESOURCES DENIAL LIST.

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implementation of this policy), the CRMC generally acts only to mitigate site impacts which are usually associated with site preparation. Such mitigation efforts frequently include minimizing erosion and sedimentation by stipulating the placing of staked hay bales on the perimeter of the site, and reseeding and replacement of vegetative cover; the stake-out of marsh boundaries to direct site preparation activities away from the sensitive natural areas, and/or the establishment of buffer zones between development and natural areas. The infrequency of project denials (Table 8) demonstrates the power of local determination. The denials have resulted, because the applicants failed the permissibility test, except in those cases where the project was for development on an undeveloped barrier beach. In those few cases, the priority of use was evoked by the CRMC.

On the more general question of priority of use, however,

TABLE 9

APPLICATIONS AND ASSENTS BY COMMUNITY FOR PROJECTS IN THE COASTAL ZONE

COMMUNITY	January 1, 1975 - September 30, 1979 APPLICATIONS	ASSENTS	May 16, 1978 - September 30, 1979 APPLICATIONS	ASSENTS
Barrington	45	40	5	8*
Bristol	17	10	6	3
Charlestown	66	43	11	6
Cranston	8	5	2	0
East Greenwich	10	7	5	2
East Providence	20	14	7	4
Jamestown	70	39	33	22
Little Compton	6	4	1	1
Middletown	3	4*	1	2*
Narragansett	121	58	50	13
Newport	46	26	17	10
New Shoreham	16	12	7	6
North Kingstown	49	34	11	6
Pawtucket	3	1	2	1
Portsmouth	38	24	11	7
Providence	10	7	1	0
South Kingstown	80	38	35	11
Tiverton	22	14	6	3
Warren	15	5	3	5*
Warwick	62	32	24	15
Westerly	54	35	14	7
**(Narrow River	27	15	16	6)
TOTAL	761	452	252	132

*More assents than applications results from carry over from previous years.

**Narrow River is a special case; applications and assents counted in the Towns of Narragansett, South Kingstown, and North Kingstown.

SOURCE: RISPP Log Notices of CRMC applications, and Division of Coastal Resources Assent Log.

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if an area is designated by the RICRMP and/or the State Guide Plan for low density or preservation activity such as recreation and conservation because of proximity to sensitive natural areas and severe development constraints such as flood hazards, poor soil capabilities, wetlands, and high water table problems, and the local community has zoned the area for development, and this is typically residential zoning, the priority designation is disregarded and the permissibility tests alone are utilized in the decision. For example, a single family dwelling unit and individual sewage disposal system was recently approved by the CRMC because it met the local zoning requirements and the state permissibility test, even though the RICRMP, the State Guide Plan, and the Community Comprehensive Plan designated the area for recreation and conservation.(15 Moreover, the applicant in this case had stated intentions for additional residential development in the immediate area.

Reliance by the CRMC on the issuance of the local building permit and the Department of Environmental Management individual sewage disposal system permits appears to back the CRMC into an untenable position with regards to the priorities of use because the CRMC is virtually forced to accept the decisions of (1) local zoning which is overwhelmingly at odds with state plans and policies in sensitive coastal areas, and often reflects decisions made decades ago, and (2) an engineering design suited to certain static conditions with "sizing" and setback requirements, but which cannot accommodate the unstable conditions of barrier beaches subject to erosion and rollback or coastal low lands that are periodically subject to flooding, and which do not consider nutrient loading criteria in delicately balanced coastal ponds. In the case of the coastal pond complexes, many of which are subjected to intensive recreational boating use, residential development requiring individual sewage disposal systems and wells, and more recently aquaculture projects, reliance on local zoning and an ISDS design may prove a wholly inadequate resources management technique over the long term. There have been 20 aquaculture proposals since 1975 and four since May 16, 1978, (Tables 1,2). Most of these have involved coastal pond complexes. The opportunities for resource use conflicts is obvious, and while there is a massive study of the Coastal Ponds presently underway by the University of Rhode Island, production of the study itself and translation of the findings of that study, like the translation of the findings of the two reports on the Narrow River, into management practices is especially difficult for the CRMC because its latitude and implementation capabilities for APR's is severely restricted by local zoning.

There is a link between permissibility and priority of use in the state's 1971 coastal resources management act which created the following decision making criteria: that each applicant demonstrate that the proposed development project does not "(1) conflict with any resources management plan or program; (2) make any area unsuitable for any uses or activities to which it is allocated by a resources management plan or program; or (3) significantly damage the environment of the coastal region. However, this statutory link appears to be infrequently utilized in the case by case decision making of the CRMC. In the words of the chairman of a New England environmental law school, the operational end of the Rhode Island Coastal Resources Management Program allows the state's coastal resources to be "nickeled and dimed" in spite of powerful enabling legislation and comprehensive long term management features.(16

In the case of the Narrow River, it is grossly unfair to lay the blame on the CRMC for the degraded water quality of that estuary. The problem with the river's water no doubt stems from several sets of circumstances. However, the CRMC through its actual operations has done little to define the problem and to develop a means to better manage the watershed primarily because (1) the local jurisdictions have determined the land use patterns through zoning, and in response to the needs of the residents in the watershed, the towns have been forced to provide certain services including storm drains; and (2) the CRMC's case by case approach to decision making neglects the cummulative impact of several or many assents, such as the five storm drain outfalls approved since 1977, and does not appear to reflect the wisdom of technical reports especially prepared by the University of Rhode Island Coastal Resources Center which recommended in 1975 no additional effluent pipes be allowed to discharge into the Narrow River. (17 Both factors render ineffective the APR designation for the watershed and in 1979, nine assents for development were issued, including a storm drain outfall, while one application was denied because an insufficient area for a buffer zone existed.(18

The problem of implementing effective resources management is aggravated in another way by the local land use determinant when combined with the policy of requiring applicants to first obtain the local building permit. This policy, and it does appear that changes in this policy are in the making, allows individuals to proceed with their project without a state assent, thereby side-stepping the state's permissibility test and any site impact mitigation stipulations that may have been required. The CRMC does not believe this to be a widespread problem.(19 Whether or not it is a widespread problem is only part of the issue. In four specific cases discovered in the past 15 months, there have been two violations of state and federal policies and regulations for flood hazard zones, two violations of verbal cease and desist orders, and one violation of the state building code.

Yet another case was revealed where fill was being placed in a salt marsh in 1977 without a state assent. A cease and desist order was issued but no requirement for restoration was evoked. Two years later, the violator applied to the CRMC to permit additional filling. This occurrence, and the four cited above were in no small measure a function of local zoning, although the other four cases also point to the flow in the sequence of permits. In the filling case, the land was zoned residential and the town's regulations had established front and back yard building setback requirements which prohibited development of the property without either a waiver of the local regulations or a violation of the state saltwater wetlands laws. The property owner chose to violate state law, and now requests a waiver of the state law rather than seeking a waiver of local building requirements. The case is pending.

B. Recommendations

The fundamental question is how can the operation of the state's management program be improved to overcome the problems cited here? First in the sequence of permitting, there is strong evidence of support for changing the CRMC policy of requiring applicants to obtain all other permits first. If the state assents, and there can be as many as four involved for air quality, fresh water wetlands, individual sewage disposal, and coastal resources, are obtained prior to the local building permit, the local building inspector who now is only responsible for town regulations, is brought into the enforcement sequence because he has the benefit of knowing what assents and/or denials and stipulations have been attached at the state level and in some instances, such as those involving the flood insurance program and the state building code, provides the local building official with benefit of the state's technical expertise. This change in the permit sequence may also impede the practice of individuals proceeding with projects without a CRMC assent, and if done concurrently at the state level, it will actually streamline the process.

A second recommendation is a more vigorous use and enforcement of written cease and desist orders, rather than the current practice of issuing verbal cease and desist orders. Violators clearly do not respect verbal cease and desist orders, but there is evidence that the written orders fulfill their intention.[20] More effort is required by the CRMC to issue restoration orders to violators. In 1979, 70 cease and desist orders were issued, but only eight orders to restore. Over 30 of the violations cited by cease and desists involved alteration or filling of coastal wetlands or marshes, or shoreline areas below mean high water.[21] At least seven involved the start of single family dwellings. These types of violations "cheat" the CRMC out of its impact mitigation efforts and permissibility tests. The orders to restore enable the CRMC to recover its position.

The CRMC should be more aware of and utilize the burden of proof features of its legislation and the <u>RICRMP</u>, especially where the State Guide Plan is involved. This will aid the CRMC in implementing its adopted priorities of use goals, which if successfully accomplished will give Rhode Islanders an opportunity to see benefit from the program over a period of time. It is the responsibility of the Statewide Planning Program (RISPP) to assist the CRMC in this effort by consistently and clearly indicating where the State Guide Plan policies and designations apply, and completion of the coastal community land use review will strengthen the utilization of the State Guide Plan by the CRMC.

At the local community level, a fourth step, and the most difficult one at that, is the required realignment of local zoning and local comprehensive plans with state RICRMP and State Guide Plan goals and policies. Fulfillment of this step is the goal of the Coastal Community Land Use Review and the technical assistance effort by the Coastal Resources Center as currently designed in the state's approved 306 Work Program. This approach is being used by Rhode Island rather than the so called three tier management approach of some other states (Maine, California, Connecticut), where the federal and state governments serve as the first two tiers that establish guidelines and policies, and the local or sub-state regional governments or councils serve as the first line of implementation. However, the local communities have little incentive or authority to proceed.

The inability of the local communities to deal with the four problems initially uncovered in the land use review, and the clear determining features of local zoning with regards to the priority of use and permissibility of use of coastal resources, including water quality, points to the continuing need for state land management legislation.

The difficulties of resource management at the local community level are acknowledged by the CRMC through its adoption of the RICRMP, and the Council has endorsed the state land management legislation as the means for dealing with these difficulties at the local level and because the legislation is "fully consistent with and supportive of its own planning and management objectives relative to utilization of the states coastal resources".[22]

NOTES

2. State of Rhode Island, "Application for Section 305 Coastal Zone Management Program Development Grant", (Providence, R.I.), February 8, 1974, pp. 6-11.

3. Rhode Island Coastal Resources Management Council, State of Rhode Island Coastal Resources Management Program (RICRMP), (Providence, R.I.) March 14, 1978, p. 368.

4. Ibid.

5. Rhode Island Statewide Planning Program (RISPP), Work Program, 1979-1980, (Providence, R.I.), March 1979, pp. II-121 to II-124.

6. RICRMP, p. 296.

7. Ibid., p. 158.

8. Ibid., p. 257.

9. George L. Seavey, Rhode Island's Coastal Natural Areas: Priorities for Protection and Management", Marine Technical Report No. 43, (Kingston, R.I.), 1975, pp. 39-41.

10. Ibid., p. 41

11. Tri-Town Narrow River Planning Committee, A Plan for the Narrow River Watershed, (River Landscapes, Inc., Cambridge, Mass.), June 1976, p. 48.

12. RISPP, Monthly Progress Reports; Division of Coastal Resources Permit Log.

13. Two other sources with the Division produced significantly different totals of the number of assents issued since 1975. The "assent file" was utilized as the data source because although its total assents represented the lowest of the three sources, it contained the greatest amount of data per assent by community, activity type, and coastal water body. Correction of this discrepancy is a major topic of a Program Review and Evaluation to be published in 1980 by a private consultant.

14. Rhode Island State Department of Economic Development, Rhode Island Basic Economic Statistics, 1979-1980, (Providence, R.I.), 1979, p. 47.

15. CRMC Application Number 79-9-7.

16. Telephone conversation with Prof. R.O. Brooks, Chairman Vermont Environmental Law School, November 1, 1979.

17. See notes 8, 9.

18. Division of Coastal Resources "Coastal Resources Management Section 312 Program Review and Evaluation", (Providence, R.I.), Feb. 5, 1980, p. 6

19. Statement by the Chairman of the Coastal Resources Management Council; Policy and Planning Committee Meeting, October 17, 1979.

20. See note 15. Reference is to a Study of the CRMC cease and desist orders prepared for the Natural Resources Defense Council.

21. Division of Coastal Resources, "Inventory of CRMC Cease & Desist Orders for calendar year 1979 (Providence,R.I.) January 1980, pp. 1,2.

22. RICRMP, pp. 368, 79, 171.

COASTAL ENVIRONMENTAL STUDIES PROJECT

Elaine Wallace

ABSTRACT: Thousands of acres of coastal shoreland have been lost, due in part to over-development and destruction of shoreland environmental areas. Yet, our colleges and universities are not training students for available jobs as aides and technicians in 1) coastal research, 2) urban planning in coastal communities, 3) environmental studies, and 4) chemical engineering. Wayne County Community College has received a two year grant from the National Science Foundation for the purpose of developing a program for training students in coastal environmental studies.

Michigan has suffered the loss of thousands of acres of coastal shoreland along the Great Lakes and the Detroit and St. Clair Rivers. There has been over-development and destruction of shoreland environmental areas. The Detroit shoreline is the most intensively developed within the state. Several public acts for control programs have been developed, but do not include the training of potential employees. The Michigan Department of Natural Resources, the Michigan Sea Grant Program, and Engineering and Geography Departments at local universities have all expressed concern about the lack of trained workers for existing jobs. Jobs exist for aides and technicians in coastal and environmental research. With the passing of the Coastal Zone Management Act, local communities need trained coastal and environmental aides to help carry out research projects in their particular locations. Water and sewage treatment agencies in Detroit and other communities in the Detroit area which have extensive coastlines have been made aware of the increased emphasis on regulations for controlling coastal environmental pollution. The State Department of Natural Resources and the Michigan Sea Grant Program have both indicated a need for trained persons who can serve as attendants, aides, and technicians to help those responsible for the development and implementation of techniques that will avoid polluting our coastlines. The Environmental Protection Agency is initiating a program of mandatory biological monitoring in EPA Region V which includes Michigan, Ohio, Wisconsin, Illinois, Indiana, and Minnestoa which will expand the demand for in-service training of on-the-job employees who need or desire training because of new technology.

The goals of the Coastal Environmental Studies Project at Wayne County Community College are to (1) provide two-year college students

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with skills and training that will make them employable in science related fields, (2) provide an in-service training program for on-the-job employees who need or desire training because of new technology, (3) provide minority students with the opportunity to spend time in practical learning situations that will augment the formal science training they receive in the classroom, and (4) prepare students for future study at other institutions in the fields of engineering, geography, geology, chemistry, biology, etc. Long range educational benefits include the following:

1. Expansion of the College's curriculum
2. Coordination of the College's Life and Physical Science program with those at four year institutions now serving the majority of our former students.
3. Increase the number of minorities participating in science careers and programs.

The program is intended to be a step toward improving the quality of the nation's science instruction at the undergraduate level, particularly in the area of environmental studies. The science division at Wayne County Community College in collaboration with the Engineering and Geography Department at Wayne State University, the Michigan Sea Grant Program, the Michigan Department of Natural Resources, the Geography Department at Eastern Michigan University, and local agencies are working together in carrying out the goals of the program.

The purpose of the Coastal Environmental Studies Project is to develop a Certificate Program and an Associate Degree Program in Coastal Environmental Studies. Students will be trained for careers as aides, technicians, and attendants in: (1) coastal research, (2) environmental studies, (3) chemical engineering, and (4) urban planning in the coastal communities. Students will participate in on-site-visits along the shorelines of Michigan. Twenty permanent field sites have been established for coastal and environmental field testing and observation. (figure I). The following activities are included in the course curriculum:

1. Technical writing and library work
2. Elementary computer and statistics
3. Land use policy (zoning) - in relation to shorelines and environment
4. Laboratory technology
5. Aerial photo and topographic map interpretation and construction
6. Field course on the use of instruments
7. Field geology (coastal depositional and erosional processes, soil training, wetland ecology)
8. Limnology
9. Water quality
10. Independent study project for each student

Upon completion of this program, participating students will be eligible for placement in available jobs related to their training and for future studies in science at other institutions.

The chronological sequence for the development of the Coastal Environmental Studies Project is as follows:

(July 1, 1979 - December 31, 1979)

The project commenced on July 1, 1979. The first six months were designated as development months. The director, research coordinator, and consultants from Wayne State University, Eastern Michigan University, Michigan Sea Grant Program, Michigan Department of Natural Resources, and the Science Division at Wayne County Community College have developed the curriculum for a certificate program and an associate degree program. The twenty field sites have been set up for field testing and observation. Applicatnts are enrolled in existing science courses.

(January 1, 1980 - December 31, 1980)

Starting January 1, 1980, students will enroll in coastal environmental courses. (figures II and III) The director, research coordinator, and consultants will be involved in classroom lecturing and in laboratory and field demonstrations. The director and research coordinator will be setting up on-the-job training employment for the participating students. An on-going program evaluation will be taking place continuously. Students, consultants, and employers will be asked to periodically fill in evaluation forms which will be designed by an experienced consultant in program evaluation.

(January 1, 1981 - June 31, 1981)

Final analysis and the preparation of reports will take place during the final six month period. Students will finish their course work and will be involved in on-the-job training at local agencies as a final phase to their associate degree or certificate program. The director and research coordinator will work with evaluation consultants to develop instruments required to determine and measure acceptable progress toward completion of project objectives and activities. Instruments will also be designed to evaluate student performance in on-the-job positions assigned in various cooperating industries and local and state agencies.

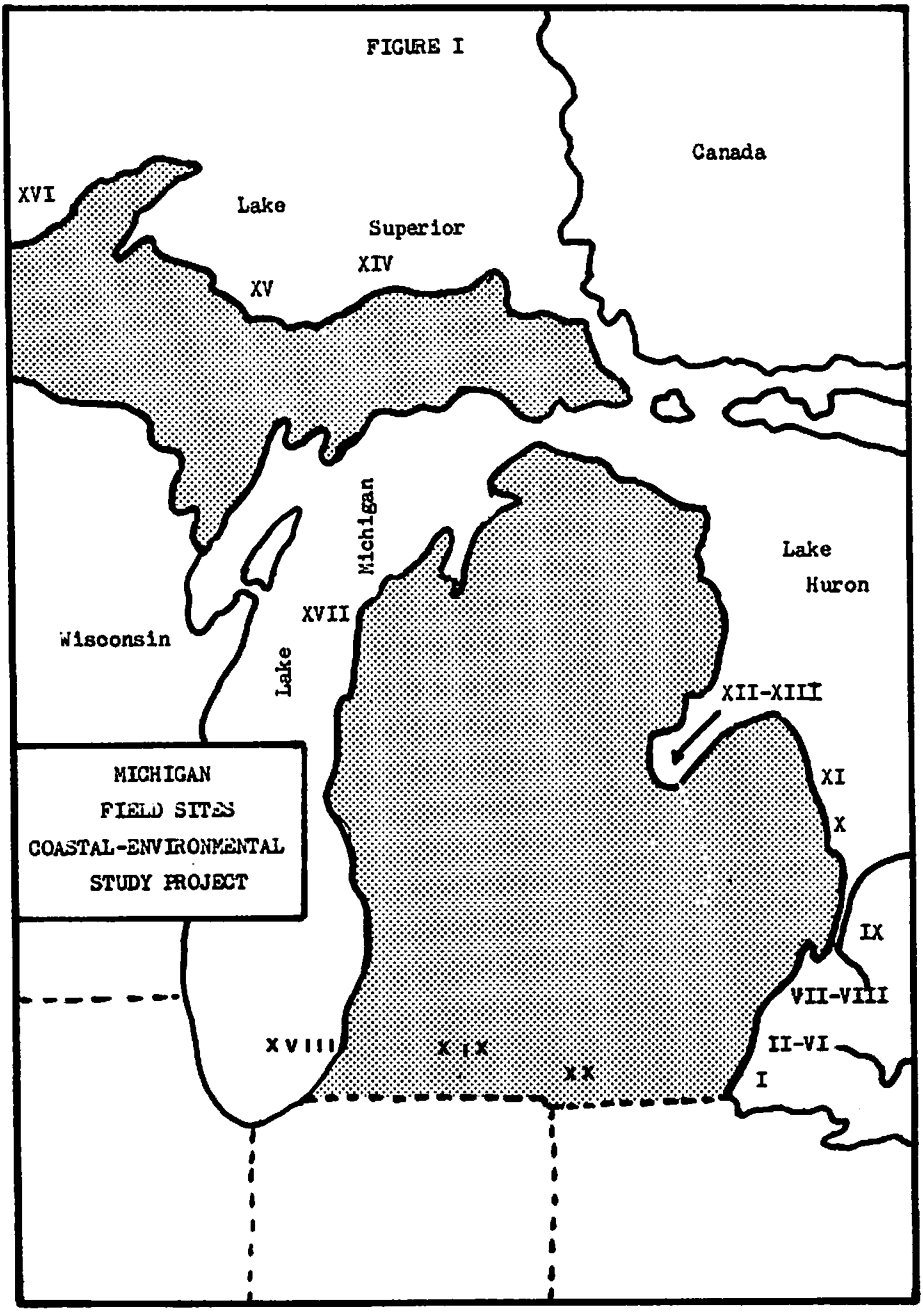

Canada
XVI
Lake
Superior
XIV
XV
Lake
Huron
Lake
Michigan
XVII
Wisconsin
XII-XIII
XI
X
IX
VII-VIII
II-VI
I
XVIII
XIX
XX
MICHIGAN
FIELD SITES
COASTAL-ENVIRONMENTAL
STUDY PROJECT

FIGURE I

FIELD SITE DESCRIPTIONS

Site I	Woodtick Peninsula, Monroe County Purpose: Observation and testing Coastal erosional and depositional formations The impact of urban and agricultural land use on the coastal zones
Sites II - VI	Rouge River Purpose: Observation and testing Water quality studies Limnology studies
II	Rotunda Dr. area
III	Greenfield Rd. area
IV	Schaefer Hwy. area
V	Oakwood Blvd. area
VI	Jefferson Ave. area
Sites VII and VIII	Detroit River Purpose: Observation and testing Water quality studies Limnology studies
VII	Hart Plaza
VIII	Fox Creek Park
Site IX	St. Clair River Delta, St. Clair County Purpose: Observation and testing Changing lake levels Streams deposits River channels Soil types Land use
Site X	Slatestone Creek, Sanilac County Purpose: Observation and testing Coastal erosional and depositional formations Exposed bedrock Fault Mass wasting
Site XI	Atwater Creek, Huron County Purpose: Observation and testing Mass wasting Coastal erosional and depositional formations

Site XII and XIII	Saginaw Bay, Bay and Tuscola Counties Purpose: Observation and testing Contrasting Shorelines Wetlands Previous lake levels
Site XIV	Tahquamenon River and Falls - Upper Peninsula Purpose: Observation and testing Bedrock stratification Stream erosion Stream deposits Limnology studies
Site XV	Pictured Rock - Marquette areas Purpose: Observation and testing Bedrock stratification Limnology studies Iron ore formations
Site XVI	Keweenaw Peninsula Purpose: Observation and testing Faulted Ridge Oxbow Lakes Flood plains Old stream
Site XVII	Betsie River Embayment, Benzie County Purpose: Observation and testing Sand dunes Fluvial terraces Delta
Site XVIII	Coastal Allegan and Van Buren Counties Purpose: Observation and testing Beach development Bluff erosion
Site XIX	Hartford, Southwestern Michigan Purpose: Observation and testing Groundwater survey
Site XX	Irish Hills Purpose: Observation and testing Glacial formations

FIGURE II

RECOMMENDED SCHEDULE

COASTAL-ENVIRONMENTAL STUDIES ASSOCIATE DEGREE

			CREDITS
SEMESTER I			
English -	110		3
Geology - physical	210	Lec.	3
	211	Lab	2
Math - algebra	113		3
Biology - basic principles	110	Lec.	4
	111	Lab.	2
Coastal Environmental Science	101		1
SEMESTER II			
Aerial photo topographic maps	230		4
Physical Science - lab. math	120		3
Chemistry - general	120	Lec.	3
Water Chemistry	125	Lab.	4
Government, law, and environment	140		3
Computer and Data Processing	123		2
SPRING-SUMMER			
Geology - field	220		6
Limnology	140	Lec.	3
	141	Lab.	2
SEMESTER III			
Chemistry - general II	130	Lec.	4
Water Chemistry II	135	Lab	4
Math - algebra	155		3
Coastal land usage	240		3
English - scientific writing	270		3
SEMESTER IV			
Humanities - two courses			6
Coastal Environmental Science	201		1
Political Science	101		3

FIGURE III

RECOMMENDED SCHEDULE

COASTAL-ENVIRONMENTAL STUDIES CERTIFICATE

		CREDITS
SEMESTER I		
Coastal Environmental Science	101	1
Aerial photo topographic maps	230	4
Physical Science - lab. math	120	3
Chemistry - general	120 Lec.	3
Water Chemistry	125 Lab.	4
Government, law, and environment	140	3
Computer and Data Processing	123	2
SPRING-SUMMER		
Geology - field	220	6
Limnology	140 Lec.	3
	141 Lab.	2
SEMESTER II		
Geology - physical	210 Lec.	3
	211 Lab.	2
Chemistry - general II	130 Lec.	4
Water Chemistry II	135 Lab.	4
Coastal land usage	240	3
Coastal Environmental Science	201	1
English - scientific writing	270	3

MANAGING THE FUTURE OF THE GULF OF MAINE

An Institutional Framework

Gregory M. Scott

Abstract

The Gulf of Maine is a unitary resource shared by a multitude of competing interests. Fishermen, oceanographers, environmentalists, oil drillers and many others view the future of the Gulf in varying special and often competing perspectives. There is, however, no central focus or means of ensuring that the resource as a whole will be managed to the benefit of all. It is time to bring people together in a series of discussions that will lead to the formation of an institutional framework for managing the future of the Gulf of Maine.

The Gulf of Maine is New England's largest and greatest natural resource. A rectangular 36,000 square mile depression with an average depth of 82 fathoms, it stretches from Cape Cod, Massachusetts to Cape Sable, Nova Scotia. The Gulf's economic value in fisheries alone reaches hundreds of millions of dollars, making it an important part of the national and world food supply. The Gulf's potential for providing oil, natural gas and mineral wealth has not been accurately determined, but is attracting substantial investment interest. As a transportation resource the Gulf of Maine is New England's gateway to Europe, the Middle East and beyond. Its recreational resources--beaches, sailing, sportfishing--attract thousands of people each year to hotels, restaurants and amusements in New England and the Atlantic Provinces.

The Gulf of Maine is unique. It has been described as perhaps the most distinctive feature of the entire northeast continental slope due to its peculiar separation from the open ocean and its concomitant physiographic and water current patterns. Its cold waters flow counterclockwise, protected by the Georges and Browns Banks from the Labrador and Gulf Stream currents. The Gulf is therefore a very special laboratory for scientific research and provides many irreplaceable wildlife habitats. It is also important to note the Gulf of Maine's rich cultural and historical maritime heritage, its potential for providing energy, including tidal power, and its many current defense and communications uses.

As a unique and multi-faceted resource, however, the Gulf of Maine rests uneasily in the collective custodial hands of many competing interests. Canadian and American fishermen vie for limited stocks, carrying on a tradition that reaches back to the sixteenth century. Before institution of the 200-mile limit, Russian and other foreign fleets seriously depleted many of the most valuable commercial stocks. Even New England fishermen compete among themselves for resources under the watchful eye of the New England Fishery Management Council.

President, TRIGOM, Yarmouth, Maine.

Other conflicts abound. Oil companies and fishermen face each other across the fish and scallop laden waters of Georges Bank. Ecologists and fishermen join forces to halt the tide of oil exploration and then turn back to face one another over utilization of special marine habitats. Joining the fray for an occasional skirmish are oceanographers, state and provincial economic development agencies, tidal power advocates and tanker terminal operators.

Competition is a treasured part of American and Canadian economic life. When competition leads, however, to destruction of invaluable and unique resource areas--areas that serve many people and fill many needs--it should be tempered by a system of management that directs competitive energies into positive channels for maximum benefit of all concerned.

Many people and interests must participate in managing the future of the Gulf of Maine: coastal organizations, state and provincial administrative agencies, transportation interests, oil and mineral developers, commercial and sport fishermen, environmentalists, resort operators, economists, historians, bankers and many others. The potential list of participants is in fact so long that the problem becomes how to combine their divergent talents in an effective management structure.

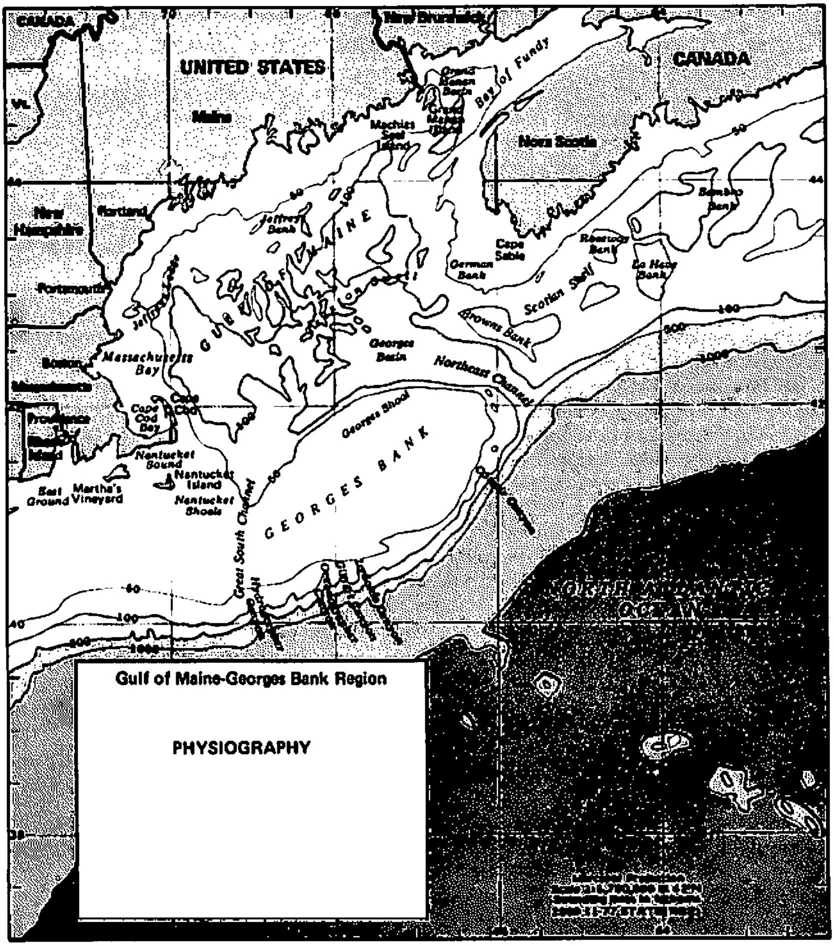
The purpose of this paper is to propose that an "International Congress on the Future of the Gulf of Maine," comprised of representatives of the above and other groups, be convened for the purpose of electing members to a permanent "Commission on the Future of the Gulf of Maine."

The Congress would have several functions. First, it would provide a setting and focus for discussion of current critical issues such as oil and gas development, U.S.-Canadian joint ventures to promote tourism, coordination of fisheries research to promote habitat protection, and many other important issues.

Second, the Congress would formulate the structure and responsibilities of the permanent Commission. Third, the Congress would elect members of the Commission and, finally, establish a process for securing the Commission's political, financial and legal support.

The permanent Commission for the Future of the Gulf of Maine would have as its central goal promotion of responsible and equitable management practices to ensure maximum benefit to all who have an interest in the Gulf of Maine. Reaching this goal will require taking three essential steps: (1) putting people on the map: identifying people who have an interest in or who can contribute knowledge or talents to the effort; (2) conducting the Congress; and (3) establishing the Commission. After the institutional framework has been created by the Congress, the Commission begins programs to reach its goals, including periodic conferences to renew interest and elect new Commission members, and operations designed to attract continued financial and political support.

At its best, the Commission can be a mechanism for coordinating and enhancing the many cooperative efforts now under way, and for fulfilling the momentous potential of New England and Atlantic Canada's greatest resource: the Gulf of Maine.


CANADA
UNITED STATES
New Brunswick
CANADA
Maine
Vt.
New Hampshire
Portland
Portsmouth
Boston
Massachusetts
Providence
Rhode Island
Bay of Fundy
Machias Seal Island
Nova Scotia
Jeffreys Bank
GULF OF MAINE
Cape Sable
German Bank
Roseway Bank
La Have Bank
Baccaro Bank
Scotian Shelf
Browns Bank
Georges Basin
Northeast Channel
Massachusetts Bay
Cape Cod
Cape Cod Bay
Georges Shoal
GEORGES BANK
Nantucket Sound
Nantucket Island
Nantucket Shoals
Martha's Vineyard
East Ground
Great South Channel
NORTH ATLANTIC OCEAN
Gulf of Maine-Georges Bank Region
PHYSIOGRAPHY

AQUACULTURE SITING ISSUES IN WASHINGTON'S COASTAL ZONE

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Coastal Resources Program
Institute for Marine Studies
University of Washington

ABSTRACT

Conflicts between important uses of the coastal zone are growing. Greater commitments of aquatic resources are required as aquaculture activities expand and intensify. At the same time, increasing recreational and residential use of the coast are placing other demands on many of the same resources. Nearshore residents want to protect recreational opportunities and the scenic qualities of the shore. To protect their livlihoods aquaculturists, including oyster growers, clam harvesters, and salmon farmers, also need space in aquatic areas and assurance that other uses will not degrade water quality or destroy their structures. In Washington State recent public debates are documented which surrounded the mechanical harvest of clams, raft culture of mussels, and pen rearing of salmon. Subjects of potential conflict are shown in the questions of continuing the subtidal harvest of geoducks, raft culturing of marine algae for food and chemical extracts, and continuing the use of public nearshore aquatic areas for private oyster farming.

The resolution of these conflicts is extremely important. Decisions made by public agencies and the precedents these decisions set will impact the balance of uses in the coastal zone, the vitality of the aquaculture industry and the maintenance of the environmental and aesthetic qualities of the coastal zone. At present no state policy exists which adequately deals with these problems. Public agency review and action can be confusing and contradictory because jurisdiction is distributed among a number of federal, state, and local agencies with diverse constituencies and contrasting mandates.

Identifying suitable sites for aquaculture is a complex task. Technical needs of the industry limit operations to sites with specific physical, biological, and chemical characteristics. Calm waters free from destructive waves and currents; high water quality unpolluted by domestic sewage, agricultural runoff, and industrial pollutants; and habitat conditions required for survival and growth of the target organisms are necessities for the success of many types of aquaculture. Additional factors also must be considered in order to protect the overall public interest. Competition and compatibility with other uses of the coastal zone and the impacts on the environmental and aesthetic

qualities of the area require the evaluation of government agencies and private individuals.

The difficulties in deciding what decisions to make, how to make them, and who should make them result in delay, uncertainty, inefficiency, and ineffectiveness. Disputes arise and conflicts can intensify. Resources can be lost or wasted while fledgling aquaculture industries have few opportunities or incentives to develop.

This report provides background information on these issues and suggests that the following aspects deserve more attention in the future: (1) how environmental impacts and risks are determined, (2) how claims for aesthetic quality can be evaluated and measured, (3) how the agencies can better coordinate their policies for coastal area use, and (4) what methods can be used to plan for the aquatic areas which recognize the special features of the aquatic areas.

Local planners and county commissioner will find this report useful for making site specific decisions and for refining and implementing the shoreline master programs. State resource or regulatory agencies and law makers can use this report in their efforts to explore avenues for administrative and legislative reform. Marine scientists may find the issues presented helpful in designing relevant research programs. The aquaculture industry and the interested public can use this paper as a guide to the scope of the difficulties and a reference source for further information and discussion.

Aquaculture Siting Issues in Washington's Coastal Zone is intended to stimulate the thoughtful examination of the many aspects of the problem. The report urges the directed search for solutions which will provide for the wise use of coastal resources, protect the integrity and value of coastal ecosystems, and lead to a more rational system for managing the many competing uses of the coastal zone.

GEOMORPHIC INVESTIGATION OF TIDAL DRAINAGE NETWORKS

Joe R. Wadsworth, Jr.[1] and Zeev Berger[2]

Abstract

Geomorphic analysis of tidal drainage networks, as outlined herein, is a useful approach to interpreting important sedimentary processes and environmental controls affecting salt-marsh development, and can reveal much useful information about large tidal systems that is not obtainable through more traditional methods. Low-altitude, color-infrared imagery of the Duplin River system, Sapelo Island, Georgia, was analyzed to produce a highly detailed drainage map. The map was digitized, and analyzed for a set of standard geomorphic variables using computer processing. Drainage density and channel reticulation, measured through quadrate analysis, were evaluated using contouring and trend surface analysis. Four principal drainage types were characterized: discrete, sparse semidiscrete, dense semidiscrete, and reticulated. Important local drainage anomalies were then identified. The distributions of all drainage types were compared with distributions of numerous environmental and sedimentary parameters measured in the field. Morphologic data from discrete tidal drainage networks were tested against five standard geomorphic relationships developed for fluvial systems, and results evaluated in terms of process and environmental differences between the two systems. Major variations in maturity and stability of development of drainage networks within the Duplin system suggest the need for reevaluation and expansion of current models of salt-marsh development.

INTRODUCTION

The geomorphology of tidal drainage networks is a meaningful reflector of the important sedimentary processes and environmental controls operating in salt marshes. As addressed in this study, salt marshes are "intertidal flats well vegetated by halophytes" (Frey and Basan, 1978). The importance of understanding salt marshes as sedimentary systems is dictated by their significance as breeding areas for commercial fish, buffer zones for coastal storms, areas of high primary productivity, and many other regards. These have all been well examined elsewhere, and need not be considered here. The principal aim of this paper is to propose a general approach to the investigation of salt marsh drainage geomorphology that emphasizes the recognition of important sedimentary processes and environmental controls. This approach was developed for the study of tidal drainage networks in the Duplin River system, Sapelo Island, Georgia (Wadsworth, 1980), and is presented here

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as a sequence of general steps applicable to future studies of tidal drainage geomorphology.

GENERAL APPROACH

(1) Field survey

In the preliminary stages of the study, dozens of salt marshes throughout the Atlantic, Pacific, and Gulf coasts of the United States were examined in the field for differences in drainage morphology and general environment. The main purposes of this fieldwork were (1) to determine those aspects of salt marsh drainage geomorphology that respond most strongly to major differences in environment and geologic process, and (2) to assess how much these aspects varied among natural systems.

(2) Selection of study area

The tremendous variability and related complexity of salt marsh drainage geomorphology noted during the field investigation demonstrated the importance of careful selection of the study area or areas, particularly if only a single region is to be examined in a particular study. Because of the great logistical and technical difficulties involved, and the basic state of understanding of this environment at present, multiple-area comparative studies are impractical, and most investigations have considered only a single region. In this way, interpretation of the geomorphology of drainage development at a single point in the salt-marsh developmental spectrum may be stressed, with a view toward rendering multiple-area comparative studies more practical in the future.

Because the most comprehensive work on tidal drainage geomorphology prior to the present study (i.e., Pestrong, 1965) had concerned relatively "mature" marshes, heavily dominated by high marsh, a study area was selected that represented the opposite (i.e., "youthful", as defined by Frey and Basan, 1978) end of the most commonly accepted developmental sequence for salt marshes: the Duplin River system, Sapelo Island, Georgia (Figure 1). During the course of the field investigation, youthful marshes such as the Duplin system were noted to display the greatest variation in drainage geomorphology, making them a particularly interesting subject for investigation.

Besides the fundamental consideration of geologic development, two other factors are critical in the selection of a study area: relatively undisturbed state, and accessability to ground-truth data, whether new or previously collected. The Duplin system meets these criteria readily, being virtually undisturbed, and having a broad data base of previous work (e.g., hydrology, sedimentology, ecology).

In addition to satisfying the criteria just mentioned, the Duplin system has other advantages as a study area. Location of the system between Sapelo Island on the east, and a roughly linear series of beach ridge remnants on the west, provides an unusual degree of intersystemic network separation for a large system in the Georgia-South Carolina marsh belt. This separation allows better definition of drainage system limits, both geographic and environmental. The Duplin system is strongly dominated by low marsh as defined by Basan and Frey (1977), and thus provides an endpoint for study of the salt-marsh developmental sequence. Furthermore, sufficient geomorphic variation in the drainage networks

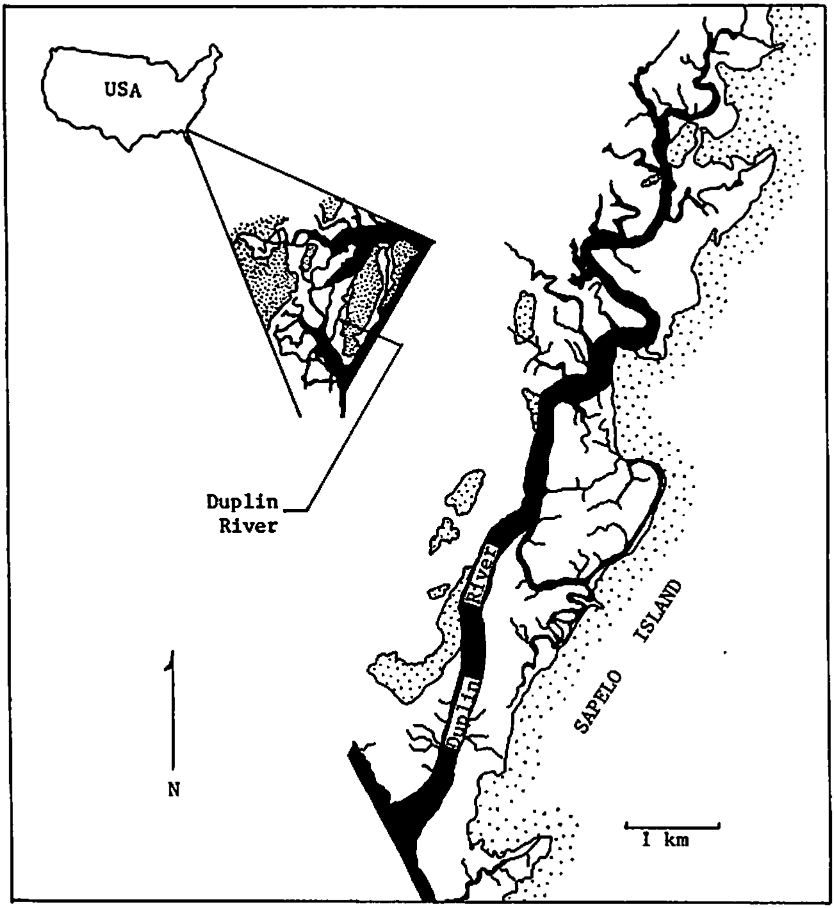

Figure 1. Location map of the study area -- The Duplin River tidal system, Sapelo Island, Georgia.

exists within the system to reveal the control/process/response relationships operating in this stage of the sequence, as discussed later in this paper.

(3) Mapping of the drainage networks

Wadsworth and Berger (1979) evaluated the usefulness of traditional approaches to drainage analysis for application to tidal systems, and concluded that detailed maps prepared from large-scale aerial photographs provided a much truer portrayal of tidal drainage geomorphology than either topographic maps or standard field surveys. The field observations discussed earlier indicated that drainage maps to be used for comprehensive analysis of salt marsh systems must be of much greater detail than those used in most previous studies, in order to represent these systems meaningfully. Such a highly detailed drainage map was prepared from color-infrared photography of the Duplin system, and was used in conjunction with available ground-based data from previous studies (e.g., channel hydrodynamics, sediment budgets, sedimentation rates) to analyse drainage morphology within the system.

Color-infrared imagery used in the study was taken at low tide, at an approximate scale of 1:5000. Drainage channels were denoted on individual overlays for each scene, using a Bausch and Lomb Zoom 70 viewing system mounted on a Richards high-intensity light table. Viewing magnifications ranged from 3.5X to 15X; the higher magnifications generally were used, to insure maximum transfer of detail. Overlays were compiled into a master composite, using an enlarged topographic map base and a 1:30,000 scale color transparency to maintain control. The composite was then reduced photographically to produce a final map at a scale of 1:10,000.

In the course of delineating drainage networks on the overlays, numerous complexities were encountered requiring evaluation of channels on an individual basis, to determine if and how they should be represented on the system drainage map. Full explanation of these considerations is given in Wadsworth and Berger (1978).

(4) Data reduction

The completed map of the Duplin tidal drainage system includes more than two thousand channels and more than a hundred discrete tributary networks entering the main channel. Reduction of such a quantity of data into standard geomorphic measures is not practical using traditional methods of hand measurement and calculation. Therefore, a procedure was developed for converting map data into digital form, using an Altek Datatab graphic digitizing system, and a computer program was written to process this input into a series of standard geomorphic measures for any discrete tributary network. Individual discrete networks were enlarged to a scale of 1:2000 and plotted individually to simplify digitization.

The computer program developed to process these data uses coordinates of channel endpoints, true channel lengths, stream orders, and network areas, perimeters, and axial lengths to calculate a set of 17 geomorphic variables, chosen on the basis of previous use in fluvial analysis and applicability to tidal systems. These measures, in turn, were analysed with a standard statistical package to derive means, standard deviations, and correlation coefficients.

(5) Characterization of variation

Visual assessment of variation of drainage characteristics within the study area showed drainage density and channel reticulation to be the most important types of variation. Quadrate and trend-surface analyses were used to characterize variation of these two parameters mathematically (Wadsworth, 1980). Trend surfaces were examined for any systematic relationships between geographic position in the system and drainage density or channel reticulation, and to identify areas that show major departures from regional trends. Particular attention was given to identifying relationships with the positions of major channels; locations of major tributary junctures; proximity to the head or mouth of the Duplin main channel or that of a principal subsystem; locations of possible buried ridge remnants; and proximity to the system boundaries, particularly in those areas where significant local influx of sediment is possible (i.e., hammocks and Sapelo Island).

(6) Identification of principal drainage types

Using the drainage map and related statistical analyses, it was possible to identify and delineate four distinct major drainage types within the Duplin system. Distinction between these types is based principally on differences in drainage density and channel reticulation, but numerous other distinctive characteristics may be recognized as well. The four principal drainage types are:

(a) discrete drainage: drainage networks that do not circumscribe any closed areas of marsh, and that feed directly into the main channel of the Duplin or one of its major tributaries. These networks are typically dendritic to pinnate, elongate, and have trunk channels that are normal to the Duplin main channel.

(b) dense semidiscrete drainage: drainage networks that do not circumscribe any closed areas of marsh, but that feed into drainage that does (reticulated drainage). They are typically dendritic but locally subparallel, and include networks that are highly irregular in outline. Principal channels of these networks extend into reticulated drainage, and overall drainage density is high.

(c) sparse semidiscrete drainage: drainage networks that do not circumscribe any closed areas of marsh, but that feed into drainage that does (reticulated drainage). They are generally similar to dense semidiscrete networks, but have a much lower drainage density, with very open networks. Networks are typically dendritic, but locally subrectangular.

(d) reticulated drainage: drainage networks that completely circumscribe and define numerous small areas of marsh, and have channels that are highly interconnected in a very irregular fashion, Drainage density is high, and stream piracy is evident in many places. Parallel and ponded drainage are common locally.

(7) Identification of anomalous drainage types

After principal drainage types have been characterized and delineated, local drainage networks of limited geographic extent may be identified that do not fit into one of these general types. While an endless number of such local variations will be revealed by a sufficiently detailed examination, a few either occur at several places within the system, or are particularly well-developed in a few places, and so are thought to be of more than unique significance. Identification of these anomalous drainage types is important in interpreting local processes and environmental controls.

Five major anomaly types were noted in the Duplin system -- pirated stream remnants, underfit streams, and annular, nodular, and complex drainage. These are described in detail in Wadsworth (1980).

(8) Correlation with field data

After the major drainage types in a tidal system have been identified and mapped, their distributions can be compared with those of environmental and sedimentologic variables, and the correlations between them used to interpret the important processes and controls affecting drainage development in the system. For example, in the Duplin system, sparse semidiscrete drainage is associated exclusively with areas of high marsh, suggesting common causal factors for the two phenomena.

Variables that were compared with drainage type include sedimentation rates; grain-size analyses; positions of detrital oyster-shell deposits and live oyster colonies; rates of lateral migration; elevation; seismic records; geotechnical properties; tidal velocity profiles; time-velocity tidal asymmetry; and proximity to a major sound. A summary of the interpretations made for the principal drainage types is given below, to illustrate the kinds of conclusions that can be derived through this approach.

(a) discrete drainage: This drainage type occurs in an area of active headward erosion, promoted by slopes that apparently are higher than those generally seen in the Duplin system, and by active, although episodic, sedimentation. These higher slopes have developed together with deposition of a broad drainage divide through storm-related sediment transport. Such storm-related activity is encouraged by the straightness of this part of the Duplin main channel, and by its proximity to the open reaches of Doboy Sound.

(b) reticulated drainage: This drainage type results from extensive stream piracy, combined with maintenance of the captured channels. Retention of these less efficient parts of the drainage network is possible due to the low rate of general surficial sedimentation and sediment redistribution, and negligible local slopes. Low sedimentation rates, verified in neighboring, environmentally similar marshes, apparently result from lateral confinement of the reticulated zone, enhanced by the net export of fine clastic sediment from this part of the system, and minimal biogenic sedimentation.

(c) dense semidiscrete drainage: This drainage type may be characterized as occuring in areas of relatively rapid sedimentation and vertical accretion. Extensive streamside-levee areas within these zones enhance the high sedimentation rate through the rapid deposition characteristic of normal levee development. Location of the zones at the headward extremes of the system promotes headward network extension by maximizing ebb-domination. With continued development, adjacent networks become interconnected, and are converted to reticulated drainage.

(d) sparse semidiscrete drainage: This localized drainage type develops under the restricted environmental and hydrodynamic conditions characteristic of the high marsh subenvironment. Infrequent tidal flooding of this topographically elevated area and relatively high permeabilities induced by the high sand content of the substrate eliminate the need for an extensive drainage network. Effective root binding by the high-marsh vegetative suite supports development of well-formed channels in an otherwise noncohesive substrate.

(9) Comparison with fluvial systems

Understanding of the geomorphic development of tidal drainage systems is currently in a very early stage. A particularly useful approach to studying such a little-known system is to compare it with a relatively well-understood one. In this study, characteristic geomorphic relationships derived for fluvial systems were used as a model of typical fluvial drainage development, and tested against tidal data from the Duplin system.

Only networks in the discrete drainage zone were used for comparison with fluvial networks, because they are the only drainage networks in the Duplin system that maintain a discrete (non-reticulated) character through the entire network, to its juncture with the main channels of the Duplin or one of its tributaries. It is usually difficult or impossible to assign stream orders to individual channel segments in a partially or completely reticulated network, rendering such networks unsuitable for comparison with fluvial systems.

To evaluate the resemblance between tidal drainage of the Duplin system and fluvial drainage, the following five characteristic fluvial geomorphic relationships were tested against data from the Duplin system: (1) geometrical similarity; (2) frequency distribution; (3) Horton's Laws of Drainage Composition; (4) area/length relationships; and (5) stream frequency/drainage density relationships. Methodology and results of this comparison are given in detail in a later paper (Wadsworth and Berger, in preparation). In brief, the tests revealed numerous differences between tidal and fluvial systems. These results suggested that the tidal networks examined were not in full equilibrium with their environment, and reacted significantly to subtle variations of environmental conditions within the discrete drainage zone.

(10) Synthesis and conclusions

Once the important sedimentary processes and environmental controls influencing the development of individual drainage types have been evaluated, they may be reexamined from the viewpoint of the system as a whole, and interpretations made regarding the general developmental model for the salt-marsh environment. In the Duplin system, drainage types suggestive of youthful development (e.g., discrete) and supermature development (e.g., sparse semidiscrete) coexist. Similarly, drainage types that seem to be in an equilibrium or stable phase (e.g., reticulated) coexist with others that are actively developing (e.g., dense semidiscrete). These results suggest that currently accepted models of salt marsh development may be oversimplified, and need to be reevaluated and expanded (Wadsworth and Frey, in preparation).

SUMMARY

The geomorphic analysis of tidal drainage networks, using a drainage map prepared from large-scale color-infrared imagery, has proved to be a valuable approach to the interpretation of important sedimentary processes and environmental controls influencing the development of drainage in the Duplin River tidal system, Sapelo Island, Georgia. Correlations with supplemental ground-truth data, including topography, vegetative zonation, current measurements, sediment analyses, seismic profiles, and historic maps, as well as numerous other studies in similar environments, have corroborated these analyses. By extending the conclusions and methodology of this study to new areas, the researcher can extract much useful information about large tidal systems that is impractical to obtain by more traditional approaches.

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VISUAL SIMULATION OF OFFSHORE LIQUEFIED NATURAL GAS (LNG) TERMINALS IN A DECISION-MAKING CONTEXT[1]

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ABSTRACT

Due to legislation passed in 1977, the Coastal Commission took part in a study analyzing potential offshore Liquefield Natural Gas (LNG) sites and the types of terminals that might occupy those sites. The study had to evaluate the engineering feasibility of siting an LNG receiving terminal offshore, in relation to the maximum protection of coastal resource provisions required by the California Coastal Act. The Coastal Act embodies a broad range of policies for the protection of coastal resources, which includes providing for the protection of scenic and visual resources within the coastal zone. This paper analyzes the use of a visual simulation technique for the siting of offshore LNG terminals and describes how the technique was used to implement the scenic and visual protection policies of the California Coastal Act.

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PART V

MARINE RECREATION: SOCIO-ENVIRONMENTAL CONFLICTS

Moderator: Robert B. Ditton

Environmental and Management Problems Associated With Recreational Boating on the Atlantic Intracoastal Waterway

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Abstract

The historical development of the Atlantic Intracoastal Waterway is briefly given along with references to sources of information. The various agencies having decision-making functions related to the waterway are summarized. Particular attention is given to problems of dumping of dredge spoil, increasing numbers of boats using the waterway, requirements for installing marine sanitation devices, and provision for marinas in coastal zone management plans. The conclusion calls for men and women to apply intelligence in developing and using the waterway so that recreational boating may be a satisfying experience for many in the years to come.

The idea for coastwise canals on the Atlantic seaboard can be traced to colonial times. William Penn is reported to have instigated an investigation into the feasibility of cutting a canal from the Delaware River to Sandy Hook.[1] George Washington called for improving coastal waterways, and Alexander Hamilton, writing in The Federalist, helped to institute the national policy of keeping waterways free from tolls.[2] In 1808 Secretary of the Treasury Albert Gallatin submitted a report recommending canals across four necks of land: Cape Cod, Delaware and Raritan, Chesapeake and Delaware, and Chesapeake Bay to Albermarle Sound.[3] With the exception of Cape Cod, these canals were all completed in the ten years following the opening of the successful Erie Canal in 1825. By 1840 many states were in financial trouble because of their efforts to build canals to, and in, the Midwest. For the remainder of the nineteenth century, national attention was directed to the westward movement and the building of railroads.

In 1881 a private canal company in Florida began construction of a fifty-foot wide, five-foot deep channel which was to extend from Jacksonville to Miami. The work was more or less completed in 1912. Tolls were charged, but the operation was not profitable and the company went into receivership in 1923. The Florida legislature created the Florida Inland Navigation District in 1927, a special taxing district of eleven east coast counties which served as the sponsoring agency to work with the federal government to provide rights of way, disposal areas, and to alter bridges, cables, and pipelines as required.[4]

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Through the Rivers and Harbors Act of January 21, 1927 and in subsequent years, Congress has funded the waterway as a federal project. During the depression years, improvements were carried on with the help of the Works Progress Administration. Submarine warfare off the Atlantic Coast in the 1940s stimulated dredging to a 12-foot controlling depth from Norfolk to Jacksonville.[5] The postwar years have seen increased use of the waterway by commercial operators and recreational boaters.

A search through The Reader's Guide to Periodical Literature, Educational Resources Information Center (ERIC) abstracts, and other reference indexes reveals a comparative paucity of articles related to environmental and management problems associated with recreational boating on the Atlantic Intracoastal Watersay. The existence of the waterway itself is probably not well known by the general public. From time to time boating magazines publish articles concerning the experiences of persons cruising the waterway. Some of these articles have become the basis for subsequent books.[6] For the yachtsman, the best source of information about marina facilities, sightseeing, and conditions along the waterway is the Waterways Guide which has been issued annually since 1947.[7]

Charts provide the datum for waterway information. A series of small craft charts cover the 1300-mile protected inside route from New Jersey to Miami, Florida (Table 1). In addition, the National Ocean Survey prepares and sells harbor charts, and detailed sailing directions are given in the United States Coast Pilot books.[8]

Table 1
NOAA Nautical Charts (Small Craft)

Intracoastal Waterway South of Cape Henry

12205	Cape Henry to Pamlico Sound
12206	Norfolk to Albemarle Sound via N. Landing R. or Dismal Swamp Canal
11553	Albemarle Sound to Neuese River
11541	Neuese R. to Myrtle S.
11534	Myrtle S. to Casino Creek
11518	Casino Cr. to Beaufort R.
11507	Beaufort R. to St. Simons Sd.
11489	St. Simons Sd. to Tolomato R.
11485	Tolomato R. to Palm Shores
11472	Palm Shores to West Palm Beach
11467	West Palm Beach to Miami
11451X	Miami to Marathon and Florida Bay

Source: Nautical Chart Catalog 1, United States Atlantic and Gulf Coasts including Puerto Rico and the Virgin Islands, April 1977.

To identify some of the environmental issues and management problems associated with recreational boating on the Atlantic Intracoastal Waterway will require a look at the agencies involved (Table 2). Foremost among these is, of course, the U.S. Army Corps of Engineers which is charged by Congress with construction and maintenance of the waterway.

Table 2

Representative Decision-making Agencies in Intracoastal Waterway Affairs

A. Government Agencies	Functions
U.S. Congress	policy and funding
Dept. of Defense U.S. Army Corps of Engineers	build, improve, and maintain channel
Dept. of Commerce Coast Guard	install and maintain aids to navigation
Nat. Oceanic & Atmospheric Adm.	compile and issue charts, disseminate weather information
Dept. of Transportation State Depts. of Transport	build and maintain roadways and bridges in conjunction with state and local govt.
Local government	zoning
Environmental Protection Agency	impact statements, air and water quality
Coastal Zone Management Commissions (regional)	planning
Dept. of Interior Fish & Wildlife Service	wildlife refuges
National Park Service	national monuments national seashores
Depts. of Natural Resources	marshland protection, registration of boats, hunting and fishing licenses and seasons
Ports Authorities	docks, cargo handling
B. Companies	
Utilities	power and water lines
Barge	freight carrying
Insurance	absorb risks

Much of the work on the waterway was done before states passed marshland protection laws, or before there was much public concern about the dumping of dredge spoil. In several lagoons, islands were created with spoil and these have subsequently become covered by vegetation. The Florida Audubon Society, in cooperation with the Florida Inland Navigation District, has established and maintained wildlife sanctuaries along the waterway on the spoil areas. Since the waterway parallels a major flyway for migrating birds, it is a great place for bird-watching. Other wildlife refuges are located along the waterway in the states to the north.

The waterway has undoubtedly provided greater accessibility for hunters and fishermen. Improved fibreglass hull designs and higher horsepower outboard motors have also contributed to this accessibility for more and more people. State Fish and Game officers monitor this activity, issue licenses, and prescribe the hunting and fishing seasons. Difficulties arose last year when Georgia and South Carolina established different dates for the start of the commercial shrimping season. This was further complicated by the fact that the boundary line seaward of the Savannah River entrance is not well defined and is currently in dispute.

With increasing numbers of small boats using the waterway, problems of boating safety have intensified. The Department of Natural Resources in the various states usually registers boats and maintains patrol boats to enforce state water safety laws. On the national level, this function is exercised by the U.S. Coast Guard which also performs rescue services. Civilian voluntary members of the U.S. Coast Guard Auxiliary inspect and approve the safety equipment on pleasure boats, and come to the aid of yachtsmen in trouble. A tragic accident on the waterway in October 1978 saddened and embarrassed the Coast Guard when the Cutter Cuyahoga was rammed by the coal freighter Santa Cruz II with the loss of eleven lives.[9] This incident not only demonstrated human fallibility, but also pointed up the fact that smaller vessels should stay out of the way of big ships--a situation reflected by a change in the Rules of the Road in the last dozen years.

Weather conditions are closely related to problems of boating safety. Boats equipped with VHF radios may receive weather alerts and notices to mariners from the Coast Guard via channel 16, or they may pick up one or two of the continuous forecasts broadcast by the National Weather Service, a division of the National Oceanic and Atmospheric Administration (NOAA). A problem with the NOAA forecasts is that they are generalized for 5,000 to 15,000 square mile zones and the conditions experienced by the boater may be at considerable variance with what he is hearing on the taped broadcast.[10] Hurricanes, waterspouts, severe thunderstorms, and full gales are meteorological problems to be encountered on the Atlantic Intracoastal Waterway.

The Environmental Protection Agency (EPA) is another governmental organization with a management function affecting the Intracoastal Waterway. The Federal Water Pollution Control Act of 1972 directed the EPA to take steps towards the goal of eliminating all untreated discharges into navigable waters by 1985. Of direct concern to the recreational boater are Coast Guard regulations issued under EPA guidelines to control marine sanitation devices (MSD's) aboard boats. Regulations originally intended to go into effect in 1975 had to be postponed because of the inability of the boating public to comply. New regulations scheduled to go into effect on January 30, 1980 are regarded with contempt by old-time sailors who plan to continue using a bucket for a head (toilet). A survey by Cruising World evoked considerable response on this subject. Eighty percent of the respondents rated government efforts to handle pollution attributable to small boat owners as "bad." Ninety percent indicated that they were concerned about pollution.[11] The regulations are retroactive to boats built before 1975, and it is estimated that 125,000 to 250,000 boat owners must still install a macerator/chlorinator, a biological digestor, or a holding tank in order to come to compliance. Costs can range from $100 to $1000 for the various devices, and often the components or hardware are not readily available. The Coast Guard is empowered to enforce the law and flagrant violations can carry fines of up to $2000.

Another federal agency involved in management decisions affecting the Intracoastal Waterway is the Department of Transportation (DOT). It works with state departments of transportation, county governments, and local authorities to build new bridges or replace old ones. Bridges often reflect a conflict of interest between vehicular traffic going from the mainland to the islands and boat traffic on the waterway.[12] Many municipalities have established bridge hours which keep the bridges closed during times of heavy commuter traffic. Where there are several bridges within a few miles, the bridge openings may be scheduled at intervals adapted to the speed of large power cruisers, and slower moving sailboats may spend half an hour to an hour sailing in circles or at anchor waiting for the next bridge opening. This can lead to frustration and sometimes to accidents since winds and currents are often tricky at bridges due to the venturi effect, and maneuvering space is restricted. In general, however, relations between yachtsmen and bridge tenders are good, and there is a cheerful wave upon making the passage, but the days of the bridge tender are numbered.

In 1960 the Corps of Engineers established a minimum clearance for fixed bridges across the waterway at 65 feet. These clearances were adopted by the Coast Guard when the bridge building function was transferred to the Department of Transportation in 1966. At the present time there are 19 fixed bridges in place or under construction across the waterway within the Seventh Coast Guard District (Florida, Georgia, and South Carolina).[13] Their average cost is about $4 million.[14] Such bridges eliminate the need for stopping traffic in either direction, but they do take additional space with their graded approaches.

Powerlines must also transit the waterway either high overhead or in cables across the bottom. Signs warn boatmen not to anchor near power cables. Utilities seeking to extend new lines across the waterway have to deal with several agencies--the Corps, the Coast Guard, the state Department of Natural Resources, port authorities, and local governments. In addition, they must file environmental impact statements and arrange easements with individual property owners. These procedures reflect where we are today in terms of environmental protection and safeguards.

As can be expected, environmental and management problems intensify in areas where recreational boating is concentrated. Desirable marinas and yacht clubs in urban centers may have long waiting lists for slips. Several cities, such as Charleston and Beaufort in South Carolina, and St. Augustine, Daytona Beach, Fort Pierce, and Fort Lauderdale in Florida, have municipal marinas with some spaces reserved to accomodate transient yachtsmen. A great migration takes place each fall and spring as yachts are shuttled between northern and southern waters. This, along with commercial fishermen, comprises more than half the traffic on the waterway.[15]

Concomitant with the installation of holding tanks on pleasure boats has been the need to establish pump-out stations at marinas. In order to amortize the costs it is necessary to charge a fee for this disagreeable service. Boats returning on weekends can cause congestion at the pump-out station.

Marinas are being faced with escalating land values and increased property taxes. It is ironic that large numbers of pleasure boats are taxed by the local government where the owner resides, often an inland area which provides no services whatsoever for the boat. Marinas face competition from developers, and zoning changes and reevaluation can force them out, as in the case of the Chevron Marina in Fort Lauderdale and Riegel's boat yard in Sarasota.[16] Even anchorage is pitifully scarce in Fort Lauderdale, and a trip on the waterway here is a constant rocking as powerboat wakes reverberate off the seawalls on either side.[17] On all the narrow portions of the waterway, bank erosion from boat wakes is a continual problem, and "no wake" signs are frequently ignored.

In addition to government agencies, municipalities, and businesses which impinge on management functions related to the Intracoastal Waterway, private boaters have banded together into various organizations which seek to influence the decision-making process. The National Boating Federation (NBF) is an alliance of state and regional recreational boating organizations representing more than one million boating families. The NBF wants practical control of pollution, uniformity of regulations affecting the operation and equipment of boats, more accurate marine weather reporting, marine gasoline taxes to be earmarked for boating needs, and greater consideration of recreational boating in long-term state coastal zone management plans.

The services of the Coast Guard Auxiliary have already been indicated. Today there are about 44,000 men and women in the Auxiliary. Another organization with an educational function is the United States Power Squadron with more than 425 squadrons across the country. Their current 10-week basic course includes boat handling, compass and chart work, seamanship, and trailering. Advanced piloting, seamanship, and navigation courses are also offered. The USPS ran into legal difficulties in 1971 when a New Jersey woman who completed the basic course sued to join the all-male organization. It cost the organization $300,000 in legal fees and 15,000 members to remain a private club.[18]

Other boating organizations have special interests in racing, fishing, and antique and classic boats. Boating consumer groups are represented by the Boat Owners Association in the U.S. and United Boat Owners of America, Inc. The latter specializes in boat registry and the recovery of stolen boats. Many boats have been stolen along the waterway or hijacked offshore for use in the marijuana and drug trade which has been especially active in Florida and Georgia.

There are still along the waterway plenty of isolated spots remote from highways and habitation. Reaching the waterway from the open ocean through shoaling inlets is often a tricky maneuver except in the deep channels maintained at large commercial ports. One of the larger dredging operations along the coast was recently performed at the entrance to St. Mary's, Georgia, in order that the U.S. Navy Trident submarines could reach a new base being established there. This base occupies a site which was an ammunition-loading depot during World War II. It is directly across from the National Park Service's Cumberland Island National Seashore. Within sight of Cumberland Island are the smoking stacks of the paper mills at St. Mary's to the west and Fernandina to the south. Of these, Jan de Hartog wrote:

> "The most distinct shadow line between Florida and Georgia is an invisible one. It consists of a smell, a new nauseous stench that will haunt the traveler all along the Georgia coast: the stink of the paper factories is omnipresent, even in the remotest jungle of the colossal tidal forest that is the Georgia seaboard."[19]

The technology has not yet been developed which will economically eliminate this olfactory pollution, traces of which can sometimes be detected 20 miles from the source.

What about the future? Accounts of travel on the waterway reveal that some areas have changed very little in the last 40 years, whereas others have undergone galloping development. Barring tsunami or hurricane, subdivisions built since World War II are apt to be around at the turn of the next century. Additional developments like Hilton Head and Kiawah are underway, and more high-rise condominiums may overlook the waterway, but their environmental impact will first be studied. Barring accident, the Turkey Point nuclear power plant along the waterway on Biscayne Bay will still be there, but one wonders about the ultimate disposal of the structures when the plant is no longer of service. Other nuclear power plants are under construction adjacent to the waterway near Fort Pierce, Florida, and on the northern end of Key Largo. How many more will there be?

The "boating explosion" seems destined to continue as more young people have opportunities for boating experiences. There are now in the United States some 50 million boaters, and the boating population is increasing by 10% a year.[20] Trailer boating is growing in popularity and ramps and launching facilities are crowded on weekends. With the rising cost of gasoline, more boaters are becoming interested in sailing. The general direction of land-sea breezes and prevailing winds often makes it possible to sail on the waterway.

Water quality on the waterway has improved in the last decade as municipalities have built sewer treatment plants, and factories have gone to secondary and tertiary processing of their waste water. The waterway is now swimmable in some cities, especially where the tides perform a flushing action. Hopefully another decade will find the water of swimming quality everywhere. Hopefully for the next century there will still be places where boaters can drop a hook and spend hours in solitude with only the sounds of nature about them. For those portions of the waterway which must be developed, may men and women apply intelligence so that living, working, and playing along the waterway may be a worthy, satisfying, and aesthetically beautiful experience.

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SOCIAL AND ENVIRONMENTAL FACTORS INFLUENCING BEACH SITE SELECTION

Susan L. Cutter, Karl F. Nordstrom, and Gail A. Kucma[1]

ABSTRACT

The role of user preference as a determinant of beach site selection was examined for five New Jersey beaches. The results of a questionnaire survey indicate no strong systematic relationship between the perception of the attributes of an ideal beach environment and the reason for selecting a particular beach for recreation. This suggests that many beach goers are opting for a less than optimal beach environment. Other factors, such as accessibility, social interaction, and the kinds of facilities available are important and can play a major role in beach site selection.

Sixty percent of the U. S. population live in counties adjacent to the coastal zone (Bennett 1980). Fuel shortages and diminishing real incomes are resulting in increased demand for recreational beach space in close proximity to major metropolitan areas. The beaches in these areas are narrow and in most cases, diminishing through persistent erosion. The planning problem is to provide the maximum number and variety of land uses given widely differing recreational preferences of the urban region on this limited physical resource. Planners must be very careful to adjust the management program of each shoreline park to the best possible land use. This task is rendered difficult in coastal parks due to the highly dynamic nature of beach processes.

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The purpose of this paper is to examine the role of user preferences in determining the selection of specific beach environments for recreation in New Jersey and to suggest how this information can be incorporated into planning and management. The focus is on the perception of the "ideal" beach environment, the reasons for selecting a particular beach for recreation, and the relationship between the two. Heatwole and West (1978, 1979) have shown that the primary reason for urban beach site selection may be the availability of public transportation. As most of the visitors to the New Jersey shore travel by private automobile, the question of the accessibility by public transportation was not examined. The assumption was made that, except for travel time, the transportation constraints were nonexistent. Our premise was that the physical characteristics of the beach (wave height, beach quality, beach width) were only partial determinants of beach selection, and that convenience, the reputation of the beach, social interaction, and the presence of amusements would be important factors. The goal was to quantify the relative importance of each of these.

MAJOR RESEARCH THRUSTS

There has been a wealth of information gathered on the sociological implications of leisure and general recreational behavior (Burch, Cheek, and Taylor 1972; Cheek and Burch 1976; Cheek, Field, and Burdge 1976). Also, literature exists on planning for recreation in urban areas (Gold 1973). Much of this provides useful introductory material for recreational research, but there is very little specific information on beach recreation.

The research on beach use has focused on three broad areas: 1) physical constraints to beach management and use; 2) user profiles; and 3) factors influencing beach participation. Much of the research effort on physical constraints has been conducted at national seashores (Hayden and Dolan 1974; Psuty, Nordstrom, and Allen 1976; Godfrey 1978; Leatherman, Godfrey, and Buckley 1978; Nordstrom and Allen 1978). One of the primary results of this research has been the identification of the requirement to adopt flexible strategies for each seashore recognizing the inherent geographic variability of the natural environment, human modification, and the administrative constraints for each park.

A second major area of research focus has been on the characteristics of the people who visit the beach. These profiles are descriptive in nature and identify the broad social and economic characteristics of the beach user, such as age, race, life-style, and social status. The majority of these studies have been done under the auspices of market analyses for tourism (Sternlieb et al. 1969; Ocean County Tourism Advisory Council 1979) and for the National Park

Service (NPS 1975, 1979). The only generalizations that can be made are that the beach users are predominately white and run the gamut of all other social and economic indicators. However, we do find some small usage of urban beaches in national recreational areas by minority populations (NPS 1975).

The last major area of research has looked at those factors which influence beach participation. A number of studies have looked at willingness to pay and the trade-offs between congestion and demand (Goldin 1971; Fischer 1975; McConnell 1977). Some studies have used the user profiles to determine the effects of race, ethnicity, age, and income as barriers to beach use and access (Spaulding 1973; Flachsbart 1978). Also, studies undertaken by the National Park Service have focused on the transportation constraints to beach use in their national recreation areas (US DOT 1977). In the case of New York City beaches, Heatwole and West (1978, 1979) found that transportation was a major constraint to beach access and a major factor influencing beach site selection.

One aspect of beach participation which has not been fully addressed is the question of the role of preference or attitudinal variables in determining beach selection and use. While the economic studies on willingness to pay have implicitly defined the trade-offs of quality, preference, and satisfycing behavior and the costs associated with each, they do not fully address the issue of the role of preference in beach selection.

PREFERENCE DETERMINATION

There are three primary ways in which preferences are determined. One method involves the use of visual material and asks respondents to state which picture they prefer and what aspects of the picture are most appealing. This approach has been chiefly employed in the determination of attributes of scenic environments (Peterson and Neumann 1969; Kaplan 1977), particularly river environments (Leopold 1968; Morisawa 1971). A second method focuses on the social uses of a particular recreational environment such as that conducted by Kornblum for the National Park Service which focused on the identification of the spatial behavior on New York City beaches (NPS 1975).

The third approach focuses on the development of a model of preferences using attitudinal information (Fishbein and Ajzen 1976; Caris 1978). The present study was structured to test this preferential model in a generalized manner. The preferential data are best obtained with the use of questionnaires. Relatively short surveys can be quickly administered to beach users to elicit a range of preferences for beach environments, beach activities, and reasons for beach use and selection This form of data collection was employed because it was easier to administer than the visual comparison model and has as much reliability. Also, it measures preferences directly and does not infer them from observed behavior.

STUDY DESIGN

For discussion purposes, beach environment refers to the infrastructure consisting of the land-water interface, the back-beach, and finally the development immediately adjacent to the beach itself. Beaches near urban environments in New Jersey are sufficiently different to offer the widest range of recreational opportunities from undisturbed beaches to intensively used areas characterized by boardwalks and amusements. There are also a large number of shore communities with extensive residential developments which severely limit day use because of limited parking and access restrictions. The shoreline of New Jersey has come under increasing pressure for recreational use because of its proximity to large urban centers--New York, Philadelphia--as well as the urban concentrations in northern New Jersey. Five study sites (Figures 1 to 6) have been selected which have slightly different physical characteristics (such as wave heights, water quality, beach quality) and varying levels of development (from undisturbed to resort). Keansburg (Figure 2) is located on Raritan Bay and has the lowest water quality and the lowest wave heights of all the sites. Asbury Park (Figure 3) is a major resort which dates back to the nineteenth century. It is an urban center with a sizable year round population. Island Beach State Park (Figure 4) is the longest stretch of natural beach in the state. Ship Bottom (Figure 5) is largely a summer residential community with very few facilities landward of the beach. Both Ship Bottom and Island Beach have dunes and have the highest water quality and beach quality of all the sites. Ocean City (Figure 6) is a major resort community which has rather narrow beaches that are intensively used in the summer.

Information on beach use and site selection was gathered using a written questionnaire. The survey was distributed to beach users at each of the five sites in August 1979. Respondents selected were those people on the beach who were not actively engaged in swimming, atheletic activities, or sleeping. As this was a pilot study, insurance of a random sample was not deemed critical enough to warrant greater disruption of activities on the beach. Both weekend and weekday users were sampled between the hours of 11:00 a.m. and 3:30 p.m. The length of the interview ranged from 5-15 minutes, and a total of 601 responses were gathered. Most of the survey questions (Table 1) were open-ended. For ease in this preliminary analysis, the beach characteristics were collapsed to fit into broad generic categories--natural features, cleanliness of beach and water, crowded, social atmosphere, lifeguards and beach safety, and facilities including boardwalks and amusements.

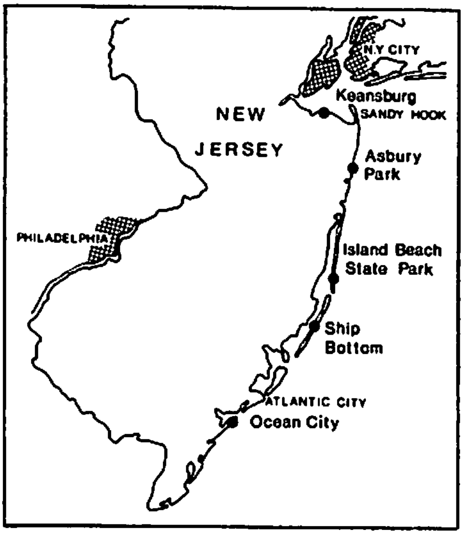

Figure 1. New Jersey study area.

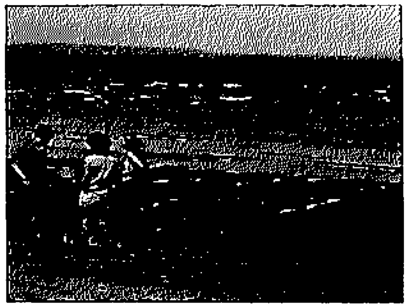

Figure 2. Keansburg, N.J. Wave energies are too low to remove the vegetative matter conspicuous on the lower beach.

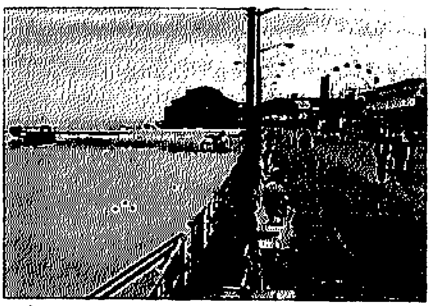

Figure 3. Asbury Park, N.J.

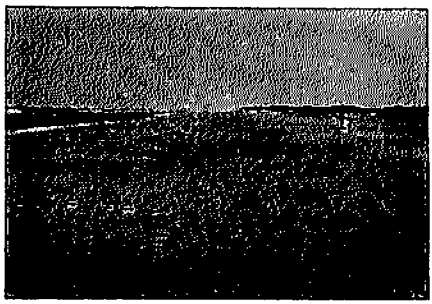

Figure 4. Island Beach State Park.

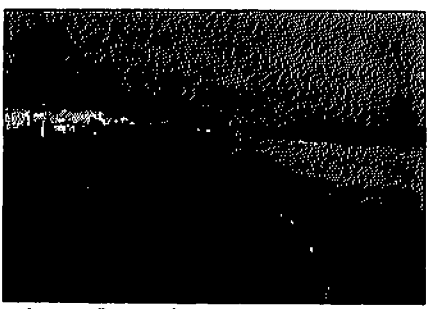

Figure 5. Ship Bottom, N.J.

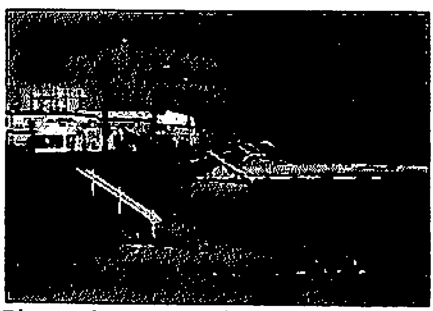

Figure 6. Ocean City, N.J.

TABLE 1

INFORMATION GATHERED BY QUESTIONNAIRE

Perceived ideal characteristics
Reasons for beach selection
Attractive and unattractive beach characteristics
Frequency of beach use
Proximity, time, and mode of travel
Willingness to pay
Sociodemographic characteristics

OVERVIEW OF SURVEY RESULTS

Attributes of an Ideal Beach

Table 2 presents the ideal characteristics of a beach according to respondents ranked in order of diminishing importance by more than ten percent of the sample. The most important ideal characteristic on all sites was cleanliness of the beach and water. At all sites, except Keansburg, the natural characteristics of the beach placed second as part of their ideal. These natural characteristics include wave conditions, presence or absence of dunes, beach width, and the quality of the sand. It should be emphasized that these are attributes of an "ideal" beach environment and not an evaluation of the beach where they were surveyed. The cleanliness and natural attributes do not always conform to the actual physical characteristics of the beaches nor to the reasons why people have gone to them.

We do find some conformity with the actual characteristics on some of these beaches--particularly at Island Beach and to a lesser extent at Ship Bottom. At Asbury Park and Ocean City there is conformity between the ideal and the actual beach environments for the third and fourth placed ideal attributes. Ocean City is highly touted as a family-oriented beach resort with no alcohol allowed, which might account for the importance of the social aspects. At Asbury Park the orientation toward structured use of the beach, as well as the boardwalk and amusements, results in a safer beach and a wider array of facilities.

Reasons for Beach Site Selection

What is the relationship between the attributes of an ideal beach and the reason for selecting the specific beach where the respondent was surveyed? At Island Beach and Ship Bottom many respondents (Table 3) actually selected those beaches because of cleanliness--the top-ranked ideal characteristic. However, the results at the other sites showed

TABLE 2

"IDEAL" CHARACTERISTICS OF A BEACH[a]

Site	1st Response	%	2nd Response	%	3rd Response	%
Keansburg (N = 76)	Cleanliness	53	Cleanliness	32	Cleanliness	12
Asbury Park (N = 158)	Cleanliness	46	Cleanliness	19	Natural	13
	Natural	14	Natural	18	Facilities	11
			Safety	10		
Island Beach (N = 133)	Cleanliness	56	Facilities	10	Facilities	17
	Natural	11	Cleanliness	32	Natural	12
			Not crowded	12		
Ship Bottom (N = 119)	Cleanliness	66	Natural	19	Natural	14
			Safety	18		
			Cleanliness	16		
			Not crowded	14		
Ocean City (N = 115)	Cleanliness	44	Cleanliness	21	Facilities	13
	Natural	18	Natural	14	Natural	13
			Social	10		

[a]Ranked by more than 10% of the respondents.

TABLE 3

REASONS FOR BEACH SELECTION[a]

Site	1st Response	%	2nd Response	%
Keansburg (N = 76)	Covenience	57	Not crowded	12
	Recommended	13		
Asbury Park (N = 158)	Convenience	45	———	
	Other	11		
Island Beach (N = 133)	Cleanliness	35	Cleanliness	23
	Aesthetics	16	Low cost	11
	Low Cost	10	Facilities	10
Ship Bottom (N = 119	Cleanliness	23	Cleanliness	15
	Recommended	18	Not crowded	10
	Convenient	16		
	Social	12		
Ocean City (N = 115)	Convenient	25	Social	12
	Social	24		
	Cleanliness	15		
	Aesthetics	11		

[a]Ranked by more than 10% of the respondents.

that convenience was the most important reason for site selection.

Keansburg is one of the closest beaches to the urban population of northern New Jersey. Most people traveled from 30-45 minutes to reach this beach. Also, Keansburg often receives the overflow crowd from Sandy Hook--a free beach in Gateway National Recreation Area--when that area reaches its capacity. The respondents lived an average of 25 miles from Keansburg, which is less than half the distance traveled by respondents to other sites. These factors appear to override what might be considered rather unattractive beach characteristics. The low quality of the beach and water was listed by 55 percent of those surveyed as the most bothersome characteristic of the Keansburg beach.

Forty-five percent of the respondents at Asbury Park cited convenience as the primary reason for selecting this beach. This can be attributed to its proximity to the metropolitan areas in New York and New Jersey, as well as the substantial year round resident population. The category "other" in Table 3 represents some unanticipated responses. For example, many people under the age of 25 listed the reputation of Asbury Park as a haven and hangout for rock musicians--Bruce Springsteen, Southside Johnny, and the Asbury Jukes--as the reason they were there. This points to the drawing potential of a major urban center where beach use is complemented by other recreational opportunities. Another example of an urban center is Atlantic City where casino gambling provides a major incentive for a visit to the shore.

Cleanliness and aesthetics were the reasons given for selecting Island Beach, which comes as no surprise. It is interesting to note that next to Ocean City, this site had the highest out-of-state users. More than 50 percent of those surveyed were from New York. It could be that people are willing to travel greater distances to get to a relatively undisturbed beach environment, particularly since it is a state park which would enhance its reputation as a natural area. It may also be a function of a location near Atlantic City, and New Yorkers might be taking long weekends to gamble and then frequent this natural beach.

A wider variety of reasons were enumerated for selecting the beaches at Ship Bottom and Ocean City than at the other three sites. Respondents listed cleanliness, convenience, and the social aspects such as family residences, being with friends, or a nice beach to bring children as the primary reasons for site selection. Twenty-six percent of the respondents had a summer residence in Ship Bottom. This could explain the high ratings for convenience and the social aspects. Also, in the case of Ship Bottom, recommendations were an important reason for going there, while in Ocean City aesthetics were important. This emphasis on aesthetics in

Ocean City is rather surprising considering the groin fields and intensive development (Figure 6). It may be that aesthetics are related to the perceived family orientation of the community and the relatively high quality and diversity of the commercial structures along the boardwalk. Ocean City had the highest out-of-state visitors (61% from Pennsylvania alone). Mean travel time to the beach was also the highest--one hour and 40 minutes.

There appears to be inconsistency between the ideal characteristics and the reasons for beach site selection (Table 4). For example, only one percent of the sample cited natural characteristics as important components of their ideal and actually went to the beach for that reason. Also, more people who cited cleanliness as part of their ideal went to the beach because it was convenient rather than because of the clean water and sand. This points to the satisficing behavior of the users. They are not selecting beach sites which conform to their notion of the ideal beach environment. Rather, they are selecting beach environments because they are convenient, have a particular reputation, or because their friends go there. In many instances they are taking their second, third, or fourth choices.

TABLE 4

RELATIONSHIP BETWEEN IDEAL AND REASON FOR BEACH SELECTION[a]

Ideal	Reason: Natural	Clean	Crowded	Social	Safety	Facilities	Convenient	Other	Total
Natural	0.6	1.4	0.4	2.0	0.0	0.2	4.3	4.9	13.8
Clean	2.0	12.8	1.6	5.7	0.2	0.8	18.8	19.4	61.3
Crowded	0.0	0.6	0.6	0.0	0.0	0.4	0.6	0.6	2.8
Social	0.0	0.0	0.0	0.8	0.0	0.0	1.2	1.0	3.0
Safety	0.0	0.8	0.2	0.2	0.4	0.2	0.8	0.8	3.4
Facilities	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.4	1.0
Convenient	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.6	1.8
Other	0.2	3.0	0.2	0.8	0.0	0.0	3.8	4.7	12.8
Total	2.8	18.6	3.2	9.7	0.6	1.6	31.0	32.4	100.0

N = 494
Chi Square = 103.79
Significance = 0.0000
Contingency Cofficient = .417

[a]Numbers represent the percentages for each cell.

Less than three percent of those surveyed at all sites selected specific natural characteristics as the reasons for site selection (Table 4). This suggests that the physical environment plays a minor role relative to the other factors which have been enumerated. However, when we asked what the most bothersome characteristics on the beaches were, aspects of the natural environment were mentioned most frequently for all beaches. These included such things as bad weather, bugs, and blowing sand. However, these phenomena are beyond the control of managers of recreation areas.

CONCLUSIONS AND IMPLICATIONS FOR BEACH MANAGEMENT

This initial analysis indicates that people appear to be weighing the positive and negative attributes of the beach, but they are willing to trade off the quality of the beach for convenience. The study shows that there are other factors, however, which are important selection criteria.

The information provided by a user preference study is directly useful to managers by pointing to the myriad of factors which comprise a person's preferred ideal beach environment. Not everyone wishes to have undisturbed beaches with primitive facilities or few recreational opportunities. This should be recognized and incorporated into recreational planning. The study illustrates the need to understand satisfycing behavior, considering the constraints on this behavior such as transportation, beach fees, and restricted access. The conclusions represent a first cut of the data and are tentative. However, this study illustrates that an understanding of the attitudinal determinants of beach site selection is required to improve the recreational potential of each beach site. Many of the preferences identified by the sample population could be translated into action by a municipality or state to increase either the number of users to the site or simply to increase the recreational experience of the current users. This type of study can and should be utilized as a check to see if existing management plans are working or as a mechanism for altering management plans. Considering the increasing demand for recreational beach space, it is imperative that management plans be developed which are more consistent with the goals of maximizing the experience of the beach user.

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URBAN BEACH USE: ETHNIC BACKGROUND AND SOCIO-ENVIRONMENTAL ATTITUDES

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ABSTRACT

This paper is part of a larger study analyzing beach recreation in New York City. The decision to participate in recreation beaching is influenced by the following three groups of variables: (a) the social and physical environmental characteristics of the beach; (b) the environmental constraints and opportunities associated with the distance between the visitor's residence and his/her chosen beach; and (c) the socio-cultural characteristics of the user. This paper explores the attitudinal similarities and differences as expressed by the users while on the beach. These expressions have been divided into both positive and negative statements describing the three major components of the beach environment. They are (a) social relationships encountered or observed while on the beach; (b) positive or negative variables related to the physical beach environment, and, similarly (c) variables associated with the management and operation of the beaches.

Research on marine recreational user preferences, with very few exceptions, has attempted to identify specific socio-economic variables as indicators or predictors of recreational behavior and very little has been conducted within an urban area.[1] This study, conducted during the summer of 1978, is part of a larger study of five Metropolitan beaches located in New York (see Figure 1).

Previous research by the authors tends to support a clustered distribution of beach users by ethnic composition. It is not known whether these patterns are influenced by socio-environmental variables external to the beach itself, such as accessibility by public transportation,[2] or if the ethnic user patterns are based on different attitudes towards particular characteristics of individual New York City beaches.

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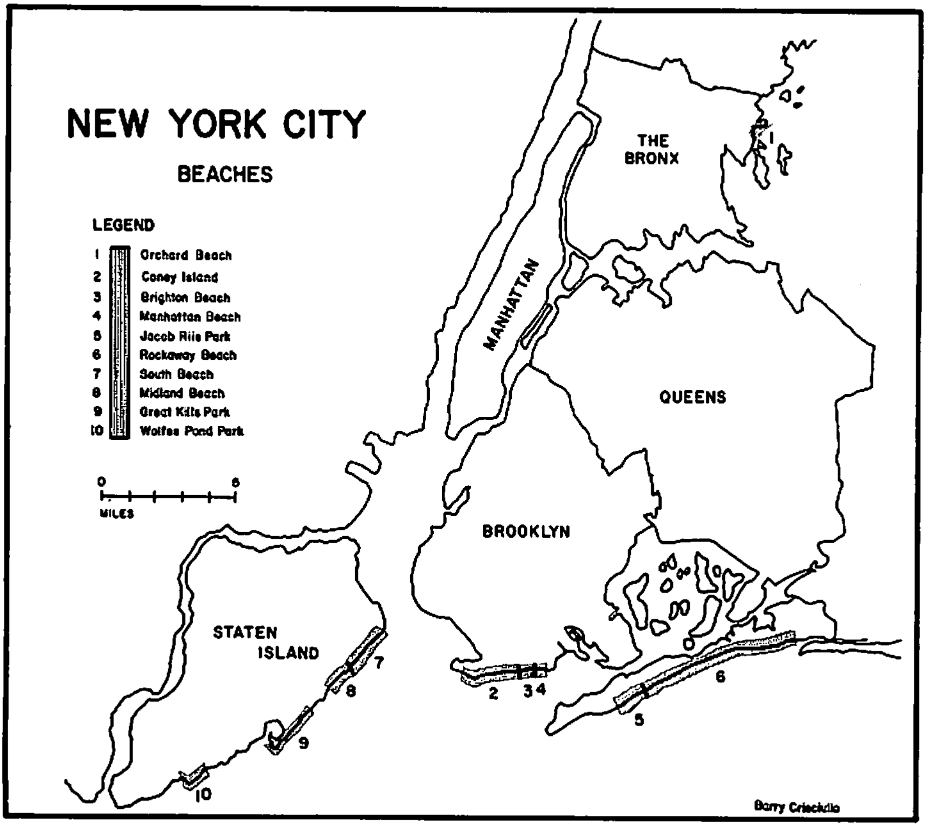
NEW YORK CITY
BEACHES
LEGEND
1 Orchard Beach
2 Coney Island
3 Brighton Beach
4 Manhattan Beach
5 Jacob Riis Park
6 Rockaway Beach
7 South Beach
8 Midland Beach
9 Great Kills Park
10 Wolfes Pond Park
0
5
MILES
THE BRONX
MANHATTAN
QUEENS
BROOKLYN
STATEN ISLAND
1
2
3
4
5
6
7
8
9
10
Barry Crieckilo

FIGURE 1

Little is known about the positive and negative attitudes which the beach user may have toward the beach itself and even less is known about the relationship between expressed attitudes and the decision to engage in a recreational activity, in this case, beach recreation. Cutter et.al. describe elsewhere in these Proceedings beach visitors' attitudes toward the beach environment, although the beaches surveyed are decidedly suburban or rural.[3] Are the preferences and attitudes which all beach visitors have toward the beaches randomly distributed, with respect to the ethnic origin of the user, or is there evidence of attitudinal differences by different social and ethnic groups? This study is an attempt to identify the nature of attitudinal differences among the three largest ethnic groups using the beaches in and around New York City.

The results are important. If different ethnic groups do tend to favor certain beaches, their attitudes towards these beaches could affect the way in which beach management decisions are made. For instance, if significant beach preferences can be correlated with particular ethnic groups, there is a possibility that beach improvement dollars may be distributed with a greater regard for the political and economic power of the users than for the needs to the beach environment itself. Conversely, if it can be shown that socio-environmental attitudes towards beach recreation and beaches are influenced by other factors, funds may be allocated to alleviate those beach problems which the users consider more important.

The question is important for another reason as well. If it can be shown that different subgroups perceive or have attitudes which differ from what is commonly believed to represent good management, these should be incorporated into management decisions as long as they are not detrimental to society or the physical environment. Consequently, there is a need to identify group value systems and to incorporate these into educational, recreational and economic systems. Before these problems can be addressed from a management point of view, it is important that relevant attitudinal information be gathered and preliminary analysis conducted.

The total data base comprising approximately 2000 responses was divided into three major groups: blacks, whites and hispanics, and subdivided by the five beaches surveyed. A series of questions was incorporated in the survey which dealt with the visitor's attitude toward the "ideal beach", the beach on which the interview was conducted, and finally the "least desirable beach." It was felt that responses to such questions might provide some insight into the extent to which different subgroups perceive beaches in general as well as the more specialized beach environments identified above.

While nearly 100 different socio-environmental responses related to the beach were cited by the respondents as factors influencing their decision to visit or not to visit the beach, it became clear that these could be grouped into three broad categories based on (a) the physical characteristics of the beach, (b) the characteristics of the beach visitor interviewed, and (c) the management of each beach. Based on the frequency of responses in each of the three major categories, the visitors surveyed were much more inclined to mention the quality of the beach's physical characteristics as the primary reason for either liking or disliking the beach. Socio-economic factors were the second major determinant in beach selection. Responses indicated that the management and administration of the beach was the least important factor in beach preference.

The attitudinal analysis was conducted on two levels. The first tested for variations across all five beaches holding each ethnic group constant. In other words, the responses from each of six attitudinal questions were cast into six contingency tables (one for each question). The three columns in each table (Fig. 2) identified the three management/social/environmental groupings described above, while the rows identified the three ethnic populations.

The second series cast the responses into six 3 x 5 contingency tables with one axis consisting of the three management/social/environmental factors identified above and the other axis made up of the five beaches on which the survey was conducted. The format of the contingency tables appears in Fig. 3. Because of space limitations, it was decided to summarize this information into two tables which include the contingency coefficients and the significance level of each of the chi square tables described above.

A summary of the responses from the total sample broken down by ethnicity and management/social/environmental appears in Table 1. This table suggests that considerable variation exists in the attitudes of the white visitors. A much weaker differentiation in the socio-environmental attitudes is found among the black and hispanic visitors with one important exception. The black responses to the two questions dealing with the specific likes and dislikes of the beach on the interview was conducted were much stronger than those of both the whites and hispanic visitors. These two statistics suggest that blacks have relatively stronger opinions with regard to the attributes and disadvantages of those beaches with which they have had direct experience.

The second part of the analysis identifies the socio-environmental attitude of the three ethnic groups for each of the five beaches. The results of the contingency tables have been summarized in Table 2 along with the questions which elicited these responses.

The analysis testing for different ethnic responses across the five beaches showed remarkably similar results. While some beaches were more favorably perceived than others, there appeared to be general agreement within each beach population regarding the significance of the social/environmental management attributes of each of the five beaches surveyed. The preponderance of the designation n/s (not statistically significant) in Table 2 would suggest that ethnicity plays a very minor role, if any, in the perceived attributes of each of the five beaches. The only question which generated some divergence within three of the five beaches related to the following: "What do you look for in a beach?" The strength of the chi square was not particularly high and may relate to the rather unique characteristics of Coney Island, Jones and Orchard Beaches. Coney Island, besides being a well known beach, is also an important amusement park; Jones Beach, on the other hand is comparatively free of concessionaires. The beach is more open and not accessible by public transportation. Finally, Orchard Beach is the only beach included within the sample which is located on Long Island Sound, relatively accessible by public transportation but without the amusements associated with Coney Island.

The conclusion which may be drawn from this suggests that each of the beach populations has similar attitudes or perceptions toward the beach environment, management, and other visitors to the beach.

Three questions dealt with negative aspects of the beach currently visited and others perceived as generally unfavorable. These questions resulted in a larger differentiation when analyzed according to ethnicity. In other words, there was general agreement among blacks, hispanics and whites concerning the positive aspects of a beach environment. Such similarities tended to break down when viewing the negative or least desirable beach characteristics. One possible interpretation relates to the many neighborhoods which are represented on the city beaches and which may reflect different tolerance levels toward undesirable beach and bathing environments.

Interpretation of this data is difficult, yet some general trends are evident. Attitudinal responses appear to span a much wider range when disaggregating white beach users from the total sample. This trend is evident when viewing positive characteristics which attract visitors to the beaches as well as negative factors which detract from the beach experience. More white visitors responded to the attitudinal questions, hence a more heterogeneous response pattern is evident for this segment of the user population. The white population is more likely to have visited a larger range of both superior and inferior beaches providing this group with a greater base on which to make comparisons. This would account for the larger response range of the whites to both the positive and negative beach characteristics across all five sampled beaches.

Blacks, although less mobile, exhibit much stronger associations with respect to both the positive and negative characteristics of the beaches actually visited. This group's response pattern to other beaches was significantly less striking. One possible interpretation may relate to the fewer beaches accessible to the visitors without cars, which include a major proportion of the black and hispanic respondents. This point is in part verified by previous research

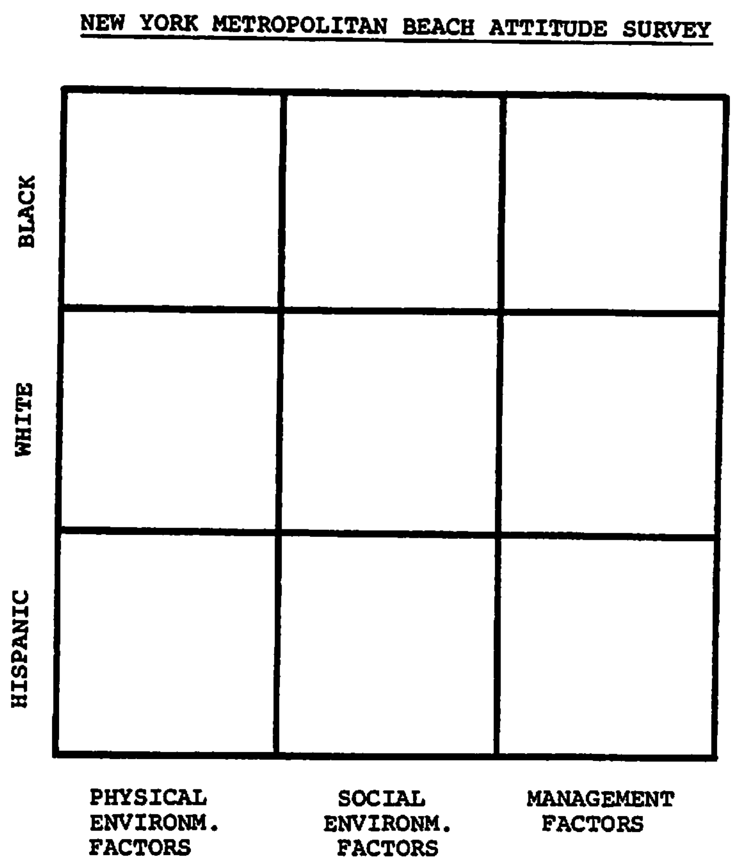
NEW YORK METROPOLITAN BEACH ATTITUDE SURVEY
BLACK
WHITE
HISPANIC
PHYSICAL ENVIRONM. FACTORS
SOCIAL ENVIRONM. FACTORS
MANAGEMENT FACTORS

Fig. 2

NEW YORK METROPOLITAN BEACH ATTITUDE SURVEY

	PHYSICAL ENVIRONM. FACTORS	SOCIAL ENVIRONM. FACTORS	MANAGEMENT FACTORS
CONEY ISLAND			
JONES BEACH			
ORCHARD BEACH			
RIIS PARK			
GT. KILLS BEACH			

Fig. 3

TABLE 1

CONTINGENCY TABLE SUMMARY

NEW YORK METROPOLITAN BEACH ATTITUDE SURVEY

	White	Black	Hispanic
"Why do you like your most favorable beach the most?"	**** .21	n/s	n/s
"What do you look for in a beach?"	** .13	n/s	* @ .27
"What is there about this particular beach that you like?"	**** .38	****@ .55	****@ .34
"Is there any reason(s) why you have not visited any other New York area beaches?"	**** .39	n/s	n/s
"Why do you not like your least favorable beach?"	****@ .24	n/s	n/s
"Is there anything about this particular beach that you do not like?"	**** .31	****@ .51	****@ .51

@one or more cells may be deficient to accurately compute significance of chi square.

n/s = Not statistically significant

* = Significant at .05 level
** = Significant at .01 level
*** = Significant at .001 level
**** = Significant at .0001 level

TABLE 2

CONTINGENCY TABLE SUMMARY

NEW YORK METROPOLITAN BEACH ATTITUDE SURVEY

	Coney Island	Jones Beach	Orchard Beach	Riis Park	Gt. Kills Beach
"Why do you like your most favorable beach the most?"	n/s	n/s	** .33	n/s	n/s
"What do you look for in a beach?"	**@ .15	**@ .23	***@ .26	n/s	n/s
"What is there about this particular beach that you like?"	n/s	n/s	n/s	n/s	****@ .37
"Is there any reason(s) why you have not visited any other New York area beaches?"	** .27	n/s	* .35	n/s	n/s
"Why do you not like your least favorable beach?"	n/s	n/s	** .35	n/s	n/s
"Is there anything about this particular beach that you do not like?	n/s	****@ .32	n/s	***@ .33	****@ .37

@one or more cells may be deficient to accurately compute significance level of chi square.

n/s = Not statistically significant

* = Significant at .05 level
** = Significant at .01 level
*** = Significant at .001 level
**** = Significant at .0001 level

conducted by the authors which shows that ethnic distribution of beach visitors is related to the availability of public transportation. Although no question was included in the questionnaire concerning car ownership, the vast preponderance of both blacks and hispanics arrive at the beach via public transportation. Consequently a "de facto" segregation appears to exist.

The still very tentative conclusion which may be drawn from this analysis, suggests that attitudes concerning beach recreation may be influenced more by the economic and social conditions describing the respondent's neighborhood environment and less by his or her ethnic background. While some responses suggest significant relationships on the basis of ethnic background, no apparent trend can be established among the five beaches analyzed. Both Orchard and Riis Park beaches are among the most integrated, yet they exhibit the widest differences in their attitudinal response pattern. Since both beaches are connected by public transportation, these beaches are accessible for people with or without private means of transportation. It appears that differences in the responses are a result of different economic opportunities which are being masked by the visitor's ethnic composition.

FOOTNOTES

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"Modeling & Predicting Human Respond to the Visual Recreation Environment" Journal of Leisure Research (Summer '69) 1,3

[2]Heatwole, Charles A.; Niels West, "Mass Transit & Beach Access in New York City, Geographical Review (Apr. 1980) 70,3.

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THE URBAN COAST: A UNIQUE RESOURCE

Grace L. Singer *

Abstract

Changing perceptions of the urban coast are illustrated in this case study of citizen opposition to further industrialization of their waterfront. Citizens in Hudson County, New Jersey are demanding amenity uses for their area on the Hudson River in New York harbor. This includes recreation, housing and other "people activities" to humanize their unique resource. This case is indicative of the feelings of residents of other cities where waterfront revitalization is taking place, notably Boston, Philadelphia, Baltimore, Chicago, Detroit, San Francisco and Seattle.

The words urban and coastal are almost synonymous since nearly every major city is located on navigable water and almost half of the U.S. population lives within 50 miles of a coast. Thus, urban coastal areas play a key role in national affairs. Many waterfronts in the U.S. cities are, however, in a state of decay and vacancy, and are ripe for redevelopment.

Waterfront development in Europe and the United States differed in that European cities grew before the industrial revolution and waterfront areas were part of the fabric of city life. In contrast, many American waterfronts were industrialized in their early development. Port activities in the U.S. proved highly susceptible to technological changes such as containerization and the advent of rail and truck transportation. This and the move of factories to suburban areas are the principal causes of urban waterfront decay.

Several cities, notably Boston, Philadelphia, Baltimore, Chicago, Detroit, San Francisco and Seattle are in the process of revitalizing their waterfronts. On the East Coast urgency is added to waterfront issues by the advent of offshore oil and gas development and the possible concommitant need for onshore service facilities. Waterfront revitalization is an important step to overall urban renewal since port areas are usually the oldest and most decayed portion of a city. These valuable areas are often vacant and offer a unique resource in a generally bleak urban picture.

At Princeton University's Center for Energy and Environmental Studies we have conducted a study for the U.S. Department of Energy on energy facility siting in urban coastal areas. We used case studies on the Texas and Louisiana Gulf Coast and in Hudson County, N.J., across from Manhattan in New York harbor. I will discuss the New Jersey case because of the clarity of the issues it raised.

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In five years, from 1972 to 1976, five major energy facility proposals were rejected here due to strong citizen opposition. These were primarily petrochemical processing and storage operations, one of which would have been the largest on the East Coast. This general area is heavily industrial and has severe pollution problems, particularly in air quality. The citizen issues which developed fell into three major categories:

1. Appropriate land use - Should there be further industrialization or primarily mixed amenity use for recreation, housing, stores and restaurants?

2. Pollution and Safety - Some of the products to be stored were carcinogenic and volatile.

3. Socioeconomic issues - including jobs. Energy facilities are not labor intensive. For example, the largest of the rejected facilities would have provided 2 jobs per prime waterfront acre in an area with high unemployment.

The underlying force in the successful citizen action was a changing perception of their urban coast as a special place and not just as another piece of real estate on which they would allow, for example, 242 6-story oil and chemical storage tanks emitting 100 tons of hydrocarbons annually. (This was actually one of the five rejected proposals.) Following is a quote which summed up the citizen's frustration.

> "Urban living is a real challenge. We are constantly fighting for survival. The problems of crime, pollution, rising taxes, lack of services plague us.... Let's make the waterfront attractive to all, industry, residents and visitors. The construction of a tank farm will result in more unhealthy air and perhaps a mass exodus of residents who will flee this city fearing for their health and their lives."

The 22 citizen groups involved in the energy facility battles joined in 1977 to form a Waterfront Coalition. Realizing they could not forever fight brushfire wars to prevent unwanted development, they requested that the state create a regional planning mechanism to coordinate development of an 18-mile stretch of the Hudson River waterfront encompassing 15 municipalities in 2 counties from the George Washington Bridge to the tip of the Bayonne peninsula.

New Jersey's Governor Brendan Byrne responded by forming the Hudson River Waterfront Study, Planning & Development Commission to recommend a course of action. The Commission was formed this year and consists of almost 40 members, including 15 mayors, county and state government representatives and a few non-government citizens mostly from outside the subject area. I am one of the people named to the Commission and the early experience is proving to be a frustrating one. This is due to the complexities inherent in cutting across 17 political jurisdictions to create a regional approach to planning for this special area from which one can view the spectacular New York City skyline, New York Harbor, the Statue of Liberty and Ellis Island and enjoy the new, developing 800-acre Liberty State Park in Jersey City.

One of the issues the Commission will be addressing, along with regionalization, is revenue sharing so that the competitive ratable race among municipalities can be diminished. Regionalization may, however, be very difficult to approve in this entrenched "home rule" area with strong political figures, each zealously guarding his own turf. There are some regional models from which the Commission can learn. One is the Hackensack Meadowlands Development Commission in New Jersey. Another is the Twin Cities Regional Commission for St. Paul and Minneapolis, both of which use revenue sharing. (The Bay Conservation and Development Commission in San Francisco does not have revenue sharing.)

In our report to the U.S. Department of Energy, we at Princeton made several recommendations. One was that only truly water dependent energy facilities be located at the water's edge. Creative siting can be employed here. For example, an oil storage facility can be located inland with only a pipeline at the shore.

One suggestion which has been made to "green up" the waterfront is a linear green strip along its 18-mile length for jogging, biking and strolling, and a waterfront park in each municipality in the area. The hope and vision is to humanize our urban coast with "people activities" and make them once again the vital, if different, areas they were. Such a turnabout can help mitigate the often harsh conditions in our cities and bring people back to urban areas. This, of course, will also alleviate pressure on the rural coast.

William Slayton of Urban America aptly expressed this vision when he said:

> "The goal is the creation of an urban society that retains a continuing association with the natural world. This is achieved not by opposing all development, but by insuring that it is channeled into forms that are in harmony with the natural environment....Even in our crowded urban regions of the future, there is a place for nature and a place for man."

The Environmental Impacts of Marinas and Their Boats: Research Needs and Management Considerations

Gail L. Chmura[1] and Neil W. Ross[2]

ABSTRACT

Any alteration or change in the physiographic features of the shoreline may be assumed to have an environmental impact. By providing services for recreational boats, marinas alter the shoreline, and thus have a complex impact, both negative and positive, on a small portion of shoreline. Defining and measuring the impact of any marina requires that each component be viewed first individually, and then as part of the whole system.

Many decisions made regarding the construction of marinas appear to be based on "common knowledge" of their environmental impacts. To determine how much of this "knowledge" is verified by scientific research, a review of the literature available on all aspects of marina and boat-related environmental effects was conducted. It was found that qualitative discussions far outnumber quantitative reports and that many discussions have been supported by limited research or have been based on inconclusive studies. Dredging, boat motor exhaust, and boat sewage are three major impacts of marinas and boats discussed.

INTRODUCTION

In Rhode Island and most coastal states, facilities for mooring and servicing recreational boats (hereafter referred to as marinas) are at a premium and pressures for continued development are intensive. The general public recognizes that by altering the shoreline marinas are capable of having significant environmental impacts and they support the regulation of such development. Regulation is imposed at the municipal, state, and federal levels, often by those outside the scientific community who do not have the time to sift through the reams of literature now available on marine-related impacts. Many decisions made regarding the construction of marinas appear to be based on "common knowledge" of their environmental impacts. To determine how much of this "knowledge" is verified by scientific research, a review of the literature (4) available on all aspects of marina and boat-related environmental effects was conducted. It was found that qualitative

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discussions far outnumber quantitative reports and that many discussions have been supported by limited research or have been based on inconclusive studies.

To illustrate these problems, three major impacts of marinas and boats will be discussed: dredging, boat motor exhaust, and boat sewage. This discussion reflects the bias of the 1978 literature review (4) it originated from, which we prepared for use in Rhode Island and other Northeastern states. However, most points are still applicable to the development and use of any small boat marina in our nation.

DREDGING

A wealth of literature has been published regarding the effects of dredging and dredge material disposal, but most of these studies are concerned with the dredging of rivers and large ship harbors, rather than small, recreationally oriented marinas. For this reason, the specific effects of marina-related dredging are difficult to define and are often misrepresented.

For example, the term "dredge spoil dumping" has been revised to "dredge material disposal," and a recent suggestion for another revision has been "dredge material discharge." This terminology has reflected the status of findings of recent reseach, which recognize limited, but positive aspects of dredging. Unfortunately, public attitude and understanding have lagged far behind. Past history has shown us that discharge at open-water sites can cause benthic habitats to be drastically altered and large volumes of sediments to be temporarily resuspended in the water column (23). Discharge in wetlands can bury these valuable habitats, while discharge on upland areas may cause pollution of groundwater and topographic and vegetative alterations (22). However, since the most common dredging praccices in marinas are spot and maintenance dredging, the volumes of dredge material are relatively low and and often can be dried at suitable upland sites with minimal negative impacts. The effects of dredge material on the environment is also relative to the nature of the sediments, which in the area of many marinas is relatively innocuous as compared to that of heavily contaminated ports and harbors.

The act of dredging may adversely affect the environment by increasing turbidity, reducing oxygen content, causing the buildup of sediment and burial of benthic organisms, disrupting and removing bottom habitat, altering water circulation, and creating "stagnant deepwater areas" (22). No reports were found which reviewed these impacts with respect to the localized, small-scale dredging operations of many marinas.

Most investigators did agree that impacts related to water quality are temporary and that benthic communities recolonized dredged areas (although in some instances species composition was altered). The creation of "stagnant deepwater areas" was often mentioned in discussions, but never examined in the actual studies of dredging. Perhaps this impact is more applicable to alteration associated with residential waterfront development, as in the case of Venetian canal construction often seen in Southeastern United States. Investigators also agreed that dredging impacts are site-specific, dependent upon the nature of the dredged area (i.e., bottom characteristics and flushing patterns), the nature of dredging methods used, and the treatment of the dredge materials. Thus, before making conclusions on the impact of a proposed dredging project it is critical that information be available on the physical characteristics and biological resources of the area.

It has traditionally been assumed that dredging in small marinas creates all the impacts described in the studies of port and harbor dredging. However, can it also be assumed that impacts are directly proportional to the size and intensity of dredging projects? Obviously, studies are needed which review dredging impacts on a smaller scale to be assured that we truly understand the consequences of these projects.

BOAT MOTOR EXHAUST

Research on the effects of boat motor exhaust have been directed exclusively to the emissions of outboard motors, excluding inboard and inboard/outboard engines. While it appears to be considered "common knowledge" that outboard motors cause deleterious impacts, extensive studies conducted with these motors have cited no serious degradation of water quality.

In 1963, English et al. conducted comprehensive laboratory and field studies on the effects of outboard motor exhaust (7, 8), but their results were based on the operation of motors which were not equipped with crankcase drainage recycling devices. Two comprehensive studies identifying the components and effects of outboard motor exhaust have been reported since the early studies by English et al. Kuzminski directed a series of studies for the Division of Water Pollution Control, Massachusetts Water Resource Commission, on the effect of outboard motor exhausts on water quality and associated biota of small lakes (14, 15, 16, and 17). The Boating Industry Association and Environmental Protection Agency jointly sponsored another study by three different research groups, published under the title "Analysis of Pollution from Marine Engines and Effects on Environment" (25).

Kuzminski and Fredette (27) found that concentrations of exhaust in waters after normal outboard usage did not inhibit the growth of two species of freshwater algae (*Selenastrum capricornutum* and *Anabeana flas-aquae*). The EPA/Boating Industry study (25) also found that there was no significant difference between diatom communities, zooplankton communities, or organic production in control ponds compared with those subjected to outboard motor use. Both the EPA/Boating Industry report and a report of another general study on Lake X in Florida (12) concluded that outboard motor emissions under normal field conditions do not significantly affect aquatic systems or seriously degrade water quality.

Although the authors of these studies found no conclusive evidence that outboard motor emissions were harmful, they did point out that there is a need for additional laboratory studies and research regarding sensitivities of vertebrate and macroinvertebrate animals (such as shellfish). Clark et al. (6) looked specifically at the effect of outboard motor effluent on marine shellfish and observed that both oysters (Ostrea lurida) and mussels (Mytilus edulis) showed stress from exposure to the effluent. This study was preliminary and utilized high (10%) levels of effluent, but it supported the concern expressed by previous researchers.

Clark et al. also pointed out that the lighter, more refined petroleum products (e.g., diesel oil) are taken up more quickly by these shellfish than heavy, more viscous products. However, URI researchers (18) have discovered that in one boating harbor (Wickford, R.I.) concentrations of aromatic hydrocarbons (probably from petroleum fuels) actually decrease during the boating season. It was suggested by researchers that these hydrocarbons might be removed from the water by evaporation or possibly degraded biologically or photochemically during the summer.

To date, most study areas have been limited to freshwater lakes, ignoring brackish and saline waters. In addition, field researchers have not looked at enclosed marina waters, where effluents could be concentrated.

Results of field and laboratory studies conflict regarding the quantity of fuel that can be used per volume of water before fuel traces become noticeable in water and fish. After field tests, the EPA/Boating Industry study (25) reported that up to 110.5 gallons of fuel could be used per million gallons of water before any alteration in the taste of fish was demonstrated. In laboratory studies by Kuzminski et al. (16), one gallon of outboard motor fuel was exhausted into 400 gallons of tap water in a stainless steel tank and subsamples at various dilutions were presented to test panels. The odor threshold concentration was found to occur at less than one-third gallon of fuel per million gallons of water.

Little can be done to reduce the impact of boat motor emissions other than reducing boat pressure. Results of boat motor exhaust studies suggest that threshold guidelines cannot be generalized, and any management of motorboat use must consider each waterway individually, by reviewing the use and characteristics of each system. Obviously, more research is required on the effects of boat motor exhaust. However, research and development by marine engine manufacturers aimed at reducing the pollutants in emissions, enabling the use of unleaded fuel, and increasing fuel efficiency will be of value.

BOAT SEWAGE

Boat waste studies can be confusing and may be inconclusive because coliform counts (used as indicators of sewage pollution) and other measurable effects of boat wastes are influenced by boat densities, number of people per boat, tides, the day of the week that samples are taken, and other factors (9). In addition, it is difficult to determine if coliforms are from human or animal wastes (such as dogs, waterfowl, or seafood-processing waste, etc.).

During one summer boating season, Fufari and Verber (10) analyzed water, shellfish, and sediment samples from a saltwater cove in Rhode Island (Potter Cove) and reported that the primary source of coliforms was boat waste, although other sources were present. Cassin et al. (3) also reported that on Labor Day weekend coliforms increased in the water column and shellfish in direct relation to a small boat population of an estuarine area on the New York coast. In a comparison study, Barbaro et al. (1) sampled marina and non-marina waters during the summer boating season on a Mississippi reservoir. Marina waters contained significantly higher fecal coliform and fecal streptococci counts than non-marina waters. Results of a study reported by Seabloom (24) may be contradictory to those conclusions. Coliform counts were taken in two small boat harbors of Washington State. During the boating season, counts increased 11% in a small freshwater inlet, but decreased 38% in a saltwater embayment on Puget Sound.

Mack and D'Itri (20) studied a freshwater marina area and found that fecal coliforms increased in the dock slips most frequently used by yachts. They also concluded that the number of coliforms was related to the number of yachts in the marina, but that no gross pollution was occurring at the marina. In a subsequent study, Mack (19) discovered that the source of a large number of coliforms was actually from local streams feeding into the boating water. Other researchers have found that water quality in some areas is too variable to measure the effect of pollution due to concentrated boat use (26), or that the background levels of coliforms resulting from land-based sewage input were so high that no boating-related impact could be detected (21).

Since coliform counts in surface waters are not always a dependable measure of water pollution by boats (19), Kassebaum (13) explored the possibility of using measurements of coliform concentration in oysters to indicate the impact of boat wastes. Unfortunately, it was found that variation in coliform bacteria concentrations in the oysters was not directly related to boat usage in the marina.

Boat wastes are considered a problem primarily in enclosed inland waters and semi-enclosed coastal waters where flushing is minimal. In problem areas, boating can be monitored and regulated. The size, depth, tidal flushing, and characteristics of boat use must all be considered to determine the sewage capacity of a waterway. As an example, Fufari (9) has calculated how many boats may be allowed in shellfish areas (assuming a background count of zero coliforms) to maintain standards of 70 coliforms per 100 milliliter of water. Kassebaum (13) also calculated the allowable number of boats to maintain coliform standards, but emphasizes that if such calculations are to be accurate, they must be derived for each water basin on an individual basis.

Further research is needed to determine the validity of the use of total and fecal coliform counts as indicators of sewage pollution in waterways. Future research must also include an exploration for and analysis of non-boating sources of coliforms, as well as the hydraulic characteristics of the waterway studied.

Boat sewage is perhaps the single environmental impact which has caused the most public reaction and the severest governmental regulation. It is also a scientific area where methodology is imperfect (especially the use of coliform count indices) and study results are inconclusive. Exaggerated impacts from boat sewage have been oversold by public health officials and disclaimed by the boating interests. Research is needed on many aspects of the impacts of sewage. It is obvious that regulation will not wait, and it appears that "common knowledge" will prevail until the facts are known.

SUMMARY

Much of the scientific literature available today adequately describes the environmental components of marina and boat impacts, but provides little hard data supporting conclusions on the severity of those impacts. Studies directed specifically at marinas are needed. The reports "Marina Del Ray: A Study of Environmental Variables in a Semi-Enclosed Coastal Water" (2) and "Ecology of Small Boat Marinas" (21) are the only comprehensive studies primarily concerned with marinas and their boats. Other studies could have been improved by including more in-depth reviews of the physical characteristics (i.e., hydraulics) of the waters. Future research on marinas must include such information.

"Common knowledge" of boat and marina impacts is currently being used to develop most coastal management programs and the regulatory measures that will mitigate the perceived impacts. It is essential that those concerned with these impacts understand where scientific facts end and where "common knowledge" begins. When such understanding is present, credible and realistic regulation and development will be assured.

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PART VI

COASTAL HAZARDS

Moderator: Rutherford Platt

Coastal Wetland Regulations Based on Physical Coastal Processes

Graham S. Giese[1] and Lester B. Smith, Jr.[2]

Abstract

In response to a need for standards for activities in coastal areas to implement the Massachusetts Coastal Zone Management Program, coastal wetland regulations were developed based on the existing Wetlands Protection Act.

This act divides the coastal environment into separate "resource areas", five of which are specifically critical to the statutory public interests of storm damage prevention and flood control: land under the ocean, coastal beaches, coastal dunes, barrier beaches and coastal banks. We first identified those resource area characteristics which affect wave action and sediment supply, the two primary physical coastal processes. For example, in the case of coastal beaches, form, volume and responsiveness to wave action were identified as the beach characteristics most critical to wave action and sediment supply. Next, standards were developed which would protect the specified resource area characteristics. In the case of coastal beaches, the regulations require that any activity shall not decrease beach volume or alter beach form.

The ultimate aim of the regulations is to reduce storm and flood damage by protecting the natural buffering functions of coastal features. This is accomplished by preserving the natural coastal processes which formed and maintain them.

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INTRODUCTION

One of the first tasks after federal approval of the Massachusetts Coastal Zone Management Program was the establishment of regulations to implement the existing Wetlands Protection Act. This was in keeping with the networking approach to Coastal Zone Management which Massachusetts developed to utilize and coordinate existing regulatory programs.

The Massachusetts Wetlands Protection Act provides for seven public interests: storm damage prevention, flood control, prevention of pollution, protection of water supply, protection of ground water, protection of marine fisheries, and protection of land containing shellfish. The following coastal wetland resource areas are specifically protected by the Act: Land Under the Ocean, Coastal Beaches, Coastal Dunes, Barrier Beaches, Coastal Banks, Rocky Intertidal Shores, Salt Marshes, Land Under Salt Ponds, Land Containing Shellfish, and Fish Runs.

Our approach to the development of the regulations was to identify the physical and biological processes by which these resource areas provide for the public interests. We are here discussing specifically the role of physical processes.

APPROACH

The five wetland resource areas of primary importance to the public interests of storm damage prevention and flood control were defined (in part) as follows:

"Land Under the Ocean" - land extending from the mean low water line seaward to the boundary of the municipality's jurisdiction and includes land under estuaries.

"Coastal Beaches" - that unconsolidated sediment subject to wave, tidal and coastal storm action which forms the gently sloping shore of a body of salt water and includes tidal flats.

"Coastal Dunes" - any natural hill, mound or ridge of sediment landward of a coastal beach deposited by wind action or storm overwash. Also included is sediment deposited by artificial means and serving the purpose of storm damage prevention or flood control.

"Barrier Beaches" - narrow low-lying strips of land generally consisting of coastal beaches and coastal dunes extending roughly parallel to the trend of the coast. They may be separated from the mainland by a narrow body of fresh, brackish or saline water or marsh system.

"Coastal Banks" - the seaward faces or sides of any elevated landform, other than a coastal dune, which lie at the landward edge of a coastal beach, land subject to tidal action or other wetland.

Coastal beaches, dunes and barrier beaches by definition consist of unconsolidated sediment. In addition, along the Massachusetts coast, most "land under the ocean" and "coastal banks" are composed of unconsolidated sediment. Sediment is transferred between these resource areas by the physical forces of wave, current and wind. This transfer produces changes which represent adjustments of the landforms to the forces acting on them (Fig. 1). In this manner, forms of maximum stability are produced and it is these forms which best provide for the interests of storm damage prevention and flood control. Absolute stability is never achieved because of changes in relative sea level, sediment input or output, meteorology, and tectonics.

The regulations are based on the observed relationship that a sedimentary shoreline responds to physical forces by approaching maximum stability (Fig. 2). The interests of storm damage prevention and flood control are best served by minimizing interference with the natural patterns of sediment exchange.

EXAMPLES

Overview of physical processes

Figure 3 illustrates the pertinent resource areas and several of the mechanisms of sediment transfer which act between them. "Coastal banks" are the primary source of sediment for the entire system. When storm waves cross the coastal beach they are able to cut into the bank, causing it to erode. The sediment eroded is transferred to the adjacent beaches. Banks are cut back by wave action until the beach is wide enough to prevent waves from reaching the banks, thus protecting them from further erosion.

The sediment supplied by bank erosion is moved along the beach and nearshore by wave action. Some of that material is moved landward by onshore winds and occasional storm wave overwash to build coastal dunes. At times, storm waves cut the face of the dunes and add this sediment to the volume of the beach.

Regulations for coastal banks

To develop regulations, we identified the following as critical characteristics of coastal banks necessary to provide storm damage prevention and flood control:

1. Their supply of sediment through erosion in response to wave action.
2. Their natural resistance to erosion caused by wind and rain runoff.

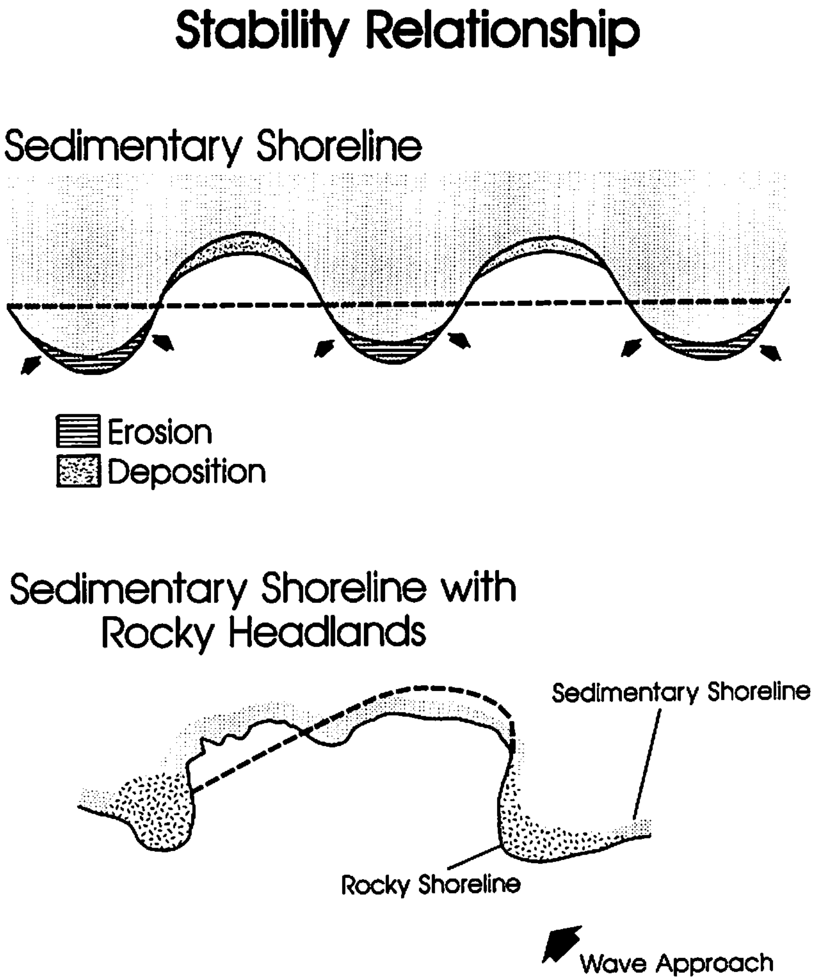

Stability Relationship
Sedimentary Shoreline
Erosion
Deposition
Sedimentary Shoreline with
Rocky Headlands
Sedimentary Shoreline
Rocky Shoreline
Wave Approach

Figure 1

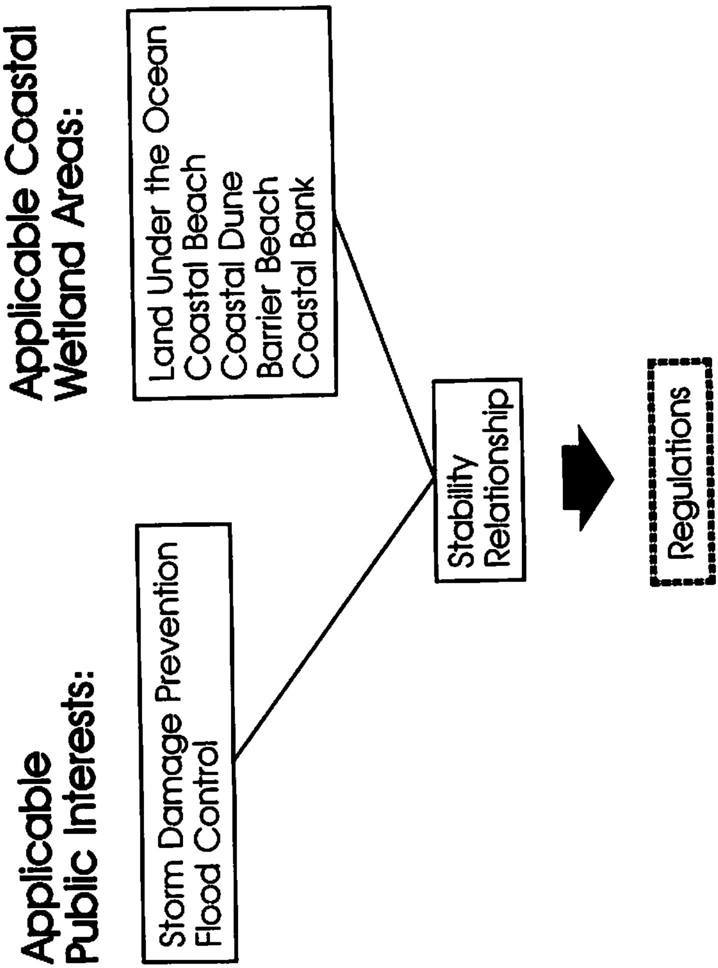
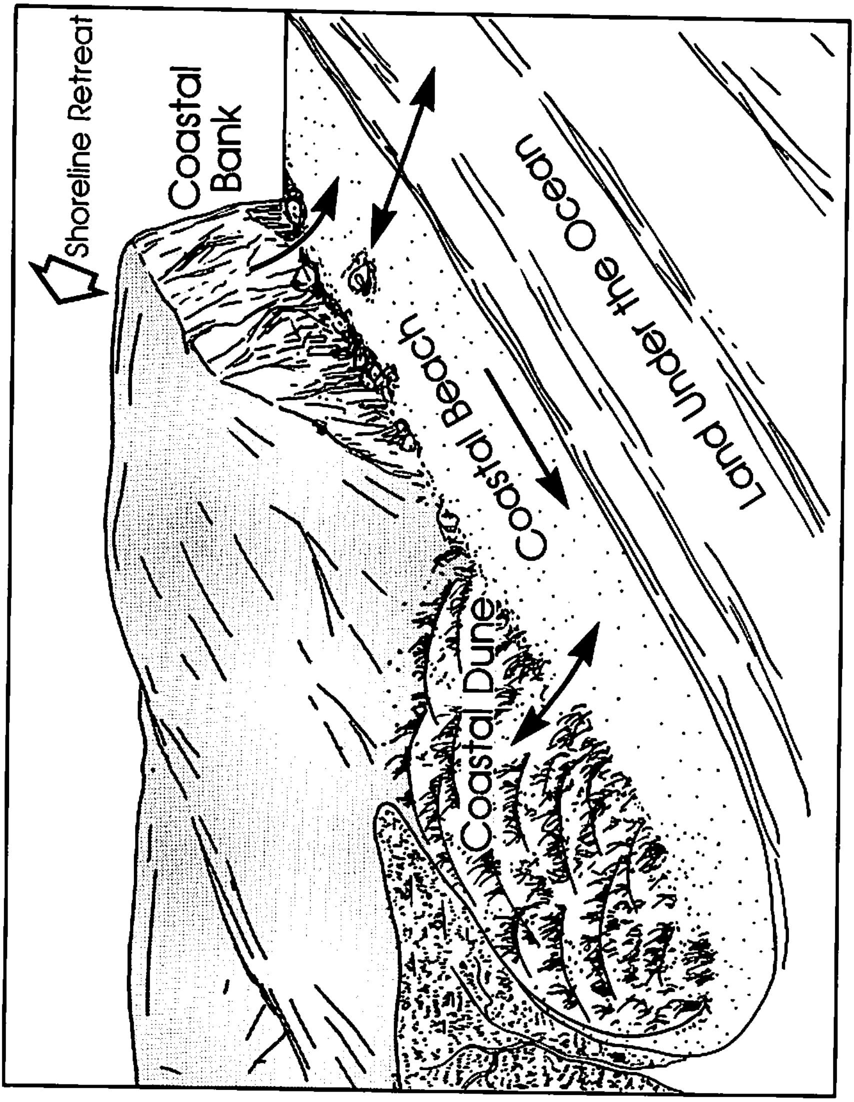

Applicable Public Interests:
Storm Damage Prevention
Flood Control
Applicable Coastal Wetland Areas:
Land Under the Ocean
Coastal Beach
Coastal Dune
Barrier Beach
Coastal Bank
Stability Relationship
Regulations

Figure 2


Shoreline Retreat
Coastal Bank
Coastal Beach
Land Under the Ocean
Coastal Dune

The first critical characteristic was protected by regulations which prevent the placement of coastal engineering structures on coastal banks which are supplying sediment to beaches. The second by not permitting projects which have an adverse effect on the stability of banks.

Regulations for coastal beaches

The critical characteristics identified for coastal beaches were their:

1. Volume and form, and
2. Response to wave action (Fig. 4).

These characteristics were protected by prohibiting any project which would decrease the volume or change the form of a coastal beach, or any project which would interfere with the movement of sediment along the shore.

Regulations for coastal dunes

The critical characteristics of coastal dunes were identified as being their:

1. Supply of sediment, through wave erosion, to beaches;
2. Form and volume;
3. Vegetative cover; and
4. Landward migration (Fig. 5).

The regulations provided protection by not allowing any project which would have an adverse effect upon these characteristics.

ACKNOWLEDGEMENTS

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Legal assistance was provided by William Clendaniel, former counsel-CZM. Matthew Poole, CZM cartographer did the graphic illustrations for this paper.

A comparison paper by Clayton et al on the biological processes portion of the regulations is contained elsewhere in these proceedings.

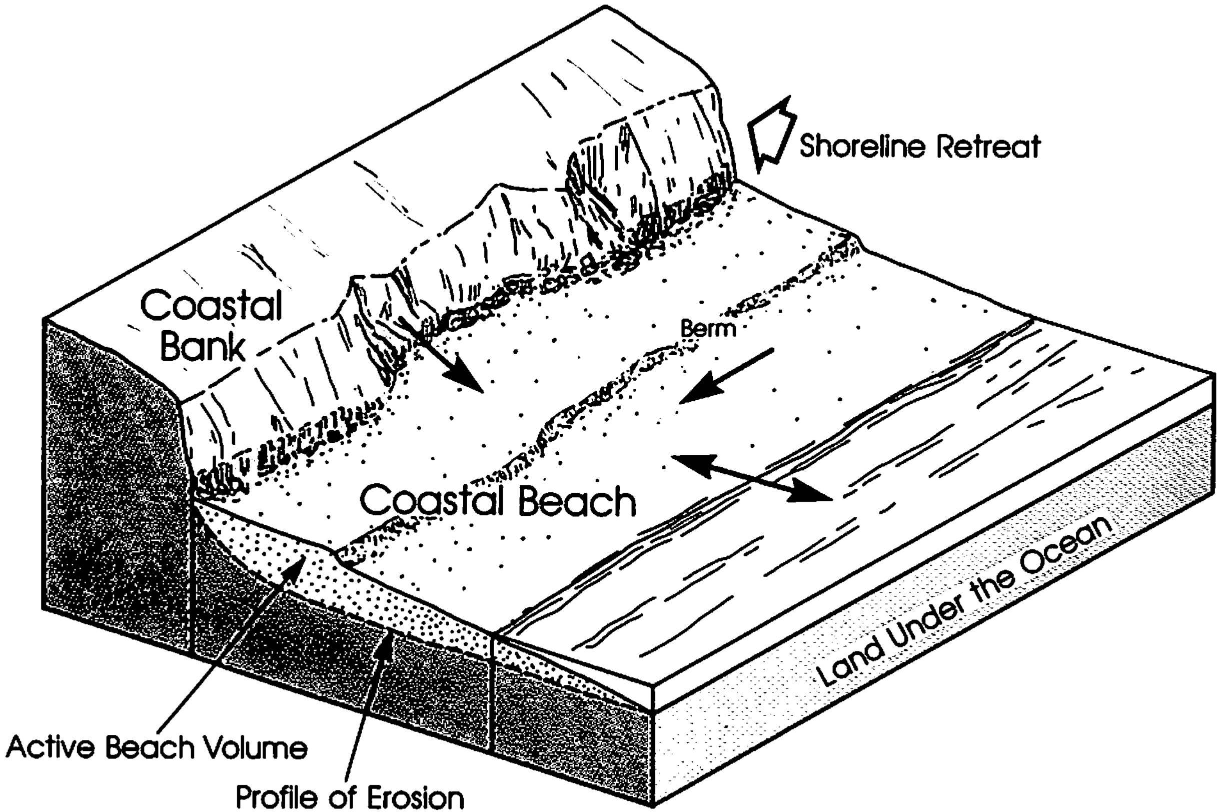
Shoreline Retreat
Coastal
Bank
Berm
Coastal Beach
Land Under the Ocean
Active Beach Volume
Profile of Erosion

Figure 4

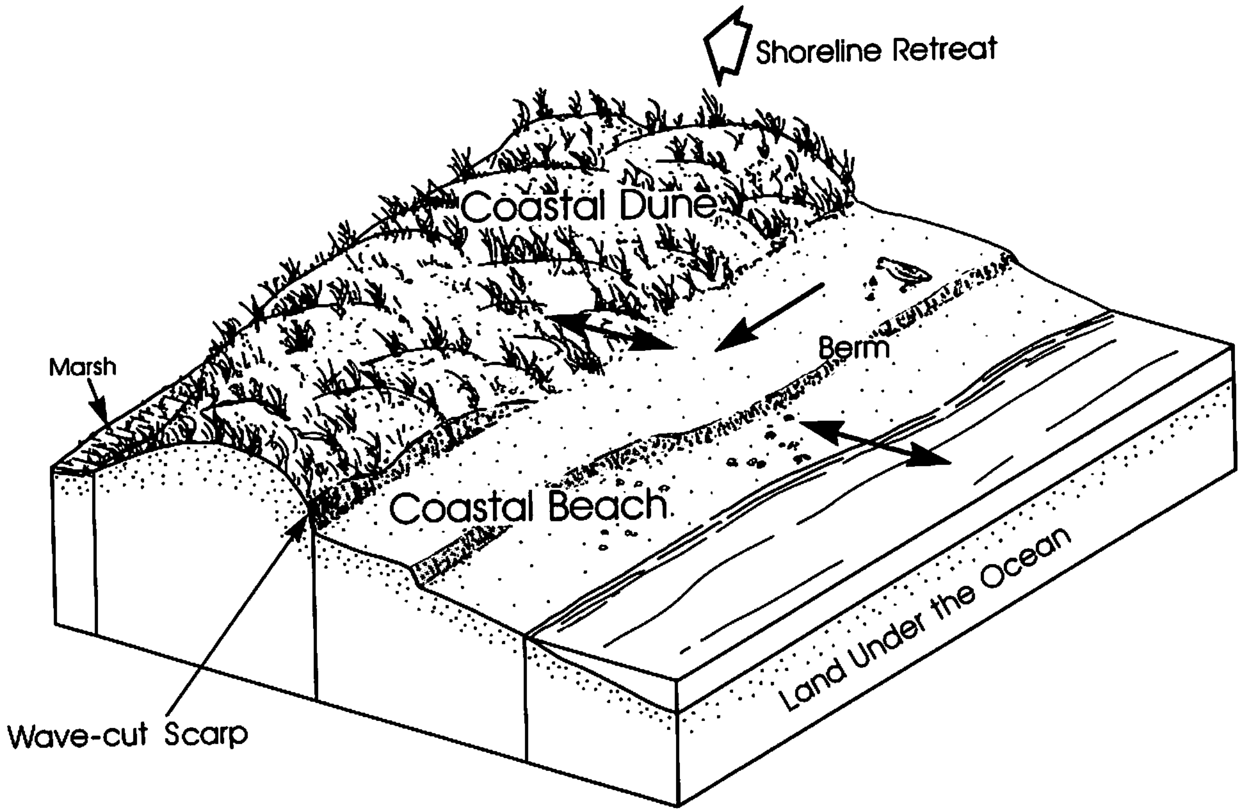
Shoreline Retreat
Coastal Dune
Marsh
Berm
Coastal Beach
Wave-cut Scarp
Land Under the Ocean

Figure 5

COGNIZANCE OF STORM RELATED HAZARDS OF SELECTED RHODE ISLAND BARRIER BEACH INHABITANTS

William R. Gordon, Jr. *

Abstract

Nearly a quarter of a century has passed since a major hurricane has impacted the shoreline of Rhode Island. As a result, many coastal residents have not experienced a coastal storm of major proportions. This paper presents some preliminary findings of a study evaluating the level of cognizance of storm hazards of selected Rhode Island barrier beach inhabitants.

Methodology

During the summer of 1979, a personally conducted survey was administered to the residents of five barrier beaches located on Rhode Island's south shore. A systematic method of sampling was employed, seeking a response from every other house or structure encountered. Multiple visits were conducted to insure a response from the inhabitants of a selected structure. The respondent was required to be at least 18 years of age. Permanent residency or ownership was not a requirement, as the response of the renters or guests using the structure was as valued as the response of the owner of the structure.

The purpose of the study was to investigate the inhabitant's perception or opinion of coastal storm hazards, particularly those of hurricanes. A total of 360 residential structures were located on the five beaches sampled, of which 168 surveys were obtained. The five beaches that were sampled are shown on Map 1. It should be noted that the findings of this paper are preliminary.

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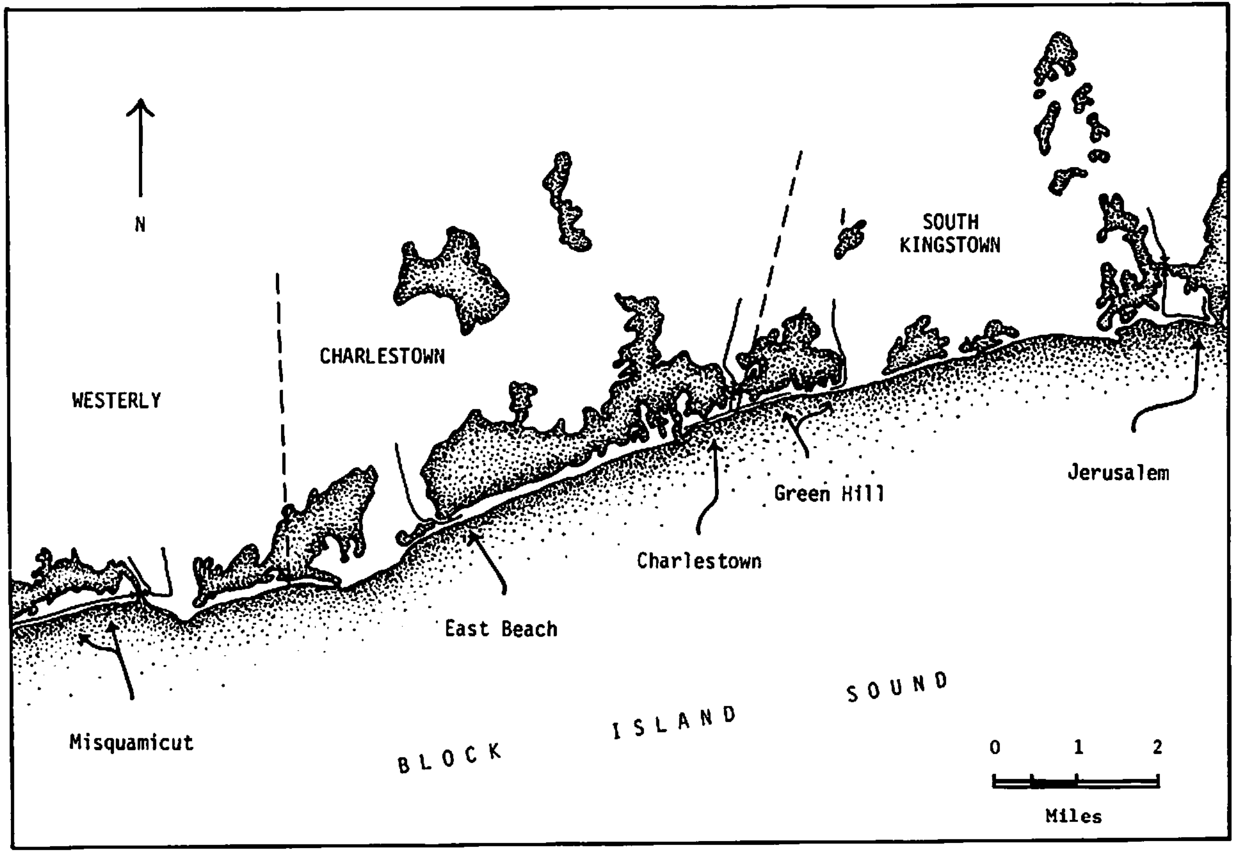
The author is a graduate student at the University of Rhode Island.



Map #1. Beaches Surveyed

Findings

As mentioned, twenty-five years has passed since a major hurricane has impacted the shores of Rhode Island. As storms of such severity are not frequent, it could be hypothesized that present barrier beach inhabitants have little or no familiarity with the storm hazards of a hurricane. It has been estimated that by 1980, fewer than one-out-of-ten coastal residents (living in areas less than 20 feet in elevation) will have experienced a major hurricane (Baker, 1979)

Research related to the influx of new residents to coastal areas, can at best be considered an estimate since the last national census was conducted ten years ago. Length of residency or personal experience with coastal storms are not the only requirement to have a high regard for coastal hazards.

It was important to determine the nature of occupancy of the structures surveyed. Responses for Question 1, which concern the occupancy status indicate that nearly 80% of the residents questioned were owners of that particular parcel of property. (Tabular results to be found at the end of this paper). Nearly 62% of the sample spends more than three months at their beach residence. This includes weekends in the spring and fall as well as full time occupance during the summer. Approximately 75% of the sample reside at the beach during the hurricane season and spring season which is known for its severe storms.

Nearly 60% of sampled respondents indicated that they had resided at this location longer than 10 years. Over 80% of those interviewed at Jerusalem had experienced Hurricane Carol of 1954, either at their present location or at another location in Jerusalem. This response was contrary to those obtained from Charlestown, where less than 40% of the occupants had experienced the 1954 hurricane. The survey suggests that some beaches maintained a more stable, long-term population whereas other beaches displayed a greater turnover in property ownership. The difference in the length of residency does not necessarily result in higher or lower levels of cognizance, as will be seen (Mitchell, 1976).

As an indicator of environmental cognizance a question was included to measure the inhabitant's response following a winter storm. Many winter storms, particularly Northeaster's, on occasion cause extensive damage to coastal property. This is a result of high sustained winds causing both flooding and erosion. Over 75% of the respondents indicated some degree of past storm efforts to check for erosion or wind and water damage. This reaction was present both among property owners and renters. Many of these people have rented from the same property owner for years and they indicated their concern for 'their' summer property.

The desire to check property for winter storm damages suggests the barrier resident's high level of cognizance in regards to the hazards of potential hurricanes. In other words, familiarity with winter storm erosion and damages, along with viewing the height of winter flooding of the barrier ponds, lends to a constant evaluation of personal risk assumed by the barrier resident. It is not uncommon for such winter flooding to inundate principal roadways for periods of 12 to 24 hours. Constant observations by the beach-side resident further act to heighten his awareness as he watches the erosion of the property. Such winter storms and erosion have lead to the damage and destruction of homes at the barrier beach in Charlestown during the past five years. Thus, even though hurricanes are not a frequent storm event, yearly experience with winter storms forces the resident to make the association between damages from a hurricane and damages from winter storms.

The response to a hurricane awareness question, indicated that nearly 93% of the residents acknowledged such awareness. This finding appears to complement past environmental hazard studies (Burton, Kates and Snead; 1969). Other questions related to the transfer of storm information indicated a great deal of personal communication between the new beach resident and residents who have resided at that location for years. As most of Rhode Island's barrier beaches support less than 150 residential structures, a fair amount of social interaction is believed to take place. It appeared that the older residents felt obliged to inform new residents, even renters, with the history of their barrier and their own personal experience with past storm events. The storm experience of the established residents provides the new resident an insight to the potential hazards of the area. When asked if they would evacuate in event of a hurricane warning, 95% of the respondents indicate they would secure the structure and evacuate.

In reference to past experience with major coastal flooding, 45% of the respondents indicated such experience. This question was neither time nor site specific. Approximately 60% of the respondents indicated that flooding <u>is</u> or <u>could be</u> a problem in their area. The "no response" does portray an ignorance on the part of some, yet was given by many because their residence had escaped flooding from both the 1938 and 1954 hurricanes. This escape from flooding was particularly true of some structures located on the dunes at Misquamicut and Jerusalem. The owners of these structures felt that since flood waters had not reached their houses neither in 1938 or in 1954, such flooding would not reach them in the future. These same residents did not fear being unable to reach the mainland because of flooding of the roads. Furthermore, most of these respondents indicated that they would wait it out at their residence, if escape were impossible. These residents were also very much aware of the elevation of their homes with reference to past peak flood heights.

A question addressed the respondent's awareness of disaster evacuation plans for the community. Nearly 40% had no such knowledge of a plan. Another 30% knew of notification procedures for a hurricane's approach because of past efforts by local and state police and fire departments. Of this, 30% of the population knew of <u>no specific plan</u> for evacuation. This suggests a severe absence of communication between local civil defense agencies, in charge of such plans, and the population, which would be directly affected in an evacuation.

A hypothetical question was asked the respondents which related to his or her action in the event of a severe flood. Nearly 82% replied that such an event would not affect their decision to return. Several responses indicated a very high commitment to return even in the event of having experienced both property loss and in a few instances the loss of a relative. Some residents acknowledged the fact that they had lost members of their family in past hurricanes and even this had not deterred them from returning. It was also evident that a majority of respondents were apprehensive about state condemnation of their land in event of a total property loss in the next hurricane. From these responses it appears that legal contest between property owners and the State of Rhode Island would be initiated if such condemnation occurred. Even though most homeowners have obtained federal flood insurance, having such insurance would not be an incentive for personal protection, if possession of such insurance required forfeiture of their property after a major hurricane. Many owners passionately explained that they had built their homes before mortgages and insurance were available. As explained by one gentleman on East Beach, 'I have enjoyed my house for twenty-five years without losing it. It has more than paid for itself. How can you put a price on being able to enjoy such amenities...'

One question (10) asked the respondent if he or she had ever been in a hurricane. Approximately 79% indicated that they had experienced a hurricane. When asked to define a hurricane, 53% of the sample were able to define that a hurricane was a tropical storm with winds in excess of 74 miles per hour, along with other features of the storm such as the surge. These same people usually qualified the impact of the surge being dependent upon the tides, whether being being high or low.

When asked of the value or function of sand dunes and their vegetative cover, 80% indicated that dunes were valuable affording physical protection from the sea. The high rate of positive responses may be related to Rhode Island Law which prohibits structural solutions to erosion such as rip-rap, groins, etc. In addition economic considerations must also be weighed. Even if the law permitted, construction of physical barriers would be cost-prohibitive, especially to the average barrier resident.

Fully 66% of the beach-front residents at Misquamicut beach utilize snow fencing to reduce wind erosion and to encourage enlargement of the dunes. Over one-half of these people use elevated dune walkover structures for beach access. Use of these elevated walkways reduces damage to dunegrass, which otherwise would be trampled and destroyed by foot traffic. It is essential to point out that the barrier resident, especially the beach-front resident, look to methods of natural protection to maintain his beach from being eroded. (Methods include: transplanting dunegrass, planting salt-resistant shrubs, fertilization, snow fencing, walkover structures and the use of old Christmas trees as windbreaks). Even though this may be considered to be a losing battle, the beach resident is only allowed such natural recourse because of Rhode Island state law. On Misquamicut beach, it was observed that even the private beach clubs utilize fencing to build the dunes, illustrating the dependence upon natural methods of beach preservation. A state operated beach on the western end of the Misquamicut barrier is void of any vegetation on its low profile dunes. No effort is made to protect this portion of the beach.

Conclusion

Preliminary findings would seem to indicate that the barrier beach resident appears to have a high level of cognizance for coastal storm hazards. As with previous research, "The coast dwellers interviewed exhibited an extremely high awareness of past experience, even when it was not their own" (Burton, Kates, Mather and Snead, 1965). As with other research efforts regarding hazard assessment,this study supports the link between past experience and future expectation of storm damage. Findings indicate that the resident's level of knowledge concerning past experience is much higher than his level of expectation for future storm events. The important issue is whether or not 95% of the respondents,who indicated their intent to evacuate prior to the impact of a hurricane, follow through with their intentions.

For the Rhode Island barrier beach inhabitant, no one variable appears to be a predictor of coastal hazards awareness. Several factors appear to be responsible for such awareness. Some of them appear below:

1. Past experience or observations of coastal storm hazards, such as hurricanes.
2. Annual experience with winter storm activity; specifically erosion and property damages for the beach-side resident, along with observations of still water flooding and related damages by the pond-side resident. (Most water damages to the beach-side resident are a result of waves or moving water).
3. State regulations indirectly heighten levels of awareness. The beach resident by not being allowed to utilize a structural solution to protect his property, resorts to natural methods or procedures. Methods such as building dunes and utilizing vegetation to anchor the dune actively involves the beach resident and tends to increase his awareness of severe storm events. It is the storm event which influences the property owner's degree of success in stabilizing and maintaining the beach frontage, dunes, etc.
4. Personal communication between beach residents concerning the past history of the area in regards to storm damages and hazards.
5. Personal research, by the beach inhabitant, concerning the area in which he resides. (Books, newspaper articles, etc.)

One serious problem which is identified, is the "lack" of communication between the barrier inhabitant and local civil defense authorities. Approximately 70% of the population were not aware of specific disaster evacuation plans for their beach community. Even though the local authorities are aware of their own operating procedures, there is a lack of specific plans for the barrier resident, as well as other coastal residents. Approximately 32% of the sample recognized and praised the local police, fire department and State Police for their effectiveness in past evacuations. Many people were not aware of the role that these people played in implementing an evacuation.

There exists a need to develop and disseminate evacuation plans on the local town level. Such information could be in the form of a brochure distributed to local town residents. Topics include: evacuation routes, shelter locations, location of food and clothing facilities, etc. At the present time it is assumed that the barrier resident knows the above information. The present research does not support this contention. Considerations must also be made for the needs of the new resident or renter. These people might not be familiar with the local area or might not be familiar with evacuation procedures.

Information on how to secure one's structure could be of use. Information regarding turning off utilities, vertical evacuation of belongings on upper levels of the structure, along with an evacuation site on the mainland for boats, could also be included in the brochure. It is recognized that safety brochures published by the National Weather Service and the National Oceanic and Atmospheric Administration fulfill some of these information needs. The advantage of such a brochure is dependent upon being tailor-made to individual communities.

Such an approach might be able to impress upon the barrier resident the nature of the personal risk he faces, versus a blanket approach to warning the individual (Baker, 1979). The latter means that everyone is warned of a danger, whereas the personal or localized approach advises the individual of the risks in his area, which he may relate to in terms of his own safety.

Seminars or hazard awareness workshops are offered by state civil defense personnel to the residents of coastal towns. These seminars are held locally. Success of these workshops is questionable, as they are not given at a beach location, serving those who face the greater storm hazards. Lack of success of these workshops may be directly attributed to the barrier resident, as he often fails to attend these meetings.

The final observation concerns the structural integrity of the house in which the barrier inhabitant resides. We have seen one adjustment that the barrier resident employs to protect his property, specifically his efforts to build-up dunes. A more common method of adjustment would be for the resident to construct or modify his home to cope with the hazards of a coastal storm. Some houses observed on the five surveyed beaches included homes which were wind tunnel modeled to withstand winds in excess of 175 miles per hour. Others utilized tempered plate glass windows which could withstand wave impact pressures of 200 pounds per square inch. Pilings were sunk deep within the dune so that in a major hurricane wave action would not undercut the pilings. The first floor of occupance was in many instances located over 20 feet above mean sea level.

Such construction techniques were a decided minority. The technology or advise on how to adequately secure a structure does not appear to be as readily available as is desired. Many elevated structures sit on pilings that would be undercut in a severe storm. These houses are also inadequately secured to the pilings on which they sit.

Guidelines exist requiring that houses located in coastal high hazard areas be located so many feet above sea level. Specific height requirements are determined by the Federal Flood Insurance Program and are implemented by the Rhode Island Coastal Resource Management Council, local communities and by the Rhode Island Building Code Standards Committee (RIBCSC). The RIBCSC requires, "that a registered professional engineer or architect certify that the structure is securely anchored to adequately anchored pilings or columns in order to withstand velocity waters and hurricane wave wash as set forth in Section 300.1 (C) (3)". (Article IV of Rules and Regulations for Construction in Flood Hazard Areas, Revised, August 31, 1979).

This regulation does not specify how many feet into the subsoil the pilings should go. If regulations were to specify that the first floor of occupance should be 16 feet above sea level, it is logical that the pilings be sunk to a depth which scientifically affords reasonable protection to the structure. Too much discretion is left to the engineer or architect in determining what constitutes an 'adequately anchored piling'.

Many respondents acknowledged a desire to have a guidebook for hazard construction purposes. It is anticipated that the federal Flood Insurance Administration (FIA) will be publishing a book on construction guideline in 1980.

With a structured management scheme, past and present experience with coastal storms, the Rhode Island barrier resident appears to have as high a level of cognition as could be expected under the circumstances. Greater efforts for the development of comprehensive construction guidelines by the Rhode Island Coastal Resource Management Council could insure not only the protection of personal investment, insurance and state assistance, but will also act to heighten the awareness of the coastal resident to the environment in which he lives.

Preliminary Findings - Personally Conducted Hazard Awareness Survey

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1. Did you buy, build or rent this house?
   1) buy 55.4% - 93
   2) build 24.4% - 41
   3) rent 18.5% - 31
   4) guest 1.7% - 3
2. How much time do you spend in this location over a one year period?
   1) less than two weeks 7.7% - 13
   2) two weeks to a month 12.5% - 21
   3) one to three months 17.3% - 29
   4) more than three months 51.8% - 87
   5) permanent resident 10.7% - 18
3. What part of the year do you reside here?
   1) summer 25.0% - 42
   2) fall 3.6% - 6
   3) all year 20.7% - 35
   4) spring, fall and winter 3.6% - 6
   5) spring, summer and fall 46.5% - 78
   6) no response .6% - 1
4. How long have you been a resident at this specific location?
   1) first year 14.3% - 24
   2) one to two years 4.2% - 7
   3) three to five years 7.7% - 13
   4) five to ten years 14.3% - 24
   5) over ten years 59.5% - 100
5. Do you visit here in the winter?
   1) yes 76.8% - 129
   2) no 23.2% - 39
6. Have you ever experienced a flood?
   1) yes, here 32.8% - 55
   2) yes, elsewhere along the coast 7.8% - 13
   3) yes, river or other 11.8% - 20
   4) no 47.0% - 79
   5) no response .6% - 1
7. Do you think flooding is a problem in this area?
   1) yes 58.3% - 98
   2) no 39.3% - 66
   3) no opinion 2.4% - 4
8. Are you aware that disaster evacuation plans exist in this community?
   1) yes 28.6% - 48
   2) no 39.9% - 67
   3) the authorities such as the police notify us 31.5% - 53
9. Would experiencing a major flood in the future at this location make you change your plans about returning here or living here?
   1) yes 8.3% - 14
   2) no 82.2% - 138
   3) depends upon the degree of flooding 9.5% - 16

10. Have you ever been in a hurricane?
    1) yes 78.6% - 132
    2) no 16.7% - 28
    3) no response 4.7% - 8
11. Are you aware of any frequency or history of hurricanes or other major storm activity in this area?
    1) yes 92.8% - 156
    2) no 4.2% - 7
    3) no response 3.0% - 5
12. Please define what you would consider to be a hurricane? ****
    1) a northeaster .6% - 1
    2) a tropical storm .6% - 1
    3) a storm with high winds 40.5% - 68
    4) a tropical storm with winds in excess of 75 mph. 53.0% - 89
    5) other .6% - 1
    6) no response 4.7% - 8

Sex:	male	56.0% - 94
	female	44.0% - 74

Joint family income

less than $10,000	1.8% - 3
$10,000 to $15,000	3.6% - 6
$15,000 to $20,000	13.7% - 23
$20,000 to $25,000	10.7% - 18
greater than $25,000	42.8% - 72
no response	27.4% - 46

Education

grade school	3.0% - 5
high school	26.2% - 44
trade school	7.1% - 12
service	1.2% - 2
college	37.5% - 63
graduate school	16.1% - 27
no response	8.9% - 15

Occupation (head of household)

blue collar	9.5% - 16
white collar	15.5% - 26
professional	36.0% - 60
executive	18.5% - 31
retired	9.5% - 16
student	3.6% - 6
other	7.4% - 13

**** All questions, except Question 1, were open response questions.

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DAMAGE MITIGATION AS A PUBLIC OBJECTIVE: THE MASSACHUSETTS COASTAL FLOOD OF FEB. 6-7, 1978

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ABSTRACT

Mitigation of future flood losses is a stated policy objective of the National Flood Insurance Program (NFIP) and the Federal Disaster Relief Act of 1974 (P.O. 93-228). Mitigation involves coordinated federal-state-local effort to reduce the exposure of lives and property investment to flood loss. Measures to achieve this include public acquisition and relocation, land use regulation and, in appropriate cases, the use of protective structures such as levees and dikes (inland) and groins, jetties, and seawalls (coastal).

The Massachusetts Coastal Flood of February 6-7, 1978 presented an opportunity to apply mitigation measures in practice. Some 54 out of 70 Massachusetts Coastal Municipalities shared in a statewide total of $140 million in federal disaster assistance. Payments from the NFIP totalled about $20 million on 1663 flood insurance claims. These two forms of assistance should have been accompanied by mitigation efforts as specified in the respective federal acts. Despite considerable rhetoric favoring mitigation emanating from the Massachusetts Lieutenant Governor's Office and the Boston press, rebuilding in hazardous areas was not deterred. No land was publicly acquired. Many structures were rebuilt <u>in situ</u>, largely at federal expenses. This paper reviews research findings and draws lessons for national mitigation policy.

PART VII

MARINE TRANSPORTATION & URBAN WATERFRONT DEVELOPMENT

Moderator: Louis Celleneri

INNOVATIONS IN THE SHIPPING INDUSTRY AND THEIR EFFECT ON THE PORT-URBAN INTERFACE

Dr. Yehuda Hayuth

ABSTRACT

Ocean transportation has gone through tremendous changes in the last two decades. The appearance of new types of ships, the introduction of different methods of cargo handling and the development of intermodal transportation systems had a considerable effect not only on the ports themselves but also on the adjacent urban areas as well as on far behind hinterlands.

Technological changes in the shipping industry have altered port functions, port operation and port infrastructure. In many cases, a traditional advantageous port location became an obstacle to further development, while new unknown ports emerged in a newly favoured location. Traditional handling methods of break-of-bulk general cargo are being replaced by containerization. These changes necessitate altering shorefront facilities and require a much greater back up and storage space per berth.

The new developments in transportation and modern port operation affected the traditional balance in the port-urban interface. On one hand, many port authorities must abandon obsolete facilities and relocate some of their terminals. On the other hand, the greater demand from recreational and commercial users for coastal use in general and for urban waterfront in particular has forced changes in the port-urban interface area. The process can be characterized by a penetration of new functions and land uses into this area, taking the place of long time traditional users which leave the waterfront and by a greater integration of the urban waterfronts within the cities in which they are located.

THE MARITIME PORT AUTHORITY AND ITS RELATIONSHIP TO URBAN WATERFRONT DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT

by

* T. H. Brillat

Abstract

The degree of involvement and influence of a port authority on its geographic, environmental, social and economic surroundings varies significantly from port to port. Of consequence, though, is the fact that modern authorities are placing increasing emphasis on urban waterfront development and environmental management. The port industry, environmental, coastal zone and community planning groups are beginning to work together. The results of this cooperation have been planned developments and programs that have benefited not only those persons in their immediate locale, but the entire country as well.

Introduction

Modern port authorities evolved from the traditional focal point of foreign trade, the town dock. As a community grew, so did its number of docks and storage sheds. The need for skilled terminal management and publicly controlled facilities eventually became evident and port authorities came into being. The earliest ones were in San Francisco established in 1863, New York in 1871, and New Orleans in 1896.[1] Significant development of public administration of ports, though, did not occur until the twentieth century.[2] Except for private and federally operated ship terminals, most facilities used today for maritime cargo and passenger transfers are under the jurisdiction of a Marine Port Authority.

These authorities are quasi-governmental organizations, usually established at the state, municipal or district level. They either operate or lease, some or all of their land and structures. Many ports receive an annual budget based on taxes, others depend solely on self-generated revenues, and still others are a combination of these. Port authority staffs can be as small as a local harbormaster, or exceed a thousand.

The growth of maritime commercial centers into large metropolitan regions, coupled with new ship designs and cargo handling changes, has

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required action by authorities. They have had to locate acres of new land and develop new technologies, or become second-class ports. Large numbers of old piers and warehouses are no longer efficient for the modern shipping industry. They are frequently neglected and quickly become engulfed by rampant urban decay. As cities spread to the suburbs and city centers corroded, ports also expanded to new locations, often with disasterous results to the older terminals.

Within the past ten years several motives have prompted port authorities to deal with problems that they have not previously encountered or have ignored as inconsequential. The increased vandalism of once sturdy, but now idle decaying docks, the growing social consciousness of the environment, and federal and state legislation have been influential reasons for action.

There have been major organizational changes and new management philosophies and policies in many ports throughout the country. Most have placed a high value on public affairs. They are searching for ideas that can improve or broaden their image. Instead of justifying all costs and expansions based on economic criteria alone, as has been the tradition, ports are analyzing their moves more closely. Port authorities are becoming more aware of their impact on the geography, environment, and society, as well as on the economy.

It must be understood, though, that all port authorities still operate with profit maximization as their main priority. In this way ports are similar to all business ventures. A few figures will make it easier to understand the economic importance of American ports to the country.

A 1977 Maritime Administration study shows that in 1970 the port industry was directly or indirectly responsible for gross sales of $28 billion within the economy; a $15-billion contribution to the GNP: 1,046,800 jobs; personal income of $9.6 billion; business income of $3.7 billion; federal taxes of $5.2 billion; and state and local taxes of $2 billion. Put more simply, the statistics show there was a total impact of $76 million per day. Since the GNP doubled between 1970 and 1977, it can be assumed that 1977 dollar figures for the port industry would be approximately double those given.[3] All this revenue is generated by ports that occupy only about two percent of America's coastline.[4] The significance of these numbers is overwhelming, and they continue to provide the foundation of all port developments.

Ports in Urban Waterfront Development and Environmental Management

Comprehending the economic impacts of the United States ports makes it easier to visualize the major benefits that can be provided to urban waterfront environments when port authorities are involved in these areas. Many ports have been seeking ways to involve their own activities with those of the public at large and have received positive public response.[5] Other ports have had to avoid getting involved, due to legal restrictions or management practices. But all ports are pressured to a large degree by federal legislation. Most importantly, the National Environmental Policy Act, Clean Air Act, Clean Water Act, Coastal Zone Management Act and land use legislation have encouraged realistic considerations of planned management and waterfront development.

There is an inseparable relationship involving Urban Waterfront Development, Environmental Management, and Community Planning. The enhancement of urban waterfront requires careful planning, which incorporates relevant environmental impact data. Successful environmental management necessitates studious analysis of the environs.

Port authorities' activities in Urban Waterfront Development can be classified into two groups. The first consists of those projects that deal directly with maritime commerce, such as: refurbishing old terminals or building new ones; and private construction requiring proximity and use of a marine terminal. The second, encompasses all other port enterprises except maintenance. These would include public parks, commercial real estate programs, and recreational piers.

Port authority ventures in Environmental Management are broad based. They comprise programs of base line data collection, making improvements to or maintaining pollution control measures and improving the aesthetic quality of the urban waterfront, which provides intangible social benefits. Many ports consider their input to local coastal zone management agencies and their expanding involvement in public affairs as environmentally related.

Individual port authority applications in Urban Development and Environmental Management range from having a few simple procedures to forming complex departments with sizeable budgets. Authorities that are earnestly involved in these new directions are eager to expound on them and quick to publicize their latest achievement. Some examples follow.

South Carolina State Ports Authority and Environmental Management

The South Carolina State Ports Authority is a self-supporting port system that includes the ports of Charleston, Georgetown, and Port Royal, S. C.. Charleston is the primary port, currently handling cargo valued in excess of $2.1 billion annually, placing it twelfth on the national list. The Port of Charleston comprises three terminals, two of which are located in the immediate downtown area.

Although lacking a major city's skyline and population, Charleston is besieged with problems common to all urban centers. A large area of downtown is a densely populated, corroding ghetto. The three-county region surrounding the city has a population of over 300,000 and is rapidly increasing. The City of Charleston is, unfortunately, sixth nationally in crime statistics and a significant percentage of its population earns below the poverty level.

The business community's influence and the state and local governments pro-growth postures have allowed Charleston to keep pace with the industrial boom throughout the Sunbelt. In spite of this support, the 1973 publication of the SPA's intentions to build a new $56-million marine terminal along an undeveloped river, the Wando, was the beginning of the SPA's involvement in Environmental Management.

Every environmental organization and several community groups in the region put up red flags against the proposal. Prior to the announcement, the SPA had the State Water Resources Commission and reputable consultants conduct intensive site selection and impact studies. The SPA was convinced that they had identified all potential impacts from terminal construction resulting in the best selection having been made.

Unfortunately local environmental groups were highly critical of SPA's negotiations concerning the construction of the Wando River Terminal, which proved damaging to the Authority's public image. Strong community groups were able to prevent permit approval and construction by forcing litigation. This resulted in many years of delay, worsened relationships, and yielded no major concessions beyond which the SPA had agreed to prior to the legal actions. Most of the concessions were of environmental consequence, including a physical buffer zone of trees surrounding the terminal; a dredge spoil site on the terminal; truck access to avoid residential areas; a scenic park for spectators; filled wetlands restricted to 30 acres; intensive engineering plans for effluent drainage and spill containment systems; an industrial park for ancillary activities; and reduction of the dock length by nearly one-third.

The concessions to the SPA's plan drastically reduced the projected profitability of the terminal to the beginning of the next century. It is now estimated that the new facility will require further expansion, possibly by the mid-1990's.

To put the SPA's actions into perspective, it is vital that one be familiar with the legal powers which the SPA operated under for 30 years. The Authority is responsible for harbor improvements, has jurisdiction over all waters to the maximum ebb and flow of the tide, can condemn state-owned land in port counties, including swamps, issues permits for any construction that may affect commercial navigation, and designates dredge sites throughout the state. These broad powers have been historically utilized and the Wando Terminal announcement was another follow-through of traditional policy.

Recognizing the importance of the SPA throughout the state, legislation forming the S. C. Coastal Council, the state coastal zone management agency, requires the SPA to submit a plan designating geographic areas appropriate for public or private ports and harbor facilities or for military uses. This plan is being rewritten to clarify the port's role as compared to that of the local planning agencies, who are upset at the Coastal Council's legislative requirements to the SPA.

Finally the SPA received a Meritorious Citation for Environmental Improvement in October 1976 from the American Association of Port Authorities, U. S. Coast Guard, Maritime Administration, and Environmental Protection Agency, for the environmental protection aspects designed into the Wando Terminal.

In retrospect it is clear that early public involvement in the site selection and environmental design portions of the terminal would have been highly beneficial. It is now apparent to most port officials that this cooperation is, in fact, essential for achieving well-balanced results, on time.

Other Authorities and Environmental Management

In contrast to the S. C. State Ports Authority, other ports have begun to build their own staff of professionals to resolve the numerous environmental questions that arise. In Seattle, Long Beach, and Los

Angeles, to mention only a few, there are personnel who specialize in handling permit applications submitted to or requested by the authority. Other in-house experts coordinate and frequently draft environmental impact reviews and environmental impact studies, monitor federal legislation and regulations, and most importantly, advise port management and the public on environmental matters.

This expertise has helped institute a garbage barge clean-up operation in Long Beach, remove harmful neon signs in Seattle harbor, build a waste water treatment plant at the Port of Indiana on Lake Michigan, and create a Marine Habitat in Los Angeles for the purpose of offsetting possible losses due to expanding terminal facilities. The Toronto Harbor Commission has joined with the city and surrounding communities in an effort to clean up the waters of Lake Ontario adjacent to the city. The Army Corps of Engineers has recognized the need for dredge spoil disposal sites and has helped fund such projects in ports throughout the country. Liquid and dry bulk cargo ports are adding the most sophisticated pollution control devices available to the industry. These projects and many more constitute a rapidly growing dimension of port authority operations.

Urban Waterfront Development

Anyone who has been to Ghiradelli Square in San Francisco, the Inner Harbor in Baltimore, the Market Place in Boston, Cabrillo Beach in Los Angeles, and the International River Center in New Orleans is familiar with the positive results of Urban Waterfront Development. With the help of environmental and land-use planners, port rehabilitation in city centers has become big business. Investors and land developers can be expected to increase their involvement with port authorities to find the appropriate methods to utilize vacant property and buildings. In the cases of large authorities, they have frequently provided vast sums of their own for these projects.[6]

At a 1973 conference on Port Planning, Walter C. Boyer, present Project Manager for Harbor Development and former Deputy Administrator with the Maryland Ports Administration, stated,

> "It is better to incorporate compatible public interest features into the port than to be faced with groups and civic planners dedicated to taking away from the port authority, large sections of the waterfront for recreational and residential purposes."

What has evolved since that time are radical changes in authorities' policies. They are still dedicated to rehabilitating old facilities and building new ones for maritime commercial uses, but many are now willing to look at alternative uses. Port authorities are slowly accepting the fact that the waterfront should be accessible to everyone.

The Port of Seattle has built a 1,600-slip small boat marina, waterfront park and refurbished old finger piers into an aquarium, boutiques and restaurants. In Milwaukee a public contest in underway for the design of a recreational facility on port authority property. The Port of Long Beach Master Plan envisions a recreational buffer zone between the port complex and the heart of the city. As recently as 1978 the Port of Providence was asked to provide assistance to the Propeller Club to establish a maritime park in the city. The S. C. State Ports Authority has donated land to the City of Charleston for public use. The Port of Oakland has several small parks throughout its terminals where the public can view the harbor activity.

Significant importance is being placed on non-maritime commercial ventures. San Francisco's famous piers are beginning to prosper again. Boston's historic waterfront has capitalized on small shops and condominiums. The Port Authority of New York and New Jersey is studying the feasibility of building residential housing units overlooking the port. Beyond this, many ports with any vacant back-up land are busy designing, building, or soliciting lessees for industrial parks. The costs for some of the projects may be sizeable.

The port industry has also provided itself and many others, with some of the world's most modern office facilities. New York, Baltimore, Long Beach, New Orleans, Los Angeles, and San Francisco have either built, or are planning to build world trade centers, exhibition halls, or conference complexes. Such hotel, office and auditorium buildings are taking full advantage of close proximity to downtown central business districts, and the prime location which most urban waterfronts represent once revitalized.

Underlying all this growth is the intent of the port authorities to build better ports. Chicago, Houston, Oakland, Milwaukee, New York, South Carolina are spending billions of dollars to provide safe and efficient cargo handling. As new techniques are devised that can earn dollars from deteriorated buildings, they are implemented. One such plan includes the conversion of some of the Port of New York and New Jersey's passenger terminals into dual purpose piers. The enclosed street level area has become a container stuffing and stripping shed, while the second floor is now the parking, Customs, and amenities area for the cruise ships.

The urban eye-sores are vanishing along the land-sea interface. New docks and environmentally designed warehousing facilities are beginning to appear in many ports. Port authorities have also taken major strides in providing assistance to other vitally important maritime industries. Ferry services, passenger liners, and commercial fishing fleets have all benefited from progressive port authority development programs.

Surveys conducted in Houston and South Carolina, indicate the public is generally willing to accept most port expansion and development activities. In those geographic locations closest to the port, public awareness of the beneficial economic impacts are the most prevalent.

In an attempt to foster better understanding between port managers, environmentalists and coastal zone personnel, the National Conference on Ports and Coastal Management was held in Boston in July, 1979. It permitted an airing of views and joint discussions of the many problems faced by each representative segment. Interchanging of ideas in this manner is fundamental to the success of all coastal management.

Conclusions

Port authorities have undergone tremendous changes during the 1970's. Many have built terminals at a frantic pace and provided new life to many cities. Efficient port expansion requires professionals, capable of handling the significant social and environmental problems facing most port authorities today.

It will be interesting to see if the evolution that has transpired within many port authorities can be transposed to the general public. Future port development is not likely to succeed without a well-informed public and body politic. The challenge is clear. There is no viable reason that systematic planning and cooperation from the conceptual stages of any project cannot maintain the ports as vital economic centers and still protect the environment for public enjoyment.

NOTES

Marvin L. Fair, Port Administration in the United States, (Cambridge, Maryland: Cornell Maritime Press, 1954), p. 41.

Ibid

U.S. Department of Commerce, Maritime Administration, Office of Port and Intermodal Development, What U.S. Ports Mean to the Economy (Washington, D.C.: U.S. Government Printing Office, 1978), p. 10.

J. Ron Brinson, Executive Vice President of the American Association of Port Authorities, Address given at the National Conference on Ports and Coastal Management (Boxton), July, 1979.

The Port Authority of New York and New Jersey has plans to use Authority property for housing projects. The Port of New Orleans has renovated several old facilities into aesthetic and functional small businesses.

Warren Lovejoy, Manager of Regional Development for the Port Authority of New York and New Jersey, indicated that his Authority plans to invest up to $400 million on a non-maritime related development. Phone conversation, Octover 4,1979.

URBAN COASTAL ZONE MANAGEMENT: THE NEW JERSEY EXPERIENCE

John R. Weingart

Abstract

Coastal Zone Management programs can be the foundation for state urban waterfront revitalization efforts. While limited by relatively shall amounts of funds and only a narrow area of land use decision-making authority, the state coastal programs can still provide a policy direction, governmental coordination, technical advise and financial assistance for small, but important, waterfront projects.

Introduction

In 1979, New Jersey's Governor Byrne created a 37 member commission to study waterfront issues facing 15 municipalities along the Hudson River. Announcement of the commission was met with two contradictory reactions which help to capsule the challenge of urban waterfront revitalization. First, some people asked how such a large group could be expected to deliberate and agree on recommendations for change and action. Others, however, quickly pointed to groups not represented on the commission and questioned whether its recommendations will be credible without their participation.

Planning and decision-making in the urban waterfront involve an enormous array of government agencies and interest groups. The revitalization of urban waterfronts is an issue which, in recent years, has moved to the top of priority lists prepared by many of these groups. While the issue itself is far from new, it is now receiving renewed and increased attention as a result of the coincidence of two programs; First, a national emphasis on cities in general and second, the coastal management program created by the Federal Coastal Zone Management Act of 1972. In this paper, I will give only passing mention to the first, more loosely defined program, exploring instead ways in which the coastal management program is, or can be, of benefit to urban waterfront areas, and also ways in which it is limited. This paper uses New Jersey, particularly its waterfront along the Hudson River, as a modified case study.

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The urban waterfront poses a set of problems and opportunities which have large areas of overlap with other coastal areas, but which are also fundamentally different. In less developed, more recreationally oriented areas, different interest groups and individuals have totally different visions of what they would like to see the area become. Some would like to see the development which exists washed away in the next storm and never rebuilt, while others dream of diverse developments quickly consuming the remaining highly marketable, undeveloped real estate.

Such battle lines are not nearly as evident at the urban waterfront. Instead, most observers and interest groups use remarkably similar language to suggest the expansion of water dependent industry including ports, the conversion of now deteriorated sites into a variety of industrial, commercial, and recreational uses, the creation of more waterfront parks and increased visual and physical access to the waterfront.

Urban coastal zone management is really two subjects; first, the urban waterfront, and second the Coastal Zone Management Program. One - the urban waterfront - is a place, while the other - Coastal Zone Management - is a governmental program. They overlap when the program addresses the place, or when people think the program could or should be addressing the place. Each, however, is larger than their area of overlap. The urban waterfront raises issues which are not, and I believe cannot be addressed by coastal zone management programs in most, if not all, states, and at the same time each state's coastal program has jurisdiction over a wide variety of types of areas that are not urban. In fact, coastal management programs in most states including New Jersey first gave their attention to beaches, wetlands and other recreational and relatively undisturbed areas, and have only recently turned their attention toward the urban waterfront.

Urban Waterfront Planning In New Jersey

New Jersey's Coastal Zone can be divided into two relatively urban areas along the Delaware and Hudson Rivers and their tributaries, and one less developed area which includes the Jersey Shore along the Atlantic Ocean and the Delaware and Raritan Bays. The "urban" or "developed" areas are themselves extraordinarily diverse with industry, ports, marinas, railroad yards, airports, highways, high rise apartments, low rise residential neighborhoods and open areas. Some of the open areas are the result of buildings which have crumbled, industries such as port operations which have changed dramatically, or activities which have gone bankrupt, while others are small pockets of wetlands and other natural areas which have survived relatively untouched by development. These diverse activities exist side by side, and often right on top of each other in the densest parts of the nation's most densely populated state.

The character of the waterfront has been formed as these different activities have competed for sites, for money, and for political support. Regional planning has not been much of a factor. As in other states, much of the industry was originally attracted to the area by the opportunity to be on or near the water for transportation. But as other means of travel, particularly trains and then trucks, were developed, the principal advantage of the waterfront areas became their proximity to New York and Philadelphia. The waterfronts gradually lost their importance and identity and, in most areas, became visually and physically unavailable to area residents and were forgotten. Moreover, much of the industry and commerce which moved away from the waterfront left the sites they had occupied not only unused, but unusable.

That describes much, though not all, of what we see today when we look at New Jersey's urban waterfronts. We also see several thriving ports, some other industrial and commercial activity, a few small waterfront parks, and one large park in Jersey City which will be discussed below.

Having briefly discussed the place - that is, the urban waterfront in New Jersey - I would like to now discuss the Coastal Zone Management Program. The program was officially created by the United States Congress in 1972 when it enacted the Coastal Zone Management Act. This Act provides money to States to design a program addressing the needs of their coastal areas. Once the state completes preparation of its program in a form acceptable to the U.S. Department of Commerce which administers the program, the State becomes eligible for somewhat larger grants to help carry it out.[1] It is important to recognize that the federal Act does not create any permit programs or in any way regulate private development. Rather, it requires that each state have approval and federal funding. In some states, this has meant that the Legislature has had to enact a new law to give the State authority sufficient to meet the requirements of the federal Act. In several states, the Governor and Legislature have chosen not to enact such legislation, and these states are now being excluded from receiving the available funds. The Coastal Zone Management Act, unlike a number of other laws, including the Clean Air Act and Clean Water Act, establishes a voluntary program for states, with no provision for federal coercion or penalty to non-participating states.

In New Jersey, the coastal management program is being prepared in two parts by the State Department of Environmental Protection. The first, for the Atlantic Ocean and Delaware and Raritan Bay Segment - basically the less urban, less developed areas - was completed and approved by the Department of Commerce in September 1978. The state plans to seek Federal approval of a program for the entire coastal zone in the Spring of 1980. Laws which appear to give the state authority sufficient to receive federal approval of its coastal program had already been passed prior to the state's active participation in the federal coastal program.[2]

In New Jersey, the core of the Coastal Management Program is a set of Coastal Resource and Development Policies which express the State viewpoint of what should and should not take place in different parts of the coastal zone. The Coastal Policies form a detailed, though generally not site specific, method for making decisions regarding the appropriate use of waterfront sites. Their direction and purpose are summarized by the following eight basic policies:

1. Protect and enhance the coastal ecosystem.

2. Concentrate rather than disperse the pattern of coastal residential, commercial, industrial and resort development and encourage the preservation of open space.

3. Employ a method for decision-making which allows each coastal location to be evaluated in terms of both the advantages and the disadvantages it offers for development.

4. Protect the health, safety and welfare of people who reside, work and visit in the coastal zone.

5. Promote public access to the waterfront and develop at least one waterfront park in each waterfront municipality.

6. Maintain active port and industrial facilities, and provide for necessary expansion in adjacent sites.

7. Maintain existing energy facilities, and site additional facilities determined to be necessary by the N.J. Department of Energy in a manner consistent with the policies of this coastal management program.

8. Encourage residential, commercial, and recreational mixed-use redevelopment of the developed waterfront.

New Jersey's coastal management program will have three tools to make these policies effective: First, regulatory authority; Second, education, persuasion and influence; and Third, money.

Turning first to regulatory authority, state agencies will use the Coastal Policies as the basis for their decisions which affect the coastal zone. The policies will be adopted as Administrative Rules and will therefore be binding on the state agencies. The effectiveness of this tool depends, of course, on the extent of the State's regulatory powers. In urban waterfront areas in New Jersey, the State's jurisdiction is likely to be modest, but significant, with land use authority over most new development in or immediately adjacent to the water.

The State will make the decisions it is empowered to make in this relatively narrow area on the basis of the Coastal Policies. But what about other development which is already standing or is proposed but not regulated by the State? This is where the influence of the coastal management program becomes important, and also where the distinction between the waterfront and the coastal program should be remembered.

Many important waterfront decisions in New Jersey and in most, if not all, the coastal states, are made by private developers and municipal agencies not subject to land use regulation by the state. In those cases, the value of a coastal management program is its influence. The Coastal Policies can be used as a recommendation to a land owner or, perhaps more importantly, to a municipal or county agency as it prepares or revises its master plan or zoning ordinance, or as it prepares to decide on a particular development proposal. The Coastal Policies can also serve to educate people affected by waterfront activity about the many competing issues and interests which must be addressed to recreate or maintain a vibrant waterfront. Lastly, the coastal policies can be used by people already interested and active in waterfront redevelopment activities as background and often support for their arguments.

In addition to regulatory authority and influence, state coastal management programs have limited amounts of funds to initiate projects of benefit to the waterfront. New Jersey is making available small grants to municipalities for this purpose. The projects can be to design a park or bike path, to plan for a mixture of commercial, residential and recreational activities along the waterfront, or to promote any other ideas which would help implement the States' Coastal Policies. These projects will be directly beneficial to the municipality, and they will also help raise public awareness of the potential of the waterfront. These relatively small grants of between $5,000 and $30,000 can serve as seed money for other federal and state programs.

One of the first such grants was awarded by the State to Jersey City, to develop a plan for the reuse of a rundown waterfront site on the Hudson River with a magnificient view of the New York skyline. This site, known as Exchange Place, is adjacent to a subway stop and offers potential for revitalizing the surrounding area. While the state's coastal grant ($30,000) is large enough only to design a plan for the area, other state and federal agencies including the Heritage Conservation and Recration Service and the U. S. Economic Development Administration have pledged to seriously consider contributing to implementing the plan. Time will be needed to determine the success of this effort to use the coastal management program as a catalyst and provider of seed money for waterfront redevelopment.

Exchange Place is just a stone's throw from Liberty State Park which is New Jersey's greatest recent waterfront success. The State responded to citizen interest in the potential of a large abandoned waterfront area also on Jersey City's Hudson River waterfront. This response led to the design and creation of Liberty State Park which opened on the site on June 15, 1976. Although the portion of the Park completed to date offers no opportunity for swimming or boating, it has quickly become New Jersey's most visited state park and a graphic demonstration of the demand for urban waterfront recreation.

New Jersey has several other urban waterfront projects initiated in recent years. This includes terminal restoration projects in Hoboken and Perth Amboy, and, along the Delaware River, a waterfront park in Burlington City and a major park and development beginning in Camden.

These projects are important and exciting because they can offer inspiration and encouragement for other waterfront projects. Before Liberty State Park, the most frequent New Jersey success stories cited by people interested in the waterfront were citizen led efforts to block undesirable waterfront projects. Those battles may have saved the Hudson River waterfront from the effects of various noxious facilities, but they did not of themselves improve the waterfront. They preserved the status quo which was none too good.

Conclusion

Increased attention, planning and development is being focused on urban waterfronts and, in New Jersey, the Federal Coastal Zone Management Act is contributing significantly to this process. The Act's contributions, however, are severely limited in two ways. First, the amount of federal money allocated for the coastal management program is, by governmental standards, small. New Jersey, for example, is expected to receive approximately $1.5 million a year to carry out its coastal program after it is approved, of which only 10 percent may be expended for the site-specific projects noted above. By comparison, one of New Jersey's 21 counties received approximately $1 million a year to prepare the Section 208 water quality plan required by the Clean Water Act. The Coastal Management Program does not begin to provide a state with the resources to consider buying sensitive land or sponsoring major waterfront development projects.

Second, the authority of the coastal management program in urban areas in many states is less than it should be to effectively promote and manage the redevelopment of the waterfront. New Jersey, for example, while probably possessing adequate authority to receive Federal approval of its coastal program, cannot directly control development more than 500 feet from an urban waterfront even though such development could have a major effect on the waterfront.

Interest in the urban waterfront is not new. A White House conference recommended treating urban waterfronts as a "new resource" in 1965. A year later, the Regional Plan Association, a private group focusing on the New York-New Jersey metropolitan area, issued a report describing the Lower Hudson River as an area "important in itself, both for the special beauty it possesses and for the special opportunity of enjoyment it presents for the millions of people who are near it daily. It is important for the basic question it raises of how urban man can live with and enjoy the city's natural setting."[4] Although the report was written thirteen years ago, that basic question is still very much a part of the current urban waterfront focus. Furthermore, the waterfront in New Jersey has changed very little in those thirteen years, unlike the waterfront in Boston, San Francisco and a few other cities which have experienced massive waterfront revitalizations.

The existence of the coastal management program and the current growing interest in the urban waterfront are necessary, but not sufficient conditions for action and progress. Since release of the Lower Hudson report noted above in 1966, at least fifteen fine studies focused on New Jersey urban waterfronts have been prepared by a variety of public and private groups during past bursts of interest and enthusiasm. The reports were printed, some supportive newspaper articles appeared, conferences were often held, and then the issues receded from public view and at least appeared to die.

The challenge we now face is to convert the current interest in the urban waterfront to significant and lasting results.

FOOTNOTES

[1]The state also can then receive the benefits of "Federal Consistency", a topic which will not be explored in this paper.

[2]In the urban waterfront areas, the New Jersey Coastal Management Program can rely upon the States' riparian statutes which date back to the 1700's under which most land now or formerly flowed by the tide is owned by the State, the Waterfront Development Permit law passed in 1914, the Hackensack Meadowlands Development Commission Act passed in 1968 and the Wetlands Act of 1970. New Jersey's other major coastal law - the Coastal Area Facility Review Act (CAFRA) of 1973 - addresses only the Atlantic Ocean and Delaware and Raritan Bay shorefronts.

[3]In particular, the New Jersey Green Acres program which is also administered by the Department of Environmental Protection, will grant funds for recreation and open space projects only if they are consistent with the State's Coastal Management Program. This is particularly important since the most recent bond issue approved by the voters to finance this program (November 1978), specifically allocated half of the $200 million for urban areas.

[4]Regional Plan Association; The Lower Hudson; New York City; December, 1966; page 6.

NEW BEDFORD HARBOR
A CASE STUDY IN WATERFRONT DEVELOPMENT AND ENVIRONMENTAL QUALITY CONFLICTS

by

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Introduction

New Bedford Harbor is a major commercial, industrial, and recreational resource of the southeastern Massachusetts region. It is a natural harbor formed by the drowned river mouth of the Acushnet River. Historically, the harbor has served as an important fishing center and is one of the major fishing ports on the east coast of the United States. The harbor is ranked second, after Gloucester, in volume of fish harvested in Massachusetts but ranks first in terms of the total catch value. According to fishery statistics compiled by the National Marine Fisheries Service, finfish landings in 1978 totaled 59,708,890 pounds valued at $23.3 million. Shellfish landings for this same period amounted to 12,500,443 pounds or approximately $31.4 million. Approximately 175 fishing vessels are currently berthed in New Bedford Harbor.

In addition to fishing, other harbor activities include shipping, ship repair, and servicing. The products that constitute the largest volume of shipping are petroleum-distillate fuel and residual fuel oils. Fish and shellfish account for the next highest volume and lumber is third.

A number of plans designed to stimulate the economy of the New Bedford area have been formulated by local and regional planning organizations. The New Bedford/Fairhaven Harbor Master Planning Committee, consisting of members in the public and private sectors form both New Bedford and Fairhaven, strongly emphasizes the harbor's role in local economic development. One of its major goals is to promote activities which enhance community economic development by providing ample opportunities for stable employment. This may be achieved by maintaining or expanding existing harbor industries, retaining and protecting the existing fishing industry, or introducing new harbor-related industries.

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The New England River Basins Commission (NERBC, 1975) in its Southeastern New England Study has made recommendations concerning the development of New Bedford Harbor. It specifically recommends improvement of New Bedford's navigational facilities and includes deepening some channels beyond currently authorized depths. More generally, it goals are to accommodate commercial fisheries and encourage overall waterfront improvement.

The Massachusetts Coastal Zone Management Office, under the Executive Office of Environmental Affairs, has assembled a number of policies related to economic development of New Bedford. One such policy encourages maritime-related development in the Buzzards Bay area where there exists the necessary infrastructure (such as in New Bedford Harbor). It affirms the need for maintenance and improvement of the approach, harbor channels; anchorage areas, turning basins, and State pier facilities to further harbor development (CZM, 1977). Both the City and State have vigorously supported the offshore oil industry in utilizing the harbor as a support base for outer continental shelf explorations. Concurrent with these development goals and objectives is the problem of disposal of dredged materials contaminated with heavy metals and PCB's. This report discusses various disposal options in view of current State and Federal directives and legislation concerning disposal of dredged materials. It briefly outlines some mitigation techniques which may be utilized to limit potential adverse environmental impacts.

Harbor Sediment Characteristics

The most complete synthesis of data on trace metal distribution in the project area is that of Summerhayes et al., (1976). Given the siting of major metals and alloy manufacturing on the waterfront, one would expect high concentrations of these metals in the sediments. The data support this hypothesis and, in essence, the entire Federal project area is highly contaminated with copper, zinc, chromium, and lead. Of the four metals, copper exceeds concentrations of 5,000 parts per million (ppm) in the sediments (8,054 ppm near the Coggleshall Bridge). Major concentrations extend through the harbor, the Hurricane Barrier, and into Fairhaven Bay. More recently efforts have focused on the chlorinated hydrocarbon situation in the harbor, specifically PCB's, and the impact on the marine resources of Buzzards Bay. The Commonwealth of Massachusetts, the EPA, and FDA have taken part in these studies.

The EPA, in a report on the PCB contamination of New Bedford Harbor, (Santos, 1978) has cited the firms of Aerovox Industries Inc., and Cornell-Dubilier Electric Corporation as the major contributors of PCB materials in New Bedford. Sediment 200 feet downstream of the Aerovox effluent discharge has been found to contain 620 ppm of PCB, and sediment 550 yards downstream of the Cornell-Dubilier plant was found to contain 143 ppm of PCB. Other sediment analyses of PCB's in the Acushnet River in New Bedford and Fairhaven indicate concentrations ranging from 0.3 ppm to 91.3 ppm. While it is known that the PCB concentration in the sediments poses a potentially serious pollution problem, the specific distribution, either vertically into the sediment or horizontally into Fairhaven Bay and Buzzards Bay, is not known.

Disposal Alternatives

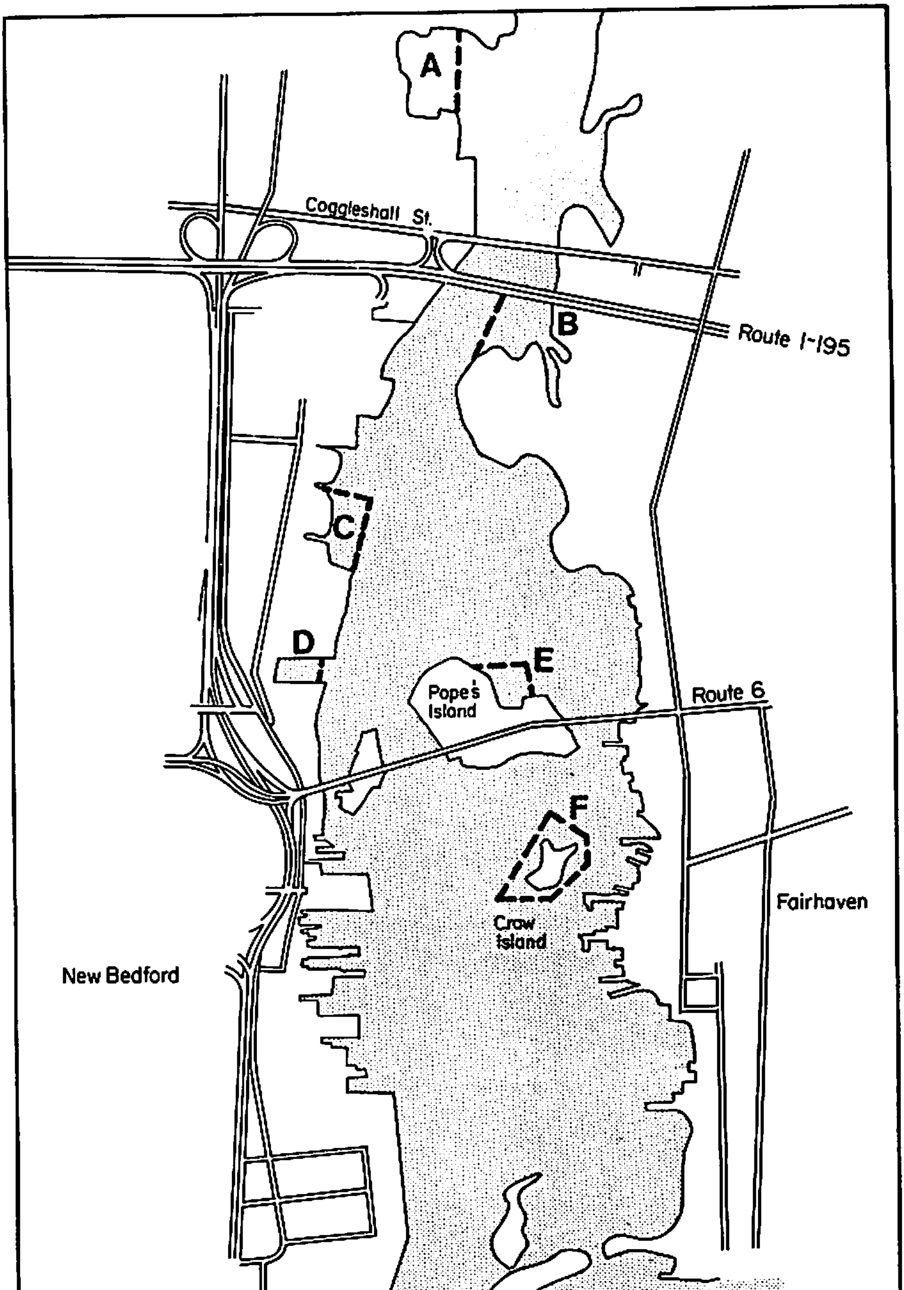
Discussions of potential locations for the disposal of dredged material from New Bedford are divided into ocean sites and land (waterfront) sites. It is recognized that much of the material to be dredged may be unacceptable for ocean disposal. However, ocean disposal is included as a consideration because of the high economic costs associated with in-harbor disposal. The London Convention prohibits ocean disposal of materials containing PCB's in excess of trace quantities. Sediments with acceptable PCB levels would be considered for ocean disposal. The Harbor sediment PCB concentrations are, in some locations, in excess of those considered as hazardous materials.

Land Disposal Sites

In the literal sense, there are not enough land disposal sites to handle and contain the contaminated sediment. Instead, the use of several sites within the harbor on both the New Bedford and Fairhaven sides has been explored. The location of the sites considered is indicated on Figure 1 and specific characteristics of each site are given in Table 1. While the selection of Site B, in Fairhaven, was based on past correspondence between the Corps of Engineers (COE), the City of Fairhaven, and local and State representatives and agencies, the other five sites were selected by a combined meeting of representatives from New Bedford, Fairhaven, and the COE. The use of these sites was also discussed with representatives of the EPA and the Massachusetts Division of Enviornmental Quality Engineering.

The City of New Bedford wishes to extend the area of Popes Island to the bulkhead line (Site E) for waterfront development. The North Terminal area (Sites C and D) is being completed. However, it is being slowed considerably by limitations placed on marine traffic by the Route 6 bridge. For the city, the full potential of the North Terminal will not be realized until the bridge clearance is increased. Such plans are currently underway in the Massachusetts Department of Public Works.

The two sites in the North Terminal collectively provide sufficient volume for the estimated 150,000 yd^3 projected for future maintenance dredging. The available volume at Site C, however, is slowly decreasing since there is disposal of building rubble occurring. In all probability, with or without disposal of dredge material at Sites C and D, the City of New Bedford will eventually fill these areas to the bulkhead line. Use of the remaining sites (A, B, and F) is considered limited at this time even though Sites A and B have sifficient capacity. Site A has limited access for the Federal project due to the clearance of the Coggleshall Street bridge and the crossing for Route I-195. This area might best be viewed as a potential site for disposal of highly contaminated sediment near the PCB sources.



Proposed Land Disposal Sites

—— Approximate extent of proposed diking scheme

Fig 1.

Table 1

PROPOSED LAND DISPOSAL SITES
NEW BEDFORD/FAIRHAVEN HARBOR

Disposal Site	Approximate Dimensions	Depth	Estimated Volume	Dike Length	Cost	Cost Per Cubic Yard	Comments
A	600' x 900'	8	160,000	850	3,191,000	±20.00	
B	750' x 500' 250' x 140'	10 11	153,000	900	2,728,000	±17.80	
C	800' x 400'	13	154,000	1300	2,971,000	±19.30	
D	280' x 450'	9	*42,000	280	924,000	±22.00	Site does not have enough area to accommodate entirety of material
E	600' x 550'	12	147,000	1100	2,451,000	±16.70	
F		11	136,000				Even if fill is extended to bulkhead line, there is insufficient room

Specific costs for construction plans at each waterfront disposal site have been calculated and range from $924,000 to $3,191,000 (1978 estimate) depending on the location in question. These figures do not include the cost of dredging. A more detailed study of engineering designs and accompanying cost estimates have been prepared by Tibetts Engineering Corporation (1978).

A dike constructed of borrow material appears to be the most feasible method of bulkheading for containment of the dredged material. The dike could be constructed by truck from the shore by end dumping. Riprap would be placed on the harbor side of the dike as construction progressed. The dike should be set back a sufficient distance to allow future wharf or bulkhead construction at the bulkhead line. It should be noted that the dikes will occupy expensive space and volume. Steel sheet pile bulkheads could be used instead of dikes at most sites but would increase the cost by four to six times.

The most feasible method of transporting the dredged material would be placing the material in barges and towing the barges to the disposal site. A barge-mounted crane or a crane mounted on the dike could then place the dredge material behind the dike. Moving barges will be severely restricted at sites located north of the Coggleshall Street bridge because of the eight-foot vertical clearance. Use of a pipeline would interfere with harbor traffic. As dredging progressed away from the disposal sites, booster pumps would be required. The increase in dredged material quantity due to dilution water would also require larger disposal sites, dewatering of the dredge spoil, and treatment and disposal of the dilution water.

Based on available sediment data, it appears that the dredged material will be 90 percent organic material. This material, untreated, would not be suitable for buildings, paved areas, or any type of structure susceptible to damage from settling. Given the poor sediment quality, it is anticipated that enclosure of the material within the disposal area will require the use of such impervious barriers as Hypalon or other similar products. Depending on the final site utilization (heavy duty industrial/commercial or park land) a minimum of one side covering will be required. In the instance of parkland, full covering and venting will be necessary.

Dewatering of the disposal site and treatment of the supernatant should not be as much of a problem with bulk handling (such as clam shell equipment) as it would be in a hydraulic dredge operation. Here, with clamshell dredging, water is displaced within a diked area as spoil is placed from a barge into the disposal area.

Depending on the nature of the suspended solids in the water and the acceptable effluent quality, it is possible that disposal area effluent could be treated within the dike to accelerate flocculation. Additionally, a sedimentation basin outside the diked area could be used.

Disposal site costs (estimated in 1978) exclusive of land acquisition and dredging would be about $16.00 to $20.00 per cubic yard of dredged material. One of the major cost items at the disposal sites is the impervious liner. Several types of liners were investigated but all estimates were based on the base liner available. Savings of up to $7.00 per cubic yard could be gained by using less expensive liners. These costs do not include treatment of the supernatant. It should be understood that placement of an impervious liner under water is not normal and problems may arise as a result of this method of construction.

Lining of the disposal site may not be strictly necessary at all locations but may be desirable for the disposal of highly contaminated material or in areas where there is no impervious cover.) is not planned. Liners should not be used in areas where piles are likely to be driven.

Ocean Disposal Sites

A number of ocean sites are within feasible transport distance of New Bedford. Of the sites considered, two are authorized for disposal of clean material and are also within the Massachusetts Cape and Islands Marine Sanctuary. The West Island site used for past dredged material disposal from New Bedford is not authorized and also lies within the boundaries of the Marine Sanctuary.

The pristine ocean site south of Browns Ledge has been investigated as a potential site for disposal of dredged material and/or as a regional disposal site. This study site is located at 40°23'25"N and 71°17'58"W approximately two nautical miles southeast of Browns Ledge proper. A Draft Environmental Impact Statement regarding the site was issued in February 1976 and received considerable objection from commercial fishing interests. A number of other alternate sites in Rhode Island Sound have been identified by Chase (1977) but none of these has yet been approved for disposal of any dredged material.

Productive Uses of Dredged Material

Alternative uses for dredged material include such possibilities as beach nourishment, construction aggregate, and fill for abandoned strip mines.

The New England Division, U.S. Army Corps of Engineers, suggests that for beach nourishment, medium grain size of the sediments be between 0.4, and 2.0 mm. Because none of the materials to be removed from the project area has suitable grain sizes and because of chemical contaminants, beach nourishment is not feasible.

It has also been suggested by various authorities that abandoned strip mines could serve as disposal sites for dredged material. At this time it is unlikely that such an alternative would be economically feasible, due primarily to transportation costs. Material from New Bedford Harbor would probably cause water quality problems due to salinity, heavy metal, and PCB levels in ground and surface water at the disposal sites.

Mitigation Techniques

In determining the unavoidable adverse effects of proposed dredging action, it is necessary to outline the techniques that will be used to limit these impacts. These can be divided into dredging techniques, disposal techniques, and timing.

Researchers working with sediment contaminated with trace metals (mercury, in particular) or PCB compounds agree that control of suspended fines is of utmost importance in minimizing the release of these contaminants to the environment. As a result of the affinity of PCB compounds for polar materials such as petroleum fractions, the control of oil scums from dredge and disposal operations is also important. These controls can be implemented in a number of ways.

The simplest, but not always most effective, is to use oil booms for containment with subsequent pickup of the collected scums. The use of oil absorbents can also aid in the capture of oils and associated contaminants. More recently, the design and deployment of silt curtains have been advanced. The curtains are generally constructed of nylon reinforced PVC materials to form barriers which are maintained in a vertical position by flotation devices on the top and ballast chains on the bottom. The curtains generally extend five to ten feet below the surface and function to control the flow of turbid water. Because of their limited depth, they do not contain or control fluid mud along the channel bottom. Field testing indicates that the curtains may be effective in sites where current velocities are less than one knot (i.e., inner harbor) and where frequent movement of the dredge is not necessary.

During hydraulic dredging of the Hudson River, treatment of the settling lagoon effluent water was necessary. The State of New York tested 20 chemicals and polymers and found three cationic polymers to be most cost effective in reducing turbidity and PCB levels in the return water. The materials were Drew floc 410, Nalco 7134, and Calgon cat floc B (Tofflemire, 1976). Application of the polymers to the suction line on the dredge resulted in reductions of PCB in the lagoon effluent from 50 ppb to 2-4 ppb. If a silt curtain is used around the dredge location, either skimming and/or application of a polymer within the enclosure would be appropriate. As an alternative to dealing with the waterfront fill areas and supernatant water, physical and/or chemical clarification of the water could be considered. With clam shell dredging, the problems of handling are compounded but the water quality implications are greatly decreased; hence, clam shell removal is the preferred technique. In either case, because of the fine-textured sediments, problems may occur at the land or bulkheaded spoil area with respect to dewatering and compaction. In view of this, a contingency plan would be necessary to outline provisions for handling of the sediments, placement of sand and gravel layers for structural stability, and installment of a drainage system in the disposal areas if necessary (Pirnie, Inc., 1978). Section 115 of the Water Pollution Control Act 1972 Amendments contains provisions setting aside money for dredging of toxic materials accumulated as a result of industrial discharges.

Mitigative techniques at an ocean disposal site would vary considerably. The site selection and nature of the materials to be dumped should be carefully considered, acknowledging that some of the outer channel sediments may be acceptable for open water disposal. Accurate monitoring of the large releases will help to ensure that short dumping does not occur. This will act to minimize the area covered by dredged material.

Capping of the contaminated sediments with clean, coarser materials is a mitigation technique used in some aquatic disposal operations. There is a problem, however, in finding suitable materials for such purposes and extra costs are involved. Monitoring studies may also increase the price substantially. Additionally, the suitability of capping is yet to be established to the degree necessary to ensure permanent submarine containment. The effectiveness of capping can be limited or negated by transient high energy events, such as hurricanes, and considerable site specific oceanographic information is required before the measure can be recommended as an alternative to confined landside containment.

Proper timing of the operations can also minimize possible conflicts with harbor usage, particularly during the recreational season. Dredging activities in the spring may interfere with spawning. However, fishing has been curtailed in the harbor due to PCB's and other contaminants so that interference with this activity is not an issue. From an environmental and a recreational standpoint, fall dredging would appear to be most suitable.

Conclusions

Many economic development goals hinge on harbor development, for which maintained channel depths are necessary. The City of New Bedford is interested in developing as many amenities as possible to attract new waterfront users. Maintenance of the Federal channel depth would be necessary to accommodate the possible siting of OCS facilities within the New Bedford North Terminal Project area. Dredging is also necessary to keep the New Bedford fishing industry vital and ensure that fishing enterprises expand in New Bedford rather than moving to other ports as benefits of the new 200-mile U.S. fishing limit are realized.

The future success of these development goals however, is contingent upon a satisfactory resolution of the disposal of contaminated dredged materials. Both maintenance and new dredging improvements will necessitate provisions of environmental acceptance of disposal solutions. In view of this, we encourage local and State interests to set aside land areas for disposal purposes. In addition, to avoid a last minute "crisis" situtation, regulatory agencies at all levels of Government are urged to continue their coordination to develop a plan to alleviate the contaminated conditions characteristic of the harbor.

The opinions and comments contained in this paper are those of the authors and do not necessarily represent the policies or official positions of the Corporation or Government agency with which they may be affiliated.

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PART VIII

COASTAL RESOURCE MANAGEMENT: THE INTERNATIONAL EXPERIENCE

Moderator: James Good

METROPOLITAN TIDAL FLOOD PROTECTION: THE LONDON EXAMPLE IN AN INTERNATIONAL CONTEXT

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ABSTRACT

Like many estuarine cities London (England) has chosen to meet the threat of potentially severe coastal flooding by investing heavily in tidal flood barriers, levees and similar engineering structures. Until the lower Thames barrier is completed in 1982 the city will rely on warning, evacuation and emergency relief programs to offset threatening floods. Weaknesses in both short and long term measures for coping with flooding in London and elsewhere are elaborated and alternatives reviewed.

In recent years there has been a shift in U.S. public opinion and government policy away from almost total reliance on engineering structures for coastal protection to a healthy appreciation of the merits of non-structural alternatives such as land use management and hazard insurance. For example, barrier islands that were once routinely "New Jerseyized" - as Orrin Pilkey describes the endless emplacement of groins and bulkheads - are gradually being accorded more even-handed treatment. This comes in the form of Presidential Executive Orders encouraging comprehensive environmental management; federally sponsored coastal zone management plans and flood insurance schemes; and state or local programs which allow for semi-continuous beach nourishment, improved emergency preparedness, anticipatory post-disaster redevelopment plans, public purchase of hazardous areas and similar initiatives.

To a greater or lesser extent many of the same trends can be observed in other nations. Coastal zone planning is becoming a significant activity in a growing number of maritime states (Szekields and Breuer, 1976). Yet, however bright the promise of these non-structural approaches to hazard mitigation, they are no panacea for much of the world's coasts. This is particularly true for large metropolitan areas.

The world's urban population is disproportionately located on or near its coastlines. In general, the larger a city, the more likely it will have a coastal location. Five of the six largest metropolitan areas occupy coastal settings. Fifty-five percent (55%) of urban areas with populations in excess of 1 million are situated directly on oceanfronts. Moreover, in a diverse array of nations the fastest and largest growth of population occurs in and around coastal cities (e.g., United States, Japan, Brazil, Australia, Ghana). Such places contain large, permanently established concentrations of human lives and economic investments that cannot readily be abandoned or moved elsewhere in the face of increasing hazard. In cities as varied as San Francisco and Rio de Janeiro, New Orleans and Venice, Providence and Manila, Boston and Tokyo, London and Hong Kong, Hamburg and Sydney, existing waterfront areas are being conserved, renewed and redeveloped while populations expand onto lands formerly avoided because of flooding, instability or other natural hazards. This growth in loss potential is often accompanied by negative changes in the physical characteristics of the hazards themselves. In view of these pressures major coastal cities face great difficulties in selecting effective hazard management systems.

This paper examines the experience of one major metropolitan area - London - with one type of coastal hazard - tidal flooding. It implies that both the problems and the responses of London are symptomatic of situations confronting metropolitan coastal hazard managers in an increasing number of places, and that there is a relatively narrow range of alternatives that might be followed - though none which generate much optimism in the immediate future. Finally, this study suggests that very much more innovative strategies for coping with hazard are necessary if coastal cities, especially cities in the developing world, are not to build themselves into positions of potential catastrophe.

TIDAL FLOODING IN LONDON

The Historic Record

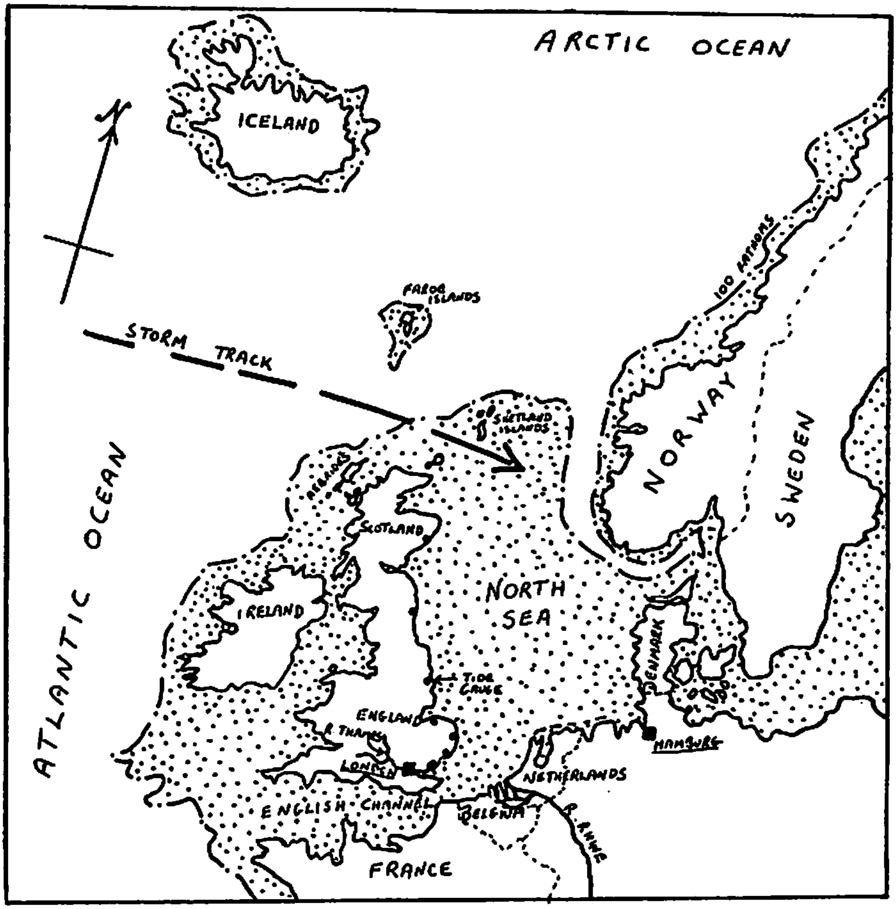
London has suffered from tidal flooding at least since the 13th century (Greater London Council, 1970). The city lies at the end of two natural funnels formed respectively by the North Sea and the Thames Estuary (Map 1). Severe storms which enter the North Sea by way of the broad opening between Scotland and Norway generate surges which progressively grow in height as they move south. Water piled up ahead of the storm is first constricted between the coasts of Britian and mainland Europe and again further confined as it moves up the lower river Thames (Pollard, 1978). Typically, a depression might raise water levels by a foot as it moves over the continental shelf off northwest Scotland. By the time the surge enters the North Sea it will have grown to approximately 2 feet. Thereafter, its height increases rapidly, perhaps reaching 7 1/2 feet above normal in the Thames estuary. In 1953 a surge of 10 feet was recorded and at other times even larger increases up to 16 feet have been noted. When combined with normal high tides this is sometimes enough to overtop the sea defenses of London. Over the last two centuries that system of embankments and walls has been repeatedly raised and strengthened to meet this threat. It is an unending task because southeast Britian is sinking isostatically and tectonically by 1 foot per century, because there is a worldwide rise in sea level, and because the clay soils of the London Basin are also compacting and subsiding relative to the sea (Greater London Council, 1970). In addition, dredging of the lower Thames for navigation improvement has permitted greater volumes of water to penetrate further upstream and a combination of industrial growth and estuarine dykes has reduced the capacity of the downstream flood plain to absorb major surges.

During the floods of 1834 highest tides at London Bridge reached about 15 feet above Ordnance Datum. By 1881 they topped 16 feet, and by 1928, they surpassed 17 feet. Shortly thereafter all river walls were raised to a new statutory defense level of 17.33 feet. However, flood levels continued to increase. When the disastrous North Sea floods of 1953 took 300 lives in Britian, London was spared inundation by the failure of downstream defenses and by a sudden shift in winds that steered the surge onto the Dutch coast (Pollard, 1978). Nonetheless, water lapped at the top of central London's embankments for several hours. As a result, sea defenses were again modified. By 1972, a new statutory defense level was set at 19.02 feet. During the winters of 1976 and 1978 water again lapped at the tops of the sea walls (Fig. 1). Although the city escaped significant damage the event was widely regarded as an ominous portent.

FLOOD DAMAGE POTENTIAL

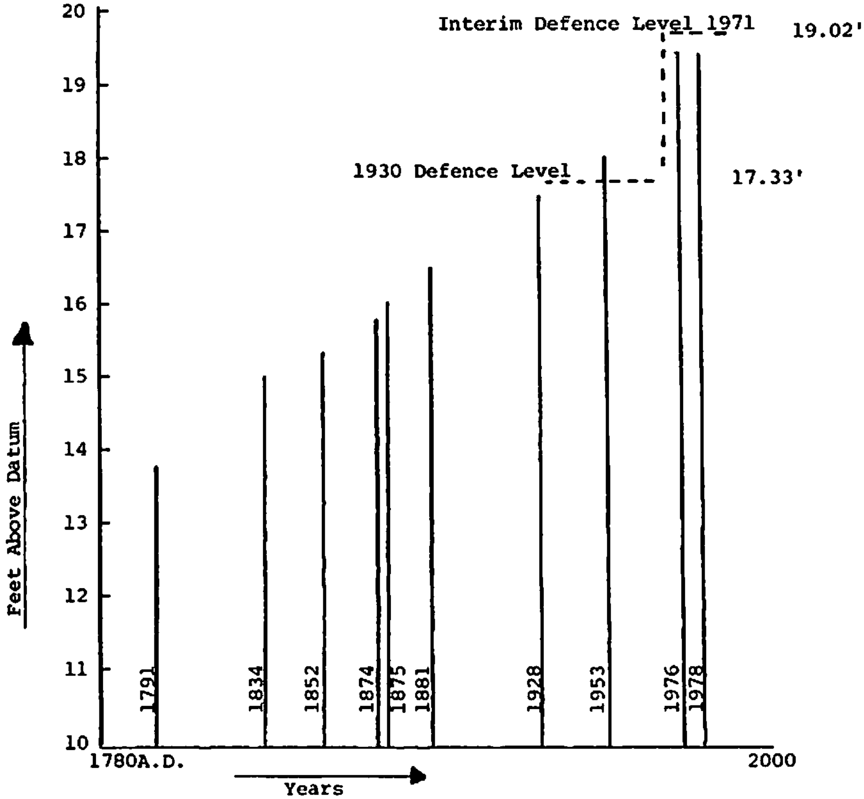
If the embankments and river walls fail during a future surge, what are the likely effects? About 45 square miles of central and eastern London would then be inundated (Map 2). This area includes 15 major power stations; the city's major sewage pumping stations and treatment works; commercial gas plants; water purification facilities; several large hospitals; many port side industries, warehouses and docks; a wide range of major administrative buildings - including the Houses of Parliament; the central section of London's subway system (i.e. 70 stations and 46 miles of track); and the homes of about 1 million inner city residents. The economic costs of direct damages to buildings and structures would total $6 million. This does not include the toll of lost lives - one scenario suggests 100,000 - injuries, mental anguish, disruption of industrial production, unemployment and many other impacts, not the least of which would be the numbing effect of such a strategic catastrophe on national life.

Clearly, the flood damage potential of London is both large and increasing. Since the floods of 1953 the government of the United Kingdom and the Greater London Council have convened a series of investigatory committees and technical panels; they have appointed special consultants; funded research on hydraulic modeling, navigation and coastal engineering - all in an attempt to find a more permanent solution to the flood problem. In consultation with local governments they have also devoted much attention to flood warning schemes, evacuation management and emergency preparedness planning.



MAP 1

THE NORTH SEA BASIN



Based on data supplied by
Greater London Council

Fig. 1

RISING HIGH WATER LEVELS AT LONDON BRIDGE

From the outset, however, structural approaches to flood protection have been emphasized. By 1958 the major choice was seen as either general elevation of existing river defenses or construction of a massive river barrier between strengthened embankments downstream from central London. The first alternative was judged undesirable, partly because it was a costly, incremental response that would eventually require further modification; partly because the technical problems of raising some river walls were extremely difficlut; but, especially, because much of the public amenity value of the river Thames would be destroyed by closing it off from view and access behind tall concrete barriers. In a city as aware of tourism, amenity and landscape as London, this is a telling argument.

THE FLOOD BARRIER SCHEME

To many, a downstream river barrier is simpler in conception, more technically feasible, less obtrusive and seems to hold out the possibility of permanently curing urban flooding. Several sites and barrier designs were proposed, investigated and rejected in the decade between 1958 and 1967. Eventually, in the autumn of 1969 a barrier plan was formulated, although Parliamentary approval had to wait until August 1972. The chosen strategy includes several engineering features. The main element is a moveable tidal barrier, 8 miles downstream from central London. This 1500 foot long structure is to be equipped with steel gates that lie flat on the river bed to permit easy ship passage, but can be raised within 15 minutes to bar a storm surge 30 feet in height. Downstream levees are being strengthened to the same standard of protection as the barrier, and river walls along the very high risk sections of the Thames upstream from the barrier are being raised as an interim emergency measure. Completion was originally scheduled for 1978 but is now anticipated by December 1982 (New Yorker, 1979).

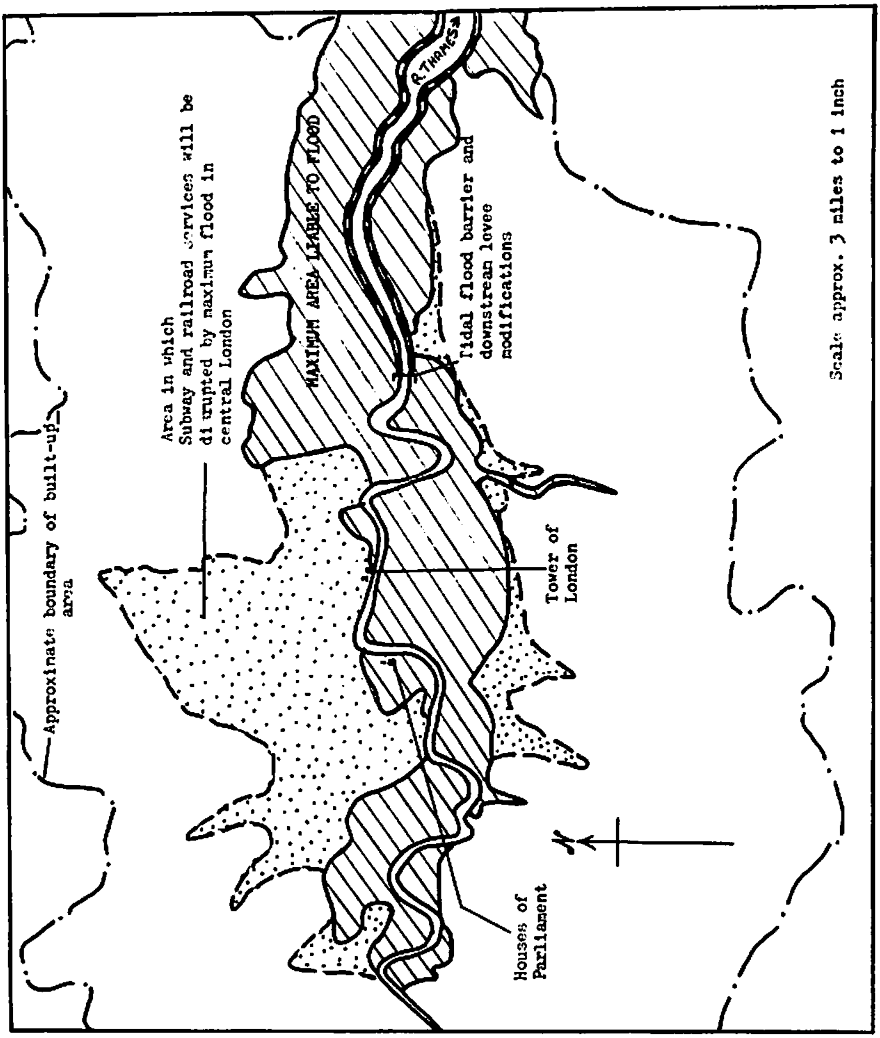
Public officials are confident that the finished scheme will afford London at least a century of protection. Their most pressing worry is that serious flooding will occur before that time. (This concern is shared by other observers and it prompted Britian's most striking example of a disaster novel, which was among the national best sellers in 1978 (Doyle, 1976). As a result, they have spent several years improving emergency warning and preparedness procedures.

FLOOD WARNING SYSTEMS

The flood emergency office in London is linked to the national Tidal Warning Service via telephone and teletype communications. This system of tidal gauges stretches from northern Scotland to the mouth of the Thames. As a surge moves into the North Sea it is first measured in the Outer Hebrides Islands 14 hours before it is due to reach London. Calculations of expected flood heights are begun and predictions improved as data from more southerly gauges become available. Six hours before an expected flood the London flood warning system goes on standby. This occurs about 30 times a year, usually between August and April (interview with M.J. Taylor, 1978). Four hours

MAP 2

TIDAL FLOODING IN LONDON



Mitchell

before high water, the Greater London Council contacts mass media and government offices and broadcasts a flood warning. Three hours later, as the surge reaches the mouth of the Thames, a signal is sent to the Metropolitan Police Headquarters, informing them that sirens may be sounded throughout the flood risk area. At the same time, the Emergency Control Center is activated as the base from which London government will operate during the flood. It is located north of the river 40 feet above expected maximum flooding.

The objective of the warning system is to give populations at risk sufficient time to leave the affected area or to seek safe shelter within it. Thus, the Metropolitan Police have been instructed to close key roads and tunnels at specific times and to channel traffic out of the flood zone. At the four hour warning stage the London Transport Corporation is requested to stop incoming traffic and to remove all vehicles at risk. Human services agencies with responsibility for the elderly, handicapped, sick, young children or other special target groups maintain lists of names and addresses to be contacted directly for emergency evacuation. In most affected London boroughs informational leaflets about the flood warning system have been distributed to all households. Similar articles are periodically published in local newspapers (personal communication, H.G. Lewis, Lambert, 1978). Business owners receive special posters detailing steps they should take to protect their employees. A poster map of the risk area of Greater London is prominently displayed throughout the city. At first glance the system appears comprehensive and foolproof. However, it is, in fact, subject to many uncertainties.

Perhaps its most reliable element is the Tidal Warning Service. Tide gauge readings and meteorological forecasts are combined in a series of formulae which predict expected flood heights with an average error of $\pm$ 6 inches. However, on occasion these predictions have varied from actual conditions by $\pm$ 6 feet!! Further, it is possible that a severe storm could pass quickly over central England rather than entering the North Sea further north, thus causing water levels to rise much faster than normal and reducing warning times to only a few hours.

The flood service does not broadcast 4 hour warnings at night when radio and television stations are not operating. Since it is assumed that people may be safer at home than travelling to work or school, this is not thought of as a serious deficiency. However, that assumption has not been substantiated. With possible flood depths of up to 20 feet, old housing stocks, many ships and barges on the river, many elderly residents, nearby oil refineries and toxic chemical industries, there are at least grounds for concern.

Perhaps the most damaging flaw in London's flood warning system is its dismal record in practice. Sirens were last extensively tested throughout the flood area in 1974. The results were not encouraging. Many residents did not hear them and most others did not know what to do. It is estimated that only about 10% of the population recognized the warnings and acted appropriately. Emergency coping plans are to some degree as hoc since the developing pattern of a spreading flood cannot be closely predicted. Once over its banks, the Thames is likely to eat away the rear side of the floodwalls where the oldest- and weakest - sections of dyke are to be found, causing them to collapse away from the river. Thus, multiple entry points for large volumes of water would be created. Further, although topography is likely to be a general controling factor, water may be channeled by street patterns and subway tunnels in ways at variance with such considerations. Nor is the river wall system an unbroken line of defense. Individual firms are permitted to open gates to gain access to barges and ships. Although owners can be heavily fined for leaving gates open, it is recognized that there are chronic offenders who could jeopardize the integrity of the walls by failing to close these gaps. Finally, London possesses no significant plans for post-disaster redevelopment and recovery.

In summary, the city of London relies for flood protection on its short run ability to predict and warn of storm surges and to evacuate or other wise care for populations at risk. Although greatly improved in recent years, this system is far from perfect. The city's long term strategy is tied to a single, technological fix - the tidal flood barrier. This is an adjustment fraught with risks. Equally sturdily constructed bridges and causeways have been immobilized for months by ship collisions (e.g. Hobart, Tasmania; Chesapeake Bay Bridge and Tunnel). The Thames has been known to freeze in severe winters. The effects of floating ice jammed against the gate supports or a solid cover of ice on the river do not appear to have been included in test calculations. Although the electrical power needed to operate the gates have several backup systems, there is no guarantee that they could not be neutralized. As was demonstrated by the Three Mile Island nuclear accident, the possibility of human error must always be considered in complex technologies. Beyond the question of whether such a barrier might work lie other issues. Presumably, an ostensibly safe London could begin to develop low lying land that had previously been avoided. This has happened very frequently in similar situations elsewhere. Such changes further increase the loss potential if a surge does break through. They also commit governments to invest even more in added protection during the future. Finally, very little is publically said about the economic and amenity costs which downstream communities must bear by raising their own defenses to resist flood waters diverted to them by the closure of upstream barriers.

INTERNATIONAL COMPARISONS

This combination of structural and emergency responses to metropolitan tidal flooding can be seen around the world. It is the mainstay of the Dutch Delta Plan. It is the basis of the several plans for protecting Venice (O'Riordan, 1975; Fay and Knightley, 1976; New York Times, 1980). It can be seen in Providence, Rhode Island. A variant is used in New Orleans, where there is no single downstream barrier, but strong reliance on strengthening levees, diverting upstream rivers and sheltering people in highrise buildings (Wagner and Durabb, 1976) Hamburg and other estuarine cities have also investigated the possibility of such barriers. Until recently they were a regular feature of Corps of Engineers hurricane plans in the eastern United States. Although barriers are not generally feasible in large oceanfront cities, the principle of reliance on structural defenses and evacuation predominates on most hazardous urban coastlines.

ALTERNATIVE PROTECTION STRATEGIES

What are the alternatives to structural defenses, warning systems and evacuation? Different communities might simply bear the losses; they could devise economic merchanisms for spreading losses (e.g. insurance systems); they could floodproof individual buildings; and they could develop land use controls that would discourage occupance of hazardous areas.

At the London scale, loss-bearing is the least desirable option. Insurance schemes merely spread the losses - at least in the initial years of operation. However, they have also been known to increase loss potential by relieving owners of the economic uncertainty surrounding loss of their property, and thus indirectly encouraging them to occupy or remain in vulnerable places. Furthermore, the burden of flood costs in London and most other cities falls on major industries and commercial properties which can usually affort to insure themselves in the private market and thus circumvent land use control aspects of subsidized schemes like the U.S. National Flood Insurance Program. Building codes and other devices can successfully be used to encourage flood proofing of individual structures but they require close monitoring, rigorous enforcement and periodic review. Nor do they help to reduce losses incurred by utility lines, roads and other infra-structure components. It is also difficult to see how zoning and other land use controls can work to reduce potential losses among existing urban structures. So little underdeveloped open space remains to be allocated in most large coastal cities that there is little room for such initiatives until after a disaster has occurred.

Unless policy makers can be persuaded to find new ways of reducing populations and investments at risk to hazard, cities like London seem to possess no significant alternatives to heavy reliance on large scale structural defenses and comprehensive warning and evacuation systems. Inasmuch as complex technologies are themselves prone to failure (e.g. Teton Dam; Three Mile Island reactor; New York electricity blackouts), it is imperative that warning and evacuation systems be fashioned to a high degree of effectiveness. This is clearly not so in London. In the United States it is also increasingly questioned whether such systems as we now posses can cope with warning and evacuation of people at risk from hurricanes or earthquakes in urbanized areas. While a complete review of hazard warning and evacuation systems is long overdue, it is widely suspected that the United States may be approaching the limits of human action in this field.

This is not a subject which lends itself to easy solutions. It does seem possible to reduce the cost of coastal hazards in areas like barrier islands and other summer resort communities by adopting ecologically, aesthetically and socially sensitive non-structural measures. Whether the same can be said of urban shores is still an open question.

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Managing Trans-Frontier Coastal Resource Problems in International Boundary Areas: the Dutch-German Experience

by
Brian J. O'Sullivan*

Abstract

Compared to domestic issues, international coastal resource management problems have received little attention in the recent environmental affairs literature. In certain respects, however, these trans-frontier problems pose just as great, if not more complex, planning and management challenges as those emerging at national and subnational levels. Paralleling the increased scale and intensity of such regional disputes, moreover, is the fact that demands for cooperative institutional arrangements to promote effective conflict resolution have also escalated. This paper summarizes the Netherlands-West Germany experience in managing trans-frontier environmental concerns in the Ems-Dollart estuary, an international ecosystem comprising their North Sea maritime boundary area. Particular attention is focused upon the area's regional setting, its water pollution and harbor development disputes, and the joint institutional framework encompassing cooperative efforts to resolve them.

I. Introduction

Most trans-frontier environmental disputes occurring in boundary areas along the coast stem from international policy conflicts over the use of shared marine resources or ecosystems. The geographic scale, issue complexity and intensity and duration of these disputes can vary considerably. In particular, a maritime boundary region's physical setting, resource endowment, and coastal development patterns represent key dispute components. Generally, the issues and resolution experiences observed in no two regions are ever alike. On the other hand, there may be more universality in the broad range of joint institutional arrangements available for managing trans-frontier coastal resource problems. Such mechanisms, both formal and informal, include permanent bilateral commissions established

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by treaty, ad-hoc scientific research and data exchange teams, occasional consultations among cabinet members and other governmental officials, and alliances of political parties, environmental conservation groups, and business development interests. Combined with the propensity for trans-frontier coastal resource issues to emerge in multiple dispute "web" configurations, this dispersed institutional framework helps to make maritime boundary areas one of the most challenging regional contexts for effecting cooperative environmental management.

This paper summarizes the experience of the Netherlands and West Germany in confronting each other over two trans-frontier coastal resource problems and in moving jointly toward the settlement of those problems. The analysis focuses only upon controversies relating to surface water pollution and threats to natural wetland habitat areas due to industrial harbor development. Both of these environmental concerns are localized within the Ems-Dollart estuary, an international river basin forming the Dutch-German North Sea boundary area. To date, neither one has yet been fully resolved.

The organization of materials is as follows: first, a general overview of study area history, physical geography, and human settlement patterns is presented; then, the dimensions of coastal resource disputes regarding water pollution and industrial harbor development are outlined; finally, the institutional framework for cooperative Dutch-German conflict management efforts is described, its performance is assessed, and constraints limiting its future effectiveness are identified.

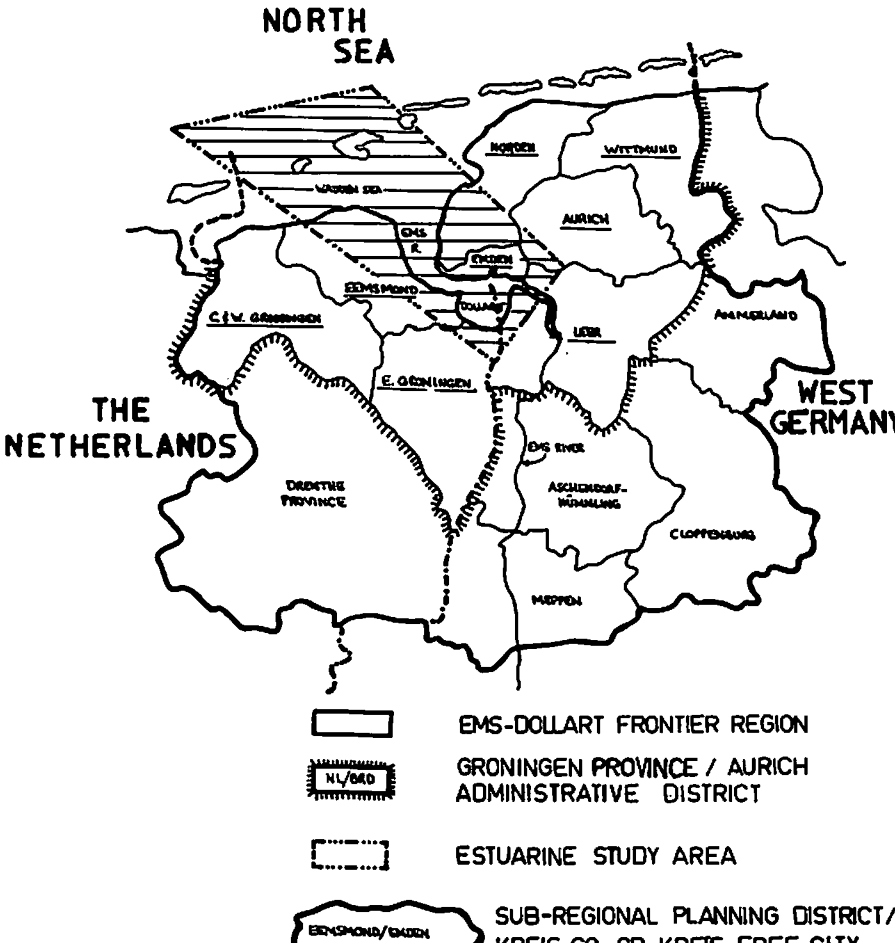
II. Study Area Overview

a. Physical Geography and Ecological Significance

The Ems-Dollart estuary is situated at the North Sea terminus of a 475 km-long mainland frontier shared by West Germany and the Netherlands (Figure 1). Along the estuary's southern periphery lies the Dutch province of Groningen; to the north is the German Land (state) of Lower Saxony. This coastal zone segment represents approximately one-fifth of the Wadden Sea, a 10,000 km^2 tidal shallows area stretching from the middle Netherlands through West Germany on up into southern Denmark. As a trinational resource region the Wadden Sea is acknowledged as western Europe's largest and most ecologically significant wetland ecosystem (Wadden Sea Experts, 1975). The Ems-Dollart is the only international river basin encompassed by, and integrally linked to, that system; however, it also happens to be one of the most heavily developed portions of the Wadden Sea's coastal zone, with a considerable amount of additonal human activities pending.

The two dominant physical components of the estuary are the Ems river and the Dollart basin. The Ems, a German water course for most of its length, first discharges into the northern reaches of the Dollart south of the port of Emden. Its main channel eventually

FIGURE 1. Ems-Dollart maritime frontier region.



branches into eastern and western streams toward the mouth of the estuary. At this point, approximately 34 km separates the Groningen and Lower Saxony coastlines; further seaward, these Ems river channels veer to either side of Borkum, a barrier island situated at the estuary's gateway. The Dollart, a broad shallow bay, is the most prominent feature of the inner Ems-Dollart estuarine eco-system. Its present "bulbous" shape stems from severe 14th century storms which innundated a considerable amount of agricultural land, particularly on the Dutch side. The Dollart is the major receiver of fresh waters entering the estuary from the German Ems and Dutch Westerwoldse Aa rivers; combined with marine tides, it represents an intensive zone of salt and "sweet" (i.e, fresh) water mixing.

Unlike the outer estuary, in which muddy flats are exposed twice daily in a limited number of areas, nearly all of the Dollart basin experiences this hydrographic transformation at low tide. Similarly, in the absence of an extensive system of inner estuarine dikes, the Dollart is far more susceptible to occasional North Sea storm surges. Biologically, it features bottom sediments of extremely fine particle size which are unique to sheltered bay environments. These hydrological dynamics and their associated sedimentation structure are matched by rather rich vegetation within the tidal transition zone itself. The flora here combine to provide an ideal natural setting for avifauna nesting, migratory nesting, moulting, and foraging by a diverse variety of wild fowl and wader bird species. Significantly, Dutch bird censuses have determined that some visitors utilizing the Dollart (for either short or extended stays) travel a considerable distance and represent significant portions of entire annual migratory populations. Wild fowl (i.e., geese and ducks), for example, originate from all over northwest Europe, the Baltic region, and northern Russia; at least eleven wader species, mainly of Europeam origins, have been noted, although some migratory visitors come from as far away as north Africa. Among the more important species in this respect is the wader avocet. Resident counts taken in late summer and fall have estimated that 75 percent of the entire northwest European avocet population frequents the Dollart basin (Wadden Sea Experts, 1975). This species appears to be well-suited to bay shallows for seasonal foraging in large part due to an innate physical capacity to feed easily through fine bottom silt.

In a much broader sense, the Ems-Dollart estuary's ecological significance is functionally interrelated with resource values of the trinational Wadden Sea shallows system. In 1975 the Wadden Sea environmental system was first acknowledged by the international scientific community to be unique in Europe, if not the entire world (Wadden Sea Experts, 1975). More importantly, attention was finally drawn to both the supranational dimension of its natural resource values and the need to conserve and manage those values at a new level of multilateral cooperation. Eight categories of regional environmental significance were assigned to the Wadden Sea; most of these apply equally well to the Ems-Dollart estuary as a bi-national component of that system: geomorphological, hydrographic, marine hydrobiological, fish and fisheries, avifaunal, marine mammals, botanical and zoological. Conference recommendations focused not only upon strategies for preserving values for scientific research, but also for achieving environmentally sound coastal development compatible with long-term natural habitat protection objectives. The Ems-Dollart estuary was singled out as posing rather special resource management problems given its existing levels of human activities and intense preserves for future coastal-dependent development. An earlier draft treaty convention on the Wadden Sea's conservation by the International Union for the Conservation of Nature and Natural Resources (IUCN) had already reiterated many of those same concerns for this maritime boundary region (IUCN, 1974). Ironically, however, IUCN also suggested that intensive coastal development and industrialization might better be "contained" within existing activity areas (such as the Ems-Dollart estuary), largely in the interests of preserving pristine Wadden Sea environments elsewhere. The proposed draft treaty has never been formalized.

The Ems-Dollart thus represents an ecologically fragile international estuarine system caught in the middle of a much broader conservation versus development struggle threatening the entire Wadden Sea Shallows. In addition, this coastal region is characterized by an interesting political history and considerable estuarine development pressures, both of which help to shape the nature of its trans-frontier environmental disputes.

b. Political-Legal History

Another significant element of the Ems-Dollart maritime frontier region setting underlying Dutch-German environmental management concerns is boundary history and politics. For example, beyond an undetermined point in the Dollart basin off Emden, no mutually agreed upon seaward boundary exists within the remainder of the estuary. The controversy over the exact path of this boundary goes back well before the 15th century. Although a "working" line was established by treaty in 1963 for navigational maintenance and shipping facilities planning, neither party has chosen to take the matter to the International Court for final adjudication. The Netherlands continues to hold fast to the allegation that the Ems river thalweg, or main channel, ought to demarcate a marine boundary denoting territorial waters. West Germany, on the other hand, contends that an historical title entitles them to sovereignty over estuarine waters "a horseshoe's throw from the Dutch coast". Bouchez (1964), a legal historian, has examined in detail the complex and often confused legal foundations of these conflicting claims without supporting either position or offering any simplistic solutions to the problem. The Netherlands and West Germany have bickered with each other irregularly ever since their last major border jurisdiction flareup. That was in 1947 following World War II territorial reparation demands made by the Dutch. No reparation awards were ever concluded in the Netherlands' favor, however. Modern Dutch and German base maps of the Ems-Dollart vicinity continue to illustrate their respective, albeit conflicting, stands on the demarcation issue. In addition, as discussed below, trans-frontier environmental concerns regarding German harbor development in Emden have again aggravated this maritime border altercation.

c. Human Activity Patterns

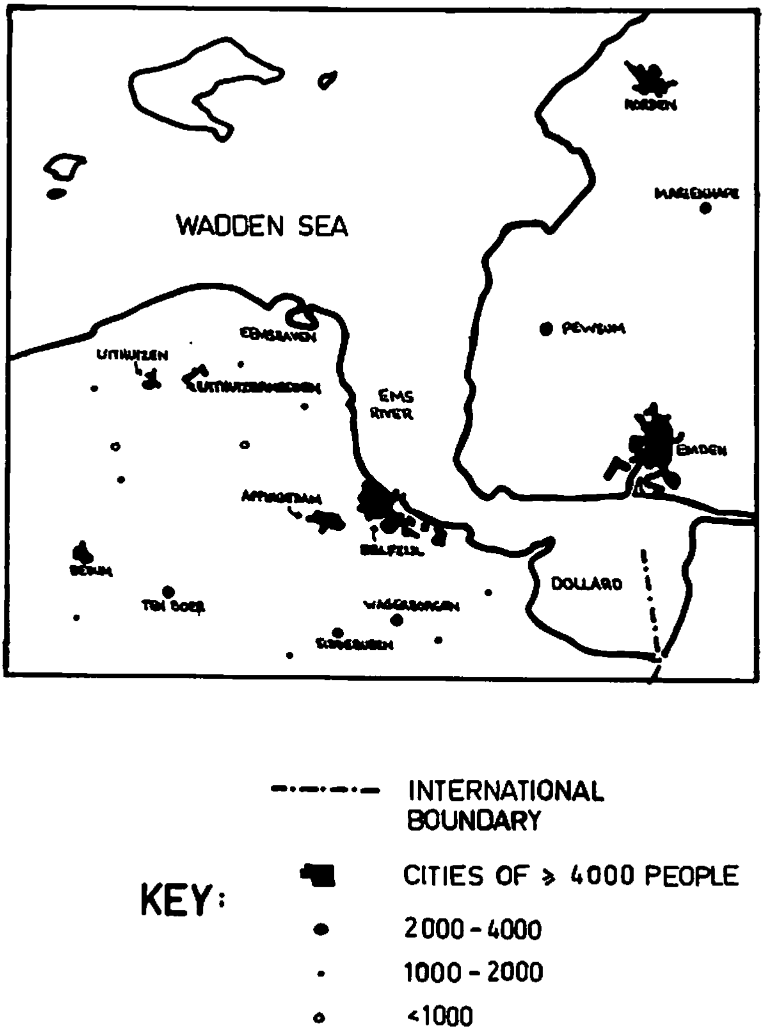
According to some western European economists and planners, the Ems-Dollart estuarine boundary area resembles a classic "peripheral" or lagging region (Peters, 1975). In both Groningen and northwest Lower Saxony, the socioeconomic infrastructure is comparatively underdeveloped and economic growth rates are well below average figures reported for the nation as a whole. The region is also somewhat remote geographically from Dutch and German economic heartlands, i.e., the southwest Randstad urbanization and the Ruhr industrialized area, respectively. Unemployment is chronically high (in places exceeding 11 percent) due to sectoral declines in agricultural manpower needs unbalanced by job growth in secondary and tertiary sectors. Also, labor-intensive industries have proven difficult to attract away from more desirable development areas situated elsewhere. This includes public as well as private enterprise.

Recently, however, more aggressive regional economic policies (both national and supranational) have emerged in many western European maritime frontier zones such as the study area. Groningen and Lower Saxony have both become caught up in the desire to alter regional disparities in their own self interests. Part and parcel of the more vigorous economic planning atmosphere now evident along both shorelines of the Ems-Dollart estuary is the encouragement of coastal zone dependent development, especially industrial port-related activity.

At present, coastal development in the Ems-Dollart is concentrated at the inner estuarine urban port waters of Emden in Lower Saxony and Delfzijl in Groningen (Figure 2). At the mouth of the river basin the more recently constructed Dutch port of Ems Harbor is just beginning to accept industrial settlement, but urbanization is minimal. Delfzijl's growth as a chemical industry center for the northern Netherlands, a traditionally agricultural area, can be traced back to 1957. At that time considerable salt and natural gas finds were made in Groningen (Stichting Werkgroep Eemsmond, 1978a). At least eight major industrial concerns, including one aluminum production unit, have located on Delfzijl Port Authority development lands since then. A number of facility expansions, such as that involving an Upjohn plastics operation, are currently in process.

The Dutch Ems Harbor, a construction project conceived long ago but only completed in the early 1970's, did not blossom overnight into the regional growth "pole" it was originally intended to be. However, a conventional power plant has already been raised, and a roll on-roll off marine freight terminal has opened. Dutch State Mines (a nationalized enterprise) has also become involved in consultations and preliminary environmental studies concerning

FIGURE 2. Estuarine urban development.



the feasibility of locating a large petrochemical complex at the harbor. Another pending scheme, but as yet undecided upon, would designate Ems Harbor as the terminal destination for Liquid Natural Gas (LNG) tanker ships originating in Algeria. One rationale for this proposal was the desire to locate high risk maritime activities (in this case due to risks of tanker or terminal explosions) away from highly populated areas such as Rotterdam's Europort complex. The Ems Harbor also continues to be favored as a settlement site for "dirty" industries due to their exclusion from already polluted zones by environmental quality regulations. Regardless of these national development priorities, however, Groningen's comparative geographic remoteness, combined with industry's reluctance to leave the southwest and environmental concerns about the adverse regional impacts of "new" pollution, have served to retard rapid growth of the Ems Harbor.

Germany's coastal development occurs a short distance across the Ems-Dollart estuary from Delfzijl, is less extensive and is concentrated near the port of Emden. Historically, Emden's economic base has revolved around semi-finished product transshipment, and ship building and repair; cleaning facilities for crude oil tankers have expanded greatly in recent years to complement that earlier maritime tradition. In addition, Volkswagen has a major assembly plant here linked to direct export marketing, and there is a fairly large oil refinery connected with the industrial port complex. An iron ore pellet manufacturing facility is also expected to be completed here sometime in 1980 (Stichting Werkgroep Eemsmond, 1978a).

As far as proposed coastal development along estuarine margins is concerned, Lower Saxony is looking toward both the expansion of industrial land uses west of Emden and the construction of a new harbor facility directly offshore (i.e., south) of Emden. The second of these schemes is by far the most ambitious and controversial. Conceived in 1973, it entails three main elements: a relocation of the main Ems river channel south of its existing course; the reclamation of an elongated industrial land parcel (± 560 hectares) offshore utilizing channel dredge spoils; and the construction of new and enlarged sluice gates at the western end of this island to allow ships (100,000 tons and greater) easy access to Emden. The rationale for the Dollart Harbor, as the project is known, appears multifaceted. On the one hand, it is intended that Emden's competitive advantage for Western European maritime trade will be enhanced; at the same time, the direct and indirect spinoffs of this expansion could upgrade the frontier area's lagging economy. The Ems channel relocation would also significantly reduce, if not eliminate, the need for expensive dredging to facilitate vessel access into Emden so navigational maintenance costs would decrease sharply. Last but not least, the new addition of reclaimed land offers long-term opportunities for industralization should new unforeseen development demands arise.

The preceding discussion has demonstrated the geography and ecological significance of the Ems-Dollart estuary, its entangled legal history and the present and future liklihood of increased coastal development pressures. Assuming all development scenarios hold, it is conceivable that estuarine industralization here will at least rival the Rotterdam Europort in area (approximately 3,000 hectares) if not sectoral diversity. So too, however, will environmental concerns inevitably accelerate both domestically and internationally. One of these trans-frontier concerns, surface water pollution, is a chronic problem and a continuing threat. Another is the possibility that significant estuarine resource values dependent on Wadden Sea nature conservation could be lost irreparably through cumulative degradation or catastrophic ecological damage stimulated by industrial harbor development. Both trans-frontier issues have already been, and continue to be, the subject of much consternation between West Germany and the Netherlands. As a consequence, a number of cooperative mechanisms have evolved to resolve these disputes. The next segment of this treatise outlines the nature of these problems and their conflict management status to date.

III. Binational Cooperation in Managing Trans-Frontier Coastal Resource Disputes

a. Dutch Wastewater Discharge Policies

A persistent environmental quality problem plaguing the Ems-Dollart region, and one which has aroused a considerable amount of West German concern over the last 15 years, is that of Groningen's discharge of untreated wastewaters into the estuary. Historically, this land-based pollution has had two chronic sources: urban wastes from the provincial capital (Groningen) which are transported out to the coast near Delfzijl via the Ems canal; and industrial effluents generated in eastern Groningen's Fens Colonies (a potatoe starch and straw paper processing center) which ultimately follow the prevailing stream and canal drainage pattern into the southern Dollart basin. More recently, the Fens Colonies problem has taken on a new dimension, however. A Dutch scheme to construct a pipeline (the so-called "Smirpijp") to discharge treated wastewaters from east Groningen into the estuary west of Delfzijl has experienced a delay in construction; moreover, industrial treatment facility schedules have lagged, so much so that a certain amount of dirty discharges continue to enter the Ems-Dollart ecosystem.

Although Germany was well aware (both in a visual and aromatic sense) of Fen Colonies pollution prior to 1960, it appears that no formal complaints arose until around 1965. This acknowledgement of concern coincided with the Netherland's own decision to design an alternative way of discharging industrial wastes, no matter how seasonal and indirect, into the Dollart. They appear to have been less concerned with minimizing estuarine pollution than with alleviating aesthetically displeasing smells, however. The original proposal would merely have pumped untreated wastewaters toward the mouth of the estuary under the assumption that tidal flushing would take care of organic and inorganic pollutants naturally.

It is unclear exactly how and when Germany first became aware of those plans. In any case, her opposition raised reservations about the Dutch scheme on two grounds: the lack of scientific data on the natural capacity of the Ems-Dollart to purify itself; and the futility of attempting to assess, much less minimize, potential estuarine resource damages likely to affect both countries without such information. In particular, fears were broached concerning the health of coastal fishery nursery grounds, marine flora and fauna, and the bathing water safety off nearby tourist islands in the Wadden Sea (e.g., Borkum).

These concerns helped to precipitate a joint declaration in 1970 authorizing an ad-hoc bilateral scientific team to further assess estuarine hydrology relative to water quality problems and to evaluate the impacts of the above-mentioned discharge scheme. The agreement was finalized verbally at a meeting between the West German Minister of the Interior and the Dutch Minister of Traffic and Water Management (Rijkswaterstaat) in September, 1970. The next two years witnessed an upsurge in cooperative water quality measurements, research, and data exchanges involving Dutch and German experts; to a lesser extent, a number of joint biological investigations were also initiated. By February, 1972, findings had progressed further to the point where the Netherlands Rijkswaterstaat minister declared it to be Dutch policy never again to discharge untreated wastewater (primarily Fens Colonies) into the estuary. The first phase of Smirpijp, scheduled for implementation in 1975, was expected to demonstrate a faithful adherence to that pledge.

Unfortunately, the Netherlands ran into numerous obstacles (both political and technical) which stalled the construction of industrial treatment facilities in the Fens Colonies and thus extended the duration of untreated discharges into the Ems-Dollart. The Smirpijp went on line in December, 1977, but, much to Germany's chagrin, a new pollution outfäll remained along the margins of the Ems-Dollart. Given the increased trans-frontier cooperation spawned some 10 years earlier, however, she at least had an established consultative mechanism for monitoring, and in part influencing, the Netherlands' wastewater abatement progress. The spirit and sincerity of Dutch efforts appears to have mitigated much of the anxiety experienced in West Germany over the continued, albeit lowered, level of pollution. Also, additional scientific research has not conclusively demonstrated any evidence of long-term, irreparable environmental degradation due to current wastewater discharges originating in the Netherlands.

The prognosis for environmental dispute management in the sphere of water quality maintenance for the Ems-Dollart estuary is reasonably optimistic. Frictions are bound to persist as long as untreated organic and inorganic wastes from Dutch land-based sources find their way into the lower Dollart basin and outer estuary. However, thanks to an established, but low-key, institutional pattern of technical cooperation among experts from both nations, they should be adequately managed. Spearheading this effort on a continuing basis (since the early 1970's) is the Dutch National Institute for the Cleansing of Waters, Germany's Federal Service for Water Science, and Lower Saxony's own Water Research Bureau. Commencing in 1977, their joint expert teams now report annually on the Fens Colonies' wastewater problem, and monitor its environmental effects on marine resources; reports will continue at least until "best practicable" abatement can be achieved. This new competence should add an additional dimension of cooperation and scientific information to an already impressive ad-hoc environmental management arrangement.

b. Germany's Dollart Harbor Development Proposal

Earlier on in this paper, the main components of West Germany's proposal to expand industrial port facilities off Emden were outlined. This scheme has been in process since 1973, but as of 1979 no firm decision regarding facility construction has been reached. One major reason for the delay has been widespread opposition by the Netherlands on grounds integrating economic, political, and environmental concerns. First, the Dutch hardly favor another port equipped to compete with their own Delfzijl and Ems Harbor complexes. Second, due to the ambiguity surrounding the path of the estuary's international boundary, they are extremely sensitive to developments nearby which could either physically intrude on Dutch territorial sovereignty or at least create a harmful "squatter's rights" - like legal precedent. Finally, the Netherlands appear genuinely concerned that hydrological manipulations, e.g., dredging and filling, of the estuarine ecosystem could adversely alter tidal processes and perhaps natural resources of the Dollart basin. It also happens that a national nature protection zone of the highest order, established in June, 1977, lies in the Dutch Dollart segment just south of the proposed project area. This zone supports many significant marine resources and is one of the more permanently undisturbed portions of the entire basin (Stichting Werkgroep Eemsmond, 1978b).

It has been estimated that offshore construction in the vicinity could directly reduce the size of this protected area by at least 12 percent (Stichting Werkgroep Eemsmond, 1978b). Other indirect consequences on the estuarine environment which could occur range from increased threats of coastal innundation during occasional storm surges to the widespread transformation of silt and sand deposition processes. Assuming that coastal industrialization linked to navigational and shipping improvements keeps pace, moreover, an even greater number of potential environmental threats may emerge. These include additional land-based pollution discharges as well as oil spills due to catastrophic oil tanker groundings or collisions.

Political and economic objections aside, this trans-frontier environmental dispute centers on the alleged inadequacy of Germany's preliminary investigations into potential environmental impacts, both domestic and international. For example, the Dutch are especially critical of a previous Dollart harbor cost/benefit analysis' failure to integrate environmental protection versus degradation tradeoffs. They also question the pursuance of such a major project in an acknowledged sensitive area without first conducting much more baseline data research and ecological monitoring. Some interests in the Netherlands would like to see this controversy end in having set a precedent for cooperative environmental impact assessment on an estuarine-wide basis.

A number of joint institutional mechanisms, but far too many to analyze here in detail, are relevant to the task of managing this coastal development dispute. Some, however, like the bilateral Ems Commission and the Dutch-German Regional Planning Commission (hereafter D-N Sub-Committee North) are not equipped with either the jurisdiction or political clout to participate decisively. The first of these entities was instituted by treaty in 1960 to administer consultative procedures involving navigational and hydrological activities in the Ems-Dollart. In 1977, a routine evaluation of the Dollart harbor scheme by the Ems Commission's combined Dutch and German delegations approved the project in principle; at the same time a lack of adequate and more comprehensive environmental data was acknowledged, especially concerning potential harm to flora and fauna.

For all intents and purposes, the D-N Sub-Committee North never grappled with the substance of the Dollart harbor issue and merely facilitated preliminary information exchanges. Despite its 10-year tradition of cooperative trans-frontier planning in the region, even this service was reportedly often erratic and at some times impossible to achieve (Puister, 1977, personal communication).

The Ems-Commission report, combined with other meetings and discussions involving Dutch and German governmental officials, served as the catalyst for further bilateral consultative arrangements on the Dollart harbor. In early 1978, an ad-hoc Dutch-German group of cabinet-level ministers and their expert advisors initiated regular meetings aimed at resolving trans-frontier environmental concerns. To date, no significant decisions or negotiations have been finalized. In the interim, however, a considerable amount of new information on probable adverse effects upon estuarine ecology has been amassed. Moreover, the intensity of cooperative environmental planning on a regional level has given greater hope to proponents of a comprehensive international resource management framework for the entire maritime region.

IV. Summary

The Ems-Dollart maritime boundary region continues to be faced by a variety of trans-frontier environmental concerns regarding coastal resources. The fact that surface water pollution disputes appear to have been managed effectively so far does not insure that they won't reappear with even greater intensity in the future. The Dollart Harbor issue's resolution, because it is still a lengthy, evolving process precludes any performance evaluation at this time.

What is evident, however, is the Dutch-German preference to establish specialized, ad-hoc consultative arrangements for handling environmental management problems, particularly where critical data gathering or policy negotiations are involved. In effect, a number of other cooperative linkages get bypassed at some point in the emergence of natural resource disputes; the jurisdictional constraints encumbering many of these arrangements' participation in environmental affairs seems to encourage their being ignored. Also, the ad-hoc approach reflects the general reluctance of nation-states to surrender political sovereignty to more permanent decision-making entities conceived at the regional level. It appears to be in the national "interest" to keep such organizations alive only for exchanging information and generating non-binding recommendations.

Promoting more comprehensive approaches to managing the environment in maritime frontier regions thus poses a difficult task governed by many complex "contextual" variables. This paper has overviewed only a few of these elements ina fairly unique boundary setting. Further investigations into experiences elsewhere, e.g., the Mediterranean Sea, might not only increase awareness of coastal resource disputes but also identify cooperative institutional arrangements meriting comparative analysis.

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SHORELINE EROSION CONTROL PROGRAM AT THE NORTHEAST BEACH POINT PELEE ONTARIO, CANADA

Placido D. LaValle[1]

ABSTRACT

Due to severe erosion problems encountered at the Northeast Beach Point Pelee, Canada, Parks Canada and the University of Windsor jointly initiated a shoreline monitoring program. Every six months and after every major easterly storm, detail topographic and bathymetric surveys are made, and the data are then subjected to computer mapping and analysis. The automated nature of the computer mapping has allowed the University of Windsor team to complete the analyses within ten days of the survey's inception, and this has allowed Parks Canada more lead time in responding to the survey results.

Since the establishment of a national park at Point Pelee, Ontario, recurring episodes of severe beach erosion has been cited as a major threat to the resource value of the National Park. According to East (1976), severe beach erosion has plagued the park since 1918, and in the early 1970's severe erosion opened a large breach in the Northeast Beach. This constituted a major problem in the management of the marsh and water levels in the farm lands to the north. In response to this threat, Parks Canada has established a program of shoreline monitoring emphasizing beach dynamics at the Northeast Beach. In addition, Parks Canada closed the breach by constructing an artificial beach and berm complex, and emplaced a series of erosion control crosses along the northernmost 280 meters of the Northeast Beach.

As part of this program, a research team from the University of Windsor was entrusted with the task of monitoring shoreline changes in the Point Pelee system. Basically, the University of Windsor team performs the following functions:

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1. provide Parks Canada with data on the nature of shoreline dynamics to be used in periodic revisions of park management plans; 2. provide data on shoreline problems prior to the development of crisis situations; 3. assess the effectiveness of Parks Canada erosion control structures on the Northeast Beach. The monitoring program was initiated in the Spring of 1978 and since that time five separate surveys have been made of beach erosion and accretion patterns. Based on the findings of these surveys, Parks Canada was able to adjust their shoreline management plans in response to these observations.

According to Shaw (1975), Point Pelee is a partially inundated peninsula that was formed over 4000 years ago. Trenhaile (1978) suggests that longshore sediment flows may not have been important in the early formative stages of the Point's development, but longshore sediment flows have become very important factors in determining the later development of the Point. If this hypothesis is true, then any factor retarding the longshore movement of sediment along the Northeast Beach should contribute to beach degradation.

The Northeast Beach is located in the extreme northeast corner of the Point Pelee National Park, and the coastline of Lake Erie north of the Park is characterized by a relatively high frequency of groynes, breakwaters, and a significant pier development at Wheatley. These structures quite possibly contribute to the inhibition of longshore sediment flows moving southward to the point. Just north of the park boundary, a rather large groyne was present up until June, 1979, but at that time it was removed. Also the northernmost 260 meters of the beach was covered with a line of erosion control crosses. Careful monitoring of shoreline change before and after the removal of the Marentette groyne should provide some insight into the effects of groyne systems on the beach dynamics. Overall, there is a strong probability that the Northeast Beach is a sediment starved system, and effective beach management programs should be designed with this in mind.

Since Point Pelee is a highly dynamic open landform system that is sensitive to the vagaries of complex coastal processes, a program of constant surveillance of changes in shoreline morphology is necessary to establish an effective program of shoreline management. In order to develop an effective program of shoreline monitoring, the following steps were taken: 1. a standardized program for topographic and hydrographic survey was developed, which was amenable to computer analysis; 2. a standardized set of survey stations were chosen as a base for all mapping programs; 3. using standard leveling methods berm and beach topography was surveyed along 18 profile lines twice annually as well as after each major easterly storm with winds exceeding 40 km/hr.; 4. using standard survey methods the bathymetry of the nearshore zone was assessed; 5. computer programs were adapted to reduce the raw survey data to computer generated profiles and maps; 6. between each of two successive survey periods comparative hydrographic and topographic profiles depicting net changes in sediment elevation were drafted using a modified CALCO II program and a CALCOMP plotter routine; 7. using a SYMAP mapping routine, topographic and bathymetric maps were constructed after each survey; 8. using the data describing net accretion and erosion derived from the comparative profiles, SYMAP was employed to generate maps of net sediment flux for a period spanning two surveys; 9. the maps of net sediment flux were subjected to trend surface analysis using a SYMAP subroutine. The results of the trend surface studies were then assessed relative to shoreline sediment character, proximity to man-made shoreline protective systems, and shoreline wave systems. These procedures were carried out for the following periods: 1) May, 1978 through November, 1978; 2) November, 1978 through April, 1979, following a major easterly storm; 3) April, 1979 through June, 1979 when the large groyne just north of the park was removed. These data were supplemented by data on shoreline sediment characteristics, vegetation patterns, and microtopography. The combination of all the data and the observed relationships were then utilized in formulating recommendations governing shoreline management at Point Pelee.

Prior to the establishment of an artificial beach and berm across the breach in the Northeast Beach in May, 1978, a complete topographic and bathymetric survey of the study site was run. In October, 1978, the breach in the central part of the Northeast Beach was filled with an artificial beach-berm complex. In early November, 1978, the beach and nearshore zone was resurveyed using the same baselines and monument stations as the preceding survey. These data were then taken by the University of Windsor team and subjected to the computer mapping and analysis procedures (see Figures 1-3).

In order to assess the nature of the coastal conditions that were imposed on the new berm structure, the first comparative analysis of Northeast Beach dynamics was made for the period May, 1978 through November, 1978. For this time period 18 comparative profiles were generated using the

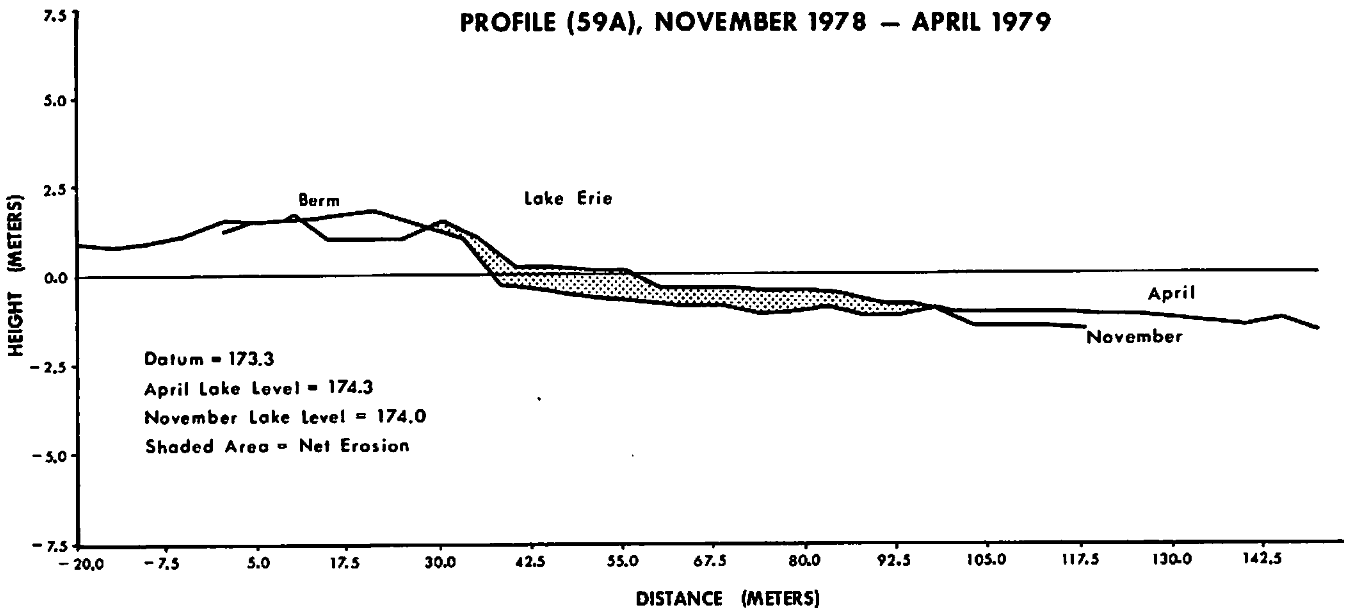
PROFILE (59A), NOVEMBER 1978 — APRIL 1979
Berm
Lake Erie
April
November
Datum = 173.3
April Lake Level = 174.3
November Lake Level = 174.0
Shaded Area = Net Erosion
HEIGHT (METERS)
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−20.0
−7.5
5.0
17.5
30.0
42.5
55.0
67.5
80.0
92.5
105.0
117.5
130.0
142.5
DISTANCE (METERS)

Figure 1

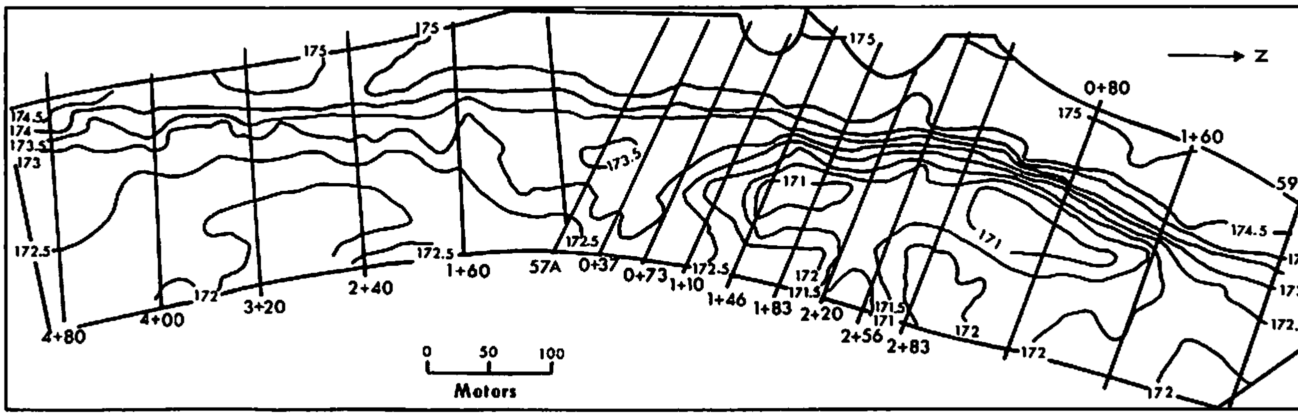

Figure 2 TOPOGRAPHY OF THE NORTHEAST BEACH

NOVEMBER 1978

Lake level = 174.0m C.I. = 0.5m

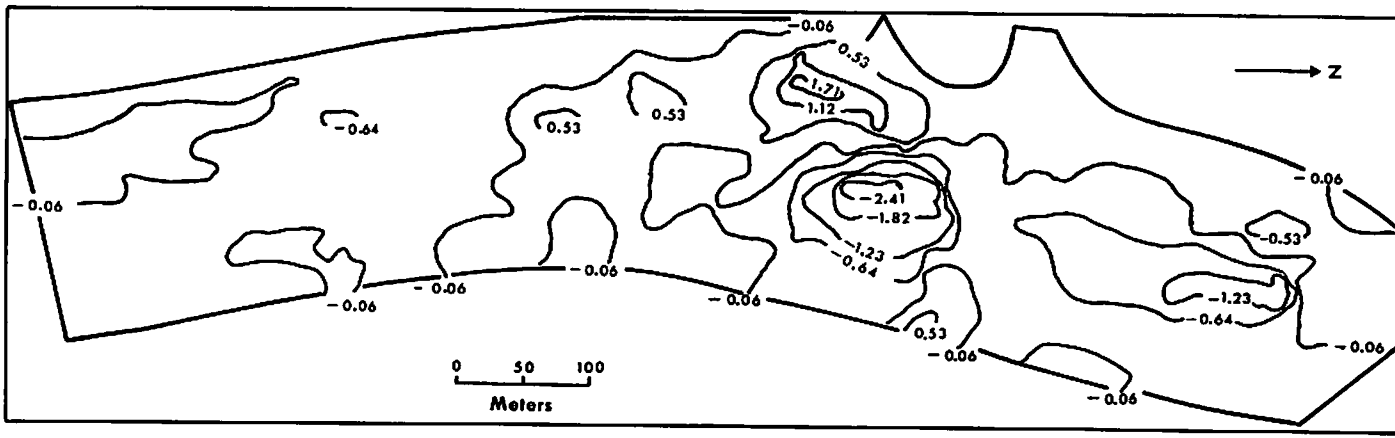

Figure 3 NET SEDIMEMT FLUX

MAY 1978 TO NOVEMBER 1978

C.I. = 0.6m

plotter subroutine, (Figure 1) and then these data were used to generate the net sediment flux map. In addition, a topographic map was made for November, 1978 (Figure 2). If one examines the November, 1978 topographic map, (Figure 2) one will note the existence of deep nearshore depressions in the northern and central sectors of the study area. If one examines the map of net sediment flux based on the comparative profile studies, (Figure 3) one will note that the areas of maximum erosion coincide with these nearshore depressions on the topographic map. Also it can be noted that some rather steep slopes separate the beach area from these depressions which are probably associated with the high erosion rates observed in the northern and central sectors of the net sediment flux map. A trend surface analysis of the net sediment flux map disclosed the fact that 47 percent of the spatial variation in net sediment flux was accounted for by a sextic order trend surface fitted to the data. An examination of this trend surface revealed the importance of the development of the troughs in the nearshore zone suggesting that trough generation is a major aspect governing the area's erosion pattern. Thus measures designed to retard nearshore trough development should be associated with the reduction of erosion levels found in the area. Examination of the trough locations relative to the existence of the Marentette groyne to the north of the study region, the existence of the line of erosion control crosses in the northern sector, and their possible effects on wave refraction patterns, as well as longshore flow patterns, led to the advancement of several recommendations. These were then passed on to Parks Canada for their consideration.

Since 26000 cubic meters of material were lost to the area between May, 1978 and November, 1978 in spite of the construction of the artificial beach-berm complex, it was suggested that a sediment renourishment program be instituted (see Table 1). It was further recommended that the renourishment sands be graded on the lakefacing side such that steep slopes are not presented to wave attack. Thirdly, it was suggested that the groyne off of Marentette Beach be removed to reduce the sediment starvation of the beach as well as cut down on wave refraction effects associated with the presence of the groyne. Of these recommendations only the sediment renourishment program was instituted prior to the Spring of 1979. The emplaced renourishment sands were located very close to the shoreline in piles characterized by very steep lakefacing slopes that exceeded 45 degrees. Parks Canada was then warned that this might reduce the effectiveness of the renourishment program.

Part of the shoreline monitoring program involved

TABLE I

NORTHEAST BEACH NET SEDIMENT FLUX BY BEACH SECTOR

Sector	Nov.'78	Apr.'79	Jun.'79
Northern	-1670	-11000	+10900
Northcentral	-13600	-13000	+240
Southcentral	+1700	-11000	+900
Southern	-13150	-24000	-4800
Total	-26720	-59000	+7160

TABLE II

TREND SURFACE ANALYSIS OF NET SEDIMENT FLUX :

COEFFICIENTS OF DETERMINATION

Source Surface	Nov .'78	Apr.'79	Jun.'79
Linear	.09*	.02	.03*
Quadratic	.14*	.03	.08*
Cubic	.20*	.11*	.09*
Quartic	.37*	.15*	.11*
Quintic	.43*	.21*	.12*
Sextic	.47*	.26*	.14*

* = significant at 0.05 level

assessing the effects of easterly storms with winds exceeding 40 kilometers per hour on the status of the Northeast Beach, and in early April, 1979 such a storm battered the Northeast Beach. This led to the resurvey of the shoreline system. Again the survey data were used to generate a topographic map of the area using SYMAP. At the same locations used in the previous survey, 18 comparative profiles were generated, and another net sediment flux map was drawn for the period November, 1978 through April, 1979. Examination of the maps and profiles disclosed the fact that erosion rates during the November-April period were nearly double those of the May, 1978-November, 1978 period. If one looks at the map of net sediment flux (Figure 4) and the map of April topography (Figure 5), one will note an enlargement of the areas dominated by high erosion levels which also tends to be located in close proximity to zones dominated by the growth of nearshore troughs. Overall 59000 cubic meters of sediment were lost from the Northeast Beach during this period, (Table 1) and much of this loss was concentrated in the northern and central sectors of the study area where nearshore depression development was evident. However, a sextic order trend surface fitted to the map of net sediment flux only accounted for 26 percent of the spatial variation in the erosion pattern (see Table II). This situation may be associated with the fact that at the time of the survey the beach was still in a state of flux, and the haphazard manner in which the renourishment sands were emplaced may have contributed to the random noise effects present in the net sediment flux surface. In spite of this situation, the sextic order surface again described a situation where nearshore trough development tended to be systematically associated with high erosion levels.

In response to the observations made in the April survey, a number of recommendations were made. The plea for the removal of the Marentette groyne and the grading of beach slopes where sand renourishment took place was reiterated. While the sediment renourishment program was not a total success, it was suggested that it be continued with more care given to the manner that the sands were emplaced. It was further suggested that the effects of winter ice on the beach system be more closely monitored in future studies, because the effects of winter ice action may have been another key factor in the erosion of the beach. These suggestions were then forwarded to Parks Canada who proceeded to implement them.

In late May, 1979 through early June, the groyne off of Marentette Beach was removed, and three weeks after its removal, another survey of the Northeast Beach was made.

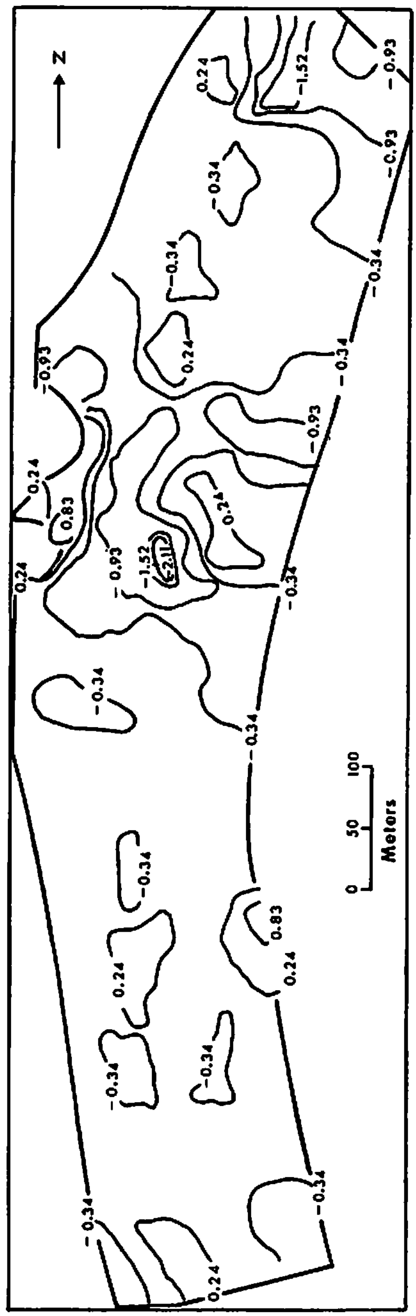

Figure 4 NET SEDIMENT FLUX

NOVEMBER 1978 TO APRIL 1979

C.I. = 0.6m

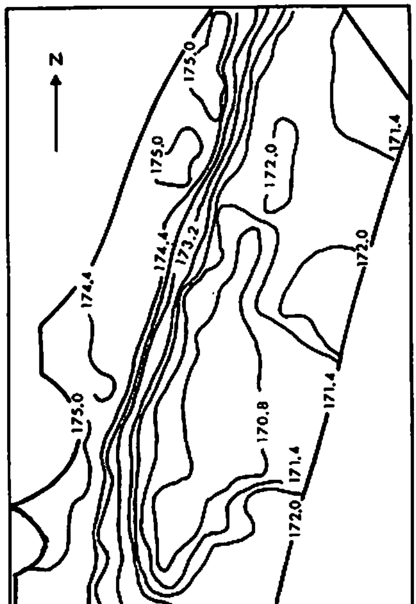

Figure 5 TOPOGRAPHY OF THE NORTHEAST BEACH

APRIL 1979

Lake level = 174.3m C.I. = 0.6m

Again a topographic map, 18 comparative profiles, and a net sediment flux map were generated for the April, 1979 through June, 1979 survey period (Figure 6-7). If one examines the net sediment flux map for April through June, 1979, (Figure 6) one will note a wave of sediment accretion that seems to have been moved in from the north. Elsewhere the shoreline system seems reasonably stable or enjoyed slight accretion except for the southern sector where the effects of groyne removal have not been felt. While this accretion episode evident in the northern part of the Northeast Beach does not constitute conclusive evidence that the removal of the groyne will reduce erosion in the future, the release of the wave of sediment trapped behind the former groyne has enhanced the sediment budget of the study site. If continued accretion is observed in the November, 1979 survey, then the removal of the groyne shall be more fully justified. When the net sediment flux map of the area was subjected to a trend surface analysis, a sextic order trend surface accounted for only 14 percent of the spatial variation in net sediment flux, which may be evidence of the possibility that the site had not adjusted fully to the new conditions promoted by the absence of the groyne at the time of the survey. Also local random noise effects seem to be more important at this time.

Based on the results of the June survey, it was recommended that the renourishment program be continued in the winter of 1979-1980, and that the emplaced material be properly graded. In August of 1979, a grading program was instituted by Parks Canada, which should inhibit accelerated beach erosion. However, the full effects of this grading program will not be evident until the November, 1979 survey.

Since our survey to report production time span is roughly eight to ten days, the computerization of the survey data, cartographic analysis, and statistical analysis has enabled the University of Windsor team to file reasonably complete reports to Parks Canada in time spans that would be impossible using other methods to obtain the same detail. With the advent of our new WYLBUR system, we can now interact with the computer through a terminal, and shortly we hope to have our digitizer hooked up with the terminal as well. These innovations should reduce the survey to report production time span to less than a week. The advantages of such an approach to shoreline managers is that it would give them more time to respond to emergencies generated by drastic coastal events. It will allow them to assess shoreline changes over larger areas in greater detail and at more frequent intervals than would be possible with other methods.

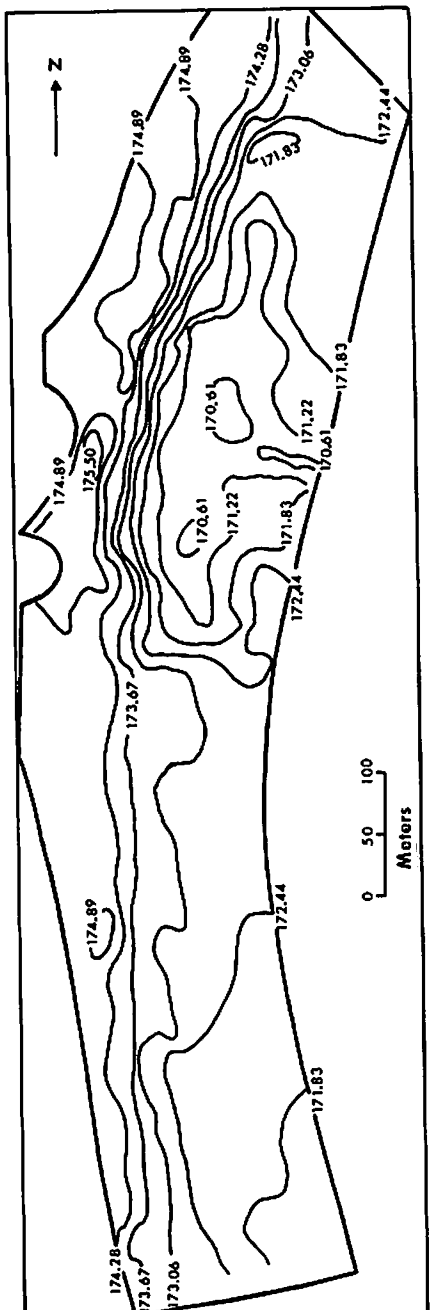

Figure 6 TOPOGRAPHY OF THE NORTHEAST BEACH

JUNE 1979

Lake level = 174.6m C.I. = 0.6m

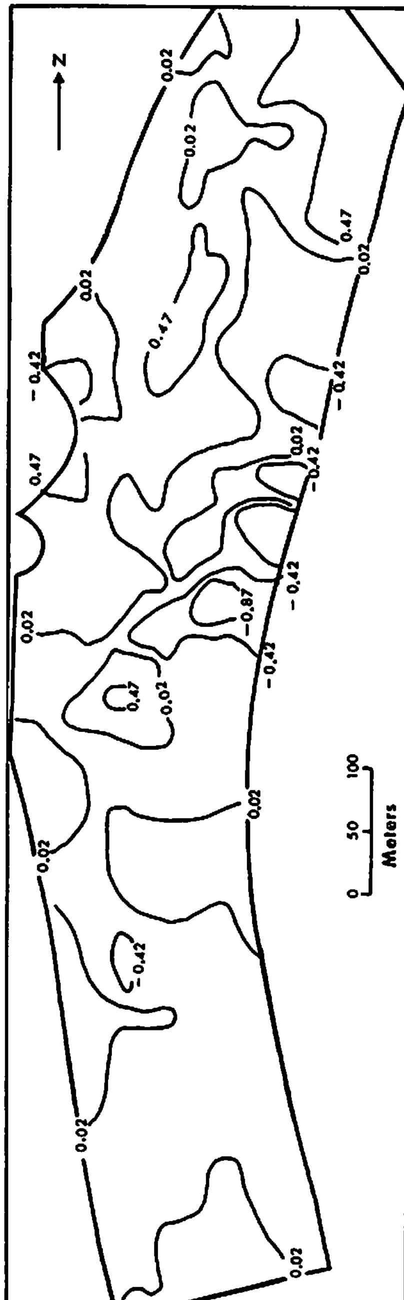

Figure 7 NET SEDIMENT FLUX

APRIL 1979 TO JUNE 1979

C.I. = 0.45m

Also the use of the computer systems helps to lower labour costs as well. It has been our experience that such a system permits a more complete analysis of shoreline dynamics to be made in a short span of time, which of course cuts into the delay between a coastal dynamic event and the shoreline managers response to this event. Thus we have the capability to move rapidly respond to coastal emergencies involving coastal erosion.

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PART IX

SHORELAND PROTECTION & RESOURCE USE I

Moderator: Bruce Hayden

A Decision Strategy for Management of Coastal Erosion

Waldon R. Kerns

ABSTRACT

This study provides an economic decision framework for management of the impacts of coastal erosion on shoreland property and structures. Coefficients were determined for use in estimating erosion induced losses to property and structures. These values plus other measures were applied to three case study coastal areas in Virginia. The evaluation procedure provided a realistic basis for comparisons of: (1) benefits and costs of selected control measures; (2) various levels of control; (3) distribution of costs between private and public sectors; and (4) ability of localities to support control programs.

Introduction

In the Chesapeake Bay of Virginia, erosion action has caused losses of up to twenty feet of shore depth per year and in several cases structures have actually fallen into the Bay waters. This physical process of erosion generally has not been perceived as a problem until it has induced an economic impact on either an individual or a community. These economic impacts have become more significant and more widespread and consequently the situation has resulted in major emphasis being placed on better management of tidal shoreline erosion.

Although erosion action and mitigation efforts to manage it have an impact on all areas (fastland property and improvements thereon; the estuarine system and its flanking tidal creek entrances; and sandy beaches and other shorelines) methodology for measuring the physical and biological impact on the beaches and estuarine system is almost nonexistent. However, accurate measurement of the impact on shoreland property and improvements can be incorporated into a decision framework.

Three case study areas in Middlesex County, Virginia, which have experienced substantial erosion action were selected for use in estimating the erosion induced impact on property and structures. A reach basis was used because a reach is characterized in physical terms as a segment of shoreline wherein the erosion process and responses are mutually interactive. A reach may include one or many individually owned parcels.

The first study area (Reach 1) was an open space, undeveloped area of 23 individually owned parcels of property along 2.27 miles of

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shoreline. The second study area (Reach 2) was a developing area of single family residential and vacation dwellings with 70 parcels of individually owned property along 1.7 miles of shoreline. The third study area (Reach 3) was an established area of single family residential and vacation dwellings with 73 individually owned parcels of property along 1.76 miles of shoreline and formed part of a shoreland point which extended into the Chesapeake Bay. These areas contained a total of 166 individually owned parcels of property.

As shown in Table 1, length of waterfront and depth of lot demonstrate the large size of lots in Reach 1, medium size lots in Reach 2 and small lots in Reach 3. Also, average present total value of lots minus improvements reflects these size differences. Average present value of lots per square foot, however, reflects the lower value for the large open space undeveloped areas and reflects the premium value of $0.91 per square foot which is placed on the lots in Reach 3, the established and small lot area. The average present value of dwellings in each area was approximately equal. The historical erosion rate in average feet per year during 1960-1978 was determined for each of the 166 parcels of property in the study areas. The overall average annual erosion rate was positive (loss of soil) in Reaches 1 and 3 but negative (accretion) in Reach 2.

Table 1. Average Value of Selected Characteristics for Three Erosion Study Areas in Middlesex County, Virginia

Characteristics	Reach 1	Reach 2	Reach 3
Length of Shoreline (miles)[1]	2.27	1.70	1.76
Number of Individual Parcels[1]	23	70	73
Average Value Lot ($)[1]	45,687	20,875	10,377
Average Value Lot/Sq. Ft. ($)[1]	0.32	0.67	0.91
Average Length of Lot (ft)[1]	546	157	73
Average Depth of Lot (ft)[1]	378	328	160
Number Lots with Dwelling[1]	18	52	44
Average Value Dwelling ($)[1]	21,686	18,515	19,643
Average Yearly Erosion Rate 1960-1978 (ft./yr.)[2]	+1.4	-0.5	+0.3
Range of Yearly Erosion Rate (ft./yr.)[2]	-1.1 to +3.3	-1.7 to +1.7	-2.2 to +2.8
Average Distance Dwelling from Shoreline (ft.)[3]	320	107	28

[1]Obtained from 1977 assessment record in Commissioner of Revenue's Office, Middlesex County, Virginia. Assessment was based on 100 percent market value. A comprehensive study of all property transactions during past 20 years established the valuation procedure.

[2]Erosion rates provided by scientists from the Virginia Institute of Marine Science. Erosion rates (positive for loss of soil and negative for accretion) for each individual parcel were obtained by interpretation of aerial photography for 1960 and 1978.

[3]Distance obtained by interpretation of aerial photography.

Procedure for Application of Economic Decision Framework

An economic assessment methodology was applied to the three reaches in the pilot study area. Values were established for costs and benefits for selected management strategies in each reach. As part of the technical assessment, the capital costs of implementing proposed structural control measures were estimated on the basis of standard cost guides and expressed in terms of present dollar values.[1] Operation and maintenance costs were discounted to current dollars. Costs were determined for proposed structures on a segment basis and summed for the total reach. Also, the expected effectiveness in percentage terms of control of erosion by the structural controls and time period of effectiveness were provided for each reach.

A second set of costs were derived from estimated decreases in values of property and improvements or losses from restrictions on use of resources because of implementation of selected non-structural control measures. Values were calculated for each reach on the basis of a "without" and "with" approach. That is, values for resources and their uses were estimated for the current situation and compared to their values after implementation of a control measure. Values were estimated for loss of agricultural productivity, loss of soil, loss to structures and other improvements, and loss of tax revenue.

For those lots with a dwelling and either erosion or accretion, as the erosion rate increased by a foot the present value of the lot per square foot decreased at a marginal rate of $.057 per square foot without any differences among the areas. This value is much less than the average value per square foot of $0.32 in Reach 1, $0.67 in Reach 2 and $0.91 in Reach 3. Thus, loss of a square foot from erosion is considerably less than the average present value per square foot.

However for the 49 lots with dwellings and loss of area to erosion, as the erosion rate increased by a foot per year marginal value decreased by $.242 per square foot (or 28 percent of the average assessed value of these 49 lots). Thus, erosion action has a very high cost in terms of value per square foot for each square foot lost to erosion if that lot contained a dwelling. The addition of area or accretion does not add to the value of the lot.

For the 52 observations without a dwelling, as the erosion rate increased by a foot, lot value per square foot decreased by $.089. However, for those lots with a positive erosion rate (loss of soil), as the erosion rate increased by a foot the marginal value per square foot decreased by $.125 per square foot (or 50 percent of the average assessed value of these 17 lots) a significantly higher rate. As with those lots with a dwelling accretion does not add to the value of the lot.

Decreases in market value of property will be reflected in lost tax revenues. The recent assessment for Middlesex County supports this assumption. Whenever a property owner requested a tax reduction due to decrease in value from soil loss, it was granted. Thus, for purposes of this study the computed soil loss in dollar value was multiplied by the current Middlesex County tax rate of 43 cents per hundred valuation.

Restriction on ownership will impact use of property in the 100-foot and 200-foot areas. In order to provide that estimate, present value of property (minus improvements) for each parcel in the study area was obtained from assessment records in the Commissioner of Revenue's Office. Value was calculated on basis of square footage in the impact area for use in determining value of loss due to restriction. That is, square footage in the parcel was divided by present value to obtain present value of parcel per square foot. Square feet in each setback or erosion year period impact area as previously obtained was multiplied by the value per square foot to get a proportionate value per square foot for losses due to restriction.

Present value for dwellings was obtained on each shorefront parcel of property from recent assessment records in the Commissioner of Revenue's office for the county. If the dwelling was located in the erosion area, the total value was recorded. If not, a second cost component for dwellings was based on decrease in distance between dwelling and shoreline as a result of projected erosion action.

The historical average annual erosion rate was not a significant explanatory variable. However distance of the dwelling in feet from the shoreline is an important explanatory variable. As distance increases value increases, at least in the limit of this analysis. Loss of distance between dwelling and shoreline could be interpreted as having a marginal impact of decreasing value of dwelling by $8.64 for each foot lost to erosion in Reaches 1 and 3 but not in Reach 2. Compared to the total value of a dwelling this may not be a very large amount. A logical explanation for the Reach 2 impact is that it had a negative average erosion rate (accretion) over the past 18 years which indicates that accretion may actually decrease value (-17.72 +8.64) of dwelling because of factors such as less access to the waters. However, these values could be substantially different for shorter distances.

A third set of costs were those associated with transaction and administration activities involved in the actual implementation and control of a program. Where appropriate, legal costs and the cost of administering compensation programs were included. These costs as with the first two sets were calcualted for individual parcels or as an average for a reach.

Benefits from erosion control measures may accrue in all three shore areas--the shore zone, nearshore zone and fastland zone. Onshore benefits of structural control measures were derived by applying a "without" and "with" control analysis. Benefits were derived by calculating future erosion damages which would be prevented by implementing erosion control measures. However, as with the cost calculations, only limited "information" exists for the impacts in the shore and nearshore zone. Benefits from accretion and the flow of services from water-borne activities were excluded because information on those activities was not available.

Evaluation of the impact of erosion control strategies on value of property (including improvements) and uses of that property for each individually owned parcel was based on the value of those resources in a status quo state (that is, let erosion continue without additional control measures) compared to the value with control strategies. Therefore, present value in 1978 dollars for the resources in the identified impact area was established as the basis for calculation of impact costs and benefits.

For purpose of this study, the value of property and improvements of individually owned parcels was determined for both a 100-foot and 200-foot depth frontage as well as erosion rate depth area, based on years of effectiveness of proposed control measures, and then consolidated for each identified reach. These alternative impact areas will allow a decision maker to compare the magnitude of costs and benefits of various management strategies. The two frontage area alternatives were selected because the 100-foot and 200-foot depth frontage are commonly suggested management strategies.

Area for each setback or erosion year period was calculated for each property segment within the reach on basis of square feet or portion of acres involved. Areas in each segment to be impacted were determined by multiplying the years in each period by the historical erosion rate in feet per year for each individual parcel transect--the point on the shoreline where a recession rate was calculated. The resultant depth line for the number of feet of erosion for each period was measured from the point of high water mark and noted on aerial photographs for the individual parcels of property.

An important constraint and limitation to the analysis is the current inability to relate cost for each level of control (the marginal cost) to the benefits for each level of control (the marginal benefit). That analysis is needed before the optimal level of control for each area can be determined. The analysis does, however, provide reasonable estimates for selected levels of control.

Consolidation of Values into Reach Basis

Because the management decision framework should be placed on a reach by reach basis, the costs and benefit values to be used for comparative purposes are the consolidated reach values. Individual parcel values were consolidated into a reach summary. The established values for dwellings, other structures, property and loss of building site were expressed in present dollar values. Annual loss of property taxes and annual net return for land-use were also expressed in present value based on the assumption of constant annual stream of benefits with a constant level of net profits and a constant tax rate over the period of analysis. Present value of the stream of benefits was calculated at an 8 percent discount rate.

The assessment as shown in Table 2, provides a benefit value based on a maximum loss to shoreland resources if erosion were to continue unabated. These opportunity type costs could accrue to either private or public parties. However, due to the nature of ownership in the sample, only loss of taxes accrue to the public section. As a result of erosion action, additional unaccounted for losses may accrue to the shoreline and nearshore areas. These losses are not included in these values because measurement of the losses and methodology to place a

Table 2A. Assessment of Proposed Structural Control Options for Three Reaches

Reach	Option	Effectiveness[1] Years	Effectiveness[1] Percent	PV Structural Costs $	PV Technical Assistance $	PV Benefits Private $	PV Benefits Public $	Transaction Administration Costs $
1	I	10	15	101,000	1,911	10,872	189	2,036
	II	15	20	125,550	1,911	18,957	484	2,036
	III	25	50	462,650	1,911	82,540	2,526	2,036
	IV	40	95	1,372,000	1,911	251,506	8,059	2,036
2	I	15	50	37,000	1,431	96,100	184	4,444
	II	40	95	395,000	1,431	298,959	1,084	4,444
	III	40	95	749,500	1,431	298,959	1,084	4,444
3	I	40	95	558,250	1,482	598,524	1,393	4,425
	II	50	95	1,476,000	1,482	781,365	1,855	4,425

[1] Years indicate the project time period of effectiveness of controls. The percentage indicates effectiveness of structures for that option in controlling erosion.

Table 2B. Assessment of Proposed Non-Structural Control Options for Three Reaches

Reach	Option	Transaction Administration Costs $	Ownership Restriction Costs Private $	Ownership Restriction Costs Public $	Public Acquisition Costs $	Dwelling Relocation Costs $
1	100-foot depth area	36,519	172,512	10,000	319,377	93,100
	200-foot depth area	36,519	345,904	20,000	599,104	170,150
2	100-foot depth area	115,667	256,270	0	964,288	540,200
	200-foot depth area	115,667	512,540	0	1,483,375	731,550
3	100-foot depth area	118,758	470,452	0	1,399,152	634,800
	200-foot depth area	118,758	921,304	0	1,850,004	634,800

value on the losses do not presently exist. Control measures may prevent all or some of these losses and thus they would become a benefit for evaluation of control options. Additional benefits other than prevention of losses (such as beach accretion) may accrue to private or public entities as a result of structural or non-structural control measures. Likewise, methodology for inclusion of these benefit values does not presently exist. Thus, actual benefits for control measures could be significantly higher than those which were included in the assessment.

Costs for implementation of structures for each option are provided in Tables 2A and 2B. These costs could be allocated to either the private or public sector. Costs of technical assistance remains constant for each reach. Benefits for each option were calculated from the potential shoreline erosion loss prevention values based on percentage effectiveness of structures for that option in controlling erosion.

In comparing the costs and benefits of each structural option for Reach 1, none of the options should be implemented. However, other benefits (perceived and non-quantifiable benefits) may dictate selection of an option. If one of these options is selected for implementation only \$10,872 under Option I, \$18,957 under Option II, \$82,540 under Option III, and \$251,506 under Option IV should be allocated to private owner costs. Costs were allocated in this manner to equal identified private sector benefits. This does not mean that these are the only benefits which will accrue to the private sector, they are the only ones identified by the analysis and subject to allocation to the private sector.

These costs and benefits are not simply additive; combinations of costs and benefits must be considered for each proposed management strategy. The maximum monetary costs of restriction on ownership in Reach 1, the open and undeveloped area, was \$172,512 for the 100-foot area and \$345,904 for the 200-foot area. The cost of an ownership type program with a taking action would be an additional \$34,150 (included in \$36,519). For this reach other transaction and administration costs were small. These options are more expensive than Options III and IV. Of course they represent a maximum cost whereas some non-structural control could be implemented at relatively low cost.

Other values in the table are not necessary for the benefit and cost evaluation but are necessary for a complete evaluation of available alternatives. Acquisition of property and improvements in the 100-foot or 200-foot impact areas may be a desirable management strategy or may be a requirement under the taking issue. For Reach 1, the maximum cost of acquisition is \$139,022 in the 100-foot or \$238,394 in the 200-foot impact areas. This may be a desirable management strategy or may be a requirement under the taking issue.

A second important factor could be cost of relocation of dwellings. Relocation could decrease cost of acquisition and make an infeasible management strategy feasible. In Reach 1, relocation cost could decrease acquisition cost in the 100-foot area by \$23,400 (\$116,500 value of dwellings minus \$93,100 relocation of dwellings). That difference is $39,000 ($209,150 minus $170,150) in the 200-foot area. Savings from relocation are relatively small for this area as it is characterized by smaller homes where relocation costs are almost as large as the value of the houses. With larger, more expensive homes, relocation costs could be a significant factor in selection of management strategies.

In Reach 1, benefits of control were extremely small compared to cost of structural controls. The non-identified benefits would have to be at least three times as great as these identified benefits to make any option economically feasible. Even cost of ownership restriction was fairly large.

In Reach 2, benefits are significantly greater than cost for Option I but significantly lower for Options II and III. Even with added cost of technical assistance and administrative and transaction components Option I appears feasible and total costs should be borne by private owners. Unquantified benefits would have to be extremely large to justify the other two options.

Cost of restriction on ownership is high for this area. The $256,270 plus $115,667 administrative and transaction costs give a total of $371,937. Any added costs of acquisition (minus difference in relocation) due to the taking issue would push this cost past that for structural controls in Option II and possibly Option III. The ownership restriction may have little impact on mitigation of erosion whereas structural Options II and III eliminate 95 percent of the erosion.

Option I is economically feasible. Options II and III appear to be better alternatives than non-structural ownership restrictions in this developing area. If implemented, over half of the cost of Option II should be borne by the public. A significantly larger amount of Option III cost should be borne by the public.

In Reach 3 potential benefits from controlling erosion were relatively high but fairly constant for each erosion rate area in this mature, developed area. The identified benefits for Option I were almost as large as the costs. Only a small number of unidentified benefits would make this option feasible. Almost all of the benefits are private and therefore, most of the cost should be borne by the private sector. Option II appears to be uneconomic. If it were implemented, a very large part of the cost would fall on the public sector.

Cost of ownership restrictions ($470,452 plus $118,758) $589,210 plus any cost of acquisition would make this alternative extremely expensive compared to Option I which also controls 95 percent of the erosion.

Summary of Assessment Procedure: A complete economic evaluation of proposed control measures is not provided by the assessment procedure. Analysis of several important factors was not within the scope of this study. Those constraints to the analysis were clearly stated throughout the text. Within those constraints, certain conclusions can be stated. The assessment procedure clearly identifies those structural control options for which costs are greatly in excess of the expected benefits; such as all structural options in Reach 1, Option III in Reach 2, and Option II in Reach 3. Benefits other than those identified would have to be extremely large to justify the action. Several of the structural control options do have identified benefits nearly equal to or in excess of costs and would appear to be economically feasible. For instance, Option I and II in Reach 2 and Option I in Reach 3 are in this category.

The procedure also provides an indication of the relative magnitude of cost for the non-structural measures such as setback requirements. For instance, an ownership restriction is preferable to Options III and IV but would be more expensive than structural Options I and II in Reach 1, the open space and undeveloped area. Of course, acquisition in response to the taking issue would add significantly to that cost but would not constitute a prohibitive expenditure. Non-structural controls become significantly more expensive and rival the magnitude of structural measures in the developing area, Reach 2. Non-structural measures become very expensive for the developed areas and do not control actual erosion as structural controls do.

The division, where possible, of costs and benefits between the private and public sectors provides a reasonable basis for consideration of allocation of the burden of costs of the program between these two sectors. The magnitude of the added cost of the proposed programs, the expected willingness and ability of each sector to pay for the programs, and an application of the analysis to the federal flood insurance program are contained in later sections of this report.

Although the assessment procedure for this case study area was limited to impacts on agricultural and residential type resource areas which constitute most of Middlesex County and other similar counties in the coastal area, the basic methodology could with slight modification be easily applied to commercial, industrial, and more urbanized areas.

Private Expenditure for Erosion Control

Successful implementation of a proposed program for any reach will depend on willingness of private property owners to construct or, where necessary, support the expenditure of public funds. Many owners of private property located in the study area have already made expenditures to protect their property from erosion. While a detailed analysis of these expenditures was not available, some preliminary observations can be made.

While the values of control structures were taken from assessment records, they do indicate a willingness of private property owners to make expenditures to protect their property from erosion. The total cost per foot for several of the proposed control options compares favorably with the assessed value of previous private expenditures of $12.46 per foot in Reach 2 and $17.88 per foot in Reach 3. The cost per foot for proposed option was:

Reach 1	Reach 2	Reach 3
Option I -$ 10.50/ft	Option I - $ 4.19/ft	Option I -$ 60.28/ft
Option II - 35.70/ft	Option II - 43.89/ft	Option II - 158.71/ft
Option III- 8.40/ft	Option III- 83.28/ft	
Option IV - 115.60/ft		

These values represent total cost for the option and an allocation of the total cost between private and public expenditures would make the comparison more favorable toward the private sector's willingness to pay for the private sector allocation of cost of controls.

Costs of Total Shoreline Control

Decision makers must have information on the total cost of a program for at least each county. While complete data for determining cost for a total county were not readily available, a procedure which gave a reasonable estimate was used.

In order to determine an approximate cost of implementing erosion control options on all shoreland of the same predominate type as in each specific reach, information on shorelands use classification for Middlesex County was assembled. The shorelands were divided into two classes depending on use. Available data and cost information limited the analysis to these two classes. Class I consisted of open and undeveloped land and included agricultural, recreational, government, preserved, and unmanaged land uses. Class II consisted of developed land and included residential, commercial, and industrial land uses. The miles of fastland in each class were determined, as well as their percentage of the total miles of fastland.

As shown in Table 3, Middlesex County had 213 total miles of shoreland with 152.4 miles in Class I, open and undeveloped, and 60.6 miles in Class II developed. However, based on the scientific projections only 25.3 miles of Class I and 17.0 miles of Class II use were eroding and suitable for management under the proposed options. For illustrative purposes costs associated with structural costs in Option I, the least amount of effort needed, in both the open and undeveloped reach (Reach 1) and the developed reach (Reach 3) were used.

The procedure for the case study area was to allocate projected erosion control costs to the private sector in an amount equal to the identified private benefits. The remaining costs were presumed to be a public responsibility. Because several structural, non-structural or any combination of control options are available within any area, only direct costs of structural controls were used for this example.

The 25.3 miles of eroding shoreland classed as I would require a minimum expenditure of $1,124,777 ($156 added cost per person) in total cost with $1,078,023 ($150 added cost per person) of that allocated to the public sector. The 17.0 miles of eroding shoreland classed as II would require a minimum expenditure of $5,410,733 ($752 added cost per person) in total cost with $987,360 ($137 added cost per person) of that allocated to the public sector. Based on this analysis, a program for only one county becomes extremely expensive.

Table 3. Projected Costs of Implementig Selected Control Options for the Total Shoreline in Middlesex County, Virginia

	Class I[1]		Class II[2]	
	Open and Undeveloped Area		Developed Area	
Category	Total Cost	Public Share	Total Cost	Public Share
Feet in shoreland in reach (ft)	12,000	12,000	9,300	9,300
Cost of structures for reach ($)	101,000	96,824	558,250	102,630
Cost per foot ($)	8.42	8.07	60.28	11.00
Total feet shoreland class (ft)	133,584	133,584	89,760	89,760
Cost of structures total county ($)	1,124,777	1,078,023	5,410,733	987,360
Population of county[3]	7,200	7,200	7,200	7,200
Added Cost per capita ($)	156	150	752	137
Years effective life annualized cost ($)	10	10	40	40
Added % points to fiscal effort (%)	6	5	17	3

[1]Figures based on data for Option I in Reach 1.

[2]Figures based on data for Option I in Reach 3.

[3]Assume constant population over period of analysis.

The additional cost per person for each option is of course a one-time expenditure which could be paid in one year or over several years. Therefore, for comparative purposes these costs should be amortized over a given payment period. A comparison of the ability of different localities to support a public coastal erosion program can be determined by amortizing cost over time and using a measure of current fiscal effort. For purposes of this study fiscal effort is used: 1) to look at the ability of each locality to support an erosion control program by using its own resources; and 2) to provide a basis for establishing priorities in the allocation of state (or state controlled federal) funds among coastal localities. Comparative measures of fiscal effort can be used to project gross variations in the financial effort of jurisdiction for implementation of proposed programs with their own resources and to aid policy-making and administration with regard to grants-in-aid from one level of government to another. In fact, grants-in-aid are generally thought of in terms of providing equalization (and defining equalization as support for a level of public service without gross variation) in the financing effort of recipient jurisdiction.

The method used in this study to measure each localities fiscal effort as a percentage figure is:

$$\% \text{ fiscal effort} = \frac{\text{revenue from own sources per capita}^2}{\text{Computed revenue capacity per capita}^3}$$

This measure of fiscal effort provides a comprehensive picture of local effort. The basis of comparison of cost per person with fiscal effort was to compare the per person increase as an annualized percentage increase in fiscal effort. This procedure provided the important link between fiscal effort and a measured need or service requirement for use in a priority index. Costs were amortized at an 8 percent rate over the years of effective life of the structural option.

The added percentage points to fiscal effort provides a basis for comparison of the cost of an erosion control program for the county. The use of only Option I represents a minimum necessary effort for each area. This effort would result in significant increases in fiscal effort for both total cost or the public share. As shown in Table 3, added percentage points to fiscal effort was (5 + 3) 8 for only the public share of costs to (6 + 17) 23 for total cost including both the public and private share. These increases in percentage points of fiscal effort do represent a substantial increase in needed effort above the current 39 percent just to support one public service program of erosion control.

Notes

1. The technical assessment for each reach was provided by Robert Byrne and Carl Hobbs of the Virginia Institute of Marine Science, Gloucester Point, Virginia.

2. Revenue from own sources includes: property taxes; penalties and interest; local sales taxes, taxes on utility services; motor vehicle licenses; permits, licenses and license fees; service charge on county owned enterprises; other local taxes; revenue from use of money and property; fines and forfeitures; and reimbursement for services to other localities.

3. The "average effort" approach was used to calculate revenue capacity per capita: true value of real estate x $.0106 plus personal income (a proxy for non-property, non-sales taxes and other revenue) x $.0106 plus number of motor vehicles (a proxy for personal property taxes) x $27.29 plus local option sales tax collection with the sum divided by population for standardization purposes.

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LAND USE EFFECTS ON A COASTAL WETLAND CHEESEQUAKE CREEK MARSH, NEW JERSEY

Carol Russell Collier *

Abstract

Environmental impacts resulting from four contiguous upland uses on a 583 hectare brackish marsh system are examined. Four subareas bordered by different land uses were selected for detailed comparison of the algae and macroinvertebrate communities, marsh vegetation zones, substrate composition and soil water constituents.

Biological information is discussed and related to the environmental effects of adjacent land use activities. Physical and chemical parameters related to substrate and soil water composition are analyzed and significant differences among the subareas are identified. The relationship between substrate - soil water constituents and vegetation type also is analyzed.

Based on biological information and marsh subarea conditions, factors having the greatest effect on coastal wetlands are determined and management alternatives suggested.

Introduction

Understanding the inherent value of coastal wetlands has not prevented their degradation by filling and dredging activities and by the products of adjacent land uses. While the need to protect wetlands is recognized, information concerning the effects of certain land uses on coastal marshes is lacking. Sound management plans can be proposed, however, if the physical parameters controlling the biological communities of coastal marshes can be identified, and the relationship of these parameters to man's activities determined. For instance, if it is found that a change in substrate causes a change in vegetation type, then any land use affecting marsh sediments must be carefully analyzed.

This paper analyzes the effects of selected land uses on a salt marsh system by examining biological, physical and chemical

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parameters in four subareas of a marsh bordered by different land uses. Two levels of analysis were used: 1) investigation of differences among marsh areas backed by various land uses; and 2) the study of relationships between physical and chemical characteristics of the substrate and the biological community, and the effects of different land uses on these abiotic factors.

For both analyses, the following parameters were studied: bulk density, percentage of organic matter, particle size distribution and pH of the marsh sediments, the salinity of soil water, the micro-elevation of the soil surface, the vegetation zones of the area and the algal and macroinvertebrate communities. In addition, the sediment was tested for its iron content, extractable phosphorus, nitrate, manganese, magnesium and potassium.

Study Site Description

To test the impact of land uses immediately adjacent to coastal wetlands, field work was conducted at Cheesequake Creek Marsh, a small embayment off the Raritan Bay in Middlesex County, New Jersey (see Figure 1). This marsh was chosen for three reasons. First, it is a drowned embayment with tidal distributaries but no major river input, a condition which eliminates any upstream effects. Second, it is surrounded by steep slopes of highly erodable soils, which makes sediment deposits in the marsh likely if erosion is occurring. The most important reason for studying Cheesequake Creek Marsh, however, is the variety of land uses adjacent to the salt marsh. The south side is bounded by Cheesequake State Park, currently wooded, which serves as a control area. Single-family homes, apartment complexes, and an abandoned sand and clay mining site border the western end of the marsh. Boat marinas and a sanitary landfill are located along the north shore. In addition, the Garden State Parkway cuts north-south across the middle of the marsh. The four marsh subareas chosen for detailed analysis are illustrated in Figure 1.

Methodology

Field work was conducted at Cheesequake Creek Marsh between January and May, 1977. The following parameters were analyzed: vegetation zones, algal macroinvertebrate communities, micro-elevation and composition of the substrate.

Biological Communities

Algae, macroinvertebrates and marsh macrophytes were examined. The algal populations were sampled in the control area, the marsh near the development and in front of the sanitary landfill. Sampling devices containing two glass microscope slides were left in the marsh for five weeks to allow the algae to establish themselves on the glass substrate. General observations of the macroinvertebrate populations were

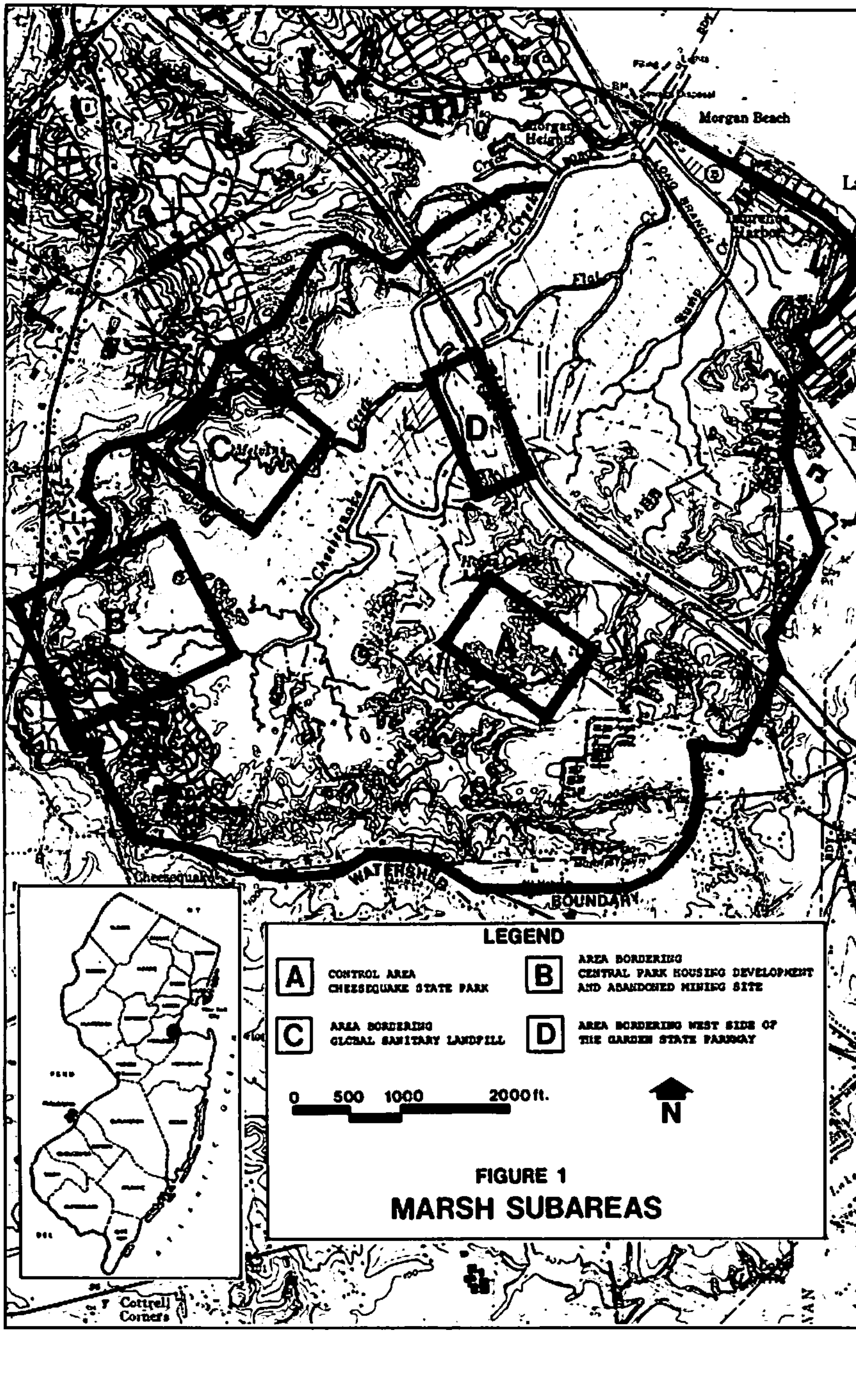

FIGURE 1
MARSH SUBAREAS

made in the four subareas. Vegetation maps were drawn for the four subareas, using aerial photography and ground truthing.

Physical and Chemical Factors

Transects: A total of seven linear transects were run, three in the control area, three in the development area and one to the west of the Garden State Parkway. The transects were laid out so that a maximum number of vegetational zones were surveyed. Each time a major plant zone was encountered, its relative elevation was measured, and a sediment and a water sample were collected. All samples were collected from the middle of each vegetation zone.

The relative elevations of the different vegetational zones were measured with an Abney Level. Actual measurements of elevation can be compared within each study site but not between them. At each sampling point, a volumetric sediment core was taken. Soil pH was tested in the field.

Forty-two soil cores were analyzed at the laboratory for bulk density, organic matter content, particle size distribution and chemical constituents. Particle size distribution was analyzed using the wet sieve method discussed in Methods for Soil Analysis.* The sodium chloride concentration of the soil water was determined by the silver nitrate titration method described in Standard Methods for the Examination of Water and Wastewater.** The analysis of iron content, extractable phosphorus, manganese, magnesium and potassium was conducted using a LaMott soil analysis kit.

Results

Biological Communities

Algal Populations: Diatoms (Bacillariophyceae) were the dominant algal type at the three marsh areas sampled: the control area, area near the housing development and area near the sanitary landfill. Green algae (Chlorophyceae) and blue-green algae (Myxophyceae) were also present. The marsh bordering the sanitary landfill had the largest diatom community, containing 13 times the density found near the

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* Black, C. A., D. D. Evans. L. E. Ensminger, J. L. White and F. E. Clark, 1965.
Methods of Soil Analysis (Vols. I & II) Madison, Wisconsin: Amer. Soc. of Agronomy, Inc. 1572 pp.

** APHA, AWWA and WPCF
Standard Methods for the Examination of Water and Wastewater, 15th edition, 1975.

development and 9 times the density of diatoms in the control area. By rough calculations, the diversity in the control area was determined to be higher than that of the landfill site. The diatom diversity was also high near the development and mining site.

Macrophytes: Nine major plant types were observed at the Cheesequake Creek Marsh site. These usually occurred as monotypic zones. In the control area and the marsh bordering the housing development, Spartina cynosuroides formed a border along the creeks and mosquito ditches. Other plants found in the control area were S. patens, Distichlis spicata, Iva frutescens, Scirpus olneyi and S. americanus, Phragmites australis and Typha angustifolia.

The development area had a greater percentage of Phragmites and Scirpus than the control area, but also contained S. patens, D. spicata, I. frutescens, and T. angustifolia. In addition, Juncus effusus and Eleocharis sp. were common. There were more forbs present in the development site than in any other subareas.

The marsh bordering the Garden State Parkway had the most notable zonation. In this area, S. alterniflora was found along the creek edges. In a transect from the creek to the parkway, the plants appeared in the following order: S. alterniflora, S. patens, D. spicata, J. effusus, S. patens, I. frutescens, P. australis.

The area bordering the sanitary landfill was dominated by a mixed zone of S. patens and D. spicata with S. alterniflora along the creek banks.

Macroinvertebrates: Few macroinvertebrates were observed on Cheesequake Creek Marsh during the site visits; this dearth of individuals can probably be attributed to the early spring sampling. The most noticeable macroinvertebrate on the marsh was the red-jointed fiddler crab (uca minax). The fiddler crab was observed in the control area and along the Garden State Parkway. A few borrows were noted in the development area. The salt marsh snail (Melampus bidentatus) was common in the control and parkway area and rare in the development site. The little macoma clam (Macoma balthica) and the ribbed mussel (Modiolus demissus) were found in the control area. Anthropods and isopods were found in the control area and along the parkway.

Physical and Chemical Factors

Physical and chemical parameters were tested to compare different vegetational zones in three subareas of the marsh: control area, the area bordering development site and the area adjacent to the parkway. Table 1 presents the mean values of physical and chemical parameters by marsh subarea. Table 2

TABLE 1

MEAN VALUES OF PHYSICAL AND CHEMICAL PARAMETERS BY MARSH SUBAREA

	CONTROL AREA	DEVELOPMENT AREA	PARKWAY AREA
BULK DENSITY (g/cm^3)	0.18 ± 0.06	1.02 ± 0.42	0.62 ± 0.28
SALINITY (PPT)	13.22 ± 4.00	2.18 ± 3.34	18.80 ± 6.48
PERCENT SAND	9.58 ± 6.29	48.53 ± 39.53	20.18 ± 27.01
PERCENT ORGANIC MATTER	49.29 ± 11.67	8.93 ± 7.04	13.76 ± 9.70
pH	6.40 ± 0.30	5.90 ± 0.70	6.44 ± 0.17
IRON (PPM)	17.52 ± 21.24	32.05 ± 25.84	6.76 ± 1.65
EXTRACTABLE PHOSPHORUS (PPM)	75.00 ± 17.68	14.89 ± 9.08	67.50 ± 63.49
NITRATE NITROGEN (PPM)	3.13 ± 1.25	9.92 ± 11.88	7.00 ± 10.06
POTASSIUM (PPM)	147.50 ± 32.05	70.00 ± 45.40	168.00 ± 48.68
MAGNESIUM (PPM)	16.86 ± 12.54	9.60 ± 9.08	20.00 ± 0.00
MANGANESE (PPM)	9.29 ± 14.56	1.00 ± 2.11	5.80 ± 1.79

TABLE 2.

MEAN VALUE OF PHYSICAL AND CHEMICAL PARAMETERS BY VEGETATION GROUP

	Bulk Density g/cm^3	Salinity PPT	Relative Elevation cm.	Distance from Upland m.	Percent Sand	Percent Organic Matter
Spartina patens	0.257 ± 0.131	13.44 ± 5.89	62.76 ± 53.21	37.01 ± 21.94	7.97 ± 4.99	42.74 ± 18.93
Spartina cynosuroides	0.682 ± 0.257	9.80 ± 3.17	15.24 ± 13.21	47.55 ± 11.53	17.35 ± 21.91	11.40 ± 8.39
Iva frutescens	0.300 ± 0.348	14.80 ± 3.22	75.18 ± 43.31	21.52 ± 16.61	9.72 ± 8.95	42.36 ± 22.91
Phragmites communis	0.732 ± 0.532	6.64 ± 5.81	64.24 ± 66.01	23.84 ± 32.90	40.27 ± 39.72	19.32 ± 18.93
Scirpus spp.	1.176 ± 0.513	2.58 ± 5.43	65.02 ± 61.52	28.86 ± 26.33	61.19 ± 40.52	10.94 ± 16.82
Juncus effusus	0.653 ± 0.186	13.65 ± 19.16	5.08 ± 10.16	54.86 ± 42.23	32.77 ± 31.53	12.32 ± 3.18
Typha angustifolia	0.765 ± 0.515	0.20 ± 0.10	80.01 ± 74.93	44.96 ± 40.39	0.00	23.50 ± 9.70
Eleocharis sp.	0.77	----	12.7	1.22	9.20	11.50

	pH	Iron PPM	Extractable Phosphorus PPM	Nitrate Nitrogen PPM	Potassium PPM	Magnesium PPM	Manganese PPM
Spartina patens	6.4 ± 0.3	13.77 ± 21.57	78.13 ± 69.50	2.50 ± 0.00	152.50 ± 49.41	20.80 ± 12.78	13.00 ± 16.05
Spartina cynosuroides	6.2 ± 0.2	47.40 ± 29.92	43.77 ± 27.23	11.50 ± 15.59	136.67 ± 35.57	16.76 ± 5.77	0.00 ± 0.00
Iva frutescens	6.5 ± 0.1	6.02 ± 2.03	70.83 ± 31.46	2.50 ± 0.00	171.67 ± 30.14	20.00 ± 0.00	5.00 ± 0.00
Phragmites communis	6.3 ± 0.4	14.04 ± 10.49	28.50 ± 27.36	6.50 ± 7.62	85.00 ± 50.40	11.33 ± 9.61	2.50 ± 2.74
Scirpus spp.	5.4 ± 1.0	20.98 ± 18.13	12.50 ± 0.00	2.50 ± 0.00	37.50 ± 17.68	2.00 ± 2.83	0.00 ± 0.00
Juncus effusus	6.6	48.75 ± 27.50	12.53 ± 10.80	25.00	101.67 ± 85.20	9.33 ± 9.24	3.00 ± 5.20
Typha angustifolia	5.7	35.00 ± 27.5	12.5	2.50	90.00	4.00	0.00
Eleocharis sp.	5.8	62.5	---	---	---	---	---

presents the mean values of physical and chemical parameters by vegetation group. The significance of the differences among the mean values from the three subareas was tested with a two-tailed t test (P = 0.05).

The control and development areas differed significantly in their bulk density, salinity, percent sand, percent organic matter, iron content, extractable phosphorus, nitrate, potassium, magnesium and manganese. The control and parkway areas differed significantly in the following factors: bulk density, percent sand, percent organic matter, iron content and potassium. Significant differences between the development and parkway areas were found in salinity, percent sand, iron content, extractable phosphorus, potassium, magnesium and manganese. There were no significant differences in pH among the three areas. Table 3 summarizes the findings of the four subareas.

The marsh bordering the housing development and mining site exhibited the highest bulk density, percent sand, iron content and nitrate levels. It also had the lowest salinity, percent organic matter, pH, extractable phosphorus, potassium, magnesium and manganese values. In general, the values for the parkway subarea fell between those of the development subarea and the control subarea. However, the parkway subarea did have the highest levels of salinity, pH, potassium and manganese and the lowest level of iron.

The following relationships were noted between physical and chemical factors and vegetation communities. The highest bulk density values were found in stands of _Scirpus_ spp. High values were also found in _T. angustifolia_, _P. australis_, _S. cynosuroides_ and _J. effusus_. _Scirpus_ spp. had the lowest salinity values while _I. frutescens_ had the highest. There was an inverse relationship between relative elevation and distance from the uplands, with _Juncus effusus_ being found at the lowest elevation and farthest from the firm ground. The highest percentage of sand and the lowest percentage organic matter were found in stands of _Scirpus_ spp. while the reverse was true for _S. patens_. _Scirpus_ spp. also had the lowest pH values. The sample closest to the uplands, which supported _Eleocharis_ sp., contained the highest level of iron. _Phragmites australis_ exhibited a very high standard deviation for all of the physical parameters.

Discussion

From the analysis of marsh subareas, it can be determined that the physical nature of the substrate has been and continues to be altered by the housing development and Garden State Parkway. Due to the low pH values and high sand content, substrate samples from the development area have a low cation exchange capacity (CEC) compared with the organically rich soils

TABLE 3

REPORT FINDINGS BY MARSH SUBAREA

Marsh Area	Adjacent Land Use	Findings
A	Cheesequake Creek State Park	1. Algae community - high diversity 2. Macroinvertebrates - highest density of fiddler crabs and salt marsh snails; amphipods and isopods 3. Physical and chemical factors • highest - percent organic matter extractable phosphorus manganese • lowest - bulk density percent sand nitrate nitrogen
B	Housing Development and Abandoned Mining Site	1. Algae community - high diversity, lowest density 2. Macroinvertebrates - low density and diversity 3. Physical and chemical factors • highest - mean bulk density percent sand iron content nitrate nitrogen levels • lowest - salinity percent organic matter pH extractable phosphorus potassium manganese magnesium
C	Sanitary Landfill	1. Algae community - highest density, lowest diversity; highest proportion of blue-green algae 2. Macroinvertebrates - not sampled 3. Physical and chemical factors - not sampled
D	Garden State Parkway	1. Algae - not sampled 2. Macroinvertebrates - fiddler crabs, saltmarsh snails, amphipods and isopods; second highest density and diversity 3. Physical and chemical factors • highest - salinity potassium magnesium • lowest - iron content

of the natural marsh. The CEC of the soil represents the ability of the substrate to retain nutrients and heavy metals. The higher the CEC, the more ability it has to retain cations. The soil grain size differences observed in the three marsh subareas may be the major cause of differences noted in the chemical data.

The control area can be characterized as having peaty soils and a high cation exchange capacity, factors which allow for maximum retention of nutrients and toxins. There is a high diversity in the biological communities and a high aesthetic appeal. The area bordering the housing development contains very sandy substrate with a low cation exchange capacity. There is a delta of sand actually washing out onto the marsh. Upland vegetation is encroaching on the marsh in this area and the aesthetic value is very low. The marsh creeks bordering the sanitary landfill are characterized by organically rich waters that contain dense algal populations. The area has very low aesthetic appeal. Clear zonation of vegetation and sediment type is evident along the Garden State Parkway.

Judging from the Cheesequake Creek Marsh Study and literature review, it seems that the land uses or activities with the most effect on the biological community of marshes are those which alter the circulation pattern of the marsh waters, change the freshwater dilution factor, alter the cation exchange capacity of the marsh substrate or affect the nutrients input into the marsh system.

Management Recommendations

From a planner's perspective, the task is to manage the marsh and surrounding area so that the marsh system can operate most efficiently with the least detriment to the neighboring land uses. The objective is to obtain the highest natural productivity for the marsh without increasing nuisances, such as mosquitoes and odor, and without unduly restricting the surrounding land uses. The following management alternatives are suggested to reduce the impact of adjacent land uses on coastal wetlands.

Sediment Control

Eroded sediment entering the marsh or the open estuary causes a loss of marsh environment, lowers habitat diversity, reduces primary productivity, clogs gills and filter feed mechanisms, causes behavior modification in fish, changes water chemistry, increases temperature, and reduces dissolved oxygen levels. Judging from this study, it seems that the large amount of mineral sediment in the western section of the marsh reduces the pH and cation exchange capacity (CEC) of the substrate, which, in turn, reduces the nutrient and heavy metal trapping ability of the marsh.

To stop the sediment problem, a vegetated buffer zone is proposed. Lands surrounding the housing development should be vegetated and a retention pond built to trap the previously eroded sediments. Holding basins should be added to the storm sewer system and strict conservation measures should be enforced during construction activities. The sediment which is trapped in the settling ponds should be transported to the eastern end of the marsh and planted with Spartina alterniflora to protect the sediment from rising sea levels and wave erosion.

Marsh and Estuary Hydrology

All proposed roadways should be elevated on pilings rather than built on a marsh surface to prevent alteration of water circulation, flushing rate and salinity regime. There should be no obstructions in the major channels.

In addition, the freshwater flow from uplands should not be altered or diverted. Impervious surface areas in the adjacent uplands should be kept to a minimum to prevent pulse flooding and to promote steady groundwater input.

Water Level Fluctuations

The water level of the marsh will be affected by adjacent upland land uses and by ditching programs for mosquito control. To ensure a steady water level, a vegetated buffer zone should encircle the marsh, impervious surfaces should be minimized, and well pumping rates should be monitored.

Open marsh water management is a more ecologically sound approach to mosquito control than drying out the marsh. Ditches are dug only where necessary to connect mosquito breeding sites with tidewater or ponds, providing Fundulus heterociltus and other mosquito predators access to the mosquito breeding grounds. The lowest, most productive marsh is not altered and permanent ponds are not drained.

Water Quality

Runoff from the uplands, input from the ocean and estuary, and the nutrient retention capacity of the soil have a critical influence on algal communities and macrophytes. To maintain the nutrient balance, the cation exchange capacity of the marsh substrate should be maintained by reducing the amount of mineral sediments entering the marsh, and limiting the nutrient sources on the uplands.

Management of New York Harbor's Sand and Gravel Resources*

J. R. Schubel[1] and D. F. Squires[2]

New York Harbor has been a major source of sand for metropolitan New York and New Jersey for more than 28 years; since 1963 it has been its principal source. Between 1950 and 1975 the rate of removal averaged about 3.6 million cubic yards per year. Since 1973 mining has been confined to the East Bank of Ambrose Channel and to the Chapel Hill North Channel. It was believed that mining in other areas might adversely affect water quality and productive fishery areas, and aggravate erosion problems along Staten Island; that the deposits in the designated areas are renewed by littoral drift; and that mining of channels is an alternative to maintenance dredging.

In 1975 the N.Y. Sea Grant Institute initiated studies to assess these concerns. Application of a numerical model indicated that changes in bathymetry produced by mining decelerate tidal currents over the hole, accelerate them outside of it, and deflect them toward the hole. Mining near the mouth of Lower Bay could substantially increase the tidal range along Staten Island. A second model showed that wave refraction and the distribution of wave energy along the shoreline is very sensitive to the mining strategy employed. Selective mining can be used to focus or defocus wave energy.

The effects of mined pits on water quality are local; confined to the holes.

Diagnostic models have been constructed to address management concerns. The results should be incorporated into new management plans.

A BRIEF HISTORICAL OVERVIEW

Mining sand from the bottom of New York Harbor has been occurring as long as man has had the capability to do it. The rocky coast of Manhattan surrounded by New Jersey and Long Island's low lands did not provide enough sand for construction aggregate and for fill material. Since

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*Contribution 261 of the Marine Sciences Research Center.

about 1963, harbor bottom sand, particularly from the Lower Bay, has displaced Long Island as the principal source of sand to the Metropolitan region. Continued suburbanization has foreclosed expansion of sub-aerial sand mining within an economic distance of the greater New York City area.

Between 1950 and 1975 the rate of removal of sand from the Lower Bay ranged from 300 thousand to more than 19 million cubic yards per year and has averaged about 3.6 million cubic yards per year, making it one of the largest open-pit sand mines in the Country. The New York State Office of General Services predicts that more than 34 million cubic yards of sand will be needed in the Metropolitan region over the next 5 years (James Marotta, personal communication, 1979).

The increasing pressure to provide sand and gravel from the Lower Bay of New York Harbor (Fig. 1) poses a number of important problems for the State of New York[1] The principal issues are: (1) allocation of the Harbor between living and non-living resources; (2) protection of the environment, including the shoreline, and the biota; (3) stimulation of private sector development; and (4) ensurance of an appropriate return to the citizens of the State from exploitation of a public resource.

Fig. 1. Map of Lower Bay of New York Harbor.

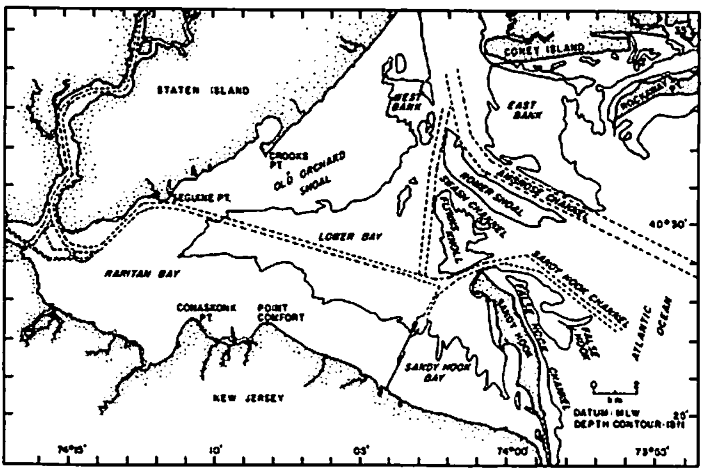


Fig. 1

[1]New York and New Jersey share ownership of the Lower Bay, but this paper deals only with New York State's portion. New Jersey has not permitted mining in the Lower Bay for at least the past two decades (Peter Sanko, personal communication, 1979).

The two State agencies involved in the management of New York's submerged sand and gravel resources are the Office of General Services (OGS) and the Department of Environmental Conservation (DEC). DEC issues the permits required for the initiation of all mining operations, and OGS has authority for licensing mining operations. A variety of Federal agencies are also involved, particularly the U.S. Army Corps of Engineers.

Prior to 1968, mining was permitted in a wide tract of the West Bank of Ambrose Channel under a 1966 "Recommendation" issued by the Department of Environmental Conservation. In 1968 additional requirements for sand led to the authorization of East Bank sites for mining. These were granted primarily: (a) to protect the bays of Long Island -- the historic sites for mining -- from further exploitation; (b) to protect finfish habitats on the West Bank Shoal and Romer Shoals; and (c) to mitigate erosion of Staten Island which had been attributed to mining on the West Bank and off Staten Island.

Through 1973 it became increasingly more difficult to obtain mining permits because of public pressure groups. A confrontation was reached in June 1973 when an Order on Court was issued by a New York court against a mining firm for excavating a deep hole (deeper than the allowable maximum of 35 ft. below mean low water) in an unauthorized area. That action essentially foreclosed the issuance of any new permits, and mining slowly decreased in volume. The offending company was ordered to backfill the hole with uncontaminated material, or face a heavy fine. This unprecedented action put the spotlight on the need for management of sand mining in N.Y. Harbor.

In July 1973, the Office of General Services, which had previously managed sand mining in desultory fashion, hired a "dredging licensing operations specialist" who quickly established contact with DEC staff. This demonstration of concern for improving the management of mining operations lessened tension between the two agencies. Concurrently, DEC staff began revising policies on sand mining.

On 22 June 1977, the Department of Environmental Conservation issued a Policy for Aggregate Mining in New York Harbor. That Policy set forth goals of

1) Effectively managing the aggregate resource for the benefit of the people of New York State;

2) Preventing water quality degradation and damage to marine resources;

3) Providing for safe navigation in the Harbor;

4) Assuring that fill would be available for construction projects;

5) Preventing an increase in the erosion rate of surrounding lands;

6) Assuring compliance with the conditions of the permits to protect the public interest.

The 1977 Policy officially limited mining to narrowly defined areas of the East Bank of Ambrose Channel and to Chapel Hill Channel where maintenance dredging is required, and to depths of not more than 45 ft. below MLW. These restrictions had been in effect since 1973, but had not been stated as official policy.

The 1977 policy statement reiterated a series of concerns contained in policy drafts dating back to 1966 which in the view of the Department of Environmental Conservation had to be resolved before an intelligent management plan could be implemented, and before expansion of authorized mining areas would be considered.

The environmental concerns are summarized below.

"Environmental Impact and Resource Management Problems

1. The effect of deepening the Harbor upon water quality, flushing rates, and circulations is unknown.

2. The effect of deepening the West Bank upon the already severe rate of erosion on Staten Island is unknown.

3. Detailed biological studies of the Lower Bay have not been done. Accordingly, it is not possible to determine all the effects of dredging on the aquatic resources of Lower Bay.

4. The quantity and quality of aggregate available has not been catalogued. Therefore, the extent and value of the resource is unknown.

5. The rate of sediment movement into the various sections of the resource should be known if proper management is to occur.

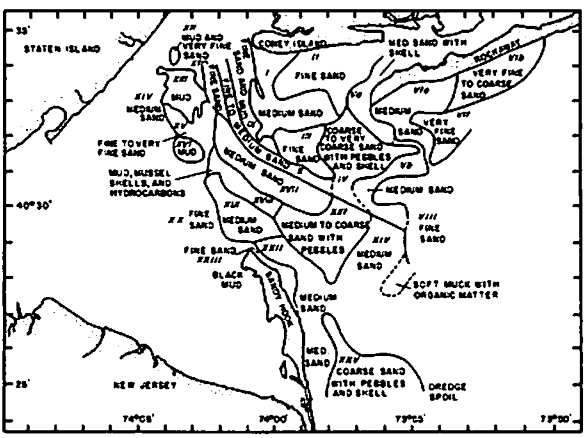
6. The effect of dredging deep pockets upon water quality, stability of adjacent sediments, and aquatic life is not known in detail."

In the fall of 1973, OGS specialists requested assistance from the N.Y. Sea Grant Institute in initiating a research program. In the summer of 1974 staff members of the N.Y. Sea Grant Institute, DEC and OGS decided that a research program should be designed to address the concerns listed above. In the fall of 1975 a planning grant was made to the senior author and in 1976 a full scale research program was initiated with support from the federal Sea Grant office and the Office of General Services under a contractual agreement with the N.Y. Sea Grant Institute. In this report we briefly describe the research carried out to address the environmental concerns listed above.

THE EXTENT AND CHARACTER OF THE RESOURCE

Jones et al. (1979) identified 25 surficial sand and mud bodies in the Lower Bay and Bokuniewicz and Fray (1979) added one additional minor sand body -- the Ward Point Sands -- off the southern tip of Staten Island, Fig. 2. Bokuniewicz and Fray examined the third dimension of the sand deposits, their vertical extent, and estimated that the volume of these surficial sand deposits total more than 3.5 billion cubic yards in the upper 100 ft. of sediments -- the lower limit of their investigation. Kastens et al. (1978) and Jones et al. (1979) determined the textural characteristics of the surficial deposits and presented maps of a variety of diagnostic textural parameters.

Fig. 2. Map of Lower Bay showing different surficial sediment bodies.



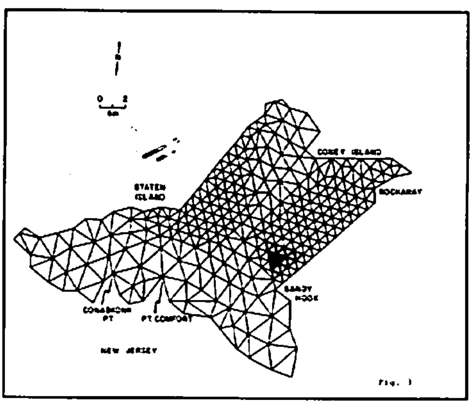
Knowing the distribution and character of the resource one can select the areas of the Lower Bay that have materials suitable for aggregate, fill, and beach nourishment.

EFFECTS OF MINING ON TIDAL CIRCULATION AND TIDAL ELEVATION

Wong and Wilson (1979) adapted to the Lower Bay a finite element, hydrodynamical-numerical model (Wang and O'Connor, 1975) to assess the changes in tidal circulation and tidal elevations that would result from modifications in bathymetry by sand mining. The model is based on vertically-integrated continuity and momentum equations and provides for a flexible gridding strategy. Wong and Wilson sub-divided the Lower Bay into 490 grid elements of variable size with the mesh being as small as 500 m on a side in potential mining areas, and coarser in muddy areas unsuitable for mining. The model was tested by comparing observed data for tidal currents and tidal elevations reported by the National Ocean Survey with values computed from the model for existing bathymetry. Frictional coefficients were adjusted until reasonable agreement was obtained. Once this match between observed and computed data was acceptable, the bathymetry, which was stored in the memory of the computer, could be altered to reflect virtually any hypothetical mining strategy, and the model run again. The new tidal currents and tidal elevations can be compared with those previously computed for present bathymetry. At that point, it is up to decision makers.

Wong and Wilson (1979) found that mining could change not only the magnitude of the tidal currents but also their direction. The general effects of mining are to decelerate the flow within the pit and accelerate the flow around its perimeter. Changes in current speed can exceed 20 cm/sec and currents may be accelerated over a relatively large distance from the hole. They applied the model to hypothetical mining operations near Sandy Hook (Fig. 3), and to other areas.

Fig. 3. Map of Lower Bay showing grid and hypothetical mining areas near Sandy Hook.



Changes in the flow fields for maximum ebb current conditions before and after mining a small and a large hole near Sandy Hook are shown in Fig. 4.

Fig. 4. Tidal current vectors near maximum ebb at Sandy Hook before and after mining a small and a large hole to 45 ft. below MLW (Fig. 3).

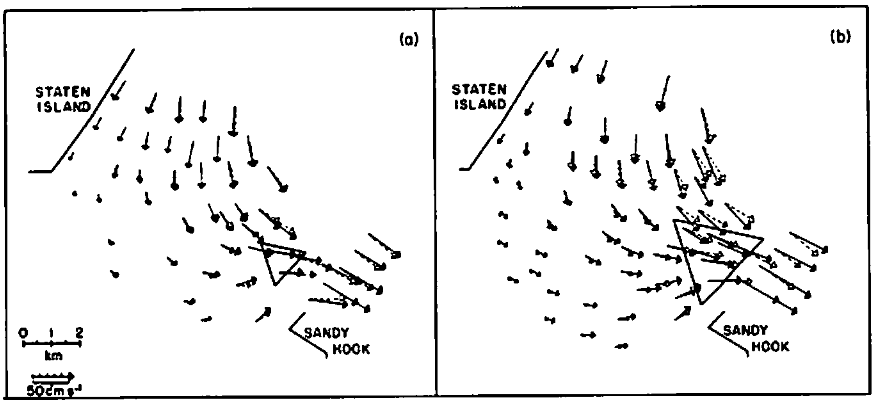


Fig. 4

Wong and Wilson's calculations indicate that significant changes in water surface elevation could occur along Staten Island for certain changes in bathymetry produced by sand mining, particularly for areas near the mouth of the Lower Bay. Mining a small hole near Sandy Hook would increase the tidal amplitude near the southern tip of Staten Island by more than 6 cm. A large hole near Sandy Hook would increase the tidal amplitude in the same area by more than 15 cm. Mining near Rockaway Point would have similar effects. The effect of mining near Staten Island on tidal amplitude along the Island is much less than that produced by mining near the mouth of the Bay. Some mining strategies near Staten Island actually decrease the tidal range along the Island. Since Staten Island is an area of relatively severe shore erosion, any increases in tidal elevation are undesirable.

This model has been developed to the point where it can be an effective management tool for predicting the effects different mining strategies would have on tidal circulation and tidal elevations before a permit is issued. Alterations in bathymetry by sand mining can have other effects on the physical processes in the Lower Bay, particularly on wave refraction. To evaluate these changes, a second model was needed.

EFFECTS OF MINING ON WAVE REFRACTION AND ON THE DISTRIBUTION OF WAVE ENERGY ALONG THE SHORELINE

Kinsman et al. (1979) adapted a simple wave refraction model developed by Wilson (1966) to the Lower Bay to evaluate changes in the distribution of wave energy along the coast of the Harbor that would result from changing the bathymetry. When offshore, deepwater, wave trains move into shoaling water and begin to "feel bottom" their crests are deflected. When the coastal bathymetry is complicated, as it is in N.Y. Harbor, the wave energy propagation can be very substantially altered and the energy may be either focused or defocused.

Until the advent of the high-speed computer our ability to trace wave rays has been of little practical value to those who must make decisions about coastal protection and the issuance of dredging and mining permits. The process required months of tedious labor at the drafting board for even the simplest situations. Today, however, wave ray tracing is a practical tool. The existing bathymetry can be stored in the memory of a computer and rays for the characteristic systems of waves which exist offshore rapidly traced in to their points of impact. This identifies those parts of the coast under intense wave attack and permits comparisons of energy expended on the several sections of a coastline. More important, it offers a relatively simple way to determine the effect of any proposed mining on the distribution of wave energy along the coastline <u>before</u> any permit is issued. One simply alters the bathymetry in the computer memory to conform to the depths of the proposed mining, re-computes the wave ray patterns, and compares them with the previous results. At this point the decision maker must determine whether the changes are acceptable.

Kinsman et al. (1979) examined the effects of mining different cells in the approved area on the East Bank of Ambrose Channel to depths of 45 and 90 ft. below MLW. They examined waves of 2, 6, and 10 second periods approaching the Harbor directly from the East, and parallel to Ambrose Channel traveling toward 297° T.

Their analysis indicates that there are now two regions of particularly heavy wave attack: the stretch from Hugenot Beach to Midland Beach on Staten Island and Coney Island. Experience confirms what their computer tells us about these two areas and lends some confidence that the analysis for situations which could only be verified by tearing up the Lower Bay are also valid. Their analysis indicates that mining within the approved area on the East Bank of Ambrose Channel would not eliminate attack on these two areas, but would shift the intensity of attack on points within them under different mining strategies.

This model has now been developed to the point that it can be an effective management tool for assessing the effects of bathymetric changes associated with different mining strategies on the distribution of wave energy along the shore line of the Lower Bay.

EFFECTS OF MINED PITS ON WATER QUALITY

The question of the effects of mined pits on water quality within the pits and in contiguous areas was addressed by Swartz and Brinkhuis (1978).

They found that pits on the West Bank of Ambrose Channel are being filled naturally with fine-grained, organic-rich sediments. Brinkhuis (personal communication, 1979) estimates sedimentation rates of up to 10 cm/yr. During summer, oxygen levels in the bottom waters of the deep holes on the West Bank are depressed relative to those in contiguous areas (Swartz and Brinkhuis, 1978). Throughout the remainder of the year, the waters within the holes are generally well oxygenated.

Holes mined into the East Bank were flushed more frequently by the estuarine flow. They did not accumulate fine sediments, and remained relatively high in oxygen throughout the year.

The effects of the pits on water quality are local; confined to the pits. Their effects on tidal currents and on tidal levels are more widespread. If the effects of changes in bathymetry are unacceptable, there may be a choice short of no mining.

POTENTIAL CREATIVE USES OF SAND MINING

Bokuniewicz and Schubel (1978) suggested that sand mining might be coupled with dredged material disposal to solve two of New York's pressing problems at once. Their strategy calls for mining relatively deep pits into the sea floor, backfilling them with fine-grained dredged materials and capping with clean sand. While present policy prohibits the excavation of deep pits, several already exist and it has been proposed to backfill one of them with <u>uncontaminated</u> fine-grained material. If the necessary permits are obtained, studies will be carried out to determine the behavior of dredged material during dumping from a scow, and subsequent to its emplacement on the pit floor. The principal unresolved questions relate to the ability to effectively cap fine-grained material that is relatively high in water content and low in load-bearing capacity with coarser-grained material, sand.

Whether back-filling and capping is a feasible operation and whether it would immobilize deeply buried contaminants to a sufficient extent deserves study. The possibility of solving two of New York's pressing problems at once is intriguing.

Mining strategies could be devised to have other beneficial environmental effects. Mining near the mouth of the Lower Bay could increase the tidal prism in the Lower Bay and the average tidal flow through the Sandy Hook-Rockaway transect by as much as 20 percent. This increased flushing would improve the water quality of the lower estuary. As pointed out previously, however, mining near the mouth could exacerbate shore erosion along Staten Island.

ECONOMIC CONSIDERATIONS

Concurrently with the environmental research, a series of studies was carried out on the economic feasibility of offshore mining for aggregate. It is important to distinguish between mining for fill and mining for aggregate. The texture of fill material is less well specified because its use often does not require structural strength. Aggregate material, on the other hand, must meet a variety of specifications for texture, composition, and physical properties, depending upon the specific use intended. Most aggregate materials consist of medium to coarse sands and gravels and are mixed with portland cement to make concrete. Fill material commands a lower price than aggregate and must be able to be transported by the least expensive means possible. Its commercial value is derived primarily from the very large amounts needed. Underwater aggregate mining has not been extensively carried out in the Metropolitan region to date because of extensive deposits on Long Island and in the Hudson Valley. These resources, however, are rapidly being closed out, or exhausted.

Carlisle and Wallace (1978) concluded that regional shortages of aggregate could be expected by the year 2000, and that prior to that time transportation costs for aggregate materials would be sufficiently high to cause suppliers to look to offshore sources. Large quantities of clean sand which would be suitable were found off New York, but much of the nearshore material, and all of that in approved mining sections of N.Y. Harbor, was too fine-grained for use as aggregate. They concluded that "state of the art" dredges could provide for the yearly construction aggregate needs of the greater Metropolitan area in about 12 weeks of operation, or less. This means that offshore mining could be independent of weather, that offshore processing and barge storage were feasible, but that some sort of on-shore storage would have to be considered.

Guyette and Wallace (1979) made a cost analysis of mining operations offshore of the Metropolitan region and Courtney et al. (1979) considered the economic viability of an offshore mining industry. They concluded that the offshore mining for aggregate is currently economically viable and would not be jeopardized by fluctuations in annual demand. Economies of scale resulting from larger capacity dredges are also apparent. Barge movement of sand from mining site to shore was shown to be less expensive than pipeline. The less expensive mining equipment "alternatives" were mechanical methods, with the clamshell dredge being least expensive. In terms of location of mining sites, from purely economic considerations, New York Harbor and the region off the south shore of Long Island are the two best sites. A projected future demand of 8.5 to 10.7 million tons annually, or about 64% to 80% of the total regional demand was forecast. Potential annual saving realized by the establishment of a least-cost offshore industry as opposed to the alternative of no offshore industry ranged from 35% to 41%.

Concluding Remarks

Studies have been completed: (1) to characterize the quality and quantity of the sand and gravel resources of the Lower Bay of New York Harbor, (2) to develop models to assess the effects of different mining strategies on tidal circulation, on tidal elevations, and on the refraction of waves and the distribution of wave energy along the shoreline, and (3) to assess the impacts of deep pits on water quality in the pits and in contiguous areas. These studies are, in our opinion, adequate for management purposes. They could, and should, be incorporated into a plan for effective management of the mining of sand and gravel resources of the Lower Bay with predictable and acceptable effects on the environment. Only the detailed biological studies remain to be done.

It is ironic that while we were preparing this paper the State of New Jersey issued its first permit in more than two decades for sand mining in its portion of the Lower Bay of New York Harbor. The area they chose is near the mouth of the Bay close to Romer Shoal. The proposed mining area is contiguous to the area where New York State prohibits mining because of potential adverse effects. The permit for removal of approximately 2 million cubic yards was issued apparently in a perfunctory fashion, without any environmental assessment. Only after it was issued did appropriate New York State agencies learn of the action.

It is distressingly clear that improved scientific understanding is no guarantee of better, more effective, management of mining activities in the Lower Bay of New York Harbor.

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NANTUCKET SHORELINE SURVEY
AN ANALYSIS OF NANTUCKET SHORELINE EROSION AND ACCRETION TRENDS SINCE 1846

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ABSTRACT

Storm-caused erosion and flooding of the nation's shorelines which have long been subject to rapid and dense development pressures, have in many cases resulted in economic losses and damage to coastal ecosystems. The coastline of Nantucket is that island's most precious aesthetic, recreational and economic resource. Nantucket cannot affort indiscriminate development of its shoreline. Large areas of previously undeveloped shoreline property on Nantucket present the unique opportunity to apply effective coastal resource management in order to avoid the consequences of inappropriate development.

It is becoming increasingly difficult for local regulatory officials and planners on Nantucket to prevent development along sections of the shoreline which are subject to severe erosion and floodings, and are seriously unstable. To help them convince real estate agents, developers, banks, and the potential purchasers of waterfront property that any permanent development directly along the most unstable sections of shoreline will almost certainly result in needless economic losses and encironmental damage, these officials require reliable data which document shoreline changes.

This study was initiated in cooperation with state and local officials in order to provide data documenting historical shoreline changes as a tool for coastal resource management. Erosion/accretion trends over a total of 125 years were determined from two sources: historical Coast and Geodetic Survey Charts (compiled by U.S. Army Corps of Engineers Beach Erosion Board) for the periods 1846-1887 and 1887-1955, and vertical aerial photography for the periods 1938-1951, 1951-1961 and 1961-1970. Linear and area measurement of shoreline trends taken by hand (historical charts) and with a zoom transfer scope (aerial photographs) every 1000 feet around the entire shoreline of Nantucket for the five time intervals, combined with error estimates, were compiled to provide a complete record of <u>average</u> historical shoreline changes. Detailed base map keys to the transects are provided in the final study report so that any official developer, real estate agent, mortgage examiner, or private buyer could locate a particular piece of waterfront property to within 500 feet of a

transect, and derive historical erosion/accretion trends from the tabulated data. For those with a basic interest in the entire Nantucket coast, summaries of general shoreline trends are included.

The most severe erosion problems on the island are along the south shore where erosion has averaged 6-10 feet per year and in some cases has exceeded 20 feet per year. The east shore was much more stable than would be expected, given an open ocean exposure to the northeast. Erosion rates from less than 1-3 feet per year are attributed to extensive shoals offshore which dissipate much of the incoming storm wave energy. The section between Great Point and the East Jetty was the most stable shoreline examined. Here, the overall trend was accretional, though at a very low rate. Erosion averaged 1-3 feet per year between the West Jetty and Smith Point. In general, of more than 215,000 feet of shoreline examined, only 20,000 feet were consistently depositional over the entire 125 year period. Accretion did occur at many locations, but only as a transient condition.

This study was undertaken to document transient shoreline change patterns to help avoid the consequences of development at unstable locations. Examples are presented showing how the study has already been used to resolve conflicts between developers and local regulatory officials, protect the investment interests of potential buyers of shoreline real estate, and as an aid to town planners and conservation interests for coastal resource management. Essentially, the results of the study will be used as a tool to effectively manage the shoreline and avoid the economic and environmental waste associated with mismanagement so common along other shorelines of the United States.

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PART X

ENERGY DEVELOPMENT & SOCIO-ENVIRONMENTAL IMPACTS

Moderator: Paul Stang

ENERGY IMPACT ASSISTANCE: COMMUNITY DEVELOPS NEGOTIATION

Francis X. Cameron*

The pending legislation to create an Energy Mobilization Board (EMB) reflects the national concern over making the hard choices necessary for the siting or certain types of energy facilities. Although the final form of the EMB hasn't emerged from the Conference Committee as yet, it will at least be able to waive federal, state, and local procedural requirements relating to facility siting, and in some cases may even be able to waive substantive siting requirements. A similar concern for expediting the siting process and for making rational siting decisions has occurred on the state level. This is reflected in the trend toward statewide energy facility siting legislation that coordinates or consolidates all state and local permits, and in some cases preempts local government decision making. A major stimulus for this state legislation has been the concern over the environmental and socioeconomic impacts of energy development, whether it be from OCS support facilities, nuclear or fossil fuel electric generating facilities, LNG terminals, and so on. This concern has been the primary obstacle to affirmative siting decisions.

In response to this concern, various programs and techniques have been developed both to induce state and local governments to accept energy development and to meet the legitimate planning and financial needs of local governments. The primary example on the federal level is the Coastal Energy Impact Program (CEIP) which provides planning and impact assistance financial aid to coastal states in order to prevent and reduce the adverse impacts of energy development. Several states mainly in the west, have also established energy impact assistance funds to aid local governments. This paper will concentrate on the techniques and opportunities available to local governments to receive impact assistance directly from the energy developer. Developer assistance can be useful in obtaining governmental assistance as in those situations where the governmental assistance programs are inapplicable or inadequate. It should be emphasized here that no amount of planning and compensation will turn a fundamentally bad decision from the viewpoint of community goals and environmental socioeconomic considerations into a good decision. Similarly, even if a local or state government is opposed to a facility, they must be prepared to deal with the potential impacts of that facility, on the possibility that a higher level of government will preempt their decision-making power.

One of the primary motivations behind government assistance programs such as CEIP is that this assistance should act as an incentive to cooperation between industry and local government. The primary responsibility for the costs of the project should rest with energy companies and energy consumers. However, the CEIP does not go as far as forcing the utilities to internalize all these costs as a requirement for obtaining a permit. However, in more and more instances

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the local community is turning to the energy developer for assistance. This can be beneficial not only to the town, but also to the developer. It often adds more certainty and speed to the licensing process. The costs of mitigation will be less than the costs resulting from the delay in the necessary approvals caused by community concern over potential impacts. If a "boom-town" situation is involved, mitigation measures that provide adequate housing and public services can facilitate recruitment of the labor force and increase their productivity.

Even though benefits may accrue to the energy company from assisting the town in mitigating impacts, it is vital that the local community possess some leverage over the developer. The town has essentially no bargaining power if the zoning laws are either non-existent or are not enforced. This leverage can take the form of "contract zoning," where the energy developer agrees to certain conditions in relation for zoning permission. This has been used successfully in Skagit County, Washington where the county rezoned 200 acres of agricultural and forestry classification to industrial use for a proposed nuclear facility. In return for the rezoning the utility agreed to, among other things, prepay taxes in order to finance the additional school and police facilities needed as a result of the inflex of construction workers and their families. Contract zoning was also used in the often cited examples of Northampton County Virginia. The county established a Planned Industrial District, and Brown and Root, the developer of an oil rig fabrication yard, agreed to:

-phase in the labor force and plant expansion;
-train local residents for employment at the facility; and
-provide land for needed facilities.

Some states government require the developer to mitigate all impacts before a construction permits are granted. In addition the newest Council on Environmental Quality regulations on the implementation of NEPA by federal agencies, requires the agency to at least describe what mitigation measures are required and why they were not made a condition of the permit.

Developer assistance can take many forms. Planning assistance is a crucial element in any mitigation strategy. The local community should know what the potential impacts are in terms of the demand for services and facilities, and how the community can meet these demands. Developer assistance can either be used directly to plan for these impacts or can take the form of helping the local community to apply for federal assistance. The financial assistance or developer expertise can also be employed to prepare a comprehensive land use and growth management plan or a capital improvement program for the community. Developer assistance can be used to pay the costs of needed facilities including health care and social services, to provide housing, to provide land for recreation, to construct highway access, and to establish a local job training program. Another important element would be to establish a program to monitor impacts.

Ongoing inputs into facility development decisions can be accomplished through the formulation of a local or regional advisory board. These Advisory Boards can assure utility responsibility and cooperation beyond the planning stage. In Grays Harbor, Washington, a regional steering committee was established to identify priority impact areas and to negotiate with the utility on the behalf of all the cities in the county.

There are many opportunities for state and local governments in the area of developer assistance. However, they may be missed if legislation such as state facility siting laws are not available to require mitigation. Federal programs such as CEIP can also be used more effectively in facilitating this government-industry cooperation.

THE COASTAL ENERGY IMPACT PROGRAM: A NATIONAL ASSESSMENT

John D. Wik*

ABSTRACT

Over the past few years, coastal and near-shore environments have been extensively used for the development and siting of energy related facilities. As the United States continues to explore alternative energy sources, in an attempt to meet its goal of energy self-sufficiency, increasing pressure will be placed on these coastal and near-shore environments. The Coastal Energy Impact Program (CEIP) directs the Federal government to assume some of the responsibility for impacts related to energy development activities in the coastal zone. The program is designed to provide financial assistance to state and local governments whose existing facilities and economic structures may be stressed by these activities. This paper first describes the Coastal Energy Impact Program, including the types of assistance available, applicable uses of these funds, and the procedures used in obtaining this assistance. The second part of the paper provides an overview of the National CEIP effort to date, including a review of the types of assistance which have been provided, and state and local government implementation of the program.

INTRODUCTION

The 1976 amendments to the Coastal Zone Management Act of 1972, included a new Section (308) which directed the Secretary of Commerce to "administer and coordinate . . . . a coastal energy impact program." The program which resulted from these amendments consists of a mechanism for providing financial assistance to coastal states, and local governments within these states, to help minimize social, economic, and environmental impacts that have, or may, occur as a result of the development of energy related activities in the coastal zone. While this program is specifically directed toward the mitigation of impacts resulting from Outer Continental Shelf (OCS) oil and gas exploration and development, the assistance it provides is not strictly limited to OCS activities. Coastal "energy activity" as defined by the regulations includes: activities related to Outer Continental Shelf development; liquefied natural gas development; and the transportation, transfer, or storage of coal, oil, or gas.

The coastal area has a unique combination of industrial waterborne transportation routes, and urban population centers which leave it particularly vulnerable to increased use as an area for the siting of energy related activities. Greater than sixty (60) percent of the petroleum refining capacity in the United States is presently located in the

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coastal zone. It is projected that most new petroleum facilities will follow this trend and that most new petrochemical facilities will locate in this area. With the increased demands for electricity in major urban centers, particularly in the northeast corridor, it is anticipated that much of the national growth in electric generating capacity will also locate along the coast. Finally, as the United States attempts to realize its national goal of energy self-sufficiency, in part through the development of OCS oil and gas resources, onshore support facilities and services will be required. The Coastal Energy Impact Program (CEIP) was created in an attempt to balance these increased demands for energy related activities in the coastal zone with the need to preserve and protect the environmental, social, and economic systems of the coast.

While CEIP funding is available to state governments, the program is more specifically directed toward local communities. At the outset it was recognized that local governments would bear the brunt of the impacts from energy related development. Local governments have the responsibility for planning for the expansion or development of facilities, in a manner which will minimize community impacts. In addition it is their responsibility to provide the needed public facilities and services to support population growth resulting from increases in employment due to these facilities. For larger communities, particularly those with significant planning capabilities, these impacts may be easily mitigated through the absorption of the increased demand into existing excess infrastructure capacities. But for smaller communities, with little planning experience, these demands might easily tax limited resources and result in significant impacts.

In general, the CEIP attempts to divert potential impacts from energy related activities away from the coast. The siting of these facilities within the coastal zone is discouraged, unless they are forced to locate there based on technical or transportation requirements. Siting the facilities outside of the coastal zone however, does not prohibit the use of CEIP assistance for either planning or impact mitigation, so long as the new facilities are related to coastal energy activities.

CEIP FUNDING ASSISTANCE

Four types of financial assistance are available to state and local governments affected by energy related development activities in the coastal zone.

1) Planning Grants to study and plan for consequences relating to new or expanded energy facilities which affect the coastal zone. Examples of activities allowable under this type of assistance include resource inventories, siting suitability studies, transportation and land use plans, and the financing of public facilities. Planning grants provide up to eighty (80) percent of the cost of the project and require state or local matching funds.

2) Loan and Bond Guarantees for the construction of new or expanded public facilities required as a result of energy related activities.

3) Loan and Bond Repayment Assistance to help local governments which cannot meet fiscal obligations incurred as a result of planning based on proposed revenues which do not materialize.

4) Environmental Grants "to prevent, reduce, or ameliorate any unavoidable loss" of environmental or recreational resources in the coastal zone.

To be eligible to receive CEIP assistance a coastal state must either have a Federally approved Coastal Zone Management Plan (as defined in Section 306), or be participating in the Federal program for the preparation of such a plan (Section 305). Alternatively, the state may receive CEIP funding if it ". . . is, in the judgment of the Secretary, making satisfactory progress toward the development of a management program which is consistent with the policies set forth in [the Coastal Zone Management Act of 1972]."

To implement the assistance programs, Congress has authorized a total of $2.1 billion, divided into two sources of funds. The first, the Coastal Energy Impact (CEI) Fund was allocated $800 million, through 1986, to be used for planning grants, loans, repayment assistance, and environmental grants. The second, the OCS Formula Grant Fund, was originally authorized $400 million, however with the passage of the 1978 Coastal Zone Management Act Amendments the amount was increased to $1.3 billion, to be used through 1988. Formula grants are the primary source of financial assistance to be used in minimizing the loss of environmental or recreational resources resulting from OCS activities. Formula grants may also be used for public facilities if CEI Fund monies are not available.

The procedure for distribution of formula grants between the coastal states is based on the amount of offshore oil and gas exploration, development, and production activity that has occurred adjacent to each state. The total yearly allotment is apportioned so that:

- One-half (1/2) is divided according to the proportion of adjacent OCS acreage leased during the previous year

- One-quarter (1/4) is divided according to the amount of oil and gas produced on the adjacent OCS during the previous year

- One-quarter (1/4) is divided according to the amount of OCS oil and gas landed in the state during the previous year

Through this allocation process, those states with the potential for receiving greater impacts from OCS development should receive a proportionally larger share of the funds.

An interesting point raised through the allocation process is the question of disputes between neighboring states over the extension of lateral seaward boundaries. The regulations have considered this question and require that:

> If no lateral seaward boundaries, or any portion thereof, have been clearly defined or fixed by an interstate compact, agreement, or judicial decision, lateral seaward boundaries shall be determined according to the applicable principle of law, including the principles of the Convention on the Territorial Sea and the Contiguous Zone . . .

PROGRAM ASSESSMENT

In December 1978 a report was prepared by the Office of Coastal Zone Management which summarized the activities of the CEIP for FY 77 and FY 78 (Pike, 1978). The report noted that during this period approximately $80 million had been awarded to fund one hundred sixty-three projects. Roughly half of these projects (eighty-two) were directly related to OCS oil and gas exploration and development activities, such as the construction of fabrication yards and services bases, thirty percent (forty-six) non-OCS related, including projects for the construction of oil or coal storage yards, and the remainder (thirty-five) were related to the development of other energy facilities, such as refineries or powerplants.

This distribution of projects suggests that one of the basic purposes of the CEIP--to minimize onshore impacts of OCS oil and gas development--is, in fact, being met. It further suggests that state and local governments are concerned about the potential impacts on the coastal zone of non-OCS related energy activities.

The objective of the CEIP to provide assistance to local governments, rather than state, for dealing with local impacts related to coastal energy activities also appears to have been met. During FY 77 and 78 approximately ninety percent of the projects awarded went to local governments. These projects included local planning studies, public facilities and service assistance, and funds for the acquisition or improvement of environmental and recreational areas.

Further analysis of the specific projects awarded during FY 77 and 78 suggests that, while many planning studies have been funded, the greatest number of awards went to projects which dealt with the mitigation of environmental and recreational losses (National Oceanic and Atmospheric Administration, 1979). Approximately forty-five percent of the projects funded were for the mitigation of environmental and recreational loss, while forty percent were for comprehensive studies of energy impacts. Even fewer of the FY 77 and 78 projects (fifteen percent) were for providing funds for public facilities and services assistance.

The large difference between the number of projects dealing with comprehensive planning and environmental and recreational losses (eighty-five percent) and those projects dealing with public facilities and services assistance is not surprising. Recent studies have suggested that few new areas along the coast will be significantly impacted by coastal energy development activities (Mylroie, 1978). In areas where impacts do occur, they will tend to be environmental and land use impacts rather than impacts to existing community infrastructure. This will occur as a result of the capital intensive, as opposed to labor intensive, characteristics of energy related facilities and because much of the labor used at these facilities will be drawn from the local population.

Gerald Mylroie, of the Office of Coastal Zone Management, in his December 1978 article on the Coastal Energy Impact Program, presents a good example supporting this phenomena (Mylroie, 1978):

> In Santa Barbara, California . . . a $2.6 million project to expand an ARCO oil treatment facility from 5 to 20 million barrels per day employed 70 construction workers. Most of the employees were from the Santa Barbara Area. When completed, the project [would] require only six to twelve persons to operate the facility.

Environmental impacts may occur as a result of the construction and operation of new or expanded facilities. Pollution from increased transporation as well as industrial operations from these facilities has the potential of reducing air and water quality. These impacts may create secondary impacts on the recreation and tourism industries by causing a decline in the number of individuals using the impacted recreational area. This in turn could result in an excess in existing infrastructure capacity, and place a long-term financial burden on the local population as it continues to support the excess capacities.

The differences between the number of environmental and comprehensive planning grants and the number of public facility grants suggests that perhaps the CEIP emphasis on public facilities and services assistance should be decreased, and an increased emphasis should be placed on environmental impact mitigation and planning. However, by reviewing the FY 79 grants (Burgess, 1979), it becomes clear that certain coastal areas, particularly those which have had long term exposure to OCS oil and gas development and whose economies have developed around OCS activities, do appear to need and use these funds.

In FY 79, the CEIP awarded approximately $46 million to twenty-four coastal states and one U.S. territory, to fund one hundred eighty-five projects. The bulk of the funds, better than fifty-five percent, went toward nine loans which ranged from $12,000 to $13 million. The remaining $21 million was used for one hundred seventy-six projects which included planning grants, grants for public facility and services assistance, and grants to reduce environmental and recreational losses.

Better than eighty percent of the funds allocated during FY 79 were used in the Gulf Coast states of Texas and Louisiana. The next largest allotments went to Alaska and California, with each receiving about three percent of the total. The variations in the levels of funding reflects the allotment process set up by the CEIP formula grants which provide those states with greater OCS oil and gas activities a larger share of funds. They also reflect the increased needs of communities, which have experienced long term, and often poorly planned, development due to OCS oil and gas activities, for additional public facilities and services. Analysis of the types of projects awarded to Texas and Louisiana provide examples of these needs. Unlike states that are adjacent to OCS oil and gas exploration activities, and primarily interested in planning and impact mitigation grants, Texas and Louisiana were mainly interested in grants and loans to construct or expand public facilities and to provide increased public services.

Since its beginning in 1977 only fourteen loans have been awarded under the Coastal Energy Impact Program. Although significant amounts of money have been available to state and local governments under the loan program, these funds have not been used. The primary reason for this lack of use stems from the initial intent of the program that the loan assistance should only be provided as a secondary source of funds; after it had been reasonably determined that private sector funding was not available for municipal loans. To realize this intent, the regulations stipulate that the interest rate on loan assistance funds is to be established at one percentage point higher than the U.S. Treasury rate, at the time of the loan approval. Since most communities can obtain private sector loans, at lower rates, they generally have not depended on CEIP loan assistance.

Recently the Office of Coastal Zone Management (OCZM) has reassessed the initial intent of the loan assistance program and proposed revisions to reduce the interest rate for general purpose loans to the current rate of municipal bonds, and set the interest rate on loans for the acquisition of environmental or recreational areas at five percent (Burgess, 1979). These actions, when implemented, should encourage greater use of the loan assistance program.

A major criticism of the CEIP concerns the process used for the allocation of the OCS formula grant funds (Mylroie, 1978). Formula grants are the primary source of funds for use in preventing or minimizing OCS related environmental and recreational losses and for other OCS planning activities. As previously discussed, the present system allocates these funds based on the level of activity on the OCS adjacent to each coastal state. However, localized land use impacts can easily occur in newly developing areas even before exploration activities begin. Onshore service bases, for example, while probably not providing a substantial impact to the local labor force or economy, if not properly planned can impact environmental and recreational areas. To eliminate problems of this nature, an allocation process is needed which considers the potential for localized impacts as a result of onshore support operations in exploratory areas. The process should include a mechanism for identifying these developing areas and directing additional funds toward them for planning assistance and impact mitigation.

An additional criticism of the program has been that the availability of planning funds and public facilities and services assistance might cause local governments to encourage the siting of energy facilities in the coastal zone (Williams, 1977). However, Section 308 of the Coastal Zone Management Act specifically discourages the location of non-essential energy activities within the coastal zone. In addition, under the CEIP, assistance can be made available to energy facilities which locate outside of the coastal zone, provided they are related to coastal energy activities.

A developing problem with CEIP assistance deals with the requirements that a state must have, or be working toward, an approved Coastal Zone Management Plan. While most coastal states meet these criteria, it appears that four states (Virginia, Georgia, Minnesota, and Illinois) will not, and, thus, be ineligible for CEIP funding. Arguments can be made both for and against providing CEIP support to states which do not comply with the regulations. However, it is the local governments that are generally impacted by coastal energy activities. Since a primary objective of the CEIP is to provide assistance to these local governments for the mitigation of local impacts, a mechanism is needed to assist these local governments in noncompliance states. An obvious and simple solution is to allow these local governments to deal directly with the Office of Coastal Zone Management in obtaining CEIP assistance. While this approach would not cause the negligent state to reassess the value of its participation in the Coastal Zone Management Program, it would assist in the prevention of impacts to the coast from energy related activities, and, thus, better serve the intent of the Coastal Energy Impact Program.

SUMMARY

Generally, the Coastal Energy Impact Program appears to be meeting the objectives of Section 308 of the Coastal Zone Management Act. Analysis of the projects which received funding during FY 77, 78, and 79 indicates the emphasis of the program toward OCS oil and gas activities is being realized. The intent of the program to provide assistance to local governments for solving local problems also appears to have been met.

Some of the criticisms that have been directed toward the program appear to be somewhat unfounded. While the suggestion that public assistance funds for facility construction and services be reduced appears to be valid when viewed from a strictly national level, when viewed from a regional level it appears that these funds are needed. This is particularly true in those areas which have had long term experience with OCS oil and gas exploration, development, and production, often with little or no facilities planning.

A second criticism has been the fear that the CEIP may influence local officials and planners to encourage energy activities to locate within the coastal zone due to the availability of planning and impact mitigation funds. Since the regulations specifically discourage the location of nonessential facilities in the coastal area and will provide assistance for energy activities locating outside the coastal zone (provided they are coastal related) it is doubtful that this fear will be realized.

It appears, however, that the Program could better serve the needs of the state and local governments if a few simple modifications were made. The current interest rate on loan assistance funds has been found to be unattractive to local governments. This has resulted in the award of few loans (fourteen) since the program began. Reducing the interest rate, as is currently being considered by the OCZM, should encourage greater use of these funds.

A second program modification is the suggestion that the process used for the allocation of OCS Formula Grant funds include a mechanism to identify and provide assistance to specific areas where onshore development activities are expected to occur, prior to an OCS lease sale. The present process does not consider potential land use and environmental impacts associated with the development of pre-lease sale facilities to support exploration activities. Since these activities are relatively site specific, the potentially impacted areas could be identified and assistance provided.

Finally, because the granting of CEIP assistance is directly tied to the Federal approval process of the Coastal Zone Management Program, local governments in noncompliance states are not eligible to receive CEIP funding. Since the objective of the CEIP is to assist local governments in the prevention or mitigation of local impacts, it is felt that the eligibility requirements need to be modified to allow local governments in noncompliance states to deal directly with OCZM in obtaining CEIP funds. This would be consistent with the objectives of the program, and would further the program's overall goal of reducing impacts from coastal energy activities.

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ENVIRONMENTAL ASSESSMENT OF DEVELOPMENT OF OFFSHORE NATURAL GAS RESOURCES BENEATH NEW YORK STATE WATERS OF LAKE ERIE

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ABSTRACT

In anticipation of the need for increased energy supplies, the state of New York commissioned a study to evaluate the environmental impacts associated with the exploration, drilling and development of natural gas resources beneath the New York State Waters of Lake Erie. In relation to the recent energy crisis the development of marginal offshore natural gas reserves assumes a new significance, however, in all cases consideration must be given to environmental concerns.

This paper utilizes the New York State study and details the areas of concern and the methodology employed in their evaluation. The basic approach was to describe each phase of the exploration, drilling and production operations associated with the development of offshore natural gas emphasizing those areas having potential environmental impact and then relating those potential impacts to the baseline physical-chemical, biological and socio-economic data. The evaluation of impact was based on available data on the current environmental conditions in the eastern end of Lake Erie, and Canadian drilling practices as modified by rules and regulations proposed by the New York State Department of Environmental Conservation.

Pipeline Landfall: Strategy Development Accomodating Natural Gas Production in the Baltimore Canyon Trough

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B. Hoff[2], and E. Linky[2]

Abstract

Offshore production of natural gas from the frontier area off the East Coast of the United States will likely be transported to the mainland by pipeline. In New Jersey, the State Department of Energy is attempting to formulate policy guidelines with respect to the siting of OCS-related energy facilities, which includes pipelines. To assist in this formulation of policy, four routing scenarios were developed to elicit both the impacts as well as the policy issues associated with the construction of a large diameter, natural gas pipeline. The impact and policy issue identification process is based on detailed characterization (biological, physical, socio-economic and legal) of the systems to be traversed as well as the intensive identification of the various technologies that may be utilized in each system.

By utilizing a scenario methodology, a number of opportunities and constraints that apply to the siting of a natural gas pipeline in New Jersey were identified. In addition, conflicts (in need of resolution) in the actual application of route selection were hignlighted.

Introduction

The oil and gas industry's search for hydrocarbon resources in recent years has increasingly focused on the "frontier" areas of the United States' Outer Continental Shelf (OCS). If not properly planned for, proposed development of hydrocarbon resources in these OCS frontier areas portends significant socio-economic, physical, institutional and environmental impacts within adjacent coastal states. If the coastal zone is, indeed, to play a major role in the

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Nation's energy future, finding acceptable sites for new energy facilities will not be easy.

At present, the identification of land parcels both sufficiently large and suitable for required energy facilities poses difficulties. This identification process will likely be compounded in the future, not only because of a more limited supply of available coastal land, but by the need to ensure that such development is compatible with overall land-use needs and is acceptable in terms of the environment and public health and safety.

Baltimore Canyon Trough

The Baltimore Canyon Trough is considered to be a major sedimentary basin in terms of hydrocarbon potential of the Mid-Atlantic's OCS. Within this trough area, oil and gas industry bids on one hundred and thirty-two lease tracts were accepted by the United States Department of Interior's Bureau of Land Management (BLM)[1]. Drilling efforts currently underway within these tracts underscores the importance to state and municipal officials to study and properly plan for the siting of energy facilities which are required to support the industry's oil and gas exploration and development efforts. Such energy facilities may have major effects on land use and growth patterns not only locally, but for the region as a whole.

The magnitude of the impacts for any given region will depend, in large part, on state and local governments' capacity to plan for and accommodate such new growth. Thus, it is advantageous for these government agencies to formulate policy guidelines with respect to the siting of OCS-related energy facilities within their jurisdiction. In turn, the development of effective and reasonable policies is dependent on an adequate physical, biological, and socio-economic data base.

Design of the Study Methodology

The methodology described in this paper was developed to specifically address the impacts and policy issues which could be expected with the siting of one type of OCS-related energy facility in New Jersey, that is, a natural gas pipeline. There were two major reasons for limiting this study's focus to natural gas pipelines. They were:

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1. Lease Sale Number 40, held in August 1976, awarded 93 tracts. Lease Sale Number 49, held in February 1979, awarded 39 tracts.

1) all OCS natural gas is transported to shore by pipeline in the United States; and 2) the environmental impacts of constructing a natural gas pipeline are basically the same as constructing an oil or petroleum-related products pipeline.

The intent of the study methodology design was to provide information pertinent to the transportation of natural gas that would: 1) be able to be updated on a continuing basis when new information is acquired, 2) be capable of being applied even before commercial quantities of natural gas are discovered offshore, and 3) allow proposals to be evaluated so they would be in compliance with the state's coastal zone management (CZM) plan.

Development of Four Routing Scenarios

To enable a comprehensive assessment of all the impacts and policy issues associated with the construction and operation of a natural gas pipeline 36 inches in diameter in a wide range of environmental-cultural systems and right-of-way (ROW) types, four routing scenarios were developed (See Figure 1). These routing scenarios were selected and developed solely to evaluate New Jersey conditions. The concept, however, of utilizing routing scenarios has broader geographic applicability than New Jersey. It can be used elsewhere to elicit: 1) policy issues in need of resolution, 2) expected impacts due to construction, and 3) the identification of new areas for further study.

To develop these routing scenarios, three offshore termini were chosen (Points A, Figure 1). The northern, central and southern termini are contained within the lease tracts and cover the eventuality that natural gas may be discovered in each locale. On the other hand, only one onshore terminus was selected. This site is in Princeton Township, (Point B, Figure 1). The Princeton Township site represents the nearest interstate natural gas pipeline of sufficient size to accommodate the transport of 2.5 trillion cubic feet of gas with an ultimate potential of about twice that volume. The site was also chosen because it had adequate land available on which to construct a compressor station and because it provides for a connection to underground gas storage in Pennsylvania. This latter point allows the operating company to take advantage of peak-shaving opportunities. The most important reason, however, for selecting point B is that it allowed this study's criteria of developing four routing scenarios which would traverse a maximum range of environmental-cultural systems and right-of-way types to be met.

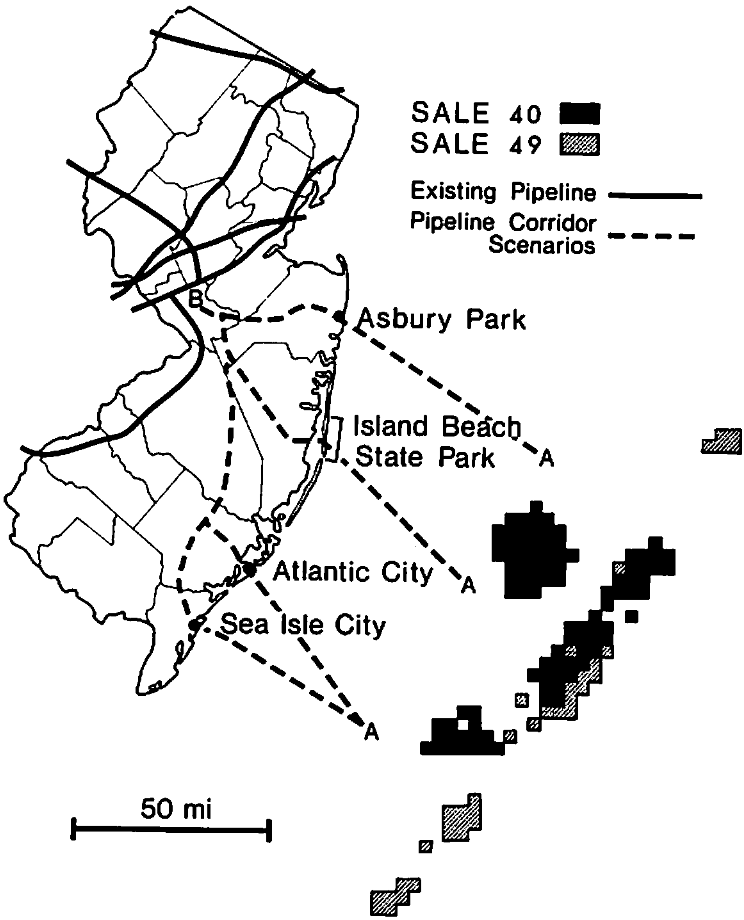

Figure 1: Alternative pipeline routing scenarios leading through environmental-cultural systems.

Selection of Landfall Sites

The three offshore termini are connected to the land terminus by four pipeline routes. These routes, as mentioned previously, were selected to provide four different landfall situations covering a large range of environmental-cultural characteristics (Table 1). Together, these four landfall sites represent those environmental-cultural conditions present along New Jersey's ocean shoreline.

Table 1

Considerations for Selected Landfall Sites

Asbury Park	Island Beach State Park	Atlantic City	Sea Isle City
Urbanized	Pristine barrier island	Urbanized barrier island	Low-density development on barrier island
Headlands	Public land	Numerous ROW's to mainland	Seasonal population
Year-round population			RR ROW
High Erosion			

Joint Utilization of Rights-of-way

The onshore segments of the routing scenarios were also developed to illustrate the joint utilization of rights-of-way. The importance of evaluating the concept of joint utilization is underscored by the policies specified in New Jersey's CZM plan as well as Federal policies which endorse the concept of corridor sharing (New Jersey Department of Environmental Protection, 1978; Oullette and Rodda, 1978).

A number of rights-of-way cross identical environmental systems. An illustration of ROW types within the environmental areas encountered in the Sea Isle City route (Table 2) points to those systems which will require a new ROW and those where some choice may be exercised. Further, when state-of-the-art technology is applied to ROW types, the selection may be narrowed by environmental, economic or social concerns.

Table 2

Sea Isle City Route Scenario

	In Road	Adj. Road	Active Rail	Aband. Rail	Utility	Exclusive
Wooded lowlands	X	X	X		X	X
Ephemeral stream corridors		X				X
Beaches						X
Coastal wetlands			X	X		
Bogs & FW wetlands	X	X				
State forests		X				X
White cedar stands						
Fed. military lands						X
Agric.lands		X		X	X	X

Impacts and Policy Issues Encountered

The intent of this paper, as stated earlier, was to develop a methodology which would identify the impacts and the policy issues associated with the construction of a natural gas pipeline. The following six examples will illustrate the magnitude of the impacts and the variety of policy issues which will be encountered in constructing a natural gas pipeline in New Jersey.

1. Utilization of existing ROW
2. Conflict in using expressways and freeways
3. Traversal of coastal wetlands
4. Conflict with interim rules and regulations for the Pinelands
5. Traversal of public lands
6. Pipeline burial at landfall and nearshore waters

Example 1

Traversal of environmentally sensitive areas is best accomplished by utilizing existing rights-of-way. Construction-related impacts on flora and fauna will be substantially decreased due to the reduced clearing requirements for pipeline construction and maintenance in an existing ROW as opposed to the construction and maintenance of a pipeline in a new ROW. These environmental benefits must be balanced against the increased short term social and economic impacts resulting from the impairment, for example, of vehicular and mass transportation along such links.

Example 2

A policy issue which surfaced upon examination of the feasibility of joint utilization of existing rights-of-way involved the discouragement of the joint utilization of freeways and parkways such as the Atlantic City Expressway (See Figure 2). This roadway, which appears to be ideal for pipeline construction due to its large width and wide center median, has been recommended in the BLM's Final EIS for lease sale number 40 for the Mid-Atlantic (United States Department of the Interior, 1976), the New Jersey Office of Coastal Zone Management's Bay and Ocean Shore Segment Document (New Jersey Department of Environmental Protection, 1978), and by the Atlantic County Planning Board (Atlantic County Planning Board, 1978) as one which a pipeline ROW should follow. However, New Jersey Department of Transportation (New Jersey Department of Transportation 1973) and Atlantic City Expressway Authority policies prohibit such an accommodation. The use of this expressway, for instance, for an oil pipeline which could connect to the refinery complex in the Camden-Philadelphia area would be in direct conflict with these agency policies. The Expressway provides a convenient route and potentially less environmental degradation due to construction than would the accommodation of a pipeline in any other existing right-of-way in the area. Thus, the option of utilizing the Atlantic City Expressway to accommodate a pipeline should not be foreclosed, as is the case under existing policy.

Example 3

Traversal of the state's environmentally valuable coastal wetlands is highly probable. The methodology of this study required that the impacts of different construction technologies which could be employed in New Jersey's wetlands' environment be examined. For example, two construction techniques, the push ditch method or the flotation method, can be utilized in New Jersey wetlands. If the push ditch method were employed in an entirely new

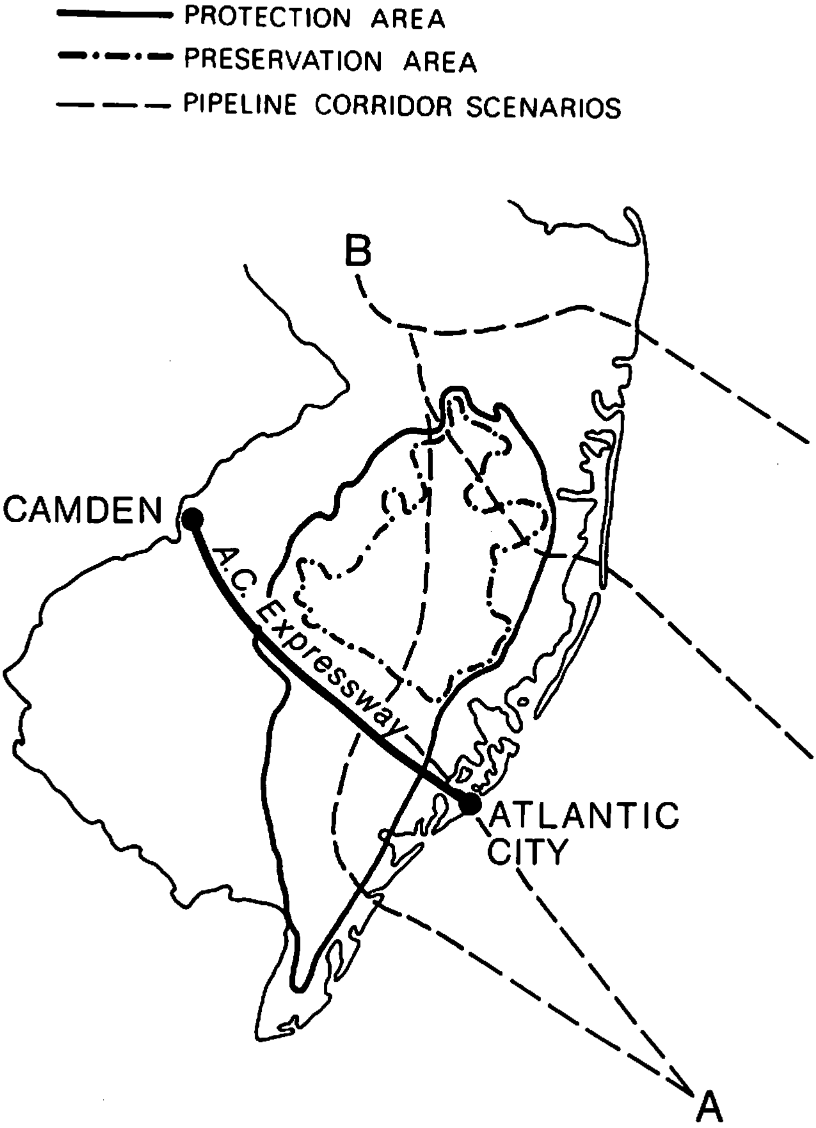

Figure 2: Traversal of the Pinelands by the Atlantic City Expressway and the four routing scenarios.

ROW, 4 to 5 acres of land per linear mile of pipeline would be directly altered. If the flotation method were utilized, 36 to 42 acres per linear mile would be directly altered. The push ditch method clearly minimizes environmental disturbances to the system.

Example 4

The recently enacted State Pinelands Protection Act (P.L. 1979, C.111) has resulted in the establishment of a Pinelands Commission to prepare and adopt a comprehensive management plan for the Pinelands. The Pinelands, which has a designated Preservation Area and a Protection Area (Figure 2) overlaps the New Jersey Coastal Zone Management's boundaries to a small extent. Within CZM's jurisdiction, policies concerning linear facilities have been developed and agreed upon by the New Jersey Department of Energy and Department of Environmental Protection.

Within the Pinelands, interim rules and regulations were designed for the review and approval of development applications. However, these interim rules and regulations, which were developed primarily to protect the water quality and unique ecological characteristics within the region from residential, commercial and industrial development, do not specifically address the development of linear facilities. If there is to be more than an ad hoc resolution of this issue, the concept of a pipeline needs to be specifically addressed in the Pinelands' final rules and regulations so as to allow for a proper evaluation procedure for linear facilities.

Example 5

Pipeline traversal of public lands, both Federal and State, presents another interesting policy issue. Landfall at Island Beach State Park is subject to the approval of the State Department of Environmental Protection, which must determine that the landfall will not disrupt the present physical state of the park as per legislative mandate (N.J. S.A. 13:6-1 et seq.). Traversal of other public lands, if not expressly prohibited, can be accommodated, given the approval of the agency administering each particular land parcel.

Example 6

Another policy issue concerns pipeline burial. Perusal of the literature raises numerous unsettled issues relative to the burial of a pipeline at landfall and in nearshore waters. In coastal environments such as New Jersey, which have experienced coastal retreat over the past several decades, exposure of the pipeline during some part of its productive lifetime may become a reality. Pipeline burial to a minimum of 3 feet at landfall is required by the Code of Federal Regulations. Continued erosion of the coastline over a 20 to 30 year period may necessitate burial of the pipeline to 15 to 20 foot depths. The penalty of deeper burial is more than cost considerations. It can be the source of greater local environmental disruption and greater disruption to the beach zone and nearby areas by several orders of magnitude.

For instance, the landfall at Asbury Park experiences an annual erosion rate of 4.3 feet. With a 20 to 30 year lifetime the pipeline burial depth would be on the order of 12 to 16 feet. This depth indicates the 3 foot burial depth required under existing regulations is insufficient. The environmental impacts of burying a pipeline to 12 to 16 foot depths at Asbury Park with presently utilized technology may become so great as to be unacceptable. New construction technologies such as the directionally controlled, horizontal drilling method (which has never been applied at landfall), need to be further developed and considered in future pipeline construction projects.

Conclusions

The value of this inquiry on pipeline impacts is directly related to the utilization of our results in assisting the formulation of New Jersey policy and also in the application of our data sets in approaching similar problems eleswhere. Our data include an intensive identification of the variety of technologies that may be employed, and a detailed characterization of the system that would be traversed. In each of the systems, we evaluated the impacts of each of the technologies and how different rights-of-way could be used to pass through the system. The result of this application of data sets was to point to preferred options for minimizing impacts. Further, the utilization of routing scenarios highlighted conflicts in the actual application of route selection and certainly pointed to areas in need of policy resolution. Thus, public issues have been identified and decision makers are confronted with a simulated problem but one that has every potential of becoming real as witnessed by yet another report by Texaco during the week of October 21 of gas being recovered from another of their exploratory wells in the Baltimore Canyon Trough area.

Acknowledgements

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POWER PLANTS IN THE COASTAL ZONE?-- AN ANALYSIS OF UTILITY SITING PRACTICES AND THEIR IMPLICATIONS FOR COASTAL ZONE MANAGEMENT

Dennis W. Ducsik*

Abstract

In this paper the problem of dovetailing coastal zone policies with the process of power plant siting is addressed from an institutional standpoint, with emphasis on the central role of the private electric companies. After a review of the requirements for energy facility planning under the Coastal Zone Management Act of 1972 (as amended), utility site selection practices are described and evaluated. Findings are reported from a recent study by the author which indicates that, among other things, preferential treatment seems to be given to concerns for economy and reliability of service, especially early in the siting process. Important coastal considerations may not therefore be sufficiently taken into account by utility planners, beyond whatever mitigation is possible through changes in plant design. Questions are raised, moreover, as to whether state and federal licensing authorities are in a good enough position to ensure that the tradeoffs made throughout the siting process are consistent with public (as well as private) interests. In light of these problems, coastal zone management agencies are advised to devote as much attention to the question of how to strengthen the interface between government and the utilities as is given (currently) to that of how to define interrelationships among agencies with jurisdiction over coastal and energy matters.

Introduction

Among the most difficult of conflicts involving the use of coastal resources are those associated with the siting of large-scale electric generating stations at or near the water's edge. Such locations are attractive to utility companies for a variety of engineering and economic reasons (particularly access to cooling water), but they also engender resistance from environmental groups concerned about potentially adverse impacts on aquatic ecosystems.[1] Another important issue involves the lost opportunity in devoting extensive shorefront acreage to power plants, to the exclusion of other desirable water-dependent uses. Under what conditions scarce coastal resources should be allocated to electric facility development has thus become a key policy question on the coastal zone management scene today.

It is reasonably well-established that future efforts to identify suitable power plant sites should not rule out either coastal or inland locations, nor a third alternative of utilizing land within the coastal zone but set back from the shoreline itself. In a study of

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electric facility siting on Wisconsin's coast, for example, Bishop and Vogel[2] found that comparative generalizations as to the desirability of using (or avoiding) lakeshore sites are unwarranted because both economic and environmental impacts turn out to be highly site-specific. All that can be said on substantive grounds, in other words, is that the question of coastal versus inland siting requires a systematic and careful analysis which clarifies the tradeoffs among whatever alternatives are available. The key question thus becomes: to what extent do we have the institutional capability to balance competing interests in the process of reaching power plant siting decisions?

From the coastal zone standpoint, of course, the most prominent feature on the institutional landscape is the Coastal Zone Management Act of 1972 (as amended),[3] which has made future power plant development a central issue of concern for federally-assisted state CZM programs. The direct mandate along these lines came in the 1976 amendments to P.L. 92-583, which required participating states to establish "a planning process for energy facilities likely to be located in, or which may significantly affect, the coastal zone".[4] To emphasize the point Congress also singled out energy facilities as an example of those for which planning must provide for adequate consideration of the national interest[5]; and, under the coastal energy impact program, funds were made available to support studies related to this planning effort.[6] It seems, moreover, that the Congress will continue to fucus attention on this element of coastal zone management, since President Carter in his latest Message on the Environment has recommended further amendments which stress the implementation of "predictable siting processes" for major energy facilities (among others).[7]

To those familiar with the institutional arrangements surrounding electricity planning and regulation, the entry of coastal zone agencies into this arena raises a number of fascinating issues. Foremost among them involves the task of effectively integrating coastal management policies with an existing bureaucratic machinery that is at best complicated--the proverbial tangled web--and at worst borders on total disarray. In many states regulatory responsibility is diffused over more than a score of seperate entities, ranging from Public Utility Commissions and Environmental Management Agencies to local Zoning and Health and Safety Boards. Although the trend in recent years has been to consolidate this authority in some form of "one-stop" siting council, more than half of all the coastal states still rely upon the traditional multiple-veto system.[8] Further complicating the situation is the fact that, in the last five years or so, about half of all the states have enacted some form of state-wide energy planning legislation. And not to be overlooked is the fact that, by virtue of the National Environmental Policy Act, the Atomic Energy Act, and a variety of other pollution control and resource management statutes enacted by Congress, there are several federal agencies that have a 'piece of the action' when it comes to the regulation of electric generating facilities (in the coastal zone or elsewhere).

In light of this multi-ministerial framework, it is hardly surprising that coastal protection as a single voice might encounter some difficulty in making itself heard above the general din that is known as power plant licensing. Nor is it surprising, therefore, that much of the discussion and debate concerning an energy planning component within the CZM context has focused on questions of inter- and intra-governmental linkage. One question of considerable current interest, for example, is how the 'federal consistency' clause will be applied to agencies like the Nuclear Regulatory Commission or the Army Corps of Engineers. Another concept that has engendered much attention is that of 'networking', a means of implementing coastal policies via formal administrative agreements among various units of state government. The federal Office of Coastal Zone Management is particularly interested in evaluating this concept as it applies to energy regulatory agencies, having noted in its rules and regulations several long-standing problems with the licensing process.[9]

One is tempted to examine further the challenging issues surrounding the problem of multi-agency coupling, but such is not the intent of this paper. Without prejudice I leave it to others to analyze and evaluate the innovations that have surfaced recently, in part because they are being actively investigated (see, e.g., the papers on networking elsewhere in this volume) and in part because there is another major line of inquiry that is much overlooked by comparison. We tend to lose sight of the fact that solving the problems of governmental cooperation and coordination within the public sector is a necessary but not sufficient condition for effective blending of coastal protection and power plant development policies. Equally important is the question: what will it take to achieve full integration of coastal management policies with decision-making within the private sector, in the form of the site selection activities of investor-owned utilities?

This issue deserves attention for the simple reason that site selection has never really been a governmental function at all. Rather, original jurisdiction has been exercised by those in the business of supplying electric power, as part of their entrepeneurial prerogatives. Government is involved in power plant siting, to be sure; but, in marked contrast to other public-works projects like water supply facilities and highways, the public sector role is limited to case-by-case evaluation of proposals emanating from the electric companies. Those who are concerned with the balancing of coastal interests vis-a-vis other societal (and corporate) objectives would thus do well to consider how effectively private planning operates in this regard, and whether the regulatory machinery now in place is truly capable of guiding the process in an appropriate manner.

In the course of doing research a few years ago on the problem of eroding public confidence in the electricity 'establishment', I had occasion to examine in some detail how power plant siting operates in practice.[10] The purpose was to ascertain the means by which environmental issues in general are typically addressed in the course of decision-making; however, insofar as the principal environment in many cases of site selection is really the coastal environment, the results of this work are quite relevant to the present discussions. Consequently, they will serve as the basis for the remainder of this paper.

Overview of Utility Siting Practices

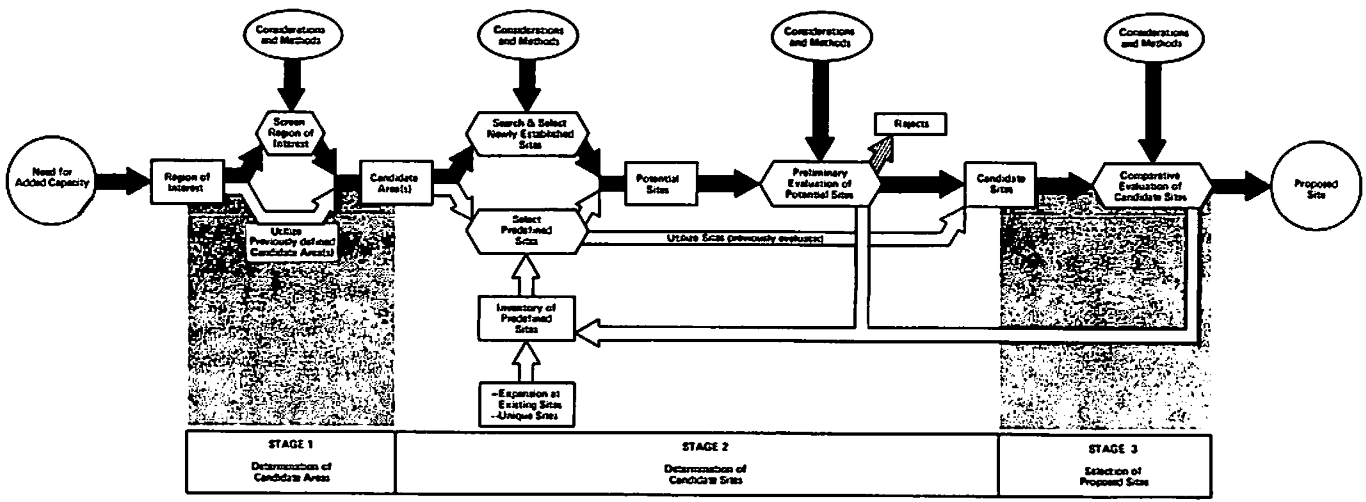
Traditionally, the basic objective of power plant siting from the utility viewpoint has been to identify sites that are potentially licensable and capable of development in a cost-effective and timely fashion. Prior to the mid-to-late 60's, utilities typically were able to find acceptable sites by applying narrow economic and engineering criteria, but this has changed in recent years with the complicating presence of environmental and other social constraints. From the comprehensive typologies that have appeared in the literature,[11] it is clear that an incredible diversity of requirements must be taken into account in searching for a power plant location. Finding sites that are desirable to the utility in terms of feasibility and cost as well as acceptable to regulatory agencies (and the public at large) has thus become a time consuming and exacting task.

Given the increasing complexity of the siting process, it is hardly surprising that most utilities conduct an ongoing search for suitable locations, which draws upon the expertise of specialists from a wide range of disciplines. Published accounts of siting experience indicate that utilities employ highly sophisticated procedures in their search activities,[12] and several major consulting engineering firms have geared up to assist the industry in this respect. Indeed, the environmental movement has triggered the development of a wide range of comprehensive siting methodologies, quantitative techniques, and environmental assessment tools. There may be some doubt, admittedly, as to just how widespread this 'scientific' approach to siting actually is, and to what extent it has influenced the way decisions are reached in the real world. Still, there is considerable evidence that utilities on the whole <u>do</u> employ systematic processes in site selection.

At the present time the best available source of information on the state-of-the-art of utility site selection seems to be an Atomic Industrial Forum report entitled <u>Nuclear Power Plant Siting: A Generalized Process</u>[13]. This was prepared by a major industry consultant who analyzed the siting practices of 26 large electric companies, whose combined generating capacity as of 1974 (the study date) exceeded one-half the U. S. total. The principal result of this analysis is shown in Figure 1, which depicts site evaluation and selection as a hierarchical process of elimination that is divisible into relatively distinct stages. In the first stage a broad region of interest is narrowed down to a set of promising candidate areas, which are then scanned for potential sites. These in turn are evaluated and reduced to a smaller set of candidate sites, whose relative merits are carefully assessed with an eye toward choosing a preferred site. Notice also that many sites which drop out of contention in the latter phases enter an inventory of pre-defined sites, which are retained for consideration in future searches. As the saying goes, 'the second best site of today is often the preferred site of tomorrow'.

Figure 1

Generalized Site Selection and Evaluation Process



Source: Reference 13

Aside from the fact that siting proceeds logically from an initial focus on broad areas to consideration of specific sites in progressively decreasing numbers, the most salient feature of the process is that it is based on comparative evaluation of a variety of parameters. Dollar cost, of course, is a pervasive consideration throughout the process and serves as a sort of common denominator for evaluation. Beyond this, the factors affecting siting can be organized into four basic groups, each of which is worthy of some elaboration at this point.

(1) System Configuration Parameters: One way to look at a geographic region is purely in terms of the demand and supply of electricity, i.e. by considering potential facilities only in relation to the existing network of plants and transmission lines and to the projected distribution of load growth in the area. From this standpoint, it can be seen how a number of system-related considerations have an important bearing on the site selection process. To begin with, utilities have certain territorial responsibilities associated with their franchise, and often operate under a number of other legal and organizational constraints where siting is concerned. Second, the results of generation expansion analysis clearly have a major effect on site selection, since the technical requirements of a suitable location are conditioned by size, type, and number of units to be placed on it. Finally, it is often desirable for technical and economic reasons to find sites in proximity to major transmission corridors and which represent a good generation-to-load match. Essentially, system configuration parameters reflect the traditional utility objective of providing low cost, reliable service to meet the needs of its service territory, irrespective of any physical or social limitations that might otherwise apply.

(2) Engineering Design Parameters: A second way of looking at a geographic region is as a resource base which must be utilized to meet the technical requirements of constructing and operating a large generating facility. The characteristics of this resource base can have a great influence on the feasibility and cost of the project. Some of the more significant factors include the adequacy of water supplies for cooling purposes; the degree of accessibility for transportation of heavy equipment and delivery of fuel; the suitability of soil conditions and topography for large foundations or cooling ponds; and the suitability of geologic/seismologic conditions (in the case of nuclear plant siting and safety design). Also important in many cases is the availability of construction materials and a skilled labor force. All of these factors are normally dealt with in conjunction with the general layout and characteristics of the planned facilities, including things like transmission interconnections, substations, and cooling system intake/outfall structures as well as the plant itself. Specific design features such as these can put certain demands on a site (e.g. in terms of acreage requirements) but can also be used as 'control knobs' to offset undesirable site characteristics, usually at increased cost. All in all, the parameters that fall into this category reflect the fact that power plant siting is a large and complicated exercise in civil engineering.

(3) Environmental Protection Parameters: Realizing that a resource base not only affects but is affected by the construction of major

power facilities leads to a third perception of a geographic region, i.e. in terms of its natural and social environment, whose often delicate fabric is susceptible to insult. The landscape, for example, may be dotted with areas dedicated to public use (e.g. parks), areas with special geographic features or ecological sensitivities (e.g. bluffs, marshlands, habitats), and areas of unique visual-cultural value (e.g. scenic vistas, historic/archaeologic sites). Potential conflicts with such uses affect site selection, as does the degree of compatibility with activities in areas surrounding the site itself (e.g. consequences of noise in a tranquil setting). In a similar fashion, the hydrology, water quality, nature of aquatic communities, and other water-related aspects of the physical locale are important for their implications with respect to, for example, the design of cooling water systems. Further, the meteorology, climatology, air quality and other characteristics of the local airshed are important factors to consider in relation to the emission of airborne pollutants from a power plant. Finally, in the case of nuclear facilities the distribution and density of population within certain distances from the plant is a key siting determinant for radiological public health and safety reasons. Many of these factors are now the subject of specific regulatory requirements as well as broad balancing criteria.

(4) Institutional/Political Parameters: A fourth and final way of viewing a region of interest for power plant siting is in terms of the existence and interplay of social forces among individuals and groups. One factor that has had a growing influence on site selection is that of public acceptance, to the point where the socio-economic status and other demographic features (e.g. age, education) of a populace can weigh heavily in locational decisions. Also important are the attitudes of state and federal regulatory officials who must evaluate utility proposals, especially with respect to elements on which the agency staff takes a position but are not controlled by definitive standards. At the local level, a utility must often take into account the ease of getting zoning variances or exemptions as well as other factors influencing the availability of land (such as the number of owners and their propensity to sell, or the likelihood of having to initiate eminent domain proceedings). Basically, this class of parameters reflects the fact that site selection affects the interests of people and must frequently anticipate the responses that are given to occur.

From this brief sketch of all the things that must be taken into account in siting, it should be clear that the choices to be made are not simple ones and that the task of evaluating large geographic areas in great detail is a potentially unmanageable one. Faced with the reality that difficult siting decisions must be reached in the presence of limited information and planning resources, utilities have reasoned that if acceptable sites can be found through a progressively intense process of elimination, there is no sense in analyzing potentially less desirable areas or sites where much more extensive study would be needed to demonstrate suitability. The underlying philosophy of search, then, has been to apply broad and rather conservative criteria to relatively few parameters in the early phases, saving the major thrust of the evaluation effort for more comprehensive and thorough analysis in the later phases. If this strategy does not yield a superior site, then less conservative criteria and a more detailed investigation of options previously rejected will be warranted.

Another important generic feature of the siting process (as described in the AIF study) is that not all factors are given equal weight at every stage. Indeed, although certain types of parameters are influential throughout the process, there are some which are important only at one or two points. Moreover, both the choice of factors and their priority apparently depend on the number of sites under consideration. When dealing with scores of potential sites the focus of attention seems limited to a few critical issues related to physical suitability for development. As the field begins to narrow, on the other hand, the emphasis shifts rather dramatically to those parameters which have a more direct bearing on the licensability of the remaining sites.

Trends can also be identified with respect to the nature of analysis in siting. As a general rule, the level of study detail increases as the field of candidates narrows, with on-site investigations usually necessary to supplement the information available through standard published sources (which provide the bulk of the siting data base). Correspondingly, the level of sophistication of evaluation normally increases from one stage to another. When the focus is on candidate areas, for example, factors tend to be assessed in absolute terms using simple, single valued criteria in the context of a <u>screening</u> approach. In the later stages, on the other hand, where the emphasis is on specific locations, acceptability is more likely to be defined in relative terms using <u>scoring</u> techniques to compare the merits of candidate sites, on either an informal or formal basis.

It is fairly obvious by now that the extent to which different considerations influence the outcome of site selection depends both on when and how those considerations are applied. Conversely, one might say that the fate of any given set of interests, e.g. coastal protection, is closely tied to how the siting process evolves in terms of what options are considered, what information is collected, what tradeoffs are made, and so on. One pivotal point, for example, occurs in the determination of candidate areas in which potential sites will eventually be identified. Clearly, if only coastal regions are brought forward for such reconnaissance, the question of inland siting becomes all but moot. Thus, protectors of the coastal zone have a very real stake in the structure of the process leading up to the identification of a preferred site. Realizing this, it is appropriate now to take a closer look at how environment-related factors tend to be factored into that process.

<u>Site Selection in Environmental Perspective</u>

There is little doubt that the objective of environmental protection has received a great deal of industry attention in recent years, and is playing a major role in the evaluation and choice of facility locations. But has the environment attained a status in the eyes of the utilities equal to that of their more traditional technical and economic concerns? One would hope that, at all stages of the siting process, the range of alternatives considered is sufficiently broad to offer real choices; that adequate information is available on the adverse as well as beneficial effects of each option; and that tradeoffs are highlighted in search of balanced and equitable courses of action--all things considered.

Unfortunately, I have come to the conclusion that such normative principles have not as yet been reflected in standard operating practice within the industry (such as can be determined from a review of both generic and specific sources). One important finding which supports this assertion concerns the relative role of environmental factors in the various stages of site selection. This is illustrated in Table 1, which I have constructed from data presented in the AIF report mentioned earlier. Note that, in general, environmental protection appears to play a much less significant role in determining candidate areas than it does later on in the process when individual sites are being evaluated. It is not uncommon, for example, for system configuration parameters such as generation-load match and proximity to transmission corridors to be the sole determinants of the areas to which the search for potential sites will be confined. And when such factors are not overriding, the most important considerations are generally high-cost engineering parameters such as condenser cooling, transportation access, and site preparation. The choice of a cooling system, of course, will reflect a utility's judgement as to what is necessary to meet effluent standards for thermal discharges. But aside from this, the only way environmental factors seem to affect the process at this early stage is in terms of avoiding obvious conflicts with publicly-owned lands.

The basic point here is that the traditional utility objectives of reliability and economy of service seem to dominate a substantial portion of the site selection process. Environmental considerations, though not ignored entirely, tend to receive systematic treatment only during the latter stages of the process. In determining potential sites, for example, only hydrology and general land use compatability seem to enter the picutre--and even then only in highly aggregated terms. One gets the distinct impression that utilities are confident that, if particularly sensitive areas are avoided from the beginning, all other problems of an environmental nature can be dealt with adequately through appropriate engineering design. Detailed impact investigations, then, can wait until after a preferred site has been identified, since they are needed only to confirm that no major impacts have been overlooked and to provide guidance on specific design choices.

The efficacy of this apparent tendency to postpone systematic attention to environmental considerations is, in my mind, highly questionable. As more plants are built and the better sites occupied, tradeoffs with the environment are becoming increasingly acute and impacts are getting more difficult and costly to design

TABLE 1

ROLE OF VARIOUS FACTORS IN SITE SELECTION

PARAMETERS AFFECTING SITING	ROLE IN DETERMINING: CANDIDATE AREAS	CANDIDATE SITES	PREFERRED SITES
A. SYSTEM CONFIGURATION			
1. Territorial Responsibilities with regard to Franchise Agreements and Projected Economic Growth	x		
2. Generation-Load Match (Geographic)	x	x	
3. Coordination with Transmission Plan:	x	x	x
4. Coordination with Generation Expansion Plan (size, type, # of units to be placed on site)	x	x	
B. ENGINEERING DESIGN			
1. Water Supply[1]	x	x	x
2. Access	x	x	x
3. Soils	x	x	x
4. Topography		x	x
5. Geology/Seismicity	x	x	
6. Flood Conditions	x	x	
7. Construction Materials and Labor Force		x	x
8. Facility Layouts and Specific Design Features		x	x

[1] Including emergency makeup water for nuclear facilities

Source: Reference 10

TABLE 1 (cont'd)

PARAMETERS AFFECTING SITING	ROLE IN DETERMINING: CANDIDATE AREAS	CANDIDATE SITES	PREFERRED SITES
C. ENVIRONMENTAL PROTECTION			
1. Dedicated Lands and Other Sensitive Areas	x		
2. Local Area Profile and Special Features[2]		x	x
3. Esthetics		x	x
4. Hydrology	x	x	x
5. Water Quality		x	x
6. Ecological Communities		x	x
7. Meterology/Climatology		x	x
8. Air Quality		x	x
9. Noise			x
10. Population Density/Distribution	x	x	
D. INSTITUTIONAL/POLITICAL			
1. Demography[3]		x	x
2. Socio-Economic Status		x	x
3. Public Attitudes		x	x
4. Land Availability[4]	x	x	x

[2] Including compatability with surrounding activities (e.g. recreation) and site characteristics (e.g. historical/archaelogical site)

[3] Includes size, composition, education and affluence of the populace

[4] Includes both ownership and state/local land use regulations (e.g. zoning)

around.* And not all impacts are amenable to mitigation in the 'technical fix' sense, the socio-economic and other effects associated with land use being a good case in point. Another reason it seems unwarranted to limit the analysis of environmental tradeoffs to the final stages of planning is that by that time the utility may be reluctant, understandably, to back up and perform more detailed study of alternatives previously rejected. The options are thereby confined to making expensive design changes or inadequately mitigating the adverse effect--a difficult and often controversial judgement to make.

It is, of course, unreasonable to expect utilities to perform detailed impact analysis over wide areas or large numbers of sites. Nor is it realistic to believe that there is an obviously superior siting procedure which, if scrupulously followed, will lead to the identification of an 'optimum' location. But saying that the process will never be without imperfection does not mean that it cannot be improved in important ways. It seems reasonable to suggest, for example, that some attempt be made to assess more fully the environmental implications of alternative candidate areas,whose selection has heretofore been governed primarily by engineering and system-related parameters. But there is no a priori reason for such considerations to be controlling. The question of proximity to a major water source, for example, can be highly subjective insofar as water for closed-cycle cooling systems can be transported considerable distances inland via pipeline. This represents a tradeoff in relation to once-through systems, to be sure, but certainly not an absolute constraint.

In a similar vein, one might also wonder why generation-to-load match is often treated as an overriding consideration when high voltage transmission technology allows power to be moved over much greater distances with smaller losses today than in the past. Another key choice made at an early stage, often without the benefit of any assessment of its environmental implications relative to alternatives, is the number of plants to be placed at a given site. The range of site choices can also be narrowed by the fact that site selection usually takes place subsequent to capacity planning, where the choice of fuel is made. This immediately rules out a whole class of options despite the fact that sites suitable for certain plant types may be less susceptible to environmental damage than others.

In general, it seems legitimate to question the appropriateness of allowing _any_ parameter to delineate the scope of future study without making some kind of attempt to assess the environmental consequences and lost opportunities that could be associated with such a decision. This applies, by the way, not only to technical and economic considerations but also to a variety of legal, institutional, and political factors which have a bearing on site selection. It is quite striking, for example, how seriously constrained the region of

* There is an interesting parallel here, by the way, with the criticism John Kemeny made recently in the wake of the Three Mile Island incident, to the effect that the nuclear industry has placed undue reliance on "fail-safe" equipment as a means of preventing major reactor accidents.

interest for siting purposes can be as a result of such items as the size of a service area, pooling and franchise agreements, and laws prohibiting investment (after a point) in out-of-state facilities. One cannot help but wonder to what extent tradeoffs with the environment (and even economics) are predetermined by these relatively 'artificial' delineations of a broad region. Still another aspect of site selection that one senses could have an enormous influence on the resulting incidence of impacts is community acceptance at both the local and regional levels. Utilities are very sensitive to public attitudes by the time candidate sites emerge, and the choices made from that point on are sometimes based as much on the politics of land use as they are on more substantive grounds.

A final point worthy of note here concerns the use of analytical methods in the evaluation of impacts and the relative merits of alternative courses of action. Such techniques play a key role in the siting process, but they also harbor considerable potential to obscure--rather than highlight--tradeoffs from the environmental standpoint. Screening methods, for example, usually lose information on differential effects altogether, and rating schemes can do the same when undue emphasis is placed (as it often is) on the composite scope. These are more subtle determinants of the priority ultimately assigned to environmental parameters, but they deserve an equal amount of scrutiny to guard against the sort of systematic planning distortion that can easily result from inappropriate methodological practices.

<u>Implications for Coastal Zone Management</u>

To some these observations may be taken as a clear indication that utility planning practices are inherently biased, an allegation long made by citizen activists and even some regulatory officials. The Region I Director of the EPA, for example, was quoted earlier this year as saying that power companies are making site decisions without concern for environmental factors,[14] a statement motivated in all probability by the agency's negative experiences in the Seabrook case. This, of course, is a rather extreme view to which industry officials would object in the most strenuous terms, and for good reason considering the thousands of man-hours and millions of dollars devoted to compliance with environmental protection requirements. In fairness to the industry, it must also be said that many companies <u>have</u> responded in good faith to environmental concerns, and others would probably go farther than they have were it not for certain legal and regulatory constraints. Site planners might well be inclined, for example, to devote more resources to environmental surveys in the earlier phases of the process were it not for the fact that they are required to study every last detail of the proposed site to the nth degree!

Still, the fact remains that environmental factors are not being considered on an equal footing with other planning dimensions <u>throughout</u> the planning process, and as a result one can hardly be confident that all issues of public concern (e.g. coastal avoidance) will receive the attention--and deference--they deserve. Let me hasten to point out that the basic problem, in my opinion, is not really one of bad faith on the part of the utilities, who as corporate entities can hardly be faulted for emphasizing the interests of their customers and shareholders. To do otherwise could even border on irresponsibility in view of their legislated mandate to 'provide power to all who demand it at the lowest reasonable cost' (a phrase appearing in most utility charters). What should really be at issue, then, is not the altogether reasonable inclination of the electricity industry to act in accordance with the objectives of economy and reliability of service. We should be concerned instead with the adequacy of the system of checks and balances historically relied upon to ensure that planning determinations made by the utilities are acceptable from the public interest standpoint as well.

It should be recalled at this point that siting decisions are not the sole domain of the utilities, at least in principle; they are shared with government by virtue of the fact that power plants must secure construction and operating licenses from a variety of federal, state, and local agencies. But, unfortunately, there is reason to believe that the imperfections noted in utility planning are essentially uncorrectable in the arena of public sector regulation (as presently constituted). Without going into detail,[15] let me say only that the basis for this contention is that the governmental role in electricity decision-making has traditionally been limited to eleventh-hour review of utility proposals on a case-by-case basis, and has been diffused across a multitude of special purpose and largely uncoordinated permit-granting agencies. What we have, really, is a system that licenses power plants but does not truly regulate the power planning process in any coherent way. Fragmented over topic and, especially, decoupled from the planning process over time, regulators are in no position to consider all relevant tradeoffs and ensure that desirable siting policies are being pursued. Rather, they can do little more than focus on narrow issues (e.g. mitigation of impact X, Y, or Z), leaving resolution of the larger matters of societal concern (e.g. inland vs. coastal siting) to the discretion of the utilities themselves.

Such de facto delegation of policy-making responsibility, clearly, has some worrisome implications from the standpoint of coastal zone management. Indeed the fact that utilities have been operating in a relatively 'loose' regulatory context with regard to site selection may well represent the weakest link in the institutional chain that connects coastal zone and electricity facility planning. What this suggests to me is that, as we proceed to fashion strategies for dealing with power plant siting within the CZM framework, at least as much attention should be devoted to the question of how to strengthen the interface between government and the utilities as is given to that of how to define interrelationships among the various specialized units within government. To date there has been a decided preoccupation with the latter line of inquiry, and should this continue I see nothing but increased frustration ahead for those who attempt to fashion a coherent strategy of power plant siting in the coastal zone.

In closing, let me point out that attempts are being made in some sectors to improve regulatory effectiveness with respect to site selection. The Nuclear Regulatory Commission, for example, has been quite active of late in changing its site evaluation procedures,[16] and major coastal states such as Maryland, Massachusetts, Minnesota and California are pioneering new strategies of government involvement in the siting process. In-depth analysis of the results of such experimentation would be the logical starting point for a program of research aimed at identifying institutional innovations with promise and the potential for broad applicability. Such an effort is sorely needed if we are to ensure the successful implementation of the energy planning requirements in the CZM legislation.

Footnotes

1. Clark and Brownell, Electric Power Plants in the Coastal Zone: Environmental Issues, American Littoral Society Special Publication, No. 7 (October, 1973).

2. Bishop and Vogel, "Power Plant Siting on Wisconsin's Coasts: A Case Study of a Displaceable Use", 3 Coastal Zone Management Journal 363 (1977).

3. 16 U.S.C. 1451, et seq.

4. P.L. 92-583, as amended, section 305 (b)(8).

5. Id., section 306 (c)(8).

6. Id., section 308 (c).

7. See press release entitled "Detailed Fact Sheet for New Initiatives, The President's Second Message on the Environment", issued at the White House on August 2, 1979.

8. Southern States Energy Board, Energy Facility Siting in the United States, volumes I and II (February, 1978).

9. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, "Coastal Zone Management Program, Development and Approval Provisions", Federal Register, vol. 44, no. 61, pp. 18595-18623 (March 28, 1979).

10. See D. W. Ducsik, Electricity Planning and the Environment: Toward a New Role for Government in the Decision Process, Ph.D. dissertation, MIT Department of Civil Engineering (January, 1978).

11. See, e.g. Nagel and Vasseld, "Power Plant Siting Requirements", Planning, volume 39, no. 2, at 24 (February, 1973).

12. See, e.g., L. P. Beer, "Quantification of Siting Factors for Rational Selection of Alternative Sites", Transactions of the American Nuclear Society, vol. 19, suppl. 1 (August 25-28, 1974).

13. Atomic Industrial Forum, Nuclear Power Plant Siting--A Generalized Process, prepared by Commonwealth Associates, Inc. (August, 1974).

14. See "N-Plant Site Risk", Associated Press article appearing in the Worcester (Mass.) Telegram (January 18, 1979).

15. A detailed discussion of the inadequacies of governmental regulation is included in Ducsik, Electricity Planning and the Environment, op.cit. note 10 supra.

16. U. S. Nuclear Regulatory Commission, "Evaluation of Alternative Sites for Nuclear Gnerating Stations Under NEPA", SECY-79-481, proposed amendments to 10 CFR Part 51 (August 10, 1979).

SOCIAL CONTROL OF NEARSHORE OIL DISASTERS

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NO ABSTRACT SUBMITTED

PART XI

SHORELAND PROTECTION & RESOURCES USES II

Moderator: Karl Nordstrom

THE EFFECTIVENESS OF COASTAL STRUCTURES AT SELECTED MASSACHUSETTS SITES

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Benno M. Brennenkmeyer, S.J.[3]

ABSTRACT

In light of severe damages to many coastal structures during the storm of February 6 and 7, 1978, several areas were studied to evaluate the effectiveness of these structures and the reasonability of rebuilding them. The areas studies were Ocean Bluffs, Brant Rock, White Horse Beach, State Point, Manomet Beach, Ship Pond, and Oak Bluffs, Massachusetts. The study entailed developing present day baseline conditions with historic data, and simulation of the overall sediment transport budget within seven areas. The baseline studies consisted of beach profiles, sediment size analysis, wave heights, and current measurements. The profiles were then compared with previous surveys and volumetric erosion and accretion rates calculated. Simulation of currents, wave conditions and sediment transport quantities were then prepared.

The results show the areas can best be categorized as those with multiple structures, i.e. groins and seawalls, or single structures, i.e. only groins. In the two areas where only groins were present, the results were distinctively different. The eleven groins at White Horse Beach appear to be working effectively: widening the beach while not causing substantial downdrift erosion. The single groin at Ship Pond, however, caused severe downdrift erosion.

At the five field sites with multiple structures the adverse impacts on the area resulted from the seawall and revetments, not from the groins. The seawalls and revetments increased erosion due to wave reflection while decreasing the sediment supply. In the presence of seawalls and revetments the groins are unable to work effectively, and only serve to aggravate the erosion problems.

In light of these results, multiple types of coastal structures do not necessarily work in concert. Therefore, the effects of their interaction should be taken into account in planning shore protection.

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IMPROPER RESOURCE MANAGEMENT OF THE POPPONESSET BARRIER SPIT SYSTEM
Cape Cod, Massachusetts

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ABSTRACT

Residential development along the top of the eroding coastal banks updrift of the Popponesset Barrier Spit precluded the need to structurally stabilize the banks. The subsequent construction of nine groins and armorment of the coastal bank face eliminated an essential source of sand to the barrier spit system. Unable to maintain its dynamic equilibrium the spit has migrated landward over 200 feet in the past 20 years.

INTRODUCTION

Popponesset Spit is a NE-SW trending transgressive baymouth barrier spit located on the south shore of Cape Cod in the town of Mashpee (Fig. 1). Except for a narrow inlet at its northeastern end, the spit separates Popponesset Bay from Nantucket Sound. Oblique wave approach has established a west to east long shore drift within this region of the Sound. The eroding coastal banks to the west of the spit are composed of Pleistocene kame deposits and have been the historic source of sediment to the littoral system.

Residential development began along the top of the eroding coastal banks during the late 1930's and proceeded rapidly for the next 20 years.

DISCUSSION

Prior to 1950 the relative shoreline position of Popponesset Spit remained stable as the landform elongated in a northeasterly direction. An uninterrupted source of sediment to the system, supplied by the eroding kame deposits updrift of the spit, caused the spit to increase in length by over 3,000 feet between the years 1893 and 1944 (Fig. 2).

Throughout its geomorphic history the spit has consisted of a low-relief profile of sparsely vegetated dunes. This low-relief topography has caused the spit to be susceptible to severe overwash events during periods of high storm surge. The barrier has actuall been breached and temporary inlets formed on several occasions during overwash events. One such breach occurred prior to 1894 and resulted in the formation of what is known today as Big Thatch Island (Fig. 2). It appears as though the available supply of sedi ment in the longshore transport system was sufficient to quickly cl

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Figure 1. Location of Study Site

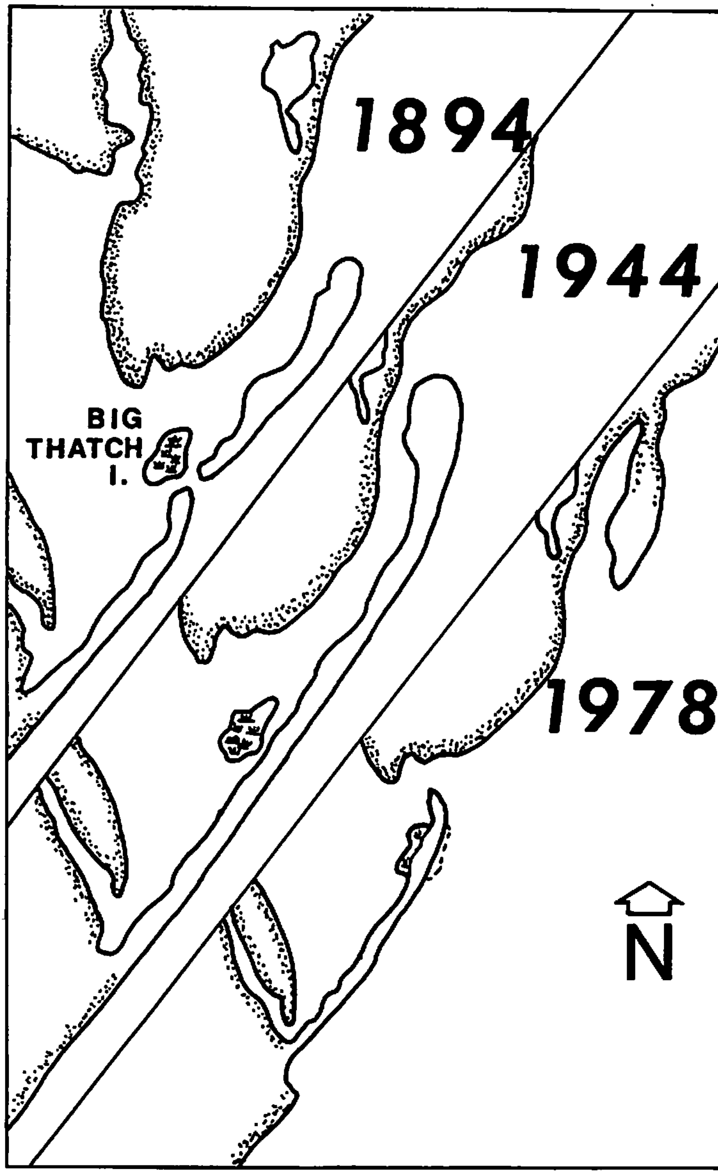

Figure 2. Shoreline Change 1894-1978

the inlets and thus each breach inlet formation cycle was short-lived.

Although residential development increased along the top of the coastal banks during the 1940's, little or no structural stabilization of the shoreline had taken place. As the eroding coastal banks continued to encroach on the newly constructed homes thoughts were turned toward securing the shoreline. Attempts to halt the retreating banks began in 1950 with construction of four (4) 120 foot long stone groins. These were the first of nine (9) groins which now exist updrift of Popponesset Spit. As the groins obstructed the longshore movement of sand the coastal banks continued to retreat. Further attempts were made to halt the coastal banks by armoring their face with massive stone revetments.

The effect of eliminating the source of sediment which had maintained Popponesset Spit as an effective natural barrier was realized following a breach of the barrier spit which occurred sometime between 1960 and 1963. As mentioned previously, the barrier spit system would recover quickly from a breaching event. This event, however, was different. The supply of sediment had been so depleted that this new inlet did not close and the entire northern half of the spit became detached. The detached end began migrating to the northeast and eventually welded itself to the downdrift shoreline.

A second impact to the barrier, attributed to the depleted sediment supply, was the landward retreat of the spit. Washover events persistently moved sediment from the beach face to the bay side of the spit and no longer having its natural replenishment the entire spit has migrated landward as much as 200 feet. The retreat has been so severe that the spit has overtaken Big Thatch Island to the extent that saltmarsh peat is exposed on the seaward edge of the spit (Fig. 2).

CONCLUSIONS

The impact of complete structural stabilization and armorment of the eroding coastal banks is apparent in the past 20-year geomorphic development of the Popponesset Spit system. From the time the natural littoral system was disrupted and sediment supply was all but eliminated, the spit has decreased to less than 4,000 feet in length, retreated landward some 200 feet, and has been lowered in an average elevation. In the past year broad overwash events have devoid much of the spit of vegetation and have created numerous breaches in the narrow dune line. The protective function of the barrier spit is now all but lost.

There is little doubt that had proper management of the resources been utilized, Popponesset Spit would not be in the critical situation it is now. Failure to consider the role of coastal processes when designing the coastal structures has resulted in a definite adverse impact to the entire spit system.

Massachusetts has taken one of the most ambitious positions in the country on managing its coastal resources. With the implementation of Coastal Regulations on August 10, 1978, engineered shoreline erosion control structures and new home construction within 100 feet landward of the top of eroding coastal banks now come under close scrutiny by the Massachusetts Department of Environmental Quality Engineering. Regulating construction activities within the coastal zone and placing rigid performance standards on such work will prevent the reoccurrence of problems such as those which now exist at Popponesset Spit.

SHORE PROTECTION STRUCTURES: EFFECTS ON RECESSION RATES AND BEACHES FROM THE 1870'S TO THE 1970'S ALONG THE OHIO SHORE OF LAKE ERIE

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The mainland Ohio shore of Lake Erie is made up of about 80 km of rock, 140 km of till, and 80 km of post-till sediment. Long-term recession rates of 1 m/yr are common in the till and post-till sediment. Because of these non-resistant shore deposits, structures (largely groins and seawalls) have been built to protect the shore; within the past 100 years, the number of shore protection structures has increased from about 60 to about 3600. With this increase in structures there has been a decrease in recession rates and a decrease in beach widths. For example, in the 1976-1937 period, 57 percent of the shore receded at less than 0.3 m/yr, whereas in the 1937-1973 period, 66 percent of the shore receded at this rate. And in 1876, beaches greater than 15 m wide fronted 23 percent of the shore, whereas in 1968 (at a lower lake level), beaches greater than 15 m wide fronted 13 percent of the shore. Assuming that the character of physical processes such as lake levels and winds has been about the same through time then the decreases in recession rates and beach widths are due to the structures. The structures by directly protecting the shore, have reduced recession rates; beach widths have decreased because the shore is the main source of sand.

Coastal Wetland Regulations Based on Biological Coastal Processes

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Abstract

The implementation of the Massachusetts Coastal Zone Management Program is based on the improved administration of existing state laws. This has included writing regulations for the Wetlands Protection Act to provide standards for evaluating activities occurring in or near a coastal wetland area.

For the purposes of the Act, the coastal environment is separated into various resource areas, seven of which are essential to the statutory public interests of protection of marine fisheries and land containing shellfish. These resource areas are: land under the ocean/estuaries, tidal flats, rocky intertidal shores, salt marshes, land under salt ponds, and land containing shellfish and anadromous fish runs. The initial step in the process of developing regulations was to identify certain physical, chemical, and biological characteristics that appeared essential in maintaining biological productivity. These characteristics included: water circulation, water quality, substrate relief and texture and specific plant or animal assemblages. For example, in salt marshes, the specific plant assemblage (growth, composition and distribution of salt marsh vegetation) and water circulation, (the flow and level of tidal and fresh water) were the characteristics identified as most critical to maintaining biological productivity. These characteristics were protected by performance standards which would prevent significant alterations in the growth, distribution and composition of the salt marsh.

These regulations have provided standards for evaluating activities in various coastal wetlands that will help maintain the biological productivity of these resource areas.

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INTRODUCTION

The management of coastal wetland resources must address a variety of issues, not the least being the wide natural variation in the amount and quality of wetlands. Massachusetts has recently developed a management program that considers not only this natural variability but also the short and long term impacts of activities in or near coastal wetlands.

The implementation of the Massachusetts Coastal Zone Management Program included writing regulations for the state Wetland Protection Act. Although administrative regulations were in place for this law, no regulatory standards or criteria existed to evaluate activities occurring in or near a coastal wetland. In addition, the law is administered at the local level; the state only establishes regulations and reviews cases on appeal. As a result, with 78 separate coastal towns, one could see various interpretations of the law in terms of assessing wetland impacts. The problems with this were obvious: the system lacked predictability and consistency and made the job of adequately protecting wetlands difficult. Addressing these concerns meant developing a methodology which could identify and protect significant coastal wetlands and be administered by local authorities.

The Massachusetts Wetlands Protection Law

The Massachusetts Wetlands ProtectionAct (c. 131, s 40) requires that any person who desires to remove, fill, dredge or alter coastal wetlands, floodplains, dunes or beaches, must have the project reviewed and approved by the town conservation commission before work can begin.

The law protects seven public interests: protection of public and private water supplies, the protection of groundwater supply, flood control, the prevention of storm damage, the prevention of pollution and the protection of fish and shellfisheries. The law requires a case-by-case determination of the significance of a particular wetland. If the wetland is deemed to be significant to one or more of the statutory interests, then conditions can be imposed on the activity.

For the purposes of the Massachusetts Wetlands Protection Act, the coastal environment is separated into 11 various wetland or resource areas, several of which are essential to the statutory interests of protection of marine fisheries and land containing shellfish. These wetland areas are:

> "Land Under the Ocean" - land extending from the mean low water line seaward to the boundary of the municipality's jurisdiction and includes land under estuaries.
>
> "Tidal Flats" - any nearly level part of a coastal beach which usually extends from the mean low water line landward to the more steeply sloping face of the coastal beach or which may be separated from the beach by land under the ocean.

"Rocky Intertidal Shores" - naturally occurring rocky areas, such as bedrock or boulder-strewn areas between the mean high water line and the mean low water line.

"Salt Marshes" - coastal wetland that extends landward up to the highest high tide line; that is, the highest spring tide of the year, and is characterized by plants that are well-adapted to, or prefer living in saline soils.

"Land Under Salt Ponds" - a shallow, enclosed or semi-enclosed body of saline water that may be partially or totally restricted by barrier beach formation.

"Land Containing Shellfish" - land under the ocean, tidal flats, rocky intertidal shores, salt marshes, and land under salt ponds when any such land contains certain species of shellfish.

"Anadromous Fish Runs" - that area within estuaries, ponds, streams, creeks, rivers, lakes or coastal waters, which is a spawning or feeding ground or passageway for anadromous or catadromous fish.

APPROACH

The various coastal wetlands that may be significant to the statutory public interests obviously differ in respect to both faunal and floral composition and/or physical characteristics. However, despite this variation, all of these wetlands contribute to maintaining the biological productivity of the coastal ecosystem which is essential in protecting the fisheries and shellfisheries.

The regulations are based on how a wetland resource area functions in terms of biological processes and how these functions help protect the statutory interests.

The initial step in the process of developing regulations required the identification of certain physical, chemical and biological characteristics of the various wetlands that appear critical in maintaining biological productivity. The characteristics which may be common to one or more of the wetland areas included: water circulation, water quality, substrate relief and texture and specific plant or animal assemblages.

Having defined these characteristics, standards were developed to protect the specific resource areas. Numerical criteria were not utilized in these standards because we felt wetlands research has generally not progressed to the point where all wetlands could be categorically evaluated according to physical classification, type or location.

For the first time in Massachusetts, these regulations have provided standards to evaluate activities in coastal wetlands. They are intended to ensure that development along the coastline is located, designed, built and maintained in a manner that protects the public interests. They have not necessarily eliminated the debate over the significance of certain resources nor the need for additional studies to help address this same question. They have, however, focused the evaluation and decision-making process on the characteristics of a wetland that are critical in protecting the statutory interests.

EXAMPLES

Regulations for Salt Marshes

Salt marshes are characterized by high fertility which is due primarily to the physical and biological characteristics that are unique to tidal marshes. Periodic tidal flushing helps ensure the high productivity of these marshes by providing a continued source of plant nutrient material. The plant life which flourishes in the marshes periodically dies and enters the estuarine food chain through tidal export in the form of particulate detritus or dissolved nutrients. This material serves as a valuable food source for organisms which are a critical link between detritus production and higher consumers.

To develop regulations, the following critical characteristics of a salt marsh were identified as necessary to protect fish and shellfisheries:

1) the growth, composition and distribution of salt marsh vegetation;

2) the flow and level of tidal and fresh water.

Both critical characteristics were protected by regulations which prevent significant alterations in the productivity of the salt marsh. Alterations in the growth, distribution and composition of salt marsh vegetation are considered in evaluating adverse effects or productivity. Activities such as salt marsh haying, the construction of small, elevated walkways or the burial of pipelines and cables across a salt marsh are permitted.

Regulations for Anadromous Fish Runs

Anadromous fish are an important element within the coastal ecosystem of Massachusetts. These fish grow to maturity in the ocean and migrate to freshwater to spawn. The various species of fish often represent an important forage, as well as commercial and recreational resource.

The critical characteristics identified for fish runs were:

1) the anadromous fish species;

2) accessibility of spawning areas and migration routes;

3) the volume or rate of the water flow within the spawning or migration routes;

4) the spawning and nursery areas.

These characteristics were protected by prohibiting any project which either impedes or blocks the migration of fish (whether by constructing a physical barrier or significantly altering the flow of water) or reduces or eliminates spawning and nursery habitat.

ACKNOWLEDGEMENTS

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A comparison paper by Giese and Smith on the physical processes portion of the regulations is contained elsewhere in these proceedings.

PART XII

COASTAL MARINE RESOURCE DECISION-MAKING METHODOLOGY

Moderator: Marc Hershman

THE REGIONAL ECONOMIC AND ENVIRONMENTAL EFFECTS OF ALTERNATIVE DEVELOPMENT PROPOSALS IN THE OREGON COASTAL ZONE: AN APPLICATION OF INPUT-OUTPUT ANALYSIS

Bruce A. Weber and William J. Rompa*

ABSTRACT

An economic-environmental model is developed for a rural county in Oregon's coastal zone. An input-output model is used to describe economic linkages in the community and this model is linked with a model which specifies the relationships between each of the 24 economic sectors and 20 "environmental" sectors. The economic-environmental model is used to estimate the direct and indirect impacts of two alternative proposed uses of port land: a new plant for processing Pacific whiting and expansion of an existing tuna processing facility. Effects of these facilities on regional income and selected regional environmental emissions (atmospheric emissions, water-borne emissions, and solid waste) and resource requirements (water and energy) are estimated. While the direct effects on the economy are identical, the projects are found to have very different total economic and environmental impacts, due primarily to differences in local purchasing patterns of the two proposed projects. The paper concludes with suggestions for use of the model in comprehensive planning.

Increased public concern about environmental quality and increasing recognition of the inter-relatedness of the economy and the environment have led to a number of attempts in the past ten years to develop models which describe economic and environmental inter-relationships for small regional economies [Isard, et. al., 1972; Laurent and Hite, 1972; Roberts and Rettig, 1975; Muangkoe, 1978; Johnson and Bennett, 1979]. All of these studies construct input-output models to describe the relevant regional economy and use information about resource requirements and environmental emissions per dollar of sales to construct a model of the relationships between economic activity and the environment. Typically, they describe water use, water-borne emissions, air-borne emissions, and solid waste which result from changes in economic activity. Perhaps the major point which such models make is that all economic sectors have either direct and indirect linkages with almost every environmental sect

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Even if a given sector does not "pollute" directly, for example, by emitting carbon monoxide into the atmosphere, any expansion in that sector's activity will almost certainly have the effect of increasing carbon monoxide emissions because of that sector's economic relationship with sectors which do emit carbon monoxide.

In this paper, an economic-environmental model is developed for a rural county in the Oregon coastal zone. This model is then used to analyze the impact on the economy and environment of the county of two hypothetical proposals for the use of port lands: a new plant to process Pacific whiting (hake), and expansion of an existing tuna processing facility. The paper concludes with suggestions for use of the model in comprehensive planning.

An Economic-Environmental Model of Clatsop County, Oregon

Clatsop County is an open rural coastal economy which is heavily dependent for its economic vitality on three sectors: timber and wood products, the seafood industry, and tourism. Almost 85 percent of the business exports of the county (sales of county goods and services to those outside the county) are attributable to these three sectors, with over half of the total exports in the timber sector alone.

The model used to describe economic inter-relationships in this paper is based on the input-output model developed by Carroll and Stoevener (1978). Carroll and Stoevener constructed a 26-sector input-output model which identifies the buying and selling patterns of each of the sectors and the direct and indirect dollar impacts on each sector of a one dollar increase in the export sales of any given sector. In order to make this model conformable to the environmental-economic linkage model described in the next section, it was necessary to aggregate several of the sectors into a 24-sector input-output model. Table 1 summarizes the basic information about the county economy contained in the 24-sector input-output model: the value of total sales and of exports for each sector and the multiplier for each sector (which gives the direct and indirect economic given sector). From this table it is clear that the sectors which constitute the primary economic base of the county (wood processing and seafood processing) do not have very high multipliers.

Following Laurent and Hite (1972) and Roberts and Rettig (1975), environmental-economic linkages are specified in this model by a three-step process analagous to the steps in constructing an input-output model. A matrix which identifies the "transactions" between each economic sector and the environment is constructed. Previous models have emphasized water, air pollution, and solid waste impacts. The model developed in this paper considers energy impacts as well and builds upon an information base which is considerably more complete than that which was available to earlier researchers. The annual resource requirements (water and energy) and environmental emissions (atmospheric, water-borne, and solid waste) of each sector are identified and arrayed in a matrix with the 20 "environmental sectors" as rows and each of the economic sectors as columns. Element a_{ij} of this matrix specifies the j-th economic sector's annual emission of the i-th

TABLE 1

Economic Profile of Clatsop County, Oregon, 1977

Sector	Sales ($000)	Percent of Total Sales (%)	Exports ($000)	Percent of Total Exports (%)	Business Income Multiplier
1. Logging	39,451	6.0	29,392	8.4	2.42
2. Wood Processing	70,487	10.0	156,558	44.9	1.65
3. Paper Products	98,442	14.9			1.45
4. Fishermen	16,614	2.5	2,730	0.8	2.50
5. Seafood Processing	66,639	10.1	64,178	18.4	2.10
6. Fish Byproducts	3,533	0.5	a/	a/	1.74
7. Agriculture	4,372	0.7	2,416	0.7	2.56
8. Manufacturing	13,251	2.0	13,434	3.9	1.95
9. Lodging	6,115	0.9	4,953	1.4	2.41
10. Restaurants	16,042	2.4	6,986	2.0	2.57
11. Service Stations	28,611	4.3	4,823	1.4	1.38
12. Automotive	21,697	3.3	4,255	1.2	1.52
13. Transportation	21,699	3.3	19,542	5.6	2.26
14. Communication	13,460	2.0	2,134	0.6	1.46
15. Professional	12,997	2.0	5,954	1.7	2.75
16. Financial	8,628	1.3	2,434	0.7	3.02
17. Construction	29,136	4.4	4,340	1.2	2.52
18. Retail and Wholesale Products	110,776	16.8	7,878	2.3	1.52
19. Retail Services	20,212	3.1	6,408	1.8	2.73
20. Education	22,402	3.4	7,808	2.2	2.99
21. County Government	4,996	0.8	1,534	0.4	2.82
22. City Government	11,659	1.8	670	0.2	2.41
23. Federal & State Agencies in County	20,058	3.0	N/A	--	2.83
TOTAL	661,277	100.0	348,427	100.0	

a/ Included in Manufacturing

pollutant or requirement of the i-th resource. Resource requirements have a positive value and environmental emissions have a negative value in the matrix. On the premise that it is not unreasonable to assume a constant linear relationship between sales and pollutants (and resource requirements), a matrix of "direct environmental effects per dollar of sales" is constructed by dividing the elements in all columns of the "transactions" matrix by that column's annual sales.

The direct and indirect environmental effects of a one-dollar change in export sales can be estimated by postmultiplying the "direct environmental effects per dollar of sales" matrix by the direct and indirect coefficients matrix (the so-called Leontieff inverse matrix) of the input-output model. Table 2 presents the results of this manipulation for Clatsop County for three important sectors and the 20 environmental sectors.

THE IMPACT OF ALTERNATIVE INDUSTRIAL DEVELOPMENT PROPOSALS ON THE REGIONAL ECONOMY AND ENVIRONMENT

The models described in the previous section have some potential in the analysis of alternative development proposals. Such analysis might be useful in a situation in which a port district or other local government were faced with two industrial prospects wishing to purchase or lease land in the local industrial park. If the prospects each expected to generate the same amount of export sales, the local government might wish to know which firm would generate more income or jobs in the community or have less effect on certain critical public services or environmental amenities.

In this section of the paper, the models will be applied in analyzing the impacts of two hypothetical proposals for industrial plants on the regional economy and environment. The two proposals are for (1) a new plant to process Pacific whiting (hake), and (2) an expansion of an existing tuna processing plant. To make the impact comparisons easier to interpret, each plant is assumed to have the same annual export sales: $452,671. Although the proposals are hypothetical, they are based on survey information obtained from operators of existing whiting and tuna processing plants in Clatsop County, and thus are expected to reflect accurately the likely purchasing patterns and technology employed by any firms which might locate in the county.

The local purchasing pattern of each of the proposed plants is shown in Table 3. While there are many sectors where the alternative proposals have substantially different impacts, the primary differences show up in the commercial fishing sector and in the imports of the two plants. Local fishermen receive three times the income from the whiting plant than they would from the tuna plant and the tuna processor imports almost five times as much in dollar terms as the whiting plant. Clearly one would expect the whiting plant to have a greater local impact than the tuna plant, for the same dollar volume of exports.

TABLE 2. DIRECT AND INDIRECT ENVIRONMENTAL EFFECTS
PER DOLLAR OF FINAL DEMAND FOR SELECTED SECTORS
CLATSOP COUNTY

	ENVIRONMENTAL EFFECT	ECONOMIC SECTOR		
	RESOURCE REQUIREMENTS	PAPER PRODUCTS	SEAFOOD PROCESSING	LODGING
WATER	DOMESTIC WATER (Gals.)	1.33899	2.24204	20.16709
	COOLING WATER (Gals.)	.00158	.65885	.00197
	PROCESSING WATER (Gals.)	132.0629	4.58523	.01295
	TOTAL WATER INTAKE (Gals.)	133.4034	7.48611	20.18201
ENERGY	WOOD (Tons)	.00010	.00003	.00004
	GAS & DIESEL (Gals.)	.01308	.04438	.04077
	FUEL OIL (Gals.)	.06915	.01041	.47003
	NATURAL GAS (10^6 BTU)	.04193	.01918	.01156
	ELECTRICITY (KWH)	6.25739	.60896	3.59138
	ENVIRONMENTAL EMISSIONS			
ATMOSPHERIC	FINE PARTICULATES (Lbs.)	-.01031	-.00156	-.00170
	TOTAL PARTICULATES (Lbs.)	-.01087	-.00188	-.01288
	SULFUR OXIDES (Lbs.)	-.00231	-.00196	-.09214
	NITROGEN OXIDES (Lbs.)	-.01346	-.01181	-.03881
	CARBON MONOXIDE (Lbs.)	-.09942	-.05600	-.08374
	TOTAL ORGANICS (Lbs.)	-.00368	-.00912	-.01417
	OTHER INORGANICS (Lbs.)	-.00179	-	-
WATER	WATER DISCHARGE (Gals.)	-113.5193	-6.97938	-18.12791
	5 DAY BOD (Lbs.)	-.01554	-.00630	-.00630
	SUSPENDED SOLIDS (Lbs.)	-.09679	-.00478	-.00486
	SOLID WASTE (Cu. Yds.)	-.00185	-.00055	-.00165

TABLE 3 LOCAL EXPENDITURE PATTERNS OF PROPOSED WHITING PROCESSING PLANT AND EXPANDED TUNA PROCESSING PLANT

	Sector	Whiting Plant	Tuna Plant
4	COMMERCIAL FISHERMEN	$268,800	$71,658
5	SEAFOOD PROCESSING	-	5,432
8	MANUFACTURING (OTHER THAN WOOD PRODUCTS AND FISH PROCESSING)	-	8,329
9	LODGING	310	*
10	RESTAURANTS	310	*
11	SERVICE STATIONS	775	407
12	AUTOMOTIVE	-	181
13	TRANSPORTATION	9,920	724
14	COMMUNICATION	-	905
15	PROFESSIONAL SERVICES	1,550	136
16	FINANCIAL	-	45
17	CONSTRUCTION	-	45
18	RETAIL & WHOLESALE GOODS	13,020	13,309
19	RETAIL SERVICES	-	1,086
20	EDUCATION	-**	860**
21	TAXES/FEES TO CLATSOP COUNTY	2,583**	91**
22	CITY TAXES/FEES	3,720**	1,584**
23	HOUSEHOLDS	93,744	74,102
24	FEDERAL/STATE TAXES	1,705	8,012
	IMPORTS FROM OUTSIDE THE COUNTY	56,234	265,718
	TOTAL	$452,671	&452,671

* less than $25

** Since property taxes and fees are based on assessed value and generally factors other than sales, these coefficients are expected to be unreliable.

The estimated direct and indirect economic effects of the alternative projects is shown in Table 4. The additional \$452,671 annual sales outside the county from the expanded tuna processing operation would generate a total of \$952,556 income in the county (\$452,671 direct impact and \$499,885 indirect impact caused by the respending of the direct increase in income). The same amount of annual sales to outside the county by the new Pacific whiting processing facility would generate a total increase in county income of \$1,443,451 (\$452,671 direct impact and \$990,780 indirect impact). The difference is due primarily to the differences in spending patterns noted above. The whiting processor purchases almost exclusively from local fishermen as opposed to fishermen who have other home ports, and spends a much higher proportion of his total purchases hiring local household labor to work in the processing plant. Local respending of these incomes from the whiting plant results in sales by local businesses (Sector 9-19) being about twice what they would be under the tuna processing alternative. Total local household income is also almost twice as high under the whiting plant alternative. In short, indirect income increases generated by a given amount of increased exports are about twice as great for the whiting plant as for the tuna plant. This is perhaps most clearly seen by comparing the multipliers in the last row of Table 4. The multiplier for the tuna plant is 2.10, indicating that each dollar of export sales in the tuna processing sector generates an additional \$1.10 in local income. The multiplier of 3.19 of the whiting sector indicates that each dollar of export sales is estimated to generate an additional \$2.19 in local sales.

This additional local economic activity which is generated by the sales of the whiting plant is not an unmixed blessing. The greater economic linkages between the whiting plant and other sectors in the local economy means that the whiting plant may be expected to have a greater direct and indirect environmental effect as well, requiring more local resources and generating more emissions into the local environment. A complete comparison of the direct and indirect environmental effects of the two projects would require data on the direct resource requirements and environmental emissions of the Pacific whiting plant which were not available. A partial comparison of the environmental effects is found in Table 5. If one compares only indirect environmental effects (on the premise that direct environmental effects of the two types of fish processing plants can be assumed to be at least of the same order of magnitude) it is seen that the whiting plant has greater indirect impacts in all categories except two: cooling water and processing water. The indirect effects are consistently about twice as great for the whiting plant as they are for the tuna plant. In fact, for all types of atmospheric emissions and energy requirements (except natural gas) the indirect effects <u>alone</u> of the whiting plant exceed by considerable margins the direct <u>and</u> indirect effects of the tuna processing plant.

Knowledge about environmental effects, particularly when combined with information about the capacities of the local water, sewer and solid waste facilities, can assist local governments and industrial development committees in choosing among alternative projects or preparing for the impacts of industries which locate in a community.

TABLE 4 DIRECT AND INDIRECT ECONOMIC EFFECTS OF ALTERNATIVE INDUSTRIAL DEVELOPMENT PROJECTS

Sector	New Pacific Whiting Processing Plant	Expansion of Existing Tuna Processing Plant
DIRECT EFFECT	452,671	452,671
INDIRECT EFFECT		
1. Logging	31	19
2. Wood Processing	570	318
3. Paper Products	-	-
4. Fishermen	274,399	94,678
5. Seafood Processing	2,077	7,063
6. Fish Byproducts	-	-
7. Agriculture	2,078	1,483
8. Manufacturing	2,536	9,148
9. Lodging	1,989	941
10. Restaurants	14,398	7,613
11. Service Stations	43,420	20,959
12. Automotive	32,194	16,168
13. Transportation	11,898	1,619
14. Communication	17,069	10,173
15. Professional	13,415	6,116
16. Financial	10,166	5,079
17. Construction	24,485	13,085
18. Retail and Wholesale Goods	173,285	96,518
19. Retail Services	24,986	12,548
20. Education	11,572	8,282
21. County Government	6,882	2,569
22. City Government	13,996	7,881
23. Households	296,634	163,103
24. Federal and State Government	13,069	14,521
TOTAL	1,443,451	952,556
Multiplier	3.19	2.10

TABLE 5 ANNUAL ENVIRONMENTAL IMPACT OF ALTERNATIVE INDUSTRIAL DEVELOPMENT PROJECTS

		WHITING PLANT		TUNA PLANT	
RESOURCE REQUIREMENTS		Direct Impacts	Indirect Impacts	Direct Impacts	Indirect Impacts
WATER	DOMESTIC WATER (Gals)		1,834,776	22,041	992,864
	COOLING WATER (Gals)		1,428	293,611	4,629
	PROCESSING WATER (Gals)	*	9,538	2,043,624	31,975
	TOTAL WATER INTAKE (Gals)	*	1,845,743	2,359,276	1,029,468
ENERGY	WOOD (Tons)		15	-	14
	GAS & DIESEL (Gals)		49,600	-	20,088
	FUEL OIL (Gals)		5,462	1,059	3,653
	NATURAL GAS (10^6 BTU)		6,994	4,753	3,931
	ELECTRICITY (KWH)	*	311,276	102,851	172,808
ENVIRONMENTAL EMISSIONS					
ATMOSPHERIC	FINE PARTICULATES (lbs)		1,474	32	672
	TOTAL PARTICULATES (lbs)		1,761	32	818
	SULFUR OXIDES (lbs)		1,458	253	633
	NITROGEN OXIDES (lbs)		13,289	177	5,169
	CARBON MONOXIDE (lbs)		53,154	-	25,352
	TOTAL ORGANICS (lbs)		8,787	27	4,102
	OTHER INORGANICS (lbs)		-	-	-
WATER	WATER DISHCHARGE (Gals)	*	1,640,583	2,241,314	918,050
	5 DAY BOD (lbs)	*	569	2,508	344
	SUSPENDED SOLIDS (lbs)	*	439	1,901	263
	SOLID WASTE (cu. yds)	*	87	199	52

* Direct environmental effects expected to be significant.

Limitations of the Model

These models are, of course, not without limitations. Most serious are the assumptions of (1) linearity in both the economic and environmental systems, and (2) constant production (including waste treatment) technology. With respect to the economic system, these assumptions imply that firms and households have the same purchasing patterns (i.e., make the same percentages of their purchases from each sector) at all levels of sales and income and no matter how technology or prices change. With respect to the environmental system, the assumptions imply that firms and households will emit the same air, water and solid waste pollutants and require the same energy and water resources, given a change in sales (income), at all levels of sales (income) and no matter what happens to technology and prices. These limitations are probably more serious in the environmental system than the economic system although they are not insignificant in either system. To the extent that these models are used in analyzing short run changes or changes which do not affect the structure of the economy in any major way, the limitations are less serious. Use of the models in comprehensive planning should be made with these limitations in mind.

Making inferences from the Clatsop County model about environmental effects of economic changes in other regions should be done with extreme caution. The economic linkages in the input-output model and the technoligical relationships embedded in the economic-environmental matrices are specific to Clatsop County. Generalization from the Clatsop County model to other regions should not be done without careful study.

Another serious limitation of this model is that pollution in one part of a region is more serious than pollution in another location. The assimilative capacities of the air and water are quite different from one location to another. One fruitful attempt to address this problem is found in Johnson and Bennett (1979) who attempt to attach a water quality index to the economic-environmental model. This allows them to determine not only the amount of water pollution generated by a given project but its effect on water quality as well.

Economic-Environmental Models and Comprehensive Planning

Economic-environmental models such as the one developed in this paper have been used in two principal ways: (1) analysis of environmental and economic impacts of individual projects, as in this paper and in Isard et al. (1972) Johnson and Bennett (1979) and Roberts and Rettig (1975); (2) analysis of environmental impacts of a projected regional income increase, as in Laurent and Hite (1972) and Roberts and Rettig (1975). In the latter analysis, a long range income forecast is projected by sector to some distant future year and the environmental repercussions of such a forecast is projected. This latter use suggests a potential value of such models in comprehensive planning which, to our knowledge, remains untapped: the analysis of alternative growth scenarios.

Comprehensive planning, as practiced in Oregon at least, is an attempt to determine community goals and objectives and to devise public policies which direct a community towards its goals. A critical issue in the selection of goals is the "proper" mix of economic activity (jobs, income) and environmental quality. Planners are accustomed to developing "scenarios" which describe alternative levels and mixes of economic activity or alternative changes in the community economic base. The economic-environmental models could quite easily be used to assess the environmental impacts of alternative economic scenarios. This information could be used by a community, along with information about the environmental constraints and capacities of the water, sewer and solid waste systems, to select the economic scenario which most closely fits its needs and capabilities. Similarly, once a "most likely" or "most desirable" growth path is determined, the models can be helpful in planning for the public service and community facility needs associated with this growth path.

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The Networking Approach to Coastal Zone Management
Its Promise and It's Pitfalls

by

Earl H. Bradley, Jr.[1]

Abstract

Maryland's Coastal Zone Management Program was approved on September 30, 1978. The Program utilizes a networking approach to program implementation. This program basically entails (1) providing a unified policy framework to guide the activities of state and local governmental agencies concerned with coastal resources and activities; (2) providing technical and financial assistance to such agencies so that they can undertake their activities in a more effective manner; and, (3) promoting coordination among such agencies to ensure that they carry out their activities in a manner consistent with the Program's policies. The purpose of this paper is to discuss the strengths and weaknesses of the networking approach based on one year's experience of program implementation.

The strengths of the networking approach lie in its greater acceptability by state and local agencies, the avoidance of legislative struggles to pass comprehensive Coastal Zone Management legislation, and the ability to concentrate on pressing issues previously not adequately addressed by state and local governmental programs rather than being bogged down in the processing of routine permits.

The weaknesses of the Program lie in the difficulty of precisely defining the role of the administrative unit charged with ensuring the effective implementation of the Program in relation to ongoing state and local governmental programs which provide the regulatory base for Maryland's Coastal Zone Management Program.

Introduction

Maryland's Coastal Zone Management Program was approved on September 30, 1978. The extent of the program's coverage includes the tidal waters of the State and Baltimore City and the sixteen coastal counties bordering the Atlantic Ocean, the Chesapeake Bay and the Potomac River below Washington, D.C. The Program utilizes a networking approach to program implementation. This approach basically entails

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(1) providing a unified policy framework to guide the activities of state and local governmental agencies concerned with coastal resources and activities; (2) providing technical and financial assistance to such agencies so that they can undertake their activities in a more effective manner; and (3) promoting coordination among such agencies to ensure that they carry out their activities in a manner consistent with the Program's policies. The purpose of this paper is to discuss the strengths and weaknesses of this networking approach based on one year's experience of program implementation.

Development of Maryland's Coastal Zone Management Program through a Networking Approach

The State of Maryland adopted the networking approach to coastal zone management for several reasons. First, by the summer of 1974 when the State first received funding under the provisions of the Federal Coastal Zone Management Act, it has already established several programs aimed at the protection and orderly development of its coastal resources - a wetlands permit program, a waterways obstruction/construction permit program which covered the 100 year river floodplain, a sediment control program, a power plant siting program, a program for the acquisition of open space and recreation areas at the State and local levels, and a state water quality program. In addition, the 1974 legislative session enacted two additional pertinent pieces of legislation, a State Land Use Act which established a critical areas program and gave the State the right to intervene in any local land use decision of greater than local concern, and a Beach Erosion Control District Act which protects the State's Atlantic Coast beaches from encroachment. In addition, local governments all had developed comprehensive plans, zoning ordinances, and water and sewer plans. Thus, there was a reluctance at several levels to pass coastal zone management legislation which could be viewed as adding another layer of bureaucracy to the management of coastal resources.

There was felt a need to pass legislation to fill two gaps in the existing legislative framework. This recognition led to the passage of a Coastal Facilities Review Act in 1975 which provided a mechanism for regulating the siting of oil and natural gas and associated support facilities in Maryland's coastal counties and a Flood Control-Watershed Management Act in 1976 which provided a mechanism for coordinating state floodplain management efforts, the Federal flood insurance program and related efforts.

The main thrust of the program development efforts in Maryland was focused in three areas: first, on developing a set of goals and objectives relating to coastal resources and activities to provide unified policy framework for implementing State and local government programs dealing with coastal resources and activities; second, on providing technical and financial assistance to such programs to promote their effective implementation; and third, on promoting coordination among such programs to ensure that all relevant coastal resource issues were addressed in a manner consistent with the common set of goals and objectives.

Thus, much of the Coastal Zone Program development effort in Maryland was spent on identifying and obtaining agreement on a set of goals, objectives and policies pertaining to each coastal activity of concern based on existing laws and regulations and on developing an implementation mechanism to ensure that coastal resource-related programs were carried out in a manner consistent with the program's goals, objectives, and policies. An Executive Order was issued mandating that State agencies carry out their activities in a manner consistent with the goals, objectives, and policies of the program. Memoranda of Understanding between the Department of Natural Resources and other State agencies were agreed upon specifying the mechanisms that would be utilized by each agency to carry out the program, and a Secretarial Order was issued within the Department of Natural Resources to ensure consistency of Departmental actions. One unit within the Department of Natural Resources, the Coastal Zone Unit of the Energy and Coastal Zone Administration was given responsibility for acting as a catalyst to ensure that the program was effectively implemented. Two procedures were established to enable the Coastal Zone Unit to carry out its responsibility to ensure that all relevant coastal management issues are effectively addressed-project evaluation and program review.

The purpose of the project evaluation process is to ensure adequate review of projects in coastal areas by identifying and comprehensively evaluating those projects needing special attention because of their potential impact on coastal resources. Particular attention is focused in cases where existing information is inadequate to base management decisions and additional study is needed to insure that all relevant issues are adequately addressed.

The purpose of the program review process is to provide a means for reviewing existing programs and procedures dealing with coastal resources and activities for their consistency with the CZM Program. It is used to review the implications of proposed legislation affecting coastal resources, issuance of new or amended regulations, development or revision of state and regional plans and local comprehensive plans and zoning ordinances, and similar actions. The purpose of this review process is to create a forum in which all program participants - governmental agencies, special interest groups, and citizen organizations can define conflicts or inconsistencies between programs involving coastal resources, and make formal proposals for administrative or legislative remedies. The Coastal Zone Unit of DNR was given the responsibility for conducting these reviews in conjunction with other State agencies and local governments.

To provide a sound technical basis for implementation of Maryland's Coastal Zone Management Program, a number of technical studies were undertaken including the Tidal Wetlands Study, the Upland Natural Areas Study, the Historic Shoreline and Erosion Rates and the Shoreline Structures in Maryland: Their Location and Extent map portfolios, the Major Facilities Study, support of the Chesapeake Bay Earth Science Study, and flood-plain delineation efforts in conjunction with the State's flood-plain management program. The results of these studies are being used to improve the effectiveness of the management programs which provide the regulatory basis for the program. Such programs include the State's Wetlands Permit Program, Water Quality Programs, Critical Areas Program, and Flood Control-Watershed Management Program.

Actual Implementation of the Program

The remainder of this paper will be devoted to an analysis of how well the strategy developed for implementing the program has worked out. I believe that the program's first year of implementation had some difficulties but that a framework has been laid for more effective implementation of the program in future years. To a certain extent, many of the features of the program that give it much potential for success have pitfalls that need to be avoided if the program is to be truly successful.

Since the unit that has direct responsibility for implementing the program is not in a dictatorial position, considerable effort must be expended to define and evaluate the relationship of its activities to ongoing programs and permit actions. Within the permitting activities of the Department of Natural Resources, inhouse working relationships have been generally established and several positive contributions are being made both with regard to providing a better information base on which management decisions can be made and on resolving agency conflicts. For example, on a proposal regarding the siting of a marina financed by the State Waterways Improvement Program, a revised plan developed by the Unit reduced the adverse impact of the proposed marina on tidal wetlands while providing approximately as many recreational boating docking facilities. The Unit has also provided much needed expertise on recreational boating facility proposals to the State Wetlands Permit Program, developed State mooring buoy regulations, and has assisted one county and is assisting several others in revising their regulations dealing with the siting of marinas and other recreational boating facilities.

However, in some of its project evaluation efforts, the Coastal Zone Unit tried to address too many issues in a comprehensive fashion and as a result much of the information developed was not developed in a form or a timeframe useful to agencies making regulatory decisions on projects in the areas studied. As a result, more attention will be focused in coming years on narrowing the issues to be evaluated in project evaluations to those which can be analyzed in a timely manner to improve relevant regulatory decisions. In addition, some difficulty has been encountered in defining the areas in which Coastal Zone Unit can make positive contributions in plan formulation and project development over which other state agencies have the principal review and coordination responsibility such as State transportation facility and sewage treatment plant planning and construction.

The lack of legislatively mandated regulatory responsibility on the part of the Coastal Zone Unit for routine regulatory activities has allowed considerable flexibility on which aspects of coastal zone management will be given priority in the Unit's efforts. Much emphasis during the first year was placed on undertaking research efforts on subjects of coastal zone management interest, with the result that program review activities and intergovernmental coordination efforts were somewhat shortchanged. Greater attention will be paid to those latter subjects in the present year's work efforts due to an internal recognition of the need to do so. This was buttressed by comments made by the Federal Office of Coastal Zone Management during its first annual program review and the comments of the Program's advisory committee.

However, the lack of direct legislatively mandated regulatory responsibility referred to above has allowed a more cooperative arrangement to be developed with local governments. With pass-through funds provided by the program, the counties have worked hard to integrate coastal zone management concerns into their planning and regulatory activities. In the Baltimore Metropolitan area, a major effort was undertaken by the Coastal Zone Unit, other State agencies, the Regional Planning Council, and the local governments in the area to identify areas in their planning and regulatory activities needing attention. The purpose of this effort was to insure that coastal zone management concerns are adequately addressed at the local level by identifying issues of major concern and to develop implementation mechanisms to address such issues. Similar action on a less formal basis has been undertaken by other coastal counties.

The program has also suffered from a lack of visibility of its actions both in documenting the positive results of its actions and in establishing its proper relationship to other state agencies. This problem has been alleviated by a reorganization which transferred the Coastal Zone Unit into a new Tidewater Administration with the State Waterways Improvements Program and Tidal Fisheries Program plus State Boat Act Administration.

The Program has also received strong support and assistance from its advisory body, the Coastal Resources Advisory Committee. This Committee is made up of over 90 members representing local governments, citizen groups, industrial, commercial organizations, and other special interests. State and federal agencies and academic interests are represented on a non-voting basis. It has provided a means to obtain the support of these entities in the administration of the Program by providing a mechanism for their active participation in providing guidance both to the overall direction of the program and to specific studies and activities undertaken by the program.

Conclusion

Based on the experience provided by the first year of implementation of Maryland's Coastal Zone Management Program, it can be concluded that the networking approach provides the opportunity to concentrate on pressing issues previously not adequately addressed by state and local governmental programs. It also promotes a more cooperative approach to coastal zone management, encouraging greater willingness of state and local agencies to participate in the program since their present authorities are not threatened. However, to make a networking approach work, a strong base of relevant coastal resource management laws needs to exist and major efforts are needed in three areas. These are in (1) establishing effective coordinative mechanisms; (2) establishing support for the program by other state agencies, local governments, citizen organizations and special interests; and (3) defining the areas in which the program can effectively supplement existing activities to accomplish more effective management of coastal resources and activities.

In the case of Maryland, the State, as noted above, has a strong framework of regulatory programs on which to base its coastal zone management efforts and will be working in the coming years to refine its coordinative mechanisms, better define its areas of emphasis, and increase supportfor its activities from other agencies and organizations. Once these actions have been accomplished, the program will better fulfill its objectives of more effective management of its coastal resources.

MODELING THE EFFECTS OF HUMAN ACTIVITIES ON THE COASTAL ZONE

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ABSTRACT

Environmental changes resulting from human activities, such as the operation of power plants, sewage discharges and other industrial effluents in the coastal zone can affect a variety of physical and chemical parameters in the receiving waterbody. Mathematical models like the one described in this paper provide a means of predicting and evaluating the effects of proposed and existing projects on important physico-chemical parameters in the coastal zone.

The model applied here is a three-dimensional steady state model capable of predicting the spatial distribution of temperature, carbonaceous BOD, nitrogenous BOD, dissolved oxygen and any conservative substance such as salt. The current version of the model originated from modifications and extensions to a two-dimensional model developed by Mississippi State University. The model is based on the principles of conservation and is solved numerically using a control volume scheme.

Following a description of the formulation of the model, an example application involving prediction of temperature profiles in Barnegat Bay, New Jersey is presented. In the Barnegat Bay study, the model was applied in two dimensions (lateral and longitudinal) in order to predict the temperature and salinity throughout Barnegat Bay under various environmental and power plant conditions.

The model was calibrated with existing dye data and then applied to predict the effects that existing and proposed power plant operations will have on the distributions of temperature and salinity in the Bay. Tidally-averaged hydrodynamics derived from wind-induced currents and the freshwater flow were input to the model. Ambient temperature and salinity profiles were computed from the results of field measurements conducted by various investigators.

EVALUATION OF COASTAL ZONE MANAGEMENT NETWORKS BASED ON THE CONCEPTS OF ORGANIZATIONAL THEORY

Paul D. Marr*

ABSTRACT. State coastal zone management programs are required by the Federal Coastal Zone Management Act of 1972 to involve federal and local governments, state agencies and regional commissions in program development and operations. This heavy reliance on liaison and on existing laws and derivative regulations is referred to as the network system. Network systems have become integral parts of most state coastal management programs but the networks can be subjected to considerable interorganizational pressure. This can have an adverse effect on the long term operations of coastal programs. In this study the state networks are examined using the general concepts of organizational theory and more specifically the literature of intergovernmental and interagency relations. This paper also provides a discussion of the basic elements of coastal management organizations which can be examined in detail or as a working unit for the purpose of assessing the effectiveness of state coastal management operations.

The states participating in the Coastal Zone Management Act (CZMA) of 1972 were given great flexibility in designing their respective management programs. The CZMA does have several programmatic requirements but the most pertinent with reference to this paper request that states:

1) Involve federal and local governments, state agencies, regional commissions and private interests in program development and operations[1]
2) Designate a single responsible agency to implement the program,[2] and
3) Assure the adequacy of governmental processes in dealing with program objectives.[3]

A significant constraint for state coastal programs is the modest level of federal funding compared to other federal programs affecting

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the coastal zone, such as the Federal Water Pollution Control Act and the civil works operations of the Corps of Engineers. The comparatively low level of funding combined with its emergence after related environmental and resource programs were becoming well established resulted in coastal zone management programs that are lean of staff and lean of constituency, both within and out of government.

The requirement for broad liaison and the constraints of funds and staff led to the implementation of state programs with a heavy dependence on existing laws, and interagency and intergovernmental cooperative relations. This dependence on pre-existing law, derivative regulations and interagency relations is referred to as a network system. The network system is an acceptable if not necessary part of state coastal management programs, but it must be initiated and continue to operate within the context of pre-existing governmental activity. The programmatic constraints of lean budgets, staff and constituencies provide only minimal resources for an organization dependent on an intergovernmental and interagency network for its basic mode of operation. These conditions can eventually result in severe stress for a network system thereby reducing its effectiveness and stability.

This paper examines coastal zone management networks based on the broad concepts of organizational theory and more specifically on the literature of intergovernmental and interagency relations. The paper is written primarily from the viewpoint of a state coastal zone management program and can be used as a preliminary formulation of a model for coastal management operations and a basis for analyzing the effectiveness of coastal management networks.

Application of Organizational Theory to Coastal Zone Management and Networks

The principle elements of organizational theory focus on domain, process and structure. Each is discussed with reference to the intergovernmental and interorganizational setting of coastal management networks.

Domain. Coastal zone management operates within a multiorganizational setting. It is, therefore, especially necessary to establish a clear delineation or organizational domain of the coastal program. This requires that the identity and function of the program be defined without any ambiguity.

Organization domain consists of the specific goals to be pursued and the functions to be used in implementing these goals.[4] Domain is an organization's locus in the interorganizational network. Domain included its "right" to operate in a specific geographic and functional area and its "right" of access to resources and assigned tasks. Competition between organizations can partly be resolved by greater domain consensus, but consensus often involves continued readjustment and compromise. Consensus consists of agreement on the clients to be served, the services to be offered, and the methods used in providing services. Obstacles to interorganizational cooperation can occur, however, if there is a lack of consensus on domain and if coordination poses a threat to the autonomy of the other organizations in the network.[5]

These aspects of domain can be clarified for coastal management programs through specific state legislation which defines the organization goals and functions of the new agency, and establishes the interorganizational network and relationships that will be required to achieve the spirit of the CZMA. The efficiency of networks can be further enhanced if the legislation demonstrates that it will lead to the promotion of the common interests of the involved agencies, that there will be the opportunity of pooling resources for the resolution of particular coastal problems, and that there will be an established basis for adjusting domain disputes.[6]

Process. The interorganizational relationships or processes operating in networks include flows of resources and information. Resource flows may be described as money, physical facilities and materials, client referrals and technical services. Information flows may consist of messages or communications between parties through various media such as reports, letters, telephone calls, face-to-face discussions and group or committee meetings.[7]

The process dimension of coastal zone management is not only a requirement of the CZMA but is a practical resolution to the problem of limited resources. It begins with the necessity of inter- and intragovernmental consultation in formulating individual programs and continues with the implementation of a complex management program with the assistance of other agencies at the various levels of government. The net of interorganizational relations can be established in the implementing design, but the effectiveness of the network will rely on the authority and financial resources granted to the program and the extent to which program leadership can convince other agencies of the need for mutual assistance when the processes of communication are not otherwise sustained by direct assistance and administrative directive.

Structure. Structure refers to the administrative arrangements established to define the respective roles of members of a system or network.[8] This aspect of interorganizational relationships can be discussed in terms of formalization, centralization, and complexity.

Formalization refers to the policies, procedures and rules that regulate interorganizational relations. The degree of formalization increases as it is expressed in verbal, written, or regulatory and contractual forms. Examples of formalization, as they pertain to the development and implementation of coastal management programs, range through the spectrum of communications from informal verbal agreements among agencies for short terms and minor arrangements to formal agreements of understanding, legislation, and implementing rules and regulations for long term interagency and intergovernmental agreements.

The CZMA requires centralization in state program design. A single agency is designated as having lead responsibility for each state program; but, in most instances, this is only a superficial acknowledgement of a high degree of centrality. It is most common for coastal programs to be implemented using several agencies and levels of government. One of the more common means of implementation is the "shared" approach in which both state and substate units have responsibility for specific program areas. In Maine, the state is responsible for developing guidelines for shoreland zoning, and local governments are responsible for implementing the zoning ordinance. In a "consolidated" approach a group of agencies with differing responsibilities may assign and coordinate responsibilities.[9] Despite an apparent lack of structural centrality, it is possible for a single agency or even a coordinating council to retain tight or loose control, depending on the management mechanisms at its disposal and the style in which it chooses to use them.

The design and implementation of coastal management programs also rely on complex organizational arrangements. They may occur, for example, when the state level of government has well-established planning and environmental protection offices and when the local level of government has strong home rule prerogatives which include control over land planning and management. In this context, coastal programs must endeavor to work with the varying goals and objectives of these organizations and respect the domains of each unit in an ordered and rational manner. A comprehensive and coordinated coastal program requires a sensitivity to other organizations if interaction is to continue from the developmental to the implementation phase. Since organizational structure, behavior, and communication styles are interwoven, different relationships and communication modes may be used between units in the same network. As an example, Litwak and Rothman hypothesize that "the more non-standardized the event, the more face-to-face (as opposed to rules) kinds of interaction are necessary to coordinate" a particular action.[10]

Selected Problems of Integrating Elements of Organizational Theory in Coastal Zone Management Networks

The CZMA requires that participating states be committed to the comprehensive management of coastal resources and requests that federal agencies participate to the maximum extent practicable. The Act also requires that private interests, local governments, and regional agencies participate in the development and management phases of of state coastal programs. But this mutual involvement in the coastal zone organizational network requires some modification of the goals and priorities of participating organizations. States will have to ascertain how much coordination is necessary to properly manage their respective coastal programs, and they will have to use great effort and skill to maintain these relationships in the long run.

The effectiveness of the systemic integration of the network is difficult to evaluate in public or non-profit organizations. Private organizations are able to modify their operations to meet profit-motivated incentives. Public organizations, however, do not have such a precise criterion. The units of a network, for example, may complement each other, but highly effective integration may not be achieved. Extensive contacts between numerous agencies in a network do not necessarily mean that significant or even tangible results are obtained or that effective communication is taking place, even when the lines of communication and coordination are formally structured. The number of contacts in a coastal zone management network, for example, may be extensive but may remain superficial.

It is important to define clearly coordination and integration in a coastal program. Perhaps integration at the policy level may be adequate if various agency program responsibilities are also closely coordinated. Coordination and integration are not just functions of legislation, agency regulations and agreements. Effective management also requires that all government units, federal, state and local, give coastal resource management a high priority. But if local governments are required to assume an important role, then they must have adequate staff with sufficient technical expertise to deal capably with their responsibilities.

Conclusion

This paper contains a selective review of the elements of organizational theory concerned with interorganizational relations. The elements examined -- domain, process, and structure -- provide a bare outline of the elements of a model of interorganizational relations, but they can provide insights for the design of state coastal management program networks. The CZMA does allow flexibility in the design of state coastal programs; but, because of the unusual brevity of the law and because the law is the first major federal-state-local partnership in planning and resource management,[11] there is an absence of criteria that can be used as indices of program effectiveness.

Each of the several levels of governmental interaction adds its own peculiar set of parameters to possible models of coastal management networks. This suggests that the coastal zone management network might be modeled using a three-tier construct comprised of federal intergovernmental relations, state intra-agency relations and local intergovernmental relations. Federal-state CZMA relations are far from being clarified, even as state coastal programs are being approved. The question of defining the "national interest" for each of the fifteen major federal agencies involved in coastal affairs is not entirely clear at this time. This task will be burdensome for each of the coastal programs but may be even more time-consuming for federal agencies that may have to coordinate activities with as many as thirty-two state and territorial programs.[12]

Intragovernmental models of coastal management appear to be developing less variability than the set of relationships that may be established with federal and local governments. Present program proposals appear to be following several very different structural patterns. One is implementation from within a state environmental protection program and the other is implementation through a state coordinating council.[13] The former would appear to be a stronger and more stable base for a coastal program. The latter could be more vulnerable because of possible periodic examination and reformulation. Interagency competition often is expressed by attempts of one agency to increase its domain at the expense of a newer and perhaps weaker program such as coastal zone management.

State-local relations can also differ from state to state because of the variability of existing state enabling legislation and because of the variability in division of powers regulating land development and resource management. These variations among states will reduce the possibility of establishing a single most effective model of state-local interorganizational relations. Nevertheless, state relations with local coastal zone planning and zoning actions will require setting of standards, reviewing decisions and perhaps legal intervention.

This paper was directed primarily to ongoing state coastal management operations. This should not detract from the consideration of financial support, staff size and constituency that were raised at the beginning of the paper. These limiting conditions mandate that initial state coastal zone management enabling legislation be carefully shaped and subsequently amended, if necessary, to assure the formation of a strong program that establishes a clear identity through its ability to resolve important coastal issues. If the new program is perceived as performing a valuable function, then it can build a constituency. This must be paralleled, however, by continuing executive and legislative interest in coastal affairs. Unless the initial funding is maintained or increased and unless the program can be defended from subsequent adverse amending legislation or executive agreements, the long term scope and impact of coastal program operations will gradually be eroded. Under such conditions, the effectiveness of state coastal management programs would be reduced not so much by internal factors but by inadequate external support.

NOTES

1. Coastal Zone Management Act of 1972, Public Law 92-583, 86 Stat. 1280, Section 303.

2. Ibid., Section 306.

3. Ibid., Section 306.

4. Levine, Sol and Paul E. White, "Exchange as a Conceptual Framework for the Study of Interorganizational Relationships," Administrative Science Quarterly, Vol. 5 (March 1961), p. 597.

5. Whetten, David A., "Toward a Contigency Model for Designing Interorganizational Service Delivery Systems," Organization and Administrative Sciences, Vol. 8, No. 1 (Spring 1977):77-96.

6. Litwak, Eugene and Lydia F. Hylton, "Interorganizational Analysis: A Hypothesis on Coordinating Agencies," Administrative Science Quarterly, Vol. 6, No. 4 (March 1962):395-420, and

   Levine, Sol and Paul E. White, "Exchange as a Conceptual Framework for the Study of Interorganizational Relationships," Administrative Science Quarterly, Vol. 5 (1961):583-601.

   as summarized in the following:

   Van de Ven, Andrew H., "On the Nature, Formation, and Maintenance of Relations Among Organizations," Academy of Management Review, Vol. 1, No. 4 (October 1976):24-36.

7. Ibid.

8. This discussion of structure is primarily based on Van de Ven, "On the Nature..," Academy of Management Review.

9. Armstrong, John, et. al., Coastal Zone Management: The Process of Program Development, Sandwich, Massachusetts; Coastal Zone Management Institute, 1974, p. 95.

   This publication includes discussions of many of the issues concerning program designers, especially questions of techniques for management and necessary powers for program implementation.

10. Litwak, Eugene, and Jack Rothman, "Toward the Theory and Practice of Coordination between Formal Organizations," William R. Rosenghen and Mark Lefton (eds.), Organizations and Clients, Columbus, Ohio: Charles E. Merrill Publishing Co., 1970, p. 152.

11. Mandelker, Daniel R., Environmental and Land Controls Legislation, Indianapolis, Indiana; Bobbs-Merrill Company, Inc., 1976, pp. 231-240.

12. Ibid., pp. 240-245.

13. The implementation and preparation of state coastal zone management programs are generally the responsibility of personnel experienced in local, regional and state planning, but the coastal programs are administratively assigned to environmental protection agencies or operated by a coordinating council. State planning offices would seem to be an appropriate organization to manage coastal planning programs, but state planning was in one of its periodic slumps when environmental protection agencies and coastal management programs were being established. If a national land use program had been established in 1972 or in the following year, state planning would have been strengthened and would have gained wider acceptance as a function of state government and probably could have been assigned coastal planning responsibilities in a substantial number of states.

DESIGN OF RESEARCH PROGRAMS TO PREDICT EFFECTS OF OIL DEVELOPMENT

R. H. Burroughs*

Baseline and monitoring studies were developed as a method for scientific research. When transferred to a resource management role, they fail to provide predictive information about likely effects of government actions. This inability to describe potential offshore, nearshore, and onshore resource disruptions in advance of their occurrence invalidates baselines and monitoring for most management objectives and has necessitated the development of methods that tie research objectives to specific decisions before government. These alternative approaches aggregate potential impacts by legally mandated decisions through consideration of the technologies activated by the decisions and the technology derived direct and indirect effects on natural and social systems.

INTRODUCTION

The translation of scientific methodology or insight to governmental policy requires sensitivity to the limitations of each. These limitations made the designation of appropriate applied research procedure on the outer continental shelf particularly difficult. The purpose of this paper is to examine baselines and monitoring and ask what constraints management of resources impose on their utilization. The principal conclusion is that the method while effective in science, even if expertly applied to this problem, would not meet the objectives of sound resource management.

BASELINES AND MONITORING IN MARINE SCIENCE

Baselines are defined as the status of a system initially. A subsequent resampling of the same parameters, monitoring, if appropriately designed may demonstrate change from the initial condition. The value of such studies for selected pollutants has long been recognized (Preston and Wood, 1971, Goldberg et al, 1971). Indeed a National Academy of Sciences report (NAS, 1971) proposed baselines of existing concentrations of pollutants in water, biota, and sediments. Such a survey would indicate the results of "fortuitous experiments" that occur through the inadvertent release of persistent pollutants. The approach was subsequently endorsed in a workshop (National Science Foundation IDOE, 1972) and in advisory activities

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for the UN Conference on the Human Environment (Secretary of State's Advisory Committee, 1972).

The use of baselines and monitoring to better understand the paths of pollutants in the environment was not without scientific criticism. First, the methodology assumes that the material of interest is relatively persistent or that its decomposition stages are relatively well known. Second, an adequate and therefore often quite large distribution of samples in time and space is required. Finally, attribution of cause and effect may at times be obscure particularly for biological systems. Natural change and variability occur in populations. Anthropogenic stress of several types may also cause changes. Hence, departure from a baseline when observed in a group of organisms may be natural or it may be anthropogenic, and if it is the latter, it may have a variety of causes.

The schedule for an accelerated OCS leasing program in 1973 and an early sale of it off the coasts of Mississippi, Alabama, and Florida prompted the adoption of baselines and monitoring in management of resources. Comments on the draft environmental statement and elsewhere included suggestions that baselines be initiated in all potential lease areas prior to the sales (Council on Environmental Quality, 1974) or more emphatically that they should be required prior to leasing (Environmental Protection Agency, 1973). In the final statement (U.S. Department of the Interior, 1973) baselines were defined as quantitative, biological, chemical, geological, and physical data in the potential oil production area. Studies based on that approach were commissioned by the Bureau of Land Management.

MONITORING AS MANAGEMENT

The implications of baselines followed by development and monitoring are that dispersion of pollutants associated with oil development will be better understood. Monitoring is not resource management but rather it passively and retrospectively assesses some of the effects of the selected management scheme. But, how is that management framework selected? In management systems where flexibility is limited--in the case of OCS oil, leasing limits flexibility--the requirements for predictive scientific information should increase proportionally to the reductions in management flexibility.

With this distinction between predictive requirements and retrospective descriptive information, one may examine the shortcomings of baselines and monitoring in terms of their role in management. First, as noted baselines and monitoring may describe but they do not predict. The mandate for government, however, is to avoid, where possible, the undesirable effects that occur from resource extraction. Avoidance requires predictions. Second baselines and monitoring require development to be able to understand the effects of development. The fallacy inherent in this kind of circular reasoning in management of resources is clear. If the development is environmentally unsound that fact becomes clear after it is too late to correct it. Third, mitigating actions, if they become apparent at all, will be evident only after facilities have been located and damage has occurred. Finally, when damage occurs and anthropogenic stress is removed--if that is possible--there is no assurance that recovery will always occur.

Direct use of an experimental method, baselines and monitoring--as a technique in management fails for the reasons noted above. Any design that is successful in meeting the challenges implicit here will accomplish two objectives. First, the results will provide predictions. Second, these predictions will concern the scientific implications of alternate decisions before government. Taken together these requirements provide a format for actively considering the effects of decisions in advance. They also test the ability of science to provide such process oriented predictive information.

One base for describing the required information is the OCS Lands Act as amended in 1978. The law (Public Law 95-372) and associated Department of the Interior policies identify a series of steps or decisions and the information required (U.S. Department of the Interior, 1978) in the process. Thus, the existing legal regime makes it possible to respond to scientific criticism (NAS, 1978) by developing a series of testable hypotheses. Decisions or groups of decisions activate or potentially activate a series of technologies. The technologies or activities are the source of pollutants or other environmental disturbances. The character and magnitude of these effects--to the extent that it may be known--is a prerequisite for the decisions In order to make such predictions the scientific method applied must be directed toward understanding processes.

For example, in each area a decision concerning the style of development and production is made by the United States Geological Survey when and if oil and gas in commercial quantities are located. At least once for each frontier area this evaluation process is subject to an environmental statement. Development and production presently imply among other activities the release of low levels of hydrocarbons as formation waters are discharged from the platforms. Hence, the discharges in number, depth in water columns, and location may have a variety of different impacts on the environment. Predicting those impacts through improved understanding of processes is a prerequisite for determining whether and how the discharges should be permitted. Controlled experiments in microcosms (Zeitzschel, 1978) provide one avenue for developing this information.

CONCLUSION

Science applied to effective management of resources must predict outcomes of legally mandated government decisions. To do so the science itself will have to lead to better understanding of natural processes.

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APPENDIX

APPENDIX

INTERNATIONAL COMMISSION ON THE COASTAL ENVIRONMENT, ATLANTIC COAST REGIONAL CONFERENCE, NEWPORT, RHODE ISLAND

November 7-10, 1979

John J. Fisher
University of Rhode Island
Conference Chairman

At the 23rd International Geographical Congress in Moscow in 1979 a Commission on the Coastal Environment was established to investigate five important coastal research activities for the next International Congress in 1980 in Japan. The five activities are:

1. Monitoring of prograding sand shorelines,
2. Documenting salt marsh and mangrove shoreline changes,
3. Analyzing affects of artificial shore structures,
4. Determination and management of important scientific coastal areas,
5. Investigating ecology, physiography and stabilization of coastal dunes.

For the IGU-ICC Atlantic Coast Regional Conference all of the above topics were discussed together with a special symposium by Dr. G. Moran on coastal archaeology as sites of important scientific interest. Another special symposium was held to discuss the "Bruun Rule". At the Commission's meeting in Moscow in 1976, of several possible causes for the reported and documented worldwide shoreline erosion, the "Bruun Rule" was suggested. The role postulates that shoreline erosion is necessary to maintain a profile of equilibrium under a rising sea level if there is a sediment supply deficit. A discussion developed as to whether Per Bruun, Norway, or V. Zenkovich, USSR, holds priority on this concept. Therefore a symposium reviewing various aspects of this "Bruun Rule" including a Soviet up-date was also held at the Atlantic Regional Conference.

Copies of the meeting and symposium abstracts and reports will be included in the Coastal Commission's final report to be presented to the International Congress in Japan in 1980. Participants in this regional commission meeting are thus considered corresponding members of the commission. In addition a one-day field conference took place at the Cape Cod National Seashore to review commission projects applicable to Cape Cod (e.g., shoreline changes, salt marshes, dune management, coastal conservation reserve and early Bruun Rule Studies).

INTERNATIONAL COMMISSION ON THE COASTAL ENVIRONMENT,
ATLANTIC COAST REGIONAL CONFERENCE, NEWPORT, RHODE ISLAND

November 7-10, 1979

PROGRAM

COASTAL ARCHAEOLOGY SYMPOSIUM - Wednesday, November 7

G. Moran - "Problems in the preservation of archaeological resources in the coastal zone of R.I."

D. Sanger - "Coastal Archaeology and site loss in Maine"

B. Luedtke - "Coastal zone archaeology in Boston Harbor"

P. Morenon, et al - "Archaeological resources in Narragansett Basin: Conanicut Island and Greenwich Cove"

F. McManamon - "Survey of archaeological resources, Cape Cod National Seashore"

R. Moir - "Preservation of land surfaces during rising sea level"

R. Barber - "The prehistoric human occupation of the Northwestern Atlantic coast"

M. Roberts - "The management of archaeologic resources in the coastal zone"

Discussion - Dr. B. Salwen, Archaeologist and Dr. M. Schwartz Geologist

COASTAL ENVIRONMENT SESSION - Thursday, November 8

J. Allen - "Magnitudes of beach erosion causes, Sandy Hook, N.J."

H. Hennigar - "Changes in coastal dune topography using parallex measurements"

J. Demarest - "Breakwater Harbor, Del.: Man-made interpretation; Part I: Historical perspective"

COASTAL ENVIRONMENT SESSION (Continued)

W. Hoyt - "Breakwater Harbor, Del: Man-made interaction; Part II: Effects of structures on geologic processes"

P. Knutson - "Sand stabilization on a baymouth bar, Nauset Beach; Cape Cod, Mass.

A. Dewall - "Beach changes at Westhampton Beach, New York"

J. Wadsworth - "Sedimentologic significance of tidal drainage networks: reevaluation of traditional salt marsh development model"

P. Godfrey, et al - "Strand vegetation and migrating barrier beaches and islands - Spartina patens"

M. Schwartz and E. Jacobsen - "Three piers and an inlet"

S. Leatherman - "Effects of storm processes and off-road vehicles on barrier dunes, Nauset Spit, Cape Cod, Mass."

J. Wadsworth - "Geologic development of Okefenokee Swamp - a multi-disciplinary approach to wetland research"

J. Dubois - "Photo-interpretation of sediment movements in a primary physiographic unit, North Shore, St. Lawrence"

G. Zarrillo - "Hydrodynamic and sediment transport in a salt marsh estuary"

H. Gierloff-Emden - "Timescale satellite data - coastal water and tidal regions"

P. Burbridge - "Tidal wetland changes, Fairfield, CT, 1835-1975"

BRUUN RULE SYMPOSIUM - Saturday, November 10

M. Schwartz and V. Milicic - "The Bruun Rule" A historic perspective"

G. Giese - "A general expression for shoreline change"

R. Dubois - "Nearshore evidence in support of the Bruun Rule on shore erosion"

J. Fisher - "Holocene sea level rise and shore erosion, R.I. and N.C. - Bruun Rule application"

P. Rosen - "Application of Bruun Rule to Chesapeake Bay, Virginia"

BRUUN RULE SYMPOSIUM (Continued)

D. Swift - "Bruun Rule and continental shelf sedimentation - an oceanographers view"

H. Allison - "Bruun Rule, Implications"

E. Hand - "Application of Bruun's concept to the Great Lakes"

P. Bruun - "Bruun Rule, boundary conditions"

MAGNITUDES OF BEACH EROSION CAUSES, SANDY HOOK, NEW JERSEY, USA

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ABSTRACT

Sandy Hook spit progrades from a northerly littoral drift rate of about 377,000m^3/yr. (1885-1932), and local sea level rise is about 5mm/yr. Localized erosion reaches 25m/yr. for several years.

A sediment budget approach to the resolution of erosion factors, from 1971-78 shows that the potential budget has risen to about 460,000 m^3/yr. due to increased storminess as measured by a Storm Index defined by the daily frequency of onshore winds times the square of wind velocity. The actual longshore supply is only 190,000 m^3/yr., with a deficit of 270,000m^3/yr., at the erosional beach.

The factors responsible for this erosion are 1) sediment starvation in the lee of an updrift sea wall/groin system (100,000m^3/yr.), 2)higher waves due to refraction that cause a locally higher transport rate (100,000m^3/yr.), 3)an increase in secular storminess that has temporarily increased the transport rate (60,000m^3/yr.), 4) profile response to the rise in sea level (5,000m^3/yr.), and 5) overwash losses during storms due to recent dune destruction (4,000m^3/yr.).

The relative values of erosion factor priority indicate the enormous impact of man on beach erosion and the temporary nature of extreme rates of erosion due to secular climate intensities. In spite of the locally high rate of sea level rise, little erosion can be explained by it.

ON THE IMPLICATIONS OF THE BRUUN RULE

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ABSTRACT

The Bruun's rule as formulated by M. Schwartz (1967) which relates sea-level rise and shore erosion, had been confirmed by numerous independent researchers in both laboratory and field experiments. The Rule was accepted as being impirical and it was sometimes felt that some additional information, such as an initial beach profile shape or sea-ward slope of the offshore bar was required for its practical applications.

The rigorous relationship between sea-level rise and shore recession is derived automatically from the Bruun's Rule and Bruun's Effect and it is shown that no additional information with respect to the beach profile is needed. The Bruun's invariant appears to be a good approximation to this relationship.

M.L. Schwartz's (1967) formulation of the Bruun's theory on shore erosion is shown to permit an analytical expression in terms of a certain differential equation. Solution of this equation is demonstrated to satisfy the theory, thus establishing a one-to-one relationship between the Bruun's theory and the presented analytical formulation.

PREHISTORIC HUMAN OCCUPATION OF THE NORTHWESTERN ATLANTIC COAST

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ABSTRACT

Along the coast of the northwestern Atlantic Oceal lie New England and the Middle Atlantic States. A recent project completed by the Institude for Conservation Archaeology, Peabody Museum, Harvard University for the Bureau of Land Management has evaluated the archaeological potential of the outer continental shelf from the Bay of Fundy to Capt Hatteras. By examining settlement patterns on adjacent dry land and synthesizing those results with predictions from optimal foraging theory, predictions of the types and densities of prehistoric sites were produced. This paper describes briefly the procedures and results of that research.

CHANGES IN TIDAL WETLANDS, FAIRFIELD, CONNECTICUT 1835-1975

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ABSTRACT

Through the use of historical maps and aerial photography the paper examines the scale and rate of wetland loss and qualitative changes in wetland habitats for four coastal watersheds in Fairfield, Connecticut between 1835 and 1975. The paper demonstrates that 410.5 of the 748 acres of tidal wetland existing in 1835 had been lost by 1975. The rate of wetland loss was more acute during the 1933 to 1975 period than for the previous 98 years. A qualitative shift from *Spartina* dominated marsh to marsh dominated by *Phragmites* is illustrated. Between 1933 and 1975 approximately 401 acres of *Spartina* had been lost with a gain of 47 acres of *Phragmites*. Land use changes were also traced and a progression of land uses from agriculture to housing or industrial development is mapped.

A parallel study of wetland land values and the resource economics of tidal wetland development has been carried out.The results of which can be made available if requested.

THE "BRUUN RULE" DISCUSSION ON BOUNDARY CONDITIONS

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ABSTRACT

The theory of the influence of sea level rise on erosion is proposed two dimensional but nature is 3-dimensional. This in turn means that one must consider a certain uninterrupted length of shore when the material transport is contained in a "box", xyz, x (length offshore from a defined shoreline point), y (length of box along the shore) and z (depth from a defined water table). The material balance in and out of two remote x-z sections y meters apart is assumed to be zero. If there is no balance between the two quantities this must be considered in the total material balance equations. There are two y-z sections, one located on the beach, the other at a certain water depth which separates the "nearshore drift" from the

"offshore drift" in the x-direction. On the beach the effect of wind-drift may then have to added. It is usually negligible but may in some cases present a non-negligible quantity. The outer y-z boundary is more difficult to define because there is no clear distinction between the limit of exchange between beach and offshore drifts of material. Often the terminology "wave base" for material agitation on the bottom is used. Recent research by the USCE, CERC, reported in TY-9 by Hallermeier in paper presented at this symposium attempt to present rational methods for calculation of limits of active agitation of the sandbottom and long-term erosion rates based on long term rises of sea level.

BREAKWATER HARBOR, DELAWARE--A CLASSROOM FOR MAN-MARINE PROCESSES INTERACTION PART I: HISTORICAL PERSPECTIVE

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ABSTRACT

During the late 1820's the first construction project in the coastal zone sponsored by the U.S. Government was initiated in Lewes, Delaware. Breakwater construction was undertaken to produce a protected harbor for ships sailing on Delaware Bay. Because of shoaling in the harbor, a second breakwater was built in the area in 1900 in order to maintain a useful harbor facility at the mouth of Delaware Bay. Over the terms of twelve presidents of the United States, more than $2,000,000 was spent on this public works project solely for the promotion of commerce establishing a precedent for expenditure of tax dollars in the coastal zone for the "public benefit".

Bathymetric surveys were conducted at frequent intervals to monitor the shoaling in the area. The first detailed survey was in 1842 with subsequent surveys every 10 to 20 years since. This excellent data base has been used to evaluate the effect of construction on marine processes of shoaling. The coastal sedimentary dynamics in the area of the breakwater has produced drastic geomorphic change in this time. A spit, Cape Henlopen, has prograded north-northwest 5000 ft. (1500m) in 130 years. Although growth of a spit at this position was inevitable, the form and rates of growth have been altered by the presence of the first breakwater and to a lesser extent by the presence of the second breakwater. The orientation of the breakwater with respect to the shoreline has served to concentrate ebb currents at the spit tip preventing the spit from recurving as it has done many times in the last 2,000 years. Shoaling patterns in the harbor have been dominated by the 1831 breakwater, while sedimentation near the spit tip has been dominated by storm events.

The construction of the breakwater for the creation of a harbor was an enormous success. The harbor is still 8 to 10 feet deep over most of the area, and over 30 feet deep in places. It is evident, however that the spit is soon to recurve and connect to the 1831 breakwater, effectively ending the "natural" life of the harbor. Substantial dredging could maintain an excellent harbor for some time if the economic incentives are great enough. Based on background studies of marine processes it is possible to estimate what the area would have looked like had the breakwater not been built. It is also possible to predict what the future of the harbor will be from a geologic viewpoint.

BEACH CHANGES AT WESTHAMPTON BEACH, NY

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ABSTRACT

Repetitive surveys of the above MSL beach were made along a total of 20 profile lines at Westhampton Beach, on the South Shore of Long Island, New York, from 1962-1973. After the study had begun, a large groin field with associated beach fill was constructed in the middle of the area being surveyed. The data show that shoreline erosion of 2 to 3 meters per year within and updrift of the groin field was reversed after groin construction while shoreline erosion downdrift (west) of the groin field accelerated to at least 20 m/yr. Profile lines updrift (east) of the groin field accreted at a rate of 1.10 m/yr. as measured at the MSL shoreline and showed a 3.68 m^3m/yr. increase in sand stored on the beach above MSL. The shoreline within the 11-groin field accreted at a rate of 3.45 m/yr. and the beach unit volume increased at a rate of 11.92 m^3/m/yr., including beachfill. Downdrift of the groin field the profiles showed an average MSL shoreline gain of 0.66 m/yr. and an average unit volume loss of 0.12 m^3/m/yr. The largest changes measured resulted from the storm of 22 March 1973, which eroded the shoreline an average of 20 m and removed an average of 29 m^3/m of beach front above the MSL elevation. Beach changes were found to be seasonal, with the least amount of sand above

MSL from January through May. The data taken provide no information on profile changes below MSL, either natural changes or changes caused by the groin field, However, bathymetric survey data collected within the groin field by the Corps of Engineers, New York District, and summarized in this report show that underwater changes are larger than changes on the beach and occasionally are opposite in sign.

EXEMPLE DE PHOTO-INTERPRETATION DES MOUVEMENTS DE SEDIMENTS DANS UNE UNITE PHYSIOGRAPHIQUE FONDAMENTALE DE LA COTE NORD DU SAINT-LAURENT, QUEBEC

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ABSTACT

Dans le but de harnacher en equipements hydroelectriques certaines rivieres de la Cote Nord, la Division de l'hydraulique de l'Hydro-Quebec nous demandait de repondre a certaines questions: 1) sens du transport littoral sur la cote et autour des iles de mingan, 2) provenance des sediments sableux et 3) impact probable sur la cote de la construction des barrages.

Les formations meubles et la geomorphologie de la terre ferme etant deja cartographiees au 1:25 000^e, nous avons complete l'information avec cinq couvertures aeriennes prises entre 1948 et 1976 a diverses positions de la maree: 1) 1:15 000^e a maree moyenne descendante, 4) 1:15 840^e a maree basse, 5) 1:40 000 a maree montante. Nous avons ainsi stabli des criteres d'identification pour trois types de donnees: 1) la repartition des processus et des zones d'erosion et de sedimentation des secteurs emerges d'apres la geogorphologie, 2) la repartition des structures sedimentaires des secteurs immerges d'apres la geomorphologie et 3) la determination de l'hydrodynamique par les leves des fronts de vagues, des zones de diffusion sedimentaire et d'interference des masses d'eau avec confrontation avec le front de vague theorique tire de la configuration bathymetrique.

Les donnees ont permis de definir une seule unite physiographique fondamentale de 70km de longueur pour le secteur d'etude entre Magpie at la point aux Morts a l'ouest de Havre-Saint-Pierre. Par contre, sept unites physiographiques secondaires homogenes ont ete identifiees; ces unites possedent leurs caracteristiques propres d'approvisionnement et de diffusion des sediments.

Les derives littorales se font presque toutes d'ouest en est, dans le sens des vents dominants principaux; les quelques derives en sens contraire semblent obeir au sens de diffusion des marees dan les endroits abrites ou au sens des vents dominants secondaires du NE dans les endroits exposes.

Les sources majeures de sediments sont les alluvions fluviales des crues printannieres et estivales qui viennent s'accumuler sous forme de deltas sous-aquatiques et qui contre-balancent les pertes de sediments sur les plages.

En consequence, les barrages installes trop pres de la cote provoquent necessairement un deficit sedimentaire a la cote soit par l effet du trappage des sediments, soit par une trop grande regularisation des debits qui empeche les rivieres de s'approvisionner adequatement en sediments a meme leurs berges.

NEARSHORE EVIDENCE IN SUPPORT OF THE BRUUN RULE ON SHORE EROSION

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ABSTRACT

The Bruun Rule on shore erosion states that for a beach and nearshore profile at equilibrium, as water level rises, sediments are eroded from the beach and deposited in the nearshore zone; in turn, the nearshore bottom is elevated in direct proportion to the rise in water level. The Rule was tested under field conditions. At Terry Andrae State Park, Wisconsin, nearshore profiles in Lake Michigan were surveyed once a week from April through July, 1971 as lake water level seasonally rose. The nearshore zone consists of two longshore bars which parallel the shore. The Bruun Rule is applicable in the zone of the first longshore bar system. As lake water level rose, the bars advanced landward, and from the base of the foreshore to the crest of the first bar, the elevation of the nearshore bottom increased. On the lakeward slope of the first bar crest, no deposition or erosion occurred. The elevation of the second bar crest remained constant as water level rose.

SHORELINE EROSION, RHODE ISLAND AND NORTH CAROLINA COASTS - TEST OF BRUUN RULE

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ABSTRACT

Analysis of Rhode Island shoreline retreat, measured on aerial photographs from 1939 to 1975 together with sea level rise rates allows a test of the Bruun Rule. This rule suggests that as sea level rises, sediment eroded from the shore is deposited offshore equal to this sea level rise. Submergence by a sea level rise of 0.3 m/yr. accounts for only 15% of the average shoreline retreat of 0.2 m/yr. Overwash accounts for 26%, while inlet deposition accounts for 35% of this retreat. The remaining 24% of the eroded sediment is deposited offshore between the breaker zone and wave base limit. A similar sedimentation situation exists along the higher energy North Carolina coast with erosion averaging 2.0 m/yr. These are the first studies of the Bruun Rule on barrier island coastlines.

TIMESCALE AS INTERFACE OF SATELLITE DATA ACQUISITION SYSTEMS AGAINST COASTAL WATER AND TIDAL REGION PROCESSES

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ABSTRACT

Some natural processes are of such time scale that a change of the phenomena is going on meanwhile a sensor system works on data acquisition.

The time-space problems of tidal coverage of wadden areas (tidal flats) is very important for remote sensing methods of coastal area.

A preliminare matrix of relationship of time scale of processes of coastal waters versus time scale of data acquisition system has been developed.

Waves and breakers with a time scale of a 6 sec. period are of the same time scale as the pathway of the nadir of Landsat: the change detection of such a coastal phenomenon cannot be taken with this very MSS-system and coastal mapping cannot obtain sharp lines of land-sea boundaries.

Flood-tidal water does cover tidal flats with a current velocity of 1 to 3 m/sec., i.e. during 30 sec. a surface of a distance up to 90 m. This is a space dimension of a size more than that of 1 pixel of Landsat-MSS and a change in the scene during less as the 30 sec. scanning time for one scene of the sensor data acquisition system of this very type.

Within the area of 1 scene of 1 LANDSAT-picture of 185 x 185 km square, there is a synoptic overview (physical quasi-synoptic), due to time of scanner process. But at this very short time, nearly a moment, the different areas of the scene do not have synchron the lowest tide water level of tidal range, because in the North Sea, as example, there is the tidal emphydromy, with some hours difference in high or low water level of tidal range of different locations along 100 km of the coastline, i.e. in one LANDSAT scene, the stage of tidal coverage is local different.

A GENERAL EXPRESSION FOR SHORELINE CHANGES UNDER SEA LEVEL RISE

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ABSTRACT

Two major processes are primarily responsible for shoreline retreat in Massachusetts: erosion due to sediment transport by waves, and submergence by a rising relative sea level. Of the two, submergence is the more important.

The mean linear rate of shoreline retreat is given by the product of the rate of relative sea level rise, the ratio of overall coastal length to actual shoreline length, and the cotangent of the overall coastal slope.

While submergence and emergence result from relative sea level changes, erosion and accretion result from sediment transportation processes.

Perhaps 90% of the Massachusetts shoreline lies along the "inner" coast---shoreline of bays, estuaries, marshes and tidal creeks---where sediment transport is negligible, because there is insufficient wave energy to transport appreciable quantities of sediment.

Along shores which do receive appreciable wave energy, the absolute value of the sediment transport term will be small if the <u>net</u> rate of transport is small, as it is along shorelines bounded by headlands; or if the <u>divergence</u> of the net rate of transport is small, as it tends to be along long straight shorelines. Under the influence of

wave action alone, an unconsolidated coast tends to develop shoreline forms which approach one or the other of these two stable conditions. However, a rising relative sea level disrupts an approach to stability by altering wave conditions at the shoreline.

At some locations, such as the cliffed shorelines of Manomet and Outer Cape Cod, the shoreline retreat is due almost entirely to erosion alone, while at others, such as the Provincetown Hook and Sandy Neck, the shoreline is accreting. It should be noted that an accreting shoreline is not necessarily advancing. The outer shoreline of the Provincetown Hook is advancing, but that of Sandy Neck is retreating.

While the net coastal change in Massachusetts due to sediment transport processes is erosion, the contribution of this erosion to the total rate of shoreline retreat is small in comparison to the contribution of submergence.

RESPONSES OF STRAND VEGETATION TO MIGRATING BARRIER BEACHES AND ISLANDS - WITH PARTICULAR REFERENCE TO SPARTINA PATENS (SALT MEADOW CORDGRASS)

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ABSTRACT

The migration of barrier islands and beachers, particularly those undergoing retreat by means of overwash and inlet dynamics, poses special problems for the survival of dune and marsh plants. Plants which survive in the dynamic environment of a migrating barrier beach must possess special adaptations to cope with the severe environmental pressures placed on them. Only a few can tolerate such stress, yet they do so with remarkable abilities which have long been of interest to ecologists and plant scientists. However, little work has been done on the ecological relationships of certain key species to the geological processes which shape and maintain the barrier beaches. For the past decade, we have been studying the response of one grass species in particular, *Spartina patens*, to oceanic overwash. In doing so, we have found that at least two forms of *S. patens* exist which show certain differences in their abilities to tolerate substantial overwash. A southern form, called *S. patens* var. *monogyna*, is a dominant grass of dunes, barrier flats, and high salt marshes on barrier islands undergoing overwash retreat. It readily grows up through deposits a deep as one meter, and even shows increased vigor when doing so. It therefore plays an important role in the stabilization of overwash deposits on barrier islands of the central

and southern U.S. states. This form reaches the Massachusetts coast, but the more typical variety, a decumbent plant, tends to dominate the high marshes where its response to overwash burial is much less dramatic. Under natural conditions, the decumbent form is usually killed by substantial overwash, depths greater than 30 cm., although it does show recovery by growing through more shallow deposits in which case it shows an upright growth tendancy. In most northern areas studies (Cape Cod, Massachusetts to New Brunswick, Canada) we find that recolonization of overwash is mainly through seedling establishment, fragment regeneration, or lateral extensions from overwash-free adjoining areas. In each case, however, the grasses play an important role in the geomorphology of barrier beaches. In the north, Ammophila breviligulata, plays a major role in stabilization of overwash, as well as dune, sand. The important relationships between sand transport mechanisms - aeolian and hydrologic - and the stabilizing activities of coastal grasses are being studied both in the field and the laboratory. This research includes surveys of various barrier beaches along the U.S. and Canadian east coasts, detailed analyses of pre-and post-overwash events on Coast Guard Beach (Nauset Spit), Massachusetts, physiological analyses in the laboratory, interactions of Spartina patens and Ammophila breviligulata in growth experiments, and burial treatments in the field. This paper will briefly describe the study areas, techniques, and a general overview of the results obtained so far. It is anticipated that such information will provide further background material for managing barrier beaches and islands on a sound ecological basis.

APPLICATION OF BRUUN'S CONCEPT TO THE GREAT LAKES

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ABSTRACT

MODEL. As described by Bruun (1962) a rise in sea level tends to shift the equilibrium shore profile upward and landward. Erosion prevails landward of a null point, and the shoreline retreats. Conceptually, this erosion supplies material to the outer portion of the responding profile and the entire profile is thus raised above the initial equilibrium profile through a distance equal to the change in water level. The landward distance through which the profile moves to regain equilibrium can be calculated if the width of the entire responding profile, and the proportion of eroded material which would be stable in the outer zone, are known. This concept is straightforward, but application is difficult. The assumption of an equilibrium profile may be unrealistic. The width of the responding profile, or equivalently the closure depth is in unknown variable, dependent on wave climate. Field verification of profile response has been scanty. While coastal submergence is widespread, it is also usually so slow that few measurements span a long enough time to accurately reveal profile adjustment. Furthermore,

the transition between the elevated equilibrium profile and the stable seabed below closure depth was never shown in previous diagrams of ideal profile response. Some undue skepticism about the model's validity may have arisen because of the apparent inadequacy of the model for explaining this transition.

FIELD CONFIRMATION. The Great Lakes are subject to sustained periods of relatively rapid changes in water level as a result of long term climatic fluctuations. During periods of increasing lake levels, which last for 5 to 15 years, average shore erosion rate increases 3 to 6 times the historic (100+ year average) rate. Response of Lake Michigan shore and offshore profiles to increased water levels has been documented over a 9-year period. The closure depth is near 11 m. A system of 4 to 5 longshore bars dominate the active profile. The bars respond relatively rapidly, migrating to maintain a constant depth beneath the rising lake surface. The inner profile recedes steadily, but is relatively sluggish compared to bar mobility. There is a timelag of several years between lake level stablization and complete profile readjustment. Though the mean lake level peaked in 1973, recession continued unabated at most stations until 1976 at which time the beach began to accrete.

FURTHER IMPLICATIONS. Due to the absence of any active supply of fluvial sediment and the closed nature of the 50 km shoreline under the study, sediment budget calculations could be readily applied to document sediment balance. The ratio of shore retreat to submergence over the 9-year study period was roughly 1 to 70. For each unit increase in elevation. The profile moved 70 units landward leaving a smooth 1:70 slope behind, thus a smooth bottom marked the transition between the raised equilibrium profile and the stable bottom. A convex trailing edge would have suggested a secular increase in profile retreat per unit of submergence. In areas with similar geology, gemorphology, and wave exposure roughly similar responses may be expected. In areas having broader active profiles, lower backshores, offshore or longshore sediment sinks, and where the eroding backshore contains a large percentage of material which could be unstable as a nearshore deposit, the ratio of profile retreat to submergence should be larger. The closure depth can be estimated from wave climate data as roughly twice the height of waves with a 5 year return period. A recommendation that shore retreat be evaluated in terms of a sediment balance model similar to Bruun's (Hands, in prep.)should lead to rigorous testing of these concepts on the Great Lakes.

MEASUREMENT OF CHANGES IN COASTAL DUNE TOPOGRAPHY USING SIMPLE PARALLAX MEASUREMENTS

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ABSTRACT

Changes in topography of a coastal dune on Currituck Spit, Virginia/North Carolina were measured from existing aerial photography (1955; 1961; 1975) using simple parallax measurements as the dune evolved from an actively migrating, unvegetated sand hill into a stable, vegetated parabolic dune over a twenty year period. Differences in elevation of ± 0.5 metre could be distinguished using a Student's t-test ($P < .005$).

Maximum height of the dune decreased from 11 m to less than 7 m and the dune slipface advanced more than 120 m (annual rate of 6 m/yr). Analysis of changes in topography revealed that adjacent vegetation effected the evolution of the dune. Inland vegetation in 1955 consisted of grass and shrubs less than 2 m tall. As a result, the dominant offshore westerly winds were the main force shaping the dune. As a maritime forest succeeded the shrubs (height 10m), vegetation decreased surface wind velocity to the point where the offshore winds were no longer effective and the onshore, easterly winds assumed prime importance in the evolution of the dune. In light of the infrequent revision of topography on topographic maps, the following conclusions can be drawn:

1) Topography shown on existing topographic maps of coastal dune areas may not be accurate because dune morphology exhibits changes in the order of metres per year, both laterally and vertically.

2) Simple parallax measurements of dune areas, both in coastal and desert regions, can be used to obtain topographic information from existing aerial photography. This can aid in the better understanding of the various physical processes at work in these areas and possibly lead to better management decisions.

BREAKWATER HARBOR, DELAWARE--A CLASSROOM FOR MAN-MARINE PROCESSES INTERACTION
PART II: EFFECTS OF MAN-MADE STRUCTURES ON GEOLOGIC PROCESSES

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ABSTRACT

Energy conditions and sediment transport in the Breakwater Harbor area have been measured peridically from 1977 to the present using hand-held, instantaneous bedload and suspended load samplers. The first areas investigated were the surf zones of Cape Henlopen, Breakwater Harbor, and Lewes Beach, consisting of a total of 16 stations repeatedly occupied. In general, the Cape Henlopen surf zones had the highest concentrations of bedload (up to 123 gm/l) and suspended load (up to 8 gm/l), the area behind the breakwater had the lowest concentrations of bedload (as low as 1 gm/l) and suspended load (as low as 0.1 gm/l), and the Lewes Beach zone had intermediate values. These sediment concentrations were measured during all four seasons as well as during storms; differences in the three zones can be accounted for by varying offshore water depth, currents, and waves. These energy conditions, in turn, are caused by the two breakwaters in the area, a large jetty, and the spit itself.

The second area in which sediment concentrations were measured was the offshore area of Breakwater Harbor. Data from eight permanent stations and several spot samples display a general trend that suspended sediments are transported through Breakwater Harbor during typical high current velocities of ebb tide (exceeding 50 cm/sec), but that sediments are deposited out during the low velocities of flood tide (generally less than 25 cm/sec). The sheltering effect of the breakwater and the cape are the major causes of this assymetry in sediment transport. Resuspension of bottom silts by large boats appears to be a significant factor in the sedimentary regime. Also, the close proximity of a stabilized inlet draining marsh and inland bay waters adds substantial sediment to the system. Concentrations of suspended sediment measured from boats in the offshore zones of the harbor range from 5 to 385 mg/l (0.005 to 0.385 gm/l) during various conditions.

Analyses of 26 shallow marine vibracores taken in the harbor area show that profound and rapid sedimentologic change has occurred following construction of the Inner Breakwater (1831) and the Ferry Jetty (1964). Low-energy deposits are easily discernable from the storm-deposited sand layers in the cores.

Vertical aerial photographs of Cape Henlopen since 1938 have been compared using a stereo zoom transfer scope, a tool which provides

excellent data on the mode of progradation and retreat of shorelines. In the last decade, for example, nearly all the progradation of the Cape has been on the northeast side, a fact which implies that the sand body may not connect with the inner breakwater as early as has been heretofore predicted. It appears that during ebb tide, the breakwater is continuing to deflect the locus of sedimentation to the east as time goes on.

SAND STABILIZATION ON A BAYMOUTH BAR, NAUSET BEACH CAPE COD, MASSACHUSETTS

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In April 1970, experimental plots were established on a baymouth bar at Nauset Harbor on Cape Cod, Massachusetts. On the bar both sand fences and American beachgrass (Ammophila breviligulata) were tested as alternative techniques for creating and stabilizing dunes. Elevational profiles were made periodically in the test plots from April 1970 to November 1977. The study concluded that sand fences initially capture sand more rapidly than newly planted beachgrass. Once established, however, beach grass plantings capture sand at a rate equivalent to multiple lifts of sand fence. Using either sand fence or beach grass, a dune growth rate of more than 11 cubic meters per linear meter of beach per year was sustained.

EFFECTS OF STORM PROCESSES AND OFF-ROAD VEHICLES ON BARRIER DUNES, NAUSET SPIT, CAPE COD NATIONAL SEASHORE

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ABSTRACT

Nauset Spit, Massachusetts, is a retreating barrier system, as evidenced by narrow beaches and scarped barrier dunes. The dunes are densely colonized by American brach grass (Ammophila breviqulate). The storm intensity in the Cape Cod area is the highest along the North Atlantic East Coast, which insures frequent wave attack of the eroding dunes and some overwash activity. At present, there are numerous washover fans/flats along the length of the Spit.

Overwash is a significant process on some Mid-Atlantic and southeastern barrier islands, but data was not previously available in order to define its role in this area. It appears that the frequent overwashes, under present conditions, are the result of intense off-road vehicle (ORV) traffic. Experimental impacting has shown that even low level ORV impacts can result in devegetation and subsequent blowouts. These pathways through the primary dune line serve as overwash channels during storm conditions. Also, the continued perturbation of the sand surface by vehicles prevents revegetation and large barren flats persist.

Colonization of washovers and dune growth is being studied under a variety of conditions. Several washovers have been planted with American beach grass (Cape variety), and the area has been closed to trespass. Other areas have been closed for natural recovery, while present impacts through certain washover fans are continued for comparative purposes. Vegetative parameters of cover and frequency and physiographic transects across these washover areas will demonstrate the rate of revegetation and dune growth. This study has been designed to determine the relative roles of overwash and dune building and the impact of vehicles on these processes.

COASTAL ZONE ARCHAEOLOGY IN BOSTON HARBOR

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ABSTRACT

Recent investigations of the Calf Island site in Boston Harbor illustrate both the problems and potential of archaeological sites in the coastal zone. The site was chosen for excavation because it appeared to be endangered by human uses of the area and also by erosion. It has since been destroyed by the Blizzard of 1978. Although this was a small site, it produced considerable quantities of material that clarify the life of Boston's late prehistoric inhabitants, and which also contribute to our knowledge of changing human adaptations to the coastal zone. Analysis of the recovered artifacts was performed with the cooperation of numerous specialists from other disciplines, and the resultant data has proved useful to these specialists as well as to archaeologists.

SURVEY OF ARCHAEOLOGICAL RESOURCES IN THE CAPE COD NATIONAL SEASHORE

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ABSTRACT

In 1979 an archeological survey of Cape Cod National Seashore, Massachusetts, was begun. The first year's investigation concentrated on sampling the Seashore area and site discovery. A two-stage stratified random sampling procedure was used. Initially, three strata were identified based upon known archeological data and environmental variables. Following the completion of stage one, analysis identified two additional strata. In stage two, the investigation concentrated upon strata with the greatest variation in site types' frequencies.

Shovel test pits, approximately .5 meters in diameter, dug to culturally sterile glacial sand were the discovery technique. The pit contents were screened through 1/4" mesh hardware cloth. Test pits were placed in a systematic grid spaced at 25 meters in 200 meter by 100 meter sample units.

The sample units serve as both investigation units and units of analysis Therefore, within each stratum, simple random sampling can be assumed

when deriving estimates of the site population parameters within each stratum.

Estimates of historic period and prehistoric period components indicate a frequency much higher than one based upon known sites. Historic period sites may occur 75 times more frequently and prehistoric sites 60 times more frequently than would be predicted by known site frequency.

THE PRESERVATION OF LAND SURFACES DURING PERIODS OF RISING SEA-LEVEL

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ABSTRACTS

The fate of land survaces as they are submerged during periods of rising sea-level is of critical importance to archaeologists. The Holocene represents a period dominated by worldwide marine transgression. Ocean levels were raised as Lake Wisconsin glacial meltwater has reentered these reservoirs. Along the eastern coast of North America, sea-level may have risen well over 100 meters since 18,000 B.P. Sea-level rise involves the landward transgression of the shoreline and includes both depositional and erosional processes. Considerable deposition occurs in river valleys, estuaries, marshes, and lagoons and often is enough to protect their former land surfaces from the destruction which accompanies erosional shoreface retreat. Knolls, uplands, and unprotected shorelines, on the other hand, usually are severely eroded during marine transgression resulting in the loss of their former land surfaces and soil horizons. The eroded material is added to the surficial sand sheet which blankets most of the continental shelf today. In this paper, I will take a look at Holocene sea-level change, processes of marine transgression, and erosional shoreface retreat in order to form a better understanding of the fate of former land surfaces that were submerged during the last 15,000 years.

The region that will be discussed in detail is the United States continental shelf from North Carolina to Canada although the processes themselves may be applicable worldwide. Important marine transgression processes will be outlined and their significance to the archaeological community will be emphasized.

PROBLEMS IN THE PRESERVATION OF ARCHAEOLOGICAL RESOURCES IN THE COASTAL ZONE OF RHODE ISLAND: A MANAGEMENT PERSPECTIVE

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ABSTRACT

In a state as small as Rhode Island, which promotes itself as the "ocean state," and boasts a Preservation Commission which received the highest score in the country for its 1980 plan, with a coastal zone management program recently described by the director of NOAA's Office of CZM as a "model" for other states, you might think that we have--or should have--the problem well in hand. Nothing could be further from the truth. Along with these potential advantages lurk glaring and even fatal deficiencies for adequate management of archaeological resources in the coastal zone. On the basis of existing experience, the threat of site loss occurring under the permitting authority of this state's CRMC exceeds that posed by FHWA, EPA, and the Corps of Engineers combined.

The Programatic plan for resource management would include two components:

1. Extend the staffing and permit review process to include sub-surface testing to verify the presence or absence of sites in project areas under consideration for which there is a "reasonable probability" of such sites being present.

2. Conduct an over-all planning study of the coastal zone based on the development of locational models to determine the probability of site occurence in various environments of the study area.

ARCHAEOLOGICAL RESOURCES IN THE NARRAGANSETT BASIN: CONANICUT ISLAND AND GREENWICH COVE AS CASE STUDIES

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ABSTRACT

Archaeological resources in the coastal zone of Rhode Island are important in two general respects. First, these resources constitute a unique body of evidence documenting the behavior of past populations. Scientific questions related to past land uses, changing subsistence patterns, demographic characteristics of past populations and former settlement patterns cannot be fully addressed in Rhode Island without intensive archaeological studies of the coastal zone. Second, archaeological resources provide evidence of importance to modern populations residing in the coastal zone. Botanical and zoological data found at archaeological sites indicate the degree to which maritime and terrestrial ecosystems have changed in the coastal zone. Sea level fluctuations and changes in shorelines can also be related to the location of archaeological sites. Work conducted by Rhode Island College on Conanicut Island and near East Greenwich is used to illustrate the importance of archaeological resources in the Narragansett Basin. Methods used in this work to document the significance of archaeological resources, and recommendations for protecting these resources are presented.

THE MANAGEMENT OF ARCHAEOLOGICAL RESOURCES IN THE COASTAL ZONE

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ABSTRACTS

The results of research by the Institute for Conservation Archaeology funded by the Bureau of Land Management reveal the fact that the Coastal Zone, both onshore and offshore, contains one of the densest concentrations of historic and prehistoric sites in the nation. At the same time the Coastal Zone is under severe attack from natural and man-made causes which are rapidly depleting this resource base. Our research has also indicated that this area is the least considered zone for archaeological exploration prior to land use.

The management element of our study for the Bureau of Land Management has identified discrete zones having different expected historic and prehistoric resource concentrations. The location of these zones has been defined, their expected contents described and survey strategies recommended for each zone. The entire process has been integrated into the Interagency Archaeological Services planning model.

Since the results of our research are predictions on resource locations based on several different types of modeling procedures, pilot studies have been recommended to test these models and thus support or modify management recommendations.

In addition, a wide range of natural and man-made impacts to cultural resources have been identified and management strategies to deal with each impact have been recommended.

AN APPLICATION OF THE BRUUN RULE IN THE CHESAPEAKE BAY

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ABSTRACT

A regional scale field test of the Bruun Rule was made on the Virginia Chesapeake Bay shoreline. This area is well-suited because: 1) accurate records of long-term shoreline changes are available; 2) the limit of offshore transport of sediment can be defined by both sedimentological and geomorphic evidence; 3) accurate data exists of rates of sea level rise from two independent sources; and 4) the morphology of the shoreline is clearly defined.

The model was applied individually to 146 beach units along the 336 km of shoreline. Relative sealevel rise in this area is as high as 5.43 mm/yr, and the mean shoreline retreat rate in this fetch-restricted environment is 0.98 m/yr. The long term, regional setting for a field application of the Bruun Rule is believed to be the context in which the model has the most physical meaning, as all seasonal or short-term variations in processes are averaged out.

The erosion rate predicted by the Bruun Rule fits the long term ($\approx$ 100 yr.) measured rate within 3%. Local variations between measured and predicted rates were highest in areas near marsh deposits along the shoreline, where the model loses physical meaning.

This regionsl concurrence of field measurements and Bruun Rule predictions of retreat of the Virginia Chesapeake Bay shoreline demonstrates that sealevel rise can account for all shore retreat in the system. However, sealevel rise "...plays only a permissive role in coastal erosion, not a causitive one" (Davis et al, 1973). The action of the short-term processes (waves, tide, surge, groundwater effects) can be regarded as the agents effecting the translation of sediment (erosion) in the presence of a rise in sea level.

COASTAL ARCHAEOLOGY AND SITE LOSS IN MAINE

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ABSTRACT

Maine has a vast archaeological resource in its littoral zone. To date nearly 1000 sites have been identified. Many of these are being

destroyed by sea erosion. In Maine there has been almost a decade of work relating to the problem of site loss and some general guidelines have been established for survey and evaluation. Funding and manpower continue to stand in the way of an effective program because of the non-permit nature of the site loss.

THE BRUUN RULE - A HISTORICAL PERSPECTIVE

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ABSTRACT

In 1962 Per Bruun proposed an hypothesis of sea level rise as a cause of shore erosion wherein: (1) There is a shoreward displacement of the beach profile as the upper beach is eroded; (2) The material eroded from the upper beach is equal in volume to the material deposited on the nearshore bottom; (3) The rise of the nearshore bottom as a result of this deposition is equal to the rise in sea level, thus maintaining a constant water depth in that area. Schwartz, in 1967, published a paper citing field and laboratory proof of the hypothesis, and suggested that it be called the Bruun Rule. The concept was subsequently adopted in the literature and is now commonly referred to as the Bruun Rule.

Kaplin, in his coastal geomorphology text published in the Soviet Union in 1973, took exception to Bruun being the originator of the concept, citing earlier publications by Zenkovich, Ionin, Budanov, and himself, in support of the Soviet claim of priority. Review of these works, in translation from the Russion, does, indeed, indicate an early inclusion in the Soviet literature of point 1 of the concept. However, mention of the relationships and quantification found in points 2 and 3 appear to be lacking.

During June 1978 Schwartz was able to meet with Kaplin in Moscow, to discuss this matter in further detail. Kaplin held that the three points contained in the Bruun Rule were commonly understood to prevail by Societ coastal specialists prior to 1962. After much discussion the two finally reached agreement by concluding that the best that could be said was that this was a case of simultaneous, but independent, research converging upon the same conclusions. Due to the history of its development, however, the concept will probably continue to be known as the Bruun Rule.

THREE PIERS AND AN INLET

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ABSTRACT

Along the Cherry Point sector of Puget Sound, shore drift is indicated in recent reports as either being to the north, or to the south in restricted cells between piers along the coast. Attesting that net shore drift is indeed to the south are the facts that: 1) the Cherry Point sector is bounded on the north by a headland bay beach and on the south by a large spit, both indicating predominant wave energy from the north and northwest, and 2) observations indicate sediment deposition on the north and northwest, and 2) observations indicate sediment deposition on the north, updrift, side of the piers and erosion on the south, downdrift, side. Aerial observations also reveal plumes of sediment bypassing the landward bulkheading or riprap of these piers, thus negating the idea of restricted drift cells.

The most northerly of the piers is that of ARCO. Crossing the beach and nearshore zone on .2 m diameter pilings, 46 m on center, it presents no obstacle to normal shore drift. Farther to the south, respectively, are the littoral zone riprap of INTALCO and the littoral zone bulkheading of the Mobil Oil Company piers. Both of these impede, but do not completely block, shore drift. On the other hand, a marina inlet dredged into the southwestern edge of the Sandy Point spit acts as a sediment trap for the predominantly southerly shore drift. The southern tip of the spit is presently undergoing severe erosion.

BRUUN'S RULE AND CONTINENTAL SHELF SEDIMENTATION: AN OCEANOGRAPHER'S VIEWPOINT

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ABSTRACT

Bruun's rule was formulated by a coastal engineer who wished to consider post-glacial sea level rise as a cause of beach erosion. Subsequent studies have concentrated primarily on short term (up to one year) and small-scale (beach and near-beach) applications of the theorem, also as an approach to the beach erosion problem. Bruun's rule has led to meaningful insights in this context. However, from the viewpoint of an oceanographer considering the continental shelf, Bruun's rule has a more basic application as a unifying principle for Holocene shelf sedimentation.

Most continental shelves have undergone more or less continuous transgression during the Holocene as a consequence of glacioeustatic sea level rise. Erosional shoreface retreat, in accordance with the Bruun principle, has sheared off the uppermost 10m of the late Wisconsin Subaerial surface. The debris thus generated has undergone kilometers to tens of kilometers of transport, downdrift and slightly offshore, before coming to rest. As a consequence, shelf surfaces are veneered with 0 to 10m of sediment, each grain of which has resided in a beach, but whose textures and structures are those of the shallow marine environment. The sediment may rest discomformably on backbarrier sands, lagoonal muds, directly on Pleistocene deposits or even on Tertiary or Mesozoic coastal plain units, but true beach deposits are generally missing. The Morphology of the shelf is thus a marine morphology. Sand ridges on the shelf are not beach ridges, but instead are large-scale post transgressional bedforms responding to storm or tidal flows. Larger sea floor ridges are the retreat paths of littoral drift convergences during the post-glacial period of sea level rise and shoreface retreat.

The Bruun model is still largely a kinematic rather than dynamic model; it says what happens, but not how it happens, or why. Our knowledge of surf dynamics is incomplete, but suffices to show that more than surf dynamics is required to explain erosional shoreface retreat. It seems reasonable to think in terms of two transport systems: a continuous, narrow, high intensity surf-driven system and a broader, intermittent offshore system driven by coastal storm currents. Coastal erosion and aggradation is a consequence of interaction between these two systems. We need to know much more about the "Coastal boundary layer" seaward of the surf and its behavior during storms, if we are to understand Bruun's scheme of coastal retreat.

THE SEDIMENTOLOGIC SIGNIFICANCE OF TIDAL DRAINAGE NETWORKS: A REEVALUATION OF TRADITIONAL MODELS OF SALT MARSH DEVELOPMENT

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ABSTRACT

Examination of the geomorphic characteristics of tidal drainage networks in the Duplin River system, Sapelo Island, Georgia, suggests that traditional models of salt marsh development are oversimplified, and make false assumptions regarding sedimentation rates and environmental statility. Accepted models of marsh maturation state that salt marshes develop from unvegetated mud flats, and gradually mature into high marshes through continual vertical accretion and lateral expansion. Sedimentation rates are assumed to be very high in the initial phases of this maturation. However, the Duplin tidal system, part of the extensive marsh belt between the Georgia - South Carolina

barrier island chain and the mainland, includes four distinct but coexesting drainage types at different stages of maturity, of which two are in equilibrium with the system and have ceased to develop. High rates of lateral migration, coupled with retention of inefficient pirated channel segments, suggest that sedimentation in the most youthful drainage areas are actually very low. Sedimentation rates in the two non-equilibrium drainage types are somewhat higher, due to intersystemic variations in channel hydrodynamics, levee development, and storm transport. Thus, the stability and level of maturity of salt marsh drainage is not restricted to any given developmental sequence, and may not be uniform within a single system.

THE GEOLOGIC DEVELOPMENT OF OKEFENOKEE SWAMP - A MULTIDISCIPLINARY APPROACH TO WETLAND RESEARCH

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ABSTRACT

The geologic development of Okefenokee Swamp, Georgia is being studied through a combination of geomorphic, biologic, archaeologic and remote sensing approaches. Vegetative zonation is being used to prepare a detailed map of relict beach ridges, formerly considered to be marine in origin, but now thought to be largely lacustrine. Geomorphic analysis of regional drainage development and pre-Trail Ridge erosional surfaces aid in interpreting the contribution of regional upwarping to formation of the swamp. Archaeologic investigations will provide information on paleoclimatic changes, and their relationship to swamp development.

Remotely sensed data are being used in mapping vegetative zonation and identifying relict beach ridges, updating of drainage maps of the swamp and basin uplands, preliminary surveying and identification of archaeological sites, comparison of ridge profiles, and examination of the swamp's shallow stratigraphy. By applying this multidisciplinary methodology, much valuable information on the development of this unique wetland environment is being obtained, which would not be revealed using more traditional geologic approaches.

RELATION BETWEEN HYDRODYNAMICS AND SEDIMENT TRANSPORT IN A SALT MARSH ESTUARY

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ABSTRACT

Sediment transport in a well-mixed, salt marsh estuary near Sapelo Island, Georgia was found to be closely related to several parameters of the tidal wave. The tide in the estuary is a damped cooscillating type exibiting a large phase lag between the head and mouth at high water. Ebb currents and ebb-related shear velocity (U*) dominate over the flood due to the large water slope that develops in the estuary during ebb.

A close correlation between maximum ebb shear velocity and a tidal datum fixed relative to the elevation of the salt marsh surrounding the estuary, indicates that modification of the tidal wave in the marsh is related to the domination of the ebb hemicycle. The energy dissipation rate for the total estuary/salt marsh system during any tidal cycle is two orders of magnitude greater than the dissipation rate in the estuary proper. The high rate of energy loss in the salt marsh retards flow and results in storage of water in the marsh around high tide creating an enhanced water slope as ebb begins at the seaward end of the estuary.

Bedform geometry and sand transport in the estuary reflect the ebb-dominated tidal dynamics. Large scale bedforms maintain an ebb-oriented geometry through both the ebb and flood. Bedform migration and net sand transport is in the ebb direction. Sand transport rates correlate well with a tidal datum fixed relative to the elevation of the salt marsh, similarly to shear velocity.

Because of the tidally varying shear and limited sources of sand, the magnitude of the yearly sand budget is low. Sand sources are local and part of the coarse fraction included in surficial sands is derived from subtidal scouring.