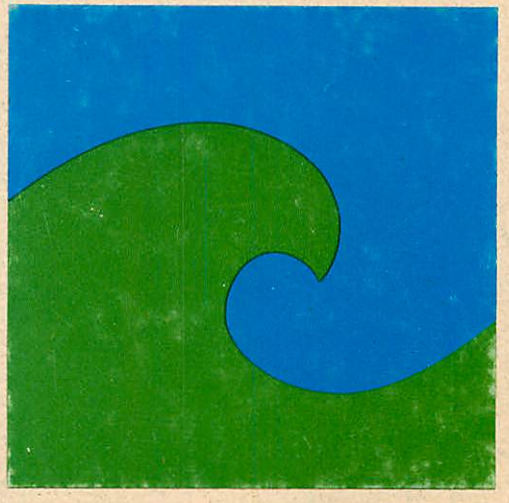
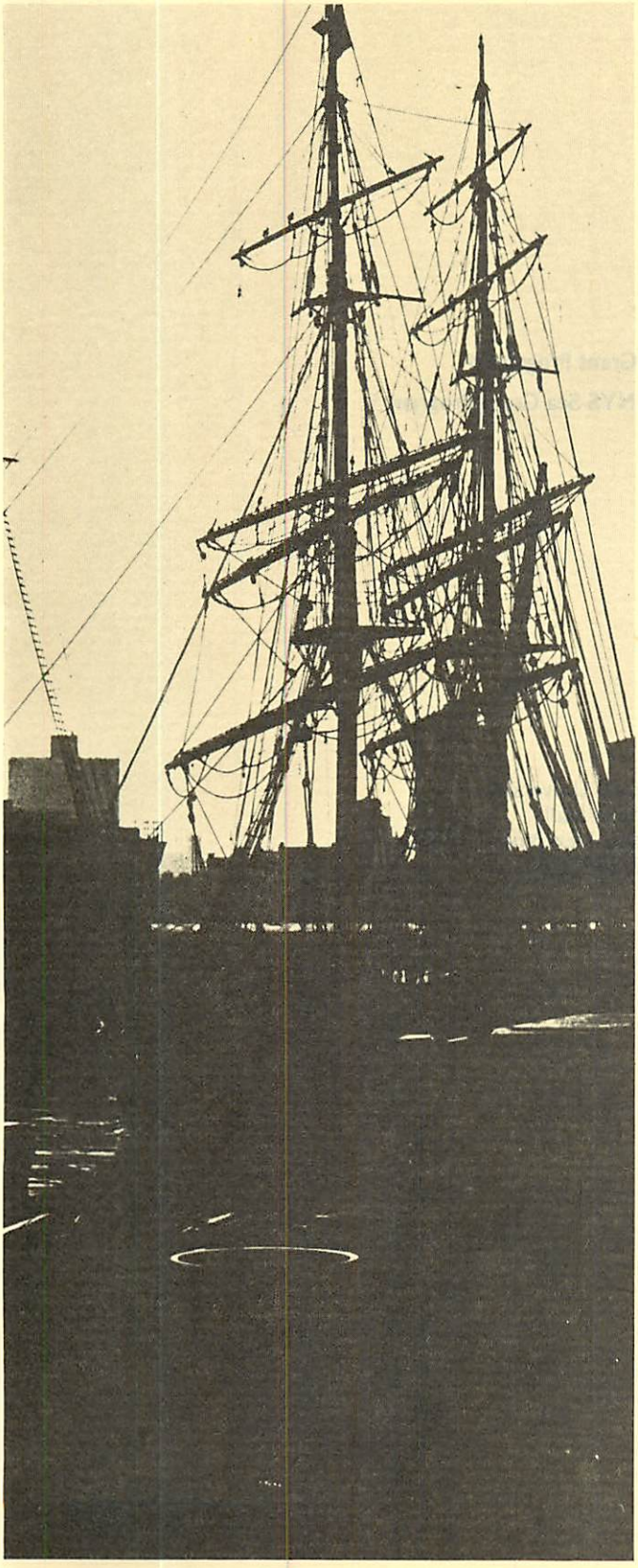
New York State Sea Grant Program

Annual 72 Report 73

State University of New York
and Cornell University



A report on the New York State Sea Grant Program from October 1972 to November 1973



NINETEEN SEVENTY-THREE was a significant year for coastal resource management. The Coastal Zone Management Act of 1972 gave the states a very important opportunity to deal with previously ignored problems. Meanwhile, a long-developing imbalance between petroleum production and consumption collided with international politics, erupting into a crisis in US petroleum supplies. The encounter was expressed here on the east coast as a conflict of environmentalists' concern for protecting the recreational and protein-producing resources of our coastal waters with public and governmental demands for offshore domestic oils and gas production. In New York the conflict developed against a background of earlier legislation which banned the exploitation of oil and gas deposits beneath Lakes Erie and Ontario for environmental reasons. Present conditions make inevitable some reassessment of New York's official position: a reluctance is embedded in the state constitution to exploit a resource commercially when that resource has natural values.

This growing recognition of the importance of New York's coastal region takes on added significance when placed in an historical perspective: two centuries' indifference to marine resources. From early colonial times the evident wealth of interior lands of the state attracted settlers away from coastal enterprises. During the eighteenth and nineteenth centuries a transportation corridor following the Hudson and Mohawk Rivers was extensively developed. Once the Great Lakes were reached, the vast rich interior of the continent lay open and accessible. New York's development followed that path. Key transshipment points grew up at Albany, Schenectady, Buffalo, and Oswego, with a major center in the port of New York. Transportation and urbanization grew around the canal system, advanced with the railroads, and mushroomed with highways and airlines. This "corridor economy" benefited the major ports but led to neglect of the earlier coastal resource base — a neglect we have only recently started to remedy.

A past record of inattention to coastal matters has not prevented New York from becoming one of the most aggressive states in defense of its environment. The recent environment plan of the NYS Department of Environmental Conservation (EnCon) has some forward-looking features. The well-publicized "death" of Lake Erie stimulated a new look at the potential of both the state's Great Lakes. There has also been real improvement, albeit at enormous cost, in the quality of our coastal waters. New York State Sea Grant is proud of its share in these achievements and of its joint role, with state agencies and industry, in grappling with the problems. Adequate management of the fragile coastal environments and rational use of their resources will not be easily achieved, but important progress has been and is being made.

Donald F. Squires
Director, NYS Sea Grant Program

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NEW YORK STATE SEA GRANT PROGRAM

State University of New York
99 Washington Avenue
Albany, New York 12210
518/474-5787

Cornell University
Fernow Hall
Ithaca, New York 14850
607/256-2162

ANNUAL REPORT CREDITS

Orville Terry, Jean Hopkins *writers/editors*
Michael Koen *cover designer*
Graphic Arts *production*
Central Administration Print Shop

INTERCONNECTIONS

One of Sea Grant's most striking characteristics is the complexity of its network of interconnections and cooperative linkages. Sea Grant activities are expected above all to be practical. There must be a direct loop extending from the user (a person needing something) to research and back to the user. In establishing such a loop, Sea Grant projects frequently require setting up multidisciplinary teams of research workers in various fields. The team may include Advisory Services personnel to establish communication with the user. The user himself is also part of the team, as much as possible. Such a team brings minds together organizationally; they may or may not need to be brought together geographically. Within the organization, Sea Grant activities are broadly distributed among research, advisory services, and education.

Sea Grant's second year in New York was marked by three major accomplishments:

(1) The multicampus organizational network grew stronger and sharpened the focus of diverse parts of SUNY and Cornell on specific areas (see Table 1);
(2) Mechanisms for establishing Program goals and priorities through the Advisory Councils were considerably refined;
(3) A long-term strategy for meeting these goals was worked out.

Developing interconnectedness to fullest advantage requires not only participation by a diversity of campuses but also a sense among participants of their common purpose and their place in the organization. In our second year, twelve campuses participated; more important, five strong research teams emerged (see Table 1). The team investigating power plant siting on Lake Ontario, put together by Ron Stewart of SUNY Albany's Atmospheric Sciences Research Center, is a good example: a dozen researchers from eight disciplines and five campuses were involved. Their results are described in Section IV.

The power plant group developed a multitude of valuable working relationships with state and local agencies and with industry people. Advisory Services-organized discussions helped get everyone talking with each other – Rochester Gas and Electric, for example, with the NYS Office of Parks and Recreation (OP&R), NYS Department of Environmental Conservation (EnCon), Cayuga County Planning Board, and representatives from the Cayuga County Cooperative Extension. Facilitating cooperation is precisely the Sea Grant style. Sea Grant is often able to supply a "neutral" meeting ground not otherwise available. Table 2 give some idea of the breadth of interconnections; at the center of this report is a chart displaying all the projects and their evolving status.

Besides acting as the "feedback loop" between researcher and user, Sea Grant's Advisory Services specialists plug in all kinds of connections. When people hear and recognize the name *Sea Grant,* that's due in large part to Advisory Services work – wide distribution of brochures, newsletters, mimeographed publications, and audio-cassettes, along with films, TV spots and guest appearances, displays, radio announcements, and speaking engagements. The movie *New York Faces the Sea* and a display exhibited at the New York State Fair, six county fairs, and two boat shows won awards in national competition. Sea Grant has funded a newly created position of economic development specialist for the Lake Erie coast; working jointly for New York Sea Grant's Advisory Services and Pennsylvania State University's Cooperative Extension, this specialist will help local residents in both states with problems stemming from high-water erosion and lake-related economic decline.

As the second major accomplishment of this past year, the Advisory Councils made significant progress in their task of defining program goals and establishing priorities among the individual proposals submitted by prospective investigators. The Advisory Council concept was thereby validated: that citizens representing the diverse constituencies of Sea Grant (see Table 3) are the best ones to pose the appropriate and necessary questions, "What for?" and "Why this more than that?" Discussions arising from the work of the Councils provided some of the most useful guidance for long-term program functioning.

Finally, our general strategy, reflecting Council and Governing Board guidance, is evolving toward a quick-response program with the following emphases:

(1) Mobilizing a broad base of institutional involvement, with due consideration for the needs of both coastlines;
(2) Developing a strong Sea Grant constituency among state and local governments, industry, and citizens' groups;
(3) Stressing activities and projects that make maximum use of existing data and research competence;
(4) Giving priority to projects that promise direct applicability;
(5) Giving priority to those short-term projects that offer fast results, i.e., quick-turnaround projects; and
(6) Developing a sense of statewide cooperative effort and partnership in progress toward common goals. □

Table 1 Intercampus/Interdisciplinary Teams in the NYS Sea Grant Program

COASTAL ZONE PLANNING TEAM

Coastal Zone Planning assists in developing an integrated management program for the state's coastal resources based on provisions of the state constitution and New York law as they currently apply to coastal zone management. The team may, for example, attempt to resolve conflicts over wetlands jurisdiction at both state and local levels; determine what coastal zone management strategies are actually being applied in specific areas of the state; correlate the environmental and economic conditions in Erie and Chautauqua Counties.

Planning	*Albany*
Law	*Albany, Buffalo*
Sociology	*Buffalo, Stony Brook*
Economics	*Buffalo, Fredonia*
History	*Stony Brook*
Advisory Services	

RECREATION TEAM

Recreation now focuses mainly on the marina industry, but also includes sport fisheries. The objectives are twofold: helping private marina operators obtain better technical and management information about their activities, and evaluating from the fisherman's viewpoint the success of the state's program to introduce salmon species into Lake Ontario.

Natural Resources	*Cornell*
Economics	*Cornell*
Geography	*Cortland*
Advisory Services	

POWER PLANT SITING TEAM

Power Plant Siting includes reviewing the state's siting policies and procedures and collecting information about the present siting process from the viewpoints of the public, the industry, and the government, using the Sterling site on Lake Ontario as a model. It means determining the size and temperature characteristics of thermal plumes; discovering more efficient use of waste heat and of buffer zones and transmission line corridors; studying power plant influence on plankton.

Atmospheric Sciences	*Albany*
Meteorological Science	*Oswego*
Political Sciences	*Buffalo*
Sociology	*Buffalo, Empire State*
Economics	*Buffalo*
Law	*Buffalo*
Biology	*Albany*
Engineering	*Cornell*
Advisory Services	

COASTAL STABILIZATION AND EROSION TEAM

Coastal Stabilization and Erosion works at identifying those natural and artificially induced geological processes shaping particular coastal regions of Long Island and the Great Lakes; analyzing the legal background as it is affected by physical processes in the coastal regions; examining the impacts of human utilization on coastal features.

Geological Sciences	*Binghamton, Buffalo*
Law	*Buffalo*
Engineering	*Buffalo*
Advisory Services	

AQUACULTURE AND FISHERIES TEAM

Aquaculture and Fisheries assists both recreational and commercial fishing by a wide spectrum of activities: collecting information so that a rational fisheries policy can be developed; determining biological significance of wetlands and how they can be regenerated; bringing the farming of useful marine organisms to the point of economic feasibility; working with the food-processing industry to solve its problems and to develop new products.

Biology	*College of Environmental Science and Forestry, Cornell, Oswego, Stony Brook*
Food Science	*Cornell, Louisiana State University*
Recreation Education	*Cortland*
Veterinary Medicine	*Cornell*
Natural Resources	*Cornell*
Advisory Services	

Table 2 Cooperative Arrangements of the NYS Sea Grant Program

AGENCIES AND GOVERNMENTS PARTICIPATING

State Departments

Environmental Conservation (EnCon), Commerce, Education

State Agencies

Office of Parks and Recreation (OP&R), Office of Planning Services (OPS), Office of Local Government, Atomic and Space Development Authority, Science and Technology Foundation, Public Service Commission (PSC)

Regional Groups

Southern Tier West Regional Planning Board, Genesee/Finger Lakes Regional Planning Board, Nassau-Suffolk Regional Planning Board, Erie County Planning Board, St. Lawrence-Eastern Ontario Commission, Allegheny State Parks Commission

International Entities

Canada Centre for Inland Waters, the Province of Ontario

INDUSTRIES PARTICIPATING

Shelter Island Oyster Company
Niagara Mohawk Power Corporation
Grumman Ecosystems, Inc.
Seneca Foods Corporation
Rochester Gas and Electric Corporation
Cooper's Fish Products
Empire State Paper Research Association
Palmer's Fish Market
Wallerstein Company
Frank M. Flower and Sons
Fire Island Association, Inc.
Blue Points Company
Wright-Malta Corporation
Long Island Oyster Farms of Inmont Corporation

(Below) Commercial fishermen looking over a beach seine. (Right) The joy of fishing — for striped bass. It looks like over 20 pounds.

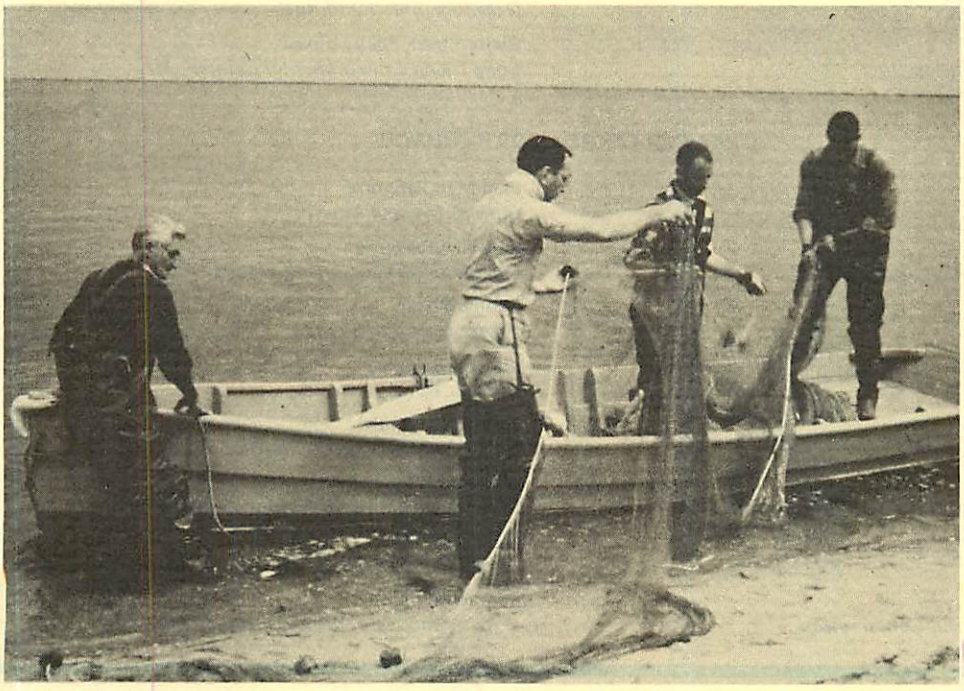


Table 3 Governing Board and Advisory Councils

GOVERNING BOARD

Albert M. Ammerman
President, Suffolk County Community College

Albert W. Brown
President, State University College at Brockport

W. Donald Cook
Vice-President for Research, Cornell University

Bruce Dearing, *ex officio*
Vice-Chancellor for Academic Programs, State University of New York

Henry Diamond
Commissioner, NYS Department of Environmental Conservation

J. Sherwood Dunham
Vice-President for Academic Affairs, State University College at Oswego

E.K. Fretwell, Jr.
President, State University College at Buffalo

S. Stewart Gordon
Executive Vice-President, State University at Binghamton

W. Keith Kennedy, *chairman*
Dean, NYS College of Agriculture and Life Sciences at Cornell University

Robert Ketter
President, State University at Buffalo

Neal L. Moylan
Commissioner, NYS Department of Commerce

T. Alexander Pond
Executive Vice-President, State University at Stony Brook

ATLANTIC ADVISORY COUNCIL

Lawrence Bertholf
Great South Bay Farmer's Cooperative

John Binner
Sportsmen's Council

Thomas Bishop
Moran Towing and Transportation

Matthew Cardaro
Long Island Lighting Company

Robert Cook
NYS Department of Environmental Conservation

Leo Geyer
Grumman Aerospace Corporation

Harry Kilthau
Long Island Waterfowlers Association, Inc.

Lee Koppelman
Nassau-Suffolk Regional Planning Board

Steven Lane
Bluepoints Company

Irving Like
Attorney-at-Law

Edward Miller
Marine insurance

Richard Miller
Long Island Fisherman's Association

G. Stanley Platt
Oceanographic Fund, Inc.

Claire Stern, *chairwoman*
Long Island Environmental Council, Inc.

GREAT LAKES ADVISORY COUNCIL

Leonard T. Crook
Great Lakes Basin Commission

Stuart Denslow
Genesee/Finger Lakes Regional Planning Board

Thomas Dyer, *chairman*
Attorney-at-Law

Irene Gossin
Town of Penfield

Gordon Haseley
Niagara County Farm Bureau

Keith Hopkins
Niagara Frontier, NYS Parks and Recreation Commission

Royal LaLonde
Hutchinson's Boat Works, Inc.

W. Mason Lawrence
NYS Department of Environmental Conservation

Paul MacClennon
Buffalo Evening News

G. Keith Rodgers
Canada Centre for Inland Waters

Leonard Starr
Fredonia Products, Inc.

William Steggles
Ontario Water Resources Commission

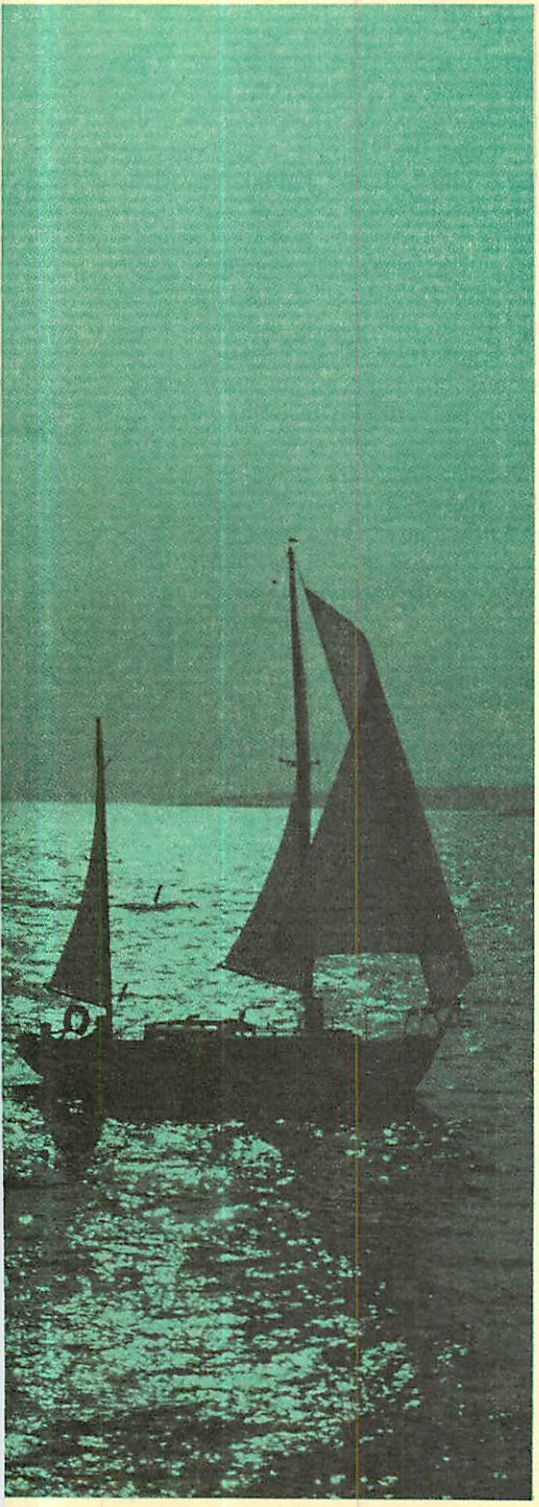
Joseph C. Swidler
NYS Public Service Commission

William E. Tyson
St. Lawrence-Eastern Ontario Commission

Marjorie Vesley
Lake Erie Basin Committee, League of Women Voters

Samuel Williams
O'Brien and Gere, Inc. (consulting engineers)

I. Raising Awareness



Developing effective solutions to coastal management problems requires first of all some degree of public awareness that the problems exist. Fortunately, an acute and widespread concern with environmental matters and past deficiencies provides a solid foundation. The public knows well that the environment has been abused, that it is highly vulnerable to continuing abuse, and that something needs to be done about the situation. However, aceptable solutions can be developed only when there is some understanding of exactly what is going wrong and why. Then one can talk about alternative courses of action and choose from among them, based on anticipated outcomes. The choices are not made in a vacuum, however; they are made in the context of existing organizations, competing powers, clashing interests – in a word, the political context. To this, Sea Grant can bring scientific input, communication via Advisory Services, and a useful marine-oriented viewpoint.

COASTAL ZONE PLANNING

New York Sea Grant's Coastal Zone Task Force, led by Paul Marr, grew out of a meeting of interestd Sea Grant people and regional planning directors in Syracuse in November 1972. Research workers and Advisory Services personnel discussed with the regional planners the status of coastal zone management in New York. A two-fold role for Sea Grant in coastal planning and management evolved from this and subsequent meetings. One was, of course, continuing research activity and maintaining communication channels with various publics. The other – unique but quite consistent with Sea Grant philosophy – was a liaison role among federal and state agencies and the legislature as they all began developing a coastal management plan for New York in response to the Coastal Zone Management Act of 1972.

To start its liaison work, the task force convened a coastal zone conference in Albany in Febraury 1973 (see *Managing Our Coastal Zone*, in the publications list for this section). The Honorable Perry B. Duryea, Speaker of the New York State Assembly, keynoted the conference and invited the attendees to make specific recommendations for new legislation. The task force and conference participants accepted the invitation and actively assisted in the preparation of each of two bills now before the legislature. NYS Department of Environmental Conservation (EnCon) and the State Office of Planning Services (OPS) are also working on plans bearing on the coastal zone, with the cooperation of – and many meetings with – task force members. Key regional planning groups, notably the Nassau-Suffolk and Genesee-Finger Lakes boards, are active in coastal management planning and have worked with Sea Grant.

Currently, Richard Nunez, a legislation specialist and task force member, is completing review of those provisions of state law and the state constitution which are relevant to the coastal management enterprise here. Some appear to have been long dormant and therefore ripe for repeal. Planner Joseph Heikoff, also on the task force, is preparing a study of the interaction

"Several times it's happened that while a squabble was going on between a local cellulose-laden industrial wastes or raw municipal sewage simply continued to

between successive levels of government as they confront coastal problems. Once the technical recommendations on a particular problem are in, he says, there begins the political bargaining that actually determines the form of the legislative solution. Trade-offs are to be expected in the difficult process of reaching a consensus. Any one jurisdiction holding out can stop everything in its tracks. Heikoff's work emphasizes case studies, including the well-publicized confrontation between pro- and anti-groin groups at Westhampton Beach. (Groins are structures extending out from a beach to protect it from erosion.) This particular dispute epitomizes a very important issue for the Long Island south shore beaches: to what extent continued massive public investment in protective structures for private property is justified, and, if the investment is made, what form it should take. There is substantial evidence that some of the groins built earlier retard erosion in one area only at the cost of accelerated erosion somewhere else. The potential for disagreement here is obvious.

Pual Marr is now completing an annotated bibliography of coastal zone publications of regional planning commissions in New York State. He will then review work done in other states, particularly techniques of boundary setting and land allocation. □

A HARD LOOK AT ENFORCEMENT

Coastal zone planning is not a completely new development. Water quality legislation, for example, has existed in various guises for a great many years. How effectively has the legislation achieved its purpose? What weaknesses in administration and enforcement have surfaced during these years? Answers to these questions may prove pertinent to the writing of new coastal legislation.

Robert Ford has investigated the day-to-day functioning of water quality laws in western New York State. He finds enforcement often ineffective. It functions most actively on the local level, despite the fact that enforcement authority is vested mainly in higher levels of government.

Ford and his students report a notable absence of initiative in using mandated powers directly. Public agencies have tended to negotiate with violators rather than to haul them into court. Mandated penalties have rarely been invoked. The general inclination has been to evade responsibility for enforcement wherever possible. Only when forced by the courts did the Atomic Energy Commission and the Corps of Engineers move on pollution — the former in the case of power plants, the latter in the case of discharge water quality.

When overlapping jurisdictions have developed, each agency tries to shift responsibility over to the other. Several times it's happened that while a squabble was going on between a local health department and a county agency, or a regional EnCon office, or a federal Environmental Protection Agency (EPA) office, cellulose-laden industrial wastes or raw municipal sewage simply continued to pour into Lake Erie or Lake Ontario. Effective, coordinated enforcement is the exception rather than the rule. Scant overall planning for enforcement has meant a crisis-by-crisis sequence of sporadic efforts — and those only because of loud public outcry.

Ford has isolated five variables that seem to account for much of the divergence between the law as written and as practiced: *visibility*, in which a smokestack belching out blact soot gets attention before invisible but noxious mercury in wastewater; *power*, relative rank of victims and offenders; *organizational persistence*, the inertia of "old-timer" agency staffs; *cooptation*, cooperation that turns into assimilation and thus smothers healthy dissent; and *economics*, the debate over who pays the high price of cleaning up.

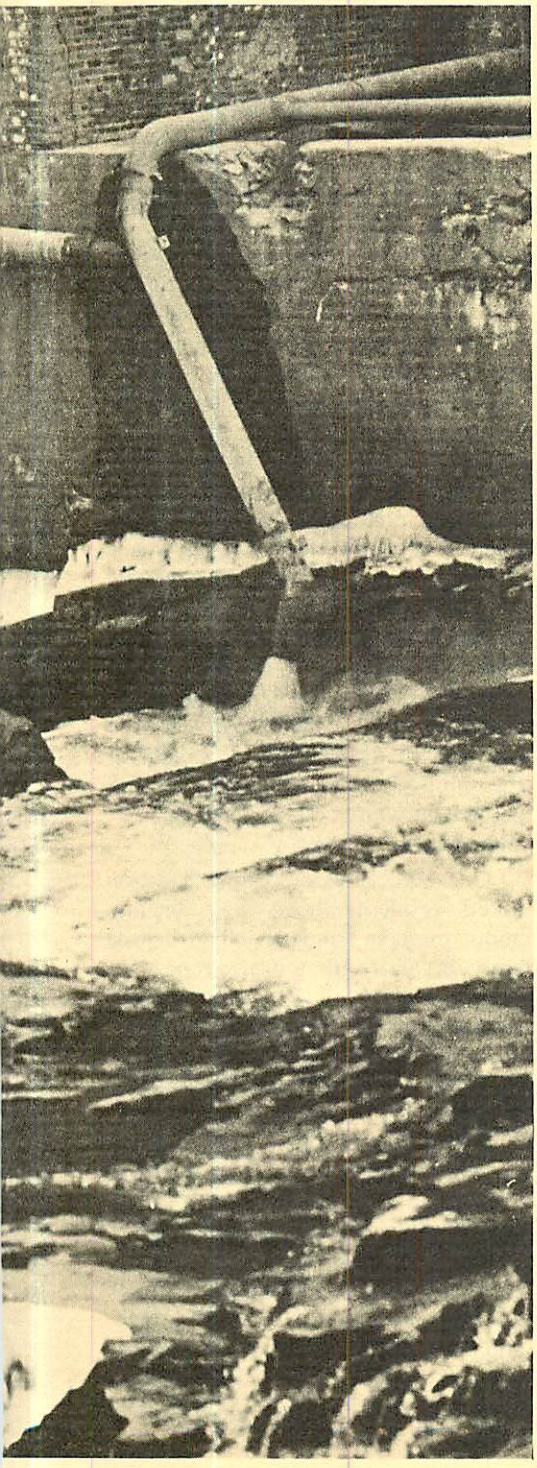
These deficiencies appear to arise less from personnel inadequacies than from weakness in organizational structure and practice. This being the case, it should be possible to alleviate at least some of the weaknesses when new legislation is being drawn up, as now. Ford suggests lawmakers write in (1) centralized, not overlapping authority, (2) better coordination and clarity of role among different levels of enforcement, (3) a way to relay stories of actual enforcement experience back to the planning levels, at the very least, or better, (4) one and the same locus for planning and enforcement; finally, (5) lawmakers should simply take more care in writing legislation, paying particular attention to what agency at which level is supposed to do what kind of enforcement, instead of "choice by afterthought." □

ENVIRONMENTAL IMPACT STATEMENTS

Environmental impact statements — oh, yes, a familiar requirement of environmental law. Well . . ., maybe not familiar enough. The more awareness the better. Advisory Services at Cornell gave a weeklong seminar on evaluating impact statements for Cooperative Extension staff and Sea Grant in-service training, with presentations by a delegate from the President's Council on Environmental Quality. Shortly thereafter, a downstate county board of representatives received an environmental impact statement from a federal agency on a proposed jet airport to be built there. They were debating hiring a staff to respond to the statement when one of the Cooperative Extension agents trained at the session came to the rescue and showed them how to do it themselves. They were much gratified, and asked for town officials to be trained, too. □

health department and a county agency, . . .
pour into Lake Erie or Lake Ontario."

Chemical wastes pour from factory outfall into stream.



Gordon Bishop, Newark Star Ledger

LOCAL DECISION-MAKING . . .

Some of the environmental decisions most strongly affecting the individual citizen are made by local-level authority, as we have seen in the realm of water quality enforcement. Zoning is another example. The mechanisms behind these decisions, the ways the value system works, are inadequately understood by most people. Therefore, public impact on local decision-making is often far less than it should be, certainly far less than the impact the other way around. Sea Grant, through the medium of important coastal issues, can contribute to public information on both technology and social process.

Paul Dommermuth's research seeks to identify the local power structure, both formal and informal, in Erie and Chautauqua Counties. He is examining the ways in which local power is actually applied to environmental issues and the constraints on it. He has conducted a series of interviews, first to identify the active leaders and then to enlist their cooperation in the study.

Among the official leaders are heads of sewer districts and heads of county planning; often, their environmental stance tends to be passive: "hold-the-line" policy maintenance. There are political leaders, in this case up-county and down-county mayors and legislators, with undertones of the classic urban-rural clash. There are business leaders: the Ralston-Purina Company, Niagara-Mohawk, Welch's grape products, wine companies, Bethlehem Steel. For all kinds of leaders, ecological priorities have to fit into an established most/least value system: most profit, least cost, most favorable image, least uproar – and definitely least taxes!

Many of the local decisions obviously depend on how conflicts of interest get resolved. How local interest groups compete, how committed they are to the public good, and how broadly they define "public" (Is the public the county? The town? The village? The block?) will emerge from Dommermuth's study. Then we should know what community leaders believe to be ecological issues, how involved they see themselves, how autonomous or constrained by outside forces they consider themselves to be, and by what criteria they choose among the inevitable competing interests, of which they themselves are part. □

. . . LOCAL ECONOMICS, LOCAL ATTITUDES

Another Sea Grant study begun in Year II, by Starler, Fisher, and Fisher, deals with the same two counties, Erie and Chautauqua, plus one other county, Cattaraugus. The local leaders Dommermuth interviewed may be quite interested when the final results are in: the study measures public awareness of Lake Erie and documents the significance of Lake Erie's health to the economy of the counties. The map at the end of this annual report may make that significance seem so obvious as to be unnecessary to mention, but at least in Chautauqua County, when people talk about "the lake," they mean Lake Chautauqua, not Erie.

Over the period 1950-1970, New York grew economically at approximately half the national rate; during the same period, the three western counties mentioned grew at less than half the *state* rate. Why were these counties left behind? Of many contributing factors, one certainly was Lake Erie's increasing pollution and decline as a regional resource during those two decades. Lake-related employment not only failed to increase in proportion to national and state growth but actually showed a net decline. Lake Erie fisheries and resort areas did not provide the jobs and incomes they had provided in the past. The fisherman, the owner of a motel for fishermen, the gas pump attendant at a marina, the bartender at the bar down the street from the Dunkirk fishing pier – such "direct" income was lost; "indirect" income, too – the groceries the gas attendant would have bought, the haircuts for

TABLE 4 *Property Values in the Town of Pomfret*

Note: Index numbers are used in place of actual prices. Note that values in 1965, a year about midway, are represented by the index base of 100.

Year	*Upland Property*	*Lakefront Nonseasonal Property*	*Seasonal Homes*
1956	100.89	114.04	122.50
1957	87.50	112.29	120.00
1958	88.09	107.02	114.22
1959	94.42	103.61	112.17
1960	96.39	106.63	110.23
1961	97.32	105.20	108.10
1962	97.47	105.10	108.11
1963	97.59	104.82	105.37
1964	98.21	102.26	102.34
1965	100.00	100.00	100.00
1966	102.12	98.95	97.71
1967	103.20	97.68	95.98
1968	105.22	97.32	98.46
1969	106.69	96.48	98.25
1970	107.63	98.30	97.87
1971	119.92	98.90	97.30

the bartender and the apartment rent he would have paid. One "direct" job supports one and one-half "indirect" jobs; one tourist dollar becomes two dollars in the local economy, according to this study.

Norman Starler, with Warren and Ann Fisher, all economists, examined how Lake Erie's decline directly affected the local economy in a "primary impact zone" two to three miles deep along the lakeshore, and indirectly the regional economy as well. They prepared and distributed questionnaires from which they are estimating the losses in income, jobs, property values, and taxes. They hope by quantifying the losses from pollution – so many thousand fewer jobs, so many dollars less income – to show people how much they have to regain by cutting off the sources of pollution and footing some cleanup costs.

Preliminary results, still inconclusive, show that of 1,079 companies in the "impact zone" with probable ties to the lake, 236 responding so far list a total of 506 full-time lake-related jobs. Commerical fisheries' catches are down from an annual average of 722,000 pounds in the 1950s to 171,000 pounds in the 1970s. In current dollars that's a dollar drop from an annual average above $150,000 in the 1950s to $60,000 in 1972. Happily, recent equipment purchases, licenses, and catches have all increased, perhaps due to less algae consuming the oxygen and good numbers of walleye or yellow pike. (Recreational fishing data is not available for the years in question.) The marina business is also beginning a slow upturn after a 15-year recession.

Property values add another dimension to the picture. Waterfront property – which everywhere else in the nation is hotly sought after – in the Lake Erie town of Pomfret slid some 18 index points in value from 1956 to 1969; then came an upturn of 2 points in 1971 (see Table 4). Values for seasonal homes dropped 25 points and are still falling. Upland property, by contrast, started out as least valuable of the three but is now 21 index points higher than waterfront property. To the extent that deterioration of the lake has reduced local taxes by reducing property values, improving the lake's quality should refurbish town coffers.

Another aspect of the situation is expressed in people's changing attitudes toward the lake, again sampled by questionnaire. Preliminary results here suggest a recent trend toward more positive responses, though local residents emphatically believe the lake is polluted. Most visitors to the two state parks located on the shore between Buffalo and the state line came from some distance away. They were evidently more willing to spend time and money there than were local residents. They came to swim, to picnic, and to enjoy peace and quiet, in that order. Even though one park was closed to swimming, and had been for several years, many swam there anyway because the water quality looked improved (perhaps because of recent high water levels). When local residents were asked why they didn't "recreate" by the lake, most generalized "too polluted," and many specified "too many dead fish," "smells bad," "too much sewage," and the like – a high proportion of pollution-related answers. Non-pollution reasons like "inadequate facilities," "too rocky," or "lake too large" were low down on the list. Nine percent used the lake in the spring, 55 percent in the summer, 5 percent in the fall, 0.5 percent in winter, 11 percent all year, and 18 percent never.

One especially interesting question asked residents how their feelings about the lake had changed during the span of years they'd lived near it. Those who'd been around since 1950 thought the lake had been "grade A" in 1950, had deteriorated to "grade E" by 1970 – but found themselves grading it D, C, and even B for 1973. People who arrived in 1965 thought the lake rated D or E back then but now rated it B more than anything else. Recent arrivals (1970) weren't so encouraged; they rated it E or D for 1970, C for 1973. Evidently, 1970 was a visible turning point in water quality, and some of the efforts of the past few years to improve lake conditions have been effective in improving the lake's image. □

"In spite of the fact that the port was the source of Buffalo's original growth, it may now be almost insignificant to the region's economy."

THE TRUTH ABOUT THE PORT OF BUFFALO

One of the economic facets of western New York which has received research attention in Sea Grant Year II has proved out a little differently than expected. The port of Buffalo's declining activity in recent years may not be adversely affecting the regional economy after all, says economist Robert Crow. Tonnages of grain, iron ore, limestone, and coal moving into the area for use by the big milling, steel, and electric generation industries are higher than ever. But the number of ships in and out of the port – both general cargo and bulk cargo carrying those commodities named – has spiraled downward. The only possible conclusion is that other transportation – trucks, and especially railroads – is taking up the slack. Comparative cost data on the other transportation modes are unavailable, but systematic application of Crow's economic model of the Buffalo SMSA (Standard Metropolitan Statistical Area) should show fairly conclusive proof. It is important for planners/managers to know that industries assumed to be closely port-related may not be tied to the port at all. In spite of the fact that the port was the source of Buffalo's original growth, it may now be almost insignificant to the region's economy. □

GREAT LAKES MANAGEMENT

Those people living beside Lake Erie who think of Lake Chautauqua when you say "the lake" are pretty much like the rest of us. That's why raising awareness is one of Sea Grant's main themes. In much of New York State, when you say "coastal zone," people think of the ocean. They just don't remember that the state owns half of Lake Ontario, plus a piece of Lake Erie, plus part of the St. Lawrence – a huge resource.

But how can active, responsive, joint management best be institutionalized? Leonard Dworsky, director of the Cornell University Water Resources and Marine Sciences Center, and George R. Francis, chairman of the Department of Man-Environment Studies, University of Waterloo (Ontario), were co-chairmen of a series of seminars at which faculty members and government representatives from both the United States and Canada explored possible answers to this question. Two major conclusions were reached by the participants. One took the form of general agreement that institutional remodelling is in fact needed, and must be rooted in local and regional arrangements. The other was the identification of two possible alternatives for accomplishing the needed change.

But some people are acutely aware of the Great Lakes. Congressman Charles A. Vanik of Ohio (one of the eight lake states) described some of the urgent pressures for improved Great Lakes management:

> The problems of stable water levels have grown more and more complicated: ship owners would like to deepen the channels and rivers connecting the Great Lakes so bigger and heavier ships can bring in more cargo; hydroelectric producers want to divert more water and keep water level flows high to allow them to make more electricity; industrial and domestic water consumption is rising while their pollution discharges present other problems; millions of Canadians and Americans want more recreational space; homeowners demand action to save their land from eroding into the lakes. (*Congressional Record*, September 27, 1973)

With the exception of Lake Michigan, which is entirely within United States jurisdiction, Great Lakes management is an international problem. The Canadian-US border runs through four of the five lakes. The IJC (International Joint Commission of the United States and Canada), established by treaty in 1909 to resolve disputes about transborder waters including the Great Lakes, exercises some degree of control. The Canadian and United States membership of the IJC has a conglomeration of responsibilities along a very extended international boundary, responsibilities that amount to whatever the two nations have relegated to them at any given time. It is hardly surprising, then, that lake management has not always received as much IJC attention as current environmental emphasis calls for.

The first alternative would expand the powers and autonomy of the IJC to increase its effectiveness in the Great Lakes region. The second would create, by treaty, a new international body to supplant IJC in the Great Lakes Basin. The IJC would carry on outside the Basin but be relieved of present treaty responsibilities within the Basin. Functions of the present IJC Great Lakes boards would be absorbed by the new body. The Columbia River Treaty (in the Pacific Northwest) provides some precedent for applying separate management to a transborder water system.

Either alternative would require that existing federal, provincial, state, and regional agencies draw closer together in harmonious and active work under guidelines to be established by the centralized binational policy-making body (either the remodeled or brand-new version).

To examine in detail the problems to be dealt with by these proposed management groups, Dworsky organized a graduate seminar at Cornell. This seminar acted as an "experimental binational operations office" to

investigate some facets of joint regional management. A series of reports resulted (see publications list for this section).

To bring this work to the attention of the public and Congress, Dworsky held a number of talks with congressmen from districts in the Great Lakes Basin. These culminated in testimony before a subcommittee of the Foreign Affairs Committee of the House of Representatives on May 1, 1973. The findings of the seminar and of the "experimental operations office" were discussed in considerable detail at this hearing. As a further indication of House interest in IJC matters, Congressman Vanik introduced a bill to require Senate confirmation of Presidential appointments to the commission. □

ADVICE AND SERVICE ON HIGH WATER LEVELS

The umbrella management level may be international, but most of the nitty-gritty still happens at the local level. *Our Great Lakes*, a booklet from the Wisconsin Sea Grant Program, gives a broad outline of who is responsible for what in the Great Lakes, pointing out, "Public and private organizations are constantly being added to the expanding collage of interlocking, intersecting, and overlapping jurisdictions. . . . The primary responsibility for managing the Great Lakes shoreline still resides with local communities. Local ordinances relevant to the lakes vary drastically from one community to the next, and a citizen seeking immediate relief for some lake-related problem would be well advised to start at home."(p. 37)

In the summer of 1973, Advisory Services assigned a staff specialist, Larry Leopold, to help get information for property owners anxious to protect their homes from high water damage, and to come up with some ideas on what they needed. It is important, Leopold found, to raise people's awareness of the longevity of weather effects. Rainfall over the entire lakes basin is what ultimately causes high water. An increased level of one foot on Lake Superior takes three years to work its way down to Lake Ontario, a natural hydraulic situation scarcely affected by flow control decisions. Newspapers had made no mention of the potential overwash damage from winds blowing across unusually ice-free waters in late winter; local weather reports come out of Cleveland and broadcasts give no explanations of weather effects on Great Lakes behavior. Many local people attribute Lake Ontario high water entirely to flow control decisions over which, they say, shipping and electric power interests exercise entirely too much influence. Feelings run high because of the considerable damage involved, but laying all the blame on any single "fault" is likely to be an oversimplication. It is certain that better information on the consequences of weather and natural processes, coupled with preventive measures, could have saved communities from some of the damage incurred, and still is needed to cope with potential spring high water in 1974, 1975, and 1976.

Advisory Services staff put together and distributed a fact sheet about delays in the Corps of Engineers' Operation Foresight, a dike-building project to prevent flooding, originally scheduled for completion in March 1973. The project had gotten snagged on getting easements from shorefront property owners and town reluctance to guarantee removal costs (the problem of spending a good deal of money for a small fraction of the citizenry). The Corps of Engineers is authorized for flood protection, and couldn't visualize building a dike with gaps in it; so they finally decided to build gabions (piles of rocks in wire baskets) for erosion protection, instead.

Advisory Services also got lots of requests from homeowners and professional engineers and contractors for A/S reference lists on how to build shore structures like bulkheads, seawalls, sandbag walls, and gabions. These structures were relatively unfamiliar to local builders and contractors until recent high water levels increased demand. □

(Left) Considerable property damage from storms combined with high water levels on Lake Ontario.
(Right) Gabions stacked to protect shoreline.

CHANGING PEOPLE'S ATTITUDES

Another way to raise awareness of coastal needs is through television. The pervasive influence of TV on the American public hardly requires documentation. Advisory Services is using TV for program exposure and information; but can television be used to change the attitudes of viewers on environmental matters? David Hanselman is in the process of testing detectable attitude change in junior and senior high students and in community volunteer club members as a result of viewing model TV spots in "alternative choice" formats. An alternative choice format describes a problem, like filling in wetlands for housebuilding, and an alternative, like preserving wetlands for natural food production. Three such spots, 30 seconds each, have been produced and screened: on wetlands, designing cities for people, and beach erosion. Questionnaires testing audience reaction right after viewing and two weeks later are being analyzed. Preliminary results suggest that a 30-second spot may be too short to get environmental issues across to the average viewer; moreover, it is doubtful TV by itself can reverse a strong community attitude.

Exactly how strong *is* community opinion on environmental topics? How strong does it have to be to change the institutions, the "establishment," the arrangements of society that lead to pollution and environmental abuse?

As sociologist Andrew Collver points out, "The trouble with the environment is man. . . . What has to be managed is not the environment itself but man's behavior." Anyone seeking to change institutions and thereby to change behavior would do well to understand the processes by which institutions develop and change. In almost every instance the problem is not one of insufficient resources but of how resources are distributed and used. Use and distribution of resources depends on the institutional structure of the society. This being the case, our question becomes, "How do you change an institutional structure that has generated a maldistribution and misuse of resources?" Institutions have no real existence except in the minds of the people, but changes in institutions hardly ever originate among those who are most involved in the life of the institution. Demands for change are more likely to arise from outsiders. This is one reason why public opinion has an important role to play.

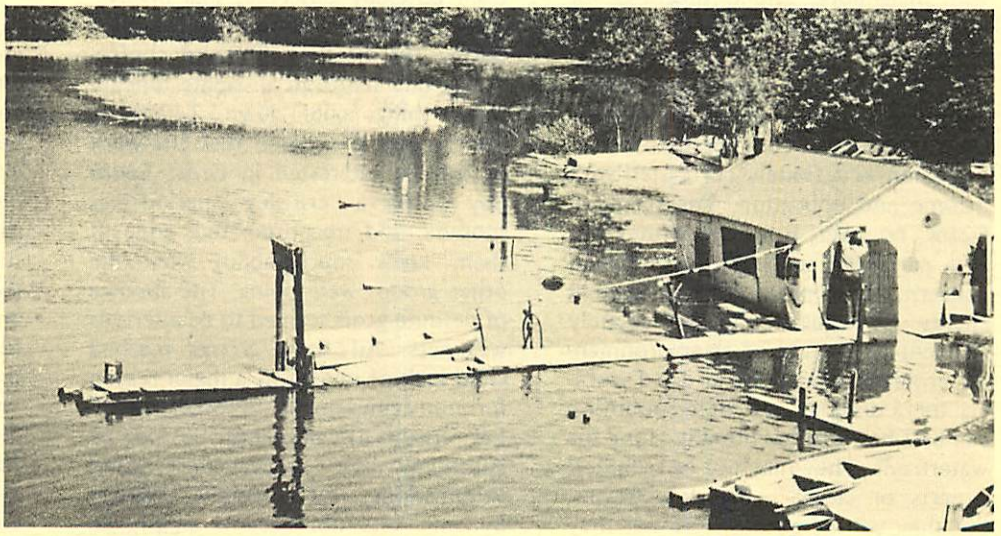
Andrew Collver and his research group have identified a sequence of steps in the process which leads to institutional change, in this case with the aim of improving environmental management.

(1) *Change in beliefs about the environment.* Before a movement for change can actually get under way, a substantial number of people must take a fresh look at the situation and see a widening gap between desires and fulfillment. This widening can be as much the result of rising expectations as of deteriorating conditions.

There is no doubt that a change in beliefs about the environment has occured in recent years. To document this change in a local situation on Long Island's north shore, Collver students sampled the number of editorials on coastal management issues plublished in *Newsday*, a Long Island paper, for every fifth year from 1947 to 1972/73. The average number of editorials per year was 5 for the period through 1957. It rose to nearly 26 per year in the period since then.

An opinion survey clearly indicated that the people questioned – all Long Islanders – were especially concerned about the *marine* environment. Those living near the shore were much more likely to see the environment as a problem than those living in the interior.

(2) *Loss of confidence in the old management system.* It takes a crisis of confidence to generate a strong movement for change. Once enough people have been jarred out of the complacent assumption that responsible, capable leaders are in charge and that "they" will take care of all problems, the citizens begin to put



Damage to towns and individual businesses, like the marina above, has aroused urgent citizen concern along the Great Lakes coast.

pressure on the institution to change – sometimes with limited or no effect. Quite often, loss of confidence in the system is expressed in a "retreat to the grassroots." Residents of a locality try to break free from controls imposed by a government once they feel it is too far away and does not respond to their needs. Unfortunately, home rule still leaves many of the community's problems unsolved. A small town or village may have the will but not the bargaining position to negotiate adroitly with large business corporations and big government.

Collver's group is now working on a questionnaire to delve more deeply into matters of alienation from established authorities. A pretest of the questionnaire reveals people's preference for scientists as a planning force (over elected officials, professional planners, residents, industry, or real estate), because scientists are seen as having no ax to grind. The present political climate has apparently produced a heightened sensitivity to conflicts of interest in government and industry.

(3) *Strong, continuing pressure from outside the system.* The group reports two studies on the mobilization of citizen pressure. One study, on who gets involved in environmental controversies, profiled people who discuss with neighbors, attend meetings, or file complaints. They tend to be in the 31-50 age group, male (though more women had filed complaints about industry), and in an occupation requiring skill in verbal communication. Participation is definitely correlated with income and education. The strongest factor, however, is how near they live to a particular spot of environmental concern. The peak of involvement energy is to be found immediately adjacent to the site of an environmental problem. The cadre of hard workers for a drive against water pollution can best be recruited literally along the waterfront. They may not be technical experts or clever political tacticians, but they will be enthusiastic and they will invest time because they personally have more at stake than others. Since such energy is highly localized, it probably cannot be tapped for abstract or generalized causes unless the local cause is clearly involved with the larger one. Thus, very few people will take the trouble to participate in an Association for the Preservation of the North Shore of Long Island, but many will get involved to save their own particular north shore spot. A small local committee will be strong in dedication and sustained drive, but it will be too small and weak to deal adequately with the very large institutions it seeks to change. According to Collver, "Some way is needed to augment and magnify the force of small committees without losing the basic dynamic of local interest." A federation approach might work.

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The other study on pressure groups was concerned with exactly this matter of organization. It indicated, as has been generally observed, that involvement is relatively easy to maintain during the heat of a major controversy, but tends to dissipate quickly when things cool down. Telephone interviewers discovered that the work of groups interested in Great South Bay during a "crisisless" period was sporadic and uncoordinated; none of them knew much about what the other groups were doing. The absence of definite goals seemed to be a serious weakness. All those groups reached cited lack of money as a major reason for non-achievement. Another potential organizational danger is loss of autonomy: how can local conservation commissions, for example, remain dynamic and not become simply an arm of the local establishment?

Steps 4-9 in Collver's sequence leading to change are not now being directly investigated. "We have yet to work out tools for analyzing public attitudes toward major dimensions of management structure," Collver says, "such as level of government responsibility for management, public versus private ownership and entrepreneurship, and the limits of public control over private property." He describes the steps as follows:

(4) *Work at all levels of government.* The present coastal zone management system relies heavily on village and town governments. Weaknesses here include parochial narrowness, inability to resist pressure from large corporations, and lack of financial resources. All levels of government will have to be involved cooperatively; pressure will therefore have to be applied at all levels.

(5) *Breaking up interlocking directorates.* In booming suburban areas, where the rate of development of coastal lands is highest, one should not be surprised to find successful politicians closely aligned with real estate development interests. This partnership arises quite naturally out of mutual needs; the developers and speculators need favorable zoning decisions, and the politicians need campaign funds. Arrangements may also exist between the commercial-political partnership and the information sources, like newspapers, which stand to benefit from public notices and real estate advertisements, and engineering firms, some of which can be counted on to deliver reports with pseudo-scientific

support for politically preconceived plans.

(6) *Administrative inventions.* Once the situation has been opened up for real change, someone has to come up with plans. A revolutionary restructuring of the entire system is not recommended. New administrative inventions should be introduced incrementally and as experiments; this would be more easily accepted than would wholesale reform.

(7) *Enactment of new programs.* People with vested interests in the old system have an arsenal of defensive weapons to prevent change at this stage. Any enactment, whether voluntary public program, or a business practice with costs to be passed on, or an administrative order from some governmental level, or a legislative action or referendum, requires public understanding and support.

(8) *Monitoring, maintenance, and improvement of new programs.* Enactment is only the halfway point. Beyond that lie years of work to obtain sufficient funds for the program, watchfulness against attempts to reestablish the old partnerships, and readiness to redesign parts that prove to be faulty or inadequate.

(9) *Restoration of trust.* The movement for change in coastal management began with a crisis of confidence in the old system. If designers of a new system do a good job building in automatic provisions for continual updating and for watchdogging on behalf of the community, the day of restored trust may eventually be reached. This happy ending is not assured, says Collver. "It may turn out after all that the price of maintaining environmental quality is eternal vigilance."

Coastal zone management is a very broad cause, encompassing a wide range of issues. As these are further defined, more informed decisions on priority can be made. Public opinion research has an important role in making effective public group action possible. □

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Long Island Sound: The Urban Sea by D.F. Squires. Bulletin, The Sierra Club. 4 pp. February 1972.

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An Investigation of the Federal, State and Local Oil Spill Contingency Plans for the Long Island Sound Area by S.T. Low. 180 pp. February 1973.

Managing Our Coastal Zone. Proceedings of a Conference on Coastal Zone Management, Albany, New York, February 20-21, 1973. 78 pp. February 1973.

An Information System for the Management of Lake Ontario by H.D. Reynolds. 190 pp. May 1973.

Environmental Management of Great Lakes International Boundary Areas: A Case Study of the Niagara Urban Region by D.R. Kisicki. 303 pp. May 1973.

Natural Resources Management in the Great Lakes Basin by J.A. Burkholder. 172 pp. May 1973.

Public Participation in Water and Land Management by A.L. Thomsen. 194 pp. May 1973.

Toward a National Population Redistribution Policy: Some Policy Issues by L.W. Saunders. 209 pp. May 1973.

Management of the Biological Resources of the Lake Ontario Basin by D.M. Carlsen. 264 pp. August 1973.

Dunes by David Hanselman. Videotape, sound, color. 30 sec. Fall 1973.

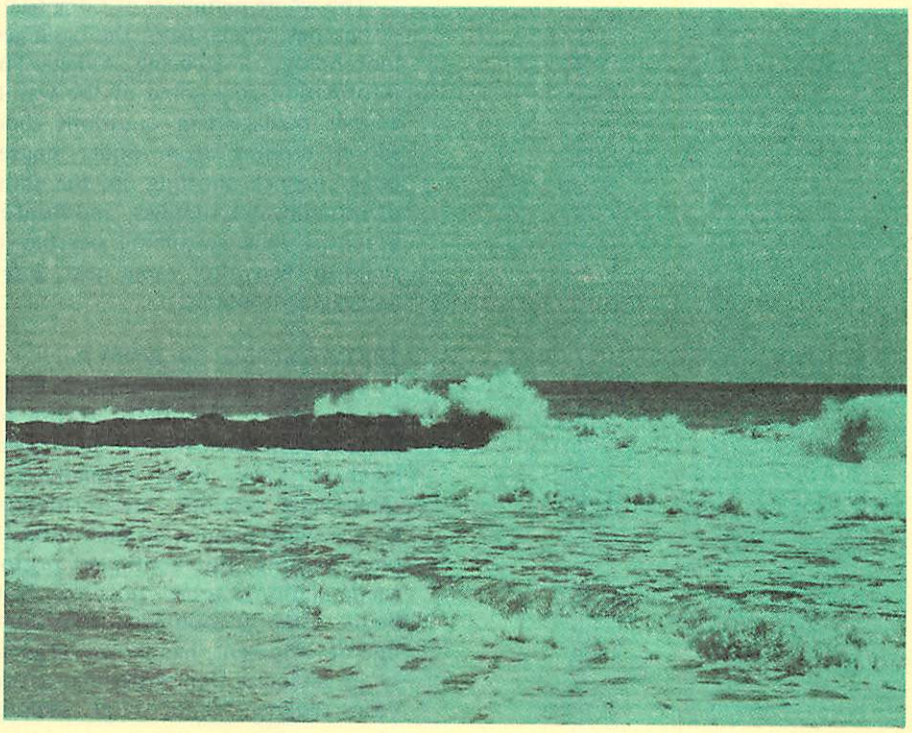
A Program for the Great Lakes by Richard W. Gross. The Conservationist, pp. ii-iii. October/November 1973.

Land Management in the Lake Ontario Basin by J.M. Wolf. 55 pp. December 1973.

Public Images and Coastal Zone Management by O.A. Collver. 24 pp. January 1974.

Public Images and Coastal Zone Management, Part II: Technical Progress by O.A. Collver. 12 pp. January 1974.

Waves breaking on a Long Island groin.



II. Managing Resources

The variety and scale of New York's natural marine resources begin to be understood and appreciated from the moment we realize that those resources are vulnerable and that we must begin to do some caretaking. It is no coincidence that awareness and the move toward resource management happen at the same time, each is essential to the other. Their variety and extent make these resources a *public* problem, owned in common; hence, conflicts — one public interest versus another public interest, public versus private interest — are almost inevitable. These conflicts are so complex as to boggle the mind, and generate such intense feelings that the political actions needed to resolve them may be thwarted — a self-defeating cycle.

Yes, we need rational planning and management for multiple use. That's unarguable, even a cliché. Multiple use is an attractive concept, but explosive political issues are contained therein. Meanwhile, we need facts about the marine resources, now more than ever. Some facts are known, but many are not. These research projects all aim at facts about resources. They are studies *toward* management.

SHORES AND BAY BOTTOMS

The whole perimeter of Long Island — beaches, inlets, bays, the basic geomorphology — is being studied. This information goes some of the way to answer management questions about shores eroding from under houses, boat channels shoaling up, the status of groundwater supplies, and locating potential new swimming beaches or shellfish beds, to name just a few management interests.

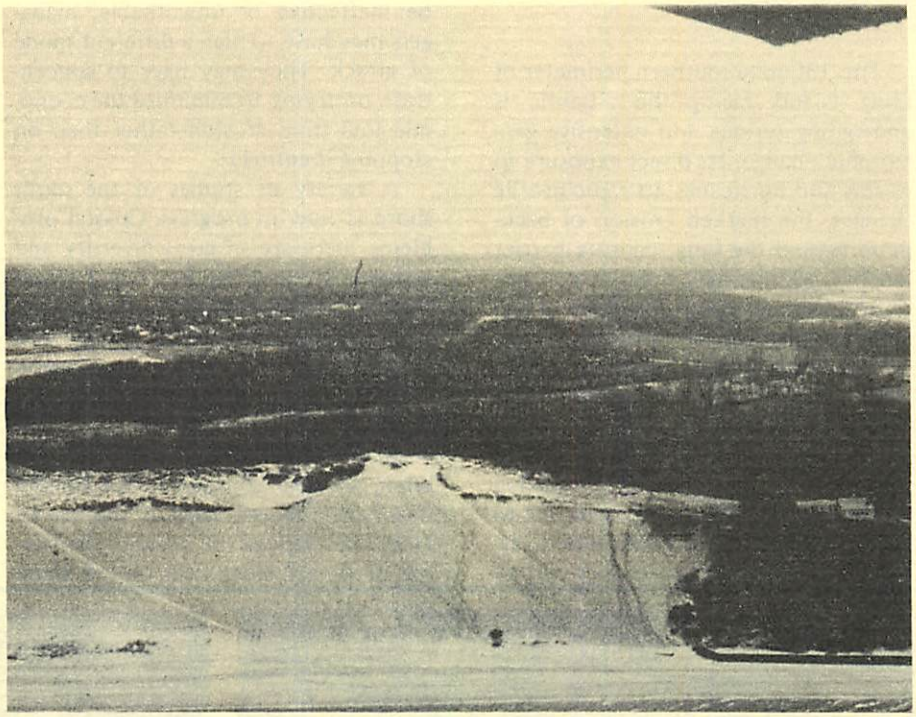
The Peconics and Gardiner's Bay

Sediment data indicates that in the Peconic Bays, the limits of use for present purposes have just about been reached. These bays, formerly rich shellfishing grounds, are surrounded by a growing population that evidently likes boating. But continued organic accumulation, some possibly from boats, some undoubtedly from shoreline development, has shown up clearly in geologist Daniel Brennan's two-year sediment and water samples. Bottom material everywhere is sand mixed with silt; there is very little gravel in the sand. The fine, silty sands are thoroughly mixed, the medium sands fairly clean and separated.

Some spots in the central areas of the bays have accumulated organic sediment very near or possibly above their capacity to oxidize it. This means eutrophication is imminent. If present practices continue, we can expect such undesirable consequences as algal blooms and deteriorated water quality. Brennan recommends that boats immediately stop the self-defeating practice of dumping sewage and begin using holding tanks. Domestic drainage, much of which is still raw sewage or seepage from septic tanks, should be treated to intercept organic particles and inorganic nutrients now reaching the bays. If present practices are turned around, we can expect some happy consequences. The shallow margins of the bays get a good oxygen

supply from tidal currents; this helps prevent anaerobic accumulations. Duck farms, two good-sized ones on the north fork, now operate settling tanks for their wastes, according to new regulations. That eliminates a significant source of organic waste. The once-abundant oysters might again be grown successfully in most areas, in reasonable compatibility with recreational boating.

Gardiner's Bay is somewhat better off than the Peconics, although it does have some local accumulations of organic sediment. It is more exposed than the Peconics to water exchange with Block Island Sound and the Atlantic. It is also actively fished by commercial "draggers," fishing boats that drag nets across the bottom for species like flounder or cod. This stirs up the bottom sediments and affects oxidation somewhat, though to what extent Brennan has not yet determined.



This bluff shows damage from motorbikes and other abuse.

Coastal Inventory of Eastern Bays

The beaches around Gardiner's Bay and the Peconic Bays are also subject to erosion problems. The width between the "forks" of Long Island is small compared to Long Island Sound, but the wind generates short-period waves of considerable erosive force. The observer is immediately struck by how very small and narrow the beaches are, compared to Long Island's north shore along the Sound, and also how critically 80 to 90 percent are eroding. The bay side of the south fork, especially where it extends out to the east beyond the protective "shadow" of the north fork, bears the erosive mark of nor'easters, notoriously severe storms out of the north Atlantic.

In the first comprehensive survey of these shorelines, geologist Marie Eisel and colleagues measured erosion rates, long- and short-term erosion/accretion trends, directions of sand transport along the shore, and effects of man-made structures. The group used aerial photographs, hydrographic and topographic surveys, tide gauge and hurricane data, questionnaires, and 100 field stations on the beaches. (About those field stations: despite long-recognized public ownership of land below the mean high water line the traditional boundary between private and public property, several property owners called police to chase the "intruders" off. Incidents like that make you vividly aware of the fierce, proprietary convictions of waterfront residents on Long Island's crowded coast, a significant factor to cope with for those managing shoreline resources.)

One purpose of the coastal inventory was to classify shore areas as to erosion hazard, recreational potential, and role in preserving wetlands or other natural assets. Eisel did find a few potentially good public beach sites, some on undeveloped state park property (Hither Hills, Long Beach). It would be important, if roads were put in for access to these beaches, to forestall what has happened to dunes and bluffs at so many points around the bays and elsewhere: people walking and driving motorbikes and dune buggies over the fragile dune grass kill the vegetation and thus open the dunes to wind pockets and blow-outs.

Mostly, the beaches are privately owned by towns or individuals. Their attitude is not exactly friendly to "expanded public recreation." Moreover, the shoreline everywhere is spotted with a profusion of bulkheads, jetties, groins, boat docks, and channels. Something like half of these are illegal, built without required permits from the U.S. Army Corps of Engineers. As is everywhere the case, these structures have both desirable and undesirable effects on erosion in their vicinity. *Bulkheading* is building a vertical wall in front of a dune or bluff to prevent undercutting and losing your property. The problem is that wave energy, particularly in winter, tends to pull everything outward from the wall. Often, no beach remains. *Jetties* of stone or concrete extend into the water on either side of inlets or channels to control infilling or shoaling. *Groins* are similar structures extending perpendicular to a beach to trap sand updrift of the groin and thus to build up the beach; downdrift, however, the shore erodes much faster than normal. The total effect of the groin is to reshape the beach, not solely to protect it. □

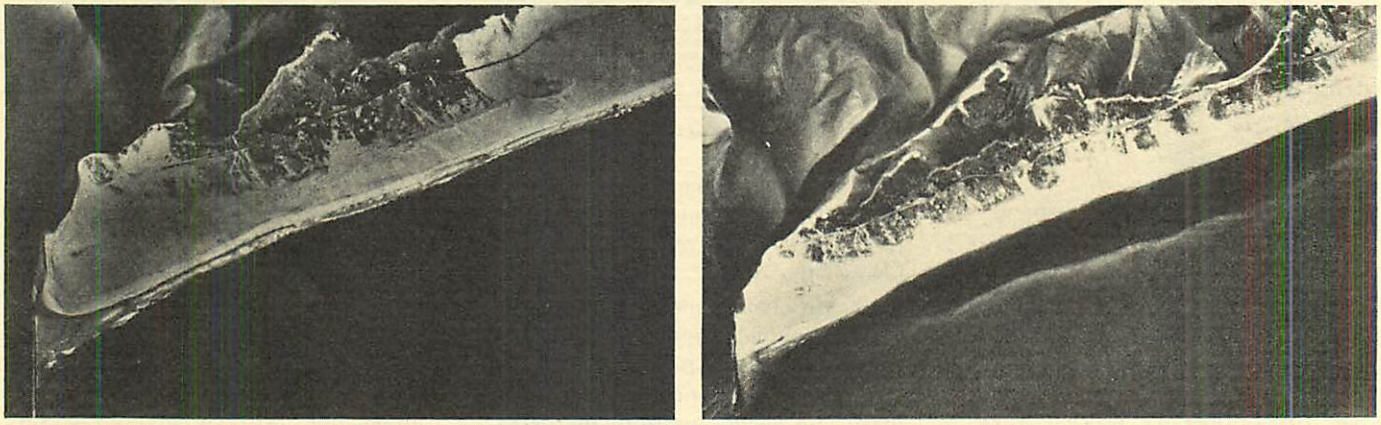
MANAGING RESOURCES
South Shore Studies

The 130-mile southern perimeter of Long Island facing the Atlantic is undergoing serious and extensive geomorphic change. Its direct exposure to storms and hurricanes, its rapid profile changes, the marked erosion of backshore behind the long, delicate barrier beaches, all involve processes still not very well understood. The price of not understanding can be rather high: substantial private and public moneys spent on groins and other controls that have behaved only partly as expected, property diminished in value and in area, activity permitted (e.g., driving on the dunes) that has turned out to be irreparably destructive. Where attempts at erosion control turn out to be ineffective or unworkable, managers may have to plan a different mode of attack. They may have to concentrate on trying to minimize the economic loss from erosion rather than on stopping it entirely.

A variety of studies of the south shore is now in progress. Coastal problems there are of great diversity and complexity, and the Sea Grant group looking at the problems – a geology team headed by Donald Coates and Marie Morisawa of SUNY Binghamton – undertakes projects general in implication, specific in focus.

Fire Island is one such specific. What are the constraints for human occupancy there? What is the use of land, the disposal of sewage, the supply of water? Most wells on the island are deep and tap aquifers down in the Tertiary-age rocks slanting out from beneath Long Island. Some shallow wells are still in use, however, and are being monitored for any *saltwater intrusion.* Long Island's geologic makeup – sand and gravel leftovers from melting glaciers – gives rise to a perpetual risk of salt water seeping into over-pumped groundwater supplies.

Behind the barrier of Fire Island lies Great South Bay, wide and shallow, with slowly circulating currents. Winds blow over the relatively short fetch of the bay from directions that average out as westerly. This produces characteristic short, steep, erosive waves and the easterly migration of shoals, leaving the coarser sediments in



East side of Shinnecock Inlet (L to R) in May 1955, May 1959, May 1968, and May 1972. Note the build-up updrift of the jetty at the inlet, and changes on the bay side.

the west. (This migration is opposite to the westerly drift of the longshore currents on the other side, the Atlantic side of the barrier islands, as we will see later. In each case, it's the onshore winds that affect matters most – northwest winds for the barrier islands' bay side, east and southeast winds for their ocean side.)

According to Paul Costa, geography student at Binghamton, nearly 31 square miles of Great South Bay's 55 square miles, or 55.8 percent, are shoal, that is, are less than six feet deep at mean low water (MLW). Shoal area is extensive in the southern half and at the two ends of the bay. A fair proportion – 39 percent – of the total southern shoal area is less than three feet deep MLW.

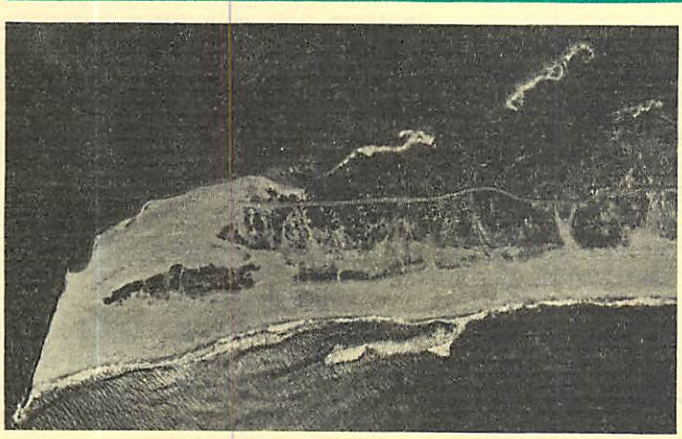
Into this shifting scene come the effects of man's activities. Clambeds are seeded and harvested: production of clams, both natural and cultured, has quadrupled in Great South Bay in the last fifteen years. Navigation channels are dredged for ferries and charter boats; dredge spoil is mounded up to create artificial islands with beaches. Then gravity pulls sediment down from adjacent shoals and beaches into the dredged depths again. Marinas, boat docks, and artificial fishing reefs act as groins, trapping sediment updrift and causing erosion downdrift. Much of the western part of Fire Island on the bay side is bulkheaded. One student, Charles Wasser, is looking at two spots on Fire Island's bay side that are eroding as much as 16 feet a year; he is trying to pinpoint the cause(s): dune stabilization/deterioration cycles? High water levels? A nearby ferry dock? Hurricanes? Great South Bay and Fire Island are used for recreation by many people from the great urban districts close by; others live or work there, especially in the summer. Information about shoaling and erosion is crucial to a workable management scheme that will benefit as many of these people as possible.

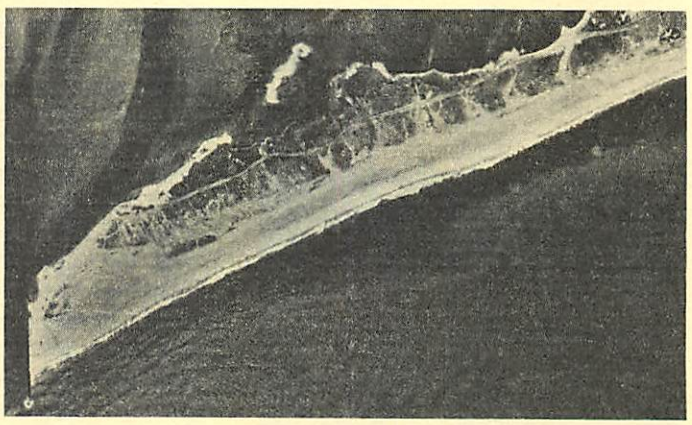
Across the barrier islands, over on the Atlantic side, the sand drifts and bumps and washes along from rocky Montauk Point westward toward New York City. Here it's the strong winds from the east and southeast stirring up big swells from off the Atlantic that in

turn impel a westward *littoral drift* (sand moving along the shore). A group of studies by Mark Griswold, Donald Ash, and Stephen Gilje has laid out the basic information on the drift system. Sand from the Montauk headlands, thought to be the point of origin for all drift system material, is moved along by the angle of the waves, gradually building barrier islands and spits toward the west, filling in inlets, and finally, at the end of the system off Rockaway Beach, sliding into the Hudson Submarine Canyon, a deep valley in the underwater expanse of the continental shelf. The larger sand grains move faster than the smaller ones, evidently from the "shadow effect": protruding grains are swept on by the water whereas small grains remain in the "shadow" of the larger ones. The farther a grain moves, the smaller it becomes, through abrasion.

Groins interrupt the littoral drift system. Many have been constructed toward the western end of the Island, often in groups (called groinfields), by riparian (shorefront) owners intending to save and improve their own beaches. But because the drift system supplies all the sand for south shore beaches, a stoppage in the system will cause erosion downdrift of that point as well as accretion updrift. The normal rate of south shore erosion, without interference, averages 5 feet a year. Erosion downdrift of groins is about twice or three times that rate; observers in some places have recorded 25 feet a year. There are two kinds of littoral transport – beach drift transport and offshore littoral currents. Groins are more effective at controlling the first. With the second, the effect depends on whether the groin deflects the current out to sea, losing the sand, or whether the groin allows the current to flow around it and on downshore.

One quite electrifying management idea proposes harnessing the natural system to recycle sand along the whole 130-mile length of the south shore. This eye-opener is the *giant bypass* concept. Giant bypassing is an extension of regular bypassing, a common practice at nearly every inlet along the south shore. Inlets being filled by





littoral drift must be dredged to stay open. The dredged sand can be disposed of (1) inland, (2) at sea, (3) updrift of the inlet jetty, or, perhaps most advantageously, (4) downdrift of the jetty, in effect bypassing the inlet. Here the sand helps relieve erosion, as long as it's placed down the beach a way, far enough to escape the backwater eddy by the jetty's downdrift flank.

Giant bypassing proposes to pick up sand from the western end of the drift system near New York Harbor and ship it all the way back to the eastern end of Long Island to go through the drift system again. This way, the sand stays in the system instead of being lost down the Hudson Canyon. Montauk headland erosion is reduced, beaches all along the way are nourished, and the need for groins in minimized. This method offers the efficiency of regional-scale operation over local-scale operation, and the attraction of going along with a natural process instead of trying to block it with massive construction now being studied: $100 million worth of groins, by U.S. Army Corps of Engineers estimate, to impede the movement of the 600,000 cubic yards of sand annually in the drift system. Giant bypassing – maintenance rather than construction – is estimated to cost about $5 million annually. Whether this includes the costs of local inlet bypassing, which would obviously have to continue, is not entirely clear yet.

These specific south shore studies – Fire Island, water supply, Great South Bay shoaling, littoral drift – fit in with more general studies whose results may be widely applicable. The characteristics of natural processes must be well understood before the effects of man-induced changes can be correctly assessed. Both these categories are being measured with monitoring stations, implanted benchmarks, aerial photographs, and hindcasting studies. Two questions about natural processes, for example, are the possible existence of erosion cycles (certain beaches have a pattern of damage at predictable, recurring intervals) and the differences between storm-induced and normal erosion/deposition. Wetland change and erosion is another general study going on in cooperation

with NYS EnCon and the Sea Grant wetland biology group headed by Orville Terry. In some places the wakes of motorboats seem to be accelerating erosion to about 10 feet a year by undercutting the vegetative mat and causing banks to collapse.

The Coates/Morisawa group has invited the public to participate in monitoring long-term geomorphic change. An Advisory Services booklet *Monitoring the Seashore* explains how "anyone can do it": map dunes, collect sand samples, monitor vegetation, or measure winds and waves and currents. Group members have also testified in legal cases concerning Fire Island – for example, in the case of an injunction against the community of Ocean Beach to restrain further groin-building. □

WETLANDS

Long Island originally had many acres of wetlands. Numerous bays and small estuaries along its irregular coastline were protected enough for marsh grasses to sprout and flourish. How many acres we'll never know; filling and dredging wetlands began before 1875, accelerated around 1900, and kept spiraling as the pressure of urban sprawl increased. Since 1945, and particularly since about 1958, an unparalleled influx to Long Island has been going on, and the intense demand for shoreline space for residences, commerce, industry, and recreation has led to the destruction of all but perhaps 40 percent of Long Island's original wetlands. The Tidal Wetlands Acts of 1972 promises to safeguard those that are left.

Most people didn't realize the value of wetlands until about 10 years ago. They were regarded as wasteland, useful only for growing thatch grass or salt meadow hay for cattle fodder or bedding, with perhaps an occasional dam for a gristmill or sawmill. Filling them in to make more land or dredging them out for dock space was considered a public gain.

Recognition of the wetlands' irreplaceable involvement in the spawning/adolescent phase in the life cycle of many important fish such as flounder, bluefish, and striped bass was brought home to people by the steep decline of commercial fishing after 1900. Wetlands also significantly improve water quality, help control erosion, and offer a wildlife habitat for birds and mammals like beaver, mink, muskrat, and deer. Public awareness of these values at long last brought pressure to bear on keeping and managing what wetlands remained. Hence the passage of the 1972 tidal wetlands law.

Historical/Legal Studies

There is still counter-pressure, however, from both private enterprise and even some public agencies, to convert wetlands to "profitable uses." Legal tangles of inordinate complexity arise in court cases between the "converters" and "preservers," since the legal and historical status of wetlands is in controversy. The opposing legal stances can be described as (1) traditional free enterprise: the owner (a town or an individual) can do what he wishes with his land, including wetland, versus (2) public-interest partisanship and environmentalism: the owner (town or individual) has a responsibility to other citizens and to the environment and is not completely free to follow his own desires.

Historian Keith Kavenagh undertook to clarify the three-century span of history of wetland ownership and use. His results will be made available to judges as solid information on precedents, and to the "converters" and "preservers," both of whom are appropriating selected history for their own special purposes. Kavenagh looked for, and found, eight representative wetland sites with these characteristics:

(1) A long history of human use (all eight);
(2) At least one obliterated by human activity;
(3) At least one still primarily a wetland despite human activity;
(4) One continuously in private ownership; and
(5) Half the sites originally in towns incorporated by 17th-century charters, half in towns originating as private grants of land to individuals.

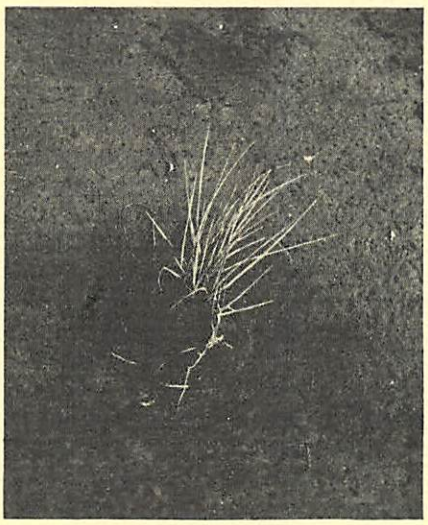
The original legal status of a wetland depended on which of the two types of township owned it. Charter towns were considered trustees of all unowned land within their boundaries. The trustees held such land in trust for the use, benefit, and enjoyment of all the inhabitants. They could convey uplands to private ownership, but the foreshore, including wetlands, and lands under water were, by English common law, vested with a *jus publicum* (public right of use) superior to any *jus privatum*. The practice of leasing thatch-cutting rights and shellfishing rights was common, but towns retained ownership. Proprietary towns, which began as private proprietary grants to individuals, usually owned land only down to the high water

mark; the fee title to the foreshore and underwater lands remained in the Crown (today the State of New York), that is, open to the public. Marshes, however, were usually specifically included in the grant and therefore private. Wetlands thus fell into a legal "twilight zone" in proprietary towns: in theory, the foreshore and underwater lands were public, but in practice, the owner/settler and his descendants treated that land as private property.

As long as wetlands were considered of little value anyway, no great controversy developed over the very slight regulation practiced by both charter and proprietary towns, which treated them as common land for grazing or shellfishing until deeded over to a private owner by the town grantee or even, in some cases, by the trustees. Once title passed to a private owner, town regulation ceased, except to approve docking out or bulkheading or dredging along the privately owned shoreline as long as it didn't block navigation or adjacent use – thus permitting "public" wetlands to be destroyed. When, around 1900, people in rising numbers began moving out from New York City into Nassau and Suffolk Counties, this pattern held. Local businesses diversified; towns divested themselves of more and more property, including wetlands; they encouraged the construction of large commercial docks and small marinas. Zoning, beginning in the early 1930s in Suffolk County, merely institutionalized the pattern. Successive state legislatures did nothing of consequence to modify local control of wetlands.

Courts still tend to favor private over public use. A decision in 1907 in the case of *Town of Brookhaven* v. *Smith* allowed private control over foreshore/underwater lands to supercede the ancient English common law retaining such lands perpetually in the public domain. Despite manifest inconsistencies in subsequent decisions, the courts have generally held to this view.

Extreme rigidity on either side polarizes matters into an impasse. Historically, free enterprise and private property were never sanctified, Kavenagh observes they were usually subordinated to community concerns and endeavors. On the other hand, "the regulatory laws and programs of politicians, planners, and scientists [are] . . . exercises in futility if they brush aside local beliefs and attitudes nurtured through generations. Efforts to preserve wetlands [must] offer viable alternatives in economic terms (tax dollars and profits) to communities and individuals."



Gunning Point, Long Island. (Top) Border between *S. alterniflora/S. patens.* (Bottom) A planting of *S. alterniflora.*

Botanical/Legal Studies

With the advent of wetlands legislation and increased public interest in preservation, technical problems arise. There must be workable and precise criteria for determining wetlands boundaries and techniques for proper management, especially public management.

The boundary between public and private property, according to pretty consistent court rulings, is mean high tide (usually MHW, mean high water). This also applies to wetlands. The MHW line divides most wetlands into two sections, one above MHW, one below. In theory, at least, the former is private property, the latter, public, although the continuing trend is to treat the public segment as private.

Nevertheless, MHW is an important line. Traditional synonyms like "high water mark" or "seaweed line" allow plenty of room for argument; the technical definition of MHW is the average high tide over 18.6 years (tides change somewhat in height over an 18.6-year cycle). Tide records are kept by the U.S. Coast and Geodetic Survey.

An on-the-spot, visual indication of MHW could be very useful, however – something like "seaweed line" but appropriate for marshes and more reliable. Long Islanders have for years used the natural boundary between two species of the marsh grass *Spartina* in this way. *Spartina alterniflora* has been thought to grow below MHW (this is usually called low marsh) and *Spartina patens,* above (called high marsh or meadow). But how good an indicator of MHW is this line?

A study directed by Orville Terry came out with the verdict "not very good." Lorraine Lagna, an intern to the New York Assembly, measured actual tides with gauges loaned by the Suffolk County Department of Public Works at three locations and obtained records for two other locations, to determine the technical MHW at all five. Since sea level has been rising in recent years, technical MHW (18.6 years) is generally lower than observed MHW (short-term). The *alterniflora/patens* boundary was often higher than

either MHW by a significant amount (0.24 to 0.47 feet vertically above technical MHW). Because the marshes are so flat, a quarter- or half-foot vertically can mean 100 feet horizontally. The plant boundary, though easily identified on the marsh, is only a very rough indicator, Lagna and Terry concluded.

This means that no good method is known for quick identification of the boundary between public and private wetland. Ordinary survey methods cannot be relied on, either, because the MHW baseline is usually not available. Proper wetland management will have to tackle this question, as well as plenty of others. At present, management of wetlands is poorly understood; interest is so recent, and many factors are simply not known yet.

Orville Terry conducted another study about one of these little-known factors: planting wetland grass artificially. In cooperation with the Town of Hempstead Department of Conservation and Waterways, Terry planted *Spartina alterniflora* on dredge spoil to begin the transformation into a new wetland. He used three methods: seeding, setting greenhouse-grown transplants, and setting turf plugs from the adjacent marsh. (Seed was contributed by Dr. W. W. Woodhouse of North Carolina State University, and transplants by Environmental Concern, Inc.) All three plantings survived well and show good promise. As would be expected, seed is easily washed out unless covered deeply. The greenhouse transplants underwent severe setback, but most eventually recovered and grew well. Plugs grew well in most locations, but the process of removing and transporting them was laborious.

None of the planting methods succeeded in fine, silty material. Apparently, something in such locations has a toxic effect; Terry is trying to determine the exact cause. Survival was good in sandy soil. For all planting methods, the tide had to be taken into account: the elevation at which *alterrniflora* grows naturally was prerequisite.

Inventory/Productivity Studies

EnCon's Division of Fish and Wildlife is in the midst of an inventory of the state's wetlands. It's the first step in a basic identification, classification, and evaluation process, with an eye to land-use planning and regulation, environmental impact analysis, and possible public acquisition or restoration (authorized by the Environmental Bond Act of 1972).

A pilot project on the wetlands inventory established that existing black and white aerial photographs (LUNR and SCS photos), taken in spring and summer and covering the entire state, are satisfactory for fundamental information. One such basic area of information is identifying some 12 to 16 vegetative cover types, as for example:

open water	floating mats, duckweed, phytoplankton
submerged	*Elodea*, water milfoil, mosses, stone worts
emergent	cattails, bur-reeds, grasses

The EnCon team working on the inventory has developed a wetlands classification system by cover types adapted for black and white aerial photographs. From cover types the team can estimate the primary productivity of wetlands, using what is known about these plants. The fertility/high productivity of marsh communities has been fairly well studied.

The productivity estimates need to be substantiated, however, by fieldwork on the ground. A given cover type can contain a tremendous variety of plant species, and other physical, chemical, and biological factors can affect productivity. Legislative intern Joseph Neafsey, working under John Peverly, NYS College of Agriculture and Life Sciences, Cornell, sampled the productivity of three freshwater vegetative cover types in a small lake and a conservation pond/wetland in the Finger Lakes region. He measured the increase in weight of plant matter per square meter at three-week intervals through June, July, and August 1973. (For phytoplankton, he measured chlorophyll *a* in milligrams per cubic meter of water.) He found that his figures correlated reasonably well with the figures in scientific literature upon which inventory estimates are based. Black and white photographs, he concluded, are adequate for estimates of *potential* primary productivity, and have the great advantage of being a quick method, but accurate and detailed productivity figures can come only from ground surveys, perhaps coupled with time-lapse photographs.

Creating a Wetland

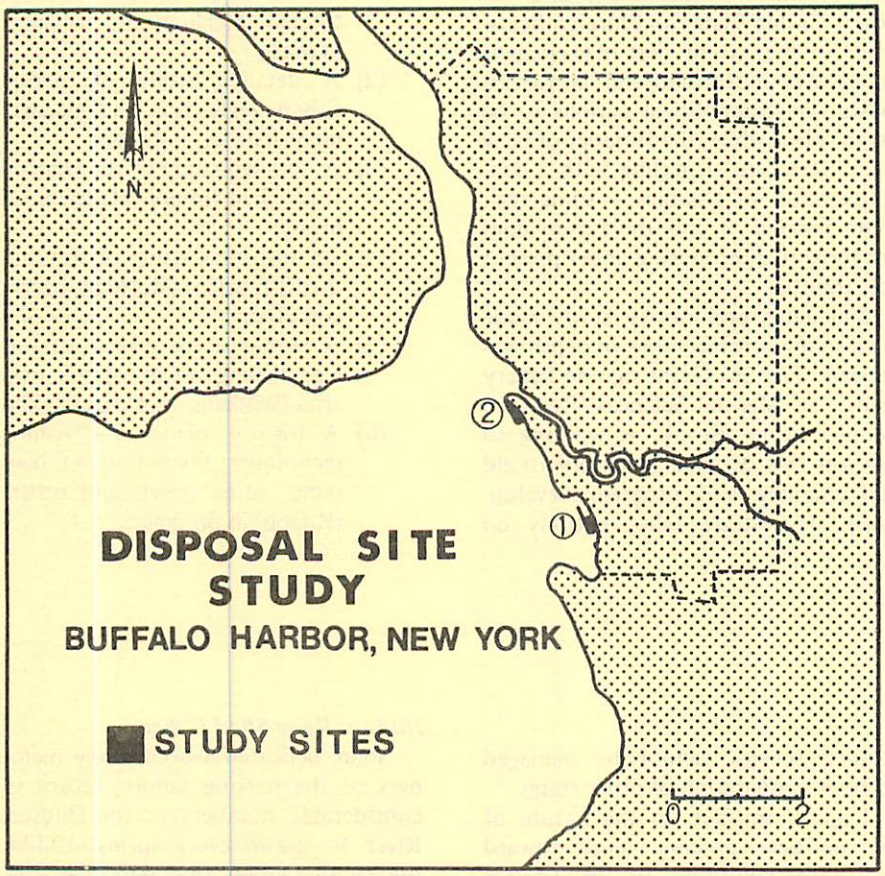
Although they undoubtedly didn't set out to, the U.S. Army Corps of Engineers has created two pretty good freshwater wetlands along the edge of the City of Buffalo on the shore of Lake Erie. Migrating waterfowl in good numbers and variety are resting and feeding there: canvasbacks, redheads, mallards, blue-winged teals, four kinds of gulls, terns, pheasants, sandpipers, to name a few. Good thing, too: these are the only significant wildlife habitats along the Buffalo waterfront, and duckhunting is up in popularity polls.

Here's how it happened. In 1967, when the Corps had to stop dumping polluted dredge spoils from the heavily industrialized Buffalo River and Harbor into Lake Erie, they diked an 18-acre spot next to a city marina with slag from the blast furnaces, named it the Small Boat Harbor Pilot Study Disposal Site, and began filling it with dredge spoil. Then they diked in another, bigger, 46-acre area at an abandoned swimming place called Times Beach near the mouth of the Buffalo River, and began filling it – 125,000 cubic yards of dredgings a year.

The Small Boat Harbor site is now considered full and "terrestrial"; conditions there range from a few inches of standing water along the dike to dry ground near the old shoreline. Cottonwoods, black willow, goldenrod, cattails, and many kinds of grasses, sedges, and weeds grow there. The Times Beach site is still being filled; dumping goes on intermittently. Its surface is all water. One-fourth of it grows emergent plants (cattails, bur-

reed) and the rest, submerged plants (hornwort, eel grass).

Since the older site was becoming in effect a wildlife refuge without ecological management, Robert Sweeney undertook to study the suitability of both sites for that use. He concluded from a three-part study of the engineering, mercury, and ecological characteristics that the sites were indeed suitable, though modifications were needed to improve drainage and some important questions remained about mercury contamination and mosquitoes.



Map by Suzanne Servis

Engineering student David Wright did the engineering investigation of the older, dry site: soil drainage, consolidation, bearing capacity, slope stability. He found the slag dikes are structurally sound and allow excellent drainage. The soil is spongy and not able to maintain a good slope, which means it won't support buildings or roads unless piles are driven or extra underpinnings constructed first. This means, in turn, that commercial developers would probably be willing to see it used for a refuge instead of a shopping mall. The soil itself doesn't drain well; it ponds and erodes with runoff. A drainage system on the surface, with shallow channels sloping gently toward the dikes, would improve matters. The ground there is now too wet to encourage grain plants attractive to game birds.

Lynn Perrott, Great Lakes Laboratory student, did the mercury study. The harbor dredgings that constitute the soil of the diked sites contain mercury – from chemical plants using mercury as a catalyst, and possibly from fallout from burning coal. Pesticides and herbicides used upstream on suburban lawns contain mercury that gets into the river in storm runoff. Mercury has a dangerous cumulative characteristic, becoming more concentrated with each step up the food chain. Even though the amount of mercury now going into the water is less than it was 10 years ago, large amounts can still be expected in sediments and thus be transferred into plants and small organisms. It would hardly do for a wildlife feeding/breeding refuge to be a prime source of mercury contamination! Lynn Perrott sampled sediments, water, plankton, bottom organisms, and plants to determine amounts of mercury uptake. She concluded that some mercury was moving from the sediments into both water and organisms, but was not being concentrated to a serious extent. She noted, however, that the study did not include fish or other species high in the food chain (there are no fish at the submerged site and the other site is dry). She also cautioned that other metals present in industrial wastewater may have a synergistic effect on mercury: small amounts of copper are known to increase the toxicity of mercury solutions appreciably. The plant species that now grow there indicate the absence of such toxic materials as oil and salt.

A mosquito survey of the two disposal sites by Jacques A. Berlin showed that the open water of the Times Beach site inhibited mosquito breeding, but the ponds and pools of the Small Boat Harbor were very attractive to mosquitoes. Old tires, cans, and other debris created plenty of water pockets for mosquito larvae. Moreover, the gentle breeze off Lake Erie was just right to blow mosquitoes over the city. The debris could be removed or covered, but if the soil height remains as now, mosquitoes are inevitable. Installing the proposed surface drainage and maintaining an open-water area (for mosquito-eating fish) would help limit mosquito population.

Done properly, with the modifications suggested, diked dredge disposal sites make fine wildlife refuges/wetlands. This ought to be good news for the Corps of Engineers, with its mammoth problem of what to do now with polluted harbor dredgings if they can't be dumped in the lake or even in the ocean. □

FISHERIES

The history of New York State's marine fisheries, in a preliminary review by J.L. McHugh (1972), showed that total landings have been declining, with major fluctuations, since 1880. Total landings in 1970, according to published statistics, were only about 10 percent of total landings in 1880, having dropped from about 150,000 metric tons to about 15,000 metric tons.

Total landings for most of this period, however, were largely a record of the menhaden industry. The menhaden, a bony, oily fish, was caught in great numbers and processed into oil and fishmeal for cattle and chicken feed. When shellfish and food fish excluding the menhaden are considered separately, the historical pattern is different. Total landings of food fish and shellfish rose from about 13,000 metric tons in 1880 to a peak of almost 31,000 in 1938, remained relatively high for about a decade, then declined rather steadily to less than 15,000 metric tons in the early 1970s. This decline over the past 25 years is even more serious than the downward trend of total landings suggests, for when landings of individual species are examined, the record shows a steady shift from one species to another as catches rise to a maximum and then decline, some to very low levels. For some species no certain explanation is known; for others, the reasons are known, albeit complex: overfishing, water pollution and other man-made environmental changes, and natural cycles of fish abundance.

Vastly complicating the situation, and leading to confusion and faulty decision-making, are heated conflicts between vested interests: between segments of the domestic commercial fishing industry, between recreational and commercial fishermen, and between United States and foreign fleets. Even to the extent that management needs are understood, no consensus exists on sociopolitical actions to be taken. Meanwhile, the fisheries of New York State are struggling with a conglomeration of troubles — some real, some fancied — and the future does not look at all promising under present constraints.

McHugh's preliminary study made it clear that an inventory in depth was needed. The Sea Grant marine fishery team, at Marine Sciences Research Center, Stony Brook, is working to develop this detailed inventory to aid policymaking and program development. The study relies entirely on existing information: catch statistics, published papers and reports, unpublished data in reports and files, and information that exists only in the minds and experience of scientists, state and federal officials, people in the commercial fishing industry, and recreational fishermen.

Accomplishments in Year II, the first year of the marine fishery study, are:

(1) A compilation of all available fishery statistics, for the area, published and unpublished, commercial, recreational, and foreign (McHugh and Williams, in press);
(2) A detailed study of marine fishery legislation and management (Ginter, in press);
(3) A detailed study of the Hudson River shad fishery (Medeiros, in press);
(4) An historical study of fish and shellfish prices (McHugh, nearly complete);
(5) A study of the effects of foreign fishing on the state's fisheries (Williams, in progress); and
(6) A history of specific fishing techniques: the pound net, haul seine, otter trawl, and others (Knapp, in progress).

Marine Fishery Legislation and Management

The major conclusion of Jay Ginter's study of fishery legislation and management is that New York State has at this time no management policy for living marine resources and no long-range plan. Law affecting the state's fisheries tends to be made ad hoc, frequently without the benefit of adequate scientific information. Present statistical data on catch and effort are woefully inadequate for answering basic questions on fish population maintenance — when, how, and why the state should regulate fishing effort. Management cannot be designed without good information. Moreover, migratory species cannot be managed without cooperation of other states.

Legislation, due to the nature of the political process, tends toward short-term solutions. In the 14-year period from 1960 to 1973, 748 marine fishery bills were introduced in both houses of the legislature, but most of these bills were never reported out of committee. Only 68 passed both houses, and 59 were signed by the governor. Bills usually favor recreational over commercial fisheries, yet recreational marine fishing is virtually unregulated.

Hudson River Shad Fishery

Shad, delicate-flavored, bony members of the herring family, return in considerable numbers to the Hudson River to spawn every spring. Unlike the Pacific salmon, shad don't die after spawning, and can come back year after year. The spring shad run used to be legendary in the Hudson River Valley, the big, dark-green, silvery fish coming upriver as far as Troy.

Landings of shad in New York State rose to almost 1,300 metric tons from 1930 to 1945, then dropped to a fairly steady level of about 300 metric tons in the 1950s; since then, landings have fallen off to very low levels. This

"Foreign fishing, especially by 'the Russians,' has been blamed for most of the trouble, real and imaginary, of New York coastal fisheries."

The Fulton Fish Market in New York City, largest wholesale fish market in the nation.

decline was recognized with surprise, since a 10-year federal study completed in the 1950s had concluded that the scientific information necessary for managing the Hudson River shad fishery was available and "the fishery can now be managed successfully." The discrepancy between expectation and reality sparked a study by William Medeiros.

Medeiros concluded that the main reason for the steep dropoff in effort was economics. Shad were overfished when the need for protein food during World War II led to relaxation of regulations. Following the war, off-flavors (to which the shad is particularly susceptible) attributed to pollution – oil, carbolic, other chemicals – damaged marketability. This led in turn to a decline in fishing effort, though by all indications the resource had recovered from wartime scarcity. Meanwhile, most of the traditional demand for shad was filled by other fish and shellfish; the remaining demand apparently is satisfied by imports of shad from southern rivers, where the runs come earlier in the season. By April, when shad are running in the Hudson River, a sated market has forced the price down to levels that do not encourage fishing, despite improved quality through pollution abatement.

What's needed now is market development – perhaps for shad roe, a delicacy now canned only on the West Coast – and encouraging recreational shad fishing. The potential is there for this resource to regain the importance it used to have.

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MANAGING RESOURCES

Is It the Foreign Fleets or Is It Economics – or Both?

Foreign fishing, especially by "the Russians," has been blamed for most of the troubles, real and imaginary, of New York coastal fisheries. Although the present effects of foreign fishing cannot be ignored, fisheries history and the timing of postwar foreign fishing expansion show clearly that foreign fishing is a recent aggravation and not a primary cause of the decline in the state's landings. Food finfish landings in New York have been dropping for 30 years and the price paid to fishermen has not risen very much during that period. This suggests that the decline is caused primarily by *economic* factors. The study of fish prices now nearing completion is confirming this tentative conclusion. The history of USSR fisheries in the area shows that until the mid-1960s the Soviet fleet had been fishing far to the north and east of Long Island. Moreover, the USSR has been concentrating on resources of minor importance to New York: sea herring, mackerel, and haddock, for example. Two exceptions: flounder and silver hake are important in New York, and the Soviets are catching these species.

Of all the fishery resources, shellfish have the greatest commercial value to the state, and shellfish, being inshore creatures, are not vulnerable to foreign fishing. Shellfish landings peaked from 1946 to 1952, dominated by the hard clam, oyster, and surf clam. A low point in 1960 was caused by the virtual collapse of the oyster industry and substantial drops in surf clam and hard clam. The oyster collapse can be blamed to some extent on management problems. First, a tremendous invasion of starfish in the late 1950s overwhelmed all methods used until then to cope with predators. Second, the practice of stockpiling seed oysters meant heavy losses if silt smothered them, as often happened, unless they were hosed off before spring. Pollution and hurricanes also contributed to the oyster collapse. The shellfishery recovery and rise in the 1960s has established its preeminence. If any fishery resource of the state could be managed unilaterally, shellfish could, but to date the state has shown little interest. The state does monitor water quality and closes polluted shellfish areas, an important function but hardly a positive management program. The Sea Grant fisheries group has been working with the Nassau-Suffolk Marine Resouces Council to plan a clam research and management program.

Public attitudes on fishery problems are influenced by two particular species, striped bass and bluefish, both very important to sportsfishermen. Neither is much affected by foreign fishing. The striped bass is a coastal zone fish. Bluefish do migrate beyond the 12-mile fishery zone, but only a few are caught by trawls on the continental shelf.

A Great South Bay clammer shows his catch. His tongs lie behind him.

Fisheries of Long Island Sound

In cooperation with the New England River Basins Commission, the Sea Grant fisheries group has been participating in the Long Island Sound Study. A paper (McHugh and Austin, 1973) submitted to the LISS concluded that effective management will require:

(1) Cooperation by other states and in some cases by foreign governments, since most important species of the Sound are migratory;
(2) Statistical information not now existing;
(3) Control of fishing activities, both commercial and recreational, as well as control of man's adverse effects on the environment,
(4) Strenuous efforts to mitigate unnecessary controversy between sport and commercial fishermen; and
(5) Priority attention to the hard clam, because of its great potential for recreational and commercial use and because it can be managed by New York and Connecticut bilaterally.

Advice and Service to Commercial Fishermen

Since the late 1920s the commercial fisheries of the Middle Atlantic Bight, including New York, have shifted from fixed equipment (gear) that intercepts migrating fish, like the pound net, to flexible gear that actively seeks out the fish, like the otter trawl. The trawl fishery in New York appears to have gone through three phases, marked by peaks in numbers of fishermen, units of gear licensed, and numbers of vessels. The peak years were 1938, 1952, and 1964, coinciding with peaks in abundance of several major species, improving prices, and shifts to new species not heavily fished before. Sea Grant, through Advisory Services, has sought to maintain good liaison with this highly individualistic industry and has in several instances

been a useful source of technical information. The high-rise otter trawl, the latest improvement in trawling, developed in Rhode Island, is of very practical interest to Long Island commercial fishermen. By actual count, one-third of the state's fishermen requested plans for this net from Sea Grant, and some have gone out on demonstration cruises arranged by Advisory Services with Rhode Island fishermen.

During the fuel crisis in the fall of 1973, Advisory Services held a number of meetings at which specialists discussed ways the fishermen could get hold of fuel on the priority basis mandated for the fishing industry. Advisory Services also offered basic financial and record-keeping help, introducing a record diary and advice on sales tax exemptions, new hull loans, and group health insurance available through the Farm Bureau organization.

The Coho Salmon Project

The introduction of salmon and trout into Lake Michigan in the 1960s gives good evidence of success. The fish thrive, fishermen are flocking in great numbers to catch them, and local communities are reaping tremendous economic benefits. New York's Department of Environmental Conservation (EnCon) decided conditions in Lake Ontario were fine for a repeat of Michigan's salmon success – plenty of room, plenty of food (the alewife). In 1968 EnCon launched the coho salmon project, as it is commonly called, though it also includes chinook salmon, lake trout, brown trout, and splake. In 1970, the Province of Ontario added its active cooperation to the project.

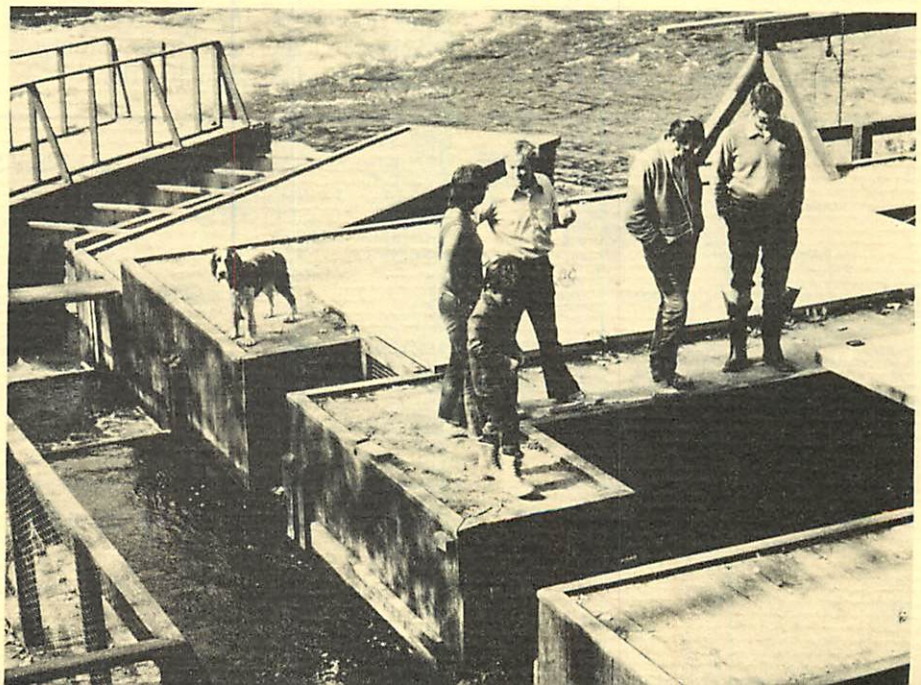
Both sponsors recognized this would be a multi-year, multi-million dollar project, partly because of two major prerequisites: control of the sea lamprey, and expanding hatchery capacity. Lamprey larvae are effectively killed in tributary streams with the larvacide TFM. Since an all-out attack on lamprey larvae began in 1971 in Canadian streams and in 1972-73 on the US side, coho have been surviving in better numbers and with fewer pock-like scars from the lamprey's teeth. Construction on a new hatchery should be under way in 1975 to help supply the estimated 3.3 million fingerlings that are New York's share of stocking Lake Ontario, plus another million for Lake Erie.

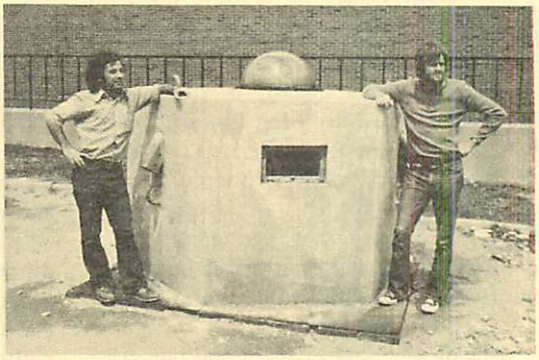
Realizing the duration and expense of the coho project, and taking into account the yearly departmental evaluations, EnCon asked Sea Grant as a neutral outsider to do the complex cost/benefit studies. Tommy Brown of Cornell University's Department of Natural Resources is conducting the research, working closely with EnCon's Cape Vincent fisheries station. He's investigating (1) the project's effect on recreational fishing activity, i.e., utilization, and (2) the economic impact on lake communities. One of the basic questions is whether or not the increase is "real" (net) or merely a shift of fishermen and their dollars from inland fishing to the Great Lakes. Hence, Brown is establishing baseline levels from existing and new economic data and from new information on fishermen and catch based on a creel census written by Brown and others and distributed by EnCon staff during the September-to-November 1973 salmon run, supplemented by aerial surveys of fishermen. This work concentrates on the area around the village of Pulaski in Oswego County, on Lake Ontario, since the Salmon River there has been stocked most heavily and thus is likely to show impact from the salmon project first. Brown and EnCon are also cooperating in writing and mailing a questionnaire to 5,000 licensed fishermen statewide to determine inland water use, expenditures, species caught, and interest in salmonids.

From first impressions and preliminary analysis of the 1973 run, Brown reports that the salmon project noticeably affected Pulaski's revenues, though they were below 1972, probably owing to the same difficulties encountered by tourism nationwide. Many firms showed higher gasoline sales, and hotel/motel operations matched 1972.

There seems to be eager, even avid interest in the salmon project, judging by response to meetings organized and publicized by Advisory Services – one at Pulaski and two in the Niagara Falls area. Big crowds came out – a total of 1,500 – to hear a progess report by EnCon personnel, a discussion on how to catch this fish, led by Dick Gross, Advisory Services recreation specialist, and an account of the economic "pluses" and how to capitalize on them from Tommy Brown. Brown calls the salmon project "very costly but potentially very successful" both as a fish resource and as an economic boost. □

Fish weir on the Salmon River, Pulaski, used in EnCon project.





MECHANISMS

Finally, two Sea Grant research projects, unlike the others, are not so much identified with a particular resource like shores, wetlands, or fish as they are mechanical means to study and come to manage the unified and interworking dynamic whole, the marine ecosystem.

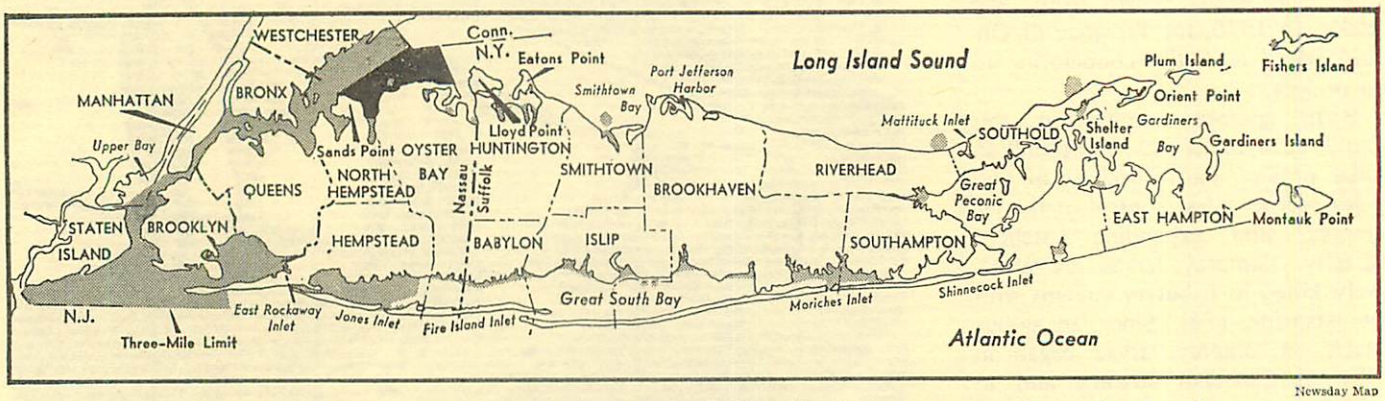
An Underwater Habitat

Underwater laboratory-habitats increase underwater working time by reducing decompression requirements in deep water, and providing a place for divers to rest and use as a base for equipment operation, power, and storage; they facilitate long-term work, time-lapse photography, and group work. Applied to resource management, their capacities suit them to deepwater aquaculture (observing shellfish pens and cages, noting feeding behavior, predation, and equipment effectiveness) or to fisheries work (assessing stocks, natural ecological relationships, effectiveness of fishing gear). In short, underwater habitats make marine-science types' mouths water and their fingers itch; such engineering feats are always attracting new talent.

New York's own SUNYLAB is a student-designed, very low cost habitat constructed from available materials with a little Sea Grant funding. Its core is a discarded cement-mixer drum, encased in cement and fitted with window ports, a plexiglass dome, and steel and concrete legs. That cement-mixer drum actually provides a 116-cubic-foot interior quite adequate for two persons for several hours at a time. It is planned for stationary submergence at a 30-foot maximum depth, supplied with power and air from the surface. All design computations and actual construction were carried out by senior students at Stony Brook's Engineering College, under the direction of Herbert Herman. Upon completion of exhaustive safety studies now going on, SUNYLAB will be "installed underwater" – sunk – off a pier of the New York Ocean Science Laboratory near Montauk, Long Island's easternmost tip.

Long Island Sound
Mathematical Model and Tide Gates

We know that the waters surrounding Long Island and the New York City metropolitan area have suffered a long history of continued decline in quality. This is as much as saying that the marine ecosystem of the region has worsened, for in the dynamics of the whole, everything is affected. For the past 20 years, the state has been closing acres of shellfish beds due to high coliform bacteria counts – a shellfish resource not being managed but lost. Two swimming beaches out of about 35 on the north shore are closed for the same reason. Stepping Stone beach, on the Great Neck peninsula, close to the East River, has been applying for a swimming permit for years without success; coliform concentrations there in 1957 were 500,000 mpn/hundred ml (most probable number per hundred milliliters) and in August 1973 were 3,900 mpn average, compared to a state maximum allowance for swimming of 2,400 and a Nassau County maximum of 240.



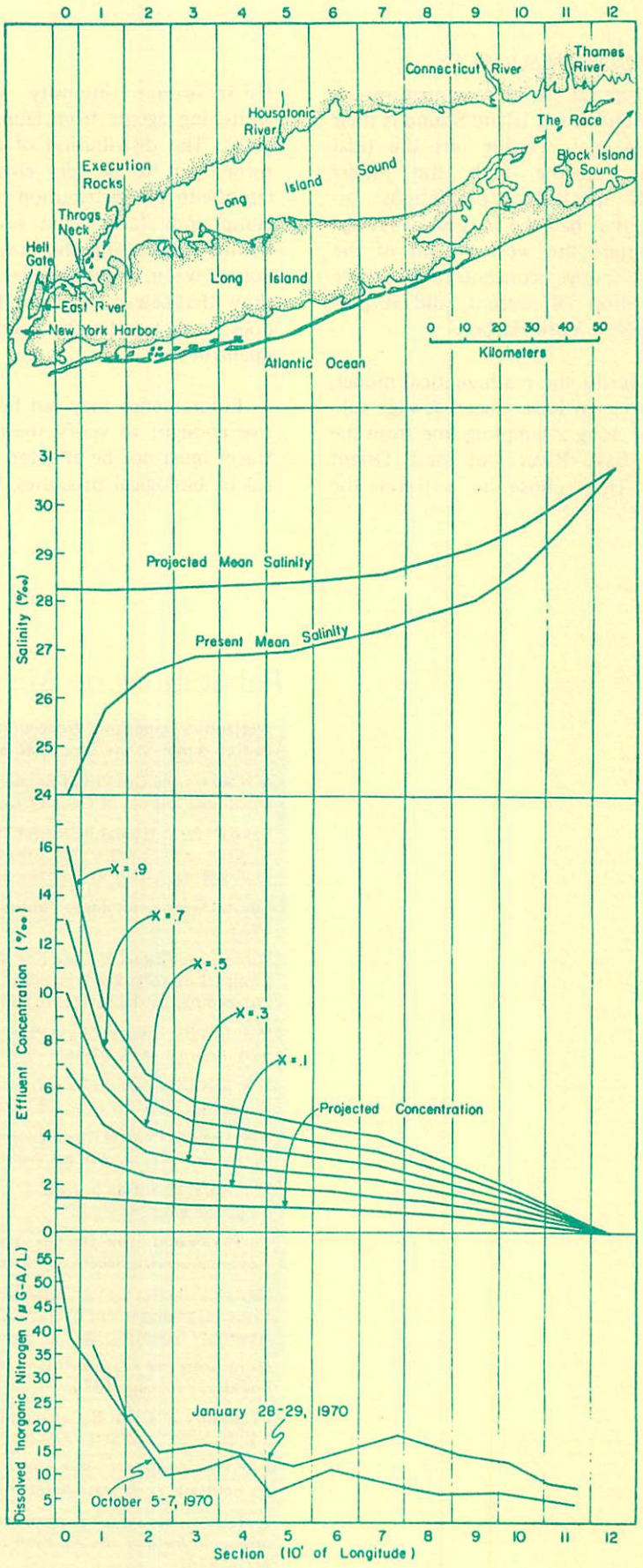
Newsday Map

Black areas represent the portions just closed to shellfishing; the shaded areas are those closed earlier

The Sound waters could be used more fully — the whole system would improve — if such pollution could be reduced. Some uncertainty exists over the extent to which the Sound is affected by the region's major source of sewage — the 1.8 billion gallons of partially treated and untreated sewage being poured every day into the water around New York City, particularly the East River. Some coliform bacteria enter the Sound from north shore bays; some enter from waste materials carried into the Sound by storm water runoff. The five major East River sewage plants are certainly a factor, however.

This contamination could be cleansed out of the Sound and New York Harbor by a novel method proposed by researchers Iver Duedall and Malcolm Bowman of the Marine Sciences Research Center, Stony Brook. Tide gates, or ship locks, constructed across the upper East River would block the flow of polluted river water into the Sound and would flush clean Sound water through the East River, down into New York Harbor, and out into the New York Bight. During ebb tide in the East River (i.e., when water is flowing from Long Island Sound into New York Harbor), these tidal gates or ship locks would be fully opened, allowing an unhindered flow of Long Island Sound water into the Harbor. Six hours later, at slack water, the locks would be closed, completely eliminating any return of New York Harbor water back into Long Island Sound. After another six hours, the gates would be opened again and the cycle repeated.

The tide gate idea comes straight out of the mathematical model of the Sound being put together and verified by Duedall and Bowman. The model itself is a means to develop and test management proposals for improving Sound water quality such as the tide



(a) Long Island Sound, (b) projected increase in salinity in Long Island Sound by operation of tide gates, (c) projected change in effluent concentration, (d) concentration of total nitrogen.

gate proposal. A management model for western Long Island Sound is their ultimate goal. Testing out the tidal flushing scheme with the model brought spectacular predictions: assuming that half the East River sewage now enters the western end of the Sound, sewage concentrations there would drop 78 percent, and 50 percent in New York Harbor.

To verify the mathematical model, the two men have traced sewage substances along a sampling line from the upper East River out past Orient Point. They chose as a tracer the fluorescence intensity of fabric whitening agents from laundry detergents. The distribution of this tracer turned out to be very closely correlated with the distribution of nitrogen compounds (also from sewage) and salinity (indicating the proportion of Sound water in the sample). All three show that sewage from the East River does, in fact, enter the Sound in large quantities.

Fluorescence may not be *conservative* enough: to verify the model, the tracer must not be affected by chemical or biological processes, but mixed and moved by water currents only. The fluorescent tracings show that the model's predictions are basically correct, but the numbers are only close approximations as yet. Bowman and Duedall are developing a two-dimensional model; the present one-dimensional model can't as accurately predict things related to the Sound's strongly estuarine circulation with its two-layer pattern of less salty water on top and saltier, denser water below. They are looking forward to predicting the effects of the tidal gate operation from two dimensions. It's bound to be impressive. □

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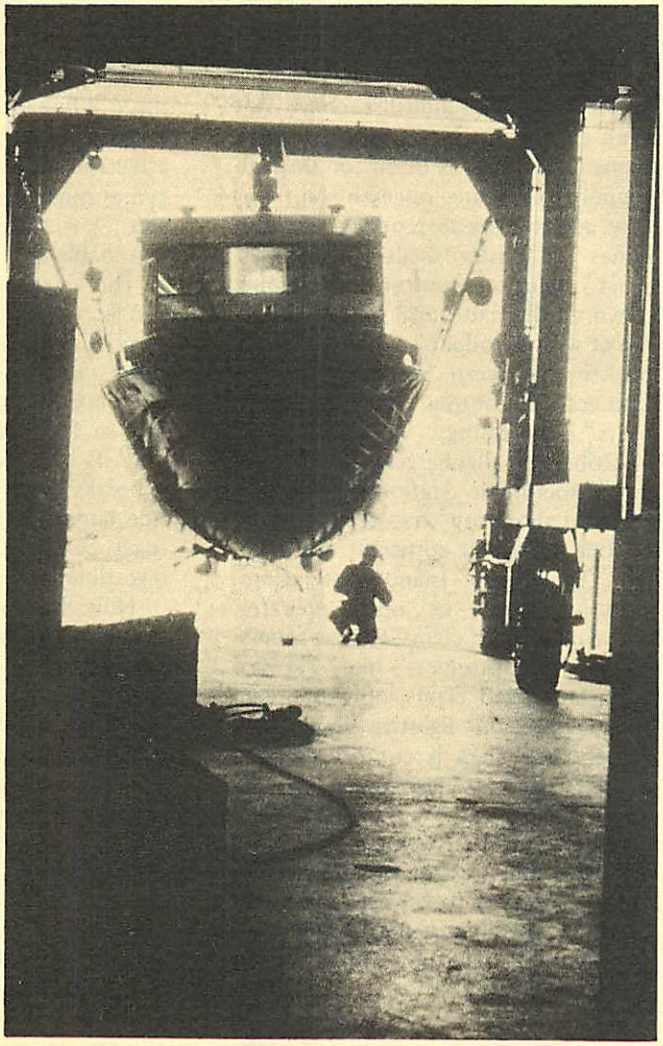
III. Working With Industry

Sea Grant has a broadly defined, significant role as a research partner to marine industry. By virtue of nationwide communications and ready access to the whole scientific/technical range of the universities, the Program can perform a unique scientific function for marine companies. The closest analogy is probably the agricultural experiment station system which supports American agriculture. Sea Grant has a further advantage in its close association with so many public interest groups. These provide a public-benefit orientation and a concern for environment. Within the limits set by available time and funds, an industry problem can be referred to the most competent people in that field, with adequate consideration for all points of view. The long-term potential for this approach is hard to overestimate.



THE AQUACULTURE INDUSTRY

Aquaculture's present status in New York depends on your definition. It seems logical to include in it not only crustaceans (lobster, shrimp), but also bivalve shellfish (scallops, clams, oysters), and trout and Coho salmon. Commercial efforts with some of these creatures are still small-scale and experimental. Aquaculture's future here, though impossible to predict in detail now, is certainly promising. Economic feasibility for a number of specific cultures — oysters, scallops, salmon, trout — seems imminent. Current food prices and potential food shortages will expedite matters.

Sea Grant can assist in many ways, primarily by developing research expertise and organization that the aquaculture industry will need as it does evolve: research capacities in marine plant and animal breeding, nutrition, disease control, and culture-related engineering. Timing and funding constraints, industry and faculty interest, determine the choice of specific projects. Probably most important at this stage of aquaculture is an information bank and a forum for discussion that takes seriously the industry's potential. This Sea Grant provides.

Experimental culture of the Maine lobster, *Homarus americanus,* was begun in Year II in cooperation with Shelter Island Oyster Company. Initially located at the company laboratory in Greenport, on Long Island's north fork, the project has recently been moved to a new site, the Cedar Beach laboratory of Prof. Walter Smith, Suffolk Community College. Cedar Beach has more space and better quality seawater. Shelter Island Oyster Company employees, however, are still actively working on the project. Orville Terry, leader of the research

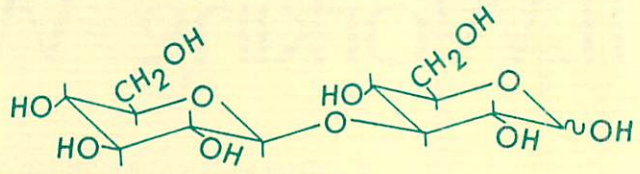
group, says the simple fact that commercial people are involved means that lobster culture techniques are evaluated automatically for commerical practicality. Bivalve industry facilities and techniques are often applicable or adaptable to the lobster.

Lobsters hatch from eggs which the mother lobster attaches to her shell and carries around for some months as the eggs develop. The newly hatched larvae swim weakly to the light and are easily captured in a dip net. For the first few weeks they are held in a special tank, agitated by flowing water to keep the little larvae in suspension and more or less separated from each other. If two meet, one may be eaten. After three molts, the lobsters reach the so-called fourth stage of development and begin to look and act like miniature adults. They tend to stay on the bottom and walk more than they swim.

Cannibalism, always possible, becomes a serious problem for the culturist at the fourth stage. The problem can be eliminated, at a cost, by keeping the juveniles in separate compartments. During Year II, Matoira and Paul Chanley developed a unique design for individual chambers by partitioning off segments of a perforated plastic tube. Recirculating seawater moves through the perforations. (Recirculation permits control of water quality and temperature.) The tube has a longitudinal slit, turned upwards, through which food is supplied. Compartmentation is far from an ideal solution to the problem of crustacean cannibalism, but it does keep the animals alive for further research. A note on this habitat will be published soon in *Aquaculture.*

Experimental diets of dry feed provided by Dr. Samuel Meyers of Louisiana State University were tested in both flow-through and closed-culture systems. None proved an adequate substitute for fresh feed or for our control diet – brine shrimp, fresh or frozen. But the longer shelf life of dry prepared foods is an obvious advantage over fresh or frozen materials.

The research group is reasonably confident about developing a culture environment in which cannibalism will be controlled, or at least not result in extensive losses. Small numbers of animals with an abundance of food have sometimes survived well together: the group grew 12 lobsters to the fourth stage without any losses in a 100-gallon wading pool full of green algae and brine shrimp. This is at least a starting point for further experimentation.



The 1,3 linkage in a laminarin molecule.

A CLAM BY-PRODUCT

Small marine industries have not been able to do much product development. Business is often too small to support adequate research on, say, new uses for waste products like fish bones or lobster shells. Increasingly strict pollution control is clamping down on the traditional way of disposing of waste products – dumping them back in the ocean. So the pressure to find economical uses of seafood "leftovers" is increasing.

Robert Shallenberger, of the Geneva Experiment Station's Food Research Laboratory, has been working on one particular corner of this problem. The Shelter Island Oyster Company processes – i.e., opens, prepares, and packs – surf clams, *Spisula solidissima.* For products like Howard Johnson's fried clams, only the clam foot is used; the digestive tract of this rather large clam is cut off and discarded, because cleaning out all the sand would have to be done by hand. The company has been experimenting with possible uses for the clam bellies – in petfood or to enhance the flavor or nutritive value of food products – but hasn't come up with anything worth the money.

Shallenberger, an enzyme chemist, had an idea from his own special angle. He reasoned that the clam must have a digestive enzyme able to break down carbohydrates in the marine plants it eats. Most sea plant carbohydrates, it seems, are structured differently from land plant carbohydrates; sea plants have what is called a *1,3 linkage* holding their sugar units together. The enzymes in humans and land animals can't digest sea plant carbohydrates – which is all right unless we try to eat lots of seaweed or feed it to our herds. There are a few carbohydrates in the "land sphere," however, that do have this 1,3 linkage, and only enzymes like those in the clam's digestive tract can effectively cleave them. Those enzymes might be useful – even marketable – if they could be packaged at reasonable cost and made available.

Turns out one was, and could be, and is. A large chemical supply company, Calbiochem, now lists this enzyme, supplied from Shelter Island Oyster Company's clams, in its catalog, so far in experimental quantities only. It is called *laminarinase,* because it breaks down the natural polysaccharide laminarin into glucose, its simple sugar component (highly soluble and digestible).

Now that the enzyme is available to the research community, it is being screened for various possible uses, among them dissolving plaque from our teeth – a major problem in dental care. Toothpaste additive is the medium being considered (the enzyme itself doesn't taste like clams!). Other new uses are almost certain to be found for it. The original problem – what to do with surf clam wastes – is still not fully solved, of course. The enzyme constitutes only a tiny fraction of the waste parts, but it promises to become a significant part scientifically and, eventually, economically. □

FPC – FISH PROTEIN CONCENTRATE

A half-century of pollution in Lake Erie has brought about a startling change in species distribution of the fish population. Seemingly worthless "trash" fish such as carp, sheepshead, and alewife have replaced the former game fish such as walleye, pike, and cisco – probably because the trash fish can get by on less oxygen in the water. The species change has severely affected commercial fishing in Lake Erie: a recent survey reported only three boats still working.

If the trash fish could be put to practical use, it might be feasible to catch more of them. In 1970 a fish packing firm expressed interest in locating a plant in the Buffalo area to produce fish meal and fish protein concentrate (FPC), using trash fish. FPC is a high-quality protein (up to 99 percent pure) comparable to milk protein. It is produced as a near-white powder without discernible flavor or odor, and can be used as a milk substitute or protein additive in many foods. Mixed with wheat flour in making bread, it supplies essential amino acids lacking in wheat protein.

Commercial FPC production from Lake Erie fish seemed to hold out some hope of recovery to the depressed fishing industry. Then a new problem was uncovered. The fish were found to contain more mercury than the Food and Drug Administration allows (0.5 parts per million). In the face of the high cost of removing excess mercury from FPC and fish meal, the fish packing company dropped its entire project.

Since 1970, however, falloff in the Peruvian anchovy catch and shortages in animal feeds have caused commercial reconsideration. The increased value of fish meal and FPC may now make mercury removal worthwhile, if it can be done cheaply enough.

Chemist Eugene Schrier of SUNY Binghamton investigated two potential methods of mercury extraction. These were the factors he had to consider:

(1) Mercury is present in very small amounts and is chemically bound very tightly to fish tissue;
(2) The fish product consists mainly of fragile proteins that cannot withstand extreme chemical treatment;
(3) A practical process must be simple enough for ordinary plant workers to handle;
(4) All costs must be kept low.

Both methods turned out to be practicable, but treatment with thioglycollic acid is the cheaper of the two. Introducing this acid to the wash water as FPC is being prepared removes up to 80 percent of the mercury by action of the sulfhydryl group in the acid. Minor problems with mercaptan (sulfhydryl) odors can be overcome by sufficient washing. An earlier method Schrier tried was sprinkling sodium borohydride powder in the crude FPC after fat extraction, to convert the various mercury compounds in the fish into pure metallic mercury, which is then removed as a solution in a gas. This method adds costs of about 10 cents to 12 cents a pound of FPC; the thioglycollic acid method runs about 3 cents to 5 cents a pound of FPC.

A nutritional evaluation of the FPC following mercury removal is now being conducted. The results look promising, and Schrier will present a paper on the project to the American Chemical Society at its spring 1974 meeting. He says that the information developed in this study is directly usable by any commercial enterprise, and may eventually lead to improved prospects for a Lake Erie fishery. □

COMMERCIAL USES FOR SEAWEEDS

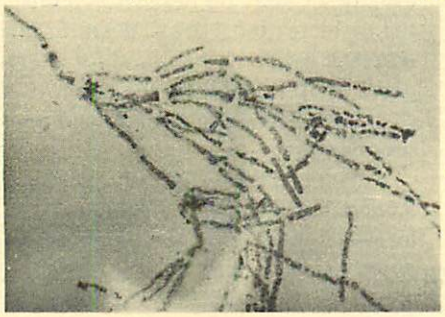
Great Lakes waters, overenriched with nitrogen and phosphorus from sewage, produce massive "blooms" of unwanted algae twice a year. The green alga *Cladophora* is a conspicuous example. Its filaments grow rapidly, break off when the water warms, and accumulate in rotting piles on the beaches all through August and again in October. Understandably, this isn't exactly an asset on beaches in residential or recreational areas. What if some practical use could be found for *Cladophora* that would pay for the cost of cleaning it from the beaches and nearshore waters?

Pursuing this line of thought, Robert LaLonde and John Judd have investigated several potential *Cladophora* uses. A particularly appealing one is based on *Cladophora's* observed insecticidal properties. In 1970, entomologists at the University of California, Riverside, reported that in the presence of some water plants, including *Cladophora*, mosquito larvae did not develop into adults. LaLonde's research at the College of Environmental Science and Forestry is testing out the matter, with two immediate objectives: one, to establish the existence of a larvacidal effect and its characteristics; the other, to isolate the actual toxic principal(s). The work is based on painstaking bioassy techniques: establishing mosquito colonies, testing *Cladophora* fractions obtained by distillation against the larvae for growth retardation; further purifying the active fractions, bioassaying them, and so on. The disease-transmitting species *Aedes aegypti* has been successfully established in culture and work on other species is in progress. The active principal has been concentrated – at this stage it looks like brown molasses – but has not yet been completely purified or identified.

The potential of *Cladophora* for producing a pest-specific insecticide is provocative. Detailed experiments by John Judd have not yet shown any deleterious effect of living *Cladophora* on aquatic creatures other than mosquitoes. The notorious tendencies of

(a)

(b)



(c)

Photomicrographs of (a) *Zostera* pulp (magnification 40x), (b) *Cladophora* pulp (40x), (c) *Cladophora* plant (32x).

conventional insecticides like DDT to damage non-target organisms are only too well-known. It is generally agreed among ecologists that the next generation of pesticides should be as nearly pest-specific as possible. The *Cladophora* extract may be one of the first.

Continuing search for a practical *Cladophora* use also led to its investigation as a raw material for paper. Another nuisance plant, *Zostera* or eelgrass, was included in the study; eelgrass is a problem in some Long Island bays just as *Cladophora* is on the Great Lakes. Both plants are fibrous, with a significant cellulose content, and therefore good candidates for paper-making. The aim of the project, directed by Bengt Leopold of Empire State Paper Research Institute, was to develop pulping techniques simple enough to carry out near collecting areas to minimize the bulk of material transported to the actual paper-making factory. A product of reasonable quality could be used alone or as an additive to other papers.

Of various pulping methods tried by Institute faculty member Renata Marton, the recently developed oxygen-alkali process was most successful. Several pulps of varying strength, yield, and brightness/whiteness were produced. *Cladophora* pulps bleached more easily than *Zostera* pulps; this difference may be related to the marked difference in cell structure between the two species (see illustration).

Yields and quality were rather disappointing. Pulps from these seaweeds could be added to wood pulps for low-grade paper like newsprint or for corrugated cardboard or fiberboard, but even these uses are not economically worthwhile at present. One major difficulty is obtaining a continuous, dependable supply. The crops are seasonal, *Cladophora* accumulating in August and October and *Zostera* in the fall. Efficient collection techniques have not yet been worked out. It remains to be seen whether shortages of conventional pulps will change the outlook.

THE MARINA INDUSTRY

New York State marina businesses, like other outdoor recreation firms, are small, seasonal, and somewhat vulnerable to public-financed competition. About 75 percent of all coastal marina berths are private. The marina industry goes back quite a while – most New York City/Long Island firms have been in business about 25 years – but marina managers have never organized for mutual assistance in, for example, marketing, lobbying, or information exchange. Moreover, it's an industry important to the local economy: the total revenue generated by the Long Island marina industry in 1972 probably exceeded $55 million. Yet, surprisingly, almost half these firms are unincorporated. Marina management was the owner's sole occupation in most of the marinas studied. Great Lakes/St. Lawrence marinas are in much the same shape. Sea Grant's contribution to an unorganized and geographically scattered industry has mainly been information and coordination of effort. Advisory Services has been holding regional forums for marina operators, who may eventually organize statewide. So many different kinds of big business are seeking coastal land these days – electric power companies, oil shippers, housing developers – that the small marina owner doesn't stand much chance of holding on to his elbow room if he tries to go it alone.

To find out precisely what the situation was, Tommy Brown of Cornell's Department of Natural Resources conducted a survey of marinas and of their customers, the boating public. He interviewed 168 firms with ten berths or more, a 25-percent sample of marinas all over the state: 70 on Long Island, 22 in the New York City/Westchester area, 34 in the Great Lakes/St. Lawrence area, and 42 on inland waters. (The inland portion of the study was funded by NYS Office of Parks and Recreation.) Detailed data on capacity, occupancy (percent of slips rented), labor, sales and repairs, and finances are currently being analyzed. The results should give a clear picture of economic viability and operating problems.

Many marina managers are plagued with the same handful of problems, as the study has already uncovered, and Advisory Services staff has begun acting on them. To get permits for

maintenance dredging from the Corps of Engineers and local and state authorities, managers have to go through an unnecessarily lengthy, complex, and expensive review process and wade through yards of red tape. Security is a big problem; some marinas are resorting to barbed wire and guard dogs to prevent boats from being stolen or vandalized. Others are overcrowded and can't expand, either because they are hemmed in on both sides or because of unfriendly local zoning. Sometimes a marina gets into a conflict with local government over rights-of-way, as when a town fills in a channel to build apartments, leaving a marina high and dry. In these cases an outside interviewer from Advisory Services can sometimes mediate. Another problem is the present trend toward comprehensive coastal zone management, which often sharpens old conflicts, not necessarily to the advantage of the commercial marina.

The number of marinas on the Great Lakes and on inland lakes is smaller than the total downstate, but still sizable, especially on Lake Ontario's south shore, where harbors and winds are more inviting than on Lake Erie. Freshwater marinas have the same problems as saltwater marinas, plus a few of their own. They are much more susceptible to flooding. Marinas along the St. Lawrence Seaway are having a very bad time from the wakes left by huge tankers plowing up the river several knots over the speed limit. It's actually happened that waves have torn boats from moorings and shot them over a dock to smash into other boats.

Brown's second survey covered boaters, to find out their needs and attitudes. Questionnaires were mailed to 4,500 of the state's registered boaters, and are being analyzed by region, along with the marina survey, to get an idea of how marina operators in particular areas could improve facilities and services. Brown is also keeping an eye out for ways public officials can make life pleasanter for boaters – improving water quality, regulating speed, dredging additional channels. □

National Boat Show, New York City Coliseum, January 1974.

Publications on Working with Industry

Possible Effects of Construction and Operation of a Supertanker Terminal on the Marine Environment in New York Bight by Marine Sciences Research Center, SUNY Stony Brook. 213 pp. November 1972.

Development of a Pollution-Free Cargo Tank Cleaning System for Use on Board Tankers by J. Femenia. 75 pp. December 1972.

Sea-Related Industries in New York State by J.D. Francis and L. Busch. 188 pp. January 1973.

Effect of Paper Plant Pollution and Subsequent Abatement on a Littoral Macroinvertebrate Community in Lake Ontario: Preliminary Survey by J.G. Boscor and J.H. Judd. Proceedings of the Fifteenth Conference on Great Lakes Research, 1972, pp. 21-34. March 1973.

New York State's Commercial Fisheries: Industry and Manpower Projectsion by J.D. Francis and L. Busch. New York's Food and Life Sciences Bulletin 28, Social Sciences no. 2. 14 pp. June 1973.

Fulton and South: Prospects and Potentials of New York State Seafood Processing and Wholesaling Industries by J.D. Francis and L. Busch. New York's Food and Life Sciences Bulletin 33, Social Sciences no. 4. 12 pp. August 1973.

Water Recreational Activities in New York State and the Effect on Associated Industries by J.D. Francis and L. Busch. New York's Food and Life Sciences Bulletin 31, Social Sciences no. 3. 16 pp. August 1973.

Laminaranase Activity in the Crystalline Style of the Surf Clam by R.S. Shallenberger, C. Searles, and B.A. Lewis. To appear in *Experentia* (Basel). 1974.

Inexpensive Modular Habitats for Juvenile Lobsters (Homarus americanus) by Matoira H. Chanley and Orville W. Terry. To appear in *Acquaculture*. Accepted April 1974.

Assistance in Solving Fishing Vessel Fuel Allocation Problems – New York Revision. Advisory Service, mimeographed. 4 pp.

Environmental Impact Bibliography. Advisory Service, mimeographed. 5 pp.

Fisherman's Diary. Advisory Service, mimeographed. 3 pp.

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Hard Clam Recipies. Advisory Service, mimeographed. 4 pp.

Home Smoking of Fish. Advisory Service, mimeographed. 5 pp.

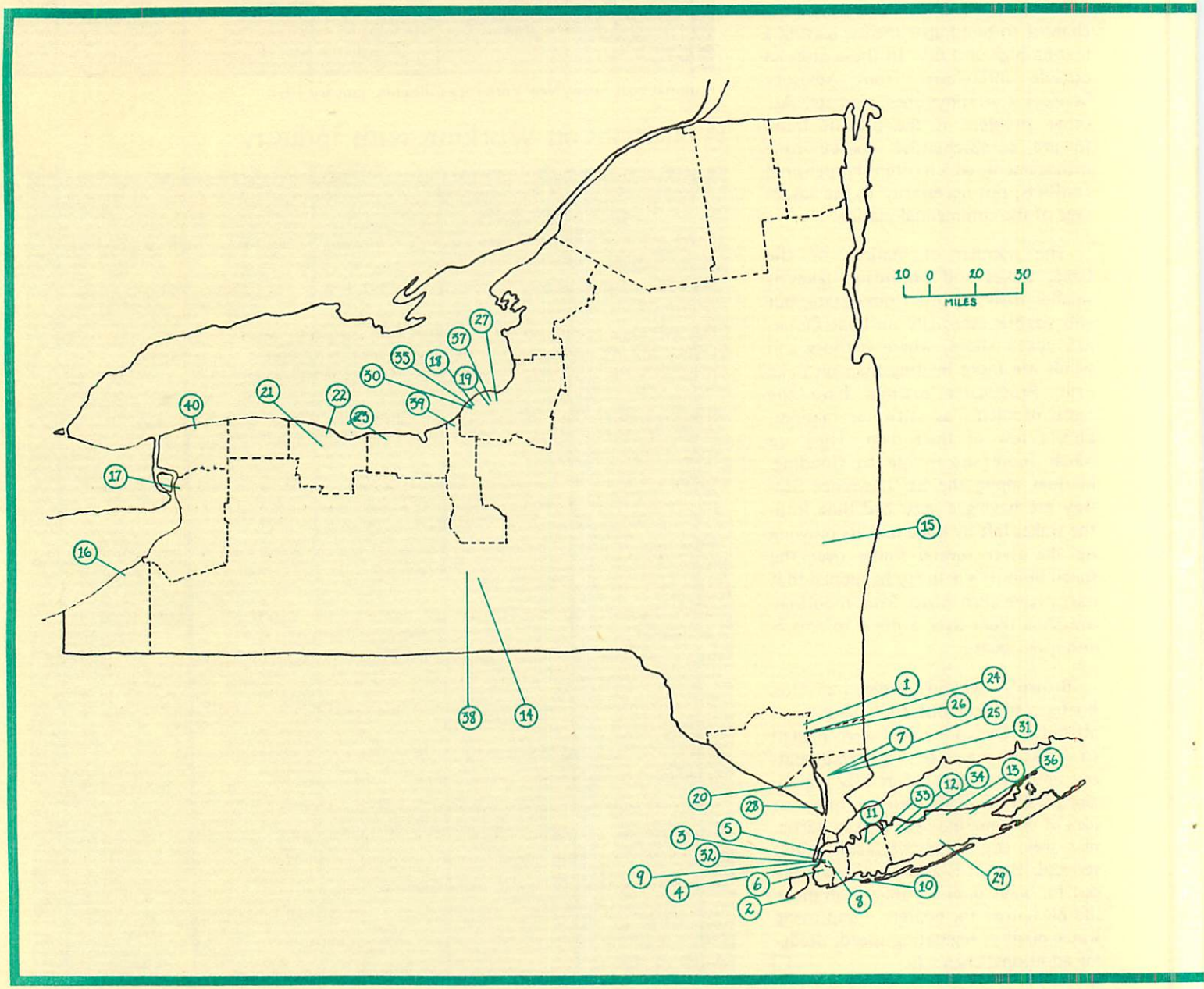
Smokehouses. Advisory Service, mimeographed. 4 pp.

Incorporating a Fish Business. Advisory Service, mimeographed. 16 pp.

Marine Insurance Guide. Advisory Service, mimeographed. 14 pp.

Scuba Air Stations – Nassau and Suffolk Counties. Advisory Service, mimeographed. 6pp.

IV. Siting Power Plants

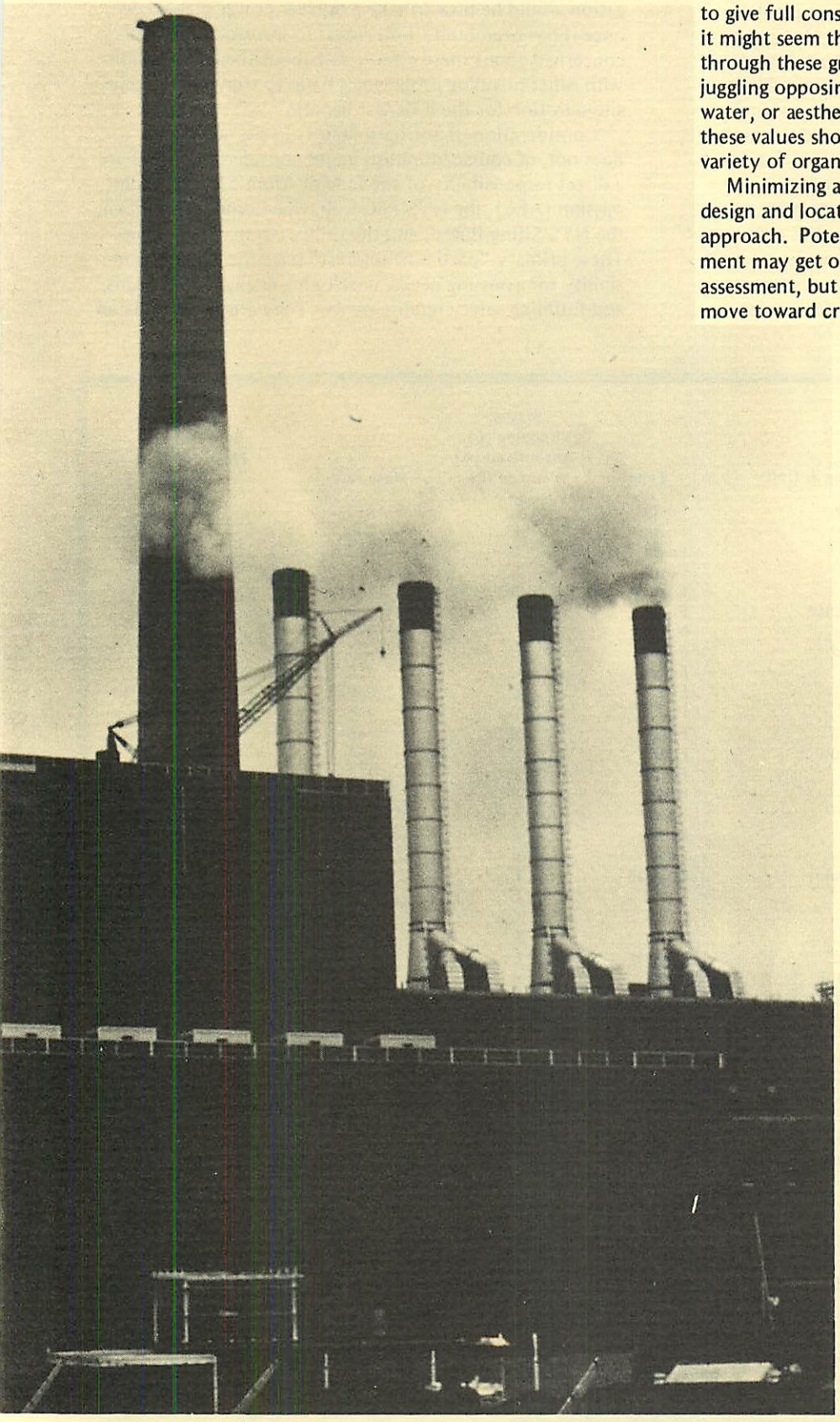


It is becoming apparent that choosing a power plant location is an extremely complex undertaking. Many considerations beyond lowest cost to the utility company are necessarily involved, particularly for nuclear plants. The increased risks of this form of power bring more exacting legislation and administrative requirements than do conventional fossil fuel plants. Nuclear power generation, for better or worse, is going to be a very significant factor in New York's environment over the next few decades. Environmentalists and planners at all levels need to consider very carefully the many side effects of a nuclear plant on the surrounding area, and the cumulative impact of multiple installations. An interesting topic for investigation would be how to take a nuclear power plant down, once it has been built. Full access to information by all concerned about these effects and about their interaction with other planning problems is basic to truly responsible site selection for the broadest benefit.

Consideration of ancillary factors in site selection does not, of course, diminish major considerations that are a direct responsibility of the federal Atomic Energy Commission (AEC), the NYS Public Service Commission (PSC), the NYS Siting Board, and the utility company or group. These primary "parties of interest" have the main responsibility for assessing needs, developing engineering designs, and fulfilling safety requirements. They are also mandated

Number	Company	Station & Unit	Type	Status: Existing (E) Authorized (A) Planned (P)	Megawatts	Current Scheduled or Proposed Date of Service
1	Central Hudson	Danskammer	Fossil	E	537	–
2	Con Edison	Arthur Kill	Fossil	E	843	–
3	Con Edison	Astoria	Fossil	E	2117	–
4	Con Edison	East River	Fossil	E	697	–
5	Con Edison	Hell Gate	Fossil	E	455	–
6	Con Edison	Hudson Avenue	Fossil	E	784	–
7	Con Edison	Indian Point	Nuclear	E	275	–
8	Con Edison	Ravenswood	Fossil	E	2181	–
9	Con Edison	Waterside	Fossil	E	650	–
10	Long Island Ltg. Co.	E.F. Barret	Fossil	E	669	–
11	Long Island Ltg. Co.	Glenwood	Fossil	E	475	–
12	Long Island Ltg. Co.	Northport	Fossil	E	766	–
13	Long Island Ltg. Co.	Port Jefferson	Fossil	E	454	–
14	N.Y. State E&G	Milliken	Fossil	E	276	–
15	Niagara Mohawk	Albany	Fossil	E	476	–
16	Niagara Mohawk	Dunkirk	Fossil	E	561	–
17	Niagara Mohawk	Huntley	Fossil	E	721	–
18	Niagara Mohawk	Oswego	Fossil	E	321	–
19	Niagara Mohawk	Nine Mile Point	Nuclear	E	620	–
20	Orange & Rockland	Lovett	Fossil	E	465	–
21	Rochester G&E	Beebee	Fossil	E	212	–
22	Rochester G&E	Russell	Fossil	E	254	–
23	Rochester G&E	R.E. Ginna	Nuclear	E	517	–
24	Central Hudson	Roseton No. 1	Fossil	A	600	3/31/74
25	Con Edison	Indian Point No. 2	Nuclear	E	350	on line
		uprating	Nuclear	A	500	12/73
		uprating	Nuclear	A	92	Spring/78
26	Central Hudson	Roseton No. 2	Fossil	A	600	1/31/74
27	Power Authority	J.A. FitzPatrick	Nuclear	A	821*	7/74
28	Orange & Rockland	Bowline Point No. 2	Fossil	A	600	5/74
29	Long Island Ltg. Co.	Holbrook GT	Fossil	A	318	5/74
30	Niagara Mohawk	Oswego Unit No. 5	Fossil	A	850	10/74
31	Con Edison	Indian Point No. 3	Nuclear	A	873	11/74 or later
		uprating	–	P	92	Spring/78
32	Con Edison	Astoria No. 6	Fossil	A	800	Spring/75
33	Long Island Ltg. Co.	Glenwood	Fossil	A	318	5/75
34	Long Island Ltg. Co.	Northport No. 4	Fossil	A	386	5/76
35	Niagara Mohawk	Oswego Unit No. 6	Fossil	A	850	11/76
36	Long Island Ltg. Co.	Shoreham No. 1	Nuclear	A	820	5/77
37	Niagara Mohawk	Nine Mile Point No. 2	Nuclear	A	1100	11/78
38	N.Y. State E&G	Bell	Fossil	P	800	Winter/78
39	Rochester G&E	Sterling	Fossil	P	1200-1600	Winter/80
40	N.Y. State E&G	Somerset No. 1	Nuclear	P	1200	Winter/82

*Will not go on line at full rating



to give full consideration to environmental effects. Though it might seem the public interest is adequately represented through these groups, the choices involved in siting require juggling opposing values – efficiency as against damage to water, or aesthetics as against employment. Fundamentally, these values should be public values, represented by a variety of organizations and officials.

Minimizing anticipated negative effects of a particular design and location has up to now been the major interests' approach. Potential *positive* influences on the environment may get overlooked in this kind of damage-oriented assessment, but some thinking and research is beginning to move toward creative possibilities.

A SITING "BUDGET"

With increasing public interest and involvement in power plant siting decisions, there is real need for complete information on the issues at stake, in an effective, understandable format. Robert Crow and Francis Loveland of SUNY Buffalo have sought to develop an informational framework to be used in weighing power plant siting proposals, including the antecedent question of whether a new plant is actually necessary in the first place. They're working out a system of evaluation accounts – a budget – similar in concept to income statements of corporations or to the national income accounts of the United States. The budget would theoretically contain all relevant information, both monetary and non-monetary, concerning a specific siting.

Three different perspectives or "accounts" on benefits and costs of a siting decision are proposed: the power consumer, the power producer, and the general public. A consolidated account will balance out all the entries in the three other accounts. Obviously, some difficult problems of measurement are involved.

Analysis of this sort should be useful, according to Crow and Loveland, for the major interested parties – the NYS Siting Board, AEC, PSC, and the utilities themselves. The budget framework should help citizens' groups to make good use of backup information, which is often a 10-foot shelf of unorganized and highly technical data, and to present their own case

in a methodical and convincing fashion.

Crow has also investigated a particular facet of the siting information problem not previously dealt with systematically: the economic effect of higher electric power costs. A fundamental siting controversy is rooted in this problem. If coastal and offshore sites are ruled out, the alternatives are inland sites using cooling towers, or fewer power plants, both with high price tags for the consumer. Cooling water availability is the major cost differential now. (But see "The Nuplex Idea" below for an abundant source of cooling water, even inland. Its price tag could be high, too, although it hasn't yet been investigated in economic detail.)

Crow is attempting to compile detailed analyses of the social and economic consequences of increased prices for the three spheres of residential, industrial, and commercial use. Regulatory agencies, utilities, and electricity-using firms commonly assert that a higher price for electric power will result in decreased consumption by the various user groups and will discourage economic activity, but there is little information to support or refute this assertion. Similarly, more expensive power is expected to affect economic output and regional growth – but how large an effect? If a reasonable estimate of such effects were available, it might lead to a more rational choice among cost alternatives – a choice now often made intuitively.

Crow has developed data series on actual electric power consumption and prices for the Buffalo SMSA (Standard Metropolitan Statistical Area). These data are being fed into the already-existing computer model of the Buffalo SMSA economy (see "The Truth About the Port of Buffalo"). He has found that residential consumption behaves as expected – that is, higher prices correlate to reduced consumption. Present work focuses on determining the sensitivity of manufacturing output and investment to electric power prices. □

WHY THE DELAYS?

Lengthy delays have marked the process of site selection and approval for new power plants. Such delays intensify power supply problems and vastly increase the ultimate cost of power generation to the consumer. Is it possible to reduce delays and improve the general efficiency of the site selection process without significant loss of public input or safeguards?

Sociologist Robert Ford of SUNY Buffalo divides siting questions into two clusters: technical questions on the physical/engineering facets of a site, and social questions on how both technologies and values translate into decision on a site. He concludes that recent delays are attributable more to social than to technical problems. Administrative procedures have not kept pace with either technical advances or power needs. These procedures are too combersome, expensive, and fraught with unproductive delays to remedy recent power shortages and meet future demands.

Recent state legislation has been directed toward streamlining and integrating site/line selection (Public Service Law, Articles VII and VIII), with at least initial improvement noted. However, much more is involved in administrative policy than the statutes themselves. Governmental agencies, Ford says, confine their concerns more narrowly than legislative intent. Extensive informal relationships have emerged between the regulatory agencies and the utilities, resulting in considerable consensus regarding goals and values.

Ford's most compelling finding was that the regulatory/governmental sector is apparently less responsible for delays in siting than was originally thought. Problems in the private sector are more serious than at first realized: tight capital on the money market, delays from equipment suppliers and consulting engineering firms. Given current shortages, these private-sector difficulties may be expected to worsen appreciably.

"Public interest groups . . . cause less delay in most cases than was thought. Their involvement is spasmodic and localized, related more to the unique qualities of a particular site than to long-term interest in policy."

Public interest groups also cause less delay in most cases than was thought. Their involvement is spasmodic and localized, related more to the unique qualities of a particular site than to long-term interest in policy. Ford points to homeowner reactions to transmission corridor siting as a growing area of concern. He believes confrontations can be reduced by adequate early consultation, a practice utility groups have not been noted for in the past.

Finally, the courts have assumed an increasingly significant role in the siting process. A trend analysis of recent decisions is nearing completion and will be integrated with the results of the statutory investigation. □

SITING POWER PLANTS

PLUMES AND PLUME CRITERIA

Most power plants draw in vast amounts of water for condenser cooling, which heats the the water by as much as 20°F. Then the water is returned to the stream or lake or estuary it was drawn from. So-called "once-through" cooling is usually cheaper than other alternatives like cooling towers. It's for the sake of once-through cooling that almost all existing New York power plants have coastal or river locations. The heated water pours out in a plume distinct, sometimes visibly so, from surrounding (ambient) water. Depending on local currents, it rises and often forms a pool. Several years ago New York State legislated specific limitations on the area and temperature elevation allowed for thermal effluent "plumes" or pools. The rationale for thermal effluent criteria was that, at least, they would help minimize any environmental damage from plumes which were not very well understood then (or now). The legal guidelines have not been actively enforced, partly because techniques for enforcement (measuring area, temperature) have not been worked out. Furthermore, although new plant design is supposed to meet the criteria, the law doesn't apply retroactively to older plants. Still, the law remains on the books.

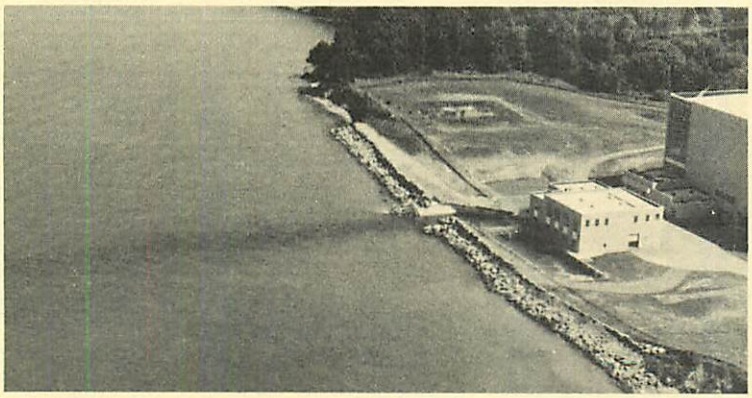
Meteorologist Eugene Chermack has been conducting a detailed study of the plumes actually produced by four power plants on Lake Ontario. He's trying to supply basic quantitative data on plume/pool size, location, shape, and behavior, to help decide the open question of whether pools of warmed water in an open lake constitute thermal pollution or thermal enrichment. In the process, he compared his data to the state thermal criteria.

Two significant observations emerged early in the study. One is that the plumes vary greatly in their characteristics with season, weather, and water conditions. At times, extent and temperature variations are far greater than the criteria authorize. During a significant fraction of the time, a "negative plume" can be observed: the effluent water is actually colder than the surrounding surface water. This can occur when the water taken in from below the thermocline (the interface between warmer, surface water and colder, deeper water) is substantially colder, even when heated, than the surface water above it. When the plume temperature is sufficiently "negative," a "diving plume" results. (This phenomenon was also observed by Czapski in his atmospheric work; see next report.)

The second observation is that the ambient water temperature, the "background" of the lake, is not easily determined. Nor do standardized methods exist for measuring it. Ideally, the ambient temperature is the temperature of the plume location without the plume. This can't be measured directly, needless to say. Prior temperature records at a site are now taken through one year, but rarely allow for normal variation from day to day and year to year. Chermack recorded lake temperatures by plane at the proposed Rochester Gas and Electric (RG&E) Sterling site, month by month for a year. (Half the flights were sponsored by RG&E.) His measurements by infrared-detecting thermometer attached to a small plane are probably the best practical means of obtaining surface temperatures, though still subject to some uncertainty.

Chermack's data show that improvements are needed in the state's thermal testing procedures. More important than detailed compliance is the matter of practical and effective guidelines. Chermack testified at En-Con hearings in Rochester (August 1973), suggesting:

(1) Better definition of ambient temperature and standard methods for its measurement;
(2) Specification of the depth at which plume temperature is to be measured (a little difference in depth can make a great difference in temperature);
(3) Fast, frequent, and year-round monitoring procedures;
(4) Aerial radiation thermometry adopted as a standard monitoring technique; and
(5) A realistic knowledge-base of effluent impact on biota and water, with criteria based on that knowledge, perhaps including duration as well as temperature and area restrictions. □



(Left) Visible effluent plume from Ginna power station, August 1973 (see sites map, No. 23). (Right) Thomas Galletta, research associate, mounts infrared thermometer for a day's flights.

PLUME EFFECTS ON THE AIR

The thermal emission guidelines we've been discussing refer only to water temperature; they are not concerned with secondary effects the heated water plume may have on the atmosphere above the water. Atmospheric scientist Ulrich Czapski has made a study of these atmospheric effects at Niagara Mohawk's Nine Mile Point nuclear plant. His results highlight the great variability in lake and atmospheric conditions surrounding the thermal plume and, consequently, the marked variation in heat transfer to the atmosphere.

Measurements of air temperature and motion, both horizontal and vertical, were made from a fixed 30-foot tower set up in Lake Ontario adjacent to the power plant's cooling water outfall. Three components of the total heat transfer to the atmosphere were identified: (1) the sensible heat (indicating a temperature change) carried away from the plume by bubbles of heated air, (2) the latent heat (indicating a change of state) used when moisture evaporates from the plume surface, and (3) radiant cooling of the water surface. Each mode of heat transfer follows a different non-linear law and therefore should be considered separately, especially in dealing with a limited-area "hot spot" such as an effluent plume. Heat transfer from such a hot spot is likely to be much more rapid than from a surface of homogeneous temperature.

The dominant mode of heat loss from a warm-water surface will always be evaporation. If the atmosphere above the plume is generally stable, the evaporation may result in fog formation. Unstable conditions, however, strongly magnify heat transfer upward from the plume and moist air over the "hot spot" is carried upward much faster. In such cases, chances of cloud formation and possible thunderstorm development are increased. Similar effects have occurred over cities and natural heat sources of size comparable to the plume.

Measurements at the tower emphasize the variation in sensible heat transfer with changing atmospheric conditions. As the air becomes less stable, more and more small, hot plumes or bubbles of warm air (termed "microthermals") rise through the sensor level on the tower, passing the instruments in about 10 seconds at wind speeds of one to three meters per second; they are responsible for a large part of the heat transport. If the lower layers of the atmosphere are stably stratified, the microthermals are reduced in number and strength. In addition to these distinct and well-organized microthermals, Czapski observed larger thermals, less-organized air parcels, especially with increasing atmospheric instability. As the warm air bubbles increase in size — some 30 to 50 meters long — they become more important as a heat transport mechanism, and they are also thought to penetrate higher into the atmosphere. A large heat source (thousands of megawatts) of significant area may be more conducive to cloud and thunderstorm formation than a smaller area with the same total heat output. The heat and water vapor fluxes from large power stations therefore have the potential for significant local weather modification. Future regulations should take this potential into account. □

PLUME AND CONDENSER EFFECTS ON PLANKTON

The lakes, streams, oceans, and estuaries from which cooling water is drawn support large populations of microscopic plants and animals — phytoplankton and zooplankton, respectively. Mostly too small to be visible to the naked eye, these organisms often total 1,500 per drop of water. They supply food and oxygen for larger aquatic animals and are therefore extremely important to lake and ocean life.

Madelyn Glase and Donald McNaught of SUNY Albany assessed the effect on planktonic organisms of "entrainment" in the flow of water through the condensers of Nine Mile Point nuclear plant, and the thermal effect on plankton out in Lake Ontario where the plume dissipates. They also developed a mathematical model for predicting plankton productivity changes resulting from specific thermal effluent situations.

The conclusion of the Glase/McNaught work is that recovery of plankton populations appears to be rapid and that any deleterious effects are localized. The scientific literature supports these findings. Zooplankton may sustain as little as two to five percent mortality directly from heat; chlorine (used to keep down bacterial growth in the condenser pipes) and mechanical abrasion probably kill more zooplankton than do abrupt temperature increases. Algal populations appear to be even less affected than the zooplankton by condenser passage.

Two opposite thermal effects on algae were found by Glase and McNaught, depending on how much and how fast the water is heated, and the mix of species present. In cold weather, the warm water had a growth-stimulating effect, though quite localized. The plume cooled rapidly by mixing with cold lake water, and no stimulation could be detected two miles from the power plant. During the warm summer months, entrainment and heat seemed to have a growth-inhibiting effect. An 18-28 percent reduction in productivity was measured after passage through the Nine Mile Point plant in summer. Since nuisance blooms of blue-green algae are often a problem in summer, it is interesting to find that heat suppressed their growth. The major effect of condenser passage was on growth rather than on numbers, that is, not many were killed.

The finding that power plants have only local effects on plankton populations has certain implications for the siting problem: clustering plants to reduce the number of affected areas is probably a good idea – for microscopic organisms, at least. Plankton would recover rapidly even around a cluster of power plants and the rest of the region would be uninfluenced. The effects on fish and on benthos – the plant and animal groups living on the lake bottom – must be analyzed first, though, in the same way plankton effects have been analyzed here. Clustering's effect on local currents and circulation should also be looked into.

THE NUPLEX IDEA

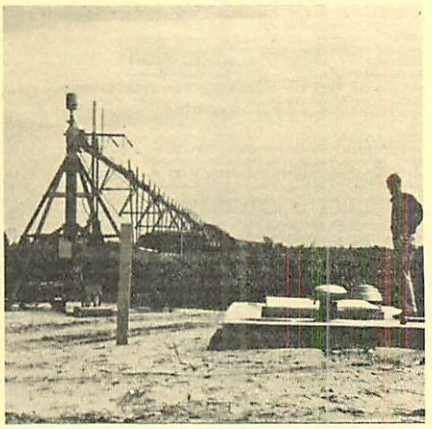
While investigations on coastal power plant impact should continue, a suitable alternative to coastal siting, at reasonable cost, could bring profound changes to the entire power generating system. Plants might then be sited nearer the electricity-consuming cities, with significant savings in transmission line costs and power losses. Though so far not attempted in this state, there is such an alternative. It is the use of sewage plant effluent for cooling purposes.

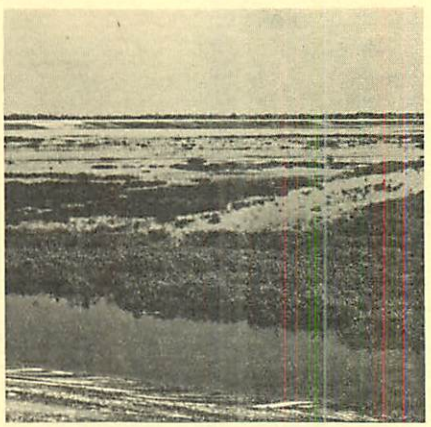
Sewage effluent in the United States is almost universally considered a pollutant, and the only concern of planners is to dispose of it as expeditiously and inconspicuously as possible. In fact, it could be an important resource. New York State residents use about a hundred gallons of water per person per day, thus disposing of two billion gallons of wastewater daily. If only half this wastewater were ponded in lagoons for winter storage, a resulting 110,000 acres of storage lagoons 10 feet deep would supply enough cooling water to power plants located on the lagoons for 110,000 megawatts of generating capacity, once-through. This is approximately five times New York's 1973 power demand of 20,000 megawatts. Locating these lagoons and putting in sewage supply pipes would present some tough problems, but the advantages would be very real, too. For one thing, both thermal and sewage effluent damage to natural water bodies would diminish. For another, power plants buying lagoon water from municipal sewage districts, on an appropriate scale, could conceivably cover the entire cost of the wastewater system. And finally, these lagoons would eliminate the need to meet thermal criteria, an expensive requirement.

The lagoon-power plant grouping has a second major use. Accumulation of sewage effluent, presumably following secondary treatment to render it aesthetic and sanitary, makes it available for another use: crop irrigation. Effluent contains important plant nutrients – a eutrophication-causing liability when the effluent is simply discharged into a body of water but a real asset when it is sprayed on grazing land, parkland, or marginal land for growing cotton, forage crops, or trees, for example. Nutrient values of typical sewage are said to be worth about $100 per acre per year, increasing crop yields 150 to 200 percent. In the process, the former wastewater is cleansed by being passed through a "living filter" and is restored to the water table for eventual reuse. Both benefits (irrigation, clean water) are significant in themselves and have been known and practiced for centuries; but they may actually be heightened when the lagoon water is also used for power plant cooling, because the heat speeds up bacterial action on the sewage.

A substantial amount of information is available on some aspects of this "nuplex" (nuclear plant complex) idea. (The power plant doesn't have to be nuclear, but the word is convenient and catchy, and more nuclear than fossil plants are likely to be built in the future.) Jon Scott of the Environmental Studies Program, SUNY Albany, has brought these data together as a basis for future site planning in New York – both power plant siting and sewage treatment plant siting. Experience in a number of places, notably in Muskegon, Michigan, and at Pennsylvania State University, supports the concept of nutrient recovery for crop use and of the "living filter" effect. The 1972 Federal Water Pollution Control Act mandates zero discharge of pollutants to US waterways by 1985. Widespread use of the nuplex concept could make zero discharge, from both sewage and power plants, a reality. □

(Right) Spray rig at Muskegon, Michigan, wastewater "living filter" system. The wheel-mounted rigs, each about a quarter of a mile long, spray 2 to 4 inches of water a week. Poor sandy soil grows vigorous corn or forage crops, helped by the nutrients in the wastewater.





(Above) An 850-acre storage basin for the Muskegon Project, being filled (summer 1973). The water is about 9 feet deep when the basin reaches capacity. It acts as a wildlife sanctuary and has good recreation potential, besides prospective power plant and other industrial use.

A. Butkas, NYS Office of Parks and Recreation

MULTIPLE USE OF SITES AND CORRIDORS

Generating plants and their power transmission lines are required by law to be isolated by prescribed distances from houses, stores, and so forth. This "exclusion zone," often many acres in size, is intended to reduce the danger of accidental exposure to high voltage or significant amounts of radiation. So much land is involved, much of it shore frontage, that people are beginning to discuss public use of it. Since the likelihood of being struck by a falling power line is slight, except perhaps in a severe storm, recreation and other non-residence use of transmission line corridors, at least, is considered reasonably safe by regulatory authorities.

Recreational Uses

Large pieces of land, some over a thousand acres and along a coastline? What a potential for multiple use, especially for recreation! Ronald Stewart of the Atmospheric Sciences Research Center, SUNY Albany, reports that an expanding and largely urban population, combined with a generally rising standard of living in New York, has brought very heavy pressure on public recreation facilities of all kinds, a trend we can be sure will continue. At the same time, he points out, one dozen generator sites along the Lake Ontario coastline on the New York side are already designated, with attendant transmission lines planned as well. The public benefit from using these restricted zones as recreation areas could be tremendous. Environmentalists see an even further dividend in more people getting out there "back to nature" and finding out that good environmental quality is vital to their fun.

A host of specific recreational uses seems promising, though not necessarily mutually compatible. Many utility corridors are already being used for hiking trails, horseback-riding, trail-bike travel, bicycling, snowmobiling, and field sports and picnicking – with or without the sanction of the utility company involved. Cross-country skiing seems an appropriate use of such corridors; it requires little landscape preparation. Stewart recommends that local clubs patrol and mark the trails. Cross-country trails need to be less steep than snowmobile trails – one of several reasons to keep them separate. Golf requires open space often difficult to find in urban and suburban regions but easily accommodated in an exclusion zone. (It's also profitable.) Some degree of planning and management will be necessary to control destructive activities the public is prone to indulge in. Management costs could be covered by moderate user fees.

Multiple Use

Stephen Wilson and his associates at Empire State College, as part of the Sea Grant power plant siting team, explored attitudes toward multiple site/line use, researched the sticky question of responsibility or liability for injury to someone who is "recreating" on site/line land, and reviewed the multiple uses being planned for RG&E's proposed Sterling site. They also put together a directory of individuals immediately or secondarily involved in siting decisions. At present a working paper only, this directory has six sections of names, addresses, and phone numbers: (1) Sea Grant team members, (2) state agency-designated representatives, (3) interested state personnel, (4) utility company people, (5) conservation organization people, and (6) interested private individuals.

Attitude Survey of Multiple Use

A questionnaire written by Wilson's team members was designed to find out how much people actually know about environmental factors in siting, and how much importance they place on these factors – the basics behind people's attitudes toward multiple use. The people surveyed were of all kinds; about half were local town mayors, supervisors, town clerks. Private citizens (many living near the Sterling site), members of organizations, planning board people, utility people, and two elected state officials were the rest.

Practically all (95 percent) recognized the nation's energy problems and hoped for national solutions to shortages. The same percent considered Americans wasteful of energy. Over 90 percent favored using power plant thermal effluent for heating houses and commercial and industrial buildings. Respondents were strongly concerned about good land use: they favored offshore and underground sites and opposed sites in residential and wilderness areas. First-choice uses for transmission corridors were agriculture, non-motorized trails, and parklands. They preferred routing lines along highways and railroads rather

The Sterling site on Lake Ontario proposed for two RG&E fossil fuel power plants. See Number 39 on the sites map (page 38).

than taking shortest routes through remote areas. Respondents favored a balanced environmental-economic approach to energy production – very much like that prescribed by the new state siting law (Public Service Law Articles VII and VIII, the New York State Major Utility Generating Facilities Act of 1972, passed after three years of debate). Two-thirds of the respondents were aware of the new law, but few understood its detailed implications for the siting process. Their main environmental objection was pollution rather than land consumption, waste of resources, or aesthetics. Hardly any were worried about getting injured while using site/line land, but many were anxious about nuclear dangers like explosion and radiation. Finally, respondents ranked their information sources on all these issues as newspapers, electronic media, and magazines, in that order. □

Multiple Use of the Sterling Site

Rochester Gas and Electric Corporation, the first utility to come under the new Article VIII, is presenting a multi-use plan with its Sterling site application. The site's 2,800 acres – wetlands, woods, agricultural land and orchards, and about one mile of coast – will easily accommodate the two fossil fuel plants proposed. RG&E and its consultant, Saratoga Associates, sought the advice of Sea Grant in preparing the plan's recreational aspects. The PSC, after review and public hearings, will make a final decision, probably within 1974.

RG&E had already learned from a survey of Sterling site residents in August 1973 that they liked "peaceful, quiet country life," though not undeveloped wilderness. The citizens favored low-intensity uses of the buffer land (parks, picnic areas, wildlife sanctuaries). Snowmobiling was hotly controversial among them: 23 percent strongly pro-, 21 percent strongly anti-snowmobile.

From community and Sea Grant input, RG&E's multi-use plan shapes up like this: a community center with parking lot, a 15-mile trail (for hiking/cross-country skiing with a shelter – no snowmobiling), picnic grounds, softball field, tennis and basketball courts, low-key shoreline development with a swimming beach, an employee recreation area, and continued farming. The relationship of this site to a state park and other preserve lands is still being considered. □

Liability Questions on Multiple Use

Rosemary Nichols, Robert Ford, and other lawyers and legal experts working with the Sea Grant team have summarized existing liability legislation, court interpretations, and opinions of lawyers involved. They have found that almost everyone is aware of the need for recreational open space, and wants to see the zones put to good public use. However, the problem of personal liability is a thorny one.

New York law recognizes three general categories for an individual on another person's land: trespasser, licensee, or invitee. The responsibility of the landowner to the visitor – and liability for accident – depends on the extent to which the landowner encourages his presence. To the trespasser, whose presence is usually unknown, the landowner has a duty only to refrain from willful injury and from setting "traps." To the licensee, a person specifically authorized to enter for his own purposes, the owner must avoid causing injury by negligence, and is further required to warn of particular dangers on the property. To the invitee, whose presence has been requested by the owner whether or not for the invitee's own purposes, the landowner has the greatest legal obligation. He is required to identify dangers, remove them if possible, or warn the invitee about them. The responsibilities and legal liability of the utility companies may not have to conform to the kind of entrant, even if that were definable. The whole picture is nebulous at best.

The General Obligations Law of 1956 is intended to minimize any

liability of the passive landowner who merely allows or does not directly forbid the use of his property for recreation. It does not, however, apply to utilities who actively encourage recreational use.

In 1970, when Consolidated Edison submitted to the Public Service Commission a statement of environmental impact and public need prior to licensing of a major new transmission line (under Article VII), PSC required the utility to make two percent of the cost of its proposed line available for recreational development along the corridor. It was expected that the actual sponsor of the recreation (not Con Ed) would assume liability for public uses. The Office of Parks and Recreation, most probable sponsor of such recreational development, has leaned toward the contrasting view: utility companies should bear the financial risks of recreational use of rights-of-way. The net outcome is that utilities still point to liability problems and the rights of adjacent landowners as major obstacles preventing multiple use.

The problems of liability assignment still need to be resolved. The recreational potential of many miles of prime land ought not to be forfeited by bureaucratic conflict or legal posturing. The team working on the liability question has identified five options, some less feasible than others:

(1) *Indemnification.* The state would reimburse a utility for loss suffered paying for a person's injuries. At present, such indemnification could be held unconstitutional, in that giving state money to private or public corporations is forbidden.

(2) *Including utilities under the General Obligations Law.* The dubious benefits of this option depend on each judge's view of each case.

(3) *Insurance from OP&R specifically covering recreation activities.* Recreation insurance would resemble automobile insurance. Problems here are insurance companies' unwillingness to enter into long-range agreements, and the determination of upper and lower coverage limits: who pays small claims under $50,000 or huge claims of millions of dollars?

(4) *A contractual agreement between a utility and a recreational sponsor* regarding care duties (e.g., posting hazards). It is not certain, however, that only the sponsor and not the utility would be liable.

(5) *Status quo: do nothing.* OP&R claims from experience that the liability risks from recreation are so small they do not warrant the utilities' delay. A statistical investigation is needed to verify or refute the claim. The utilities are reluctant to go ahead without insurance coverage, and so far, public demand for a return on the vast land and water required for power generation and transmission is satisfied with merely the energy itself.

Why should the companies authorize public recreation? Pressure for open space on the coasts inevitably will clash with the utilities' needs for more sites that consume large pieces of our scarce coastal land. The power plant siting team encourages utilities to see that their best interest lies in supporting multiple — in fact, maximum — public uses of these coastal lands. □

Publications on Siting Power Plants

Power Plant Thermal Effluents in Southeastern Lake Ontario by E.E. Chermack and T.A. Galletta. Proceedings of the Sixteenth Conference on Great Lakes Research, 1973, pp. 663-674.

Power Plant Siting. Proceedings of the Meeting, May 1972, State University of New York, Oswego, New York. 57 pp. Advisory Service Publication, March 1974.

Table 6 1972 - 1973

Program Staff

Donald F. Squires	*Program director*
John H. Judd	*Executive officer*
Ellen Arel/Jean Hopkins	*Editor*
Orville W. Terry	*Scientific editor*
Marian N. Steinberg/Suzanne Servis	*Administrative assistant*
Virginia Haynes/Douglas Bacon	*Financial assistant*
Patricia O'Shea	*Secretary*
Marc Helsinger	*Research assistant*

Advisory Services Staff

Bruce T. Wilkins	*Associate director for administration*	Ithaca
Barbara Kirk	*Administrative assistant*	Ithaca
Linda Camp	*Media specialist*	Ithaca
William Walters	*Marine biology*	Stony Brook
Peter Sanko	*Marine geology*	Stony Brook
Roger Allbee	*Resource economics*	Stony Brook/Brockport
Richard Gross	*Marine recreation*	Brockport
Sandor Schumann	*Aquatic sciences*	Brockport
Dale Baker	*Environmental engineering*	Oswego
Glenn Malloff	*Marine youth education*	New York City

Program Expenditures

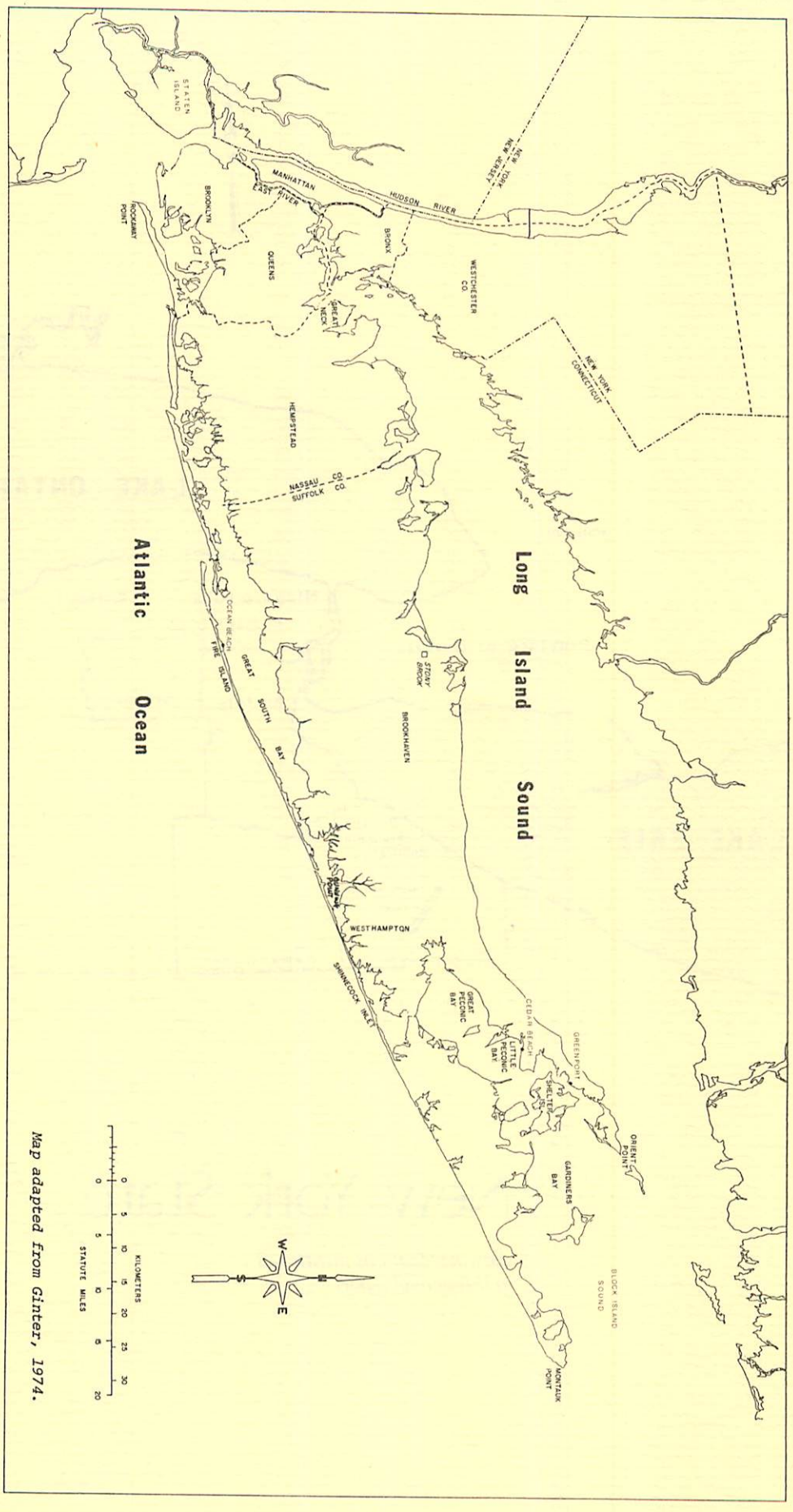
Program Area	*NOAA Funds*	*Matching Funds*	*Total*
Coastal Zone Studies	85,693	67,535	153,288
Managing Resources	154,054	102,713	256,767
Working with Industry	106,937	60,827	167,764
Siting Power Plants	114,968	155,466	270,434
Special Projects			
New York Bight Atlas	157,560	1,713	232,173
Environmental Data Base Directory	72,900		
Advisory Services	200,000	155,046	355,046
Education	17,960	14,457	32,417
Program Management	120,388	70,745	191,133
	1,030,460	628,502	1,658,962

Budget Notes:

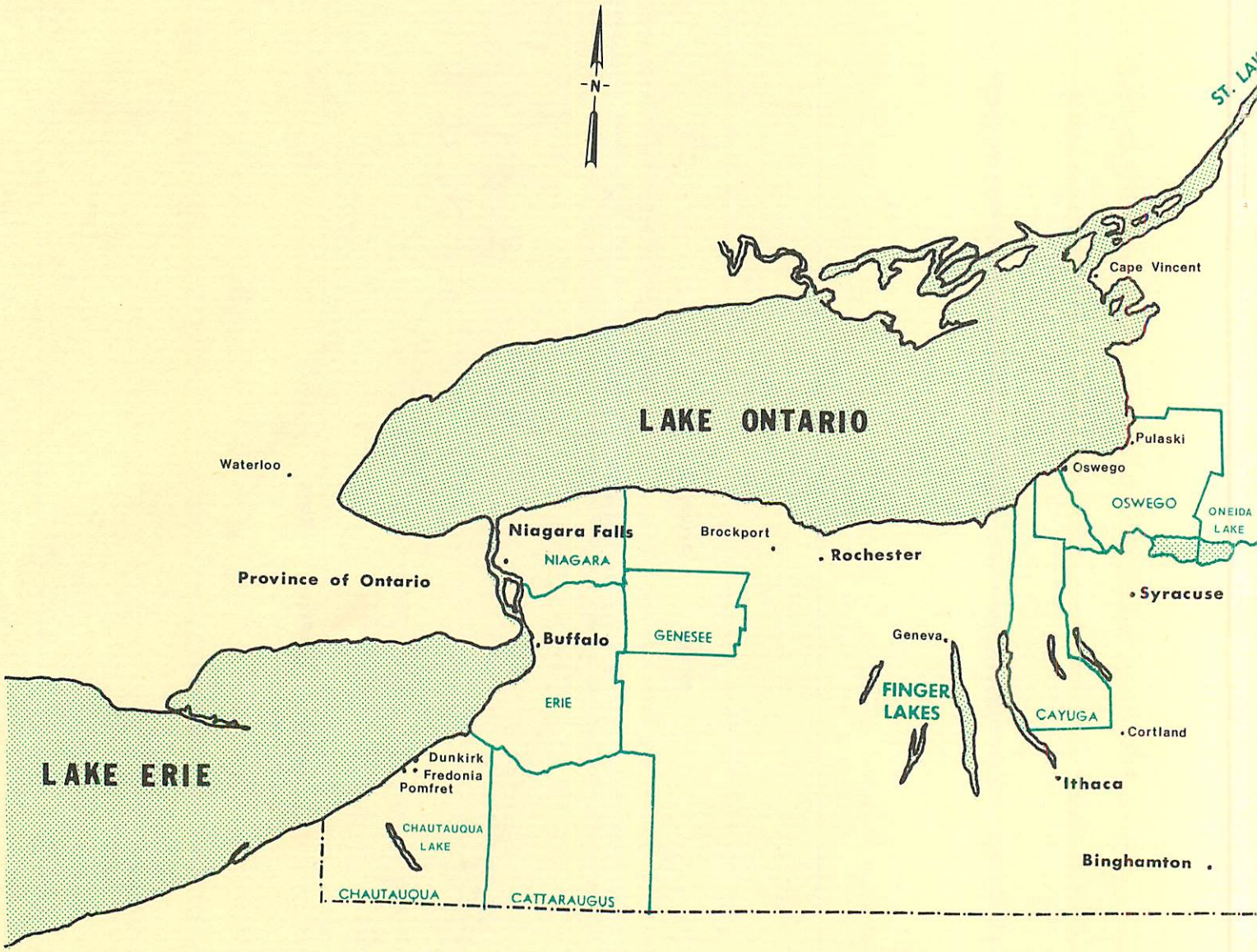
Though Advisory Services and education expenditures are shown separately here, their efforts are described within the four work areas in the text of the annual report.

The two special projects are grants being carried out under the supervision of D.F. Squires (Bight Atlas) and J.H. Judd (Directory).

Long Island Area



Map adapted from Ginter, 1974.



New York State

showing locations mentioned in this annual report

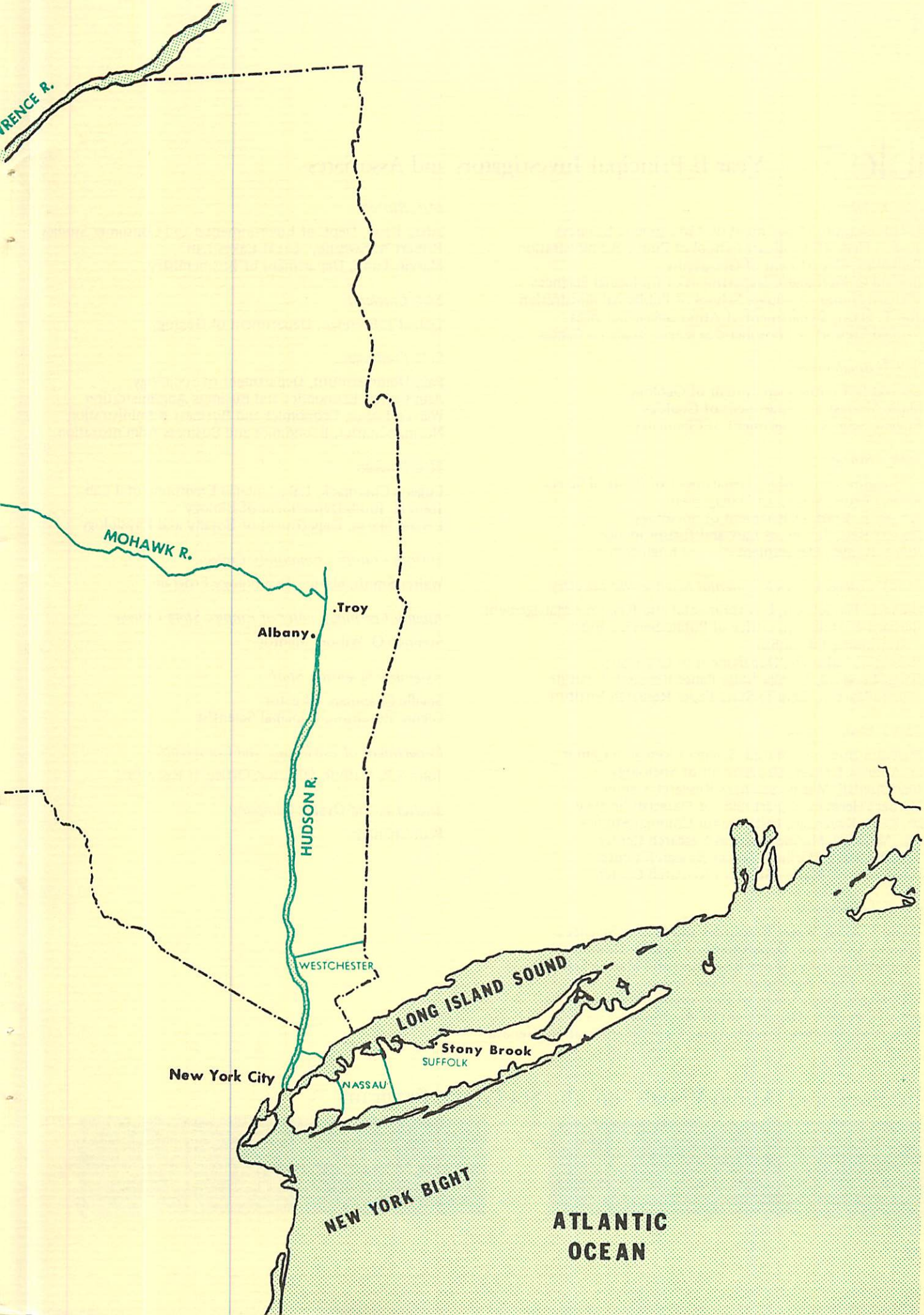

RENCE R.
MOHAWK R.
Troy
Albany
HUDSON R.
WESTCHESTER
LONG ISLAND SOUND
Stony Brook
SUFFOLK
New York City
NASSAU
NEW YORK BIGHT
ATLANTIC
OCEAN

Table 7 Year II Principal Investigators and Associates

SUNY Albany

Ulrich Czapski, Department of Atmospheric Sciences
Joseph Heikoff, Graduate School of Public Administration
Paul Marr, Department of Geography
Donald C. McNaught, Department of Biologcial Sciences
Richard Nunez, Graduate School of Public Administration
Jon T. Scott, Department of Atmospheric Sciences
Ronald Stewart, Atmospheric Sciences Research Center

SUNY Binghamton

Donald R. Coates, Department of Geology
Marie Morisawa, Department of Geology
Eugene Schrier, Department of Chemistry

SUNY Buffalo

L. Vaughn Blankenship, Department of Political Science
Robert Crow, School of Management
Robert E. Ford, Department of Sociology
Robert Reis, School of Law and Jurisprudence
Ralph Rumer, Department of Civil Engineering

SUNY College of Environmental Science and Forestry

David L. Hanselman, Environmental and Resource Management
Bernard T. Holtman, Office of Public Service and Continuing Education
Robert T. LaLonde, Department of Chemistry
Bengt Leopold, Empire State Paper Research Institute
Renata Marton, Empire State Paper Research Institute

SUNY Stony Brook

Malcolm Bowman, Marine Sciences Research Center
O. Andrew Collver, Department of Sociology
Iver Duedall, Marine Sciences Research Center
Herbert Herman, Department of Materials Science
W. Keith Kavenagh, Institute for Colonial Studies
J.L. McHugh, Marine Sciences Research Center
Fred Roberts, Marine Sciences Research Center
Orville Terry, Marine Sciences Research Center

Cornell University

David J. Allee, Water Resources and Marine Sciences
Tommy L. Brown, Department of Natural Resources
Leonard Dworsky, Water Resources and Marine Sciences
Doyle A. Eiler, Agricultural Economics
C.D. Gates, Department of Environmental Engineering
John H. Peverly, Department of Agronomy
Robert Shallenberger, NYS Agric. Experiment Station, Geneva

SUC Buffalo

Allan Kron, Dept. of Environmental and Consumer Studies
Robert A. Sweeney, Great Lakes Lab
Marvin Tunis, Department of Biochemistry

SUC Cortland

Daniel J. Brennan, Department of Geology

SUC Fredonia

Paul Dommermuth, Department of Sociology
Ann Fisher, Economics and Business Administration
Warren Fisher, Economics and Business Administration
Norman Starler, Economics and Business Administration

SUC Oswego

Eugene Chermack, Lake Ontario Environmental Lab
John H. Judd, Department of Biology
Leland Marsh, Department of Botany and Physiology

Suffolk County Community College

Walter Smith, Marine Technology Program

Albany Learning Center of Empire State College

Stephen O. Wilson, Mentor

Assembly Scientific Staff

Seville Chapman, Director
Glenn Stevenson, Principal Scientist

Department of Environmental Conservation

John S.P. Mathur, Director, Office of Recycling

Shelter Island Oyster Company

Paul Chanley

Publications and Audio-Visuals on the Sea Grant Program

Annual Report. About 40 pp. Available around April of each year.

New York's Sea Grant Program. About 150 pp. Available around January of each year, current year only.

New York Sea Grant Community Development Program. 8 pp. Advisory Service brochure, January 1974.

New York Faces the Sea. 16mm film, sound, color. 12.5 min. 1972.

A New Film: New York Faces the Sea, Advisory Service flyer.

New York's Sea Grant Program and You, Advisory Service flyer.

Sea Grant Cassettes, Advisory Service flyer, describing the audio-tape series.