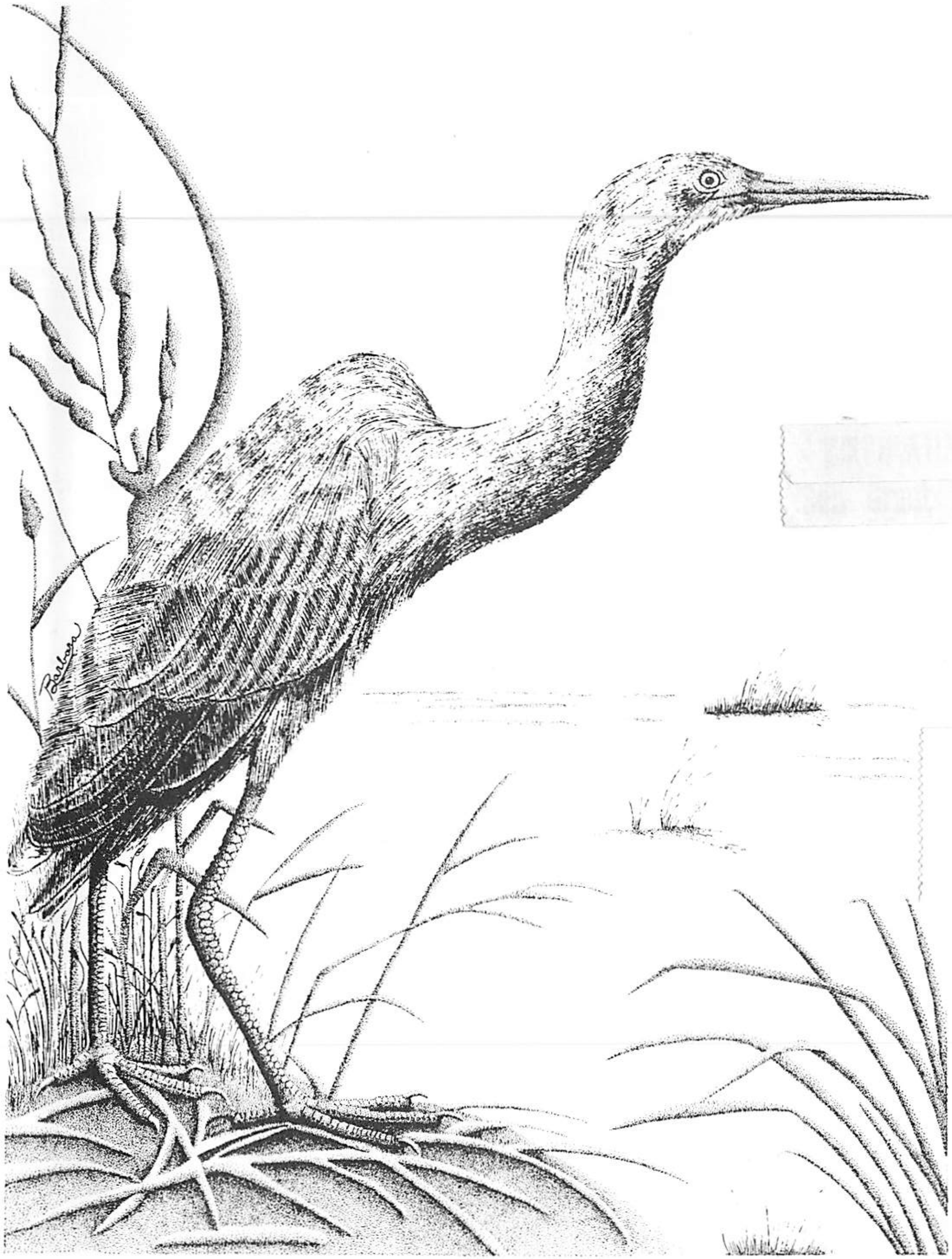
New Jersey Sea Grant Annual Report 1981-1982



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INTRODUCTION TO THE NEW JERSEY SEA GRANT PROGRAM

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Report of the Sixth Year 1981-1982

In 1966 the Congress of the United States created the National Sea Grant College Program. Sponsored by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, the National Sea Grant Program is a partnership of government, university and industry working for sound economic development and appropriate use of our nation's marine and coastal resources.

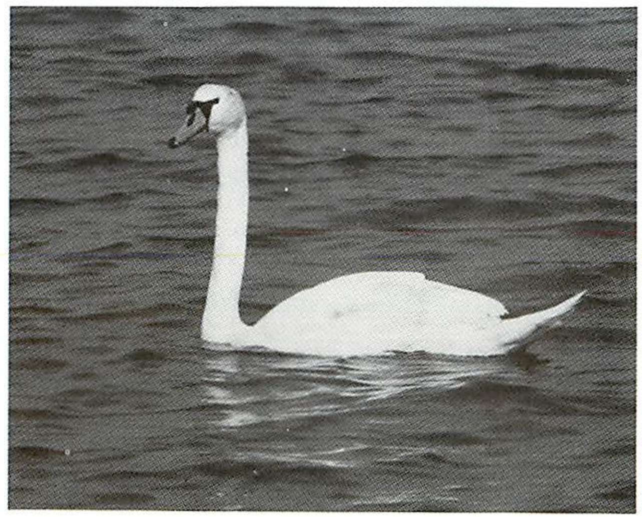
The New Jersey Sea Grant Institutional Program is managed by the New Jersey Marine Sciences Consortium, an alliance of 25 institutions of higher education, a number of business and industrial organizations, and individuals with marine related interests. The Consortium was established in 1969 to pool scientific expertise and institutional resources for the purpose of addressing the challenges and opportunities presented by the state's diverse marine resources.

The Consortium conducts a comprehensive program of marine research, education and advisory services. The early years of the New Jersey Sea Grant Program were characterized by steady growth and increasing value to the state and nation. New Jersey Sea Grant has now completed its sixth year of activities in coastal and marine concerns.

During the 1981-82 Sea Grant year fourteen projects were carried out under five major program categories: Fisheries, Northern New Jersey Estuarine System, Ocean Engineering, Coastal Systems and Marine Education. Consortium institutions participating in Sea Grant Six included: the Lamont-Doherty Geological Observatory (of Columbia University), Lehigh University, New Jersey College of Medicine and Dentistry, Princeton University, Rutgers University, St. John's University, Stevens Institute of Technology, the Wetlands Institute (of Lehigh University) and the Burlington County chapter of the Girl Scouts of America. Further, the New Jersey Sea Grant Extension Service, formerly known as the Marine Advisory Service, expanded its role as the marine educational and informational arm of the Sea Grant Program and the Cooperative Extension Program of Cook College/Rutgers University.

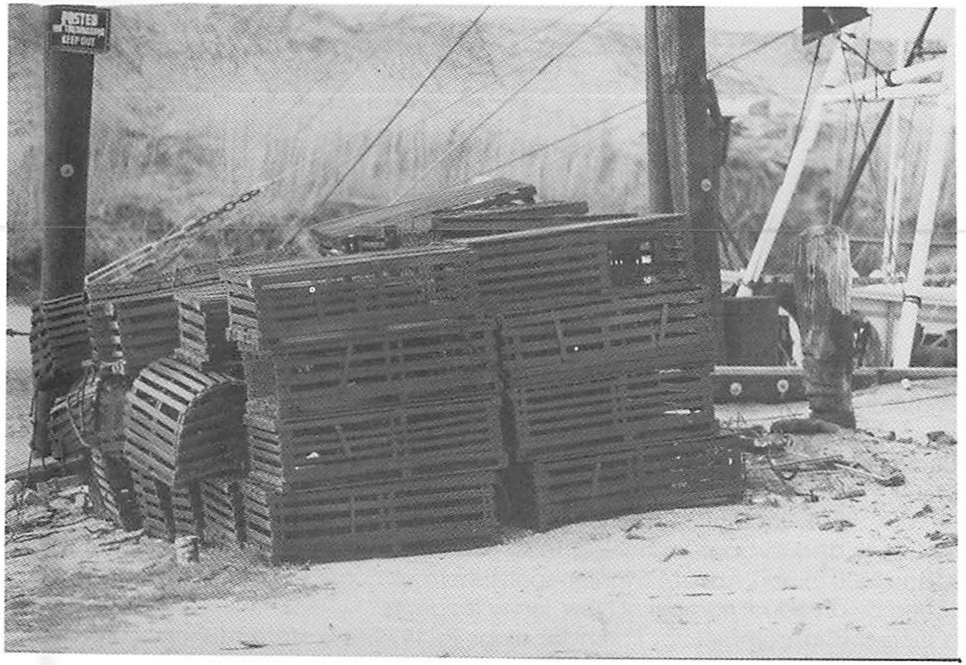
This, then, is an account of the sixth year of Sea Grant in New Jersey. As it expands and matures in New Jersey, the Sea Grant program continues to achieve the goals and objectives established through the creation of the National Sea Grant Program.

Dr. Robert B. Abel
Director



NEW JERSEY
MARINE SCIENCES
CONSORTIUM

TABLE OF CONTENTS

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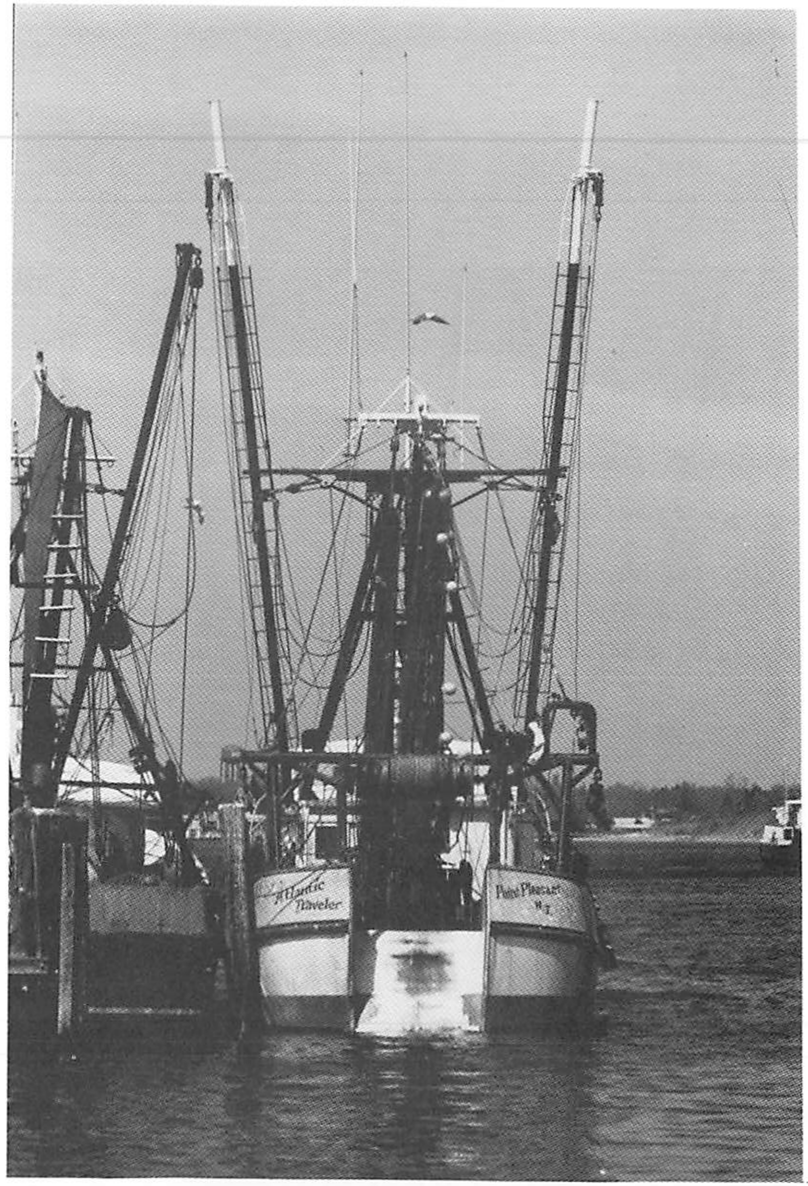
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MARINE SCIENCES
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FISHERIES PROGRAM

The importance of New Jersey's fisheries is illustrated by a few statistics:

First, the commercial fisheries rank 12th in landed value in the entire nation and 6th on the East Coast. The port of Cape May/Wildwood went from third among east coast ports in 1978 to second in 1979, led only by New Bedford. In 1979, 189 million pounds of fish with a value of 53 million dollars were landed in New Jersey.

Second, the New Jersey recreational fisheries lead the nation in expenditures for travel to fish, in charter boat rentals, and in boat launching fees. Economic value of the recreational fisheries is between $300 and $400 million. About 1.5 million sport fishermen come from out of state each year, and they are matched by an equal number of New Jersey residents.

Despite an increase in commercial finfish landings in 1979, the state's fisheries are beset with problems. Heavy pollution has resulted in closure of close to 100,000 acres, a fourth of the state's shellfishing areas. There is growing uncertainty, because of lack of data, about the present safety to consumers of some finfish and crustacean stocks, and of the future health and continuance of such stocks.

Both the commercial and recreational fisheries are difficult to manage because of inherent conflicts and a continuing insufficiency of information; both are affected, to an extent which has yet to be quantified, by rising fuel costs.

During 1980-81 New Jersey Sea Grant developed a fisheries program plan with the participation of a Fisheries Advisory Committee composed of representatives of state and federal agencies, leaders from the commercial and recreational fishing industries, and university scientists. The program plan is based on a long history of problem assessment and interaction among state officials, fishermen, and university researchers. Joint planning with representatives of the fisheries groups and agencies ensures that Sea Grant research will be focused on priorities most susceptible to study by university scientists. In addition, committee members provide direct liaison with the interests they represent.

SUBLETHAL EFFECTS OF HEAVY METALS ON INTESTINAL ABSORPTION OF NUTRIENTS IN FISH FOUND IN NEWARK/RARITAN BAYS

NEW JERSEY MARINE SCIENCES CONSORTIUM

A. Farmanfarmaian

Newark and Raritan Bays (and in general the Hudson-Raritan estuary) receive heavy metal pollution from industrial and domestic wastes in the New York metropolitan region. This pattern of pollution has been recorded for many other metropolitan regions on the United States and the world. Due to trophic amplification through phytoplankton, zooplankton, small invertebrates, and small fish which are ingested by larger commercial or sport fish, high levels of heavy metals are expected in the intestine of fish. In fact, these have been recorded for Newark Bay. It may be expected that sublethal levels of heavy metals in coastal waters, sediments and the food chain impair intestinal nutrient absorption in fish. This, in turn, will result in malnutrition and under-nutrition, stunted growth and development, reduction in fecundity, and a general weakening of fisheries stocks.

Fisheries records for flounder show that the wholesale price in New Jersey varies with size, the smaller fish bringing a lower price on a per pound basis. Therefore, reduction in fish growth resulting from heavy metal pollution can directly affect fisheries economics and the income of commercial fishermen. It is also common knowledge that malnutrition reduces resistance to disease and environmental stresses in all animals and no doubt contributes to unexplained fish population crashes. It is necessary to determine which heavy metals, and at what levels, cause inhibition of nutrient absorption in fish. Information from these studies are now available to the environmental conservationists and fisheries management agencies for the development of public policy, regulation, court testimony, and public education. This information can be used by other scientists, engineers, and industrialists concerned with environmental pollution and industrial production.

In vitro and *in vivo* techniques were used by Dr. A. Farmanfarmaian of Rutgers University to determine the effects of mercuric chloride (HgCl) methylmercuric chloride (CH3HgCl) and other heavy metals on intestinal absorption of the essential amino acid L-leucine in several marine fish collected from coastal waters of Sandy Hook and Cape May regions of New Jersey and Woods Hole region of Massachusetts during 1981-1982. Several levels of heavy metals ranging from 0.5-20 ppm (parts per million) were selected based on reports of pollution levels in the water column, sediments, or reported accumulations in the natural foods of these fish species. Study results are summarized below.

Summer Flounder *(Paralichthys dentatus)* -$HgCl_2$ inhibited the absorption of 1 mM leucine significantly ($p < 0.01$) by 36% at 10 ppm and 43% at 20 ppm. At 2 ppm, 23% inhibition was observed but was not significant ($p < 0.05$) due to small sample size and variability. At 0.25 mM leucine, significant ($p < 0.05$) inhibition of uptake by $HgCl_2$ was observed at 0.5 ppm (23%) and 10 ppm (69%).

Winter Flounder *(Pseudopleuronectes americanus)* - $HgC1_2$ inhibited the absorption of 1 mM leucine significantly ($p. < 0.05$) by 29% at 10 ppm and 51% at 20 ppm.

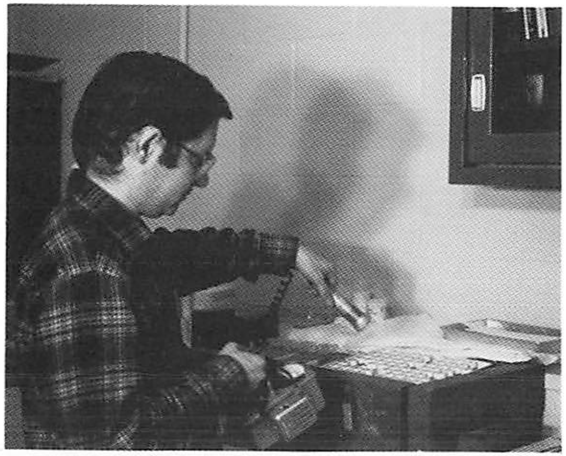
Common Killifish *(Fundulus heteroclitus)* -$HgCl_2$ inhibited absorption of 1 mM leucine significantly ($p < 0.01$) by 18% at 2 ppm, 36% at 10 ppm, and 44% at 20 ppm. In contrast to $HgCl_2$, parallel experiments with CH_3HgCl on *Fundulus* from the same population did not show any inhibition of amino acid absorption over a ten minute exposure of the tissue. $HgCl_2$ significantly ($p < 0.05$) inhibited absorption of 0.25 mM leucine by 33% at 10 ppm and by 56% at 20 ppm.

Compared to $HgCl_2$, CH_3HgCl gives reduced inhibition of 0.25 mM leucine absorption at 10 and 20 ppm. Other heavy metals ($CdCl_2$, $CoCl_2$ and $PbCl_2$) were tested under the same conditions as $HgCl_2$ and CH_3HgCl. No significant inhibition was observed in this species.

The contrast between $HgCl_2$ and CH_3HgCl is highly significant and implies that Hg^{++} and not CH_3Hg^+ is the immediate and powerful suppressant of amino acid membrane transport. The investigations on *Fundulus* are very important in that this genus of small fish serve as food for many pelagic commercial and sport fin fish.

Sea Urchins - Sea urchins, which are important food of fish and lobster, were also examined with respect to heavy metal effects. It was shown that amino acid absorption by the intestine of sea urchins was inhibited by 21% at 2 and 46% at 10 ppm, $HgCl_2$.

NEW JERSEY
MARINE SCIENCES
CONSORTIUM



Robin Socci, a doctoral student, monitors the decay of ^{203}Hg radioactivity in samples taken from fish.

Toadfish *(Opsanus tau)* - The toadfish is used as a model experimental animal because in this species *in vitro* and *in vivo* (under anesthesia or swimming in sea cages) experiments can be compared, and findings under conditions closely resembling nature can be validated. $HgCl_2$, *in vivo*, inhibited the absorption of 1 mM leucine significantly ($p < 0.01$) by 57% at 10 ppm and 80% at 20 ppm. Lack of inhibition at 2 ppm may be due to the *in vivo* unstirred layer in the intervillous areas which can prevent the diffusion of sufficient Hg^{++} (from the 2 ppm level) to the cell membrane surface in ten minute incubations. This interpretation was supported by the findings of parallel *in vitro* experiments on toadfish where stirring is high. Under *in vitro* conditions, $HgCl_2$ inhibition was significant at all levels: 10% at 2 ppm, 28% at 10 ppm and 70% at 20 ppm. CH_3HgCl, *in vivo*, did not show any significant inhibition of 1 mM leucine uptake at 10 or 30 minute incubations. $HgCl_2$, *in vitro*, significantly ($p < 0.05$) inhibited the uptake of 0.25 mM leucine by 43% at 5 ppm and 64% at 10 ppm. CH_3HgCl gave significant ($p < 0.05$) inhibition of 26% at 10 ppm and 46% at 20 ppm. These results show that the inhibition equivalent to 5 ppm $HgCl_2$ is produced by CH_3MgCl at 20 ppm. *In vivo* results for 0.25 mM leucine support those from the *in vitro* work. These data further reinforce the view that Hg^{++} initially attacks the transport mechanism from the outside of the cell membrane and that CH_3Hg^+ cannot act in the same manner. Both Hg^{++} and CH_3Hg^+ may cause subsequent inhibition via metabolic effects from within the cell. $CdCl_2$, *in vivo* and *in vitro*, did not affect the absorption of 1 mM leucine significantly when it was applied.

In summary, it has been demonstrated that $HgCl_2$ and CH_3HgCl significantly inhibit the absorption of the essential amino acid leucine from the intestine of fish. Beyond this it is necessary to determine if this is true for other essential amino acids and to what extent does this inhibition actually retard fish growth and affect fisheries economics.

Virginia Klimek, an undergraduate, prepares an anesthetized toadfish for mercury experiments.

LIFE HISTORY AND POPULATION DYNAMICS OF TILEFISH

C. Grimes and K. Able

The tilefish, *Lopholatilus chameleonticeps*, a large (20 kg and 120 cm) demersal species of the outer continental shelf, occurs from Nova Scotia south to Surinam, South America and throughout the Gulf of Mexico. Since the early 1970's the

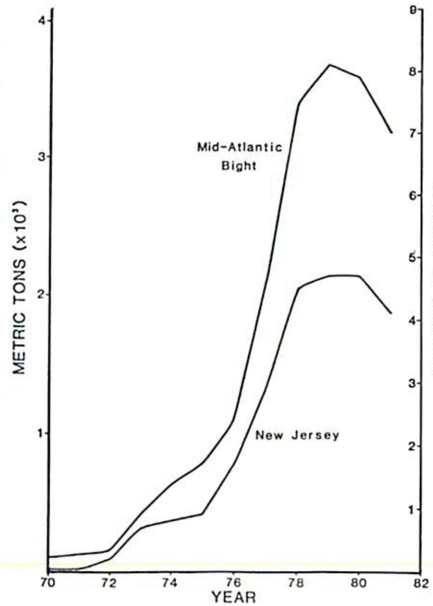


Fig. 1. Landing of tilefish in New Jersey and the Mid-Atlantic Bight

species has been the object of a rapidly expanding and increasingly valuable commercial fishery in New Jersey and the entire Middle Atlantic - Southern New England region. Landings in this fishery peaked in 1979 and 1980 at about 3800 MT (8.1 x 10^6 lbs.) and declined slightly in subsequent years (Fig. 1). However, the fishery is presently the most valuable finfishery in New Jersey and New York.

The longterm objective of this project is to assemble the information required to rationally manage the fishery for tilefish in accord with the principles of population dynamics. Specifically this involves the study of stock identity, age, growth, mortality, reproduction, and yield. Drs. Grimes and Able, Rutgers University, have completed investigations of stock separation of tilefish; age, growth, mortality and age/size structure of the fisheries; reproductive biology; and are continuing to collect catch and fishing effort data for yield analysis.

Stock separation studies completed in earlier years using electrophoretic and morphological data suggested two stocks of tilefish, one north of Cape Hatteras and one south. Age and growth analysis of annual marks on saggital otoliths showed that the maximum age of females was 36 years for an 87 cm individual, while the oldest male was 28 years of age at 108 cm. The largest female was 95 cm at 29 years, and the largest male was 112 cm at 22 years. Growth of approximately 10 cm per year was observed for the first five years, after which it slowed, but more in males than females (Fig. 2.).

Analysis of data to determine reproductive seasonality, maturity, sex ratio and fecundity are now complete. Analysis ot visual staging data, ovum diameter distributions and gonosomatic

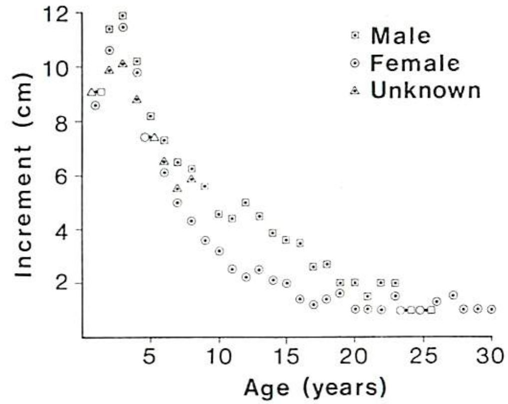


Fig. 2. Growth increments by age for tilefish in the Mid-Atlantic Bight

indices indicate that spawning occurs from May to October. Eggs are matured (1.30 mm diameter) and released in several batches per season; a typical (60 cm) female may release 1-2 million eggs per year. Sex ratio was skewed toward males at large size, but sex ratio does not differ from 1:1 for the population. Sex ratio was approximately equal until about 55 cm, when females began to predominate; and above 65 cm, males became increasingly preponderant. The unequal sex ratios most likely result from differential growth between the sexes and not from sex reversal as is the case in some fishes. Visual staging data suggested that most females matured at 52-57 cm, and most males were 62-71 cm. However, histological studies of gonadal tissues suggested that both males and females were mature at 50-55 cm. Predorsal adipose flap size becomes sexually dimorphic in adult fish, with males developing enlarged flaps at

NEW JERSEY
MARINE SCIENCES
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about 65 cm (Fig. 3). These findings may indicate that males delay spawning for as much as two or three years following physiological maturation. Taken together these results may indicate that participation in reproduction by males is under social control.

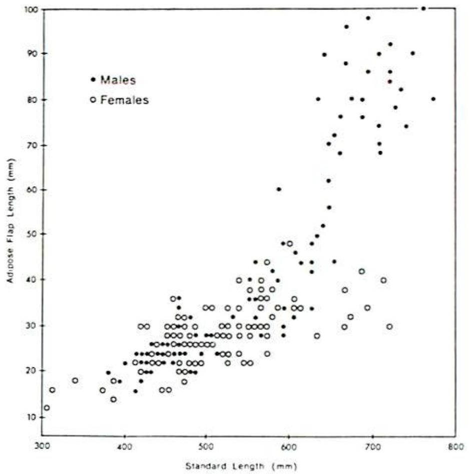

Fig. 3. Relationship between adipose flap length and length for tilefish from the Mid-Atlantic Bight

Studies to develop a suitable tagging technique for tilefish were completed and the method is now being used to study tilefish movements. Movement information is needed to fully interpret other fishery data (e.g., catch and fishing effort). Conventional tagging methods were inappropriate for marking these deep water fishes, because mortality is induced by pressure and temperature change when fish are raised to the surface. Therefore, a tag that would detach from conventional longline gear to mark fish on the bottom was designed and tested. Tags consisted of a curved or straight hook (6/0 or 8/0, respectively) crimped to a 30 cm length of 50 lb. test monofilament inserted through red vinyl tubing. Tags were tied to the longline with 2, 4, or 6 lb. monofilament so that a fish which became hooked would detach the tag by breaking the weaker monofilament. During 1979, cooperating commercial fishermen deployed longlines fitted with 1179 tags at two locations near Hudson Submarine Canyon in 117 meters and 137 meters of water. Commercial fishermen have recaptured seven tagged fish at virtually the same location where they were tagged. Time at liberty ranged from 115 days to roughly one year.

The submersible *Nekton Gamma* was used in coordination with the commercial fishing vessel *Lori-L* near Hudson Submarine Canyon to evaluate the performance of longline fishing gear. Tilefish were observed in or entering burrows, or hooked on longlines. Most hooked fish were in good condition; however, some fish were dead from gut hooking and sharks *(Carcharinus milberti)* occasionally took hooked fish on the bottom. Seventeen percent of the catch was lost, apparently when longlines were retrieved and hooks pulled free from fish in burrows. Although the longline moved very little on the bottom, tilefish were attracted from a wider area than that transected by the longline. Bait predation by starfish *(Astropectin* sp.*)* and crabs *(Cancer* sp. and *Acanthocarpus alexanderi)* resulted in 50% bait loss in four hours. Bait predation proceeded rapidly; all exposed baited hooks were preyed upon after three hours. Minimum soak time may be around two hours, and due to 100% bait loss from predation maximum useful time is eight hours. Most of this assessment could only have been conducted using a submersible.

During submersible dives numerous juvenile and adult tilefish have been observed in and around vertical burrows in the clay substrate of portions of Hudson Submarine Canyon in depths from 110-230 m. The size and shape of the burrows varied considerably with the smallest juveniles occupying simple vertical shafts in the substrate. Larger fish were found in much larger burrows (up to 4-5 m in diameter and at least 2-3 m deep) that were funnel shaped in cross-section with the upper conical portions containing numerous smaller burrows of associated crabs. The range of burrow sizes observed suggests a regular sequence of burrow construction by tilefish and the associated crabs. Both juvenile and adult tilefish swam into the burrows head first and exited tail first. This behavior, which would preclude the possibility of ambushing prey, suggests that the burrow is a refuge from predators such as sharks and other tilefish.

Tilefish burrows appear to serve as a focus for biological activity. Species associated with the burrows included galatheid crabs, *Cancer* sp., *Acanthocarpus alexanderi*, *Homarus americanus*, *Helicolenus dactylopterus* and *Conger oceanicus*. Tilefish may play an important role in structuring outer continental shelf communities. They physically shape their environment and probably have significant biological interactions with the species that associate with their burrows.

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HUMAN ECOLOGY OF NEW JERSEY FISHERIES

B. McCay

One of the corollaries of the fact that we live and participate in complex ecological and social systems is that man-made efforts to change those systems—such as the 200-mile limit established by the Magnussen Fishery Conservation and Management Act of 1976—may have unintended and unexpected consequences. The 200-mile fisheries limit was intended to reduce competition for fish and markets between foreign and U.S. fishermen and to enable the development of scientific systems of fisheries management to halt processes of overcapitalization and overfishing. Dr. Bonnie McCay of Rutgers University has completed work designed to provide information for an assessment of the impacts of extended fisheries jurisdiction on northern New Jersey commercial fishing communities. The "human ecology" approach taken in this work emphasizes human processes of response to changing environmental conditions.

Reduced foreign fishing effort in waters off New Jersey may have enhanced the abundance of some species of fish; however, evidence on this is not clear. The vast majority of fishing captains interviewed in the three northern New Jersey ports studied (Belford, Belmar, and Point Pleasant Beach) indicated that market conditions were more important to ups-and-downs of their fisheries and that the observed effects of the 200-mile limit were negligible or very subtle (e.g. less dispersal of whiting stocks, making them easier to catch). Statistical analyses of changes in fish landings done on a national level by other researchers show mixed results, including the interesting one that most increases in catches nation-wide since 1977 come from inshore stocks that were never directly affected by foreign fishing effort. Management plans, especially those developed by the Mid-Atlantic Fishery Management Council, have attempted to so reduce foreign access to regional stocks of "underutilized" species such as butterfish, squid, and Atlantic mackerel that foreign buyers would be forced to arrange purchases with U.S. fishermen. In northern New Jersey this has not yet come to fruition, although there have been a few short-term enhanced fisheries and joint-venture operations for underutilized species in neighboring Long Island and Cape May ports.

Accordingly, the major intended effects of extended fisheries jurisdiction are not very evident in northern New Jersey. One beneficial impact noted soon after 1977 throughout the United States was a "prevailing mood of optimism" that encouraged bankers, government agencies, and other investors to invest more capital in fisheries. New Jersey has seen a significant increase in new boats and gear purchased since 1977 - usually replacing older equipment. In addition, several entrepreneurs have restructured marketing and retailing in one of the ports studied. However, recession, inflated costs, deflated prices for some species due to oversupply and limited market expansion and periodic or persistent declines in the availability or abundance of certain commercially valuable species—irrespective or beyond the scope of new management systems—now make the optimism and high levels of investment (and indebtedness in many cases) of the past seem unwarranted and unwise to many fishing captains.

One unintended result of extended fisheries jurisdiction in the northern New Jersey area was the complete restructuring of the nature of offshore lobster fishing within only two years. "Gear conflict" between foreign and domestic fishermen was rapidly replaced by intensified gear conflict among domestic fishermen, an unintended social and economic outcome of the FCMA. The offshore lobster fishery developed rapidly during the 1960's. This was initially a by-product of otter-trawl fisheries directed for other species, but at ports such as Atlantic City and Point Pleasant Beach, local otter-trawl ("dragger") fishermen came to depend heavily on a directed summertime fishery for lobsters, using their dragging techniques rather than lobster pots, to compensate for low landings and value of many traditional finfishes. The advent of the hydraulic pot hauler in the 1960's also made the prospect of using lobster pots in offshore, deep waters more attractive. In the early 1970's this kind of lobster fishery expanded rapidly from southern New England to Norfolk Canyon, off Virginia. However, the offshore pot fishery was limited to large foreign fishing fleets by losses of gear and in later years, offshore oil and gas exploration. Thus, in northern New Jersey the predominant modes of lobstering were offshore dragging for lobsters and inshore pot fishing. Gear conflict between local dragger and pot lobster fishermen was relatively minor, since most were fishing different grounds, but offshore pot fishing was increasing.

Lobstermen of all kinds joined other fishermen to fight for passage of the act creating extended fisheries jurisdiction. When the law went into effect in 1977, one result was a rapid increase in the number of pots set in offshore grounds. By the end of 1977, "the bottom was carpeted with pots," and conflicts between dragger and pot fishermen escalated. Although lobster draggermen fought hard through the legal and political process to obtain protection for their fishery, within two years they had all given up the summer dragger fishery for lobsters. At the fisherman's cooperative of Point Pleasant Beach two members engaged in offshore lobster pot fishing, but the rest gave up lobstering entirely and were more than ever dependent on their late-fall to early-spring fishery for whiting, and hence, dependent on an unstable market. There and elsewhere some former lobster draggermen turned to sea scallop fishing (using large dredges), a profitable endeavor but one that involves working conditions and crew relationships disliked by most local fishermen. Sea scallops also showed signs of overfishing. Others responded to the decline in summertime fishing opportunities by initiating a migratory fishery to southern New England and southern New Jersey ports with better access to fish during that season. This entailed spending weeks or months away from home, and, for those who moved to New England ports, coping with problems of a fisheries management system developed for cod and yellowtail flounder. By 1981-82, many of these fishermen had given up the migratory fishery and simply tied up their boats during part of the summer when, in the pre-1977 past, they would have been dragging for lobsters. In addition, loss of opportunities for summer lobster dragging meant intensification of local fishing effort on summer flounder stocks, especially in late spring and fall months, adding to problems in managing a heavily exploited inshore resource. Thus, extended fisheries jurisdiction not only resulted in an unexpected problem for offshore lobster draggermen, but also, through their responses to the problem, had ramifying and unintentional effects on the level of fishing effort for other stocks.

Another corollary of the fact that fisheries are part of complex ecological and social systems is that costs and benefits of attempts to manage fish resources may be unevenly distributed and some groups of fishermen may suffer more than others from the effects of restrictions on how and for what they fish. A vivid example is the present situation of northern New Jersey inshore lobstermen, especially those out of Belford and Highlands, Monmouth County. The abundance of the American lobster *(Homarus americanus)* has declined markedly over past decades, due largely to heavy fishing effort and consumer demand. In New England most lobsters are caught within three miles, hence within state rather than federal or regional management council jurisdiction. In New Jersey, however, most "inshore" lobsters are caught beyond three miles from shore, as far as fifteen miles, and state jurisdiction is limited to lobsters landed in New Jersey ports. In addition, state jurisdiction over lobster management is inadequate to cope with offshore lobstering and with the mobility of lobstermen. Moreover, effective management requires coordination among states, so that lobsters caught illegally (e.g. too small) within one state's jurisdiction cannot be sold legally in ports of states with different regulations.

Extended fisheries jurisdiction facilitated the development of a regional management plan for lobsters. The draft plan proposed a 3 3/16 inch minimum carapace length requirement, continuance of laws against the taking of egg-bearing females, and a regulation against breaking-up lobsters at sea. These proposed regulations for the zone of extended fisheries jurisdiction (3 to 200 miles) coincide with recent changes in state regulations throughout New England and thus will have minimal impact on the lobster fishermen of the main lobster-producing states. However, New Jersey is a major exception: there is no state law against breaking up lobsters ("mutilating" them) and the minimum carapace length is 3 1/8th inches. For these reasons alone, the impact of the new management plan would have drastic short-term impacts on inshore lobstermen of New Jersey. The situation is worse because—partly enabled by the fact that New Jersey fishermen are allowed to break up lobsters before entering part—the vast majority of lobsters caught inshore by some communities of New Jersey lobstermen are "sub-legals". The New England Fishery Management Council's staff prepared a rough estimate of the "worst case" economic loss expected for New Jersey lobstermen when and if these provisions are enforced: losses of from 4.5 to 7 million dollars in the first year, or two. While this estimate is considerably over-inflated according to Bruce Halgren, N.J. Department of Environmental Protection, it does indicate the probable severity of the economic impact of lobster management changes.

A questionnaire administered to a sample of lobster fishermen at two northern New Jersey ports, designed to elicit information on possible responses to stricter regulations of lobstering similar to those proposed in 1982, found that most lobstermen perceive taking sublegal lobsters as the difference between success and failure in the business. For some, sublegals are conceptualized as paying the expenses of a fishing trip; for others, as the profit or the source of money to pay off indebtedness incurred in trying to become established as fishermen. Very few respondents felt they had any alternative opportunities either within the lobster fishery or within fishing in general. One possible way of coping with stricter regulations and larger minimum sizes is to move into the offshore lobster pot fishery, but respondents repeatedly said that they were pessimistic about obtaining the financing necessary to acquire the larger, more seaworthy boats required. Those who are making the shift into offshore pot fishing (where lobsters are, on the average, larger) are those who already own large fishing trawlers or the two or three who invested in dual-purpose medium-sized vessels designed for both lobster pot fishing and finfish dragging.

Another possible response is to shift out of lobstering and into finfishing or scalloping. Respondents said this was either economically unfeasible or undesirable. Most lobstermen are already engaged in a variety of fisheries, especially those of Belford, and have enough experience to know that opportunities are restricted in available alternatives, especially given relatively poor market conditions, depleted stocks, and polluted coastal waters. In addition, people involved in inshore lobstering are among the many fishermen of northern ports who feel that scalloping is an unacceptable way of making a living, because of the long trips (up to two weeks at sea), large crews (up to fifteen or more men, very difficult to manage), and high initial investments required. Another possibility is to increase effort within the inshore fishery; e.g., put out more pots to increase the likelihood of getting more legal lobsters. However, all respondents said they were working what they viewed as the maximum number of pots feasible, given the time required to build, repair, and actually fish pots; indeed, in the five years prior to 1980, they had already responded to lobster decline by increasing the number of pots to the economic maximum.

What lobstermen said they would do is what they had in fact already done and what they continued to do after the survey: (a) work through their associations, cooperative, and congressmen to try to halt changes in management measures; and (b) resolve to ignore new laws, presuming that enforcement would not be adequate to the task of making illegal fisheries uneconomic. The first has contributed to delays in approval and implementation of the regional lobster management plan, but northern New Jersey lobstermen now express recognition of the fact that they are politically powerless within the wider East Coast region, since there are so few of them compared with lobstermen in New England. The second is a tactic well-developed in the northern New Jersey area—and beyond—since effective fisheries law enforcement is always difficult, even under the best of conditions, and in recent years has been constrained by losses of state support and personnel.

In this context, without widespread consensus among fishermen that management regulations are essential and "fair" to all concerned, regulations become virtually meaningless. The fairness of lobster regulations within the New Jersey context is questioned by inshore lobstermen, who persist in arguing that the regulations discriminate against them. For offshore lobstermen, a distinction which they often present is one between "independent" small-scale fishermen and people who work for investors with other business interests as well. Thus, one social impact of management systems is to increase awareness of—and in some cases to intensify—differences in economic position and status within the fishery. The question about what makes fishermen see management regulations as essential (or acceptable) is even harder to answer.

It must be noted that New Jersey inshore lobstermen take the position that a prior and more urgent problem than lobster depletion through overfishing is the more pervasive one of polluted coastal waters, and a great deal of their political efforts have been focused on the pollution issue. There is also a "culture of piracy" or illegal fishing in the inshore fisheries of New Jersey, for which ecological, economic, political, and historical explanations are still sought. The discriminatory effect of many fishery mangement systems, in the past as in the present, appears to play a large role in their piratical stance.

TOLERANCE TO CHRONIC EFFECTS OF POLLUTANTS IN NEWARK BAY AREA KILLIFISH

J. Weis and P. Weis

Previous observations by Drs. Weis and Weis of increased tolerance to methylmercury by embryos of the killifish, *Fundulus heteroclitus*, from Piles Creek (a highly polluted tributary of the Arthur Kill in Linden, N.J.) as compared with fish from cleaner waters off Southampton, N.Y., were extended into investigations of tolerance of other life stages of these fish from both populations.

Mortality was used as a parameter of larval tolerance. Adults were collected, eggs and sperm stripped into fingerbowls and embryos raised in 50 ml of 30 parts per thousand (ppt) salinity sea water at 24° C. To stimulate hatching, water was changed daily, starting on day 12 of development. When sufficient numbers had hatched, larvae were transferred in groups of ten (from the same clutch) to 100 ml of sea water. Experimental groups were dosed with 0.05 ppm meHg and controls were untreated. Solutions were changed daily and dead larvae removed for up to 8 days. For each group, an LT_{50} (time to 50% death) was calculated, and the mean LT_{50} for each population was calculated. Also, analysis of covariance was used to compare slopes and Y - intercepts of regression lines generated by number dead vs. day for each population.

The LT_{50}'s of the two populations showed no significant difference (Fig. 1). The analysis of covariance similarly revealed that no significant difference in Y - intercept (time at which larvae began to die) or slope (death rate) existed between the two populations. Thus, the striking tolerance seen in the embryos no longer existed in the larvae.

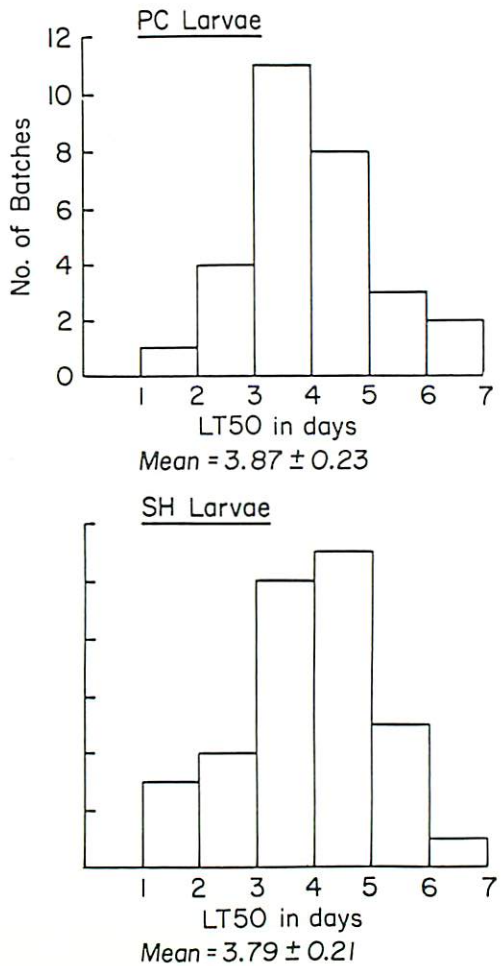


Fig. 1. Distribution of LT_{50} in 0.05 ppm meHg among batches of larvae from Southampton (clean) and Piles Creek (polluted).

Mortality and rate of fin regeneration were used as parameters in studying methylmercury tolerance of adults. After amputation of half of the caudal fin, experimental fish were maintained in 0.05 ppm methylmercury in 20 ppt salinity artificial sea water, while controls were kept under the same conditions without the toxicant. Water was changed and redosed twice a week, and regeneration of the amputated fin measured at 1 week, 1½ weeks, and 2 weeks, using a calibrated ocular micrometer in a stereomicroscope. Data were analyzed by t-test and by analysis of covariance. The analysis of covariance can test for differences in Y -intercept, reflecting the time needed for wound healing and blastema formation, and differences in slope, representing the rate of blastema formation. The first experiment utilized unconditioned (freshly made up) artificial sea water, while the second utilized conditioned water, in which other fish had lived for several days.

In the first experiment, the methylmercury exposed fish from both populations regenerated their fins more slowly than their controls. Controls from Southampton, however, regenerated significantly faster than their Piles Creek counterparts (Fig. 2). Experimental fish from Piles Creek exhibited much higher mortality (85% vs 15%) than their Southampton counterparts. In the second experiment, the methylmercury-exposed fish did not exhibit a decrease in fin regeneration. However,

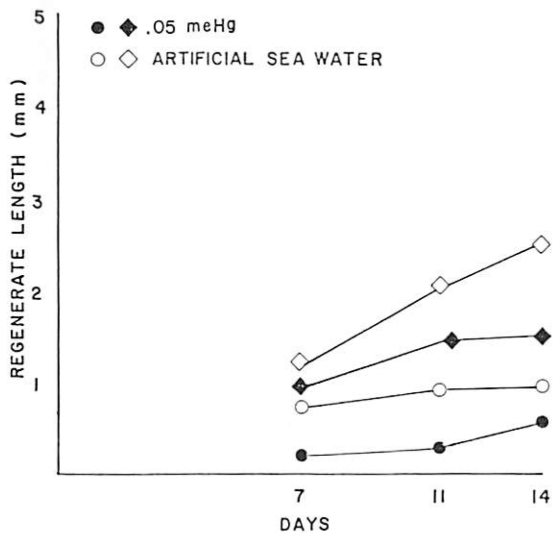


Fig. 2. Caudal fin regeneration under conditions of 0.05 ppm meHg and unconditioned artificial sea water (expt. 1). Circles represent the Piles Creek population and diamonds represent the Southampton population.

regeneration was again significantly faster in Southampton controls compared to Piles Creek controls, and Piles Creek experimentals again showed much higher mortality (67% vs 22%).

The higher mortality of the Piles Creek fish indicates a lower tolerance to the methylmercury stress, rather than increased tolerance which was present in the embryos. The reduced rate of regeneration of Piles Creek controls may be further evidence that this is a population under stress. The stress of pollutants in Piles Creek may have reduced the energy available for regenerative growth.

In short, the killifish from the polluted area which showed striking methylmercury tolerance as embryos, showed larval tolerance equivalent to that of the unpolluted population, and finally, signs of stress and lowered tolerance as adults.

NEW JERSEY MARINE SCIENCES CONSORTIUM

OIL POLLUTION IMPACT IN NEW JERSEY COASTAL WATERS: NAPHTHALENE TOXICITY AND ACCUMULATION IN MYSID SHRIMP

B. Hargreaves and S. Herman

The ultimate objective of this project by Drs. Hargreaves and Herman of Lehigh University is to develop a toxicity model for mysid shrimp exposed to aromatic hydrocarbons. Mysids are ecologically important for their central role in the coastal and estuarine food web. Mysids have economic importance as well: they are significant prey items for many juvenile fish, especially weakfish and flounder. Aromatic hydrocarbons are a toxic component of gasoline and oil which enter the estuarine environment from boats, ships, storm drains, industrial discharges, and road-surface runoff.

Experiments on the fate and effects of such pollutants are difficult if not impossible to conduct in an estuary, but simplified experiments in the laboratory can provide an indication of the potential for damage to estuarine mysid populations. Laboratory exposure of mysids to a representative aromatic, naphthalene, (year 1) indicated that the sensitivity of the animals increased during the summer, the time of year when mysids are multiplying to their highest numbers, when young fish are feeding on mysids, and when oil pollution from recreational boating is probably at its peak. Experiments in the second year were designed to investigate the cause of this change in sensitivity. Other work was aimed at developing better test methods to be used in the remaining two years of the project.

Naphthalene toxicity experiments conducted at various temperatures (Fig. 1 shows representative results) indicated that mortality increased whenever the water temperature exceeded 20° C. Entry of the toxicant at summer and winter temperatures was investigated using two innovations of the project: a continuous flow chamber (Fig. 2) which maintained the proper water quality during each 96-hour test and a simple method for extracting

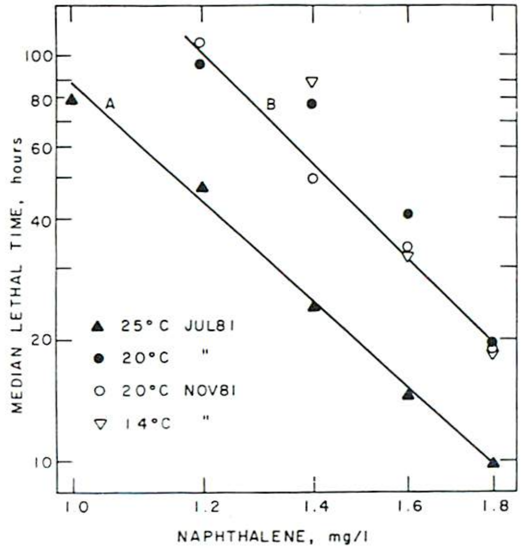


Fig. 1 Neomysis americana: Effect of naphthalene concentration (ppm, log scale) and temperature on median lethal time, LT_{50} (hours, log scale). Each symbol represents the LT_{50} determined by a hand-fitted line of cumulative mortality (probit scale) plotted against time (log scale) for a given concentration of naphthalene.

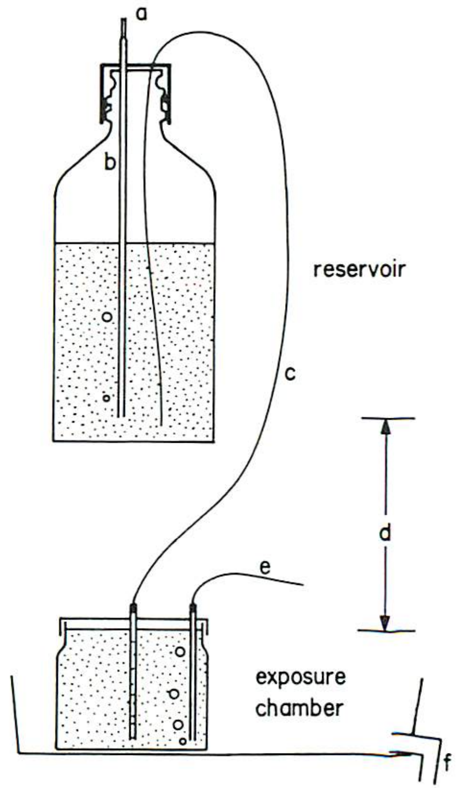


Fig. 2 Continuous-flow toxicity apparatus. a = air inlet restriction (15 mm length of 0.562 mm i.d. thin-wall teflon tube), b = air inlet tube (3.2 mm o.d., 1.6 mm i.d. teflon), c = mixture outlet tube (0.562 mm i.d. thin-wall teflon), d = effective pressure head, e = aeration tube (0.305 mm i.d. thin-wall teflon), f = drain to collection jug.

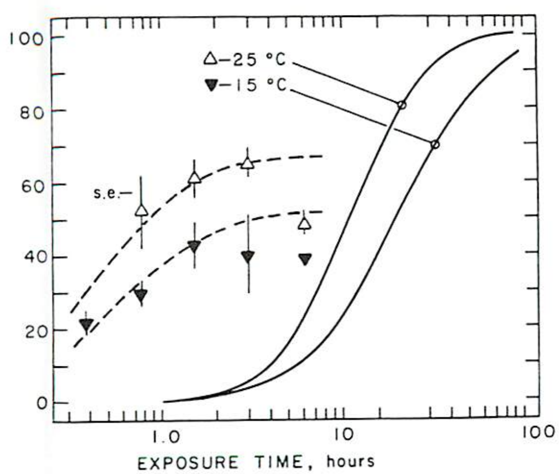


Fig. 3 *Neomysis americana: Naphthalene accumulation and mortality versus time at 2 temperatures. Regressions for tissue concentration (ppm, broken curves) were fitted to fall data. Mysids collected in November 1981 were maintained in culture at 15° (collection temperature was 14° C). After 2 wk. the culture was divided and half were acclimated to 25° C (4 d at 20° C and 3 d at 25° C) before both were tested at the acclimation temperatures. Salinity was 32-34°/oo. The regression equations plotted are 15° C:* $C_t = 52\,(1 - e^{-1.18t})$ *25° C:* $C_t = 66.5\,(1 - e^{-1.59t})$*. The solid curves show percent cumulative mortality (linear scale) drawn from points along the straight line fitted to a graph of probit-transformed cumulative mortality versus log time (data from July and November 1981).*

naphthalene from mysid tissue. Figure 3 shows that after 3-6 hours of exposure to toxicant the tissue concentration of naphthalene was higher at 25° C than at 15° C. The necessary condition for high tissue accumulation was acclimation (a physiological process during several weeks of exposure) to a temperature above 20° C; animals treated with naphthalene at 25° C without prolonged prior exposure to this temperature did not accumulate extra toxicant. More work is planned on the link between tissue accumulation of toxicant and toxic effects.

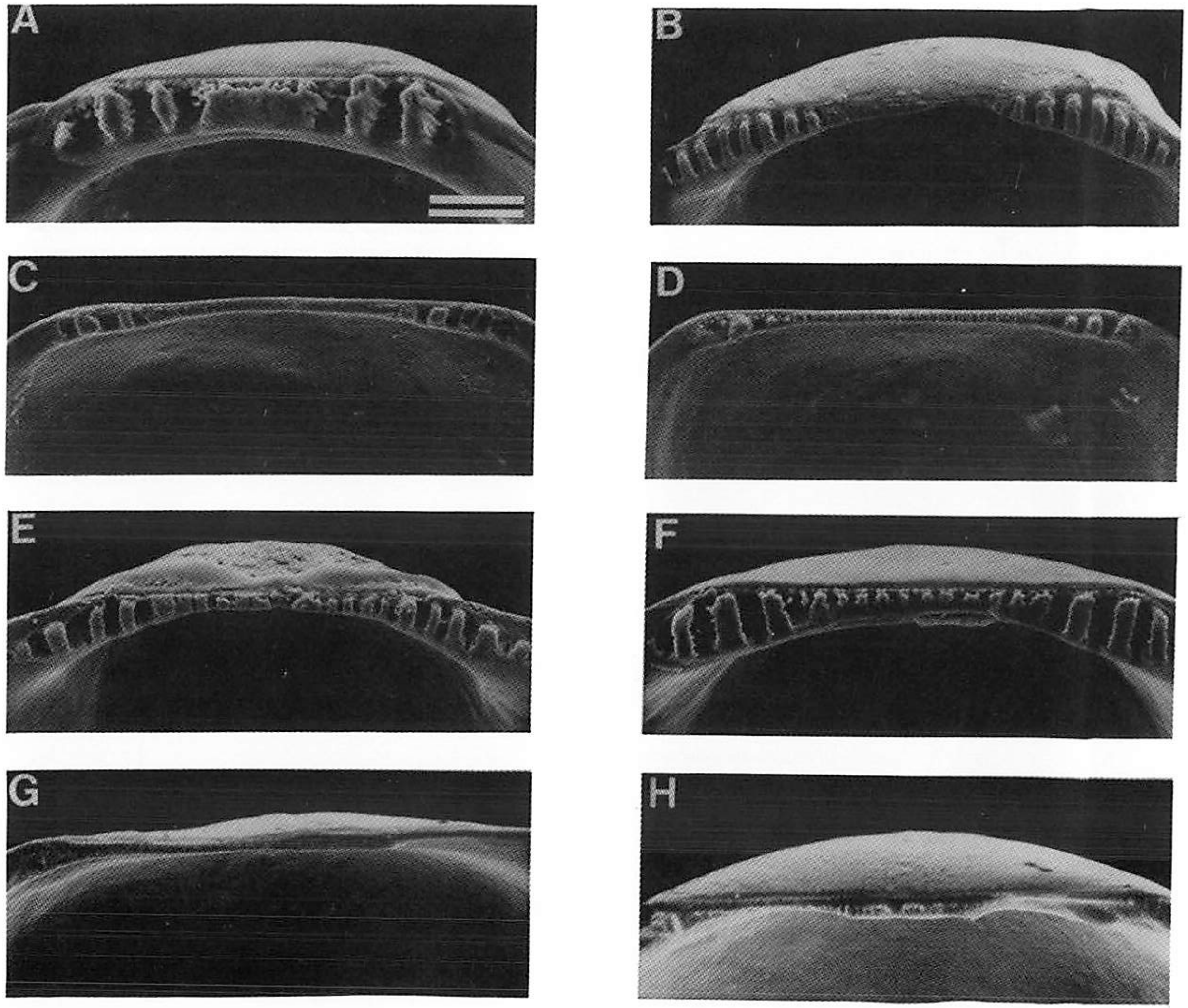
Significant steps were taken in the development of a mysid respirometer to examine the sublethal response to toxicant. Mysid respiration was measured at three temperatures (without toxicant) to obtain background information for future studies. These measurements were conducted for brief periods in a small sealed chamber, and will be compared with long-term measurements from a flow-through respirometer during the third year of the project.

IDENTIFICATION OF BIVALVE LARVAE: A MULTI-INSTITUTIONAL APPROACH

R. Lutz

Sea Grant VI was the first year of a proposed 5-year project by Dr. Richard Lutz of Rutgers University, whose primary objective is publication of a comprehensive manual for the identification of bivalve larvae (through *routine optical* microscopic examination of the larval hinge apparatus) in estuarine and marine waters of the North Atlantic. This objective is being accomplished through a multi-institutional cooperative effort, involving 12 institutions (academic, federal and private industrial) along the east coast of North America.

An inability to accurately identify bivalve larvae within the plankton has long hampered applied and basic research efforts in estuarine and open coastal marine environments. For example, as a result of existing practical barriers, detailed studies concerning spatfall prediction for aquacultural and fisheries management purposes have been extremely difficult. Year-to-year fluctuations in larval abundance and juvenile recruitment are often not possible to detect due to an inability of researchers to discriminate individual larval and early postlarval specimens. Similarly, it has been virtually impossible in routine plankton identification studies to unambiguously assess the impact of various environmental perturbations (natural "disasters", chemical pollutants, thermal discharges, oil spills, dredge spoil dumpings, etc.) on the larvae of individual species of bivalves. While a few keys for larval bivalve identification do exist, their usefulness is limited and, at the present time, it is not possible to unambiguously identify the larvae of many bivalve



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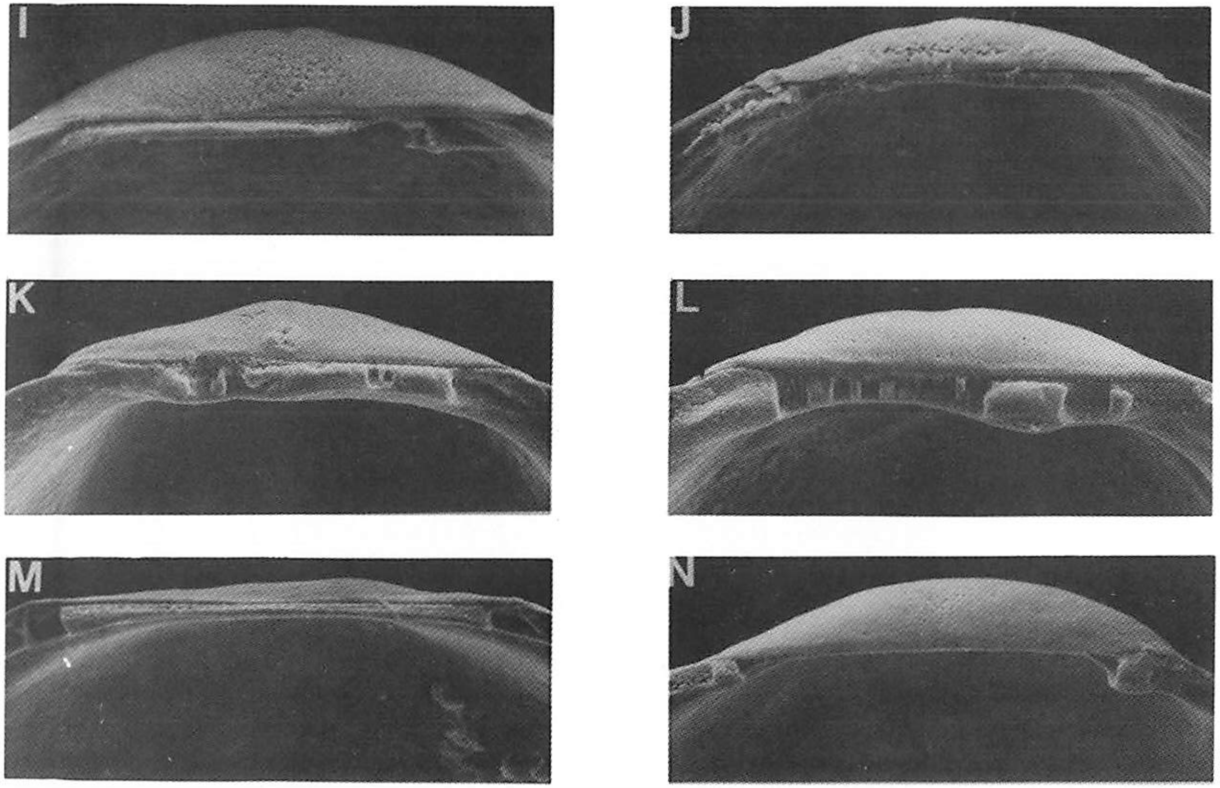
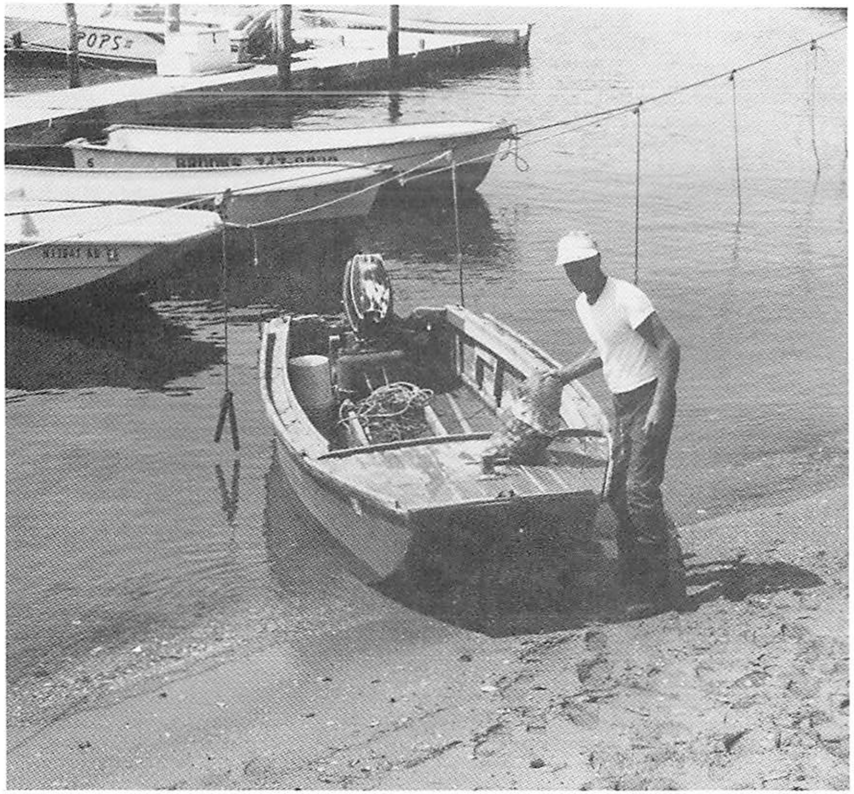


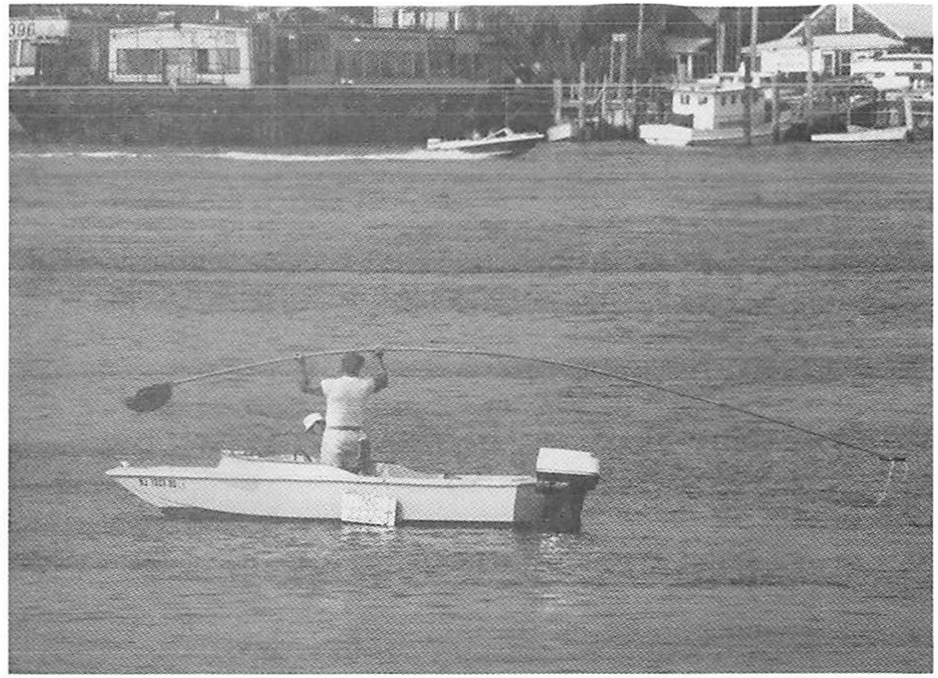
species, particularly at the early (straight hinge) developmental stage. This multi-institutional approach is aimed at eliminating many of the existing obstacles to future research.

During the course of this project, larval and, in many cases, postlarval developmental sequences were obtained for a number of bivalve molluscs. Representative scanning electron micrographs depicting the hinge morphology of the larvae of various species of bivalves cultured to date are depicted here. Examination of structures associated with the larval hinge apparatus enable researchers to unambiguously identify individual specimens of bivalve larvae found within plankton samples. (A) *Crassostrea virginica* (American oyster); (B) *Arca noae* (common arc); (C) *Argopecten irradians* (bay scallop); (D) *Placopecten magellanicus* (deep sea scallop); (E) *Mytilus californianus* (sea mussel); (F) *Geukensia demissa* (Atlantic ribbed mussel); (G) *Arctica islandica* (ocean quahog); (H) *Mercenaria mercenaria* (hard clam); (I) *Mya arenaria* (soft shelled clam); (J) *Mulinia lateralis* (dwarf surf clam); (K) *Spisula solidissima* (surf clam) (left valve); (L) *Spisula solidissima* (surf clam) (right valve); (M) *Ensis directus* (razor clam) (left valve); (N) *Ensis directus* (razor clam) (right valve). Scale bar (= 20 um) in A is applicable to all micrographs in the figure.

A paper entitled "Larval and Early Postlarval Development of the Ocean Quahog, *Arctica islandica*" has been published in the *Journal of the Marine Biological Association (U.K.)*. The photographic format to be utilized for each species included in the final practical manual is presented in the publication. Similar ontogenetic sequences of the larval and postlarval stages of the other species cultured to date are being assembled.

Thirty letters detailing the practical usefulness of the proposed laral identification manual have been received from private industrial and non-academic sources (state and federal governmental agencies, etc.), as well as academic sources.





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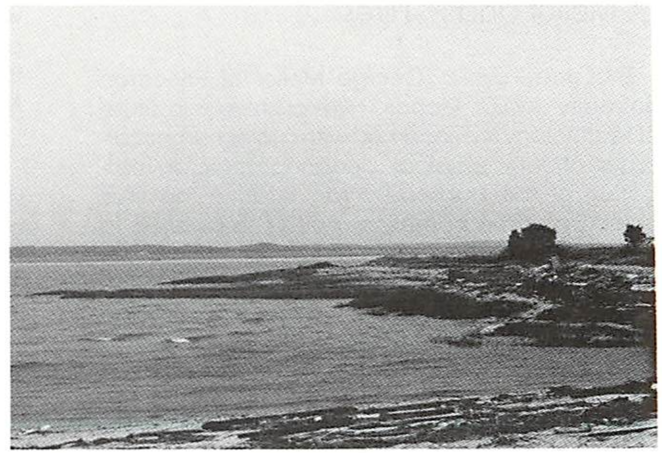
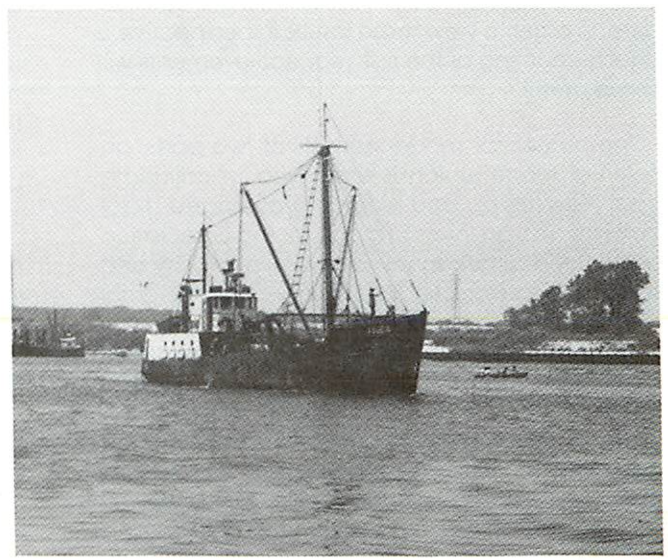
NORTHERN NEW JERSEY ESTUARINE PROGRAM

The estuaries of Northern New Jersey are the most heavily used and polluted waters of the nation. In addition to being the sink for the most densely populated region of the state, the estuaries drain the massive industrial chemical and petrochemical complex of northeastern New Jersey. While great attention has been focused on the problems of solid waste disposal and resultant contamination of the New York Bight, such wastes account for less than 10 percent of the contamination; over 90 percent is contributed by the Hudson-Raritan estuary.

Only in recent years has there been realization of the hazards to the environment and to the health of both human and marine populations in the region. Coupled with this realization is the awareness that management and remedial actions are severely hampered by lack of understanding of the natural processes involved, particularly as those processes affect the time and space distributions and fate of such toxic materials as heavy metals and chlorinated hydrocarbons and the impact of biological pollutants. Circumstances force decisions by federal, state, and local agencies, and such decisions too often must be based on inadequate information.

The Sea Grant purpose is to contribute to delineation of the natural processes and to understand the effects of pollutants on the marine ecosystem. Achievements of the purpose will have two important results: providing data for management of the region, and contributing substantially to knowledge of the fate and behavior of dangerous toxicants and pollutants in estuarine environments everywhere.





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PHYSICAL OCEANOGRAPHIC STUDIES IN THE HUDSON-RARITAN ESTUARY

G. Mellor and R. Hires

This study by Dr. George Mellor of Princeton University and Dr. Richard Hires of Stevens Institute of Technology is concerned with a joint numerical-observational physical oceanographic investigation of the Hudson-Raritan Estuary. The final objective of the numerical part of this work is to apply a completely three-dimensional, time dependent model, to the estuary for the calculation of tides, currents, and salinity distributions. For the observational part the major objectives are to obtain field data appropriate for the specification of boundary conditions and for assessment of the predictive skill of the numerical model. The duration of this joint undertaking is for three years; accomplishments for the second year's efforts are reported here. In order to view these results in perspective a brief recounting of the first year achievements will prove useful.

The numerical model consists of two parts: an external mode which is employed to calculate tidal elevations and vertically-averaged tidal currents and an internal mode for the calculation of the three-dimensional variations in velocity and salinity distributions. For the first year of this research, attention was primarily focused on the external mode model results and the comparison of the predicted tidal characteristics with available observationally based, tidal information for the estuary. The agreement between predicted and observed features of the tidal hydraulics was very good throughout the estuary. Also during the first year, a start on the three-dimensional modeling was made by applying a width-averaged version of the full model to the Hudson River from the Battery at the southern end of Manhattan to Troy, New York.

Accomplishments during the second year of this study included the following: (1) a detailed comparison of the external mode model predictions with available field observations in Raritan Bay was made, (2) the width-averaged Hudson River model results were compared with field observations, (3) the fully three-dimensional model was successfully applied to the entire Hudson-Raritan estuary and (4) preliminary analyses of the three-dimensional model results have been initiated. The last two items listed above form the basis of the achievement of the primary objectives of the project. Clearly, extensive further analyses of the three-dimensional model results will constitute the major effort during the third year of the project. The first two items in the above list of accomplishments represented important steps in achieving the overall goal of this research.

One fundamental reason for initiating this physical oceanographic study was to integrate its results with collateral Sea Grant sponsored research in Raritan Bay. As a start towards achieving this integration the external mode model results for Raritan Bay were examined in considerable detail. Particular attention was paid to the residual circulation which results from the nonlinear interaction of the tidal currents with the bottom topography and the coastline geometry. The calculated distributions of these residual currents in Raritan Bay for the case of no wind and for a moderate southwesterly wind are shown in Figures 1 and 2. The circulation patterns shown in these figures are in substantial agreement with results based on field observations presented in previous studies in the Hudson-Raritan estuary by Jeffries (1962) and Abood (1972). The magnitude of the calculated residual currents are found to agree well with estimates derived from observations. It is apparent from a comparison of Figures 1 and 2 that the residual circulation in Raritan Bay is significantly affected by prevailing wind conditions.

The width-averaged model of the Hudson River has been exercised to provide a simulation of current and salinity distributions in the Hudson River during April, 1981. During this period, the National Ocean Survey obtained 15-day current and salinity data at 5 stations in the lower Hudson which were supplemented by our own observations over complete tidal cycles at six other locations in the Lower Hudson. Comparisons of model results with this set of field observations has demonstrated the capability of the model to predict accurately both the gross features of the circulation and salinity distributions in the Hudson and the detailed variations with depth and time of the velocity and salinity fields over a tidal cycle.

One important result of the experience obtained with the Hudson River model was a far clearer understanding of the requirements for a proper specification of the downstream open boundary conditions. These insights gained from the study of the Hudson River model were directly transferable

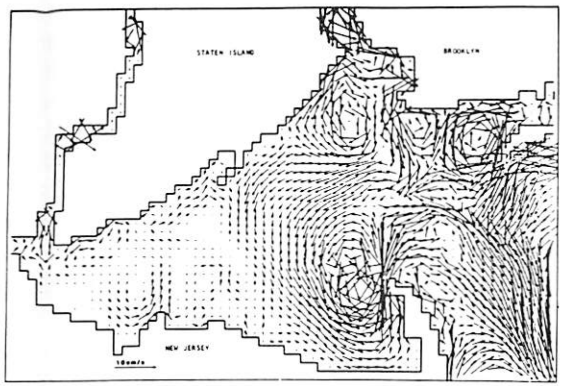

Fig. 1 Tidal residual currents in Raritan Bay

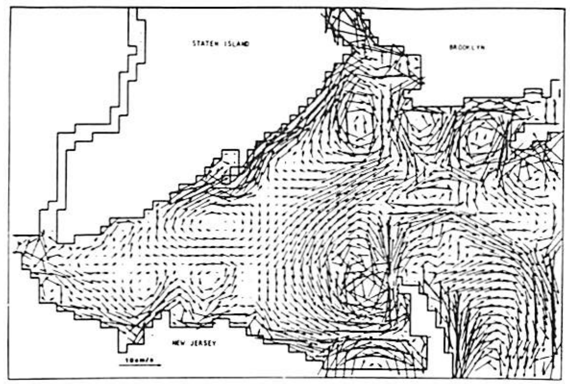

Fig. 2 Residual currents in Raritan Bay with a Southwesterly wind

to the specification of the open ocean boundary conditions for the three-dimensional Hudson-Raritan model.

In conclusion, it should be noted that comparison of model results with field observations has been a continuous and vital aspect of this research. The good agreement between model predictions and observations attained thus far provides for confidence in the predictive skill of the final numerical model of the Hudson-Raritan estuary which will emerge from this work.

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RELATIONSHIP OF SALINITY AND OTHER ENVIRONMENTAL PARAMETERS TO MICROBIAL TRANSFORMATIONS OF MERCURY IN ESTUARINE SEDIMENTS

R. Bartha

Mercury is an insiduous environmental pollutant. Though all of its chemical forms are toxic to some extent, its methylated forms (monomethyl and dimethyl mercury) are particularly dangerous poisons of the nervous system. The latter forms of mercury are also subject to "biomagnification," i.e, they tend to accumulate in food chains even at relatively low environmental concentrations. In two tragic incidents that took place in Japan in the 1960s, methylmercury poisoning from tainted seafood caused the death or permanent disability of more than one hundred persons.

Mercury pollutants arise from various chemical and electronic manufacturing processes as well as from the burning of fossil fuels such as oil and coal. However, the highly hazardous methylmercury compounds are rarely released directly. Instead, they arise by the microbial methylation of other forms of mercury. New Jersey has its share of mercury pollution, the most notorious case being a former manufacturing site near the present Meadowlands Sports Complex. For containment and eventual cleanup of mercury pollutants, it is crucial to know the factors that control the undesirable microbial mercury methylation process.

The principal sites of mercury methylation are the anaerobic (oxygen-free) aquatic sediments. Working with mercury-spiked saltmarsh sediments, Dr. Richard Bartha's research group from Rutgers University noted a strong negative correlation between salinity and methylmercury concentrations. It should be noted, that while some microorganisms produce methylmercury, others tend to destroy it, and the overall environmental concentration of methylmercury is determined by the rates of the two opposing processes. Therefore, the observed negative correlation of salinity with mercury methylation may reflect either an inhibition of the methylation or a stimulation of demethylation process. In fact, Dr. Bartha's group found both propositions to be true. A major component of sea salts is sulfate. Under the same anaerobic conditions that would favor mercury methylation, other sediment bacteria reduce sulfate to sulfide. Sulfide forms a strong chemical complex with mercuric ions and makes them less available for microbial methylation. Sulfide alone inhibits mercury methylation as effectively as total sea salts do in anaerobic sediments. In addition, it was found that the chloride component of sea salts stimulate the microbial demethylation of mercury, although the mechanism of the latter process is yet to be elucidated.

A knowledge of the factors that control the environmental transformations of mercury has important practical benefits. It pinpoints the environments where mercury pollutants pose the greatest threat and where they are relatively harmless. Furthermore, it is likely to lead to improved management and cleanup techniques for mercury-polluted sites and thus will help to reduce the environmental and health hazards of this poisonous heavy metal.

INTERDISCIPLINARY INVESTIGATION OF NITRIFICATION IN RARITAN BAY

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H. Simpson, H. Ducklow, B. Deck and F. Cantelmo

In the last several decades numerous problems associated with the disposal of raw and treated sewage into estuaries and coastal waters have become apparent. As a result, steps have been taken to improve sewage treatment in many areas of the country. In the Northern New Jersey - New York region bordering on the Hudson estuary and Raritan Bay, new sewage treatment plants have been constructed and existing plants expanded to allow better treatment of the substantial amounts (ca 10^9 gal per day) of sewage discharged to these waters. Yet a clearer understanding of the processes by which sewage is processed in natural ecosystems is still necessary for more effective waste management.

During this New Jersey Sea Grant year, Drs. Jim Simpson, Bruce Deck and Hugh Ducklow from Lamont-Doherty Geological Observatory of Columbia University initiated a new project to evaluate the role of bacterial nitrification in regulating the levels of nitrogenous compounds and oxygen in Raritan Bay.

Within Raritan Bay, in common with other estuaries polluted by domestic sewage and agricultural runoff, severe depletion of oxygen from the water column is possible. Two processes contribute to oxygen depletion. The first process is straightforward - the decomposition of organic matter by bacteria, and is termed carbonaceous biological oxygen demand, or BOD, by environmental engineers. Another, less well understood process is nitrification, the oxidation of ammonium to nitrate by a specific group of bacteria. The oxygen demand from this process is the nitrogenous BOD. Most of the improvement in the quality of discharged sewage has been from the reduction of carbonaecous BOD. The nitrification research is designed to assess the importance of the NBOD in Raritan Bay.

Large quantities of ammonia are present in sewage and present treatment methods are not effective in removing very much of the potential oxygen demand from this source. Thus large amounts of ammonium are released into the Bay from the Hudson River and Arthur Kill, making Raritan Bay an optimal environment for nitrification. The Lamont group made a preliminary estimate that nitrification could contribute as much as 20-30% of the total oxygen demand. During this project, rates of oxygen consumption and nitrification have been measured directly and estimated by observing water column concentrations of nitrite and nitrous oxide (N_2O), a by-product of the first step in the nitrification process. A better understanding of the nitrification process in general and of the rates at which it operates in Raritan Bay, will be of great use to state and local agencies trying to plan effective but economical sewage management strategies for wastes discharged into the Bay. If nitrification is an important factor contributing to oxygen depletion, it may be necessary to remove ammonium from waste water prior to discharge.

The data gathered during the project indicate that the process of nitrification varies seasonally. Higher rates were found in the late summer when ammonia concentrations are the highest and water circulation is the lowest. Rates of nitrification also vary with location in Raritan Bay with the highest rates being found at the western end, where salinities are the lowest and ammonia concentrations the highest. Incubation of water samples from Raritan Bay shows that the majority of oxygen consumption occurs within 5 days and that nitrification activity does not usually become appreciable until after this time period. The lag time observed in our experiments is consistent with other microbiological observations which suggest that it takes 5-7 days for communities of nitrifying bacteria to become established.

The substantial influence of the sediments and organisms within them on the nitrification process in Raritan Bay are being investigated in this project by Dr. Frank Cantelmo of St. John's University. Bottom populations of small worm-and shrimp-like organisms living in estuarine sediments are collectively referred to as meiofauna. These organisms include the nematodes and harpacticoid copepods and range in size from .040 mm to 0.500 mm. The meiofauna are the most numerous multicellular animals and average populations of 40,000 per m^2 are commonly found in local estuaries such as Raritan Bay.

Enumeration of the meiofauna in Raritan Bay indicate that nematodes are generally the most abundant (80-90% of total meiofauna) and the

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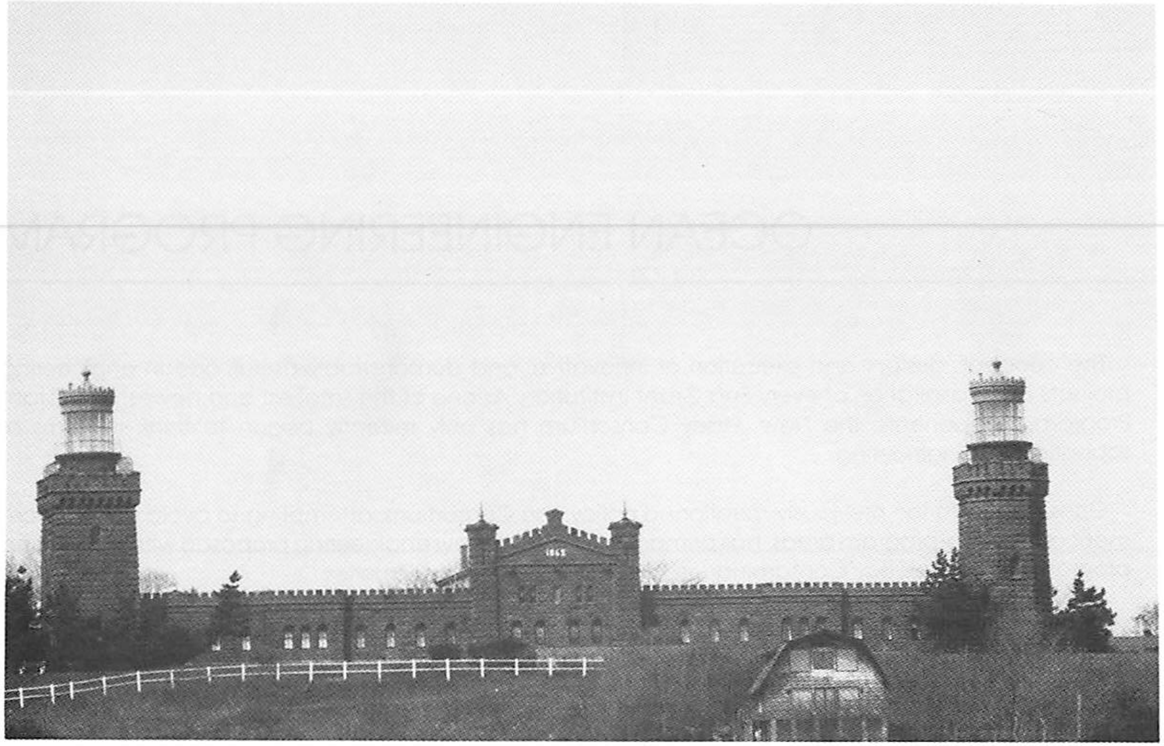
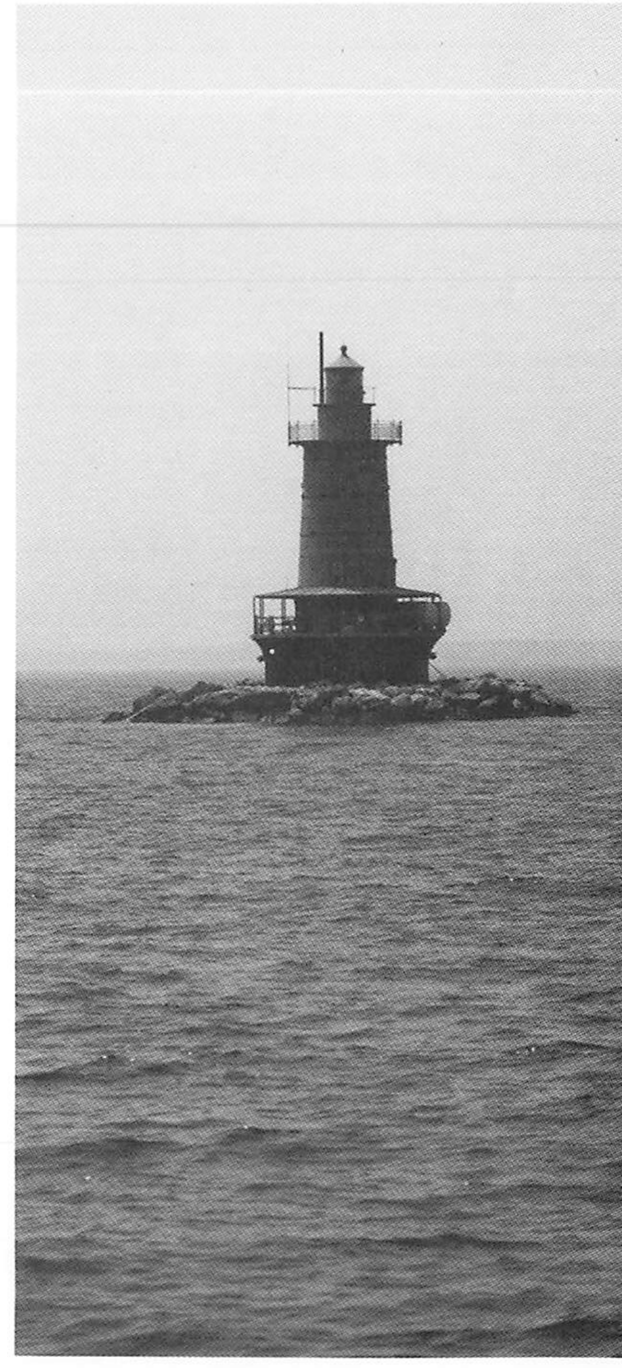
majority (90-95%) occur in the upper 1 inch of the bottom sediments. Dr. Cantelmo has found that meiofauna exert a profound influence on ammonia oxidation. Meiofauna may significantly enhance the supply of nitrogen into the water column by their burrowing activities or by direct excretion of nitrogenous compounds.

In summary, studies of the nitrification process in Raritan Bay indicate that several factors are important in controlling the rates observed. These factors are salinity, temperature, ammonia concentration, growth lag time, bottom communities, and the dynamic circulation in the bay. Most of these factors are interrelated and continued work in successive years will be necessary to allow a more complete understanding of the nitrification process.





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OCEAN ENGINEERING PROGRAM

The concept, design, and execution of innovative, and demonstrably useful, ocean engineering projects is the aspiration of every Sea Grant Institution. As one of the smallest and newest Sea Grant Program components, the New Jersey Consortium has only recently begun to think in terms of sophisticated engineering.

Consistent with the previously mentioned policy, the Consortium, attempting to avoid commencement of new sub-program areas, has primarily affiliated its new engineering proposals with the existing program categories: Bay Contamination, Coastal Systems, and Fisheries.

An early example of this doctrine is Dr. James Parks' (Lehigh) project on channel maintenance through scouring. His project has fitted clearly into the Coastal Systems sub-program, and now, past the experimental phase, must seek a sponsor more appropriate to a larger scale effort.

One project which fit none of the existing sub-program categories, but was deemed worthy of inclusion owing to the previously described properties of innovation and prospective utility, dealt with advances in Dolphin-Cell-Platform technology to give added protection to bridges and other implanted structures and to reduce cargo spill probability. This project is particularly appropriate in the New York environment—the most heavily trafficked bay area in the hemisphere.

VESSEL IMPACT ON DOLPHIN-CELL-PLATFORM SYSTEM DESIGN CRITERIA

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K. Derucher

This project by Dr. Kenneth Derucher of Stevens Institute dealt with the computerization and development of design criteria for the proper design/analysis of dolphin-cell-platform systems.

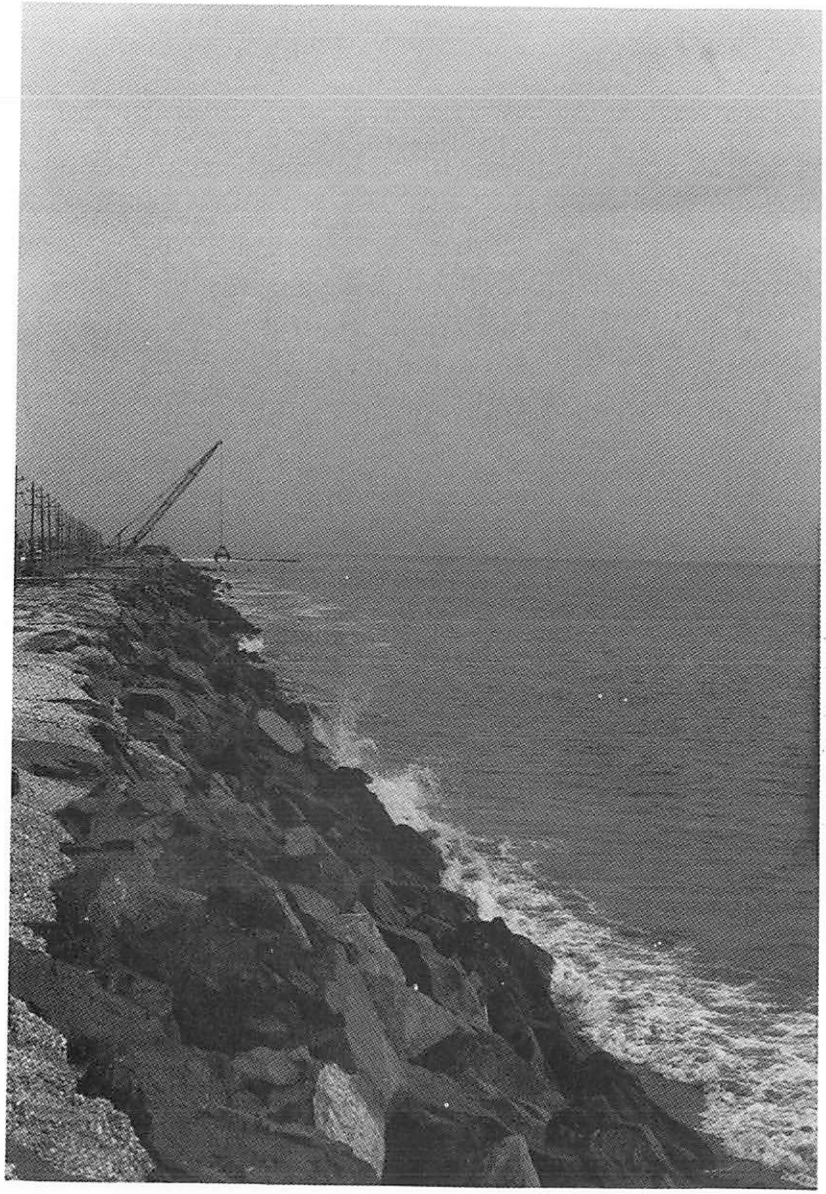
Tankers, bulk carriers, cargo vessels, and barges are being built increasingly larger in recent years. This places increasing demands on waterways and adjacent structures such as bridges, docks, harbors, piers, marinas, dock and port entrances. Thus, over the past several years, considerable attention has been placed on bridge and pier protective systems such as dolphin-cell-platform systems. One study revealed that during a four year period over $23 million in damage and fourteen fatalities occurred when vessels impacted the protective system and went on to strike the bridge pier when the protective system failed to perform its design function.

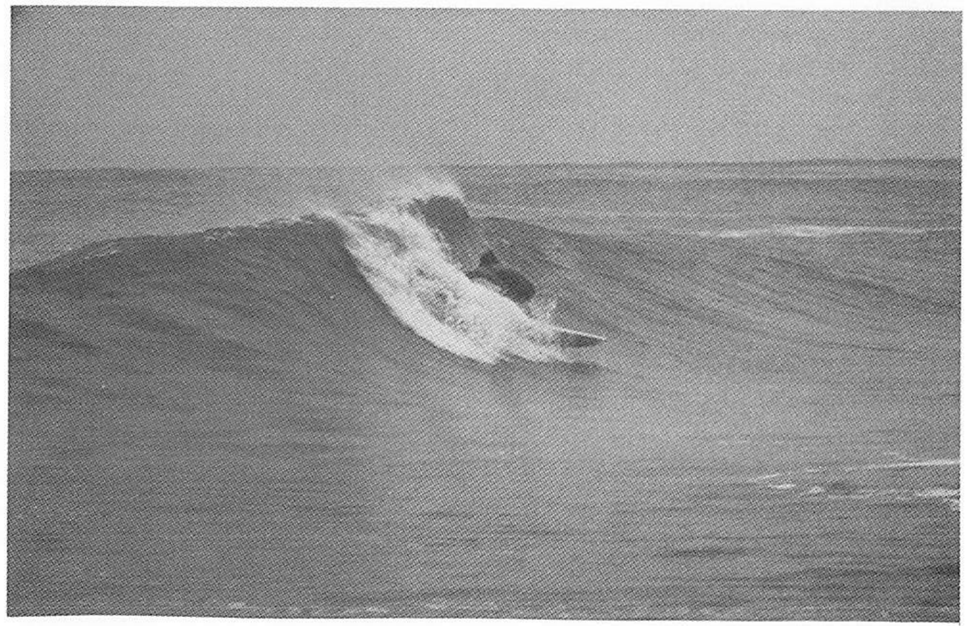
In the United States, there are approximately 100 major bridges over waterways used by large vessels. Since 1970, there have been 11 "major collisions". Fifty three people have died. These major arteries have been out of service for as long as two years. Reconstruction cost exceeds 100 million dollars.

Thus, one in ten bridges can be expected to be partially destroyed during its life. If we discount the fact that all of the above occurred in the last ten years and if we extrapolate the 10 year experience to a bridge life of 50 years, this means half of all bridges will suffer major catastrophe.

One of the most recent failures in the United States occurred in 1980 with the partial collapse of one of the Sunshine Skyway Bridges across Tampa Bay when a vessel wiped out one of its piers. The National Transportation Safety Board faults unexpected severe weather and the pilot's failure to abandon the attempt to pass under the bridge to be the major cause of the bridge failure. But, they also note "the lack of a structural pier protective system". Thus, NTSB recommended a study which would eventually lead to federal standards for the proper design of structural pier protective systems.

With these thoughts in mind a study was undertaken to develop a computer program for the proper design/analysis of dolphin-cell-platform systems which would lead to a manual of tables and charts such that one can readily pick the best system for the given situation and to ensure proper design.





NEW JERSEY
MARINE SCIENCES
CONSORTIUM

COASTAL SYSTEMS PROGRAM

In recent years there has been a growing appreciation of the importance and fragility of our coastal systems, exemplified by the recent "Year of the Coast." Among the coastal features of greatest concern have been the beaches and barrier islands many of them substantially altered and damaged by human intervention caused by inherent conflict between the need of people for permanance and the ephemeral character of shifting sands.

New Jersey's coastline, with nearly 200 kilometers of beaches, is the focus of tourism, the state's second largest industry. Most of the beaches are on barrier islands, and most have been subject to haphazard buildup because there has not been sufficient understanding of the natural processes involved in beach and dune building and maintenance. The result is severe crowding on most barrier islands, dangerously inadequate corridors for evacuating populations in times of storm danger, and severe problems of beach maintenance.

While New Jersey has been a national leader in legislation and regulations for improvement of the present situation and prevention of further damage, proper management is handicapped by incomplete understanding of coastal system dynamics. It is for this reason that Sea Grant, in full cooperation with the State Department of Environmental Protection, (DEP) has set up its Coastal Systems Program.

BEACH NOURISHMENT ON LONG BEACH ISLAND: AN EVALUATION THREE YEARS LATER

G. Ashley and S. Halsey

New Jersey's Atlantic coast was battered by severe storms during the winter of 1977-78. In response to the extensive erosion which occured during that winter, a beach nourishment project was carried out by the Army Corps of Engineers on the northern end of Long Beach Island. At the cost of $4.6 million, one hundred million cubic meters of sediment were pumped from the Barnegat Inlet channel and dispersed on the beach during spring and summer of 1979.

During the subsequent three years Dr. Gail Ashley of Rutgers University and Dr. Susan Halsey of the NJDEP collected field data (beach profiles, longshore current measurements, sediment samples and oblique aerial photos) in order to monitor the longevity of the beach fill and to determine timing and direction of sand movement if it did not remain in the nourished area. Figure 1 shows the shoreline configuration prior to nourishment, the zone of critical erosion, location of beach profiles, and the longshore current results.

Repeated surveys of each beach profile (taken at two-week intervals) at profile locations 03 through 11 allowed computation of the volume lost or gained for each profile for discrete time intervals. These results are tabulated in Table 1. Volumes (numbers in boxes) are in cubic meters of sand per meter (m^3/m) of beach, and gains are shown by +'s and losses by -'s. The area of beach nourishment is diagramatically hached and the position of the south jetty is also drawn in. Column A

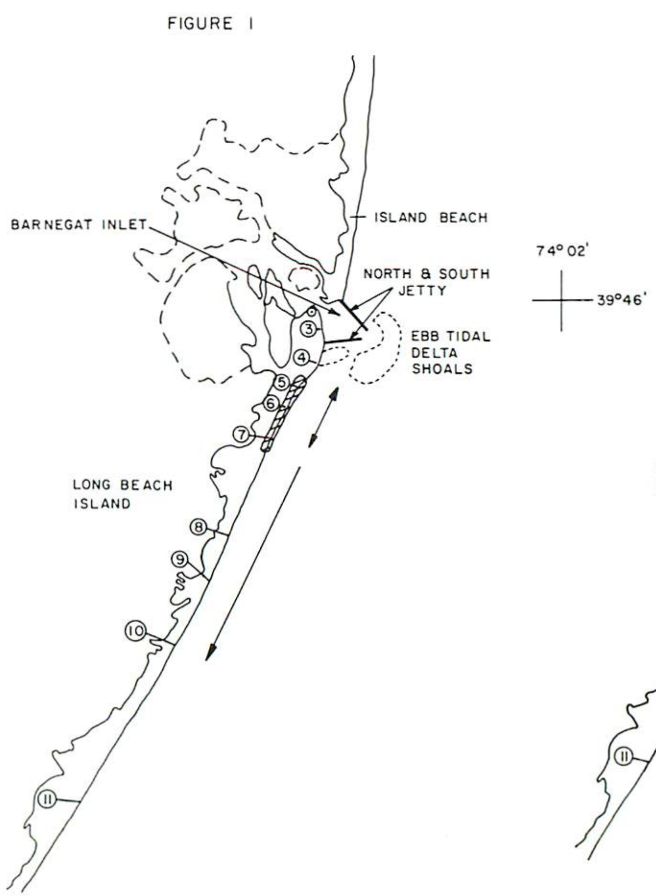


Fig. 1. Shoreline configuration prior to nourishment, 1978.

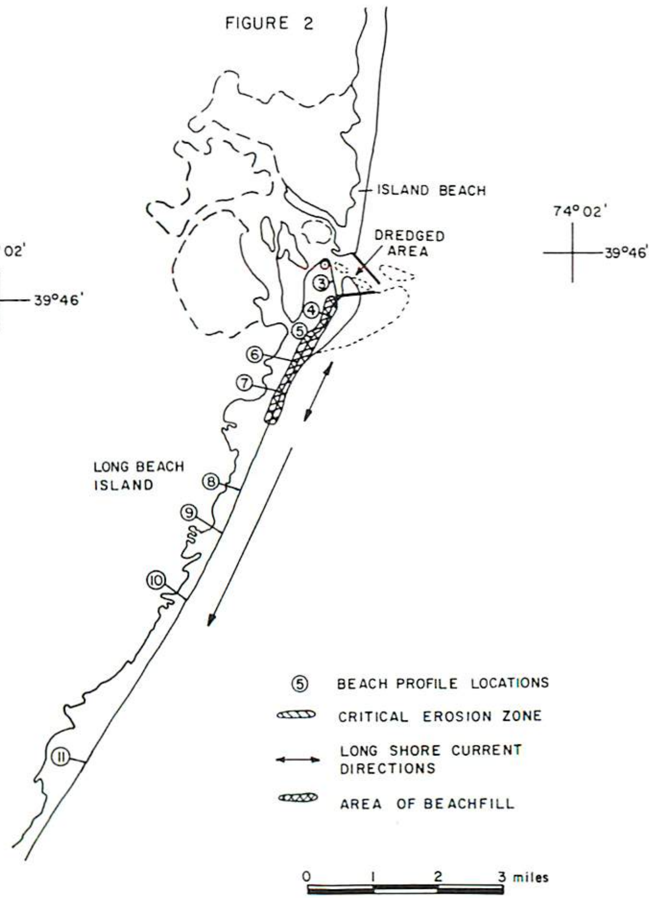


Fig. 2. Shoreline configuration August, 1980: dashed line Shoreline configuration August, 1982: solid black line.

PROFILE	A JAN 1979 AUG 1979	1 AUG 1979 AUG 1980	2 AUG 1980 AUG 1981	3 AUG 1981 AUG 1982	B NET CHANGE JAN 1979 AUG 1982
03	+7*	+8	- 30	+11	-5
SOUTH JETTY					
04	+ 16	+ 69	+ 180	+302	+566
05	+ 72	+46	- 52	+ 55	+ 120
06	+ 73	-95	- 74	+ 95	- 1
07	+44	- 54	- 50	+ 13	-48
08	- 18	-20	-98	+ 90	- 48
09	- 12	-156	-35	+103	- 100
10	-18	-5	-65	+6	- 84
11	+ 3	+91	-110	+43	+27

DISTANCE ↑

TIME →

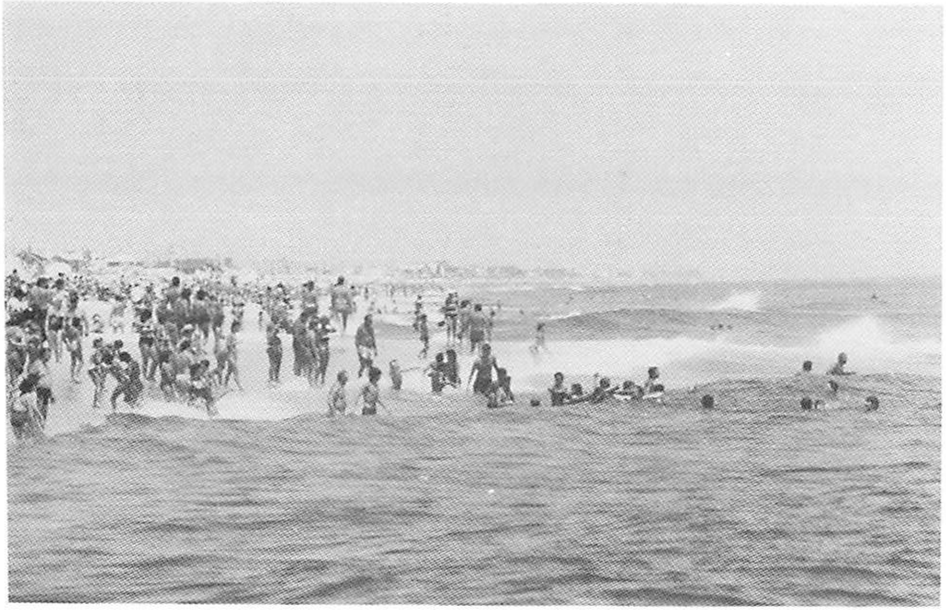
BEACHFILLED AREA (profiles 04–07, column A)
* VOLUME IN M3/M OF BEACH

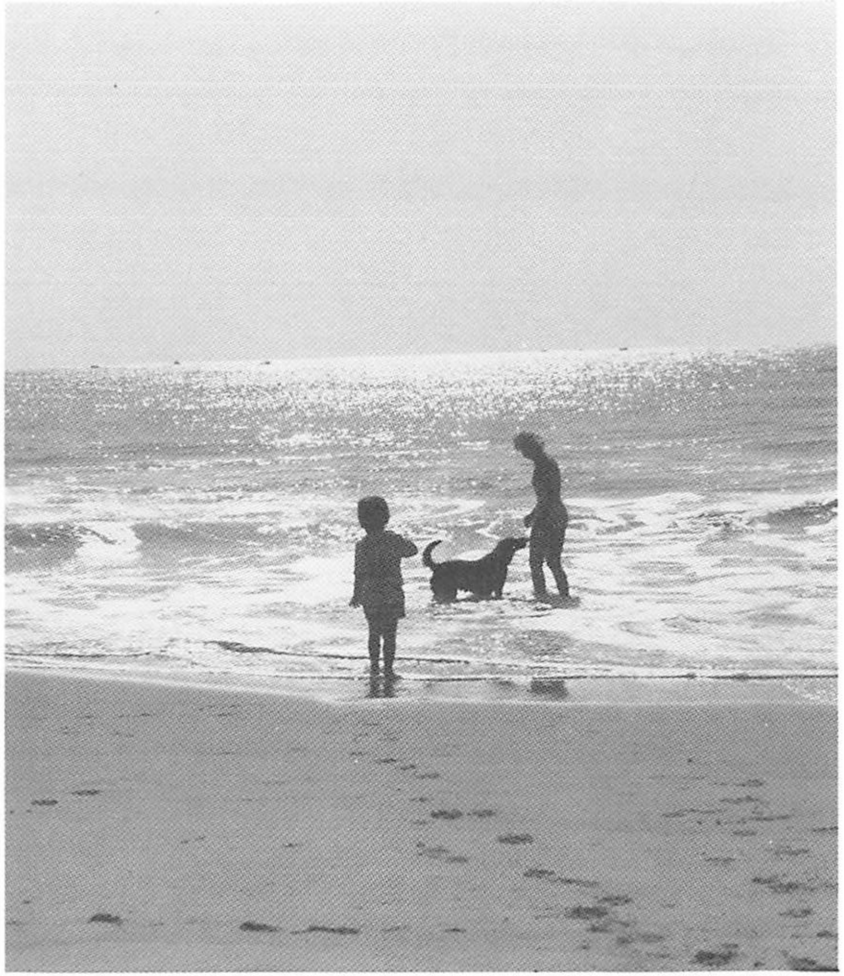
Table 1. Volumes of sand lost or gained at beach profiles 03-11.

shows change in volume from January, 1979 to August, 1979. All the gains in the northern profiles were due to sand emplacement. Columns 1 and 2 show volume changes at yearly (anniversary) increments. As a result of frequent storms during 1979, 1980, and early 1981, sediment from the beaches was gradually eroded and moved by longshore currents northward towards the inlet, as well as taken offshore. During the third post-emplacement year (Column 3), all profiles showed gains due to a long period of low storm frequency from mid-1981 through 1982 that caused sand to be brought back onshore.

Calculations of net change for the 3-year period (Column B) indicates that sand emplaced at profiles 06 and 07 moved northward and created a large shoal behind (and then over) the south jetty of Barnegat Inlet (profiles 04 and 05). However, when the shoal welded to the north end of Long Beach Island during November, 1980 (Column 2), the sand supply to profile 03 and other beaches in the intrajetty area were cut off resulting in significant beach erosion there. Figure 2 depicts the shoreline configuration (in solid black line) three years later (8/82) and reveals the dramatic change to the area caused by the beach nourishment project.

The conclusions of the study indicate that sediment was inadvertently emplaced in an area of previously undocumented northerly longshore current and, therefore, was completely lost within the first year from the southern end (profiles 06 and 07) of the beach fill zone (which was in 1979 the most critically eroded area). This sand moved northward by longshore currents and was temporarily stored behind the south jetty (1979-1980) before migrating over the jetty (1980-1982) and back into the inlet from whence it was dredged initially. Thus, the sand migrated away from eroded beach areas backed by homes and roads where the beach fill was needed most and accumulated in largely undeveloped areas backed by already wide dune areas. An additional unexpected negative effect of the nourishment project was the increased erosion of the beaches of the intrajetty area due to sand starvation after the bar welded to the beach. The study clearly indicates the need to understand the local vagaries of longshore current patterns in an area *before* undertaking multimillion dollar beach nourishment projects. In addition, valuable data on residence time for beach fill for the area was gathered which casts some doubt on the previously projected beach nourishment residence time of eight years for Long Beach Island by the New Jersey Department of Environmental Protection's Shore Protection Master Plan (1981).

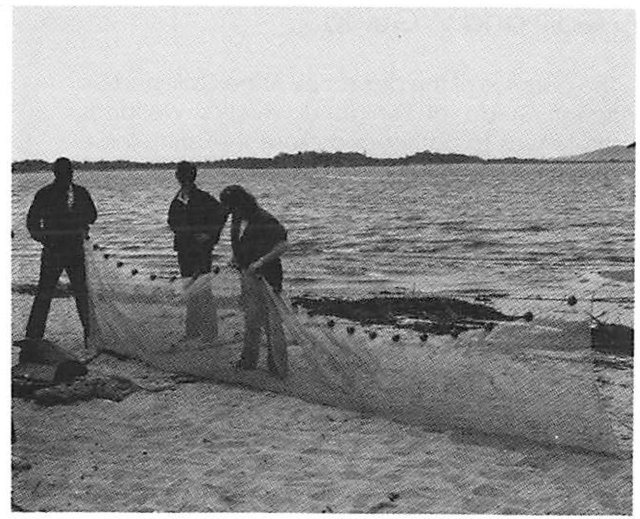




NEW JERSEY
MARINE SCIENCES
CONSORTIUM

MARINE EDUCATION PROGRAM

New Jersey is a surprising state. Noted for its teeming metropolitan areas and urban blight, it has the highest population density of any state. At the same time, its Pine Barrens, mountains, marshes and some of its estuaries are among the most beautiful and pristine natural areas bordering the northeastern megapolis.



Marine education is a strong plus on New Jersey's tally sheet, but suffers from a similar image problem. Excellent programs from public and graduate levels down to Kindergarten have gone largely unnoticed by marine educators outside the state, although this is beginning to change.

Problems associated with man's uses of marine resources are increasing in number and severity. Water is needed for drinking, irrigation, fishing, waste disposal, recreation, and other often conflicting purposes. Wise use of our aquatic environments and their resources will most likely result if our citizens are well informed and understand all the implications of the decisions they must make or influence.

If we are to reach the majority of our citizens through our educational system, it is necessary that we do so before they graduate from high school. It is also necessary that we teach more than facts, since it is the application of facts to specific situations that is important.

An early, positive exposure to our oceans and estuaries is essential as a first step in educating the people of New Jersey about the value, beauty, and critical importance of these parts of their environment. Marine topics can also be used to motivate learning in all subject areas, since the sea and its creatures have a fascination for most students which is often sadly lacking in their other studies. For these reasons, we need programs for everyone, not just future marine scientists.

Our goal is to provide a comprehensive marine education program tailored to the needs of New Jersey. Because New Jersey has a wealth of marine resources and many problems endangering our use of those resources, we offer many programs to educate the public through pre-college and undergraduate programs aimed at those not specializing in marine science, and through continuing education.

NEW JERSEY
MARINE SCIENCES
CONSORTIUM

SHORE PROCESSES AND PROBLEMS: EDUCATING THE PUBLIC ON CRITICAL COASTAL ISSUES

A. Galli and V. Guida

The purpose of this project by Anne Galli and Dr. Vincent Guida of Lehigh University's Wetlands Institute was to gather and present existing information on coastal issues in a form that is palatable to various segments of the general public. Four fact sheets and two children's activity booklets were written in order to make adult laymen and elementary school-age children more aware of four critical issues along the New Jersey coast: shorefront protection, maintenance dredging, hurricane preparedness, and wetlands utilization. Information contained in the fact sheets and activity booklets was obtained from presentations made by three to four expert panelists during four panel discussions held at the Wetlands Institute.

Each fact sheet is two to four pages in length and deals with one of the four critical issues. Specific topics addressed in the fact sheets include the following:

1) Shorefront Protection - the dynamism of barrier island landforms, the dangers posed by this dynamism to manmade structures, and New Jersey legislative battles over how best to cope with those dangers;
2) Dredging - the need for maintenance of navigational channels, the environmental impacts of dredging and dredged material disposal, problems of financial responsibility for dredging, and sediment fluidization as an alternative for channel maintenance;
3) Hurricanes - the formation and behavior of hurricanes, the low probability (1%) of hitting the N.J. coast and the large potential for injury and damage should one hit, and a description of plans to evacuate one million people from Cape May County in 30 hours with tips on what to do in case of a hurricane alert;
4) Wetlands - the value of wetlands in terms of fisheries production, stormwater control, pollution control and wildlife habitat, the destructive effects of filling and ditching by man, and current controversies over the fairness of New Jersey state regulations and over changes in wetlands-based tax revenues.

All four of the issues treated in the fact sheets are addressed in each of the two 14-page activity booklets, one for elementary school grades three and four and one for grades five and six. The activity booklets make use of map and vocabulary exercises, riddles, cartoons, word games and discussion questions to present the material to young readers. The activity booklets are appropriate for both classroom and non-classroom learning groups. A teacher's guide accompanying each activity booklet contains instructions for use of the booklets, detailed background information, suggested reading lists, and answers to the specific question in the activities booklets.

MARINE AQUATIC AWARENESS AND THE NEW JERSEY GIRL SCOUTS

B. Church

The United Nations has proclaimed the 1980's as the International Water Decade, and the Girl Scouts have taken up the challenge as members of the World Association of Girl Guides and Girl Scouts. To stimulate interest in the problem of water, the Girl Scouts have developed guidelines for projects that promote the wise use of water resources. The following topics are projects Girl Scouts are engaged in across the country: water habitats (preservation of the natural environmental balance); water safety; water conservation (including community service plans in case of water shortage); water purity (fighting pollution by identifying problem areas, awakening the interest of the community and initiating action); water, the arts, and our past; water and food (study of aquaculture and hydroponics to learn about the importance of these sciences in maintaining an adequate world food supply); water emergencies (development of community plans to help in the event of floods and hurricanes and to give assistance to people who have to evacuate their homes); aquatics and boating (cooperation with community efforts to provide water activities for fun and health); mainstreaming people with disabilities (water recreation and hydrotherapy); careers in the world of water (expansion of career education programs ranging from oceanography and marine biology to underwater archeology and maritime law).

New Jersey Girl Scouts have been involved in water conservation concerns since 1979 when they received Sea Grant support for training programs for adult volunteers and educational activities for girls. At Sandy Hook, Girl Scout volunteers and staff members from ten counties met with DEP officials and representatives of national and state organizations that foster water resource conservation. As an outgrowth of these sessions, many local projects were initiated. Enthusiasm continues with the national and international emphasis on the "Water Decade."

Girl Scouts in the Ocean County community of Point Pleasant looked at a small unoccupied island in the Manasquan River called Treasure Island. There is no bridge so the island must be reached by small boat. It has been used in recent years as a picnic and recreation area. The girls were concerned about the accumulation of debris on the island and organized a clean-up day. The workers paused in their busy day for a short program, on the history of the island, its occupation by Indians in early America, and its current importance to the community as a natural preserve.

In Burlington County, a Junior Girl Scout troop from Willingboro combined a trip to Historic Gardner's Basin with a restoration project. The girls scraped and painted rooms in the *Lightship WLV189* which had been an ocean lighthouse. Burlington County Girl Scout Council sponsored a "Rake the Lake" Day at Candlewood Lake at Camp Kettle Run in Marlton that attracted 230 girls and adults who came to rid the lake of excess bladderwords and improve the water habitat.

Teen-aged Girl Scouts in Hopatcong have been studying the problem of improving the quality of Lake Hopatcong's water and have learned a great deal about the role of citizens in effecting change through elected officials, town committees and regional boards. Last year, girls form Morris County toured the Old Morris Canal Route from Port Warren to the Paterson Falls. A number of troops have sailed on training ships from Mystic Seaport and Gardner's Basin.

Girl Scout troops have reached out to share their discoveries with the public through exhibits at malls and at special events. A troop in Parsippany has been especially interested in whales and set up a booth on New Bedford and Nantucket for their town's International Friendship Day. Last year Lenni-Lenape Council which serves Passaic and Sussex Counties held a Jamboree at Willowbrook Mall in Wayne, with a "Gift of Water" theme. During the last water crisis, Essex County Girl Scouts distributed water conservation checklists to 100,000 families.

It is difficult for children in our society to visualize the deprivation that water shortage and contamination has created in other countries. The Girl Scout program presents a panorama of the uses and benefits of water in the child's own community and neighboring areas. It explores the recreational, economic, cultural and historical significance of water. Through a variety of experiences geared to each age level, children are led to see how the lack of resources affects the development of countries. They begin to see the dangers of assuming that it can't happen here.

NEW JERSEY
MARINE SCIENCES
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SPECIAL STUDENT RESEARCH TOPICS ON NEW JERSEY MARINE AFFAIRS

D. Morell

Princeton University's Center for Energy and Environmental Studies supports several university departments independent senior thesis and other independent student research projects related to marine affairs in New Jersey. By so doing, highly qualified Princeton students are encouraged to examine marine related issues in New Jersey and the quality of their research is enhanced. As a result, our knowledge about New Jersey's marine environment, and the pool of individuals knowledgeable on this subject, and the number of students interested in marine careers will increase.

Students from any of the university departments are eligible for this assistance; however, most come from the Woodrow Wilson School of Public and International Affairs; the Departments of Politics, Economics, and Geology; the School of Architecture and Urban Planning; and the School of Engineering and Applied Science. Student research may cover a wide range of coastal topics relevant to New Jersey. In each case, students requesting research support under this program submit a brief proposal to Dr. David Morell, the Principal Investigator.

The following independent student research projects have received some financial assistance from New Jersey Sea Grant in the past:

(1) "The Politics and Unpolitics of the Chemical Control Corporation Case," Nevin Kelly, 1980.

(2) "Two Investigations in Analytical Chemistry": Part 1, "Theoretical Background for Shear Field-Flow Fractionation," 1979; Part 2, "Trace Metal Transport in the Raritan River," Susan Brantley, 1980.

(3) "A Proposal to Quantity Circulating B - Ecdysone Titers Throughout the Molting Cycle of *Homarus americanus*," David Siebert, 1980.

(4) "Relative Beach Profile Responses: Evaluation of a Beach Nourishment Project", Lydia Fox, 1979.

(5) "As Assemblage of Successful Techniques to Enhance the Growth Rate of *Homarus americanus*," 1979 and "Contemporary Rise of World Mean Sea Level - Continental Submergence -Barrier Islands, N.J.", David Siebert, 1979.

(6) "The Socioeconomic Impact of Offshore Oil and Gas Production on Coastal Communities: Lessons for New Jersey Based on the Scottish Experience" L. Stout, 1979.

(7) "Soluble Versus Particulate Transport of Iron and Aluminum in Streams in the New Jersey Pine Barrens" D. Hastings, 1979.

Results of this activity are in the form of student research reports, primarily senior theses, but also including some doctoral dissertations, junior independent papers, and graduate or undergraduate student coursework papers. Where appropriate, these papers are reproduced as formal Working Papers or Reports of the Center for Energy and Environmental Studies, thereby available for wide distribution to interested users in government, industry, academic, environmental groups, and the public at large. To date, the Center has published 106 Reports. Through this mechanism, new information about marine affairs in New Jersey should reach a broader audience.


MISS JEAN

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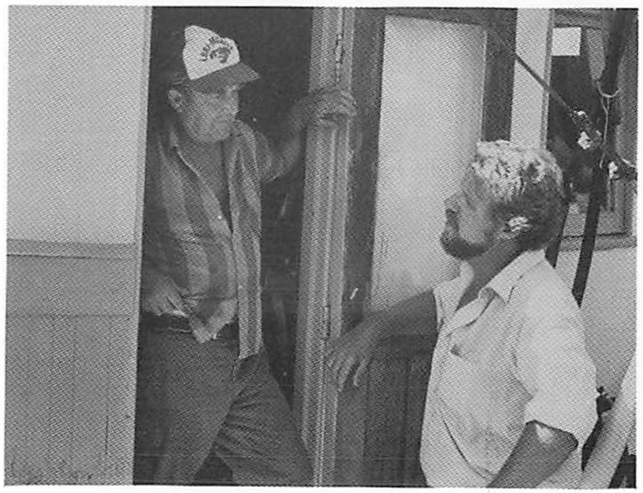
ADVISORY SERVICES



Formerly known as the New Jersey Marine Advisory Service, the New Jersey Sea Grant Extension Service (SGES) is the public educational arm of the New Jersey Sea Grant Program, funded in part by the National Oceanic and Atmospheric Administration's Sea Grant Program, through the New Jersey Marine Sciences Consortium, headquartered at Sandy Hook. In addition, SGES is the marine informational and educational component of the Cooperative Extension Service at Cook College, Rutgers, the State University.

The overall objective of the Sea Grant Extension Service is to develop and implement educational and informational programs which promote wise use and development of New Jersey's coastal resources. Specifically, the SGES identifies informational needs of various coastal user groups; transfers information to coastal user groups; aids the user groups in applying this information; and assists the research community in developing research programs that address specific user group needs.

NEW JERSEY
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NEW JERSEY SEA GRANT EXTENSION SERVICE

R. Zimmer

This was the third full year of operation of the SGES. Its staff, although small in size, is competent, active and enthusiastic. Its marine agents and specialists in pollution, recreation, coastal law and communications represent, at least for the time being, a "critical mass" to serve the major users, and their interests, of our marine and coastal resources. In addition, these individuals have demonstrated a genuine concern for the people whom they serve and a high degree of effectiveness in communicating among both users and researchers. This year has also shown a maturity and steady growth in its dual responsibilities to the N.J. Marine Sciences Consortium and the N.J. Cooperative Extension Service. Some of the major accomplishments of the Sea Grant Extension Service for 1981-82 are outlined below.

The SGES marine advisory committee expressed concern with the time lag of obtaining National Weather Service satellite isotherm data and relatively poor offshore long-range weather forecasting. As a result, the SGES Agent in Toms River arranged for satellite data to be transmitted directly to the agent's office in Toms River by Telefax from Washington, D.C. Loran-C overlays and temperature conversion charts were developed by the agent and are now received by fishermen in one day, rather than seven. A letter from the president of the National Swordfishermen's Association indicated this program saved his industry approximately $2,250,000 in fuel costs in the first year!

The marine agents also worked with Bendix Engineering Corporation on a pilot project to provide telephone tape recording of offshore "canyon" weather forecasts. This report assists sport and commercial fishermen in planning offshore trips. Seventy-five fishermen use the report each day. Subscribers are charged $80.00 per year to defray costs of the program. In addition, fifty fishermen attended a conference entitled "Fishing by Temperatures", for the purpose of explaining the physical and behavioral responses of fish species to water temperature.

SGES, cooperating with the National Marine Service and Japanese Trawlers Association, held two meetings in Cape May to educate American fishermen about quality improvement methods necessary to export to Japan and to introduce Japanese importers to U.S. processors in an effort to stimulate another American market. Two hundred fishermen attended these meetings. As a result, one Cape May processor has entered into a joint venture with the Japanese for squid.

To meet the increasing interest in artificial reef development off the New Jersey coast, SGES took the lead in organizing a Mid-Atlantic Artificial Reef Conference. It was attended by 120 individuals, including representatives from as far as Japan. Panels discussed "Innovative Legislative Programs", "Ecology of a Temperature Reef", "New Technologies in Reef Development" and "Industries' Role in Reef Development". The assistant commissioner of the N.J. Department of Environmental Protection was so impressed with the concept of artificial reef development, that he promised to commit State resources to develop an artificial reef program.

The Cape May marine agent met with representatives of the Farmers Home Administration (FHA) to determine the availability of assistance to osytermen through its Disaster Relief Program. During 1981, the oyster industry suffered extreme hardship as a result of the MSX disease which caused extensive oyster mortality. As a result, FHA responded to 4 oystermen who obtained low-interest loans to replace lost seed stock.

Cooperating with the National Marine Fisheries Service, National Fisheries Institute and the Food Marketing Institutes "Catch America" national campaign, SGES arranged for a tile-fishermen to go to Buffalo, N.Y. to educate the staff of Kotok-Heims, a major seafood distributor, in the marketability of tilefish. For the first time, this species is now marketed in the Buffalo area.

In the field of Marine Trades, SGES worked closely with the N.J. Marine Trade Association to sponsor their 3rd annual conference. Fifty-five marina owners and boat dealers attended. The subject of marine condominiumizing was addressed and an article was subsequently written for *Jersey Shoreline* and a national periodical entitled *Marina*.

The director of SGES is a member of the Advisory Committee to the Governor's Fisheries Development Task Force. The Secretary of Agriculture chairs this group and asked SGES to conduct a seafood education presentation for the Department's

NEW JERSEY
MARINE SCIENCES
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Annual Food Editor's Tour. Demonstrating SGES's excellent relationship with the Department of Agriculture, an agreement was reached to permit fishermen to form commodity promotion councils, under the legal aegis of the Agriculture Promotion, Research and Education Act. Councils were organized for the surf clam and oyster industries. The staff's coastal law specialist assisted in this effort.

At the request of Switlik, Inc., manufacturer of life rafts, and the U.S. Coast Guard Training Center at Cape May, SGES arranged a training session for emergency evacuation of personnel, using the clipper ship, ***Brigantine Young America.*** Thirty Coast Guard recruits and the crew of the ship participated.

In regards to communications, close to 7 million viewers saw the 31 SGES-conducted TV shows aired on network stations in Philadelphia. A wide variety of topics related to the Sea Grant Program were covered. When publications were offered to the viewers, an average of 125 requests were received per show. In addition, the Cape May agent conducted 9 cable TV programs in his area, and the communications specialist was selected as a regularly-featured guest (once a month) to discuss marine and coastal topics on the New Jersey Public Television network. ***Rutgers Marine Line***, a weekly radio presentation made available to 23 New Jersey stations covering all of the state and the New York metropolitan area, reached an estimated audience of 3 million each week. The communicator also produced and circulated ***The Jersey Shoreline*** to about 2000 subscribers as a quarterly newsletter. SGES staff members regularly contribute one or more articles to each issue.

The marine pollution specialist, working under contract to NOAA's Office of Marine Pollution Assessment, conducted a number of public education meetings and worked closely with state and federal officials in addressing the sensitive issue of ocean dumping. The specialist also worked with local industry and water pollution control groups in meeting waste discharge standards. In addition, the pollution specialist coordinated a study among three universities whereby blue mussels ***(Mytilus edulis)*** were used as bioindicators to determine the effects of ocean dumping of dredged material.

It would appear that the major objective of SGES—to transfer knowledge of the State's extensive marine resources in forms useful to people who have an interest in these resources, either direct or indirect—was acheived during this year. Most program areas became strengthened, reinforced and intensified.

At present, the Sea Grant Extension Service consists of the following individuals:

Robin Zimmer, Director, NJSGES — 201-431-7920
20 Court Street, Freehold 07728

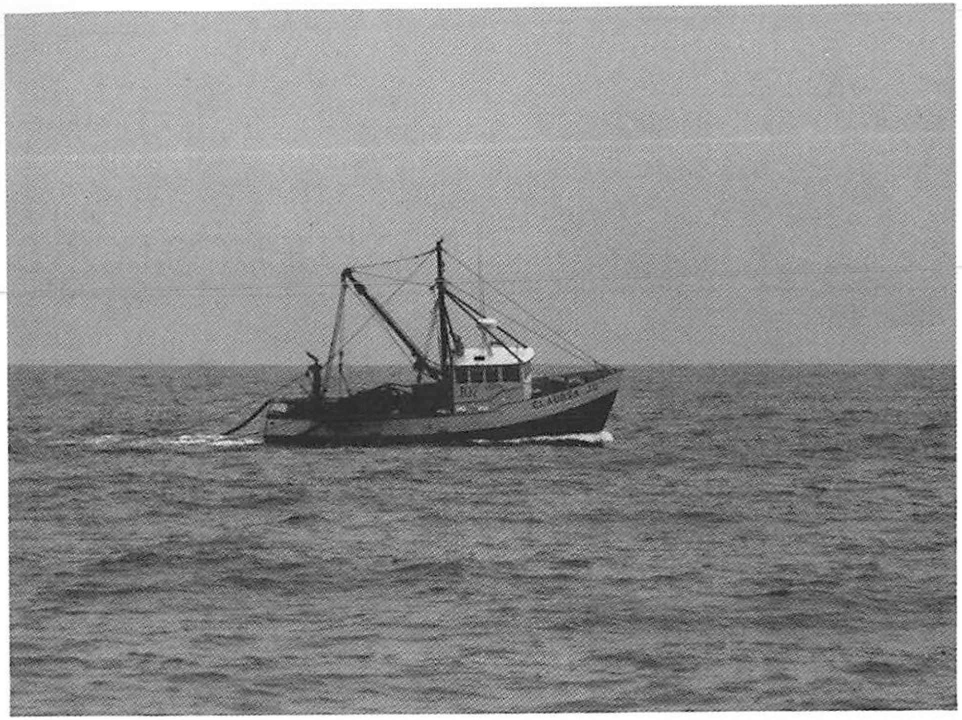
Gef Flimlin, Marine Extension Agent—
Ocean County Agricultural Center, — 201-349-1152
Whitesville Rd., Toms River 08753

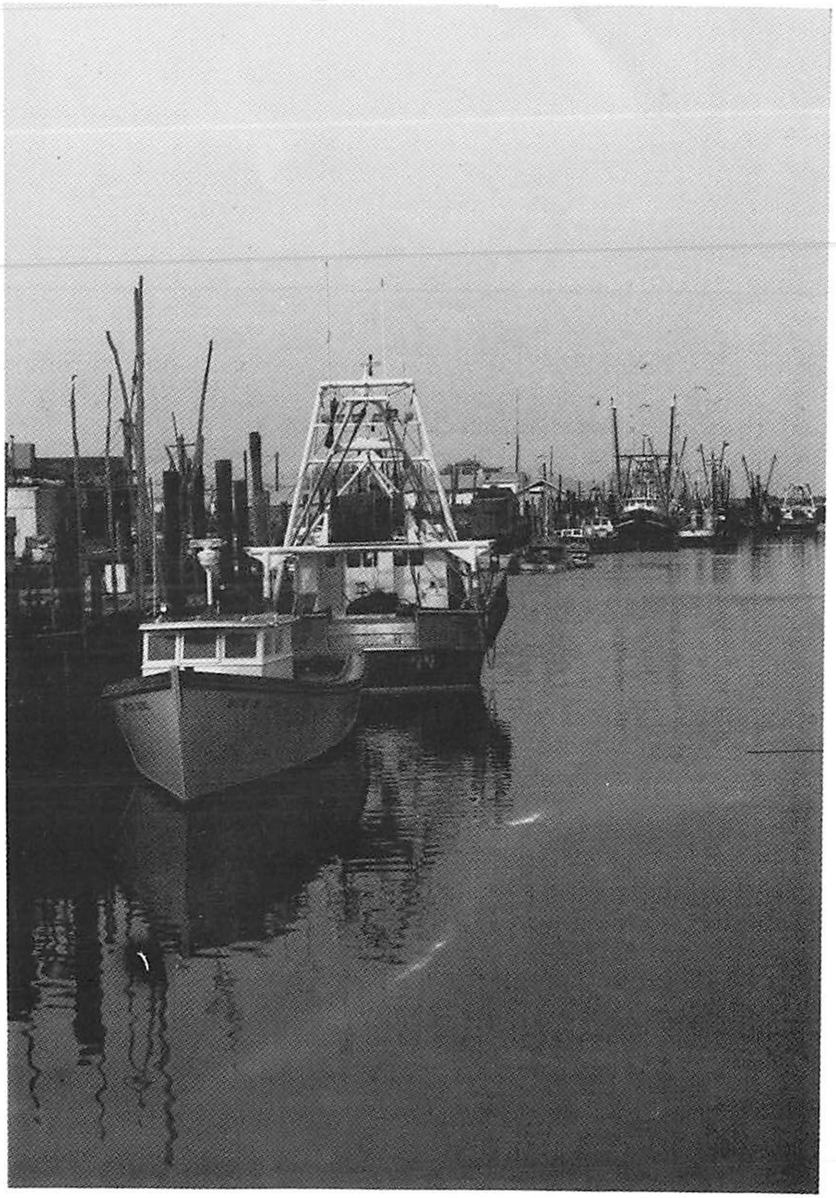
Stewart Tweed, Marine Extension Agent—
Cape May Extension Center, — 609-465-5115
Dennisville Rd., Cape May Court House

Alex Wypzyszinski, Coastal Law Specialist
Cook College, — 201-932-9636
P.O. Box 231, New Brunswick 08903

Chester Teller, Communications Coordinator
Cook College, — 201-932-9498
P.O. Box 231, New Brunswick 08903

Their expertise is available to provide educational and informational assistance to marine researchers, marine resource users, teachers, consumers and citizens throughout the state.





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NEW JERSEY MARINE SCIENCES CONSORTIUM

PROGRAM SUMMARY

MARINE RESOURCES DEVELOPMENT

Living Resources
R/F-1
Sublethal Effects of Heavy Metals on Intestinal Absorption of Nutrients (Amino Acids, Sugars and Cations) in Fish Found in Newark Bay/Raritan Bay Areas.
Dr. A. Farmanfarmaian, Rutgers University

R/F-2
Life History and Population Dynamics of Tilefish, Lopholatilus chamaeleonticeps.
Dr. C.B. Grimes, Dr. K.W. Able, Rutgers University

R/F-4
Tolerance to Chronic Effects of Pollutants in Newark Bay Killifish.
Dr. J. Weiss. Rutgers University
Dr. P. Weiss, NJ Medical & Dental University

R/F-6
Oil Pollution Impact in N.J. Coastal Waters: Further Studies on Naphthalene Toxicity and Accumulation in Flounder Species, Mysid Shrimp, and Other Prey.
Dr. B.R. Hargreaves, Dr. S.S. Herman, Lehigh University

R/F-7
Identification of Bivalve Larvae: A Multi-Institutional Approach.
Dr. R.A. Lutz, Rutgers University

Marine Law and Socio-Economics
R/F-3
Human Ecology of New Jersey Fisheries.
Dr. B.J. McCay, Rutgers University

MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT

Ocean Engineering
R/N-2
Vessel Impact on Dolphin-Cell-Platform Systems Design Criteria
Dr. K. Derucher, Stevens Institute of Technology

Coastal Engineering
R/S-2
Littoral Sediment Dispersal of Materials Dredged from Barnegat Inlet Used as Beach Nourishment on the Northern End of Long Beach Island, New Jersey.
Dr. G.M. Ashley, Rutgers University
Dr. S.D. Halsey, NJDEP

MARINE ENVIRONMENTAL RESEARCH

Ecosystem Research
R/E-6
An Interdisciplinary Investigation of Nitrification in Raritan Bay
Dr. H. Simpson, Dr. B. Deck, Dr. H. Ducklow, Lamont-Doherty Geological Observatory
Dr. F. Cantelmo, St. Johns University

Pollution Studies
R/E-5
Relationship of Salinity and Redox Potential to Microbial Transformations of Mercury Pollutants in Estuarine Sediments of Northern New Jersey.
Dr. R. Bartha, Rutgers University

Environmental Models
R/E-3
Physical Oceanogrpahic and Numerical Simulation Studies of the Hudson-Raritan Estuary.
Dr. G.L. Mellor, Princeton University
Dr. R.I. Hires, Stevens Institute of Technology

MARINE EDUCATION AND TRAINING

College Level
E/T-2
Special Student Research Topics on New Jersey Marine Affairs.
Dr. D.L. Morell, Princeton University

Public Education
E/P-1
Shore Processes and Problems: Educating the Public on Critical Coastal Issues.
A.E. Galli, Dr. V.G. Guida, Wetlands Institute, Lehigh University

E/P-2
Marine Aquatic Awareness Project
Ms. B.S. Church, Burlington County Girl Scout Council

ADVISORY SERVICES

Extension Programs
A/S-1
New Jersey Sea Grant Extension Service
Mr. R. Zimmer, Director

PROGRAM MANAGEMENT AND DEVELOPMENT
M/M-1
Program Administration
Dr. R.B. Abel, Mr. R.S. Stevens, New Jersey Marine Sciences Consortium


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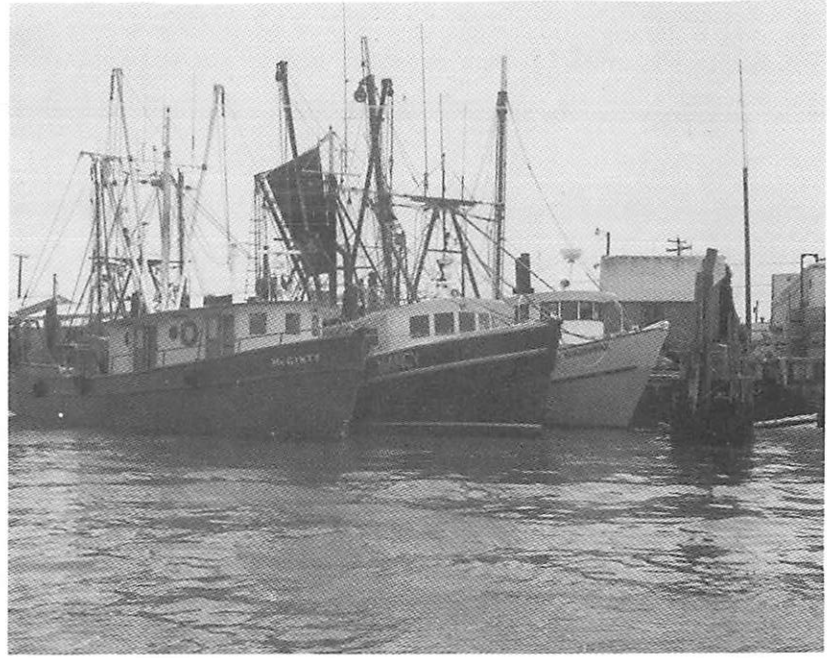
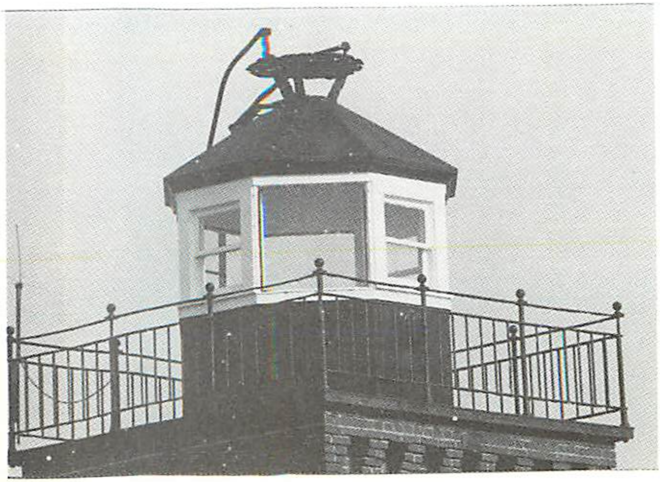


ACTIVITY BUDGET

ACTIVITY BUDGET SHEET (Summary Totals by Activity)

	NOAA Grant Funds	University Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living Resources	131.000	123,940
Marine Law and Socio-economics	17,000	9,000
MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT		
Ocean Engineering	20,000	10,000
Coastal Engineering	15,000	9,600
MARINE ENVIRONMENTAL RESEARCH		
Ecosystems Research	36,000	27,050
Pollution Studies	9,000	18,000
Environmental Models	24,000	21,400
MARINE EDUCATION AND TRAINING		
College Level	3,000	3,000
Public Education	20,000	15,000
ADVISORY SERVICES		
Extension Programs	129,000	109,400
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	100,000	47,000
TOTAL	504,000	393,390



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Director, New Jersey Sea Grant Extension Service

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