NEW JERSEY SEA GRANT ANNUAL REPORT 1985-86

SEA GRANT REPORT

NEW JERSEY MARINE SCIENCES CONSORTIUM

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Message From the Editor

This publication marks both the tenth anniversary of the New Jersey Sea Grant Program and the final annual report in this format. Revised policies from the National Sea Grant Office no longer require publication of detailed annual reports. In the years ahead, New Jersey Sea Grant will be presenting the information contained in this report, through a number of publications including an annual brochure on the program's projects and progress.

In presenting this, our final formal annual report, we would like to acknowledge and dedicate this publication to the man responsible for starting the New Jersey Sea Grant Program, Dr. Lionel A. Walford. As Director of The New Jersey Marine Sciences Consortium in 1975, Dr. Walford launched New Jersey's introduction into the National Sea Grant Program, and charted its course toward the future. Dr. Walford's dedication and commitment to the New Jersey Sea Grant Program set the standards for excellence and achievement through its formative years. As New Jersey Sea Grant celebrates its first decade, we acknowledge Dr. Walford's contribution to all the program has become, and all that it hopes to be.

Kim Kosko
Editor

Dr. Lionel A. Walford

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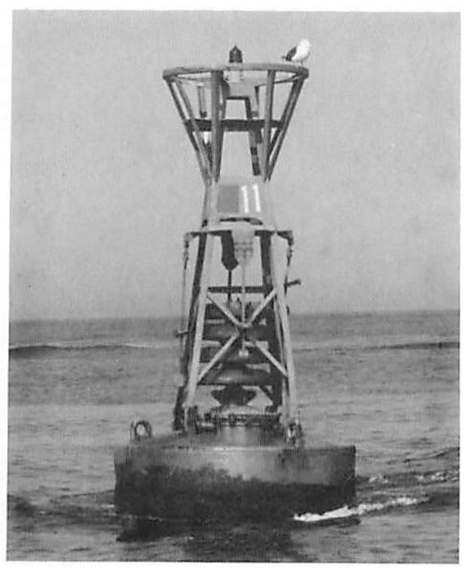

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New Jersey Sea Grant Program Report of Sea Grant Ten 1985-1986

Among Sea Grant Programs, New Jersey's has, from the very beginning, occupied a distinctive place both because of the special problems of the state's highly industrialized northeast coast and Hudson River estuary, and the lack of a major academic focus for marine research.

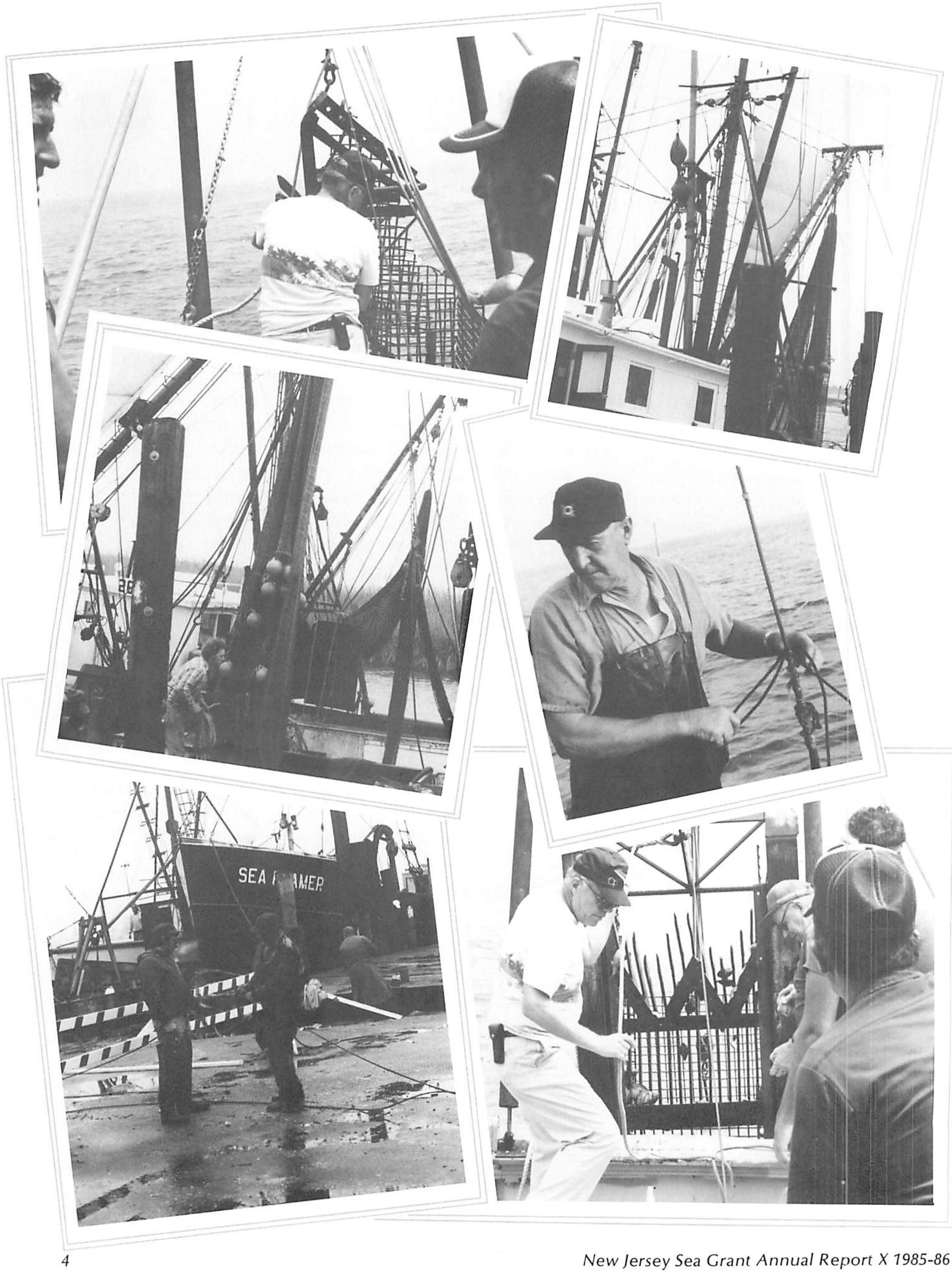
The New Jersey Sea Grant Program began at a time when the small "teacher's colleges" of the nation were expanding with great (and perhaps undue) speed into universities. In New Jersey, many colleges underwent metamorphosis which did not quickly produce substantial and significant graduate research programs. The Marine Sciences Consortium was created as a means of focusing and combining the existing marine research and education competence of the state, and helping it expand and grow. The Sea Grant Program was the vital means of growth.

This year ten program represents maturity in several ways. First, there is the increased competence and sophistication of the proposals. Second, there is the increased number of academic participants; 9 institutions are represented. Fifteen projects comprise the program for 1985-86; ten are renewals and five are new projects. Most of them are partnership projects with industry, other Sea Grant Programs, and/or the New Jersey Department of Environmental Protection. Third, in fields where circumstances allow, projects are combined into programs with strong leadership and full coordination and communication.

The Advisory Service and Education portions of the New Jersey Sea Grant Program still are not adequate to the needs of the state, but this reflects lack of funds and not a dearth of interest or competence; we propose improvements.

This program also reflects, with our thanks, the counsel and support of the National Sea Grant Office, not only in the improved quality of the projects, but in the more mundane elements of style and clarity. We hope you'll agree that New Jersey Sea Grant has come a long way.

Dr. Robert B. Abel
Director



Fisheries Program

New Jersey's fisheries continue to be a priority with the Sea Grant Program. As the fisheries become more efficient and as demand increases, so does the need for emphasis on solutions to scientific and management problems.

This year, Dr. Richard Lutz's project approached its ultimate objective: completion and publication of a practical manual and scientific monograph for identification of bivalve larvae through routine optical microscopic examination of the larval hinge apparatus. Richard Lutz and assiciate investigators in 16 institutions have obtained larval—and in many cases post-larval—sequences for 57 bivalve species. Results were written up as achieved, and eight papers and eight abstracts were published or are currently in press in seven journals.

The impact of an important protozoan in causing disease and mortality in American flounder, builds on the substantial work of Ann Cali and Peter Takvorian of Rutgers who, with cooperation from the National Marine Fisheries Service, demonstrated that the microsporidan protozoan *Glugea stephani* infects winter flounder and causes mortality in young-of-the-year. Until the two Rutgers scientists completed their first investigation, it was thought that *G. stephani* was present from Massachusetts north. With the hazard to flounder established for New Jersey waters, the investigators propose to evaluate the impact of the protozoan on the American winter flounder populations of the Northeast coastal region, mapping variability of occurrence and trying to determine causative factors in spots of heavy infestation.

A major shellfish fishery is for the ocean quahog, *Arctica islandica*, with over 10,000 tons of meat landed each year in New Jersey alone. But what if, as research has seemed to indicate, quahogs over a century—and perhaps over two centuries—old are being harvested? Clearly, if these indications are correct, the quahog fishery becomes closer to a mining operation, so slow would be new population recruitment and growth. Richard Lutz of Rutgers and Michael Castagna of Virginia Institute of Marine Sciences have available laboratory grown post-larval specimens of known age which they planted in the large commercial beds off Cape May. Through use of NOAA's R/V *Seahawk*, its diving bell capability, and acoustic relocation system, the investigators will be able to check growth of the planted specimens over various lengths of time determining not only growth characteristics, but when this important species reaches sexual maturity, a matter of concern to fishery managers.

Timothy Carter and Frank Cantelmo of St. John's University continued their study to determine viral content and filtration rates in the hard clam at a commercial depuration facility. During the first months of the project, the investigators established a flow-through system parallel to the commercial system using the same water supply. Samples were studied from the depuration facility and from condemned sites. None of the samples yielded enteroviruses, though the studies confirmed the observation that bacterial depuration was quite efficient. A small fraction of clams did not extend siphons during the depuration period and this showed high *Clostridia* count. During the second year the enterovirus study will continue and the investigators will examine the effects of various physical and chemical conditions on clam filtration rates.

This year marked the second year of a comparative study of job satisfaction and fishing, by Bonnie McCay of Rutgers and John Gatewood of Lehigh. The need for including socioeconomic factors in fisheries management plans is explicit in the Fishery Conservation and Management Act. Last year, Gatewood and McCay designed the study and questionnaire, trained a graduate assistant, and began interviews with surf and bay clammers and longliners; data analysis was not complete at the time of renewal proposal submission, but the project is on schedule and interviews will be expanded to obtain insights into specific issues arising from the Mid-Atlantic Fishery management Council's Management plan for surf clams and ocean guahogs.

In summary, the projects forming the New Jersey Sea Grant Fisheries Program are directly responsive to the needs of the state and the region. The common thread which ties the several projects together is the basic goal: *Achievement of the full economic, social, and environmental potential of the New Jersey commercial and recreational fisheries.*

IDENTIFICATION OF BIVALVE LARVAE: A MULTI-INSTITUTIONAL APPROACH

R. Lutz,
Rutgers University

New Jersey Sea Grant X was the 5th year of a 5-year project directed by Richard A. Lutz of Rutgers University. The primary objective of the effort is publication of a comprehensive manual/scientific monograph for the identification of bivalve larvae and early postlarvae (through *routine optical* microscopic examination of the larval or postlarval hinge apparatus) in estuarine and marine waters of the North Atlantic. This objective is being accomplished through a multi-institutional, cooperative effort, involving 16 institutions (academic, federal, and private industrial) in both North America and Europe.

As emphasized in our Sea Grant IX annual report, the many difficulties associated with accurately identifying bivalve larvae within the plankton have 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 predictions for aquacultural and fisheries management purposes have been extremely limited. Year-to-year fluctuations in larval abundance and juvenile recruitment are often not possible to define 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 dumping, 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 species, particularly at the early (straight-hinge) developmental stages. This ongoing project offers an approach aimed at eliminating many of the existing obstacles to future research. The involvement in this project of a number of researchers at various institutions, who are presently culturing the larvae of numerous species of bivalves for other purposes, has proved to be an extremely cost-efficient means of achieving the goal of the proposed effort (i.e., publication of a practical identification manual).

Over the past two years we expanded our studies through a collaborative effort with Dr. Marcel Le Pennec of the Laboratoire de Zoologie, Universite de Bretagna Occidentale, Brest, France. Dr. Le Pennec presently has at his disposal preserved samples of the larvae and early psotlarvae of over 20 species of bivalves and has agreed to provide us with subsamples of these for photographic documentation of the various ontogenetic stages for inclusion in the final manual. For the past two years we have been in the process of assessing how adequate these specimens (which have been preserved for considrable lengths of time) will be for inclusion in the manual.

Over the past 3 years of our project we have obtained larval and, in many cases, postlarval specimens of the following 59 species of bivalves (the list includes those of Dr. Le Pennec, some of which may not be adequately enough preserved for inclusion in the final manual): *Mytilus edulis* (blue mussel); *Modiolus modiolus* (northern horse mussel); *Geukensia demissa* (Atlantic ribbed mussel); *Mytilus californianus: Ischadium (= Brachidontes) recurvum* (hooked mussel); *Brachiodontes exustus; Perna perna, Mytilus galloprovincialis, Crassostrea virginica* (American oyster); *Crassostrea gigas* (Japanese oyster); *Ostrea edulis* (European oyster); *Argopecten irradians* (bay scallop); *Placopecten magellanicus* (deep-sea scallop): *Pecten maximus; Chlamys opercularis; Chlamys varia; Chlamys distorta; Mya arenaria* (soft shell clam); *Mya truncata; Hiatella arctica; Hiatella rugosa; Spisula solidissima* (surf clam); *Spisula subtruncata; Mulinia lateralis* (dwarf surf clam); *Macoma mitchelli; Macoma balthica; Tagelus plebeius* (stout razor clam); *Donax variabilis; Ensis directus* (razor clam); *Arctica islandica* (ocean quahog); *Noetia ponderosa* (ponderous arc): *Arca noae* (common arc); *Astarte castenea* (chestnut clam); *Periploma leanum; Lyonsia byalina; Anomia ephippium; Anomia patelliformis; Anomia simplex* (common jingle shell); *Cyclocardia borealis; Cerastoderma edule; Cerastoderma glaccum; Corbicula manilensis; Pholas dactylus; Diplothyra smithii; Nucula proxima; Nucula annulata; Venerupis aura; Ruditapes decussata; Ruditapes philippinarum; Venus verrucosa; Venus faciata; Petricola pholadiformis* (false angle wing); *Gemma gemma* (gem clam); *Pitar morrhuanus; Mercenaria mercenaria* (hard clam); *Teredo navalis;* Tellina sp.; *Laevicardium mortoni;* and *Lithophaga bisulcata.* It should also be mentioned that in the case of one of the above species (the bay scallop, *Argopecten irradians*), we have reared the larvae of adults from two geographically-separated populations (one in Massachusetts and

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IMPACT OF GLUGEA STEPHANI *DISEASE ON AMERICAN WINTER FLOUNDER POPULATIONS*

A. Cali and P. Takvorian,
Rutgers University

New Jersey Sea Grant X was the first year of a three year project directed by Drs. Ann Cali and Peter M. Takvorian of Rutgers Unitversity, Newark, New Jersey to study *Glugea stephani*, a disease of American winter flounder (*Pseudopleuronectes americanus*).

Glugea stephani is a spore forming protozoan (Microsporida) parasite that causes an intracellular infection in the intestinal connective tissue of at least seven genera of the economically important flatfish. The infection results in production of *Glugea* cysts, each formed by an encapsulated and hypertrophied host cell, in which the protozoan proliferates and matures. The cysts range in size from microscopic to macroscopic (approximately 5.0 mm).

In an effort to understand the effects of this disease on winter flounder stocks, we exposed juvenile winter flounder to *Glugea stephani* spores in the laboratory. Juveniles were used because they live in shallow estuaries for at least the first year of their lives and it is in this environment that the water temperture will support the initiation and growth of the parasite. The fish were given one exposure to the parasite. Although the fish are probably subject to multiple exposures and infections in their natural habitat, we first wanted to develop a successful infection system. No one had previously succeeded in experimentally infecting winter flounder with *Glugea stephani* in the laboratory. We repeated the experiment with a second group of fish under the same conditions and thus verified that our results were reproducible.

To further ensure the validity of our experiments, the fish were maintained under optimal environmental conditions in large flow-through aquaria in which the water temperature, water flow and aeration were all controlled and the fish were fed daily.

The winter flounder were maintained in the flow-through tanks for approximately 4 months at 19 C, with the first mortalities due to *G. stephani* infections occuring approximately 3 weeks post exposure (PE).

All mortalities during the experiment occured within 95 days PE (Table I). Surviving fish were sacrificed 115 days PE during the first experiment and 127 during the second. Eleven surviving fish from the exposed tanks and 10 from the control tanks were infected with *Glugea stephani*. Thus, 30/61 (19 died and 11 survived) of the exposed fish, and 4/56 (4 died and 10 survived) of the control fish were *Glugea stephani* positive.

Among fish in the experimentally exposed group, 49.1% were infected and 63.3% of them died from *Glugea stephani*. In the control group, 25% of the fish were naturally infected and

Table I
Time interval distribution of *Glugea stephani* intensity in experimentally exposed winter flounder

Number of days post exposure	Number of fish mortalities	Infection intensity 1	2	3	4
10-20	1				1
21-30	1				1
31-40	5	1		1	3
41-50	3				3
51-60	3			1	2
61-70	2			1	1
71-80	1		1		
81-90	1				1
91-100	2			1	1
	Sacrificed				
115	23	3	1		1
127	14	2	1		3
Totals	56*	6	3	4	17

* 5 fish died of other causes not included.

The intensity of *Glugea stephani* infection was rated on the following scale:
+1, 1-12 cysts;
+2, 13 and more diffuse, countable cysts or an uncountable number of cysts in one or more foci of infection <<25% of the intestine);
+3, an uncountable number of cysts in two or more foci <>25% <50% of the intestine;
+4, an uncountable number of cysts distributed throughout 50% of the intestine.

28.5% of them died of the infection (Table II). The percentage of mortality observed due to *Glugea stephani* relative to the total number of fish in each was 31.1% in the exposed group and 7.1% in the controls. The G-test of the above data indicated that the differences between the prevalence of *Glugea* in the exposed and control groups were significant at the $P<0.04$).

The overall *Glugea* mortality of the exposed group (19/61 fish) was found to be significantly greater than that of the control group (4/56 fish) at $P<0.005$.

A comparison of infection intensity between the two groups (Fig. 1) indicated that fish which were experimentally exposed to *Glugea* spores had significantly more intense infections than those of the control group with naturally acquired infections. The Mann-Whitney U-test showed that the mean infection intensity of the exposed fish ($x=3.07$, $n=30$) was significantly higher ($P<0.001$) than that of the controls ($x=2.35$, $n=14$). The large number of experimentally exposed fish (17) with an intensity of +4 compared with only 2 fish in the control group is noteworthy (Fig. 1).

Infections resulting in mortality were due to one of three types of pathological condition: a low-grade infection (+1 or +2 intensity) with cysts located in the mucosa, resulting in rupture of the epithelial lining; total disruption of the intestinal integrity or occlusion of the intestinal lumen; massive infection of the serosa (+3 or +4 intensity) resulting in starvation and emaciation. A +4 infection associated with starvation is shown in Fig. 2. The skeletal structure in this starved and infected fish was visible through the nearly transparent flesh of the "blind" side of the moribund fish.

Four survivors with the highest intensity of infection (+4) were observed after sacrificing at 115 and 127 days PE (Table I). Histological examination of these fish revealed the presence of serosal infections, while their mucosal structures appeared normal and were devoid of cysts.

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TABLE II

COMPARISON OF EXPERIMENTALLY EXPOSED WINTER FLOUNDER AND CONTROLS

Group	No. of fish	No. of *Glugea* infected fish	(%)	Mortality of *Glugea* infected fish	(%)
Exposed	61	30	(49.1)	19	(63.3)
Control	56	14*	(25.0)	4	(28.5)

* Infection acquired naturally, prior to being collected in the fields.

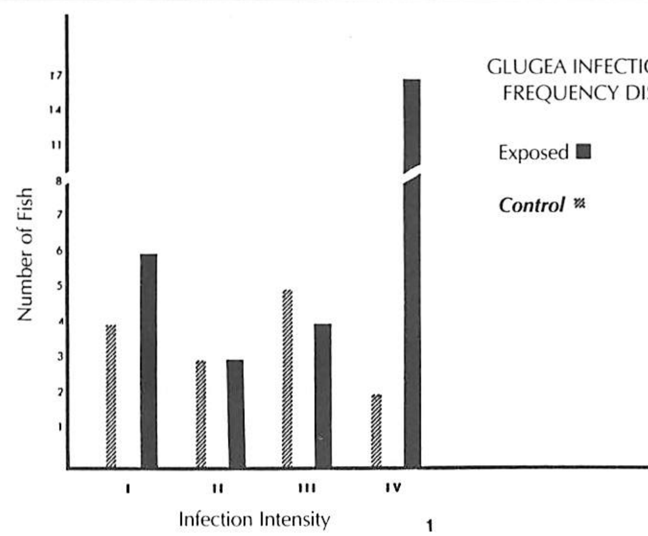


Figure 1. Histogram of *Glugea stephani* intensity. Note the large number of +4 intensity infections in the experimental group.

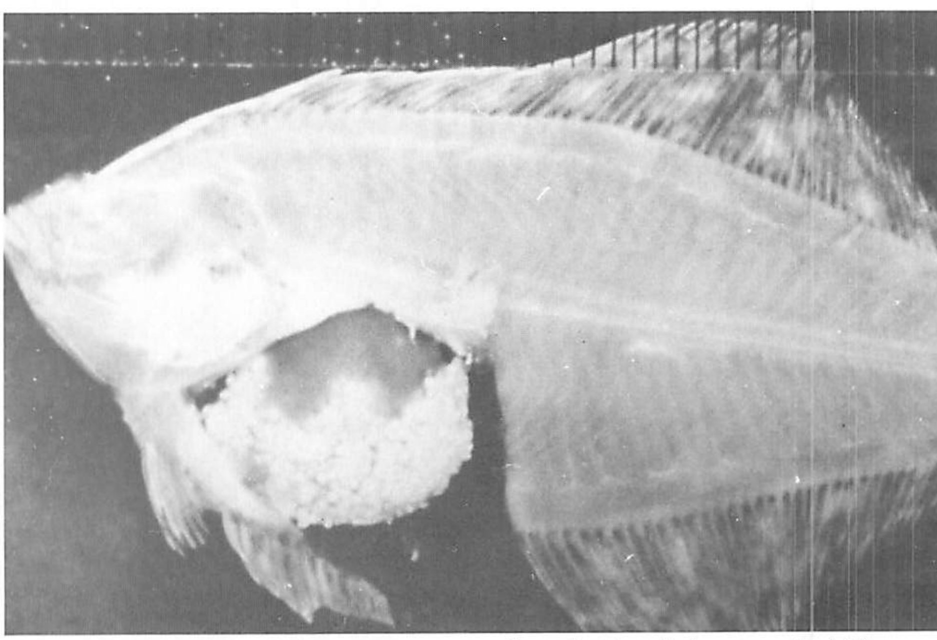


Figure 2. Massively infected pre-recruit winter flounder that died as a result of *Glugea stephani*. The cysts (arrows) cover the entire intestine. Skeletal features can be observed through the musculature as a result of parasite induced starvation.

IN SITU STUDIES OF OCEAN QUAHOG GROWTH IN NATURAL POPULATIONS

R. Lutz, *Rutgers University*
M. Castagna, *Virginia Institute of Marine Science*

The ocean quahog, *Arctica islandica*, currently is harvested in tremendous quantities off the east coast of North America. At present, approximately 10,000 metric tons of meat are landed annually in New Jersey alone with an estimated dockside value in excess of $7 million. Several workers have recently suggested that the growth rate of this species may be extremely slow in natural populations. Based on analyses of "annual" growth patterns within the organism's shell, age estimates as high as 157 and 221 years have been reported for clams dredged off central New Jersey and southern Massachusetts, respectively. Furthermore, as much as 17% of the New Jersey resource and 16% of the Delmarva resource may be in excess of 100 years old. If the reported age and growth rate estimates are correct, the maximum sustainable yield of the fishery may be quite low. In contrast, results of a few recent studies conducted under controlled laboratory and field conditions (at VIMS, Rutgers, and the Maine Department of Marine Resources) have suggested that the growth rates of larval and juvenile ocean quahogs may be relatively rapid, or at least typical of bivalves in general.

A major portion of the controversy concerning the age structure of natural populations of ocean quahogs centers around the question of whether or not the alternating sublayers within the inner shell layer of this species, which consist of aragonitic prisms and fine to irregular complex crossed lamellar structures, reflect annual cycles of growth. Landing quotas for the existing *Arctica* fishery off the east coast of the U.S. are presently based, at least in part, on data that have been obtained assuming an annual periodicity of formation of these patterns. Although an excellent data base has been accumulated to date which supports the annual nature of these patterns, many questions still remain concerning the periodicity of these structures in many natural populations. Members of the ocean quahog industry remain extremely skeptical of the reported slow growth rates, especially in those areas where the majority of the fishing activity has been concentrated to date, such as off Cape May, NJ. An alternative explanation concerning the formation of the alternating sublayers reflect alternating period of shell deposition and dissolution associated with the utilization of aerobic and anaerobic metabolic pathways, respectively. This species is known to respire anaerobically during its extended aperiodic burrowing.

Our two research groups at VIMS and Rutgers have numerous living ocean quahogs that have been reared from larval cultures. Two separate groups of these known-age quahogs exist: (1) approximately 300 juveniles spawned in May 1984 with shell lengths ranging from 5.0 to 20.1 mm in August 1985; and (2) approximately 50 older specimens spawned in October 1980 ranging in length from 35.4 to 60.8 mm in August 1985. As part of the present continuing project, we have placed some of these organisms in cages on the bottom in 145 ft. of water off Cape May, NJ, in an area that has been fished for ocean quahogs over the past decade. During Sea Grant X, we received a grant from the National Undersea Research Program (NURP) for utilization of the R/V *Seahawk*, a research vessel equipped to support surface-supply dive teams. Our first research cruise took place between 30 July - 6 August 1984, during which a series of preliminary studies were conducted aimed at evaluating the suitability of the site for our studies. Various types of experimental cages were constructed and placed on the bottom adjacent to a submerged shipwreck. During this first cruise, we planted "expendable" quahogs gathered from the natural population rather than our known-age organisms. These juvenile specimens were collected off Machias, Maine and the ventral shell margin of each was notched with a small etching stylus before being placed in the cages.

During the second cruise (15—22 October 1984), approximately half of the deployed cages were retrieved and samples of the notched organisms were obtained. At this time, we also planted approximately 150 of the known age specimens (from the May 1984 cohort), which ranged in length from 1.6 to 7.8 mm, in new cages which were protected within a larger "corral".

On our third cruise (16-25 August 1985), we planted an additional 40 specimens, but inclement weather prohibited the retrieval of the previously deployed cages during this cruise. Arrangements have been made with NURP to schedule another cruise for retrieval of these cages.

It is anticipated that our studies will permit us to:

(1) accurately determine *in situ* growth rates of known-age specimens of the commercially important ocean quahog, *Arctica islandica;*

(2) validate or invalidate the annual nature of growth patterns found within the inner shell layer of this species; and Continued on page 14.

VIRAL CONTENT AND FILTRATION RATES IN THE HARD CLAM AT A COMMERCIAL DEPURATION FACILITY

T. Carter and F. Cantelmo,
St. John's University

This project summary describes some of the major research accomplishments during the first two years of our Sea Grant funded study. The objectives for the complete project are:

1) To determine whether a depuration facility in Highlands, New Jersey is able to reduce or eliminate enterovirus contamination of the hard clam *Mercenaria mercenaria* harvested from restricted waters.
2) To examine the effect of various physical and chemical parameters on the filtration rate of *Mercenaria mercenaria* with the further objective of defining those physiological characteristics that may be correlated with uptake and accumulation or mobilization and unloading of enterovirus contaminants.
3) To apply results of laboratory model studies to the Highlands hard clam depuration plant with the intent of maximizing viral depuration efficiency.

The commercial fishery for hard clams (*Mercenaria* sp.) is the most valuable clam industry in the United States. In data compiled by the National Fishery Statistical Program (U.S. Department of Commerce, 1986), landings of hard clams account for 40% ($51.3 million) of the total exvessel value ($128.3 million) for all commercially harvested clams during 1985. The Atlantic Coast landings of *Mercenaria mercenaria* account for approximately 95% of all hard clams harvested. Coliform standards are currently being used as indicators of fecal pollution and are the basis for national classification of growing areas as approved, conditionally approved, restricted and prohibited (NSSP, Part 1, Sanitation of Shellfish Growing Areas). However, it is questionable whether the coliform standards are applicable to enterovirus contamination of either ambient water or hard clams.

Analysis of 17 sets of clam samples taken from May, 1984 to June, 1986 detected no enteroviruses (<3/clam) in either undepurated or depurated samples in all but 2 months. Clams harvested during the summer from condemned waters in Raritan Bay and the Shrewsbury River at four separate locations also failed to yield detectable levels of enteroviruses. On the two occasions when enteroviruses were detected in samples from the Highlands plant, both occurred during the winter months, when *Cl. perfringens* levels were low and when the ability to depurate the resident *Clostridia* was generally poor. Although the viral data are not extensive, the following conclusions appear warranted 1) Levels of recoverable enteroviruses were generally low or absent in the clams depurated at the Highlands facility. 2) Winter months appear to be the most likely time for occurrence of enteroviruses in the hard clam population under study. 3) When enteroviruses were present, the levels varied widely among individual clams. 4) Commercial depuration during the winter did not always eliminate enterovirus contamination.

Results from August 1984 to May 1986 (Table 1) indicate that the percent siphon extension activity over a 48 hour depuration cycle is highly variable for *individual* hard clams. These differences in siphon extension activities for individual hard clams were not related to sex. A similar activity range and average was observed among male and female clams regardless of their spawning condition e.g. ripe, partially spent or spent. The percent siphon extension activity for populations ranged from 0% to 46.5% during the 17 months (8/22/84-5/27/86) in which clam activity during depuration was observed. Although 10 of the 17 months had population averages >20% siphon extension activity, a significant number of months had extremely low population averages (<20%). There appears to be evidence of rhythmicity during some months with generally higher levels of population activity during the first 24 hours of depuration after clams are placed in the commercial system.

Prior acclimation conditions before depuration were shown to be extremely important. Similar population of clams held under refrigeration for up to 48 hours had significantly higher ($p=.05$) siphon extension activities but the same overall pattern as those directly placed in the depuration . (Fig. 1). However, during periods of extremely low activity in August, for example, prior refrigeration did not increase the average siphon extension activity compared to those clams depurated immediately after harvest. (Fig. 2).

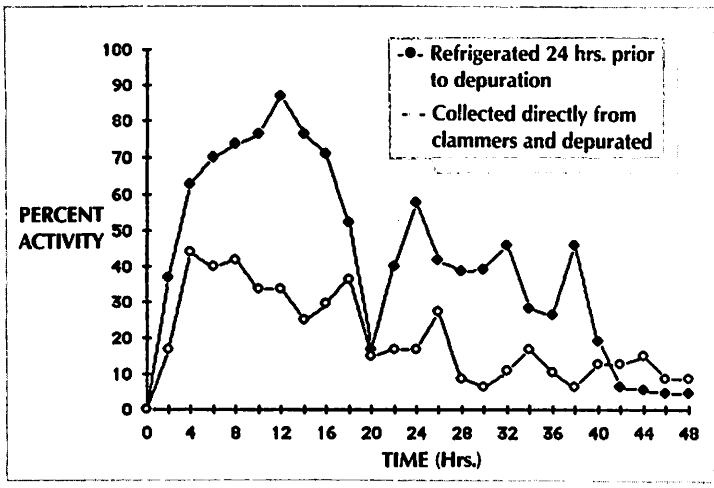
In a series of experiments, we studied the relationship between siphon extension activity and the depuration of *Cl. perfringens* and

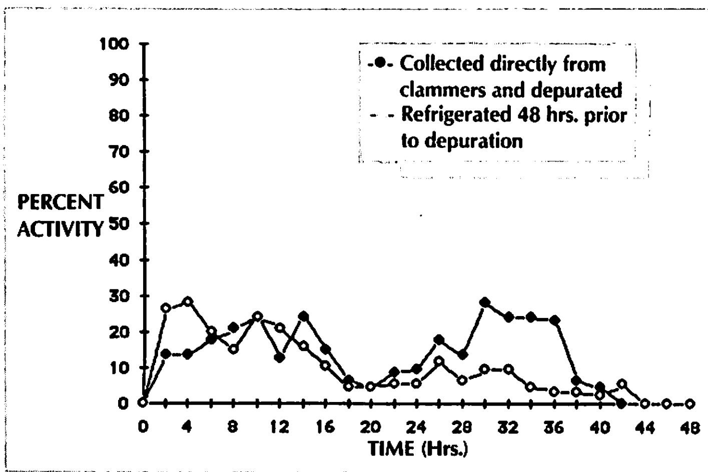
TABLE I
Siphon extension activity of hard clams depurated at Jersey Shore Shellfish (8/22/84 - 5/27/86).
PERCENT SIPHON EXTENSION ACTIVITY

Date	N	Temp[1]	Temp[2]	Variability of Individuals	Population Average	Acclim.*
8/22/84	24	20.0	23.0	0-24	12.4	1
10/5/84	24	14.0	14.5	2-52	26.0	2
11/9/84	24	15.0	12.3	1-53	20.9	1
12/7/84	24	9.5	3.0	—	0.0	3
2/22/85	48	15.0	5.7	4-63	21.4	2
3/22/85	48	12.0	6.5	11-77	46.5	4
4/12/85	48	12.0	9.6	10-67	40.9	2
5/13/85	48	16.8	19.2	17-65	44.1	1
6/24/85	48	19.2	20.2	21-54	30.6	4
7/22/85	48	17.8	24.9	15-54	29.1	2
8/28/85	48	19.8	24.5	0-52	9.3	4
11/1/85	48	13.1	11.0	16-88	45.5	4
12/27/85	48	11.0	1.0	5-72	34.3	4
2/14/86	48	11.9	-0.1	0-48	15.7	4
3/14/86	48	11.0	5.3	0-89	11.1	1
4/25/86	48	10.8	9.9	0-46	12.8	2
5/27/86	48	15.4	17.6	4-40	17.0	1

*Acclimation: (1) Depurated as soon as clams were brought into plant.
(2) Refrigerated for 24 hrs. prior to depuration.
(3) Experimental run at low depuration temperature.
(4) Refrigerated for 48 hrs. prior to depuration.

[1]Depuration Temperature (°C) [2]Sandy Hook Bay Temperature (°C)





Above
Figure 1. Siphon extension activity of hard clams at the Jersey Shore Shellfish Depuration Plant (4/12/85).

To the right
Figure 2. Siphon extension activity of hard clams at the Jersey Shore Shellfish Depuration Plant (8/28/85).

poliovirus. The results are shown in Figures 3-7. As in previous experiments, there was no correlation between the bioaccumulation of *Clostridia* and poliovirus by individual clams (Fig. 3). After depuration, the same lack of correlation was manifest (Fig. 4). In this case, however, the difference between the behavior of the two organismas was even more striking than during bioaccumulation: of the several individuals that retained the highest levels of either bacteria or virus, none had elevated levels of both organisms. When microbial content after depuration was plotted against siphon extension activity, significant differences between bacterial and viral depuration were apparent (Figs. 5 and 6). Although *Clostridia* were depurated from most clams (average reduction of 49%), there was little correlation between duration of siphon extension during the depuraton period and final bacterial content. In contrast, depuration of poliovirus was clearly related to duration of siphon activity. The total population had an overall depuration efficiency for poliovirus of 79%; when only clams with siphon activities of >20% were considered, however, the average efficiency was 91%; clams with siphon activities of <20% were depurated an average of 55% (Fig. 7). The difference between the two populations was statistically significant at a level of

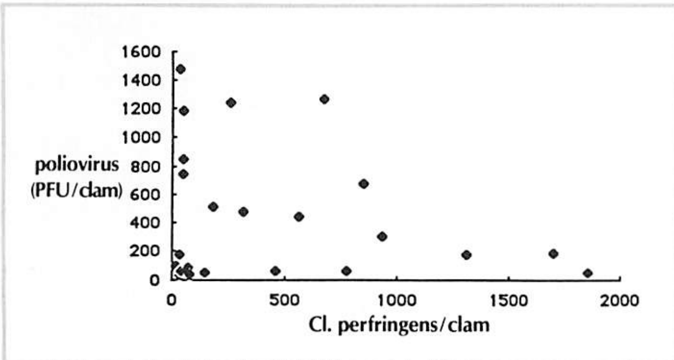


Figure 3. Microbial content of loaded clams 3/11/86.

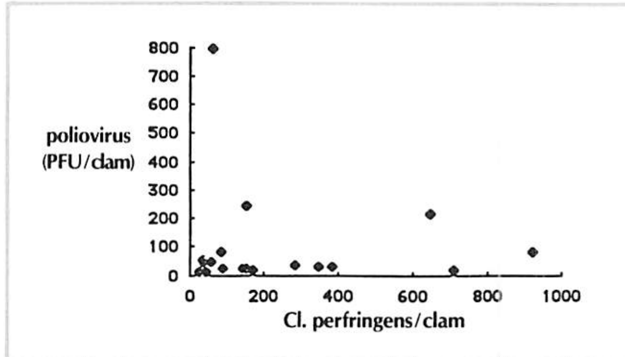


Figure 4. Microbial content of depurated clams 3/14/86.

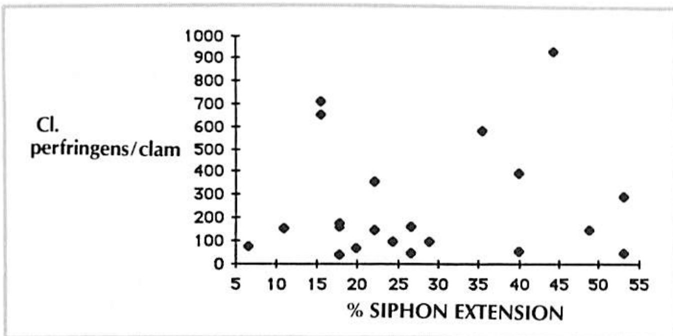


Figure 5. Correlation between siphon extension and Cl. Perfringens depuration (3/14/86).

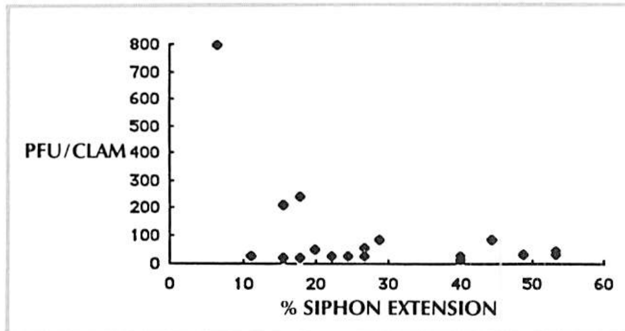


Figure 6. Correlation between siphon extension and viral depuration (3/14/86).

p=0.05 when analyzed by the unpaired t-test.

We conclude from the foregoing experiments that siphon extension measurements, when applied to populations as opposed to individual clams, have predictive value specifically with respect to viral depuration. Furthermore, it appears that it may be feasible to assign a minimum value to the average siphon extension below which the probability of successful viral depuration is low. However, no such claim can be made at present for depuration of *Cl. perfringens.*

In order to test the hypothesis that clams undergoing depuration may actually become contaminated by ingesting microbes released by others into the surrounding water and thus lead to lower depuration efficiency, we performed the following experiment. A population of depurated clams was divided into three parts. One third were analyzed for *Cl. perfringens* and enterovirus content. One third were allowed to bioaccumulate *Clostridia* and poliovirus, and the remaining third were held in an instant ocean tank (uncontaminated controls). At the end of 4 hours, loaded and control groups were refrigerated for 24 hours, arranged alternately in the laboratory flow-through system, and then depurated together under standard conditions. After 48 hours all clams were analyzed for microbial content. Loaded, depurated clams released 68% of the *Clostridium perfringens* and 84% of the poliovirus. However, all clams that were initially uncontaminated accumulated significant amounts of *Cl. perfringens* during depuration, and virus was detected in one out of six of these clams.

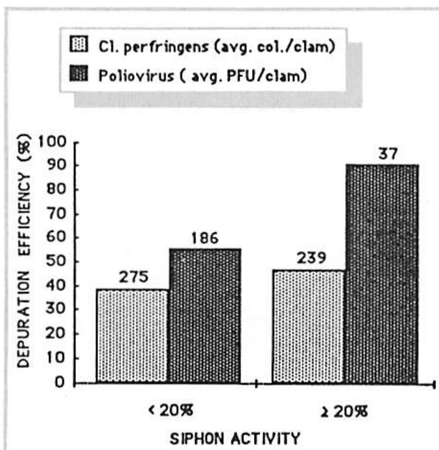


Figure 7. Relationship between siphon extension and depuration efficiency 3/14/86 (N=41)

In summary, these data provide the first instance of experimental support for the idea that siphon activity is a key parameter in determining the ability of depuration to effect a reduction of microbial pathogens in clams harvested from restricted waters. The duration of siphon extension during depuration correlates with the efficiency of release of bioaccumulated poliovirus. However, siphon activity during depuration can also result in the introduction of bacterial and viral contaminants into otherwise uncontaminated clams. Thus, process design for efficient depuration will require both maximization of siphon activity for the clam population and also arrangement of the clams and flow patterns as as to minimize the chance of reingestion of the contaminants released during depuration.

JOB SATISFACTION AND FISHING: A COMPARATIVE STUDY

B. McCay, *Rutgers University*
J. Gatewood, *Lehigh University*

Fishing is a unusual form of work. Fishermen labor long and erratic hours in an economically uncertain enterprise. The work setting is typically far from home and family. Computed on an hourly basis, fishermen's earnings are generally low compared to other forms of work and also unpredictable. Despite the uncertainty, long hours, and low pay, thousands of Americans persist in the occupation of commercial fishing. What, then, is so attractive about commercial fishing? What do fishermen like and dislike about the work they do?

Drs. McCay and Gatewood are investigating these questions by surveying commercial fishermen in New Jersey's marine waters. The questionnaire went through five revisions, the final form being twelve-pages long. It is administered to fishermen dockside, and it is in two parts. The first part consists of 33 specific items, for which fishermen indicate their level of satisfaction on a five-point scale ("very dissatisfied" to "very satisfied"), three global measures of job satisfaction, and two questions dealing with alternative work opportunities. The second part asks a wide range of biographical questions, providing descriptive information about the people engaged in commercial fishing and specifics regarding their boats, gear, and other objective aspects of their current situations. Data from part I of the questionnaire allow comparisons to be made among different fisher groups, both in terms of levels of job satisfaction (analysis of variance) and patterning among the specific components of satisfaction (factor analysis). The biographical information from Part II provides the independent variables for other sorts of correlational analyses of the job satisfaction data.

The survey is expected to take three years and will include interviews with about 350 fishermen working in six fisheries. Sampling is done by the "dockside intercept" method in several ports along the Jersey Shore. No more than three interviews are done with the fishermen on a single boat: the captain and two hands (captain and three hands in fisheries where crews are large).

After two years, 309 commercial fishermen have completed questionnaires. Except for an "incidental catch" of nine purse seiners and one gillnetter, the sample represents six groups—clammers, oystermen, baymen, longliners, trawlers, and scallopers. These six groups well represent the range of variation among New Jersey's major commercial fisheries. For example, sea clamming (including both surf clamming and quahogging) is a heavily mechanized fishery, involving daytrips in pursuit of relatively immobile prey. Longlining for swordfish and tuna is more of an open ocean enterprise requiring trips of several days to several weeks, and the prey are highly mobile. Baymen operate on a much smaller, personal scale and have much more control over the timing of their activities.

We modified the job satisfaction questionnaire and administered it to 48 fisheries managers and scientists during the 1985 annual meeting of the American Fisheries Society. This group will provide an interesting comparison to the fishermen because, although doing a very different kind of work, fisheries managers and scientists also make their living from the fishing industry.

Only a few, very preliminary results are available at this time. In general, fishermen are very happy with their work. This is apparent from the average responses to the 33 specific questions (only "performance of officials" and "crowding on the fishing grounds" had means of less than neutral), as well as from direct comparisons of fishing with other finds of work by those fishermen who had experience with nonfishing jobs, as shown in Table 1.

Comparing the responses of sea clammers, oystermen, longliners, and baymen, we found that these fisheries have significantly different levels of job satisfaction on 22 of the 33 specific items, and the patterning of these questionnaire findings is consistent with our ethnographic understandings of the fisheries in question. For example, longliners show high satisfaction levels with respect to such things as the challenge, the adventure, and pitting their skill against nature, but are relatively dissatisfied with how much time they are away from home. The distinguishing aspects of job satisfaction for baymen are peace of mind, being their own boss, and coming and going as they please. Clammers are relatively satisfied with the amount of money they make, but are unhappy with the healthfulness of their work and their daily work schedule. Finally, oystermen appear relatively content with the future of their fishery and how officials have

Table 1.

Comparison of Fishing with Other Work (n = 241)

	Fishing is better	They are about the same	Fishing is worse
Earnings	71%	14%	15%
Enjoyment of work itself	70%	18%	12%
Time for other things	32%	16%	52%
Overall satisfaction	73%	19%	8%

managed it, but are relatively dissatisfied with their earnings and such intangible rewards as the challenge, the adventure, and pitting their skill against nature.

Another general finding is that fishermen are pessimistic about the future of their fisheries. When asked to rate the economic conditions in their fishery this year on a ten-point scale (1=worst, 10=best), the mean response was 5.75, whereas the mean for conditions five years ago was 6.73, and the mean for conditions five years from now dropped to 4.61.

Finally, the response rate has been very high (fewer than 10% of the fishermen asked to fill out a guestionnaire have refused), and 75% of the sample interviewed so far have asked for copies of the results when the survey is finished. These figures are indicative of the interest and cooperativeness of New Jersey's fishermen. Apparently, they too regard fishing as an unusual form of work.

Continued from page 6.

IDENTIFICATION OF BIVALVE LARVAE: A MULTI-INSTITUTIONAL APPROACH

the other in Virginia) to assess whether or not subtle differences in shell and/or hinge morphology may be present between larvae and/or early postlarvae from geographically-separated localities. Photographic sequences of the available larval and/or postlarval specimens of each of the above species are being prepared for inclusion in the final monograph, together with other useful aids for the identification of individual organisms isolated from both benthic and plankton samples.

More than a dozen papers and abstracts have been published in refereed journals summarizing our results obtained to date.

Continued from page 9.

IN SITU STUDIES OF OCEAN QUAHOG GROWTH IN NATURAL POPULATIONS

(3) provide incidental information on the age at which individual ocean quahog reach sexual maturity in natural populations.

In short, our efforts should provide an excellent data base for more effective management of this extremely valuable shellfish resource.

Continued from page 8.

IMPACT OF GLUGEA STEPHANI DISEASE ON AMERICAN WINTER FLOUNDER POPULATIONS

The statistical tests overwhelmingly demonstrate that although there was some feral infection, our exposure of the fish to the parasite produced the disease under laboratory conditions. Additionally, it is difficult, if not impossible to demonstrate mortality in the field. Prior to these experiments no one had been able to demonstrate the pre-recruit winter flounder die from this disease. The high percentage of mortality from this parasite is probably responsible for a significant decrease in the juvenile winter flounder population.

A typical field situation would probably include multiple exposures of the fish to the disease. As a consequence, experiments currently in progress include weekly exposures of the winter flounder to *Glugea stephani* in an effort to more closely parallel what occurs naturally.

Additionally, studies on the response of the winter flounder immune system to the presence of *Glugea stephani* have been initiated.

In addition to these laboratory experiments, winter flounder are being collected along the Northeast Coast of the United States. These fish are grossly examined for the occurence and intensity of *Glugea stephani* infections. The data from these collections is presently being accumulated and analyzed to determine the distribution of the disease in flounder populations.

One of our major goals is to raise the public awareness to the impact of this disease in the marine fishery. Diseases such as these have gone unnoticed, unmonitored, and their impact on the fishery unknown, for too long.

This research represents the cooperative involvements of Rutgers University, New Jersey Sea Grant, the National Marine Fishery Service, N.E. Laboratories, the NEMP program, the Milstone environmental laboratory, Waterford, Conn., and the Massachusetts State Ground Fish Survey.

Marine Technology Research and Development

The New Jersey Sea Grant Marine Technology Research and Development program substantially improved during Sea Grant X with the addition of two new projects, representing new university participation and the addition of highly qualifed engineers and technologists who have not previously participated.

Among the continuing projects was J. R. Weggel's study to evaluate the performance of a perched beach. As a reminder of descriptions given in Weggel's project of last year, a perched beach has a low, submerged sill constructed offshore parallel to the coastline, forming a discontinuity in the beach profile so that the beach landward of the sill becomes higher than the seaward beach and so is "perched." The Weggel project to evaluate perched beach performance has the purpose of quantifying physical processes and developing guidelines for design of similar beach erosion control systems.

Gurdial M. Sharma's continuing project to isolate proteins in marine organisms which may bind vitamin B_{12} levels in human blood and ocean water, previously demonstrated the presence of proteins in the blood of horseshoe crabs, which do bind cobalamins—B_{12} and analogs. The blood plasma proteins have been resolved into four fractions, all of which have high binding capacities. Application of the developing techniques to "B_{12} Bioassay Kits" thus looks promising.

The search for biomedicinals from marine organisms has shown more promise than applicable results, but more than two decades of intensive search by a variety of investigators have provided a sound base for more sharply directed studies. Michael A. Pisano of St. John's University initiated a new and promising direction conceived as a logical extension of the present state of knowledge and experience. In the past, soils have been the most productive source of actinomycetes which yield antibiotics, with *Streptomyces* the outstanding example. It is now apparent that other actinomycete genera have the capacity to produce potentially useful metabolites, but not many have been studied or exploited. Pisano will isolate some of the less commonly encountered species of actinomycetes from marine and estuarine sediments and determine their possible utility. The importance of finding new antibiotic sources is emphasized by the growth of resistant strains of pathogens which no longer can be controlled by existing medicines.

The sea does not treat gently man's engineering works, and the pursuit of materials better able to resist the extreme variables of dynamic pressure and corrosive elements of the marine environment is a continuing search. Methi Wecharatana and Chin C. Lin of New Jersey Institute of Technology are attempting to determine the value of newly-developed polymer concrete which uses a polymer latex mixed with the traditional components of cement, sand, aggregate and water. The investigators are studying the optimum mix proportions which yield the least cost with highest strength and durability of the concrete. After standard tests for compressive strength, tensile strength, rupture modulus, elasticity, and so on, several full-scale structures of types used in shore protection will be built to provide a full field test.

As noted in previous years, the nature of marine technology and engineering and the broad spectrum of the problems to which it can be addressed results in a Sea Grant category, and not in integrated program directed to common objectives. The common broad goal, however, is to seek improvement in the state of the art of marine technology and engineering, to solve problems as opportunities arise either from the specific needs of New Jersey and the region, or from the special competence and facilities offered by the New Jersey Marine Sciences Consortium and its member institutions.

EVALUATION OF THE PERFORMANCE OF A PERCHED BEACH-SLAUGHTER BEACH, DELAWARE

J.R. Weggel and S. Douglass,
Drexel University

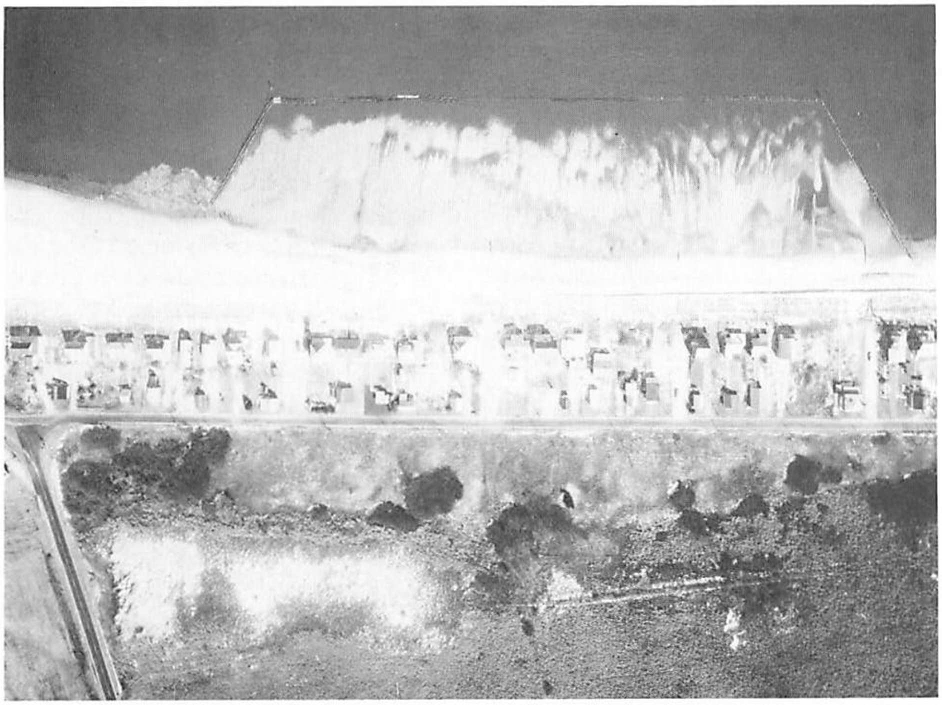


Figure 1. The perched beach at Slaughter Beach.

Beach nourishment (placing sand on a beach to provide a wide recreational beach or to protect development behind the beach) has historically been an economical way to address many beach erosion problems. In recent years, however, the cost of sand for beach nourishment has increased significantly. One way of possibly reducing these costs is to include sand retaining coastal structures in a project to reduce the rate at which sand is lost from the project. Conventional coastal structures such as groins (jetties) have traditionally been used to prevent longshore movement of sand out of a project area. A little-tested sand retaining structure thought to be effective against offshore sand loss is a low-crested, shore-parallel sill. In theory, it reduces offshore sand transport rates and elevates (or "perches") the beach behind it above the surrouding beaches. Thus the term "perched beach."

Few perched beach projects have been built and none have been built on an exposed, open ocean coastline. In 1978, the Corps of Engineers built a perched beach on the western shore of Delaware Bay at Slaughter Beach, Delaware. This two-year study quantified the behavior of the perched beach in the first few years after construction.

The offshore sill at Slaughter Beach is 1000 feet long and about 300 feet from shore. It is built in water about 3.5 feet deep (MLW datum). Shore return sections connect the sill with the beach at the northern and southern ends so that the structure forms an enclosure. The enclosure was subsequently filled with coarse beach fill dredged from offshore in Delaware Bay. Figure 1 shows the sill at low tide.

The wave climate is such that the dominant direction of longshore sand tranpsort is northward. This was verified for the period of interest using two separate sets of data, visual wave observations and nearby wind records. As part of the Corps' monitoring program, visual wave observations were made daily at the site. Longshore sand transport rates were calculated from the visual data by using two different procedures.

Wave climate at the site was also hindcast using wind data from Dover Air Force Base. The development of the computer program for this hindcasting procedure was a product of the first year of this study. The report entitled, *An Interactive BASIC Program to Calculate Shallow Water, Limited Fetch Wave Conditions,* describes the theory and methodology for estimating waves from wind data and includes an interactive form of the program written in the BASIC computer language. Weekly averaged longshore sand transport rates at Slaughter Beach for 1979 are shown in Figure 2.

Corps of Engineers and State of Delaware beach surveys provide the data for calculating the sediment volume changes in and around the perched beach. Figure 3 shows the volume changes inside the perched beach from just before the fill was placed inside the sill to four years later. 20,000 cubic yards of sand were pumped into the beach compartment created by the structure in the fall of 1979. Unfortunately, no surveys were taken between November, 1980 and October, 1983. By October 1983 essentially all of the fill's volume was lost.

An interesting feature of the beach fill response is that the rate of volume loss appears fairly constant. (Although the gap in the data record makes this somewhat of a conjecture). The rate of loss of a beachfill is usually greatest during the first year, decreasing thereafter as the profile approaches its new equilibrium. Therefore, the presence of the sill may have decreased these initial losses.

Although the total volume of sand within the perched beach had returned to its pre-fill volume by 1983, the distribution of sand within the sill was dramatically different. Figure 4 shows the location of the shoreline (mean water level) and the pattern of deposition and erosion within the weir enclosure from August 1979 to October 1983. The shoreline position changes are a classic response to both an offshore breakwater and a shore perpendicular groin. The northern shore-return structure is performing like a low profile groin. The bulge in the shoreline, or salient, is a function of the sheltering of waves by the breakwater. The sill is performing like a submerged offshore breakwater. The assymetry of the salient (offset to the north relative to the sill) is a result of a longshore transport climate that has a dominant direction of transport (in this case northward) with significant periods of direction reversals. There is difficulty in separating the effects of the two components of the structure, the shore return and the sill.

The major conclusions of this study are that during the first four years, the perched beach at Slaughter Beach, Delaware failed to hold the volume of sand placed within it. However, the presence of the sill structure may have slowed the rate at which the fill was lost. The structure has performed like both a groin and a submerged offshore breakwater in that a salient has formed behind the sill. There also appears to be some lowering of the profile offshore of the sill.

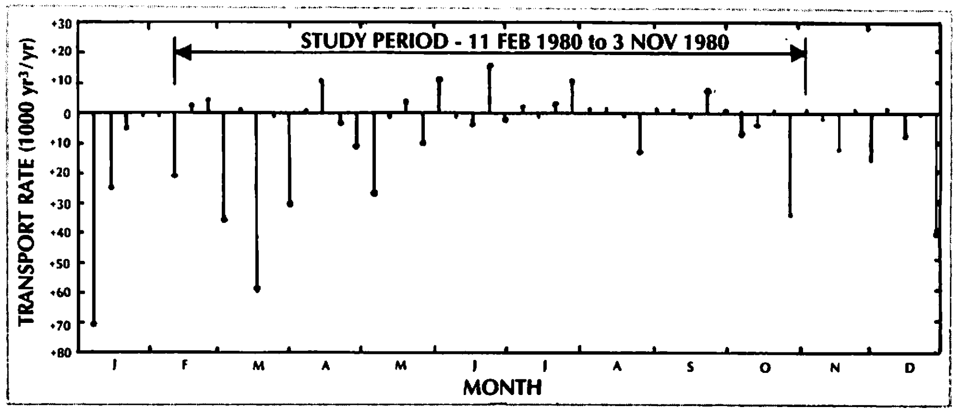


Figure 2. Weekly net longshore sand transport rates from wind data for Slaughter Beach in 1979.

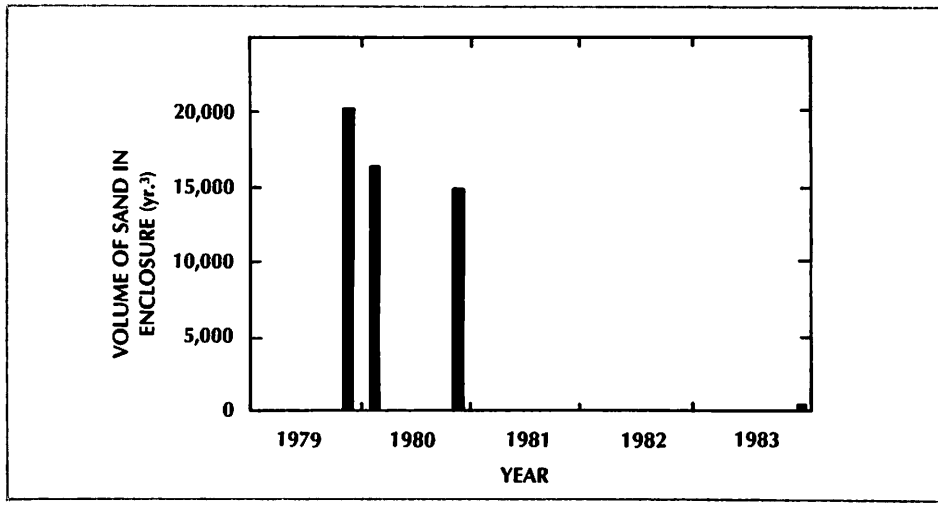


Figure 3. Volume changes inside of Slaughter Beach perched beach sill structure.

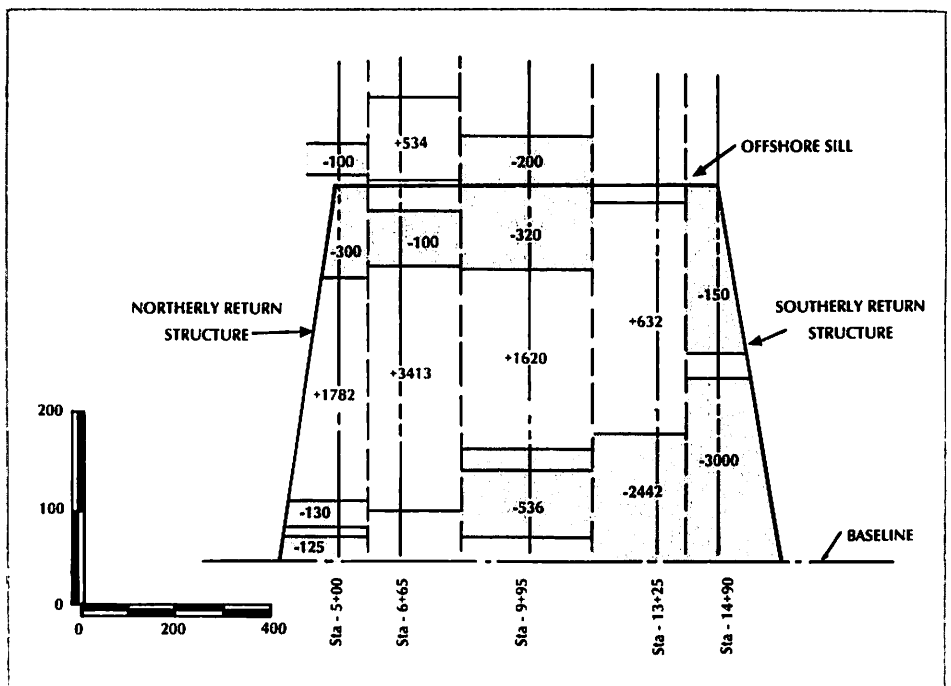


Figure 4. Deposition and erosion inside of Slaughter Beach perched beach sill structure from August 1979 (before fill) to October 1983.

RADIOISOTOPE DILUTION TECHNIQUES FOR THE DETERMINATION OF COBALAMINS IN MARINE WATERS

G. M. Sharma,
William Paterson College

Concentration of vitamin B_{12} in ocean water lies in the 1-15 pg/ml range. Accurate determination of such low levels of B_{12} by Radioisotope Dilution Techniques (RID techniques or simply radioassays) will require a protein which should bind the vitamin specifically with an affinity constant in excess of $10^{11}M^{-1}$. In this annual report, we describe the isolation of such a protein from hemolymph of the horseshoe crab, *Limulus polyphemus*. The protein exhibits a binding constant of 2 x $10^{12}M^{-1}$ for B_{12}. By using this protein as a B_{12}-specific binder in radioassays, we are able to determine as little as 2 pg B_{12}/ml.

During the previous New Jersey Sea Grant years, it was discovered that *Limulus* blood plasma samples, prepared from horseshoe crab blood collected in citrate buffer, were rich in two types of B_{12}-binding proteins. These proteins were separated into fractions A and B by sequential application of ammonium sulfate precipitation and gel filtration techniques. The molecular weights of the B_{12} binding proteins present in fraction A were estimated to be around 100,000 dalton. This fraction was found to bind B_{12} preferentially with an affinity constant 5 x 10^{11} M^{-1}. The single B_{12}-binding protein in fraction B had molecular weight close to 50,000 dalton. This protein bound B_{12} specifically with an affinity constant 10^{11} M^{-1}.

By using fraction B as a B_{12}-specific binder a radioassay for the direct determination of the micronutrient in ocean waters was developed. The detection limit of the assay was around 5 pg B_{12}/ml and the standard deviation at this level was around $\pm$ 1 pg.

We have now discovered that the B_{12} binding proteins in fractions A and B are the dissociation product of an oligomeric B_{12}-binding protein which is present in Limulus blood plasma during summer months only. The dissociation of the oligomeric protein into fraction A and B B_{12}-binding proteins was triggered by the citrate buffer which was added to *Limulus* whole blood to prevent clumping and lysing of amebocytes. In winter months the Limulus blood plasma was found to contain different types of B_{12}-binding proteins. Unlike summer B_{12}-binding proteins, the winter B_{12}-binding proteins were stable in cirtrate buffer.

The B_{12}-binding proteins present in Limulus blood plasma during summer and winter months were isolated by using the following new 4-step sampling and purification procedure:

(1) Collection of the horseshoe crab blood either as neat specimens or in 1% aqueous solution of Tween 80 (polyoxyethylene 20 sorbitan tristearate). Tween 80 prevents the clumping and lysing of amebocytes without altering the tertiary and quanternary structure of the proteins present in the Limulus blood plasma.

(2) Preparation of cell-free plasma by centrifuging the whole blood at 10,000 x g.

(3) Ultra-centrifugation of the cell-free plasma at 40,000 x g to pellet hemocyanin and other high molecular weight proteins.

(4) Isolation of B_{12}-binding proteins from hemocyanin-free supernatants of step 3 by gel filtration over sephadex G-150.

The molecular weight of the B_{12}-binding protein isolated from the summer blood plasma samples was 150,000 dalton. The blood plasma was richer in this protein (hereafter called sprotein; "s" for summer) during the month of June, when the breeding activity was at its peak.

The S-protein was found to bind B_{12} specifically with an affinity constant 2 x 10^{12} M^{-1}. The binding of S-protein to B_{12} was inhibited by calcium ions. The inhibition was overcome by EDTA which chelates the bivalent ion strongly. The solutions of S-protein in 0.02 M phosphate buffer (pH 8.2) were found to lose B_{12}-binding activity completely when stored at 5°C for more than two days. The solutions retain B_{12}-binding activity for an indefinite period of time when kept in a frozen state below 0°C. Repeated thawing of the solutions also denatures S-protein. The denaturation seems to occur in two steps: transformation of S-proteins into species which bind B_{12} with low affinity; and change of low-affinity species into biologically inactive products.

By using the S-protein as a B_{12}-specific binder a radioisotope dilution technique for the determination of the vitamin was developed. The detection limit of the new RID technique is 2 pg B_{12}/ml. The standard curve used in the determination of B_{12} is shown in Fig 1.

In winter months (November to April) the *Limulus* blood plasma was found to contain proteins (hereafter called W-proteins; "w" for winter) which bind B_{12} with an average affinity constant of 10^9 M^{-1}. The W-proteins were comparable in molecular weight to that of S-protein which is present in *Limulus* blood plasma during summer months (Last week of May to September). Because of their low affinity for B_{12} the W-proteins are not suitable for the development of highly sensitive RID techniques.

We have also analyzed amebocyte lysates for the presence of B_{12}-binding proteins. The lysates were found to contain two types of B_{12}-binding proteins, which were isolated by gel filtration over sephadex G-150. These proteins bind B_{12} and its analogs indiscriminately; consequently, they are also not suitable for the development of highly sensitive RID techniques. The B_{12}-binding proteins present in amebocyte lysates undoubtedly play an important role in the transport mechanisms which make the micronutrient available to cell organelles.

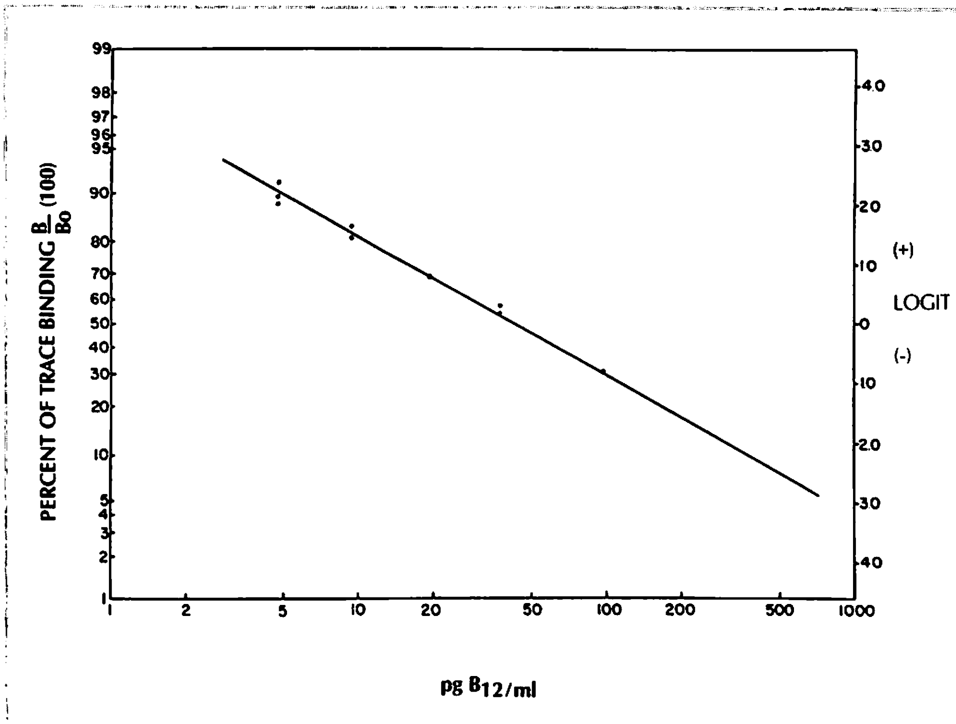


Figure 1.
Standard curve for the determination of B_{12}.

It is not know whether horseshoe crabs satisfy their biological need for B_{12} by absorbing the vitamin directly from sea water or by injesting B_{12}-rich food. In case horseshoe crabs are not sequestering B_{12} from sea water, then these are not the organisms which should contain B_{12}-binding proteins with the highest possible affinity constant and specificity for the vitamin. There is, however, no doubt that marine phytoplankton are among those organisms which absorb B_{12} directly from the sea water. Consequently, marine phytoplankton should contain proteins which bind B_{12} with extremely high affinity and specificity. We will, therefore, test marine phytoplankton for the presence of such proteins. These proteins, if discovered, will enable us to push the low-end sensitivity of the radioassays to less than 2 pg B_{12}/ml.

Further work on the B_{12}-binding proteins of marine organisms is in progress.

ISOLATION AND CHARACTERISTICS OF ANTIBIOTICS FROM MARINE AND ESTUARINE ACTINOMYCETES

Michael A. Pisano
St. John's University

Actinomycetes represent the most important group of microorganisms capable of synthesizing clinically useful antibiotics. Previously, most of the species studied have been isolated from a variety of soils. In recent years, however, interest in actinomycetes from other sources has become evident. Of these, one that has been comparatively neglected is the marine environment. Accordingly, we have initiated an investigation involving the use of pretreatments for the selective isolation of actinomycetes from marine sediments. The isolates obtained have been characterized according to total numbers occurring in specific sample sites, amino acid analyses of whole cell hydrolysates, and the production of antibiotics in submerged culture.

The recovery of actinomycetes from Sandy Hook Bay, New Jersey serves as a satisfactory example of the kind of information being generated. Actinomycetes were obtained at eight sampling sites. The marine sediments collected were subjected to pretreatments using heat, phenol, and filration through cellulose membrane filters. In addition, sediments, diluted in sterile saline, were plated on chitin agar or starch casein agar. The number of actinomycetes obtained at each sampling site (Fig. 1) are shown in Table 1. It may be seen that cell numbers ranged from 4.7×10^3 to 9.9×10^5 cfu/g of sediment. The failure to recover actinomycetes from two other sites is surprising and difficult to explain. Among the factors possibly contributing to this phenomenon are the nature of the sediments collected at

Table 1.
Total number of actinomycetes isolated from Sandy Hook Bay sampling sites (see Fig. 1.)

Sample location	cfu/g sediment (mean)
SH-1	9.9×10^5
SH-2	3.4×10^5
SH-3	3.9×10^4
SH-4	4.7×10^3
SH-5	3.6×10^5
SH-6	6.9×10^3
SH-7	7.6×10^4
SH-8	6.5×10^3

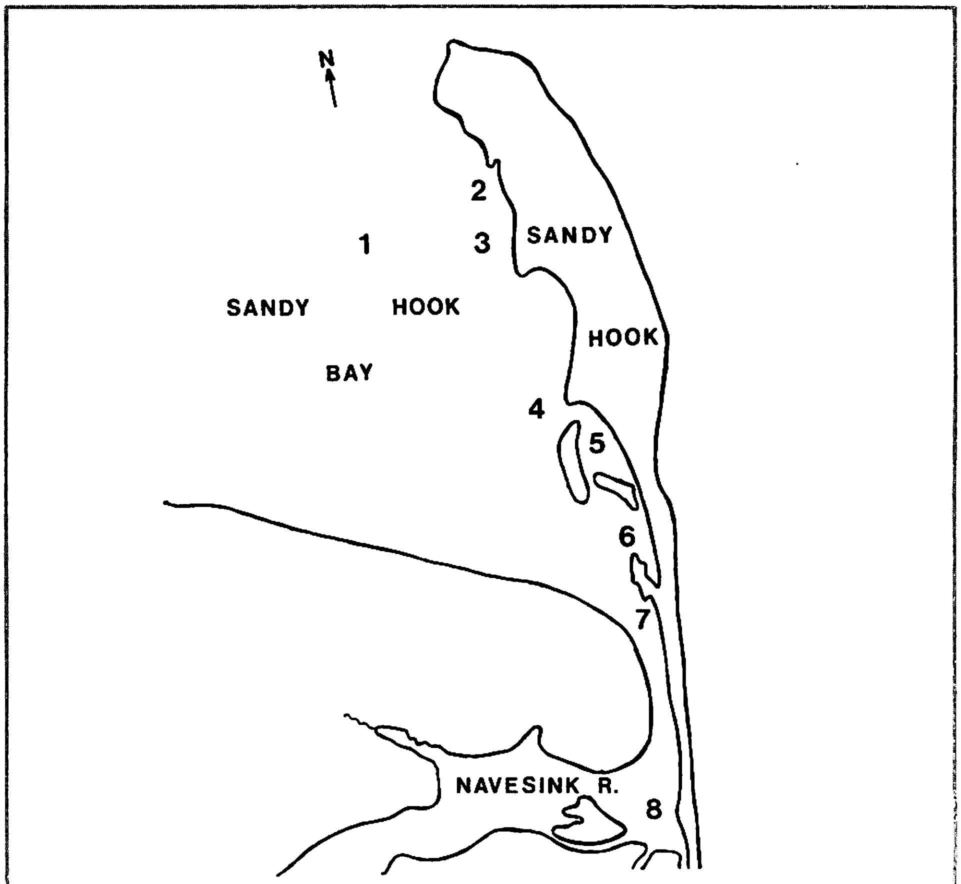


Figure 1.
Location of sampling sites in Sandy Hook Bay.

these particular sites as well as the presence of antimicrobial pollutants.

A total of 19 strains of actinomycetes, out of 120 collected, exhibited antimicrobial activity. Both bacterial and fungal test species were inhibited (Table 2). It is obvious that gram-positive bacteria were the most susceptible to inhibition by the actinomycetes. *Staphylococcus aureus* and *Bacillus subtilis* were particularly sensitive whereas gram-negative species (*Escherichia coli* and *Pseudomonas aeruginosa*) were more refractory. Significant activity was also noted against *Mycobacterium smegmatis* and the yeast *Candida krusei*.

All of the active isolates were subjected to amino acid analyses of their respective whole cell hydrolysates. The objective was to establish the cell wall chemotype, and thereby contribute to identification of the isolates. All 19 strains contained L 2,6-diaminopimelic acid which is typical of cell wall chemotype I. This information, as well as colonial morphology and microscopic examination established that the bioactive actinomycetes were streptomycetes. This is not unexpected since the vast majority of actinomycetes known to produce antibiotics belong to the genus *Streptomyces*.

Another aspect of the physiology of actinomycetes is a near universal ability to utilize chitin. Indeed, this enzymtic property is useful for the identification of these microorganisms. Of the 19 streptomycetes, which desplayed antimicrobial activity, 15 were found to be chitinolytic. Fig. 2 demonstrates the appearance of two colonies of actinomycetes, growing on chitin agar, surrounded by clear zones where chitin digestion occurred.

The approach employed with the Sandy Hook Bay samples was also applied to other sampling sites. These include the Hudson River, the New York Bight, the New Jersey Coast, and Baltimore Harbor. A total of more than 500 actinomycetes have been isolated and characterized with respect to colonial morphology and microscopic examination. Cell wall analyses conducted to date indicate that a small, but significant, number of the isolates are not streptomycetes. The vast majority of these strains have been grown in submerged culture and their fermentation broths tested for antimicrobial activity. Approximately one-third to one-half of the actinomycetes have exhibited antibacterial or antifungal activity, or both. Attempts are now underway to identify the various antibiotic substances.

Table 2.
Number of marine actinomycetes inhibitory to test microorganisms

Test species					
S. aureus	E. coli	P. aeruginosa	B. subtilis	M. smegmatis	C. krusei
12	3	1	19	16	14

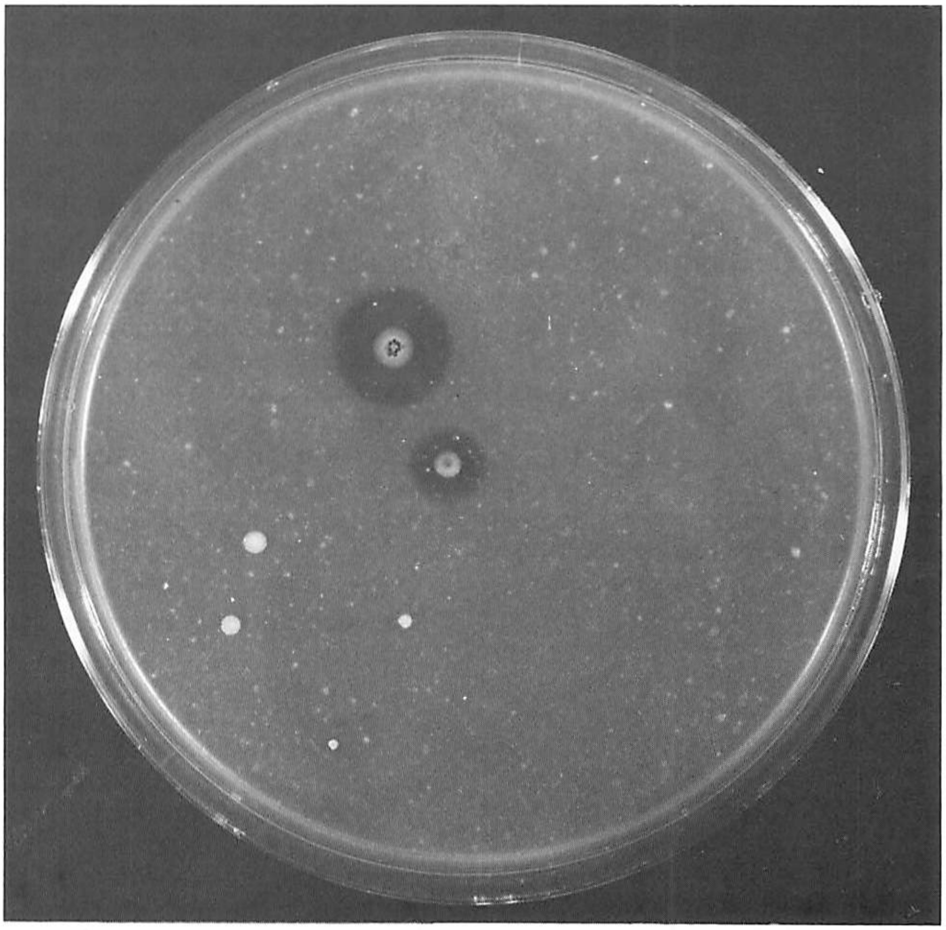


Figure 2.
Examples of chitinolytic activity of actinomycetes plated on chitin agar.

NEW POLYMER CONCRETE FOR SHORE PROTECTION AND MARINE STRUCTURES

M. Wecharatana and C.C. Lin
New Jersey Institute of Technology

Marine structures and shore protecting structures are frequently subjected to not only dynomics and fatigue loadings but also chemical attack from sulphates and chlorides in the sea water. Consequently, severe damage and corrosion of concrete and the main reinforcing bars are often experienced in most marine structures during their life time. Maintenance and repair of these structures are difficult and very costly. To resolve this problem, many attempts have been made in the past few decades to improve the strength and durability of concrete. One of the most promising solutions lies in the area of using polymers in concrete.

Polymer concrete can generally be classified into three types of composites as: 1) Polymer Impregnated Concrete (PIC) is a hydrated portland cement which has been impregnated with a monomer and subsequently polymerized in situ, 2) Polymer Concrete (PC) is a composite material formed by polymerizing a monomer and aggregate mixture. The polymerized monomer acts as the binder for the aggregate, 3) Polymer Portland Cement Concrete (PPCC or PCC) is a premixed material in which either a monomer or polymer is added to a fresh concrete mixture in a liquid, powdery or dispersed phase and subsequently allow to cure and polymerized in place.

Polymer concrete, in general, exhibits higher strength and higher corrosion resistance than conventional concrete. This is primarily attributed to the stronger bonding characteristic of polymerization process as compared to the hydration process in cement gel. As a result, aggregate particles are more densely bonded together and subsequently reduces the amount of voids in the composites. Although polymer concrete is known to be strong and durable, its applications have been limited and overshadowed by its cost. While conventional concrete generally costs about 3¢ per pound, the price of polymer concrete is much more expensive and is in the order of $1.50 to $2.00 per pound depending on the amount of polymer used in the composites. Most common applications of polymer concrete have been in the area of bridge deck overlays and repairs, patching compounds, floorings, and pilings, etc. For large scale construction projects such as shore protecting structures, use of polymer concretes remains impractical due to economical reasons.

In the 1985 Sea Grant proposal, we proposed a study on the mechanical properties and chemical resistance of a newly developed polymer concrete (PCC) for shore protecting and marine structures. The new polymer concrete was a product of a special latex, which was developed by C.C. Lin, mixed with other conventional concrete components such as cement, sand, coarse aggregate and water, etc. While the new polymer concrete has a reasonably high strength and chemical resistance characteristic, its cost has been substantially reduced to a more affordable level as compared to normal PIC and PC. This makes the new polymer concrete an interesting material for shore protecting and marine structures where a more durable concrete is urgently needed.

The first year of our proposed investigation primarily dealt with the development and optimization of the mix-proportion, studies of chemical resistance and some important basic mechanical properties of the composite such as compressive strength, tensile strength, flexural resistance, etc.

The basic material compositions of the new polymer concrete used in this study are listed in Table I. Latex was prepared by mixing 3 parts of resin with 1 part of water. The unsaturated polyester-styrene containing less than 10% of promoter was mixed with water and emulsifier in the agitator to obtain a white viscous latex. The optimum ratio of resin and water was found to be 3: 1 in order to produce a stable emulsion. The addition of promoter to the mixture was intended to reduce the curing temperature of the polymer. Two percent of catalyst was also used to control the rate of polymerization.

The new polymer concrete was made by simply dry mixing cement and aggregate in a conventional concrete mixer. Latex was then added to the mix to form a paste mixture. After proper mixing of all the components for about 5 minutes, the mixture was then poured into oiled steel or plastic molds. Vibration and rodding during casting are still needed to minimize the entrapped air in concrete. General mixing and casting procedures are very much similar to the method used in conventional concrete. Setting time of the new polymer concrete is approximately 20 to 30 minutes. Most test specimens were then cured at room temperature and humidity for 7 to 28 days before testing. To study the chemical resistance of the new polymer concrete, some test specimens were cured in different kinds of concentrated chemical solutions for a period of 1 day to 12 months.

The optimum mix-proportion for the new polymer concrete was determined from the study of twelve selected mix proportions of the composite as listed in Table II. Three different types of test specimens, namely, a dog bone (see Fig. 1), a 3" x 6" cylinder, and a 12" long beam, were used to study the tensile strength, compressive strength, and the flexural behavior of the composite respectively.

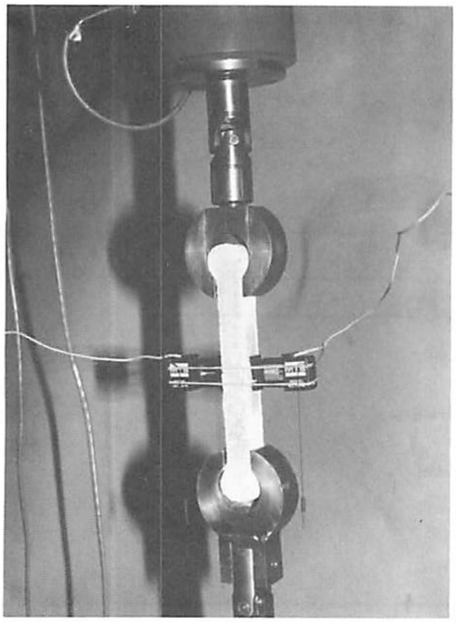


Figure 1.
Test Setup for Uniaxial Tension Test.

During the course of this study, a simple direct tension specimen, dog bone, was developed and introduced to measure not only the tensile strength but also the whole post-peak response of the composite (Fig. 1). For brittle material like concrete, conventional testing method was unable to monitor the softening response due to the abrupt failure. This resulted to a lower measured tensile energy absorbed by the composite. Closed-loop strain control was used to monitor the softening portion of the load-deformation curve. Fig. 2 shows a comparison of the stress-strain curve of normal plain concrete versus the new polymer concrete. It can be seen that the maximum tensile strength of the new polymer concrete is approximately double the value observed from the ordinary plain concrete. The area under the whole stress-strain curve, which normally represents the energy absorption of the material, for polymer concrete is approximately 10 to 20 times higher than those recorded for conventional plain concrete. The increase in tensile strength of the new polymer concrete means a highr resistance to cracking, and consequently, a highly corrosion resistance.

Compressive strength, the most important parameter for design of concrete structures, was measured by testing a 3" x 6" cylinder using a 400-KIP Soil Tests compression machine. These tests were conducted under a constant loading rate of approximately 10,000 pounds per minute. Fig. 3 presents the observed ultimate compressive strength of each selected mix proportion at 1, 7, 21, and 28 days. It can be noted that the compressive strength of concrete can be improved by up to nearly 9,000 psi (62 MPa) for the proposed polymer concrete. Optimization of the selected mix proportion was judged from the strength over cost ratio. The result presented in Table III indicates that the new polymer concrete has a strength/cost ratio vary from 1.58 to 3.22 times the normal concrete, while PIC or PC (last row in the table) are approximately 10 times more expensive than conventional concrete. According to the cost analysis, it is noted that series L, which has a mix-proportion of 1: 1.5: 2.0: 0.5: 2.0 (Latex: Cement: Sand: Fly Ash: Peroxide), is considered to be the most economical mix design with the cost/strength ratio of only 1. 58 times the normal concrete. The price per pound of this optimum mix-proportion was found to be about 13.55 cents (see Table III).

The flexural behavior of the composite was investigated by conducting a three-point-bend test. The beam has a cross sectional area of 1" x 1" and 2" x 2" with a span length of 12". Fig. 4 presents the effect of promoter on the observed

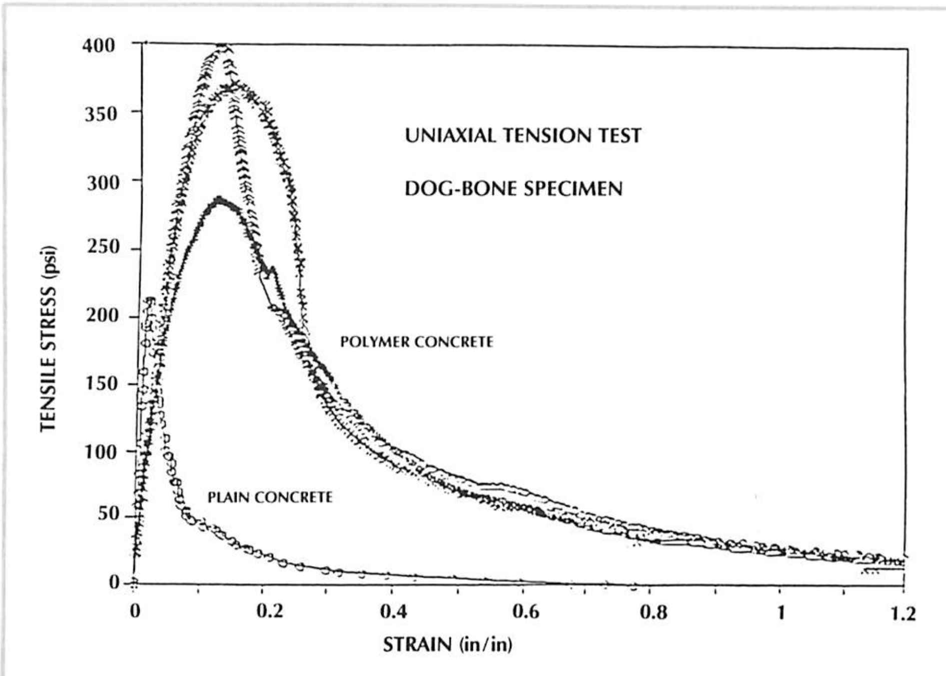


Figure 2.
Stress Strain Curve of New Polymer Concrete and Normal Plain Concrete.

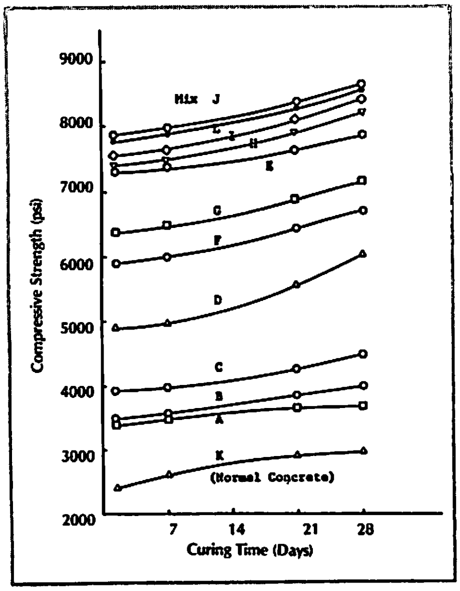


Figure 3.
Effects of Mix Proportion on Compressive Strength.

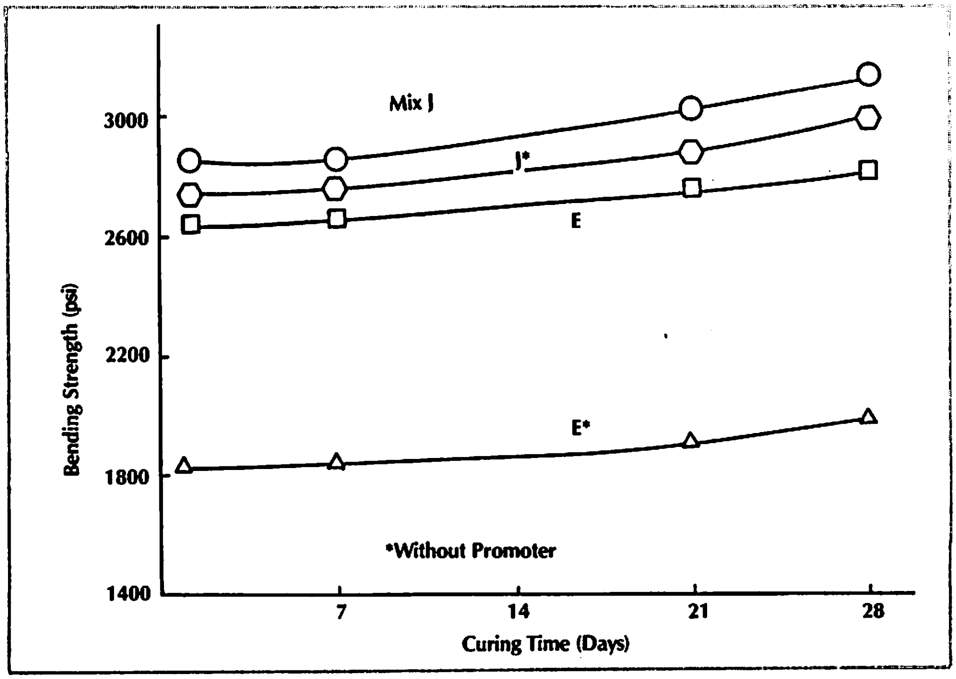


Figure 4.
Effects of Promoter on Bending Strength

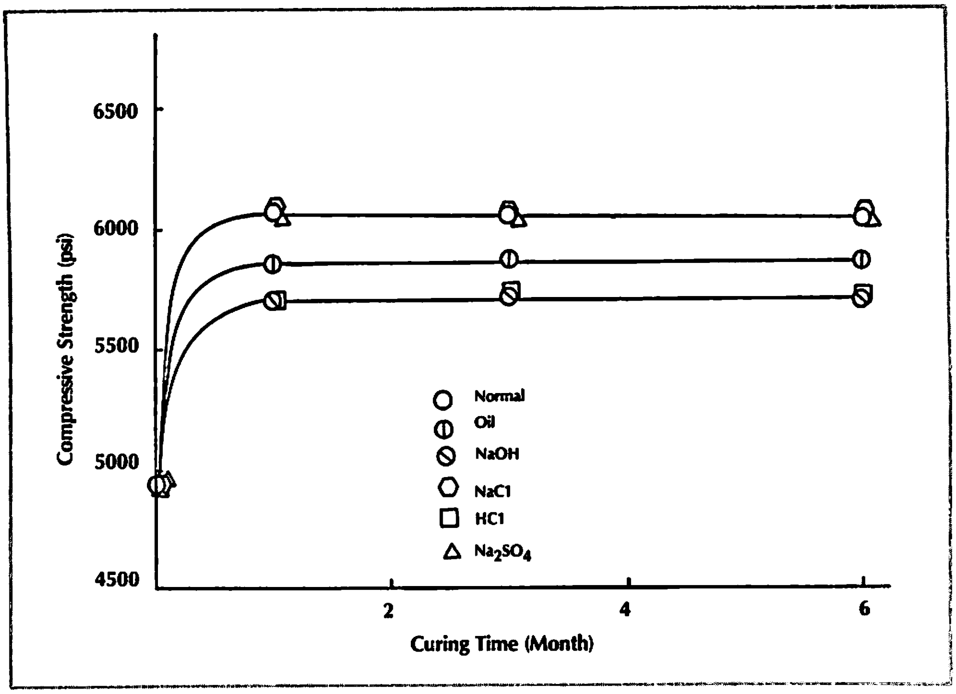


Figure 5.
Effects of Chemical Attack on the Compressive Strength

bending strength. It can be seen that without the promoter the observed flexural strength is about 2,000 psi (14MPa) at 28 days. By adding the promoter, the same mix-proportion provides a flexural strength of nearly 3000 psi (21 MPa). Normal concrete has a flexural strength approximately 450 psi (3 MPa). The new polymer concrete has a 7 fold increase of flexural strength than the conventional concrete. This increase will also be significantly crucial to the design of concrete structures.

The study of chemical attack on the new polymer concrete was conducted by measuring the compressive strength of the corroded specimens after being immersed in different concentrated chemical solutions for a period of 1 day to as long as 6 months (as of the present time). The concentrated chemical solutions are motor oil, 10% Caustic Soda (NaOH), 10% Sodium Chloride (NaCl), 20% Hydrocholoric Acid (HCl), and 10% Sodium Sulphate (Na_2SO_4). Fig. 5 shows the effect of these chemical influences on the ultimate compressive strength of the composite. The results in Fig. 5 also indicate that Caustic Soda and Sodium Sulphate are the two most corrosive solutions for the proposed polymer concrete. They both caused about 6% loss of strength as compared to the uncorroded specimens. It can therefore be concluded that the new polymer concrete has excellent chemical resistance.

In conclusion, our investigations have shown that the new polymer concrete is economical as compared to the conventional PC and PIC. The proposed polymer concrete also exhibits high strength with excellent chemical resistance. The optimum mix-proportion of the new polymer concrete was determined from the cost analysis with a unit cost of 13.55 cents per pound. While most of the basic mechanical properties and some chemical resistance characteristics have been established for the proposed polymer concrete, more studies will be conducted in the second and third year of the project. These investigations include the study of fatigue characteristic, fracture toughness, impact resistance, Poisson's ratio, creep and shrinkage, and most importantly the full scale structural test which is presently being investigated. With the above information, we anticipate that the proposed polymer concrete will be a better structural material for shore protecting structures and other marine constructions than conventional concrete.

TABLE I

MATERIAL COMPOSITIONS

Cement:	Portland Cement Type I
Sand:	Dry Silicious Sand passing sieve no. 10 (2mm)
Resin:	Unsaturated Polyester with less than 50% of Styrene Monomer
Emulsifier:	Dodecyl Sulphate or Span 80
Promoter:	Dimethyl Aniline
Catalyst:	Benzoyl Peroxide
Fly Ash:	ASTM Class C Fly Ash
Others:	Water
	Glass Fiber

TABLE II

MIX PROPORTIONS

Mix Symbol	Latex*	Cement	Matrix Sand	Compositions Fly Ash	Glass Fiber	Peroxide***
A	1	1.0	3.0	-	-	0.6
B	1	1.0	3.0	-	-	1.0
C	1	1.0	3.0	-	-	2.0
D	1	1.5	2.5	-	-	2.0
E	1	1.5	2.0	0.5	-	2.0
F	1	1.5	2.5	-	0.1	2.0
G	1	1.5	2.5	-	0.2	2.0
H	1	1.5	2.0	0.5	0.05	2.0
I	1	1.5	2.0	0.5	0.10	2.0
J	1	1.5	2.0	0.5	0.20	2.0
K	0.5**	3.0	3.0	-	-	-
L	1	1.5	2.0	0.5	-	2.0

* Resin: Water = 3:1 ** Water Only, (Series K is a conventional concrete Mix) ** Percent of Peroxide based on resin

TABLE III

COST ANALYSIS

MIX	COST (¢/lb)	COMPRESSIVE STRENGTH (psi)**	COST/STRENGTH PCC/CONCRETE
A	12.53	3889	3.22
B	12.89	4059	3.18
C	13.61	4526	3.01
D	13.77	6082	2.26
E	13.71	7920	1.73
F	16.17	6789	2.38
G	18.53	7199	2.51
H	15.14	8250	1.84
I	16.11	8486	1.90
J	18.77	8698	2.16
**** K	2.98	2970	1.00
L	13.55	8575	1.58
PC, PIC	150.00	15000	10.00

** Strength at 28 days **** Series K is a normal concrete mix






Coastal Systems Program

New Jersey Sea Grant has initiated a fully coordinated Coastal Systems Program, four projects directed to the state and national problem of the filling and narrowing of tidal waters between barrier islands and headlands. The mutually supporting studies focused on the Great Sound area of southern New Jersey, a complex of waterways with ocean inlets at Townsend Inlet at the northern edge of the town of Avalon and Hereford Inlet between the towns of Stone Harbor and North Wildwood.

The program goal is to define the processes of sediment transport that fill in back bays and narrow the waters between barrier islands and headlands. With the processes understood, management steps can be defined and actions taken to preserve or utilize the system to the best environmental and public advantage.

Gerard P. Lennon and Richard Weisman of Lehigh University, applied a mathematical model developed for the U.S. Corps of Engineers to the selected study area. Use of the so-called HYTID model already has resulted in two journal papers now in preparation. Calibration of the model is well underway, and when completed, several different geometry changes will be considered which would affect flushing characteristics of the waterways.

Three cooperating projects are providing data necessary to full definition of the system processes and dynamics and for input to and verification of the model.

Bob Carson of Lehigh has produced detailed size analyses of bottom sediments and their 50-year accumulation rates, and this information already has been included in the numberical model. Carson's data also characterize settling velocities of agglomerates, and similar characterization of fecal material and single grain mineral materials is underway. For the third year, Carson will define the distribution of suspended matter, correlating it with tidal flow under summer, winter, and storm conditions.

Gail Ashley of Rutgers has contributed velocity profile data, suspended sediment data, and simultaneous tidal stage data to the program data bank, providing hydraulic data to the Lehigh model and to fellow investigators Carson and Nadeau and Hall. Ashely will compare empirical data in the two primary tidal channels feeding Great Sound with conditions predicted by the Lehigh model under Summer Spring Tide, Winter Spring Tide, and immediate post-storm events.

Joseph Nadeau and Mary Jo Hall of Rider College complete the existing four-project team focused on ten trace metals in suspended and bottom sediments both as a means of defining sediment transport and deposition and of determining the concentrations of contaminants. The third year of investigation will focus on the major transport systems which enter Great Sound.

Throughout, the investigators have worked together, coordinating field measurements whenever possible and communicating ideas and data.

Like all shore areas, the southern New Jersey barrier island and back bay system is under heavy development pressure, with the usual conflicting interests of real estate, fisheries, beach and water users, and environmentalists who settle for nothing less than the status quo—which, as the program already has shown, Mother Nature is rapidly altering. Completion of the program will provide an understanding and a tool for the use of managers responsible for the area, including the U.S. Army Corps of Engineers, the New jersey Department of Environmental Protection, and the governments of county and towns of the region.

Along the U.S. Atlantic Coast from Sandy Hook to southern Florida and around the Florida peninsula to Texas there are barrier islands of similar geometry with problems similar to those of New Jersey. The scientific and technical publications that will derive from this Sea Grant will find broad applicability.

SEDIMENT CHARACTERISTICS AND RECENT ACCUMULATION RATES: Determination of Variables Required for a Numerical Simulation of Modern Sedimentation in the Salt Marsh Complex of Southern New Jersey

B. Carson,
Lehigh University

The third year of this study was designed to determine the vertical distribution of suspensate in the major channels draining Great Sound, and to assess the affects of storm conditions on suspensate composition and concentration.

Transmissometer profiles and suspensate samples collected at sites 1 and 2 (Fig. 1) indicate that inorganic particulate matter is distributed relatively uniformly throughout the water column at concentrations of 1-3 mg/1 under fair weather conditions (Fig. 2). At or near maximum tidal velocities (75 cm/sec), a thin bottom nepheloid layer exists within 1 m of the bottom, within which concentrations increase non-linearly to as much as 12 mg/1, reflecting local resuspension. Inorganic matter comprises about 25-50% of the total suspensate under fair weather, fall conditions.

Sampling immediately after passage of Hurricane Gloria (September 28, 1985) indicates that storm-induced inorganic suspensate concentrations (5-40 40 mg/1 near the bottom, Fig 2.) are commonly 4-10 times as great as fair weather concentrations, although maximum tidal current velocities are only nominally higher (84 cm/sec) than non-storm velocities. Inorganic particulate matter dominates (50-85%) the storm-related suspensate throughout the tidal cycle.

Under all weather and tidal conditions 6-7 um particles dominate the suspensate (Fig. 3). These inorganic particles are transported primarily within organic-mineral aggregates, and to a lesser extent in fecal material or as single grains. The

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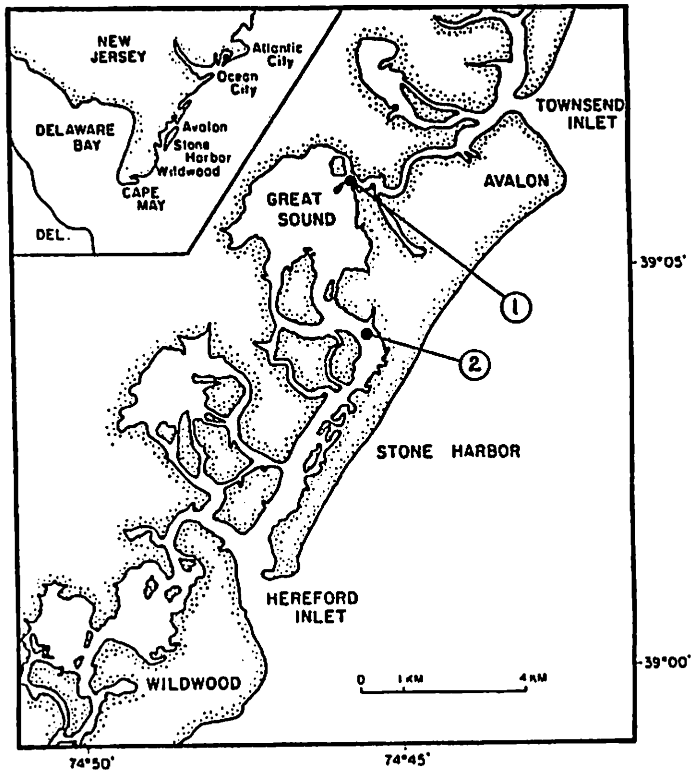


Figure 1. Location of Great Sound along the southern coast of New Jersey, and position of suspensate sampling sites (1 and 2).

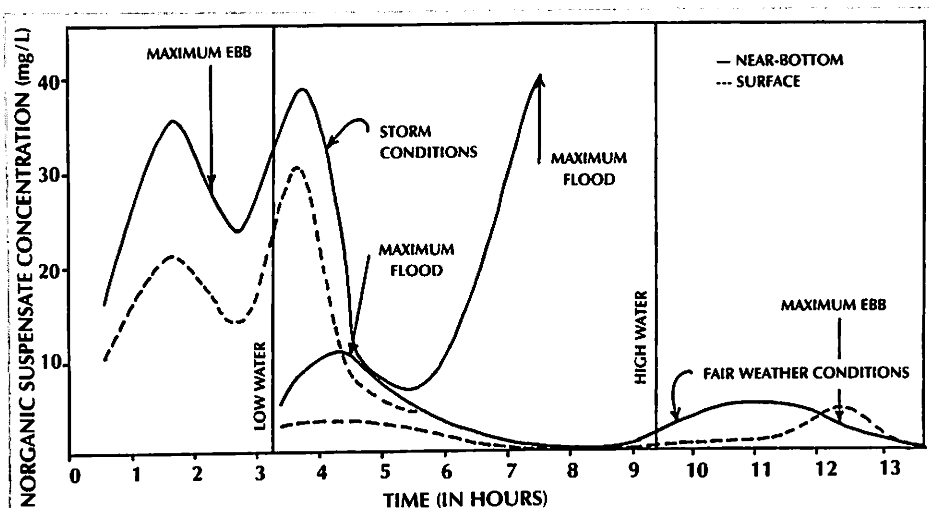


Figure 2. Temporal distribution of inorganic suspensate at sampling site 1, under storm (September 28, 1985) and fair weather (October 17, 1985) conditions.

HYDRODYNAMIC AND MODEL OF AN INLET-SOUND SYSTEM IN SOUTHERN NEW JERSEY

R. Weisman and G. Lennon
Lehigh University

Sea Grant X was the final year of the three year project to model flow patterns and sedimentation in Great Sound, New Jersey. This last year was devoted to constructing a model for calculating sediment deposition in the Sound.

The model utilizes the hydrodynamic properties of the Sound which were defined by field data and modeling using the HYDTID model during Sea Grant VIII and IX. This data includes the initial flow volume in the Sound at mean low water, inflow hydrographs and tidal range for neap, mean, and spring tides, and tidal prism in the Sound for various tidal conditions.

Information on sediment characteristics obtained by fellow Sea Grant investigators were essential for both model inputs and model verification. These data include suspended sediment sizes and settling velocities, concentration hydrographs entering the Sound for fair weather and storm conditions, bulk density of sediment already deposited in the Sound, and long term accumulation rates in the Sound.

One important piece of information not available for Great Sound, but extrapolated from data in the literature, is a relationship between sediment concentration and frequency. Very high concentrations are infrequent and are associated with storm events, while low concentrations occur during frequent fair weather days.

TABLE 1

Yearly Sediment Deposition Rate for Great Sound

Test Section	Concentration Hydrograph	Accumulation % Per Tidal Cycle (mm)	Frequency # Cycles/Yr.	Accumulation Per Year (mm)
Part I	Fair	0.00446	66 (462)	2.1
Part II	Pre/Post Storm	0.01799	32 (224)	4.0
Part III	Storm	0.17991	2 (14)	2.8

Total Accumulation = 8.9 mm/yr

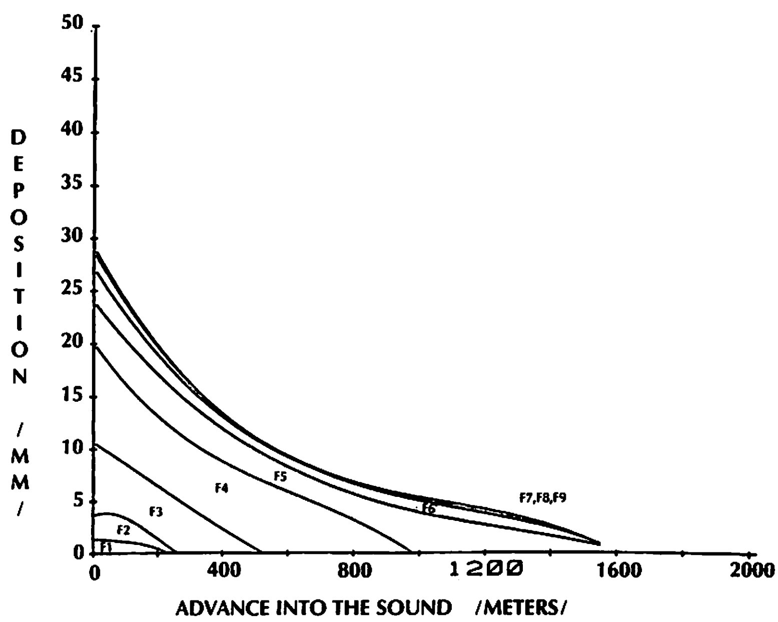


Figure 1. Layered distribution of sediment by size fraction; largest fraction, F1, through the smallest fraction, F9.

The sediment deposition model utilizes the settling tank concept which assumes plug flow hydrodynamics, a uniform velocity profile, and simplified geometry. The model was adapted for the unsteady flow occurring in the Sound and for the special geometry where the inlet to the tank is also the outlet (the Intracoastal Waterway).

The deposition for a single tidal cycle is simulated for a chosen set of conditions. By summing the deposition over 705 tidal cycles for a combination of fair weather, poor weather (pre- and post-storm conditions), and storm conditions, an annual sediment deposition is obtained. Table 1 shows that the total accumulation predicted by the model is 8.9 mm/yr, in agreement with the estimates of other investigators using various Pb dating techniques. With recent sea level rise estimated to be 4.5 mm/yr along Southern New Jersey, sediment has been depositing faster than sea level has been rising. Table 1 also indicates the relative importance of storms on sediment deposition in the Sound. Only 14 tidal cycles (7 days) of intense storms can lead to more deposition than 462 cycles of fair weather.

Figure 1 shows the sediment deposition for an average year by size fraction versus distance into the Sound measured from the Intracoastal Waterway (IW). The figure shows that the largest size fractions deposit near the IW while only a portion of the smaller fractions deposit. Approximately 57% of the total of incoming sediment deposits; the rest exits the Sound during ebb flow.

Because the model is one-dimensional (in plan view), it does not utilize all the detailed information available from the hydrodynamic model. Also, the effects of sediment resuspension have not been addressed. Finally, the frequency versus concentration relationship was extrapolated from a different geographical area. We hope to continue this research to refine our data base and address these problems. A more sophisticated model will provide details on the two-dimensional (horizontal) distribution of sediment.

In spite of the simplified conceptual basis of this model, it has proved to be an accurate predictor of average annual depostion and distribution of sediment deposited across the Sound.

Continued from page 28.

SEDIMENT CHARACTERISTICS AND RECENT ACCUMULATION RATES: Determination of Variables Required for a Numerical Simulation of Modern Sediment in the Salt Marsh Complex of Southern New Jersey.

suspensate is characterized by a paucity of 30-90 um material, probably because there is no local source for silt- and fine sand-sized grains. During periods of levated current velocities (50 cm/sec), induced either by storm conditions or tidal flow, sand grains (90-150 um) are eroded from the bottom and transported as suspensate.

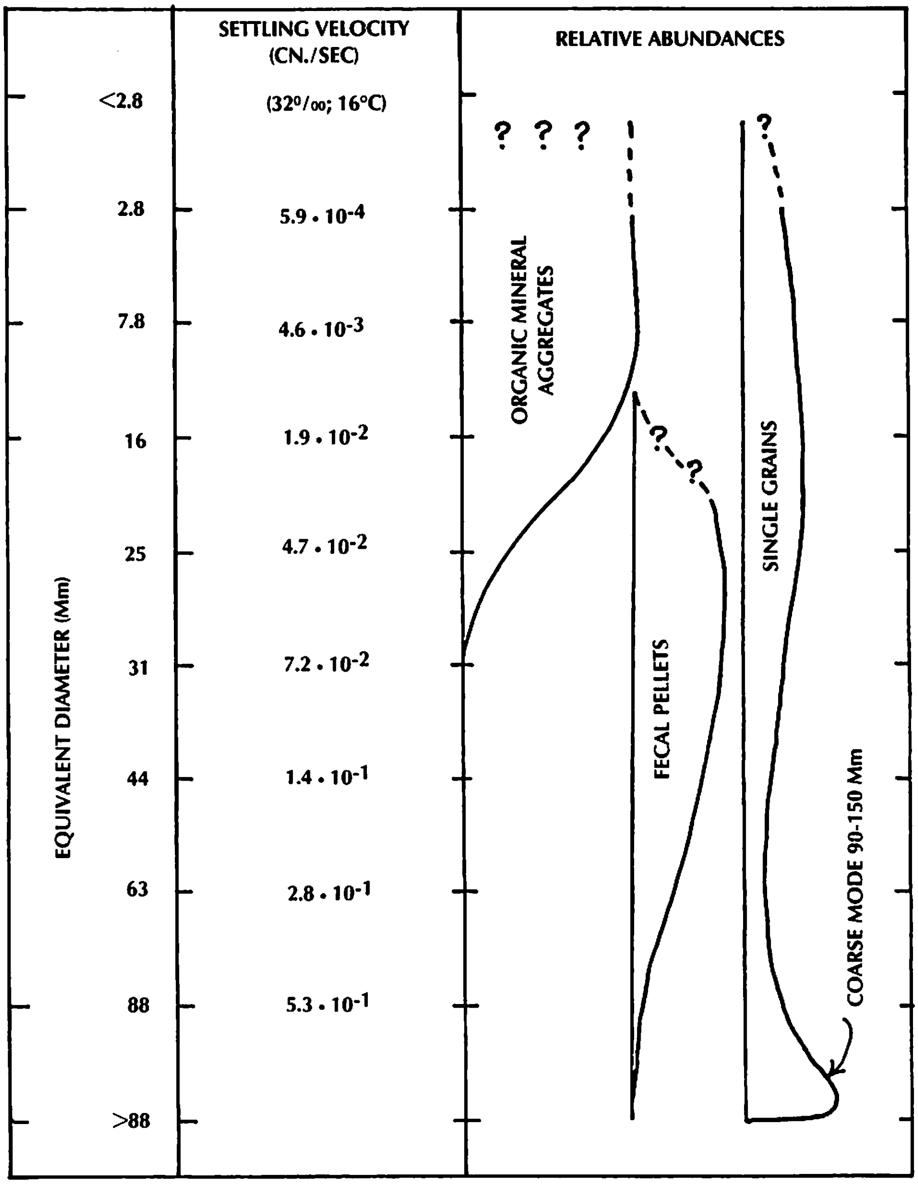


Figure 3. Relative abundance of types of suspensate and associated settling velocities and equivalent spherical diameters (assuming particle density of 2.65 Mg/m^3). Single grains contain particles of all sizes, although they are dominated by sand grains larger than 90 um. Fecal pellets are comprised largely of constituent grains smaller than 25 um, while organic-mineral aggregrates consist largely of individual particles less than 10 um.

FLOW CHARACTERISTICS AND SEDIMENT FLUX IN THE GREAT-SOUND SECTION OF THE INNER COASTAL WATERWAY (AVALON-STONE HARBOR, NJ)

G. Ashley and M. Zeff
Rutgers University

This report concludes a 3-year study undertaken at Rutgers University by Prof. Gail M. Ashley and Marjorie L. Zeff (PhD candidate) to investigate the roles played by tidal channels in sediment dispersal through a salt marsh of Cape May, New Jersey. Previous Sea Grant research (SG VIII, 1983-84; SG IX, 1984-85) led to the development of a descriptive model of fair-weather (normal) water and sediment flux in the back-barrier area stretching from Townsend Inlet south to Hereford Inlet. The objective of year 3 (SG X, 1985-86) has been to extend this model to include storm conditions.

Barrier islands of the southern coast of New Jersey are backed by extensive salt marshes which are dissected with branching networks of tidal channels of various dimensions (Figure 1). A large, primary channel (Ingram Thorofare) at the study site of Stone Harbor leads from Townsend Inlet to Great Sound, a shallow lagoon (Figure 2). Long Reach (a secondary channel) and Redfield Creek (a tertiary channel) are smaller distributaries that branch off Ingram and penetrate the marsh interior.

Field data for Sea Grant X were collected during spring (lunar) tides under both fair-weather and storm (including Hurricane Gloria) conditions (Table 1). Velocity profiles and suspended sediment samples were taken simultaneously in Ingram Thorofare, Long Reach, and Redfield Creek. In addition, just after the peak of the Hurrican (September 27, 1985) surface velocity and suspended sediment data were collected from the Ingram Thorofare bridge.

Figure 1. Aerial photo of Stone—Harbor and Avalon salt marsh - tidal complex

Water and sediment flux is strongly controlled by the distribution of channel types (*i.e.* primary, secondary, or tertiary) during both strom and fair-weather conditions. The hydraulic and sedimentary properties of this system differ, however, under the two situations (Figure 2). Storms are found to have their greatest effects on: (1) the sediment loads of the primary channels and, (2) the current velocities reached in the secondary and tertiary channels.

The timing of peak velocities are the same during storm and "normal" conditions. Secondary channels peak early in the flood cycle, followed by primary, then tertiary channels. When the direction of flow reverses, tertiary channels rapidly drain the marsh and peak earliest in the ebb, followed by primary and lastly, secondary channels. During storms

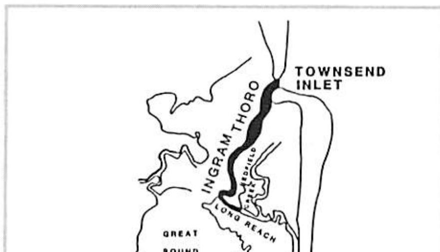


Figure 2. Location of the study area: back-barrier coastal zone between Townsend and Hereford Inlets.

and fair-weather primary channel velocities are greatest. Peak velocity magnitudes, however, differ significantly. Normal spring peak velocities measured in Long Reach and Redfield Creek were 31 cm/s and 19 cm/s, respectively, while storm spring tide conditions found maximum values of 38 cm/s and 30 cm/s, respectively. Normal spring peak velocities reached in Ingram were 76 cm/s and 97 cm/s, but an intermediate value 86 cm/s was measured during a relatively low intensity storm compared to Hurricane Gloria. The extraordinary storm Hurricane Gloria produced surface current velocities of 146 cm/s after the eye of the storm had passed. Velocities reached during the height of the storm were likely much greater.

Calculations of the total suspended sediment load carried through the channels show a dramatic increase during storms. Maximum normal spring tide values in Ingram were relatively low, ranging 17-39 mg/L. However, storm values were 85 mg/L and reached 384 mg/L after the hurricane. In contrast, the suspended load of the secondary and tertiary channels increased only slightly, from 25 to 34 mg/L in Long Reach and from 27 to 39 mg/L in Redfield Creek. Thus, while secondary and tertiary channels carry more suspended sediments than primary channels under normal conditions, the bulk of suspended sediment transported during storms is the through primary channels.

Another significant contrast is found in the temporal variations of suspended sediment concentrations. Previous data indicated that the suspended load increased gradually during the ebb, reaching a maximum late in the ebb and early in the flood. During the flood cycle suspended load concentrations decreased. This, in conjunction with current time-velocity asymmetries, suggested that fine sediments fraining off the marsh during the ebb are transported back to the marsh interior when flow direction reverses and are deposited there as velocities wane.

This is still found to hold true for the elevated suspended load carried by Ingram Thorofare during storms, but this trend can reverse for Long Reach and Redfield Creek during fair and stormy weather. This implies that primary channels act as major conduits transporting large amounts of suspended sediment into Great Sound during storms where it is deposited, while smaller secondary and tertiary channels act simply as pathways through which lesser amounts of fine sediment shift in location in the more interior portions of the marsh.

TABLE 1

Spring tide peak velocities (cm/sec) and maximum suspended sediment concentrations (mg/1) in the three channels under Flood and ebb flows.

Flow	Tidal Channel		Fair Weather		Storm	
Direction	Type	Name	Velocity	Sediment	Velocity	Sediment
INLET						
	Primary	INGRAM THOROFARE	97	39	86	69
	Secondary	LONG REACH	31	25	27	34
MARSH	Tertiary	REDFIELD CREEK	19	27	30	39
MARSH	Tertiary	REDFIELD CREEK	09	16	06	30
	Secondary	LONG REACH	27	11	38	15
INLET	Primary	INGRAM THOROFARE	54	13	60	85

flood ebb

TRACING POLLUTANTS USING TRACE METALS ASSOCIATED WITH SEDIMENTS IN THE LAGOONS OF SOUTHERN NEW JERSEY

J. Nadeau and M.J. Hall
Rider College

The study of trace metals in estuarine and coastal sediments has increased in recent years as a result of the concern about the fate of potentially toxic substances in the coastal environment. Meade *et al* (1975) suggested that the identification of specific trace metals found in river and estuarine derived sediments be used as tracers for sediment in the coastal environment. Numerous studies have successfully used trace metals found associated with sediments to determine the movement of sediment within estuarine and marine systems (Bopp and Biggs, 1973; Gibbs, 1973; Perkins *et al*, 1973: Loring, 1978; Eaton *et al*, 1979; Trefry and Presley, 1979; Hall, 1981; Nadeau and Hall, 1984, and Hall *et al*, in press). Eaton *et al* (1979) used variations in the chemical composition of suspended sediments in Chesapeake Bay to provide a tracing mechanism for the mixing processes of various sediment sources for material derived from the Susquehanna River. More recent trace metal data provide evidence that Delaware Bay derived sediments are a major contributing source to inner shelf fine-grained sediment (Hall, 1981; Kelley, 1983). The relatively low trace metal concentrations found in sediments near tidal inlets of southern New Jersey suggests that Delaware Bay derived sediment deposited on the inner shelf subsequently may be swept through coastal inlets on flood tides and deposited in the lagoonal complex behind the barrier system (Hall *et al*, in press).

This study focuses on Great Sound and associated tidal channels which are a part of the tidally influenced back bay environment landward of the barrier island chain of southern New Jersey (Figure 1). To the north is Ingram Thoroughfare which connects Great Sound to the ocean via Townsend's Inlet. To the south Hereford Inlet provides access to Great Sound through Great Channel which separates into Gull Island and Cresse Thoroughfares before entering Great Sound. Great Sound, therefore, is a sink for the characteristicly fine-grained lagoonal sediments.

Suspended sediment samples were collected 1.5 meters below the surface with a portable filtration system employing two 90mm nylon filters. These samples were collected three sites including 12 stations each at both flood and ebb tide on the same day where each of the major access routes enters Great Sound. Suspended sediment was washed off of the nylon screens and stored in acid cleaned jars which were refrigerated until processing prior to analysis. Suspended sediment samples were slaked to remove salts and then digested by means of a nitric and hydrochloric acid extraction (Grieg and McGrath, 1977) in preparation for anaylsis. Metal concentrations were determined by atomic absorption spectroscopy. Metal concentration is reported as micrograms per gram.

Analysis reveals that higher metal values in suspended samples occur in those samples collected from the southern access avenue, even though the major flow volume of water now enters from the north through Townsend's Inlet. Results of trace metal analysis of suspended sediment reveal two general trends. First, the ebb-tidal samples have higher metal content than flood-tidal samples (Table 1). Ashley (pers. comm.) observed that there is an increase in abundance of finer grained sediments carried in suspension late in ebb-tidal cycle. She suggests that this increase is due to the contribution of sediment derived from draining of the marshes and from resuspension in smaller marsh channel bottoms. Since finer grain size particles provide greater surface area per unit volume for coatings, the observed increase of fine-grained sediment during ebb cycles should correlate with higher trace metal concentrations observed in these samples.

Second, trace metal concentrations in suspended samples are generally higher than those found in bottom sediments for the same location (Table 1) which is again interpreted to be a function of particle size. The size distribution of particles in the suspended sediment are finer than those in the analyzed portion (less than 63 micron fraction) of bottom sediments. Finer particles have greater absorbed trace metal concentrations due to the high surface area per unit weight. In addition, the finer particles are more easily maintained in suspension reflecting the concentrations observed.

Table 1 — Analytical summary of sample suspended sediment sample sites. Values are in ppm and are mean concentrations for 12 stations at each site.

SITE	SAMPLE	Cu	Zn	Cr	Pb	Fe
	Suspended Ebb	314	276	37	49	6412
Gull Island Channel	Suspended Flood	69	107	32	37	4474
	Bottom	61	155	28	35	1471
	Suspended Ebb	186	297	61	56	5612
Cresse Thoroughfare	Suspended Flood	119	203	52	39	5073
	Bottom	131	197	34	98	1135
	Suspended Ebb	216	172	25	38	4205
Ingram Thoroughfare	Suspended Flood	70	85	26	32	4292
	Bottom	25	79	19	16	1052

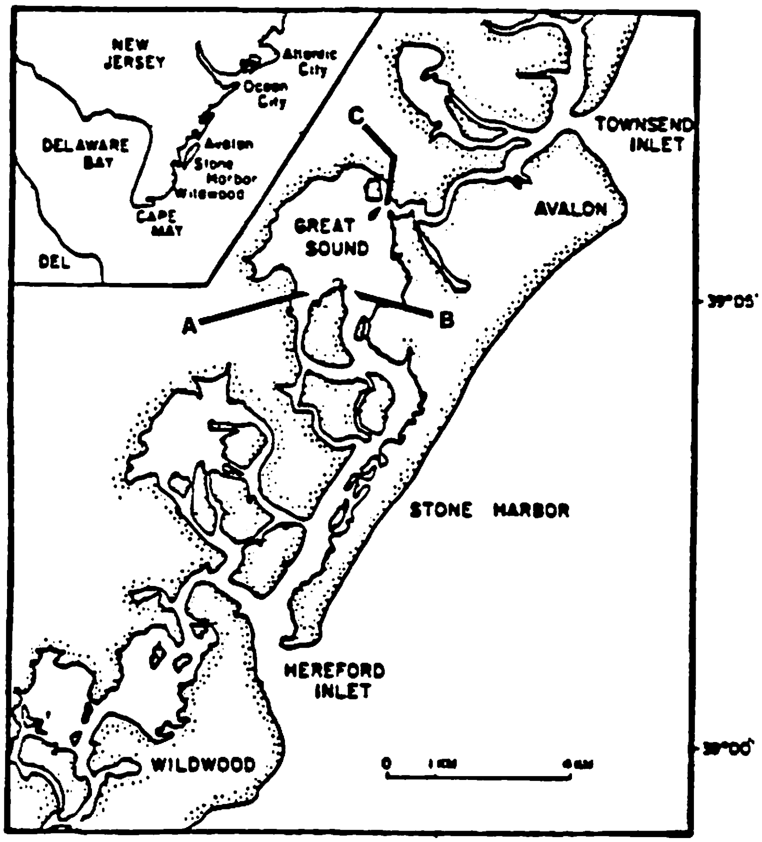


Figure 1 — Location of study area and sample sites. Sites entering great sound are: A. Cresse Thorofare; B. Gull Island Thorofare; C. Ingram Thorofare.

Marine Education

The marine educational needs of New Jersey are many. New Jersey Sea Grant's goal is to provide comprehensive marine education programs tailored to the needs of the state. Our programs are designed to educate citizens through pre-college, college and public programs aimed at those not involved with marine related fields.

An early, positive exposure to our coastal resources 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.

Utilizing the successful structure of the popular Cape May County 4-H Program, Betty Jean Jesuncosky, County 4-H Agent, developed a comprehensive marine science education program, with the ultimate goal of expanding participation and utilization of materials designed for the program, by the states quarter-million 4-H youth members. The outstanding one-year project has enhanced the understanding and appreciation of those involved, of New Jersey's Marine environment, its coastal resources, its marine problems and its related career opportunities.

NEW JERSEY 4-H MARINE SCIENCE PROGRAM DEVELOPMENT

B.J. Jesuncosky
Rutgers Cooperative Extension/4-H Agent

While New Jersey residents enjoy the benefits of abundant marine resources we also face the challenge of addressing many serious current and future problems and issues related to management and wise utilization of the marine and coastal environment.

Educating our youth is essential to providing the knowledge and understanding necessary to make critical decisions affecting the future of our marine resources.

The 4-H Youth Development program of the Rutgers Cooperative Extension, Cook College, Rutgers University provides informal educational activities for almost 132,847 youth in New Jersey. The youth are organized into 4-H project clubs on a neighborhood or county level, based on their individual interest. The education in 4-H takes place through "learn by doing" projects and activities based on the interests and concerns of volunteer and youth participants.

Developing a marine education program through 4-H to educate youth to understand the natural processes and value of our marine environment and resources, is the focus of this project.

New Jersey 4-H Marine Science Project

Primarily through the efforts of the National Sea Grant program, an extensive variety of educational materials, projects and programs have been developed and are available to educators nationwide.

The goal of the New Jersey Marine Science Project was to adopt and integrate available marine education information into a 4-H project booklet to be used to develop a statewide marine science program which focuses on greater understanding and appreciation of New Jersey's marine environment, its coastal resources, marine related problems and career opportunities.

The leaders guide developed as a basis for this program is designed to provide background information and guidelines for volunteers working in the 4-H club environment with youth. The activities outlined in the guide incorporate specific information on New Jersey's marine environment into interesting and fun hands-on experiences designed to enhance knowledge, skills and values in youth.

The 4-H project guidelines include activities for youth on marine habitats, organisms, career opportunities, community projects, seafood preparation, coastal issues and many other topics of interest and impact in the marine area.

The process for developing the New Jersey 4-H Marine Science Program included accessing the needs and interests of various adult and teen clientele and include their ideas and suggestions into the final project.

New Jersey 4-H Marine Science Weekend

In 1980, the 4-H department in conjunction with the New Jersey Marine Sciences Consortium established the New Jersey 4-H Marine Science Weekend. Now in its seventh year this three day teen event utilizes the educational opportunities available at the Consortium's Seaville Field Station and incorporates the expertise of Rutgers Cooperative Extension's personnel to provide for participants, a brief but comprehensive overview of the New Jersey marine environment and coastal resources.

Combining seminars, field trips, lab experiences and other hands-on learning experiences, this event has generated and maintained much interest in marine science and has provided a greater awareness, a better understanding, and deeper appreciation of our marine environment for over 300 teens.

Through this event a need was determined to provide marine science programming not only once a year but on an ongoing basis through numerous 4-H project clubs in each of the New Jersey counties.

Adult Idea Sharing Seminar

The success of any 4-H project or activity lies in it ability to meet the needs of the clientele for whom it is designed. Nine New Jersey 4-H volunteer leaders with background in environmental science projects provided input for activity and subject matter content in the New Jersey 4-H Marine Science Project. While attending lectures, participating in field and boat trips, discussion groups and completing research assignments, these volunteers contributed many valuable ideas for project activities and resources throughout the state which are included in the project guide and member worksheets.

Pilot Projects

Since the beginning of the project several 4-H clubs have become involved in implementing various activities and testing potential project ideas.

In addition to short term activities in existing clubs, a new countywide 4-H club was established in Cape May County for marine study. Under direction of Sea Grant Extension Agent Stewart Tweed, members of the Blue Claw 4-H Club were directed in testing activities in the following areas:

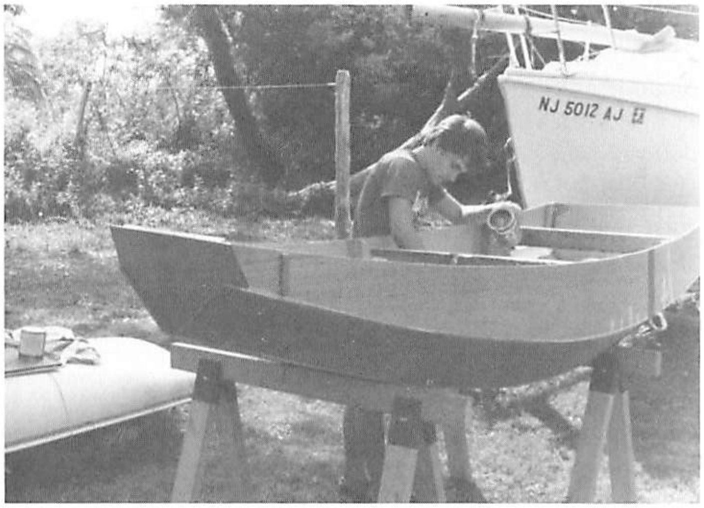
- establishing salt water aquaria
- shell and specimen collection
- marine photography
- horseshoe crab egg hatching
- blue crab shedding operations
- boat building
- clam growing
- water testing

Through working with various test groups, procedures and materials to be included in the project were revised and adopted for use in the prepared lessons. As a result of these efforts, 75 volunteers and youth in Cape May County gained valuable experience in marine education.

4-H members preparing soft shell crabs.

4-H'ers seining in Barnegat Bay.

Prize winning Blue Claw 4-H Marine Science Club closed system crab shedding display.



4-H member working on boat building display.

Program Promotion - Community Involvement

As a part of the 4-H project activities, a section was included to focus on "sharing your knowledge". Within this segment 4-H clubs and individual project participants were encouraged to develop exhibits and displays to promote marine education within their community.

Each of the following exhibits were developed by 4-H members under the direction of 4-H and Sea Grant Extension Staff. They have been on display at numerous public functions. Manned by 4-H volunteer leaders and members, they provided an excellent opportunity for education and creating awareness of this project. Through these displays over 7,000 people have received educational information and $1,000 in donations generated for additional marine education opportunities.

4-H Outdoor Education Opportunities for Youth - an informational display encouraging participation in available environmental programs.

Blue Crab Shedding - the design and building of a closed soft shell crab shedding system emphasizing crab biology and the soft shell crab industry.

Seafood - an exhibit and demonstration of cleaning and preparing New Jersey seafood for taste testing by the general public.

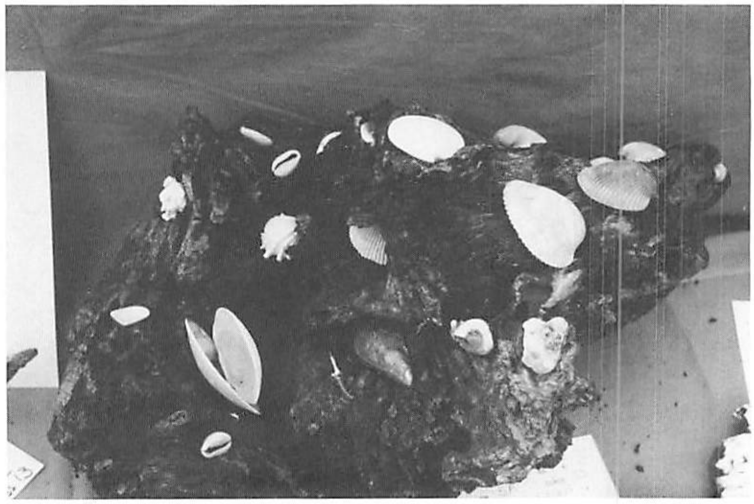
Boat Building - The Six Steps of Boat Building - a display including a home built boat and photos of 4-H members depicting the process by which they planned and built their boat.

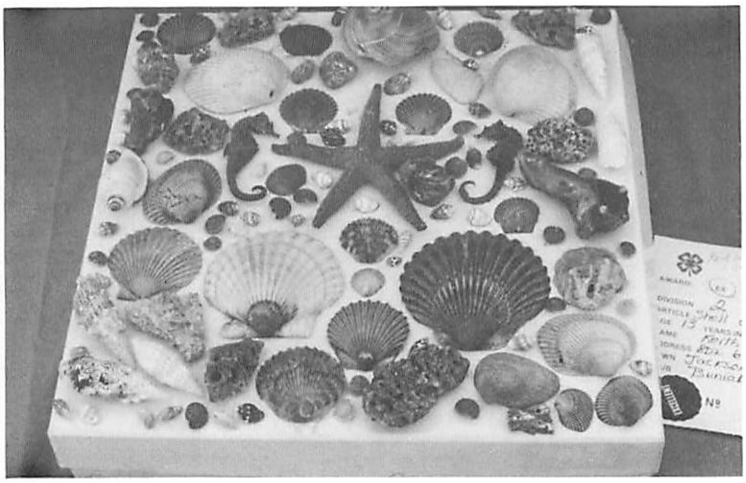
Beach Zonation - Mural and project display developed by 4-H prep club members, 7-9 years old, on various species and habitats on the beach.

4-H Marine Science - Crab Shedding, Boat Building and More - a display of photos of 4-H members participating in and completing various 4-H projects in marine science.

Touch Tank - a display developed with 4-H prep members 7-9 years old featuring a pool with local marine organisms for handling and observation.

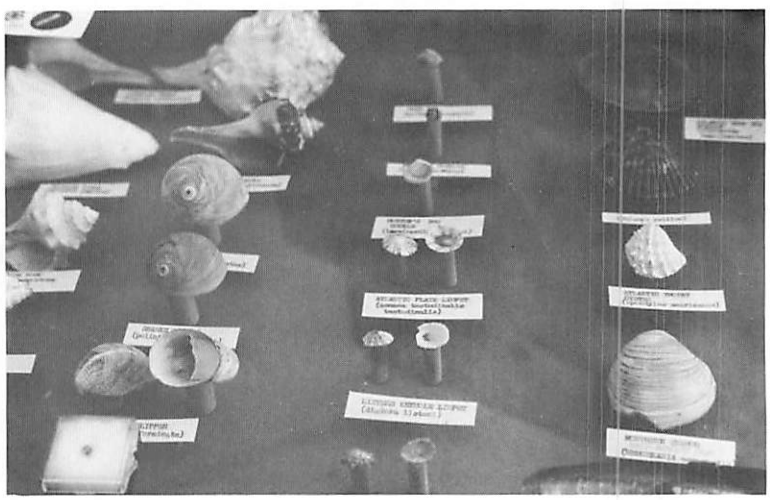
4-H member entry in the Ocean County Fair.





4-H member entry in the Ocean County Fair.

4-H member entry in the Ocean County Fair.



New Jersey 4-H Camp's Fishing Program

This project also provided the necessary equipment and lesson plans for the Fishing Program at the Lindley G. Cook 4-H Camp. As a result, each year over 900 youths from 10 counties throughout New Jersey enhanced their outdoor educational experience at 4-H camp through not only learning how to fish but valuable information about habitats, aquatic organisms and the comparison between fresh water and marine environments.

National Seminars

The process and accomplishments of this project were presented in a seminar at the 1986 National Marine Educators Association Conference at John Carroll University, Cleveland, Ohio and at the 1986 National Association of Extension 4-H Agents Conference in Hershey, Pennsylvania. Response to these seminars has been excellent. The benefits of these efforts are two-fold, sharing educational information and program ideas with fellow educators while promoting marine science as a recognized 4-H project.

Future Accomplishments

The unique contribution made by this project is that it provides a good basic foundation for building future marine education programs for 4-H youth and volunteer adults.

By incorporating New Jersey's 4-H Marine Science project into the variety of subjects already available to youth for study through the 4-H Youth Development Program, it has the potential for providing additional educational experiences for the over 33,00 youth presently enrolled in 4-H environmental projects.

If the interest generated by this project is an indication, as a result of this project additional adult volunteers and youth in New Jersey will be motivated to take advantage of the educational opportunities provided by the New Jersey Sea Grant program, Rutgers Cooperative Extension and the New Jersey Marine Sciences Consortium.

Through the education provided by this project, adults and youth will develop a greater awareness of the importance of protecting and intelligently using our marine resources to the benefit of marine life and the people who live and work on the New Jersey shore.

4-H member exhibit in the Ocean County Fair.

4-H project promotion exhibit at Egyptian Acres Sire Stakes and Country Fair.

4-H project promotion exhibit at Egyptian Acres Sire Stakes and Country Fair.

4-H project promotion exhibit at Egyptian Acres Sire Stakes and Country Fair.

Marine Advisory Services

The Jersey Shore is many things to many people: a place to live, a place to work and a place to visit. Sandy beaches, dunes, wetlands, jetties, fishing and amusement piers, inlets, bays, rivers, vacation houses, year-round residences, hotels, motels, marinas and shops all make up the developed and natural environments of the shore.

New Jersey is a state richly endowed with coastal and marine resources. Despite its small physical size, the State's 1792 miles of coastline ranks fourteenth among the states. Eighteen percent of the land area is classified as coastal by the legislature — a percentage which ranks NJ fifth among the states.

With a dense population, considerable industrialization and a valuable fisheries resource, the competition for use of NJ's coastal waters is keen. There is constant pressure for increased beach access, shorefront development and waste disposal.

Conflicts over usage of these valuable marine resources must be addressed. The general public, marine resource user groups, legislators, regulatory agencies, news media and the scientific community must be kept informed of developing research, policies and events affecting the wise use and management of ocean and coastal resources. In addition, each group must be encouraged to communicate with the others. Since the beginning of the Sea Grant Program in New Jersey in 1975, the Sea Grant Extension Service has been instrumental in addressing these needs while effectively serving as the outreach arm of the New Jersey Sea Grant Program.

NEW JERSEY SEA GRANT EXTENSION SERVICE

The basic goal of the New Jersey Sea Grant Extension Service is to provide valuable marine and coastal related information to those people who need and use it. Through its multi-faceted efforts, the New Jersey Sea Grant Extension Service plays a vital role in disseminating this information and facilitating communication, and is thus a catalyst in promoting the wise use and development of New Jersey's coastal resources.

New Jersey Sea Grant Extension Marine Agents are the principal contacts within the counties where they are located and are expected to have broad subject matter knowledge and a thorough familiarity of marine interests in their areas. Stewart Tweed works with fisheries in Cape May, Cumberland and Salem Counties; Gef Flimlin addresses the needs of the fishing communities of Atlantic, Ocean and Monmouth Counties. John Tiedemann, housed in Ocean County, has coastwide responsibility for program delivery to the marine recreational fishing industry, marine trades industry, and other components of the State's enormous recreation industry. The six coastal counties provide support and assistance to the respective agents.

Marine Extension Agents work closely together to meet the needs of consituents and rely as well on expertise provided by staff specialists. The specialists provide applied research and support the educational activities of the SGES agents and NJMSC personnel throughout the State.

Kim Kosko, the Marine Communications Coordinator, is located at the N.J. Marine Sciences Consortium offices on Sandy Hook. She provides a broad range of marine related materials to the public through television, radio, newspaper articles, the SGES newsletter, displays and slide presentations. She also prepares the Sea Grant Annual Report, solicits progress reports from researchers and assists in planning, advertising and conducting workshops, seminars and symposia. In general, she handles a diversified range of media and communications projects and serves as the "voice" of New Jersey Sea Grant.

The Seafood Marketing Specialist, Nona Henderson, is housed at the Agriculture Economics Dept. at Cook College in New Brunswick and has responsibility for determining promotion and research priorities affecting NJ fin and shellfish resources, and conducting marketing research. Nona also designs and conducts educational programs in cooperation with other Sea Grant Extension faculty.

SGES Director, Alex Wypyszinski, is housed at the Department of Environmental Resources at Cook College. As the program's Coastal Law Specialist, Alex also provides information on marine law, taxation and policy matters to SGES staff and to marina owners, coastal developers and property owners and regulatory agency officials.

The small, but dedicated New Jersey Sea Grant Extension staff has come to be recognized as the state's primary source of marine and coastal-related information and assistance. The following activities and accomplishments are representative of NJSGE's many outstanding achievements for 1985-86.

COMMERCIAL FISHERIES:

In 1980, the New Jersey fishing industry ranked ninth in pounds harvested and eleventh in dollar value of the U.S. catch. There are about 2,000 commercial fishing vessels in the state employing over 3,000 full time fishermen. The core of the SGES program and the largest area of emphasis continues to be that of commercial fisheries. Stew Tweed and Gef Flimlin, the two Marine Extension Agents with program responsibility to the commercial fishing industry, pursued both new and continuing projects during the past year.

As a result of Stew Tweed's efforts to establish an industry advisory group, the Seafood Producers' Association was formed. The Association has since met with state and federal officials to determine solutions to problems in Cape May such as harbor dredging and bridge clearance. Stew's efforts also produced three Seafood Producers Association scholarships which were awarded at the Annual Cape May Seafood Festival - which Stew also helped to organize.

Stew has also continued his efforts to promote soft-crab shedding in southern New Jersey. Utilizing flow sheets developed by North Carolina Sea Grant, Stew presented a paper at a conference orgainzed by Delaware Sea Grant. One new crab shedding operation in Cape May County which used Stew's expertise produced 29,000 soft crabs during the season and employed ten people.

Gef Flimlin has become a fixture on Barnegat Bay this past year in a boat purchased in a cooperative effort of Rutgers Cooperative Extension, the Cook College Agricultural Experiment Station and SGES. Gef has done much of the organizational work involved in the Hard Clam Spawner Sanctuary project. He has provided meeting facilities for researchers, state officials and industry representatives to discuss plans; obtained Ocean County Vo-tech assistance in designing and building equipment; purchased chowder clams to be planted by baymen; alerted press and other media representatives to provide coverage of the work; and in cooperation with the County Sheriff's Dept. obtained several crews of prisoners to paint and plant the clams. The success of the spawner sanctuary concept has yet to be measured, but Gef Flimlin's work as a gadfly in obtaining the cooperation of so many agencies and individuals has already been successful.

MARINE RECREATION:

Tourism is acknowledged as the second largest industry in New Jersey, generating more than $8 billion in revenues annually and providing over 300,000 jobs. The industry has many components; however, the single most important component is marine recreation and coastal tourism. Marine recreation and coastal tourism is a broad topic encompassing people's activities along the coast and the businesses supported by those activities. The most popular marine recerational activities in the state are directly dependant on water. Swimming, beach use, fishing, and boating issues have been the focus of the SGES marine recreation program.

John Tiedemann's efforts to address the needs of the boating industry, which contributes over $300 million annually to the state's economy, have focused on boating facilities and public access. John was responsible for completing the New Jersey portion of the National Marine Manufacturer Association sponsored National Boating Facilities Inventory. He also completed inventories of public boat launch sites, sewage pump-out facilities, and marina facilities lost to changing land uses (e.g. condominimus). This information has been transferred to interested state agencies and the public in the form of special reports, magazine articles, and fact sheets in John's Sea Note Series. Two other fact sheets were developed to promote boating safety and safe navigation.

John has focused his efforts regarding the state's marine recreational fishing industry, by working with the charter boat industry, organized fishing clubs and the public. He has completed two surveys of fishing tournaments, one for a local chamber of commerce and one for a charter boat association, which resulted in the sponsors and host marina having information on advertising success, sales levels, and angler participation which have been valuable in planning their future events. He is presently working with the Jersey Coast Anglers Association - a conglomerate of 47 fishing clubs representing over 25,000 in-state anglers - to profile membership views on marine recreational fishing activities, opportunities, and problems in New Jersey. John's directory of charter boats willing to book fishing trips for groups of children, senior citizens and the physically impaired has been distributed state-wide and, along with his fact sheets on seasonal fisheries and fish temperature preferences, has resulted in making marine recreational fishing opportunities and the charter boat industry known to new clientele.

Finally, John continued his efforts to address water quality issues as they affect marine resource users and coastal communities. His efforts included working with local and county administrators regarding impacts of an industrial ocean discharge in Ocean County, participation on the Interagency Green Tide Strategy Committee, participation on a State Panel on the Quality of New Jersey's Coastal Waters, and invitation to present his paper "The Importance of Coastal Water Quality to New Jersey's Marine Recreation and Tourism Industry" as the opening presentation at a special symposium on New Jersey coastal water quality at the annual meeting of the New Jersey Academy of Sciences.

SEAFOOD MARKETING:

Nona Henderson cooperated with state agencies in developing new product forms for underutilized Atlantic mackerel. The first phase of the project began in April with a trial run to produce a boneless, skinless, canned consumer pack at Cape May Canners. To test consumer acceptance of unsalted, steamed mackerel, Nona conducted taste tests at the Cape May and the Boston Seafood Festivals. There was a very favorable rate of acceptance by the over 600 people who participated. Nona worked with Dr. Laurie Post in the Department of Food Science at Rutgers during the fall to develop formulations and determine heat curves for a consumer pack.

Complementing the canned mackerel project, Nona has undertaken a promotion and consumer education program for Atlantic mackerel. She prepared a fact sheet including 6 recipes, nutritional data, and health benefits. Copies were distributed at the Cape May and Boston Seafood Festivals. In addition, she developed a consumer education booth which featured the nutritional and health benefits of Atlantic mackerel for the Boston Seafood Festival. Along with Stewart Tweed, Nona promoted grilled Atlantic mackerel at the annual NOAA fish fry in Washinton, DC, authored two articles and was interviewed by NJ radio and press regarding the mackerel development project.

COMMUNICATIONS:

New Jersey Sea Grant and the Extension Service acquired its first full-time Communicator in 1985. Kim Kosko's prior experience in commercial radio, TV and advertising has enabled her to establish a solid communications base for the program, in the short time she's been with New Jersey Sea Grant. In addition to handling writing, production and editing of all Sea Grant related materials, including annual reports, research abstracts, publications policies, press releases, etc., Kim also edits and produces the Extension's quarterly newsletter, The Jersey Shoreline and regular bulletin series and publications produced by the Extension Service.

Special projects launched by Kim in 1985-86 included a 1-minute radio feature, The Jersey Shoreline, which is currently heard on 25 stations around the state, with a potential listening audience of more than 2 million people. The radio features generated tremendous response and requests from listeners for Sea Grant related information. The series also caught the ear of an executive from Silverton yachts, who requested the series be adapted for a column in the company's monthly newsletter, which is distributed to employees and boat dealers.

Kim headed up a Cooperative Education Project with Jersey City State College to produce and distribute video versions of Shoreline, and New Jersey Sea Grant PSA's for TV. A team of media and geology research students were involved in the project. Equipment and studio facilities were provided by the college. Five separate programs are now being completed for distribution this year.

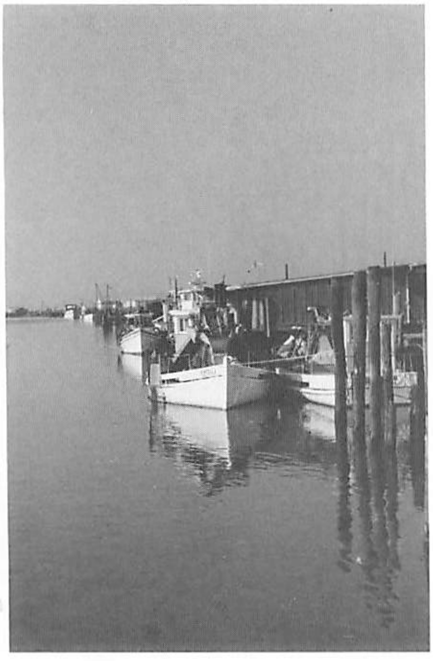
Kim also contributed to national and regional publications, providing articles on New Jersey Sea Grant programs and projects. These include "Crime on the High Seas" for *The World & I*, a Washington D.C. based, national magazine and an article on a NJ Sea Grant on Winter Flounder Disease project for *Fisherman Magazine*.

Additionally, Kim's efforts as media liason and Public Relations rep for Sea Grant resulted in a major article in the New York Times, which featured another Sea Grant project dealing with marine antibiotics.

COASTAL LAW:

In his capacity as Director of NJSGES, Alex Wypzszinski devotes 50 per cent of his time to program administration and 50 per cent to coastal law activities. During the past year, Alex wrote a paper delivered at the East Coast Fisheries Law Conference in Protland Maine, wrote a chapter on resource management which will be published in the Delaware Bay Atlas and taught a course on Legal Aspects of Coastal Development. As part of a committee comprised of representatives of the NJ Department of Environmental Protection, NJ Public Advocates Office and the NJ Attorney General's Office, he's assisted in drafting legislation which will insure beach access at reasonable costs to NJ residents and tourists. Alex also worked on planning the second Security of the Seas Conference.

The primary administrative objectives of the Director in the past year included maintaining program continuity and developing new projects in cooperation with the New Jersey Marine Sciences Consortium, the Rutgers Cooperative Extension Service and other Sea Grant Extension staff. Additionally, Alex worked in soliciting non-traditional funds to help support program activities. In the past year, the Cook College Fisheries Technology Extension Center funded the position of the Seafood Marketing Specialist, who is attached to the SGES staff. The SGES also obtained funds from the New Jersey DEP Division of Water Resources to assist in planning and promoting a public education project on the Navesink River.



WHO'S ON BOARD

At present, the New Jersey Sea Grant Extension Service consists of the following individuals whose 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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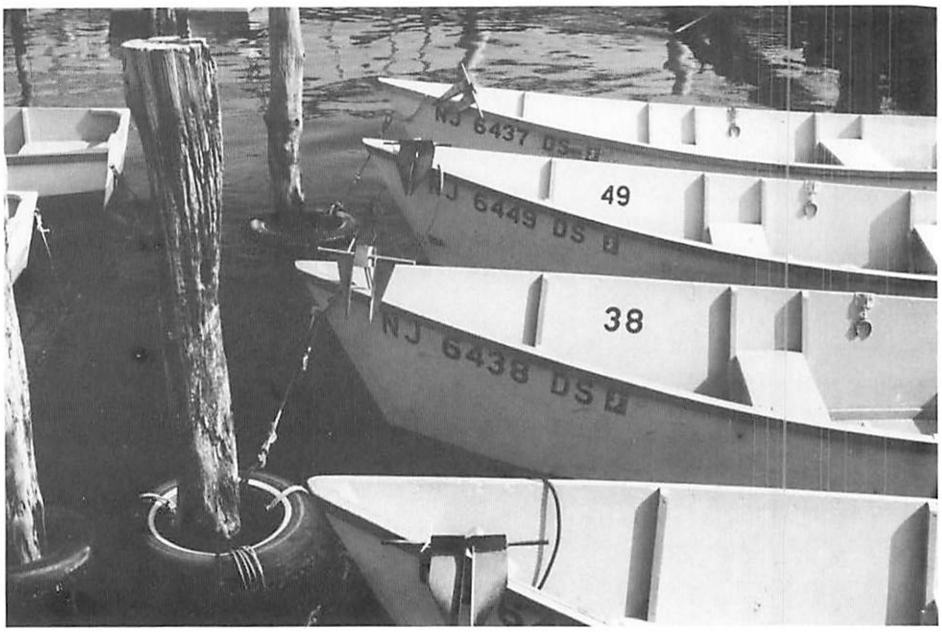

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Program Summary

MARINE RESOURCES DEVELOPMENT

Living Resources

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

R/F-13
Impact of *Glugea stephani* Disease on American Flounder (*Pseudopleuronectes americanus*) Populations
A. Cali
P. Takvorian

R/F-16
In situ Studies of Ocean Quahog (*Arctica islandica*) Growth in Natural Populations
R. A. Lutz
M. Castagna

R/F-17
Viral Content and Filtration Rates in the Hard Clam (*Mercenaria mercenaria*) at a Commercial Depuration Facility
F. Cantelmo
T. Carter

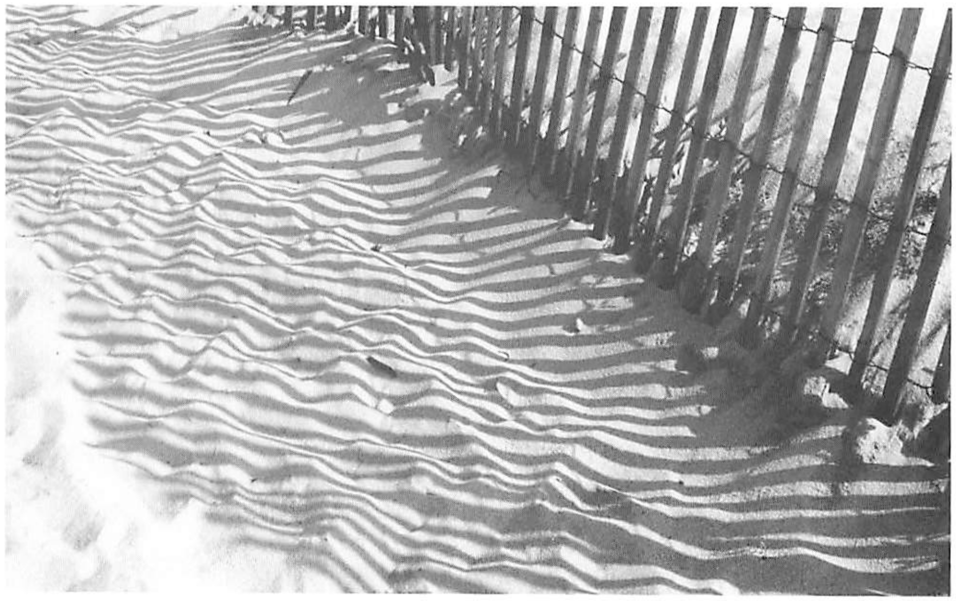
Marine Biomedicinals and Extracts

R/N-6
Radioisotope Dilution Techniques for the Determination of Cobalamins in Marine Waters
G. Sharma

R/N-7
Isolation and Characterization of Antibiotics from Marine and Estuarine Actinomycetes
M. Pisano

Socio-Economic and Legal Studies

R/F-18
Job Satisfaction and Fishing: A Comparative Study
B. McCay
J. Gatewood



MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT

Ocean Engineering

R/N-4
Evaluation of the Performance of a Perched Beach
J. Weggel

R/N-10
New Polymer Concrete for Shore Protection and Marine Structures
M. Wecharatana
C. Lin

Marine Environmental Research and Studies in Direct Support of Coastal Management Decisions

R/S-5
Suspended Sediment Composition and Distribution in Great Sound: Determination of Variables Requried for a Numerical Simulation of Modern Sedimentation in the Salt Marsh Complex of Southern New Jersey
B. Carson

R/S-6
Hydrodynamic Model of an Inlet-Sound System in Southern New Jersey
G. Lennon
R. Weisman

R/S-7
Flow Characteristics and Sediment Flux in the Great Sound Section of the Inner-Coastal Waterway (Stone Harbor, NJ)
G. Ashley

R/S-8
Tracing Pollutants Using Trace Metals Associated with Sediments in the Lagoons of Southern New Jersey
J. Nadeau
M. Hall

MARINE EDUCATION AND TRAINING

E/T-4
New Jersey 4-H Marine Science Program Development
B. J. Jesuncosky

ADVISORY SERVICES

A/S-1
New Jersey Sea Grant Extension Service
A. Wypyszinski

PROGRAM MANAGEMENT

M/M-1
Program Administration
R. B. Abel

M/M-2
Program Planning
R. B. Abel

Activity Budget

ACTIVITY BUDGET SHEET
(Summary Totals by Activity)

	NOAA Grant Funds	Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living Resources, Other Than Aquaculture	$106,500	$283,500
Mineral Resources	59,000	82,500
Marine Biomedicinals and Extracts	83,500	107,800
	$249,000	$473,800
SOCIO-ECONOMIC & LEGAL STUDIES		
Socio-Political Studies	24,400	27,200
	$ 24,400	$ 27,200
MARINE TECHNOLOGY RESEARCH & DEVELOPMENT		
Environmental Models	$ 39,700	$ 19,900
	$ 39,700	$ 19,900
MARINE EDUCATION AND TRAINING		
Other Eduation - 4-H	$ 4,000	$ 11,500
	$ 4,000	$ 11,500
ADVISORY SERVICES		
Extension Program	119,200	183,200
	119,200	184,200
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	157,700	59,100
Program Development	20,000	0
TOTAL	$667,000	$817,500

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