Sea Grant in Connecticut

A report on the Sea Grant Program at the University of Connecticut
July 1, 1983-June 30, 1984

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From the Director

Change continues to be the order of the day at Avery Point. The decision to move toward a major marine center for education and research was made early in 1984. This decision has resulted in the creation of five State-funded positions which are now being advertised, and a sizeable commitment for capital improvements. With the creation of the Northeast Center of the National Undersea Research Program at Avery Point in May and the commitment to an expanded and modified Marine Sciences Institute, in addition to Connecticut Sea Grant, the overall program is clearly starting to move forward.

During the 1983-84 budget year, the Sea Grant program continued the two research projects on hard clam growth and oyster management which had started in 1982. To these were added research projects on soft-clam utilization and dredge spoil stabilization. Several additional research project areas were explored for future development. These include a regional study of the impacts of coastal tourism product mixes and exploration of a program in fisheries management. The latter is being moved ahead by James Wallace, who joined the Marine Advisory staff in December, 1983, with some input from the Departments of Animal Industries and Nutritional Sciences. The federal grant of $350,000 for July 1, 1983 to June 30, 1984, was supplemented by a State grant of $40,000 and increased support from the University of Connecticut. Much of the additional funding was used to increase our capabilities in communication and publication.

The hard clam research has resulted in techniques that will insure increased survivorship of seed clams. Proper management of the conditions under which clams are grown can foil predators and permit greater numbers of clams to reach maturity. One commercial hatchery has already been established, based on these methods. The work on the dredge spoil mounds has already shown the possibility of large savings by using thinner layers of capping material under controlled conditions.

The Marine Advisory Service has worked with nine shoreline towns in developing shellfish management plans, in creating local shellfish commissions, and has assisted in the creation of a statewide Aquaculture Commission. In another direction, they have provided technical assistance which has helped materially in the revitalization of the Port of Stonington commercial fishing facility. That work paved the way for construction of a $300,000 dockside processing plant in 1984.

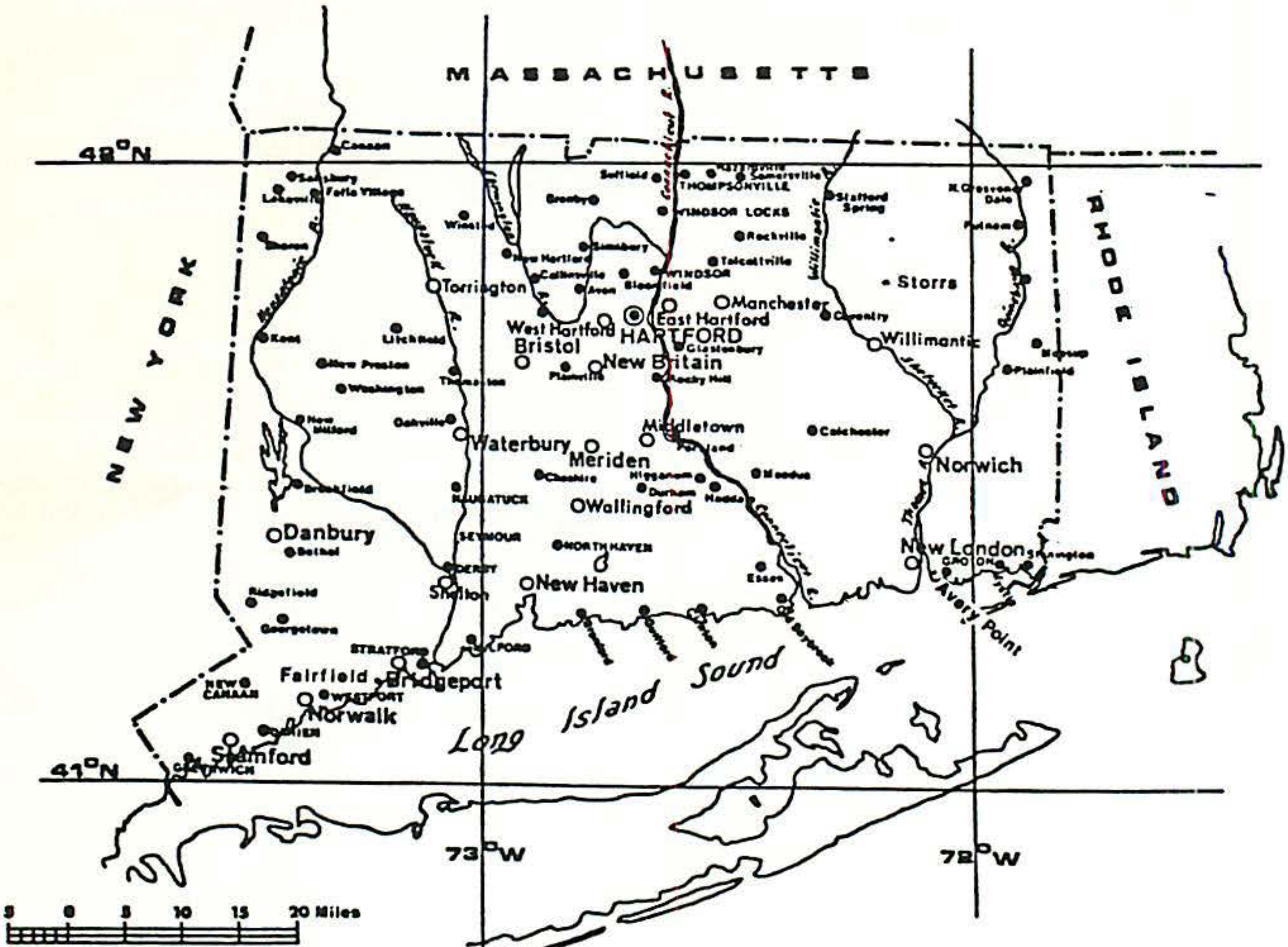
During the spring of 1984, the Avery Point Campus was designated the undersea research center for the coastal northeast and the Great Lakes. This change resulted in the assignment of Lance Stewart on a full-time basis as Science Director for the NURP/UCAP program. A search is now being conducted for his replacement in the MAS Program Leader's position. All of these changes have served to keep the attention of the University of Connecticut and the State on our maritime activities.

Our relations with the Congress and the Connecticut General Assembly continue to be good. Assistance by many individuals has not only been promised, but actually been delivered, at times above expectation. Senator Lowell Weicker continues to be the great defender of Sea Grant and other maritime programs. Senator Chris Dodd and Representatives Sam Gejdenson, Barbara Kennelly and William Ratchford have assisted materially in Sea Grant reauthorization and appropriations. Many of the State Legislators, including Senators Gunther, Johnston, O'Leary, Schneller and Skowronski, Representatives Bertinuson, Cibes, Goodwin, Helfgott and Polinsky have helped us move forward.

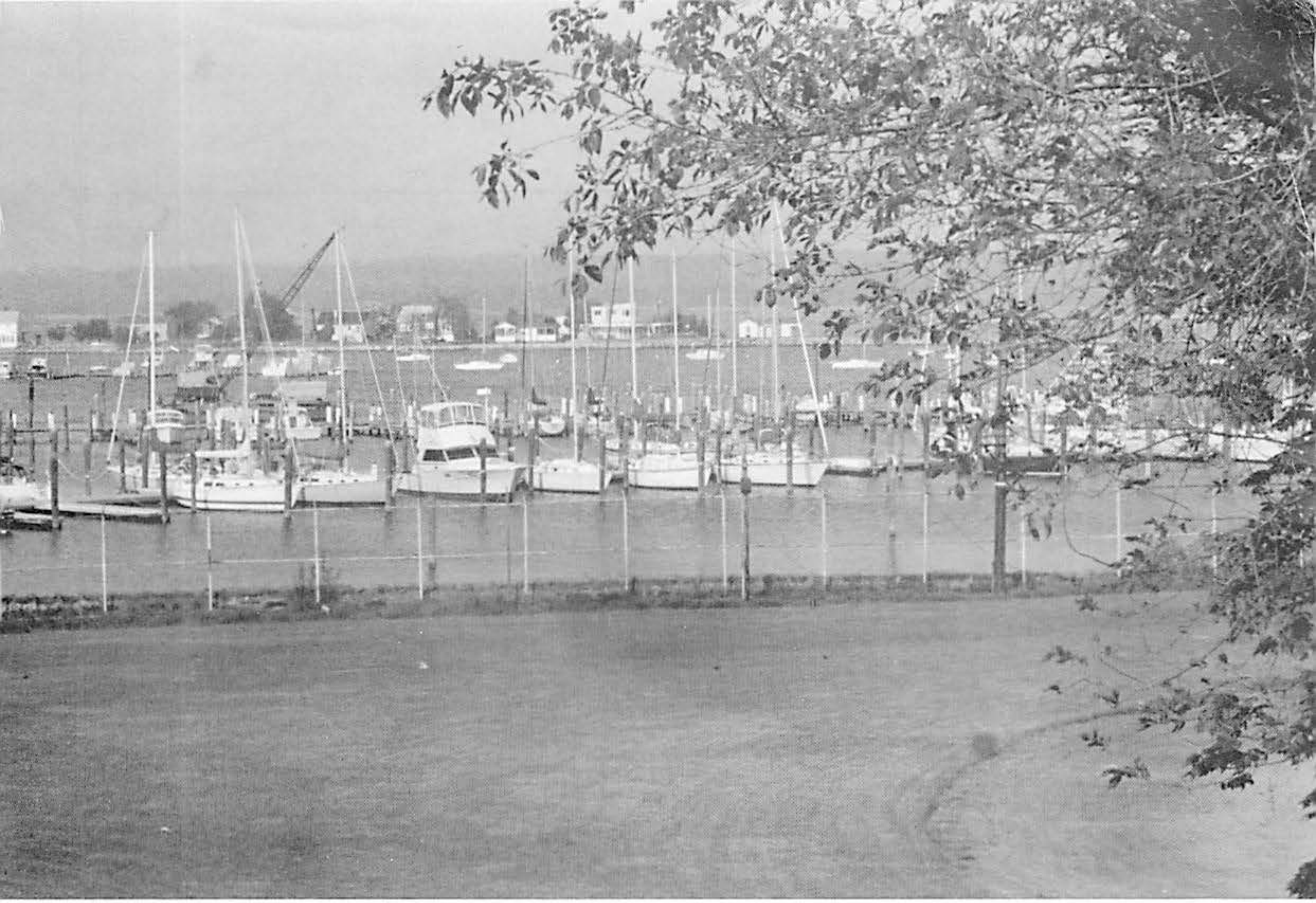
In this second year of the Connecticut Sea Grant Program, we have moved much closer to NOAA and the National Sea Grant College Program, both in terms of our understanding of what Washington expects of us and in terms of their understanding of our present capabilities and future plans for Avery Point. These plans received an enormous lift from the discussions held in May between the leadership of NOAA and the University. With respect to the Connecticut Sea Grant Program, we wish to express our thanks to the National Office of Sea Grant for many hours of effort and endless patience in helping us to move toward mutual goals.

Victor E. Scottron, D. Eng.
Director
Connecticut Sea Grant

Introduction



Connecticut



"The ocean knows no favorites. Her bounty is reserved for those who have the wit to learn her secrets, the courage to bear her buffets and the will to persist, through good fortune and ill, in her rugged services."

Maritime historian Samuel Eliot Morison wrote those words in his "Maritime History of Massachustts." They might equally well have been written about Connecticut and the men and women who live from the waters off her coast—whether they harvest her bounty, plumb her depths to unlock her secrets, keep silent vigil fathoms beneath the surface, or brave her buffets to secure the safety of others.

Science has become a tool for all of the followers of the sea, to help each become better at his task. Technology helps fishermen catch more fish and make the most of their operating time. Science has a role in keeping the water clean, in making vessels safer, in increasing harvests of the sea—whether through increased efficiency of a trawling operation, or development of techniques that will permit the use of shallower water to grow shellfish.

In Connecticut, Sea Grant provides some of the answers. Research scientists at a half-dozen institutions search for solutions for problems identified by industry and Sea Grant or Marine Advisory Service staff within the state. Their projects are funded by the National Oceanic and Atmospheric Administration. The Marine Advisory Service agents help those in the marine industries apply the research in the field.

This state-federal-industry partnership is typical of Sea Grant programs across the country. Their aim is to promote wise use and conservation of the nation's marine resources. In 1966, Congress took the century-old Land Grant College system as a model for Sea Grant, and charged the Sea Grant program with unlocking the secrets of coastal zones and the oceans, and disseminating the findings to people who will benefit from them.

In Connecticut, Sea Grant research projects focus on hard clams, soft clams, the behavior of dredge spoil disposal mounds, helping shoreline towns develop their shellfish resources, and coastal development issues.

Sea Grant in Connecticut began in 1980 with the establishment of a Sea Grant office at the Avery Point Campus of The University of Connecticut. The research arm of Sea Grant joined a strong Marine Advisory Service, which had been operating in conjunction with the UConn Cooperative Extension Service since 1974.

But, whether through the research sponsored by Sea Grant or the education and technical applications demonstrated by Marine Advisory Service specialists, the aim of Connecticut Sea Grant remains unchanged: to help the state's residents appreciate the resources Long Island Sound has to offer all of them.

Research

PROJECT R/LR-1:
Life History and Resource Management of the Hard Clam, *Mercenaria mercenaria*
Robert Whitlatch and Wendy Wiltse

Although the present hard clam fishery in Connecticut is small, potential growing areas are plentiful and coastal towns are actively developing the fishery. Several towns are drafting management plans, initiating efforts to seed local beds, transplant contaminated clams, and lease beds to private clam farmers. The focus of the research by Robert Whitlach and Wendy Wiltse is to experimentally examine the population dynamics of *M. mercenaria* and apply the resulting data to the development of effective resource management practices. Their research includes studies of natural populations, larval settlement and recruitment, experimental evaluations of the growth and survivorship of juvenile and adult clams, and comparative studies of grow-out techniques.

Natural Populations: Hard clam populations are patchily distributed within and between sites. The age structure of the populations is variable, but suggests that significant recruitment or increased juvenile survivorship occurs every three to four years. The clams experience high mortality in the first three years of life and a lower and constant survival rate following that period. It also appears that recruitment and growth rates of the hard clam are influenced by density structure of local populations: recruitment increases and growth declines as population density increases.

Work with juvenile *M. mercenaria* is being conducted at two sites, the Poquonock River in Groton and West Harbor, Fishers Island. These experiments involve planting juvenile clams of different sizes (1-2, 5, 10, 15, 18, 21 mm) in ¼ m^2 sand-filled trays in order to assess natural survivorship and growth patterns and the effects of juvenile density (for 5 and 10 mm sizes) on these patterns. Growth rates of 5 and 10 mm seed clams are not significantly different between the two study sites, although water temperatures at West Harbor were typically 3-5° C cooler than at the Poquonock River site.

Significant between-site and between-size mortality rates were found. Survivorship of 15-21 mm clams were greater than 5 and 10 mm seed. Both monthly and full season survivorship of all sizes was greater in the Poquonock River than at West Harbor. Monthly survivorship patterns show a strong seasonal pattern with least intense predation in September in the Poquonock River for 5 and 10 mm clams.

At both sites, more than 90% of the juvenile mortality is attributable to crustacean predators (primarily green crabs, *Carcinus maenas*). Surveys of predator density and activity patterns correlate with juvenile survivorship patterns during crustacean molting periods, clam survival being greatly increased. In addition, there is evidence suggesting that lobsters (*Homarus americanus*) and rock crabs (*Cancer irroratus*) are important predators of clams greater than 20 mm.

Juvenile survivorship is strongly density-dependent. Correcting for size, seasonal and site-specific differences, overall survivorship of clams planted in low density plots (25 clams/plot) is about two times greater than clams planted in intermediate density plots (150 clams/plot) and three times greater than the highest density planting (300 clams/plot).

Adult Experiments: After the first year of adult experiments, survivorship was 91.5%, and adult mortality was apparently not a function of density, and all age classes had an equal probability of dying. Individual growth rates were variable and did not appear to be affected by density. Estimates of relative individual fecundity (displacment volumes) also showed little variation between density treatments.

Recruitment Experiments: Natural recruitment of *Mercenaria* at the field sites was sparse and variable. Although some settlement of *Mercenaria* was detected at the sites monitored in 1982 and 1983, the only noteworthy set occured in the Poquonock River in 1982. The density peaked at 13,600 m⁻² on 19 July, but this year class disappeared shortly after settlement, before clams reached 500 mm shell length.

Experiments in laboratory aquaria and field enclosures tested the hypothesis that benthic organisms reduce larval settlement and/or postlarval survival of *Mercenaria*. These experiments showed that deposit-feeding bivalves, *Macoma* and *Tellina*, reduced the number of Mercenaria to 3-66% of control densities within six days after larval settlement. The natural benthic assemblage from one field site reduced densities of *Mercenaria* to 6% of control levels in six days. Deposit feeding polychaetes and other species of suspension feeding bivalves had no effect on recruitment of *Mercenaria*.

The effect of *Mercenaria* on recruitment of its larvae appears to be related to the density of clams present.

Low densities of *Mercenaria* enhanced recruitment, whereas very high densities inhibited settlement, possibly due to ingestion of larvae by adults.

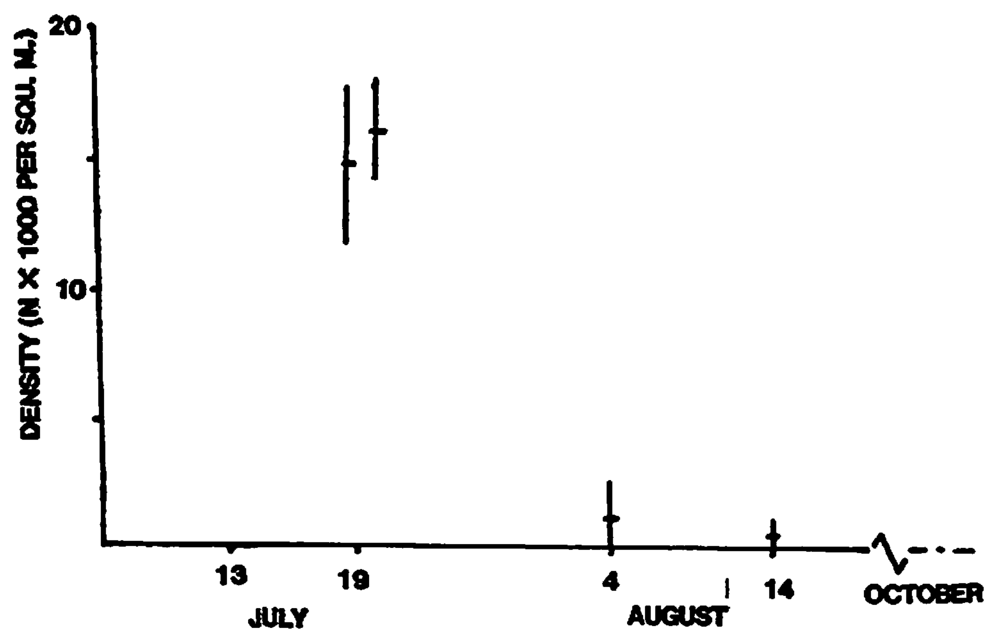
Grow out studies: The overall objective of this experiment is to compare different techniques of growing intermediate sized *M. mercenaria* seed to market size. The study is being conducted in West Harbor as part of a cooperative research program with a private clam grower (The Clam Farm).

During the first week of July, 1983, a total of 35,000 seed clams (average size =12 mm) were planted in five different grow-out systems: (a) bottom trays (6′ x 25′ x 4″) filled with sand; (b) bottom trays filled with sand and covered with a 3-4 cm layer of pea gravel; (c) tents composed of a 2.5′ x 6′ layer of plastic mesh (Conwed 1.5 x 1.2 str./in) placed directly on the bottom, covered with a pea gravel and second layer of mesh at the top; (d) an identical design of (c) with no mesh cover, and (e) Pearl nets suspended in the water column. At monthly intervals, random samples of 50 clams were measured from each replicate (four replicates per treatment).

Clams grew equally well in and out of substrate. Growth of clams in treatment (c) was less than both treatments (b) and (e), however. Density experiments were conducted in tents only and revealed a negative effect of density on growth. The probable cause of depressed growth in the tents, and possibly the density effect, is the frequent blanketing of the tents by drifting macroalgae (primarily detached *Laminaria*).

The primary clam predators at the site are green crabs (*Carcinus maenas*), rock crabs (*Cancer irroratus*), lobsters (*Homarus americanus*) and starfish (*Asterias forbesii*). Being suspended in the water column, the Pearl nets afforded the highest protection and clam survival. The gravel substrate also provides considerable protection from predators. More than 99% of the clams planted in trays with sand only were eaten within one week of deployment. However, a layer of gravel over the sand resulted in survival rates over 90%.

Information generated by these studies will be used directly in towns and industry to develop or increase optimal planting methods for seed clams (e.g., time, size and density of planting) and to assess techniques for increasing clam recruitment and survival in natural populations.



PROJECT R/SL-1:
The Influence of Management Strategies and Regulatory Policies on the Production and Marketing of Long Island Sound Oysters

Marilyn Altobello, Madelyn Huffmire, Lance Stewart

Profit and loss is a key factor in any business—and oystering is no exception.

How he chooses to grow his stock can substantially affect the balance sheet for an oysterman.

And, the regulations governing his business—and how they are applied—also have a significant effect on whether an oysterman will show a profit at the end of the year.

An economist and a lawyer teamed up to survey Connecticut's oyster industry and examine the effects that regulatory policies and marketing strategies have on the oysterman's business.

Marilyn A. Altobello is a resource economist in UConn's College of Agriculture and Natural Resources. Madelyn M. Huffmire, a lawyer, teaches business law in the university's Department of Business Environment and Policy.

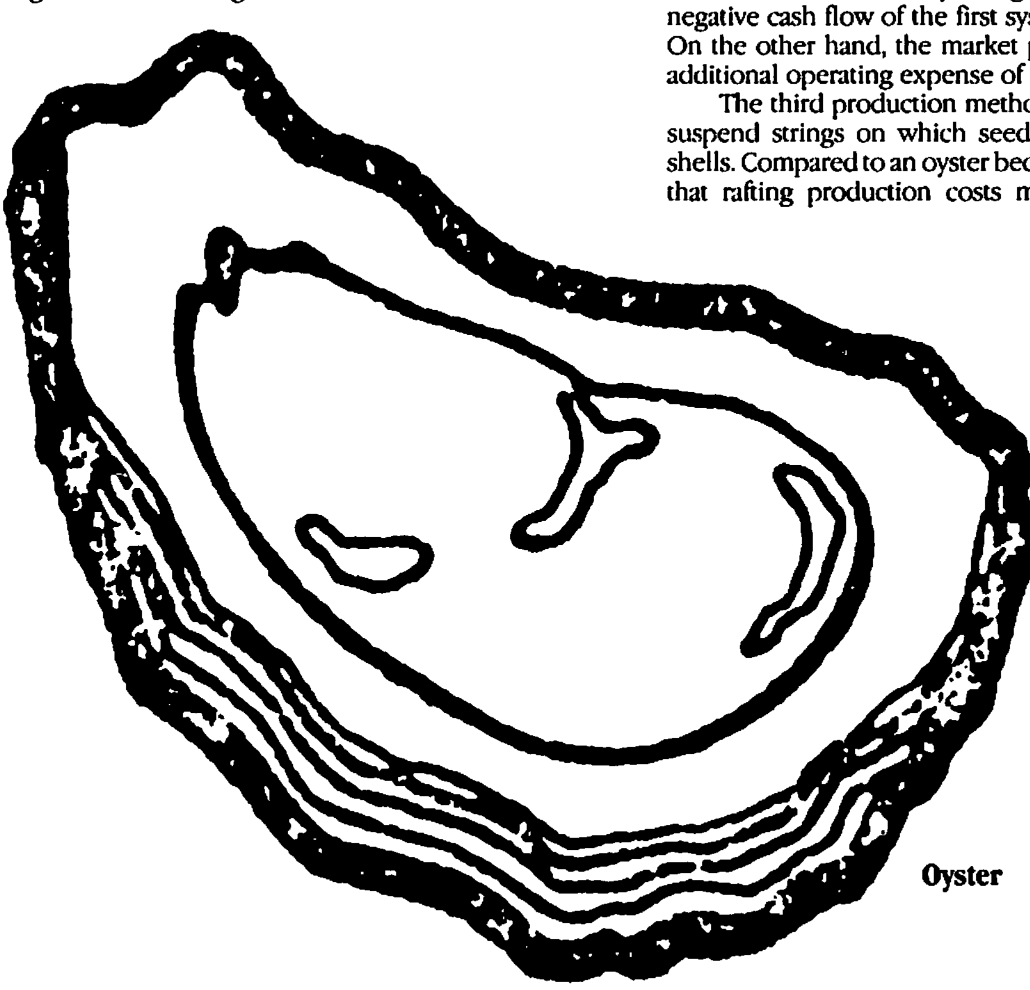
They examined methods of growing oysters and how oystering is regulated, to develop recommendations for increasing the volume of oyster production in Long Island Sound.

During the first year of this project, representative budgets for natural growthers and individual market producers were developed, based on survey data collected. Since then, emphasis has been placed on the market producer and the particular management strategy employed when raising oysters to marketable size. Various techniques have been investigated and the economic strengths and weaknesses of the different production techniques have been identified. Based on this analysis, recommendations have been made which are designed to improve the efficiency and operation of the Long Island Sound oyster industry.

Four culture systems were defined. The first system is where the market producer dredges for seed on the natural public beds, transplants to grow-out beds, then markets the oysters on the half-shell market in four years. The advantage of this type of production is the vertical integration which effectively eliminates any intermediary labor. The major disadvantage is the four-year lag between incurred operating costs and revenue.

The second system is similar to the first, with the only difference being that the seed is purchased from the natural growther. It is assumed that the oysters are purchased at a relatively large size and are expected to reach market size in only one growing season. Thus, the negative cash flow of the first system is not experienced. On the other hand, the market producer must incur the additional operating expense of seed purchases.

The third production method involves using rafts to suspend strings on which seed oysters are attached to shells. Compared to an oyster bed on the bottom, it is clear that rafting production costs more due to the capital



Oyster

investment, depreciation and costs associated with rafts.

There are, however, certain advantages which offset the added expense. If the strings are not touching the bottom, predators cannot reach the oysters. The mortality rate is very low when comparing the rafting method to cultivation on the bottom. This system is also able to benefit from rapid growth rates where oysters reach market size in two to three years rather than three to four years as with bottom cultivation.

The major disadvantages associated with rafting cultivation are the increased fouling which occurs on oysters in suspension, requiring additional labor for culling and cleaning, and a relatively thin shell that is easily chipped when handled. The profit potential for rafting cultivation is promising in those years that oysters are marketed. One way to offset the losses incurred in years without revenues is to supplement the rafting stock with seed that will mature during those years. This solution is contingent on the existence of sufficient grow-out beds and financial capital.

The fourth system assumes that the market producer purchases seed from hatcheries. The system does not consider the production method of the hatchery operation itself, since interviews with hatchery operations indicated that they were not usually economically viable. The major advantage of hatchery seed is its more predictable supply relative to natural seed. However, the costs of producing hatchery seed is considerably higher than that of natural seed. It is concluded that hatchery production should be supplementary to natural recruitment.

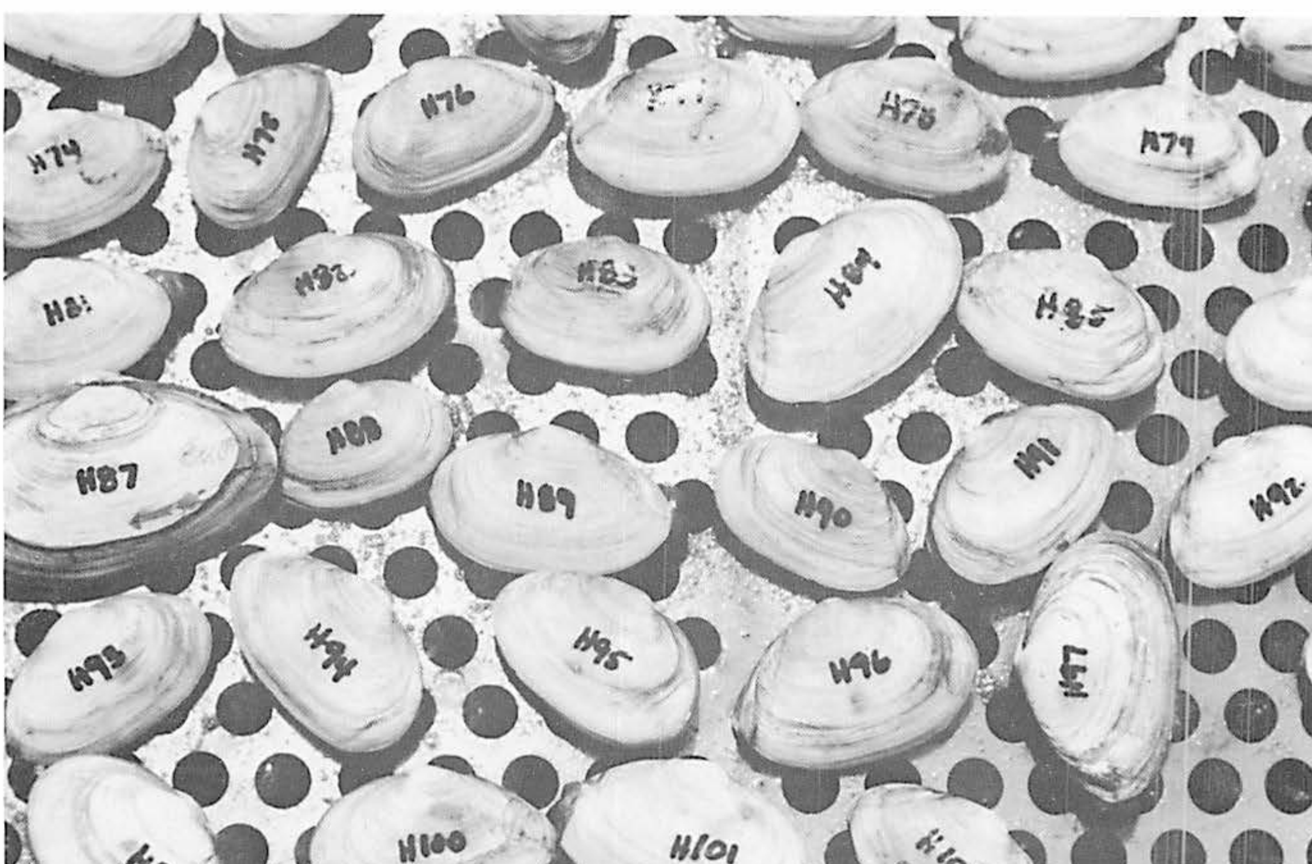
The major recommendation which evolves from this study is that greater emphasis should be placed on the management of natural beds. Management policies would include: (a) proper preparation of setting beds, which would include the elimination of predators and removal of silt immediately before and after setting; (b) careful monitoring of larvae to determine both when and where the cultch should be spread; (c) the use of dock-dried shell, rather than recently dredged shell, as cultch; (d) the systematic control of predators once setting has occurred, and (e) transplantation of the young oysters in early spring as a means of preventing mortality by siltation. It is estimated that, as a result of these practices, the current volume of production from Long Island Sound could be increased substantially.

In addition, the researchers see a need to identify the bottom land that is still available for lease, and determine whether it could be returned to production.

They urge a cooperative effort among the state and towns to review policies concerning leasing of underwater lands for shellfish beds, and also revaluation of beds currently under perpetual leases. Current leaseholders have a five-year supply of oysters on their beds, but they are taxed at 60 cents per acre a year, prompting the researchers to urge regulatory agencies to devise tax strategies that would promote increased competition in the Long Island Sound oyster industry. The cooperative effort should include New York, the researchers suggest.

Another recommendation is for organization of the "extremely diverse" interests within the oyster industry itself, and development of mechanisms that would permit communication of the unified interests to state and local governments, as well as the federal government.

Also recommended are establishment of on-shore facilities to increase marketing of Connecticut's seafood products, efforts by the state to make entry into oyster culture efforts easier, and allocation of additional money for enforcement of existing regulations.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PROJECT R/LR-2:

Life History, Modelling and Research Utilization of the Soft-Shelled Clam, *Mya arenaria*

Diane Brousseau, Jenny Baglivo, George Lang

Computers are playing a major role in development of a blueprint for management of the soft-shell clam in Connecticut.

Dr. Diane Brousseau, a biologist, and Dr. Jenny Baglivo and Dr. George Lang, both mathematicians, are teaming up to determine how many soft-shell clams there are, how much they grow and how often they reproduce.

The information can be integrated into a computer model that will allow the state or local authorities to set limits on clammers' take, and help local authorities determine the best times for opening clam beds.

Funding for the project began on January 1, 1984. During the initial phase of the study, biologists began field and laboratory studies to determine mortality, growth and reproductive cycles of *Mya arenaria*. The mathematicians designed both the simulation and sensitivity analysis software.

In order to determine biological populations, the biologists monitored intertidal populations of soft-shell clams at Barn Island in Stonington, and at two sites in Westport. The Stonington population spawned twice during 1983-84, once during the early summer and again in the fall. Data from the Westport sites is less complete. Monthly samples have been collected since March, 1984, but have not yet been analyzed for Gametogenic development.

In order to determine fecundity rates for clams of various sizes (ages), 200-300 individuals were sampled at each of the three study sites during the May and June spawning period. The gonads were extracted and embedded in paraffin to await final histological anlaysis.

Mark and recapture experiments to determine survivorship rates of adult clams were begun in May. Four study sites were established—in the Saugatuck River in Westport, at Milford Point in Milford, at Long Wharf in New Haven, and at Jordan Cover in Waterford.

Approximately 2000 individuals from each site were dug, marked with a code number, measured and replanted in experimental plots. The plots will be dug in the spring of 1985 to determine annual survivorship rates for adult individuals of various sizes (ages).

Initial work to determine survivorship rates for juvenile clams was begun in July immediately after settlement of spat occurred. Densities of newly settled and adult clams were determined by sampling along transect lines laid out across the clamflat at low tide. The largest spatfall occurred at Gulf Pond in Milford, where juvenile clam densities of tens of thousands per m2 were reported. Light spatfall (< 100/m2) occurred at the sites in Westport, Milford Point, West Haven and Waterford. Repeated sampling at the same sites during the next year will provide information on the survivorship patterns of young clams.

An indirect method of aging, using internal growth lines in the shell of *M. arenaria*, is giving promising results. Age-size relationships are being determined for the two Westport populations and the one in Stonington. Since growth rate and shell characteristics depend, to a large part, on the type of substrate in which the clams are growing, this method provides a reliable means to generate detailed information on age and growth for populations living in a variety of sediment conditions, without having to rely solely on labor-intensive mark-recaptive experiments.

A systematic survey of intertidal flats in Connecticut waters has revealed the presence of natural populations at the following locations: Cove Beach, Stamford; Saugatuck River, Westport; Sherwood Island, Westport; Lewis Gut, Stratford; Milford Point, Milford; Gulf Pond, Milford; Oyster River, West Haven; Bradley Point, West Haven; Long Wharf, New Haven; Jordan Cove, Waterford; Poquonock River, Groton; and Barn Island, Stonington.

In the first phase of the mathematical modelling portion of the project, software was designed that will: 1) simulate the populations dynamics of *M. arenaria* under various harvesting strategies; 2) test the sensitivity of harvesting strategies to errors in the life history parameters, and 3) graphically display the results of the analyses of the model.

The random number generators were also extensively tested. (These programs are needed to incorporate the effects of environmental variability and sampling errors.) The software was tested for sensitivity, using life history data for the literature, and the graphics software to display the results of the tests. Finally, the mathematicians began testing of the simulation package.

PROJECT R/ME-1:

Geotechnical Aspects of Dredge Spoil Mass Behavior and Capping Procedures for Managing Coastal Disposal Operations

Kenneth R. Demars, Richard P. Long

Dredging keeps Connecticut's harbor channels open. Techniques for removing the silt that fills up the channels are fairly well developed, but there remains the question of how the dredged material is to be disposed of, and how it will behave after it is dumped.

Kenneth R. Demars and Richard P. Long of The University of Connecticut's Department of Civil Engineering are examining material dredged from harbor channels and how it behaves under pressure.

That information will enable them to construct a computer model that will demonstrate how the dredged material will react under water, or when another load is dumped on top of it. Ultimately, their findings are expected to result in a handbook for dumping that will describe the way to build the most stable possible mounds.

In addition, they expect to develop procedures for capping contaminated material that could result in significant savings if less cover could be used.

The research during the first year was concerned primarily with establishing the geotechnical properties of the dredged material from disposal mounds in central Long Island Sound. These properties will be used in analyses of shallow ocean behavior of the mounds.

Both surface and subsurface soil samples were recovered from the Central Long Island Sound disposal sites. Thirteen surface samples were acquired with a clamshell sampler and transferred to a 6 cm (2¼ in.) diameter plastic tube for transit and storage. These samples were taken from three mounds, including the Field Verification Program (FVP) mound and the two cap site mounds, CS-1 and CS-2, as shown in Fig. 1. The samples are designated by the mound and surface location relative to the mound center. For example, surface sample CS-2-100E is from 100 m east of the center mound CS-2. Additionally, seven gravity core samples were acquired from the Stamford-New Haven North and South mounds (STNH-N and STNH-S). These core samples had lengths varying from 1 to 5 m (3 to 16 feet).

The samples were tested in the laboratory to determine their physical and engineering properties. The test program utilized standard test procedures to determine: water content, Atterberg limits, grain size distribution, undrained shear strength by fall core, organic matter content by weight and compression behavior. The test results to date are shown in Tables 1 and 2 and are typical of coastal and estuarine sediments in Connecticut. Mound sediments are primarily organic silts with variable amounts of sand and clay. As can be seen from the tables, the natural water content and Atterberg limits reflect the relative amount of fines present in the sample. The samples which have the larger amounts of fines also have the greater liquid and plastic limits and natural water contents. Most samples containing a large amount of fines showed a low value of coefficient of consolidation and considerable secondary compression. Compression indices for both spoil and natural bottom sediments are

about the same value of 0.7. The undrained strength values were very low, reflecting their recent deposition and short stress history. Organic matter contents ranged from 1% to 9% by weight.

Two cores were recovered across the sand cap spoil interface on the STNH-N mound and four cores from the silt cap-spoil interface on the STNH-S mound allowing a comparison of the properties of both materials. The grain size distribution results from one typical core is shown in Table 3. In Table 3, the particle size distribution progress from predominately sand (cap) near the surface to a silty spoil material at a depth of 80-90 cm. Visual observations on split core samples show that there is some interlayering of cap and spoil.

A successful cap must confine and isolate the polluted spoil. To do this, the pores of the capping material must be small enough to prevent the larger particles of the spoil from migrating. Thus, the immobilized larger particle sizes in the spoil will prevent the smaller spoil sizes from moving. The result is that essentially all of the spoil solids are contained by the capping material.

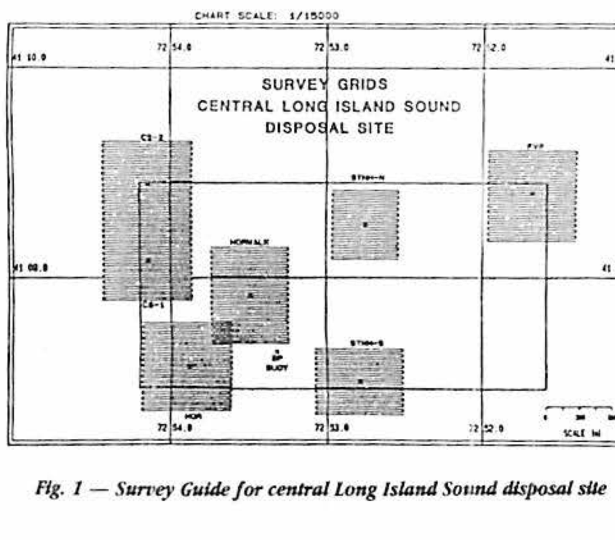


Fig. 1 — Survey Guide for central Long Island Sound disposal site

TABLE 1

Summary of Index and Geotechnical Properties of Surface Samples

Surface Sample	Desc.	Water Content w_n	Liquid Limit w_l	Plastic Limit w_p	Grain Size Sand/ Silt/ Clay (%)	Compr. Index C_c	Coef. Consol. $C_v(cm^2/min)x10^{-2}$
FVP 400E	Ol-Gry Silt with clay & some sand	119.4	92.8	40.	5.3/70.7/24.	0.82	5.5x
FVP 200E	Blk silty sand (B.R.)	150.0	119.1	23	21.6/55.4/23.		
	Ol-Gry clayey silt	104.0		44.2	2.6/68.4/29.		
FVP 100E	Blk Organic silty Sand (B.R.)	125.9	40.1	52.1	63.8/24.2/12.0	0.75	2.6
FVP 50E	Blk Silty Sand with some clay	117.5	71.1	33.9	44.1/37.9/18.		
FVP CTR	Silty Sand-some shells (B.R.)	99.5		36.4	63.6/22.4/14.0		
	Blk Silty - sand	62.8	56.9	22.8	57.6/32.4/10.		
CS-2 200E	Ol Silt/clay with some sand (cap)	109.5	76.8	38.6	12.8/58.2/29.	0.67	5.2
	Blk sandy - silt spoil	88.		36.7	40.7/46.3/13.		
CS-2 100E	Ol-Gry sand with some silt (cap)	30.9			83.8/10.2/6.		
	Blk. Organic silty sand	83.5		31.5	61.0/26/13.		
CS-2 50E	Sand with silt and shell hash	26.2			92.6/5.4/2.		
CS-2 CTR	Lt. Ol. Sand w/some silt & shells	24.8			80.8/16.2/3.	0.04	
CS-1 200E	Dk. Ol. clayey silt	127.6	107.8	39.5	5/60/35.		
CS-1 100E	10 cm Blk silt spoil (B.R.)	132.0	120.9	55.6	22.5/50.5/22.	0.87	4.8
	2 cm Gry. clayey silt	157.5	127.1	22.8			
CS-1 50E	Blk clayey silt spoil (B.R.)	167.0	151.2	62.3	3.2/61.8/35.		
	Ol. clayey silt	164.0	132.9	66.7	4.4/63.6/32.		
CS-1 CTR	Blk clayey silt w/some sand (cap)	153.2	103	62.7	16.0/53/31.	0.59	4.8

ABBREVIATIONS

B.R. - Black Rock Harbor Spoil
Ol - olive
blk - black
gry - gray

TABLE 2

Summary of Index and Geotechnical Properties of Core Samples

Sample Depth (cm)	Desc.	Water Content w_n	Liquid Limit w_l	Plastic Limit w_p	Grain Size Sand/ Silt/ Clay (%)	Compr. Index C_c	Coef. Consol. $C_v(cm^2/min)x10^{-2}$
STNH-S-1:							
000-010	Ol.-gry silty clay	99.5	92.8	51.7	09/61/30		
100-110	Nat. Bottom	98.5	98.1	36.7			
STNH-S-2:							
000-010		89.3			26/50/24		
015-025	Alter. layer gry silt cap. dr. gry to blk silt spoil & gry	81.2			40/40/20		
030-040	Sandy silt w/some clay	84.5			12/58/30		
045-55		109.3			22/28/20		
060-070		102.7			15/65/20		
070-080	Brn gravel - sand w/some silt	63.6			84/16/0		
080-090					30/50/20		
090-100		90.2	76.5	38.5	02/68/30	0.58	9.61
175-185	Ol. gry clayey silt, natural bottom	91.0					
185-195	Ol. gry clayey silt, natural bottom	83.7	77.7	38.2		0.53	15.2
STNH-S-3:							
000-010	Ol. gry silty sand	54.3			69/21/10		
090-100	Blk to olv-gry, silt	84.0	85.1	40.0		0.90	10.6
185-195		78.9	76.4	34.3			
195-205		79.0	70.5	35.3		0.65	16.1
205-215		79.0					
STNH-S-4:							
040-050		115.3	96.4	60.5			
050-060	Dr. gry to blk clayey silt				06/58/38		
090-100	Dr. gry to blk clayey silt + 1/4" shell	100	100	44.5		1.03	13.2
STNH-S-5:							
190-200	Olv.-gry clayey silt, nat. bottom	91.9	75.7	24.7	05/70/25	0.68	20.4
290-300	" "	88.8	76.3	30.4	05/67/28		
390-400	" "	109.8	97.3	46.2	52/30/18		
490-500		93.2				0.83	14.6

This effect is similar to that sought in the design of filter layer in drainage. Experimental evidence shows that successful containment can be predicted by the ratios of certain particle sizes in the cap and the spoil. The particle size analysis in this laboratory program indicates that the ratio of particle diameter representing 15% finer by weight in the capping material to the particle diameter representing 85% finer by weight of the spoil is well within the limit (i.e., less than 5) for containing the spoil particles (Cedergren, 1967). Since there is presently no selection procedures for capping material, these criteria should be addressed when selecting future capping material.

Typical settlement plots show that the behavior of the dredged material and the natural bottom material is similar. Both sample types exhibit a compression index of about 0.7. All samples with more than 40% passing the No. 200 sieve show significant secondary compression. These geotechnical properties will be used in appropriate computer models to analyze and predict field behavior. The following programs have been mounted on the IBM 3081 at UConn for use in this project: ICES LEASE, ICES SEPOL AND CSLFS, WES.

TABLE 3

Summary of Index and Geotechnical Properties of Sand Cap

Sample Depth (cm)	Desc.	Water Content w_n	Grain Size Sand/ Silt/ Clay (%)	Wet Density g/ml
SNH-1:				
000-010	Lt. gry. silty sand, cap with shells		98/02/00	
010-020	" "		99/01/00	
020-030	" "		100/0/00	
030-040	" "		99/01/00	
040-050	" "		100/0/00	
050-060	" "		100/0/00	
060-070	" "		100/0/00	
070-080	Alt. layers ol. clay, dr. gry. spoil & shell sand	33.7	75/11/14	1.890
080-090	" "	45.2	45/43/12	1.766
090-100	Dr gry sandy silt spoil	82.1	25/56/19	1.528
100-110	" "	73.5	40/48/12	1.570
110-120	" "	65.5	55/34/11	1.614
118-126	Ol. gry clayey silt nat. bottom	69.9	30/48/22	1.509

Education

PROJECT E/T-1:
1983-84 Marine Research Programs for High Ability Secondary Students
Howard M. Weiss

Sea Grant funding helped support a marine research program at Project Oceanology for 12 secondary students with high academic ability and interest in the sciences. Funding also was provided by The Pfizer Foundation, Inc. and by local school districts. The objective of this program was to enable students to gain first-hand experience with the scientific process by participating in all phases of a year-long rigorous research project.

Sea Grant funds also were used to encourage and facilitate minority participation in the 1983 Project Oceanology summer marine studies program. Although this three-week program is free to all students, economically disadvantaged students have, in the past, had difficulty in providing their own daily transportation to Avery Point. Nine minority students attended the 1983 summer program, utilizing a free car pool which was funded through this Sea Grant project.

Project Oceanology is a marine education center operated by a non-profit association of public and private schools and colleges. Students were nominated to attend the year-long marine research program and the three-week summer marine studies program by the science faculty of the high schools in the association.

The ecological role of salt marshes was selected as the general research topic for the year-long marine research program. Students began their studies by attending the spring 1983 New England Estuarine Research Conference in Portland, Maine, and by conducting a thorough search of the technical literature in nearby university libraries. They then designed field and laboratory investigations which were carried out by the team as a whole and by individual members during a six-week period in the summer of 1983. During the fall, the students analyzed their data and wrote reports on their findings.

This work was carried out using the facilities at Project Oceanology, which includes the Enviro-lab, a 15 m research vessel, a fleet of small boats, oceanographic equipment, and a waterfront laboratory located on the University of Connecticut Campus at Avery Point in Groton. Field studies were carried out on marshes along the Poquonock River.

Students presented the results of their investigations at a number of seminars and conferences with research scientists from the University of Connecticut and Pfizer Laboratories in attendance. Five of the participants in the marine research program were invited to present their work at the Junior Science and Humanities Conference conducted in the winter of 1984 at Wesleyan University. One of these students, Todd Milne, was selected at the Wesleyan Conference to present his work at the national conference in Wisconsin. Two of the students in the marine research program presented their work at the Connecticut State Science Fair and both projects were selected as finalists.

Advisory Services

PROJECT A/EI:

Connecticut Sea Grant Marine Advisory Services, Cooperative Extension

Gene Whaples, Lance Stewart, Norman Bender, Timothy Visel, James Wallace, Marilyn Altobello, Melvin Goldstein

The Marine Advisory Service is the extension arm of the Sea Grant program at The University of Connecticut.

Since its inception in 1974, MAS has established itself as the place to come for information and answers to questions relating to the ocean and its resources.

Fishermen, the State's lawmakers, the staffs of other state agencies, town officials and educators are among the people who ask for information from MAS.

In 1984, addition of a specialist in seafood marketing and processing expanded the audience MAS can serve.

The Marine Advisory Service develops and implements educational programs that benefit all the state's citizens with major impacts upon the coastal and marine resource users.

The fishing industry benefits from MAS programs. Continued development of the state's fishing industries involves educational programs covering fishing gear and harvesting technology, management practices, and marketing and financial management of fishing firms. The third annual Fisheries Forum involved over 150 harvesters, processors, resource managers and others working with the industry.

Other major program areas are marine education for youngsters, coastal development, marine economics and marine recreation.

The Marine Advisory Service, in cooperation with the Connecticut Department of Environmental Protection, was requested by the Connecticut General Assembly to conduct a joint study on the gear conflict issue of lobster trawling in Long Island Sound. The effort will be directed at providing scientific information (underwater observations on net behavior and habitat, trawl gear definitions, mortality estimates, and an economic survey) to be used when making fisheries management decisions. Multiple conflicting uses of Long Island Sound (mobil trawl, fixed pot, recreational fishing) will be addressed in the investigation and will determine a major reciprocal (New York/Connecticut) regulatory recommendation when presented to the Legislature in December, 1984.

MAS staff members aided the Town of Stonington, home port for the state's only offshore commercial fishing fleet, by providing research and information on revitalization of the port. They worked with fishermen and state and local officials to determine alternative methods to improve the harvesting, processing and marketing structures, and their efforts laid the groundwork for a new dockside processing plant.

The MAS fisheries development effort also included introduction of new and more efficient harvesting techniques to the state's fisheries. Initial steps are being taken in development of a statewide seafood processing and marketing strategy. The full-time specialist in that area is identifying the segment of the fishing industry that includes seafood processors, wholesalers and retailers, as well as the potential for establishment of a Connecticut Seafood Council. In addition, the specialist is working with fishermen to make them aware of marketing alternatives, such as farmers markets, for sale of their catch.

The state's coastal towns are showing renewed interest in the management of shellfish resources for commercial and recreational purposes. Marine Advisory Service programs have concentrated upon the development of scientific shellfish management practices, as well as the application of the latest aquacultural techniques by shellfishing firms.

In response to a request by the Connecticut Senate Majority Leader's office, the Marine Advisory Service assisted with draft legislation that eventually formed the State Aquaculture Commission. The MAS program leader was appointed by the Governor to serve on the commission, which includes other state marine agencies, town and industry representatives, to develop a state aquaculture plan.

A Regional Shellfish Officers Association, formed with MAS assistance, brings together eastern Connecticut shellfish commission members to exchange information

and experiences concerning shellfish management plans, research findings and demonstration project results. It is speeding up the process of creating a more scientific and uniform approach to management of shellfish resources.

In addition, MAS has been involved in efforts for development of shellfish management plans in nine coastal towns, and has been working with the State Vocational-Technical Education Program for development of appropriate training courses at a marine vo-tech center.

The recreational boating industry is an important element in the total economic strength of Connecticut. A recent MAS study estimated the industry's total sales at over $200 million annually with over 2,700 fulltime equivalent employees earning $37 million in wages, salaries and commissions from 337 firms. The study report, "Connecticut's Recreational Boating Industry: An Economic Evaluation," is being used by state and municipal planning officials, boating firm managers and economic developers.

Coastal land use is a growing focus of MAS efforts. Officials of a half-dozen shoreline municipalities have sought MAS aid regarding maintenance of water-dependent coastal land uses like shoreside fishing and recreational boating facilities.

One hundred and thirty officials of those and other towns participated in the day-long "Harbor Management" conference, the second Coastal Trends in Connecticut Conference sponsored by MAS and other state and local agencies. Focus of the 1984 conference was resource use conflicts affecting the state's 100,000+ recreational boaters, 1,000 commerical fishermen and many coastal land owners. Conflict-resolution methods discussed at the conference are being used at the state and local levels to resolve mooring siting and dock expansion issues.

One portion of the MAS effort involved teaching commercial fishing firms to utilize financial management techniques and information in their business operations to provide increased net incomes and more stable business situations.

Efforts included distribution of tax information to both fishermen and tax preparers. In addition, individual fishermen received advice on basic record-keeping, tax management and decision-making techniques through

one-to-one visits and telephone calls, workshops, and distribution of published material.

In addition, members of the MAS staff coordinated a committee that developed the "Advisory Handbook on Fishing Financial Management." The 133-page handbook was distributed to Marine Advisory Service staff and other professionals who advise commercial fishermen across the nation to provide basic information on business techniques and financial considerations fishermen face as they operate their businesses.

Looking toward the Future

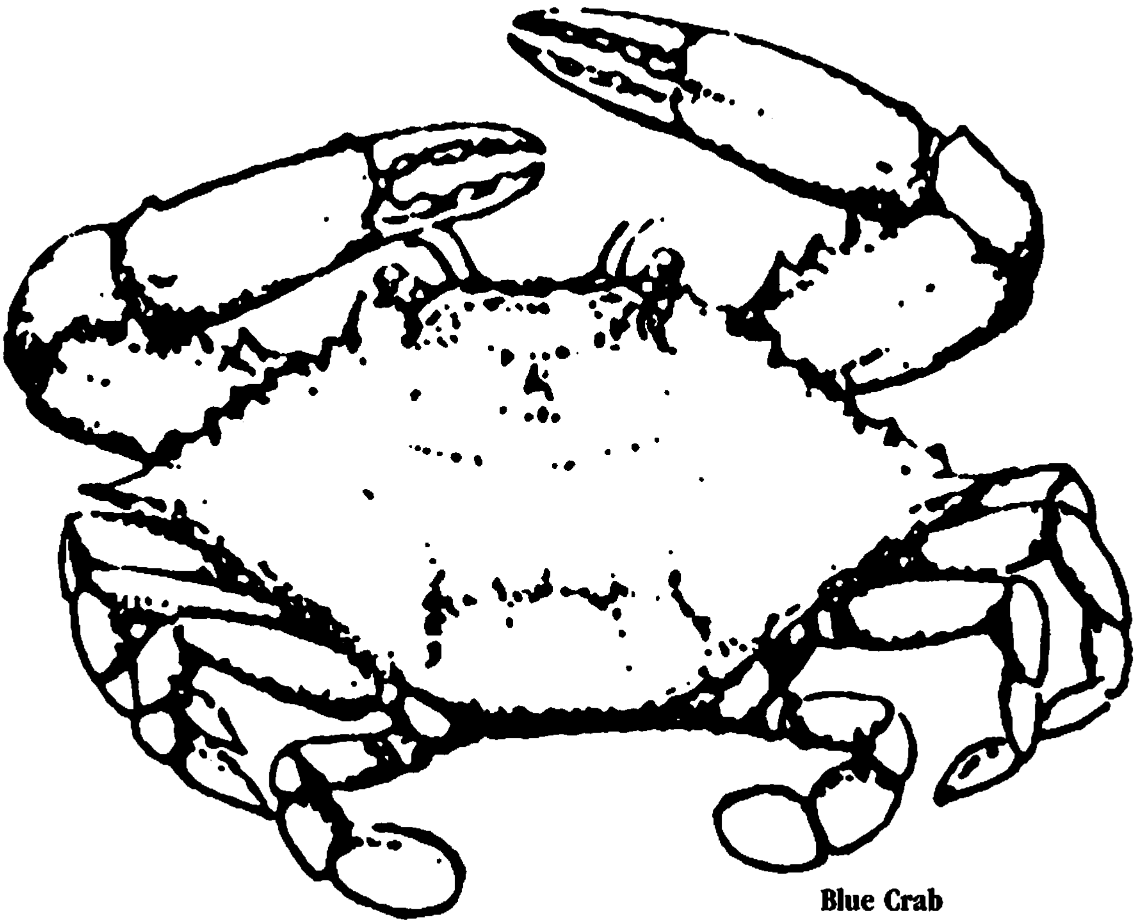
Aquaculture, in two different areas, is the focus of a pair of projects being added to the Sea Grant research list for the fiscal year that began July 1, 1984.

Dr. Hans Laufer of the University of Connecticut's Biological Sciences Group, proposes to study the effects of pesticides on the growth of crustaceans. Indications are that hormonal pesticides inhibit the growth of crustaceans such as crabs and lobsters. Dr. Laufer feels that once the inhibiting factors are understood, scientists should be able to reverse the process to speed up the growth rate.

Preliminary work is being done on a study of *Laminaria longicruris*, brown seaweed, in the western end of Long Island Sound. Dr. Charles Yarrish, on the Stamford Campus of the University of Connecticut, is working in conjunction with scientists at the State University of New York at Stony Brook to determine why the brown seaweed grows on the Connecticut side of the Sound, but not on the New York shore. The Stony Brook scientists are involved in a project to create energy biomass from seaweed—to use seaweed as a fuel, much as the Irish use peat—and have identified brown seaweed as having the best prospect. Dr. Yarrish's project will attempt to select out fast-growing warm water strains of *L. longicruris* that could be grown on the New York side of the Sound.

Connecticut Sea Grant is going in a new direction for advisory services as well. For the first time, a video project has been funded. Dr. Melvin Goldstein, a meterologist at Western Connecticut State University, is developing a program on marine meteorology for boaters.

The videotaped educational program will be made available for distribution to yacht clubs, boating safety programs and other organizations whose members would benefit from having increased knowledge of weather conditions they are likely to encounter while at sea.



Blue Crab

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Financial Report

Project Number	Section and Project Title	Investigator(s)	NOAA Sea Grant Funds	Other Funds
	Marine Resources Development			
R/LR-1	Life History and Resource Management of the Hard Clam, *Mercenaria mercenaria*	R. Whitlatch W. Wiltse (Univ. of Conn.)	$ 62,972	$ 36,247
R/LR-2	Life History, Modelling and Resource Utilization of the Soft-Shell Clam, *Mya arenaria*	D. Brousseau J. Baglivo G. Lang (Fairfield Univ.)	$ 15,400	$ 11,653
	Socio-Economic and Legal Studies			
R/SL-1	The Influence of Management Strategies and Regulatory Policies on the Production and Marketing of Long Island Sound Oysters	M. Altobello M. Huffmire L. Stewart (Univ. of Conn.)	$ 47,281	$ 25,344
	Marine Engineering			
R/ME-1	Geotechnical Aspects of Dredge Spoil Mass Behavior and Capping Procedures for Managing Coastal Disposal Operations	K. Demars R. Long (Univ. of Conn.)	$ 32,568	$ 32,258
	Marine Education Training			
E/T-1	Marine Research Program for High Ability Students	H.M. Weiss (Project Oceanology)	$ 5,000	$ 8,400
	Advisory and Public Services			
A/E-1	Connecticut Sea Grant Advisory Services, Cooperative Extension	L. Stewart N. Bender, P. Staley T. Visel, J. Wallace (Univ. of Conn.)	$155,059	$132,983
	Program Management			
M/PA-1	Program Management, Administration Planning and Development	V. Scottron E. Minikowski (Univ. of Conn.)	$ 31,720	$125,335
			$350,000	$372,220

BUDGET SUMMARY

	NOAA Office of Sea Grant	State Legislature	University of Connecticut	Industrial and Private	Other Federal
Research	$158,221	—	$ 70,019	$ 35,483	—
Education	5,000	—	—	8,400	—
Advisory	155,059	24,548	92,716	—	15,719
Management	31,720	15,200	110,135	—	—
	$350,000	$ 39,748	$272,870	$ 43,883	$ 15,719

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