

NJMSC-Q-95-001

Sea Grant

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NJ Sea Grant

**Projects
&
Progress**

1993-1995

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NJMSC
MEMBER INSTITUTIONS

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Brookdale Community College
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Trenton State College
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*Indicates institutions participating in NJ Sea Grant research projects listed in this directory.

INTRODUCTION

The National Sea Grant College Program, created by Congress in 1966, is operated by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). It represents a successful investment in the nation's marine resources by funding research, education, and advisory services that promote the wise development and conservation of those resources. Through the activities of state Sea Grant programs, universities, the private sector, and all levels of government work to create a model partnership. Sea Grant's success is based on a national network involving strong local program participation.

The NJ Sea Grant College Program, managed by the New Jersey Marine Sciences Consortium, is an alliance of 30 colleges and universities, private organizations, and individuals interested in marine affairs. Having met the high standards set by the National Sea Grant Program, NJ Sea Grant became the 26th program in the nation to earn the status of *Sea Grant College* in 1989. Now in its twentieth year of operation, the NJ Sea Grant College Program is recognized as one of the state's leading marine and coastal research, education, and public outreach programs.

The value of Sea Grant to New Jersey has grown steadily by directing attention to the changes, challenges, and opportunities presented by the state's valuable marine and coastal resources. Emphasis on critical coastal problems dealing with fisheries, shoreline processes, and water quality continue to be at the forefront of NJ Sea Grant activities.

These activities are sophisticated in academic and scientific terms, but relevant to the state's economy. Despite its small size, New Jersey is bounded by more than 1,700 miles of coastline. Tourism is the second largest industry, accounting for over five billion dollars annually, most of that generated by marine recreational activities. New Jersey consistently ranks among the top ten in the nation in commercial fishing landings, with the fishing industry alone generating nearly one billion dollars annually. Recreational fishing also contributes significantly to the economy of all coastal communities.

From Sandy Hook to Cape May, and into the shallows of Delaware Bay, New Jerseyans are becoming more aware of the importance of preserving the state's marine resources. They have also come to recognize the leadership of the NJ Sea Grant College Program in these efforts.

PROGRAM INFORMATION

FOLLOWING IS A CAPSULE DESCRIPTION OF NEW JERSEY SEA GRANT SPONSORED RESEARCH PROJECTS FOR PROGRAM YEARS XVIII-XIX (1993-1995). IF YOU'RE INTERESTED IN OBTAINING ADDITIONAL INFORMATION ABOUT A SPECIFIC PROJECT, CONTACT THE RESEARCHERS DIRECTLY. PARTICIPATING PRINCIPAL INVESTIGATORS ARE LISTED IN THE DIRECTORY LOCATED ON PAGE 22.

COASTAL ZONE MANAGEMENT

Field Test and Calibration of an In Situ Instrument to Determine Groundwater/Surface Water Exchange in the Salt Marsh Complex at Stone Harbor, New Jersey. *R/S-17.*

B. Carson, G. Lennon, Lehigh University
Initiation Date: *8/21/92* Completion Date: *7/31/94*

Pollution of surface waters (bays, sounds, and channels) in back-barrier regions often occur from recharge of contaminated groundwater. Recharge of high salinity surface waters into groundwater can also degrade fresh ground water. The exchange processes between surface and groundwaters are not fully understood and are complicated by (1) the heterogeneity of coastal sediments, (2) a limited number of land-based wells, and (3) tidal affects on surface and ground water levels which make single measurements of water levels insufficient. This project supported the development of a Portable In Situ Permeability and Pore Pressure Instrument (PISPPI). The sensitive device, first calibrated in a lab, was then field tested and used to determine the pore pressure and permeability of the sediments in the bottom of Great Sound near Stone Harbor, New Jersey. This provided the data necessary to calculate exchange rates of groundwater and surfacewater across the sediment interface. There is still

much to learn about the exchange process between surface and groundwaters in New Jersey's marshes and associated tidal areas. As pollution of surface water in these regions increases, the data generated by the PISPPI can provide a better understanding of the physical transport process that may lead to the exchange of these contaminants with the groundwater system.

Development of Raritan Bay Hydrostratigraphy Using Geophysical Methods. *R/S-24.*

G. Ashley and R. Sheridan, Rutgers University.
Initiation Date: *8/1/93* Completion Date: *7/31/95*

During the last few decades, excessive pumping (triggered by rapid development) has caused water levels to decline below sea level and some water wells have been contaminated with salt water and pollutants. This study will determine the stratigraphy of marine and estuarine deposits in the shallow subsurface of the Northern New Jersey Coastal Plain, using high-resolution seismics and vibracores in order to provide essential geologic information needed for groundwater modeling. This geologic study will delineate any buried channels (with high permeability) and determine the location of fine-grained muds (with low permeability) which will provide crucial information for ground water flow models that can be used to better understand the movement of water and pollutants.



Dune Development and FEMA Standards: A Test and Application. *R/8-26.*

N. Psuty, P. Gares, M. Mauriello

Initiation Date: *8/1/94* Completion Date: *7/31/95*

Coastal dunes are a very important component of the beach system. They store sand which can later buffer the efforts of erosion and they act as a barrier to the inland penetration of storm surge. The magnitude of dune change with storms is not well known. There have been several attempts to relate storm frequency (1 in 100 year storm, for example) to a measure of dune change. The previous work is important in establishing a guideline that the Federal Emergency Management Agency (FEMA) applies to evaluating dunes and their level of protection. Unfortunately, the number of studies that are used to arrive at the guideline value is small. This project intends to add to the data base by monitoring dune dimension changes associated with storms of a particular frequency interval (i.e. 1 in 10, 1 in 20, or 1 in 30 year storms). At least four sites on the New Jersey shore are being monitored to establish these values. An additional benefit will be the ability to compare changes resulting from the same storm in different parts of New Jersey. This information will be shared with the coastal communities.

ECOSYSTEMS

Continued Studies: Role of Dissolved Organic Nitrogen in Estuarine Eutrophication. *R/E-40.*

S. Seitzinger, R. Sanders, Rutgers University, Academy of Natural Sciences of Philadelphia

Initiation Date: *8/1/93* Completion Date: *7/31/95*

Nitrogen is an essential element in the life-support systems of estuaries. But an excess of nitrogen and other nutrients results in dense populations of microscopic algae. When these single-celled plants become very abundant, water quality is degraded and other estuarine life

such as finfish, shellfish, and bottom vegetation are threatened. Coastal development continues to add more nutrients to estuarine ecosystems despite efforts to reduce overall nutrient loads. More development can mean more sewage and runoff. A large proportion of the nitrogen from both of these sources is in the form of dissolved organic nitrogen (DON), but scientists do not yet know the overall contribution of DON to the eutrophication of estuaries. This project is using a combined field and laboratory approach to evaluate the changes in algal and bacterial production that result from increased loading rates of dissolved organic nitrogen to estuaries. This information will help local, state, and national agencies that are involved in nutrient management decisions to set appropriate and cost-effective policies regarding reduction of nutrient sources that contain significant amounts of dissolved organic nitrogen. Initial data from this work has already been presented to several state agencies and the U.S. Environmental Protection Agency.

FISHERIES & AQUACULTURE

Absorption of Vitamins by Fish. *R/F-58.*

R.Ferraris, D. Casirola, University of Medicine and Dentistry of New Jersey

Initiation Date: *8/1/93* Completion Date: *7/31/95*

This research project addresses two major concerns in aquaculture: feed expenses which account for half the cost of raising fish to marketable size, and effluents containing excessive amounts of phosphorous from uneaten food or unabsorbed nutrients in fecal matter. There are 68 known symptoms of vitamin deficiency in finfish, but there has been no extensive study of vitamin absorption by fish intestines. Vitamin supplementation is presently excessive to compensate for deterioration during storage, insufficient assimilation, and unknown absorption characteristics. In mammals, water-soluble vitamins are known to be absorbed either by

slow processes like simple diffusion or by faster mechanisms like carrier-mediated transport. Present studies now focus on obtaining information about mechanisms of intestinal absorption of four water-soluble vitamins (biotin, folic acid, nicotinamide and riboflavin) in the following commercially important species: channel catfish representing warmwater fish, and hybrid striped bass, striped bass, and rainbow trout representing coldwater species. The molecular form of a vitamin best absorbed by fish intestine will also be identified, and the concentration and salinity optimal for absorption determined. The results of this work will provide an important data base for use not only in feed development but also in nutritional interventions to improve fish growth and health. Future studies will focus on dietary and hormonal manipulations to improve assimilation of dietary phosphates by fish.

The Effects of Sound on the Control of Predation by Decapod Crustaceans on Cultured Clams.
R/F-60.

A. Cristini, P. Anderson, T. Halpern and G. Flimlin, Ramapo College, NJ Sea Grant MAS
Initiation Date: *8/1/93* Completion Date: *7/31/94*

Aquaculture of the hard clam, *Mercenaria mercenaria*, has been carried out in North America for nearly thirty years. Recently clam growers have been somewhat successful in developing profitable businesses because of the improved technology and market demand. However the problems of predation on the juvenile clams still contributes substantially to the loss of revenue for the clam growers. One of the most serious group of predators on juvenile hard clams are the decapod crustaceans particularly the blue crab, *Callinectes sapidus*. This project was the second phase of a response to an inquiry by a hard clam and seed producer requesting assistance in reducing the predation of their stocks by the blue crab. With initial funding from NJ Sea Grant, the first phase involved developing a project in the laboratory, exploring a novel approach, aimed at reducing

the consumption of juvenile clams by crustacea such as the blue crab using sound. The results were encouraging enough to initiate a full field trial and research toward a cost effective method of deploying this anti-predation device. The results of the field study suggest that more work must be done before the sound protection system developed by the research team can be considered for use in the clam aquaculture industry. The development project and completed one year study have produced enough data for the research team to take the next step and seek funding for further development and production of the sound protection system.

Determinants of Habitat Quality in Stressed and Unstressed Estuaries. *R/F-65.*

K. Able, Rutgers University

Initiation Date: *8/1/93* Completion Date: *7/31/95*

Habitat degradation and destruction are ongoing problems in New Jersey estuaries, and these will likely continue because of human population growth along the shore. Currently, scientists lack the knowledge to confidently identify the habitats that are critical to the numerous commercially and recreationally important fishes that depend on estuaries during part or all of their life histories. The objective of this research is to determine the factors affecting recruitment of estuarine-dependent fishes in New Jersey estuaries. This research will help determine the importance of habitats to the growth and survival of juvenile fishes by comparing a relatively unaltered, unstressed estuarine system (Great Bay-Mullica River Estuary) versus a heavily altered and stressed system (Hudson-Raritan Estuary). For juveniles of economically important species, the study will 1) compare seasonal, diel and ontogenetic patterns of habitat use, 2) determine movement patterns and turnover rates within and between habitats to further evaluate habitat use patterns for selected species, and 3) determine growth and survival of winter flounder, summer flounder, black sea bass and other selected estuarine dependent species. These comparisons will provide a

ranking of habitat quality among habitats under different levels of stress and thus enable resource managers and a better informed public to make effective decisions regarding habitat protection and enhancement.

MARINE BIOTECHNOLOGY

New Opportunities for Ploidy Manipulation in Shellfish Using Tetraploids. *B/T-4*.

S. Allen, Jr., X. Guo, Rutgers University

Initiation Date: *8/1/94* Completion Date: *7/31/96*

In the last decade, triploid Pacific oysters *Crassostrea gigas* have become an important component of the aquaculture industry. Currently, triploid oysters are induced primarily by inhibiting the second polar body with cytochalasin B (CB). There are severe limitations to the use of CB, including restrictions by the FDA, inefficiency in producing triploids, and possible negative genetic effects. Theoretically, all these problems could be eliminated if triploid oysters could be produced by crossing diploids and tetraploids. Besides serving as brood stock for the creation of triploids, tetraploids would open other breeding possibilities not heretofore possible in shellfish. For example, tetraploids might serve as a bridging taxa for attempted hybridization between incompatible species, a strategy embraced by plant breeders. Tetraploids offer unique possibilities in the area of uniparental inheritance, e.g. gynogenesis, whereby strains could be produced without the high mortality usually associated with this procedure. Tetraploids, themselves, may be candidates for aquaculture, if as hypothesized, they exhibit gigantism. Finally, tetraploids may offer a bridge to even higher levels of polyploids. The recent development of tetraploid shellfish engenders new opportunities for engineering chromosome sets in shellfish. The objective of this study is to test the breeding potential of

tetraploids with the goal of determining the most promising directions for this new technology. The long term objective is to establish tetraploids in the mainstream of hatchery production for shellfish.

Hyperthermophilic Bacteria from Deep Sea Hydrothermal Vents: A Treasure Trove of Enzymes for American Industry. *B/T-12*.

D. Eveleigh, R. Vrijenhoek, Rutgers University
Initiation Date: *8/1/94* Completion Date: *7/31/95*

Enzymes have long been used as catalysts for industrial processes: classic examples of their use include conversion of starch to high fructose sweeteners used in soda drinks, to cleaners (proteases) for laundry detergents both of which are produced as large scale commodities. More general commercial application of enzymes has been thwarted by their somewhat unstable nature. However, mud samples taken from ocean hot smoker vents contain bacteria that bask in temperatures over 175° F. Such heat loving bacteria produce extremely stable and efficient enzymes. One example being studied as part of this project is *Thermotoga neapolitana*, from ocean hydrothermal vents which produces enzymes of potential use in the pulp and paper industry. This microbe produces extremely stable enzymes that are potentially valuable to the paper industry for biobleaching. The "biobleached pulp" is produced with 25-40% reduction in the use of water polluting chlorine compounds. Assuming there is a treasure trove of other heat loving bacteria awaiting discovery, this study is addressing the isolation of such useful bacteria strains.

Using *Enteromorpha* for Production of Starch and Protein. *B/T-13*.

B. Moll, Pennsylvania State University

Initiation Date: *8/1/94* Completion Date: *7/31/95*

We are entering an era in which we will have to shift our economy from dependence on dwindling fossil resources to renewable resources. Biotechnology can facilitate this transition by finding new crops and new culture methods that permit us to utilize areas not adapted to traditional agriculture. Stress tolerant strains of the marine seaweed *Enteromorpha* can be grown using simple, inexpensive culture methods, which yield about 10 times of those of terrestrial crops. This project will characterize nutrient uptake, starch and protein content in this plant, utilizing a laboratory scale model of field culture methods. The project will also characterize heat tolerance of *Enteromorpha*. Data from this research will lead to the creation of fertilization schemes that are optimized for productivity and product composition. Currently, we know that composition is suitable for use as a feed supplement or as bulk feed. Protein content can be as high as 25%, and a fertilizing scheme is now being developed that will give a starch content of 50%. New strains with improved heat tolerance have also been developed, and characterized genetically and biochemically. The information and strains developed in this project will be used to set up field demonstrations of the cultured methods, which will in turn lead to commercial production of *Enteromorpha* by marine aquaculture farmers.

SOCIOECONOMICS & LEGAL STUDIES

A Comparative Study of ITQ Management:
Mid-Atlantic Clams and Nova Scotia Groundfish.
R/SE-8.

B. McCay, Rutgers University

Initiation Date: *8/1/93* Completion Date: *7/31/95*

Surf clams and ocean quahogs, large shellfish found off the coast of New Jersey and the larger region, are extremely important to New Jersey's commercial fishing economy. In 1993, over 50% of the landings of fish and shellfish, by weight, were of those species, and about 40% of the dollar value of fish and shellfish came from surf clams and ocean quahogs. The New Jersey and Mid-Atlantic surf clam and ocean quahog fishery is also important as the first U.S. case of the use of an innovative tool in fisheries management: Individual Transferrable Quotas (ITQs). The annual quota, which is established to help conserve the clam stocks, is divided into shares which can be traded and combined according to market forces. The major argument for this form of management is that it helps promote more economic efficiency on the part of the companies involved, particularly in reducing the number of boats in the fishery. But there is concern about the social and ecological effects of ITQ management and very little information available about these systems. Consequently, the project compares the Mid-Atlantic surf clam and ocean quahog ITQ system, which began in 1990, with a Canadian system that began in that same year. It's hoped the comparison will broaden understanding of ITQs and their potential impact and consequences for individuals, companies, communities, and management systems. Field research is being conducted in New Jersey, elsewhere in the Mid-Atlantic, and Nova Scotia, Canada. Datasets for both ITQ systems are being examined. Funding received from additional sources has also enabled the project to expand to Newfoundland and Norway.

ZEBRA MUSSEL RESEARCH & OUTREACH

New Jersey Sea Grant Zebra Mussel Outreach Program. *A18-6ZM*.

Dr. Eleanor Bochenek, Rutgers University, New Jersey Sea Grant Marine Advisory Service
Initiation Date: *8/1/92* Completion Date: *7/31/95*

New Jersey and Pennsylvania waters continue to be threatened by the invasion of the zebra mussel. The NJ Sea Grant Marine Advisory Service has launched a comprehensive education and outreach program which includes special publications, workshops, volunteer monitoring programs, teleconferences, and curriculum development. Through these efforts, industrial and municipal water users, recreational boaters and fishermen, lake associations, government agencies, environmental groups, natural resource biologists and managers, teachers, children and the general public have become better educated about implementing effective zebra mussel prevention and control measures. This in turn, can help slow the spread of this nuisance species in New Jersey's and eastern Pennsylvania's waterways and reduce their potential ecological and economic impacts.



The Use of Acoustic and Hydrodynamic
Techniques to Control Zebra Mussel Infestation.
R/E-29ZM.

D. Donskoy, Stevens Institute of Technology
Initiation Date: *9/1/92* Completion Date: *9/30/95*

The freshwater bivalve mollusk, *Dreissena polymorpha*, better known as the zebra mussel, is a native of southern Russia, and since its introduction into the Great Lakes nearly a decade ago, has been spreading quickly throughout United States and Canadian waterways. The broad physiological adaptive capabilities and genetic plasticity of this species, coupled with dispersal via human activities, predispose it to an eventual wide distribution in North America, with potentially serious environmental and economic impact, specifically on power plants and various water facilities. Effective conventional zebra mussel control methods have proven to be chlorine, thermal treatment, and protective coatings. Unfortunately, these control methods are harmful to the surrounding environment. Therefore, the U.S. EPA and other agencies are restricting use of chlorine, oxidizing and non-oxidizing bodies, and many antifouling coatings. This project will examine the potential for using acoustic and hydrodynamic techniques to control zebra mussel infestation. Tests will be conducted to see how zebra mussel adults and veligers respond to varying frequencies, intensities and duration of sound vibration. Ultrasound and cavitation effects on zebra mussels will be studied, acoustic methods will be developed for measuring zebra mussel population in tanks and pipes, the feasibility of converting hydrodynamic energy to acoustic energy to enhance the efficiency of the control technique will be evaluated, and additional acoustic control strategies and techniques will be developed.

Species Identities and Relationships of North American and European *Dreissena*. *R/E-30ZM*.

G. Rosenberg, Academy of Natural Sciences of Philadelphia

Initiation Date: *7/1/92* Completion Date: *6/30/94*

This study will provide genetic data on European populations of *Dreissena*, introduced there in the early 1800's and on populations in the Black and Caspian Seas, the presumed source of European and North American introductions. These data will be used to determine the identity of *Dreissena* populations in North America and to predict the degree to which they might differentiate and thereby complicate efforts to control them. Morphological data in combination with allozymic data will be used to determine relations among populations and species. These determinations will make it possible to identify *Dreissena* species by shell or anatomical characteristics alone, and produce a key to their identification which can be used in the field. Similar tests and studies will be conducted on the genus *Mytilopsis*, the closest living relative of *Dreissena*, which has also been introduced in various parts of the world.

Chlorine Minimization and Boundary Layer Injection for Control of Zebra Mussel Fouling in Hudson River Water Intakes. *R/E-44ZM*.

V. Guida, N. Sarunac, Lehigh University

Initiation Date: *8/1/93* Completion Date: *7/31/94*

Since their introduction into North America, zebra mussels have become a particular pest to electric utilities that draw large quantities of fresh water for cooling steam. Clumps of mussels are sucked into narrow steam condenser tubes and other small pipes, where they prevent the water flow necessary for cooling and other vital functions, including fire fighting. Currently effective methods for controlling mussel accumulation are expensive and require

shutdown of power units. Chlorine treatment can be done while the unit is running and is relatively inexpensive, but the release of large quantities of chlorine into natural waters raises serious environmental concerns. This project tested a method for the application of chlorine for mussel control that reduces chemical use and discharge by 20-to-50-fold. The new method is called "Boundary Layer Injection". It's an innovative design for a chemical injection system that maintains high concentrations of chlorine only along the walls of a cooling system, where it is most needed to prevent mussel settling and growth. A small-scale outdoor test facility was set-up in an area of New York State already infested with zebra mussels to test the use of this system against fouling. The test provided needed data for designing a full-scale system on the same principle. Previous tests have proven the effectiveness of this system against blue mussel fouling of salt water intakes.

Species Identification of Early Life History Stages of Dreissenid Mussels and Other Co-Occurring Bivalves in Freshwater and Oligohaline Habitats. *R/E-452M*.

B. Baldwin, R. Lutz, Rutgers University
Initiation Date: *8/1/93* Completion Date: *7/31/95*

The continuing rapid advance of the zebra mussel, *Dreissena polymorpha*, throughout North American waters is of great concern. Efforts to control and manage this biofouling species in the Mid-Atlantic and other areas depend greatly on the ability to identify the target species under study. This is particularly important for the study of early life history stages which are inherently difficult to identify. This study is designed to establish routine methods to allow scientists and other users to identify and discriminate between the larvae and postlarvae of *D. polymorpha* and other co-occurring bivalves such as the quagga mussel *Dreissena bugensis*, the dark false mussel *Mytilopsis leucophaeata*, and the wedge clam

Rangia cuneata. To this end, detailed micrograph sequences of the shell morphology and hinge structure of larval and postlarval stages will be prepared using the light microscope and the scanning electron microscope. These micrographs can then be used to identify the young bivalves collected in field samples from the plankton or on settlement substrates. This study will also develop successful and routine procedures for rearing these dreissenid larvae through to postlarvae and will help define their tolerances to environmental factors, thus enhancing the ability to predict their geographic spread in North America and to devise control measures that exploit these tolerances.

MARINE ADVISORY SERVICE

NJ Sea Grant Marine Advisory Service. *A/S-1*.

A. Wypyszinski, Rutgers University

One of NJ Sea Grant College Program's main objectives is providing marine-related information to people who depend on coastal and ocean resources for their livelihoods or use them for recreational purposes. Sea Grant Marine Agents and Specialists are the program's representatives throughout the state. Staff members are generalists, but also have special areas of expertise. These areas include commercial and recreational fisheries, marine recreation and safety, aquaculture, coastal law, seafood marketing, and marine and coastal pollution. Working daily with residents and other organizations, MAS staff members deliver the latest marine information and related research results. They also bring to program management new or potential problems and needs that should be addressed by research and education. Through this project, residents and target user groups have access to and benefit from program-generated information about managing, utilizing, and conserving the state's marine and coastal resources.

COMMUNICATIONS

NJ Sea Grant Communications. *A/S-2*.

K. Kosko, New Jersey Marine Sciences Consortium

Communications plays a key role in the NJ Sea Grant College Program. Information about research, MAS, and education activities is distributed and publicized through brochures, fact sheets, newsletters, the print and electronic media, technical reports, conferences, workshops, virtually every avenue of communication. It is the responsibility of communications to develop, produce, distribute and organize these products or events. Scientists, educators, legislators, industry, the press, and the general public continuously use and benefit from the products and services provided by NJ Sea Grant Communications.

MANAGEMENT & DEVELOPMENT

Program Management. *M/M-1*.

G.D. Klein, New Jersey Marine Sciences Consortium

Through this project, the Director and staff of the NJ Sea Grant College Program manage the program by planning, coordinating and evaluating its activities. These efforts maintain and improve both the program and its relationship with educational institutions, federal, state, and local agencies and marine and coastal businesses and industries.

Program Development. *M/M-2.*

G.D. Klein, New Jersey Marine Sciences Consortium

These project funds are used to provide support for research and other activities that respond to the needs of the state, industry and businesses on short notice. Information obtained from activities supported through program development is then used for long-range planning and often encourages the submission of future proposals to address these needs. Some of the research areas supported through this project include: *Development and Application of Molecular Probes for Surf Clam Larvae (Spisula solidissima)(R/F-81D); Development Funds to Undertake In Situ Optical and Acoustic Measurement of Fish Use (R/E-950007D); Development of An Aquaculture Plan For the State of New Jersey (R/F-81D); Development of An Undergraduate Curriculum in Aquaculture Technologies for New Jersey (E/T-16D); Experimental Taphony of Bone Modification by Marine Organisms (E/T-13D); Expression of IGF-I mRNA Induced by Growth Hormone-Intestinal Epithelium of Striped Bass (R/F-950006D); Holocene Sea Level Rise-Raritan Estuary: Implications for Erosion of Salt Marsh and Estuarine Shorelines (R/E-57D); Impact of CCA Pressure Treated Wood Structures in Estuaries (R/E-22D); New Jersey ShoreLine Newsletter Special Edition: Fisheries Bulletin (E/T-14D); MAS Rapid Response Funds for Special Projects (A/S-8D); Shellfish Farm Spreadsheet and Economic Analysis Software Package and Users Guide (R/F-71D); Special Events Planning Workshop (E/T-16D); and A Technique for Marking Bivalve Larvae (R/F-50D).*

NJ SEA GRANT DIRECTORY

The following directory includes all staff, researchers and advisory board members involved in the projects and programs included in this publication. For additional information regarding a specific project or activity, please contact the people or departments listed on the following pages.

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