PROJECTS & PROGRESS

Congress established the National Sea Grant College Program in 1966, to foster research, outreach and education that focus on marine issues. The program represents a unique partnership between the nation's universities and the National Oceanic and Atmospheric Administration.

The National Sea Grant College Program works closely with 32 state Sea Grant programs located in every coastal and Great Lakes state, Puerto Rico and Pennsylvania. These programs serve as the core of a dynamic, national, university-based network of over 300 institutions involving more than 3,000 scientists, engineers, educators, students and outreach experts. Through their research, education and outreach activities, Sea Grant has helped position the United States as the world leader in marine research and the sustainable development of coastal resources. Sea Grant activities exist at the nexus of local, state, national and sometimes international interests. In this way, local needs receive national attention, and national commitments are fulfilled at the local level.

Since 1976, the New Jersey Sea Grant Program has been managed by the New Jersey Marine Sciences Consortium (NJMSC), an alliance of colleges and universities, private organizations and individuals interested in maintaining a healthy balance between economic growth and environmental stewardship of our marine resources. In 1989, having met the high standards of research and academic excellence set by the National Sea Grant Program, New Jersey Sea Grant became the 26th program in the nation to earn the status of Sea Grant College.

For the past 32 years, New Jersey Sea Grant researchers have conducted extensive research in areas such as coastal ecosystems health, biotechnology, nonpoint source pollution, fisheries and aquaculture, habitat restoration and dredge materials management. Information gathered from Sea Grant research impacts New Jersey and its coastal environment on all levels: economically, environmentally and aesthetically.

This publication includes capsule descriptions of research and program activities sponsored by the New Jersey Sea Grant College Program between 2008 and 2010. For additional information about a specific project or program area, please contact the appropriate NJSG researcher or staff member.

2008-2010 Research Projects

Habitat dynamics of adult winter flounder: Connectivity between estuaries and inner continental shelves influence management of human impacts associated with dredging R/6840-0002

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Dredging, one of the most common forms of human impact along the U.S. East Coast, is practiced in estuaries to maintain navigation channels for local commerce and recreation as well as on the inner continental shelf to mine sand for nourishment of nearby beaches. There is concern that these activities may negatively influence habitat quality in these ecosystems. Most attempts to evaluate the effects of dredging on important finfish resources assume that they are stationary in space and time, such as for the indicator species winter flounder (*Pseudopleuronectes americanus*). A current definition of winter flounder "spawning habitat" as strictly estuarine results in denial of many winter-spring dredging permits in estuaries of New England and the Mid-Atlantic states and subsequently impacts maritime industries. However, accumulating evidence suggests that this species is quite mobile, that its movements are variable, and that spawning may take place in estuaries as well as on the inner continental shelf. As a result, current attempts to define the time and location of dredging activities do not take these dynamics into consideration.

The long term goal of this project is to clarify the seasonal and annual dynamics of adult winter flounder residency/movements in estuary/inner continental ecosystems in order to protect the habitats they use while providing an improved understanding of the timing and location of spawning relative to dredging activities in New Jersey estuaries and the ocean and elsewhere in the northeast U.S. This two-year study will serve as a proof of concept, utilizing telemetry of tagged winter flounder to define seasonal fish-habitat associations.

Shoreline stabilization and ecosystem enhancement of eroding marsh habitats using intertidal reef communities R/6840-0003

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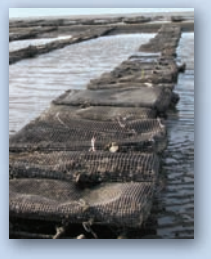
Habitat restoration is a fundamental component of the overall strategy to improve ecological conditions within the Delaware Estuary. Opportunities to conceive and carry out restoration in many areas are limited because techniques have not been developed or proven regionally. For example, strategies have not been developed or widely adopted in the Delaware Estuary or elsewhere in New Jersey to combat sea level rise by arresting erosion of tidal marshes and intertidal shorelines. Rutgers University and the Partnership for the Delaware Estuary are collaborating on this project to develop novel methods to protect marshes and enhance habitats by using living structures in a project called the Delaware Estuary Living Shoreline Initiative (DELSI). Tidal marshes throughout the estuary and elsewhere are threatened by a variety of factors, but sea level rise is gaining attention by eating away at the seaward margins. In many areas, the apparent rate of sea level rise is much greater than the global average due to local effects such as land subsidence and hydrodynamic alteration. Impacts related to human use, such as boat wakes and bulkheading, can also contribute to marsh erosion (Anderson 2002, Meyer et al. 1997). With much of the adjacent uplands already developed, the ability of marshes to retreat landward with rising sea level is restricted. Therefore, the stabilization of eroding marsh edges with living shorelines concepts to help marshes accrete vertically to keep pace may provide one of the tools needed to offset impacts of sea level rise.

This component of the DELSI project is testing the use of natural coir fiber products to stabilize sediments for plant growth and attract marsh mussels to naturally armor banks and shorelines against erosion. Intertidal ribbed mussels are a functionally dominant species in the ecology of most salt and brackish marshes of the Delaware Estuary. In this habitat, they increase the deposition of sediments through their active filtration of the water column when submerged and they physically armor the marsh edge against erosion. To catch recruitment of mussel spat in the intertidal zone, the researchers will employ natural fiber products that mussels adhere to using their byssal threads. The primary objective for this project is to evaluate the use of coir fiber materials as a specific tactic and the goal is marsh habitat restoration and stabilization using shellfish as a tactic.

Marker-assisted breeding technology for the eastern oyster R/6840-0005



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The eastern oyster (*Crassostrea virginica* Gmelin) is one of the most important marine resources in the U.S. During the past 50 years, over-fishing, habitat destruction and diseases have decimated eastern oyster populations in much of the mid-Atlantic region including Delaware Bay. Oyster aquaculture has the potential to ease the economical pain of coastal communities and satisfy the demand for high quality oysters without adding additional fishing pressure to wild stocks.

Oyster aquaculture in New Jersey and much of the Northeastern region faces many challenges. The lack of domesticated stocks with desirable traits for aquaculture is a major impediment. The eastern oyster faces three major diseases in the northeastern region: MSX (caused by the parasite *Haplosporidium nelsoni*), Dermo (caused by the parasite *Perkinsus marinus*) and JOD (juvenile oyster disease, caused by the bacterium *Roseovarius crassostreae*). The diseases can cause up to 90% mortality in susceptible stocks. Rutgers University has been breeding oysters since the early 1960s. Strains resulting from the Rutgers breeding program have shown strong resistance to MSX, but only moderate resistance to Dermo, and their growth rate is unremarkable. Further improvement of the Rutgers strains, especially in Dermo-resistance and growth, is urgently needed, and progress depends on the development and application of advanced genetic technologies.

Most oyster breeding programs are based on individual/mass-selection. Mass-selection can lead to rapid inbreeding which hinders long-term gains. Family-based evaluation is clearly more effective for oyster breeding, but it requires the production and maintenance of hundreds of families. Most oyster hatcheries don't have the necessary resources to produce and maintain hundreds of families. The problem can be solved by the use of genetic markers and marker-assisted breeding (MAB). In MAB, many families can be produced and pooled at larval stages. The pooled families are cultured as one group in a common-garden environment. After field evaluation and measurements, genetic markers are used to determine parentage and assign progeny to their families. MAB eliminates the need to maintain hundreds of separate cultures and therefore greatly reduces the cost in space and manpower. By culturing all families in a common-garden environment, MAB provides the most powerful way to estimate genetic breeding values, by removing environmental effects that are otherwise confounded within families.

This project will test genetic markers for MAB. We have produced, pooled and deployed 81 oyster families. We will evaluate them in the field and then use a set of genetic markers to separate them. The successful application of MAB could greatly speed up the development of superior oyster stocks for aquaculture production.

2008-2010 Research Projects

Evaluation of wind and wave processes critical in sustaining beach backshore environments R/6840-0004

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Beach nourishment is routinely used in New Jersey and locations throughout the world to protect coastal facilities and enhance recreation. However, the true restoration potential of nourished beaches is rarely achieved because most beaches are raked to remove wrack (litter) and maintained as "slabs of sand." Landforms and habitats on the backshore are rarely allowed to evolve by natural processes, preventing topographical and biological diversity, threatening endangered species and reducing seed sources, thereby decreasing resilience of plant communities and sustainability of coastal resources. The backshore is a source of sediment for dune formation and a zone that can generate habitats not found elsewhere. The few dunes that are allowed to form naturally on unraked beaches reveal great diversity of topography and vegetation. There is a need to identify the types, persistence and scale of landforms and habitats that can evolve on the backshores of nourished beaches, the way they interact with wave and wind processes and the most appropriate strategies for managing them.

Data on surface sediments, topography and vegetation will be gathered on six pairs of unraked and raked beach sites in Avalon and Ocean City, NJ to identify landform and habitat types. The effect of storm wave runup and aeolian transport on changes in surface sediments and topography will be evaluated during an entire winter storm season using photogrammetric imagery of one of these sites. Wind flows and rates of sediment transport within and through characteristic raked and unraked beach environments will be monitored during two one-month instrumented field studies conducted during the winter storm season to quantify the processes causing change. Results will be synthesized and used to evaluate the long-term benefits of alternative management strategies and develop guidelines for managing backshore environments.

This research will determine differences between raked and unraked beaches and use this information to make informed decisions about the significance of raking to evolution of habitats and provision of sediment to the dunes that protect human infrastructure from erosion and flooding. The results will be valuable for planning, construction and regulatory branches of the state and federal governments and for municipal managers deciding why, when and how to remove litter and whether or where to place sand fences to build dunes or control inundation of human infrastructure.

An unwelcome guest? Is the presence of the invasive swim bladder parasite, *Anguillicola crassus*, influencing American eel (*Anguilla rostrata*) recruitment in New Jersey estuaries? R/6848-0001

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The American eel (*Anguilla rostrata*) is a critical component of New Jersey ecosystems and an important source of bait for recreational fishers, yet the species is thought to be in decline over portions of its range. Recently, the causes of this decline have been the focus of a U.S. Fish and Wildlife Service technical review, a stock assessment by the Atlantic States Marine Fisheries Commission and a U.S. Endangered Species Act petition. Although not warranting endangered status, this migratory species faces an array of threats during its freshwater residency period before returning to the Sargasso Sea to spawn.

During this critical period, American eel juveniles are exposed to a recent addition to New Jersey estuaries, the invasive swim bladder parasite *Anguillicola crassus*. Originally native to Asia and Europe, this nematode species is contracted when an eel consumes an intermediate host carrying its early stage juveniles. Within the confines of the swim bladder, mature *Anguillicola crassus* feed on the infected eel's blood supply and deposit eggs which are flushed back into the estuarine environment. Acquisition of *Anguillicola crassus* has been shown to induce damage to swim bladder tissue, which may eventually compromise the migration of older individuals back to the spawning grounds.

The main goal of this multi-institutional project is to quantify the spread of *Anguillicola crassus* in New Jersey estuaries, with an emphasis on eel early life. Documenting the pattern of infection includes quantifying the prevalence/intensity of infection over a range of estuaries and estuarine habitats, as well as its rates and routes. An equally critical goal is to test the biological consequences of infection on organism health and, by extension, recruitment, via environmental metabolomics (an emerging field that measures the metabolic response of an organism to natural and anthropogenic stressors by assessing organism function at the molecular level).

Assessing the impact of the invasive Asiatic sand sedge, *Carex kobomugi*, on coastal dune communities in New Jersey R/6847-0001

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The combined economic and environmental costs of invasive species are estimated to exceed $137 billion per year in the U.S. alone. As a result, invasive species are generally listed as one of the most important environmental threats of the 21st century. One such invasive species is the sedge, *Carex kobomugi*, which was accidentally introduced to North America from Asia about a century ago. In the 1960s and 70s, it was propagated and deliberately planted as a dune stabilizer, but increased awareness of the problems caused by invasive species halted this practice in the early 1980s. However, *Carex kobomugi* is still spreading via natural propagation, creating problems for coastal managers from Rhode Island to the Carolinas. The problems are particularly acute in New Jersey where the species is expanding exponentially along the state's vital coastal dune systems. This expansion is significantly reducing the diversity and abundance of native species in affected areas. The species' expansion also threatens a number of endangered species such as piping plovers, sea-beach amaranth and tiger beach beetles.

In addition, *Carex kobomugi* negatively impacts seaside goldenrod, the nectar of which is an important food resource for migrating monarch butterflies. This sedge is also believed to change the size and shape of the dunes that it invades in ways which reduce the dunes' effectiveness in preventing flooding during storm surges. In order to guide the state's management effort for this species, we will look for patterns in spread rate and direction of *Carex kobomugi* in New Jersey. We will also look at the effects of this plant's invasion on the animals inhabiting the dunes, and on dune shape and height. Finally, we will sponsor a workshop to review strategies currently being used to manage this and other invasive species in coastal dune and maritime forest habitats on the U.S. Eastern Seaboard.

Program Management – M/M-1

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

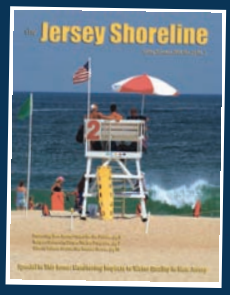
Program Development – M/M-2

This project component provides 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 often used for long-range planning and encourages the submission of future full proposals to address these needs.

New Jersey Sea Grant Extension Program – A/S-1

One of the New Jersey Sea Grant College Program's main objectives is providing marine-related information to people who depend on coastal and ocean resources for their livelihood or recreation. Staff members' areas of expertise include marine recreation and safety, marine and coastal processes, and water quality. Working daily with individuals and organizations, marine agents and other specialists deliver the latest marine information and related research results to stakeholders. They also bring to program management new or potential problems and needs that can 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 – A/S-2



The Communications program is responsible for collecting, cataloging and distributing all information generated by the New Jersey Sea Grant College Program. Information about research, education and extension activities and accomplishments is distributed and publicized through *The Jersey Shoreline* magazine, brochures, fact sheets, newsletters, print and electronic news media, the Internet, technical reports, conferences, workshops and other outlets. Communications develops, produces, distributes and organizes all of these products and events. Scientists, educators, legislators, industry, the news media and the general public all use and benefit from Communications' products and services.

Education – E/T-1

The Education Program performs a wide range of marine-related environmental science education and outreach services for audiences that include pre-kindergarten, pre-college and college students, professional educators, family groups, youth groups and the general public. Private sector partnerships allow the program to contribute to formal education reform by providing professional educators with classroom tools and the necessary skills to bring marine and marine-related environmental science-based curricula that support achievement of high standards by all students in all subject areas while promoting marine stewardship. The well-established infrastructure of NJMSC/NJSG education programs and audiences and this collaborative approach also provide an efficient way to transfer information about Sea Grant research to the public.

Development Projects 2008-2010

System dynamic model development for Passaic River Watershed sustainability and environmental management study
R/D 6605-0003

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Sub-lethal effects of contaminants on ontogeny of larval fishes: effects of changes in morphology and behavior on predation risk
R/D 6605-0004

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