Sea Grant
NJ Sea Grant Consortium
Research Projects
2014-2016

Facilitating Natural Dune Building R/6410-0013

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Bulldozed dune at Brick Township following Hurricane Sandy 2013

Assessments of damage along the New Jersey shore after Tropical Storm Sandy indicate that the condition of the dunes had a pronounced effect on susceptibility to flood and wave damage. Not all dunes were alike; some dunes evolved by natural processes; some were created by direct deposit of fill; some were created using sand-trapping fences; some were bulldozed using local beach sand or storm-wave deposits. Some dunes had surfaces stabilized by planted vegetation; some had vegetation growing throughout; and some were unvegetated. The size, shape, and resistance to erosion of dunes are related to the method of construction, but when and how the different methods can be optimized to provide a better protective dune is poorly understood.

Naturally evolving dune at Avalon 2009

This project focuses on the quantification of the resistance of different dune types to wave erosion and of sand supplied to the dune by winds, accounting for the constraints to wind-blown sand transport across narrow beaches of developed shorelines. Field investigations will provide data on the ability of human-modified dunes to withstand wave impact, the rates of delivery of sediment to dunes from nourished and unnourished beaches, and the ability of dunes to resist erosion and maintain their effectiveness as a barrier against flooding, especially during the critical period when they are rebuilding after storms. Maintaining healthy dunes on developed coasts like New Jersey is challenging because dunes require space to accommodate growth and time to evolve, which are frequently unavailable.

The results of this project will provide better criteria for creating protective dunes where human development has introduced spatial and temporal constraints. Local managers can use results of this project to design management activities that enhance dune resilience based on site-specific constraints.

Advancing Eastern Oyster Aquaculture through Marker-Assisted Selection R/6410-0010

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Dr. Ximing Guo and colleague Paola López-Duarte challenge oysters with *Perkinsus marinus* (a pathogen that causes Dermo disease) in the lab.

The eastern oyster (*Crassostrea virginica* Gmelin) is one of the most important marine resources in the US. Over the past 60+ years, however, over-fishing, habitat destruction and diseases have decimated eastern oyster populations and fisheries in much of the mid-Atlantic region including Delaware Bay. The prolonged decline in oyster fishery has brought social and economic hardship to coastal areas. Oyster farming or aquaculture has the potential to ease the economic pain of coastal communities by providing stable jobs and high quality oysters without adding additional fishing pressure to wild stocks.

Oyster aquaculture in New Jersey and much of the Atlantic U.S. faces many challenges. The lack of a domesticated stock with desirable traits for aquaculture is a major impediment. The eastern oyster faces two major diseases: MSX (caused by the parasite *Haplosporidium nelsoni*) and Dermo (caused by the parasite *Perkinsus marinus*). These diseases present a major threat to oyster aquaculture, as each of them 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. However, the Rutgers strain has only moderate resistance to Dermo. Further improvement in Dermo-resistance has been slow. Currently, selection is based on field-exposure, which becomes ineffective in years when disease exposure is low or absent. The inability to maintain constant selection pressure presents a major challenge for breeding disease-resistance in oysters. The problem can be solved by identifying genetic markers for disease-resistance and practicing marker-assisted selection. With disease-resistance markers, we can target them in years when diseases are absent. Even when diseases are present, disease-resistance markers can be used to increase selection pressure and efficiency by selecting the best genotypes among survivors.

Dr. Guo's team at Rutgers University has been actively working on the identification of disease-resistance genes in oysters. Through several years of research on the oyster genome, they have identified a few disease-resistant markers that are ready to be tested for marker-assisted selection in the field. In this new project Dr. Guo's team will test the efficacy of marker-assisted selection for disease-resistance. They will select the most disease-resistant oysters based on their field survival as well as their genetic makeup. The addition of marker-assisted selection is expected to improve selection efficiency and speed up the development of disease-resistant oysters. These improved disease-resistant oysters should give oyster farmers a much better return. They may also speed up the recovery of wild oyster populations in Delaware Bay and beyond.

Oyster spawn.

Research Projects 2014-2016

Development of Historically-Calibrated SeaLevel Rise Projections for Risk Management Along the New Jersey Shore R/6410-0014

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Chris Vane, a collaborator of Benjamin Horton, works with high school students in the coastal marshes of New Jersey to collect sediment cores that will be used to reconstruct past sea-level changes. ***Photo - Benjamin Horton***

The devastation caused by Superstorm Sandy highlighted the vulnerability of communities, economies and ecosystems in our region to sea-level rise and the associated increase in the intensity of coastal flooding. A mere 1.1' of sea-level rise would be sufficient to cause the 1-in-10 year storm at Atlantic City to exceed the worst known from the historical record, including both Sandy and the December 1992 nor'easter. Both tide gauge and satellite records show that the rate of sea-level rise is increasing globally and in New Jersey. In fact, geological records show that the twentieth-century rate of sea-level rise in New Jersey was faster than during any other century in at least 4300 years.

Decisions on how to adapt to rising seas and protect vulnerable ecosystems require probabilistic sea-level rise projections to inform risk analysis. Accordingly, this project, led by Dr. Robert Kopp, assistant professor of Earth & Planetary Sciences at Rutgers University and associate director of the Rutgers Energy Institute, in collaboration with other researchers at Rutgers and Climate Central, will produce state-of-the-art sea-level rise projections for the region, grounded in the best available science on historical and pre-historical sea-level change, sea-level physics, and uncertainty analysis.

The project will develop a database of geological and observational sea-level and ice sheet volume constraints and use it to disentangle the different factors that have driven sea-level rise in New Jersey over past millennia: among them, the ongoing effects of adjustment to the end of the last ice age, compaction of coastal sediments, uptake and loss of heat from the oceans, changes in ice sheet and glacier volume, and changes in ocean dynamics. The past responses to changes in climate will be used to calibrate a model of future sea level change, the projections from which will be integrated with statistical analysis of extreme flooding to provide predictions of changing flood risks over the next century on the Jersey Shore.

The results will be used to identify the vulnerable developed and undeveloped land areas, infrastructure, assets, ecosystems and populations exposed to flooding during the 21st century. The research team will communicate the results to Federal, State, and local policymakers and the broader public through direct outreach and through tools such as Surging Seas (sealevel.climatecentral.org) and NJ Flood Mapper (www.NJFloodMapper.org).

Flooding in Atlantic City due to an increase in water level of 5' above mean highest high water), indicated by blue shading. This level exceeds the highest known from the observational record (4.4'), and is expected to be comparable to a 1-in-10 year storm after 1.7' of sea-level rise. Children icons indicate schools, red cross indicates a hospital.

Source: Surging Seas, sealevel.climatecentral.org

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Determining Sustainable Catch Limits for Data-Poor Fisheries in New Jersey: Validation and Refinement of a Data-Poor Harvest Control Rule

R/6510-0012

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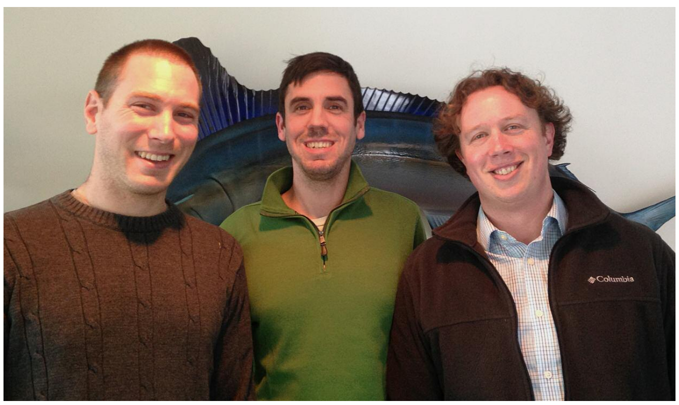

Research team (left to right): Chris Free, John Wiedenmann and Olaf Jensen.

Many fish populations support thriving commercial and recreational fisheries in New Jersey, and the health of these fisheries has broad implications for the economies of many coastal communities. Sustainable fisheries management typically requires large amounts of data to estimate population size and sustainable catch levels using a stock assessment model. However, many species in New Jersey are considered data-poor, where data are limited or of poor quality, preventing the use of traditional stock assessment methods. As a result, sustainable fisheries management is particularly difficult.

Recently, an approach for classifying abundance and setting catch limits for data-poor fish populations has been developed. The Only Reliable Catch Series (ORCS) approach utilizes readily available information on the population and fishery characteristics of a population to predict abundance and set catch levels. The ORCS approach is being considered for the management of many data-poor fish populations (including black sea bass), despite the fact that it has not been validated. Led by Dr. John Wiedenmann, Assistant Research Professor in the Institute of Marine and Coastal Sciences at Rutgers University, along with Dr. Olaf Jensen and graduate student Chris Free, this research project will evaluate the ability of the ORCS data-poor approach to reliably estimate the abundance and sustainable catch levels for a fish population. To test the ORCS method, a database will be utilized that contains stock assessment estimates for over 300 global fish populations. The reliability of the ORCS method will be determined by applying it to populations in the database, and comparing the predicted estimates of abundance and sustainable catch levels to the stock assessment-estimated values in the database.

Black sea bass support large commercial and recreational fisheries in New Jersey.

The main benefit of this project will be to improve the ability to manage data-poor stocks in the region. If effective, the ORCS approach represents a potentially powerful tool to help sustainably manage many of the data-poor fish populations found in New Jersey and the greater Mid-Atlantic.

Understanding the Impacts of Climate Change on the Distribution, Population Connectivity, and Fisheries for Summer Flounder *(Paralichthys dentatus)* in the Mid-Atlantic R/6410-0011

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Summer flounder is a critically important species to commercial and recreational fishermen throughout the Middle Atlantic region, but the species has been found further and further north at the same time that temperatures have warmed in recent decades. These shifts in summer flounder have greatly complicated fisheries management, and climate change will likely further impact the distribution and productivity of summer flounder. This project aims to uncover why summer flounder have shifted north and what the implications for management will be. The ultimate goal is to provide information that supports management of the summer flounder fishery for both high yields and long-term sustainability.

The project brings together a diverse, multi-state and multi-university team with expertise in fisheries ecology, climate science, and economics. Dr. Malin Pinsky, assistant professor of Ecology, Evolution, and Natural Resources at Rutgers University, leads the team. Co-investigators on the project include Olaf Jensen and Ken Able (Rutgers), Janet Nye and Hyemi Kim (Stony Brook U.), Joel Fodrie (U. North Carolina), and Chris Kennedy (George Mason U.).

The project will integrate a range of scientific approaches, from genetics to microchemistry, analysis of historical data, and bioeconomic modeling of fishery outcomes. Key questions to be answered include the degree to which summer flounder move up and down the coast, and to what extent they move in response to changing temperatures. In addition, the combined impacts of climate and regulations on the fishery will be examined. In total, the project aims to provide much of the scientific understanding needed to begin including climate change and range shifts in assessment and management of summer flounder.

Photos - Rutgers University Marine Field Station