Impacts of Nitrogen Loading & Pathogens

Project At a Glance

Title
Impacts of Land Use Change and Nitrogen Source Shifts Over Time: Building Capacity for Collaborative Research Leadership at the Grand Bay Reserve

Place
Grand Bay, Mississippi

Reserve
Grand Bay NERR

Intended Users
- Grand Bay NERR
- Mississippi Department of Archives
- United States Food and Drug Administration
- University of Southern Mississippi
- Portersville Revival Group
- Eco-tours of South Mississippi

Project Team Partners
United States Food and Drug Administration Office of Food Safety; University of Southern Mississippi Gulf Coast Research Laboratory; Grand Bay NERR; Auburn University Shellfish Laboratory

Timeline
10/2010 to 10/2013

Learn more
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Planning the Future With an Eye on the Past

People have harvested oysters in Mississippi's Grand Bay for more than 4,000 years. Today, the future of that legacy is at a crossroads. Increased nitrogen pollution from residential and industrial development and overtaxed wastewater treatment infrastructure is flowing into coastal waters with potentially far-reaching effects on ecosystems, human health, and local economies. As controversy over the habitat and fishery impacts of constructing a new facility and outfall continues, waste from local fish processing operations goes into coastal waters untreated, taking with it pathogens that may influence the harvestibility of oysters and other seafood. And less than five years after Katrina's storm surges swept through the estuary, the first, and far from last, tar ball from the Deepwater Horizon spill washed onto Grand Bay's shores.

For local communities dependent on water-based economies such as commercial fishing, fish processing, and eco-tourism, the ability to establish a baseline against which to assess the influence of future human activity and natural forces on water quality and habitats is critical. Fortunately, as they plan for the future, Grand Bay decision makers have a unique resource in the past. For those who know how to read it, the nitrogen content of oyster shells in fragile, ancient middens along the coast provide a record of human activity and its impact on ecosystems going back thousands of years.

Dauphin Island Sea Lab is working with the Grand Bay NERR and other partners to open these biological time capsules and combine this record with data from sediment cores and current sediment and water samples, and contemporary shellfish communities. They plan to provide a benchmark to improve the ability to measure land-use related nitrogen sources and pathogen changes through time, and define the resulting effects of these changes on ecosystems and human health.

Deploying caged oysters on Grand Bay

Local Context

Located on the southeastern tip of the state, Grand Bay is one of the largest estuaries on the Mississippi coast. Much of the Bay is occupied by the local NERR, which encompasses roughly 18,000 acres of pine savannas, salt marshes, saltpans, bays, bayous, and forests. Patchy residential sprawl lies to the north, and industrial facilities lie to the west, placing the Reserve in the crosshairs of increasing land-use intensity.

Among the Reserve's most precious and fragile resources are archaeological sites, including shell middens that lay next to modern day shellfish beds. This unique set of co-located environmental, historic, and land use characteristics make the Reserve and its adjacent watersheds an ideal system in which to trace the shifts in nitrogen sources and their impacts over time.

As one of the newest Reserves in the NERRS, Grand Bay is also among the least studied in the System. This project will serve as springboard for Reserve staff to work with a broad set of collaborators to collect data of key interest to the reserve, support future research activities, and provide highly transferable data that answer questions of broader interest. It will also support local decision makers to identify areas at risk for habitat degradation and fisheries loss.

NERRS Science Collaborative

The Science Collaborative uses a competitive process to identify and fund science to address environmental challenges in communities served by Reserves. Projects are selected through annual competitions, designed to insure that investigators, intended users of the science, and relevant stakeholders work together to describe science and technology needs to address specific problems, define research questions, design and implement projects, and apply the results.

The program works with outreach specialists, trainers, and communicators to share information about the science that it funds with other Reserves and the broader coastal management community.

The Science Collaborative also sponsors Training for the Integration of Decision Making and Ecosystem Science (TIDES), a UNH-based program that helps individuals develop the skills needed to link science-based information to coastal resource management decisions. TIDES offers a non-thesis master's degree track and a professional certification program.

The NERRS Science Collaborative is administered by the University of New Hampshire (UNH) through a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA).

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Clam shell sliced to show annual bands and vials showing steps of preparation for stable isotope analysis (above); oyster deposit adjacent to a midden in Grand Bay (left)

Project Goal

This interdisciplinary project team aims to define the legacy effects of land-use change on coastal ecosystems and human health using Grand Bay as a benchmark estuary by measuring shifts in nitrogen sources, shellfish growth, and pathogen accumulation over time. They hope that the data they provide will not only build and foster ongoing collaborative research efforts at the Reserve, but serve as a model for other estuaries impacted by urbanization.

Approach

Collaborative

The project team is using the Joint Fact Finding approach to connect their work to intended user interests and decisions making. This effort began before the project's proposal was written, with early meetings that focused on dovetailing the interest priorities of the Reserve and project partners with the needs and capacities of intended users in the management community.

- Project participants meet regularly to provide opportunities for vetting the project's progress and findings on an ongoing basis. At least once each year, all project participants, including intended users meet to share translated data and uncertainty estimates, gather and discuss feedback, and define necessary changes to methods. These meetings employ principles from Structured Decision-Making to establish ground rules and resolve conflicts.
- The project is establishing working groups to determine how to translate outputs from participant meetings into technical changes in the project's methods. The project integration lead will keep notes for each working group and share these on a website and discussion board to provide a record and an ongoing opportunity for input.

Ecological, Archaeological Science

The project team's work combines data that extends from the present back 3,000 years:

- Land-use change: To define time scales of land-use change and provide context to evaluate ecosystem and human health data, the team will model land-use change in three sub-watersheds that represent a land-use gradient from relatively undeveloped to residential/industrialized.
- Historical data: To collect nitrogen source, ecological, and human health data for recent decades, the team will analyze sediment cores from undisturbed sites for carbon and nitrogen content, stable isotope (SI) ratios (indicators of land derived nitrogen and carbon sources), and *Clostridium perfringens,* an indicator of potential human health risk. They will measure internal growth patterns in clams and oysters. To link biological responses of shellfish to nitrogen source shifts, they will measure SI ratios in bivalve shells and tissues.
- Present day data: To calibrate historical and present-day data, they will evaluate modern sediments, water, and living bivalves. To define modern anthropogenic and natural influences, they will also sample water quality for nutrients, carbon, nitrogen, surface sediments, and chlorophyll.