Photo courtesy of George Proios

Breaking Through

Nothing is more constant than change itself...

And nowhere can this be demonstrated more graphically than along Long Island's barrier beaches where the dynamic interactions between shifting sands and crashing ocean waves constantly reshape the thin strands of beach and periodically form new inlets. When new inlets form, salty water from the ocean enters the calmer, shallow waters of Long Island's south shore estuaries (LISSE), potentially changing the delicate balance of the estuaries' ecosystems. In recent decades, each of these estuarine ecosystems has already undergone change due to increased community development along Long Island's populated south shore coupled with changes in business and municipal practices that may have led to a decline in commercial shellfish populations.

Looking long-term at the effects that future breaches along barrier beaches might have on these estuarine ecosystems, New York Sea Grant has funded four novel research projects. Each has a different approach and thus provides a different piece of the puzzle.

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Breaking Through

Through documentation of geological history, mathematical modeling, and biological field work and assessment, a whole picture will emerge to show how barrier breaches alter the ecology of these related estuaries. Long Island's south shore estuaries (see map on opposite page) make up a series of contiguous barrier island estuaries that have been subject to severe storm events that cause ephemeral or permanent barrier island breaches. Such inlets can substantially alter the ecology of these estuaries by increasing bay flushing and salinities. It seems clear that LISSE have experienced a phase shift in recent decades. These ecosystems once enjoyed balanced and robust biological production both in the pelagic region (water column) with a variety of phytoplankton and in the benthic region (bottom) dominated by eel grass and hard clams. But now these regions are dominated by pelagic algae such as brown tide which is having a deleterious effect on commercially significant clams and scallop as well as submerged aquatic vegetation (SAV) such as eelgrass.

Using the Past to Plan for the Future

One way of assessing what has changed in Long Island's estuaries is going to the geological record. At present, almost nothing is known about the sub-bottom resources of Great South Bay (GSB) or their history through Colonial times. The research team of **Steven Goodbred**, **Robert Cerrato**, and **Kirk Cochran** of Stony Brook University's Marine Sciences Research Center (MSRC) will be the first to determine GSB's sub-bottom structure and use it to infer its geological history in their project *The History of Great South Bay: Its Geological Evolution, Benthic Faunal Records, and Past Environmental Change*. This information will be useful for understanding the system's evolution and possible future response to environmental changes such as sea-level rise and barrier breaches and their management. Sub-bottom surveys will also delineate the thickness, distribution and nature of mineral deposits.

These surveys of Great South Bay will have an immediate application of providing Long Island towns with valuable dredge spoils management information. Findings from this research project will also provide details about the structure and variability of the natural and more recently perturbed GSB ecosystem, thus helping shellfish managers to set realistic standards and expectations for shellfish restoration efforts. The Long Island South Shore Estuary Reserve's Comprehensive Management Plan gave a high priority to this information for public and government stewardship.

Using the Power of Physical and Mathematical Models

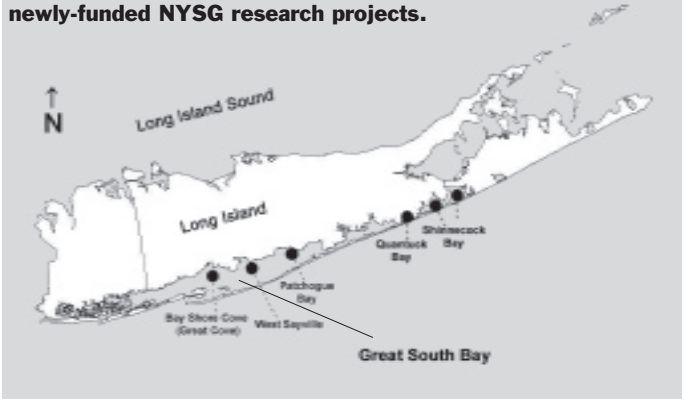
Barrier island breaches in Long Island's south shore estuaries are a continuing possibility, potentially threatening the water quality and biological resources within the system. MSRC's **Bob Wilson**, **Charlie Flagg**, and **Henry Bokuniewicz** in their project *The Impact of Barrier Island Breaches on the Circulation and Water Properties of Great South Bay* will be applying a 3-D numerical model to investigate the impact that barrier island breaches might have on the ecology of Long Island's south shore estuaries. The model will be sensitive to changes in circulation, salinity, temperature, stratification, nutrient supply, productivity, bed-form and submerged aquatic vegetation.

Modeling represents a potentially very useful tool for gaining a unified picture of how the various components of the system interact and are affected by alterations in the system. This research team will apply a 3-D numerical model, using salinity as a keystone parameter, to evaluate the changes in residence time, 3-D temperature and salinity distributions, tidal and residual circulation, tidal and sub-tidal sea-level variability, and bottom stress with the system. The calibrated model will be used to investigate the response to current US Army Corps of Engineers breach scenarios for Fire Island.

In another newly-funded project, *Physical,*

Background image of Great South Bay. Photo by Barbara A. Branca

Long Island's south shore estuaries are the focus of four newly-funded NYSG research projects.



Sedimentary, and Hydrologic Impacts of Barrier Island Breach Events on Long Island Estuaries, researchers will look at the physical characteristics of the water in LISSE and their effects on living things both in the water column and on bay bottoms. The formation of breaches in a barrier island separating estuaries from ocean water can cause substantial changes in the water quality, volume of water exchanged, sediment composition and bottom type, and the biological resources of the estuarine environment. The Southampton College research team of **Joseph Warren** and **Robert Turner** will collect baseline data to characterize Long Island south shore bays' hydrography, bathymetry, and sediment characteristics and their effects on pelagic and benthic communities. Resource managers, agency personnel, scientists and modelers will be able to use this information to aid in decision making regarding breach events.

Establishing Gradients for the Biological Communities

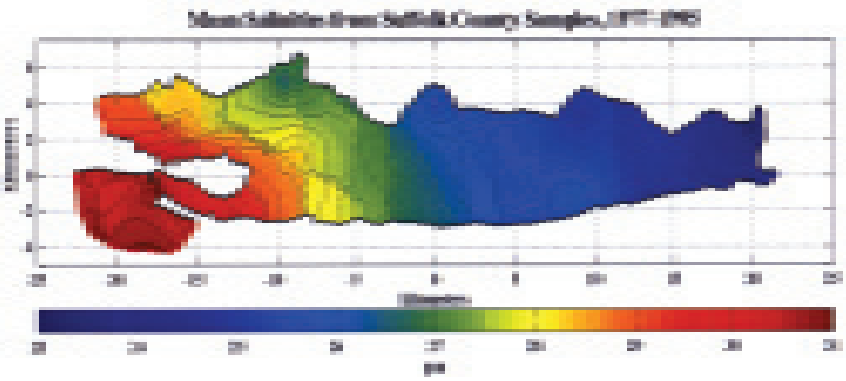
During a breach event, less saline bay water is exchanged for saltier ocean water. To ascertain how ocean exchange influences phytoplankton, SAV, and shellfish populations in LISSE, another research team will concurrently conduct field experiments to assess predation on the growth of SAVs and hard clams across ocean-to-estuary gradients. **Christopher Gobler** and **Bradley Peterson** of Southampton College, Long Island University will conduct *Influence of Ocean Exchange on Nutrients, Plankton Assemblages, Submerged Aquatic Vegetation and Shellfish within Long Island's South Shore Estuaries.*

Establishing gradients in nutrient concentrations, phytoplankton abundance, diversity and productivity, SAV densities and shellfish densities along estuary-to-ocean transects within LISSE is of critical importance for future managerial decisions aimed at understanding the impacts of breaches on the estuaries and restoring their once-productive shellfisheries.

Because of the significance of these four projects, this summer's Research Experience for Undergraduates (REU) program at Stony Brook's MSRC will focus on Great South Bay. A small group of students from around the country will be mentored by many of the breach project investigators during a unique summer session. New York Sea Grant will be sponsoring a student from Northwestern University, **Sarah Holsinger**, who will work with MSRC's **Roger Flood**. This successful summer program initiated by the National Science Foundation and led by MSRC's **Josephine Aller** is now in its sixth year.

The integration of these four projects will provide a greater understanding of estuarine ecosystems and will provide results of interest to planners, managers, citizen groups and the businesses of Long Island's south shore communities as they look long term at land use, development and the commercial and recreational exploitation of marine resources.

— Patrick Dooley and Barbara A. Branca



Maps like this one that indicate the salinity of Great South Bay will be used to create a 3-D numerical model to show the impact of breaches on the estuarine ecosystem.
Courtesy of the Suffolk County Department of Health Services