Exploring the Impacts of Swashes on Coastal Water Quality

Project At a Glance

Place

Grand Strand,
South Carolina

Project Team Partners

North Inlet-Winyah Bay NERR

S.C. Sea Grant Consortium

Coastal Carolina University

S.C. Department of Health and Environmental Control

S.C. Department of Natural Resources

Horry County

City of North Myrtle Beach

City of Myrtle Beach

Town of Surfside Beach

Timeline

October 2010 to October 2013

Funding

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Learn More

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The Swash Cycle

In the summer of 2004, anglers casting off South Carolina's Grand Strand were surprised to find themselves in the heart of a flounder jubilee. The flatfish were so plentiful and slow moving you could practically scoop them up with a net. Scientists were able to confirm that oxygen levels in nearshore waters had dipped to a point of hypoxia, a level that is harmful to animal life, creating a dead zone that was driving suffocating flounder toward the shore.

For communities dependent on coastal tourism, this event was unexpected and troubling. Out of that concern emerged the Long Bay Working Group (LBWG), a group of resource managers and scientists dedicated to understanding the causes of hypoxia in local waters. Their research has suggested the local hypoxia events are not directly fueled by phytoplankton blooms in the ocean. Instead, it appeared that the necessary ingredients for future hypoxia events come from natural and anthropogenic (man-made) sources. Anthropogenic sources include stormwater pipes, groundwater, and swashes—tidal creeks that traverse the local beach faces, funneling stormwater runoff and groundwater from a heavily developed landscape directly into coastal waters (see side bar on next page).

A team led by the North Inlet-Winyah Bay NERR is working with stakeholders to test the idea that swashes collect, transform, and export the nutrients and organic matter required to fuel hypoxia along the coast. They plan to share what they learn with state agencies and local governments interested in making land-use and stormwater management decisions that protect coastal water quality in the Grand Strand.

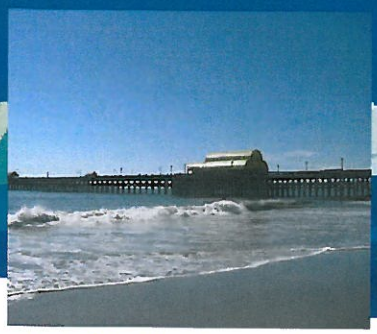
Local Context

An economic pearl in South Carolina, the Grand Strand is a sixty-mile stretch of beaches and resort communities that draw roughly 15 million visitors each year and generate about 40 percent of the state's $16 billion tourist industry. Fishing and water sports top the list of local attractions, making coastal water quality a priority concern.

Addressing that concern, however, is a challenge along a heavily developed coast where much of the runoff washes into coastal waters through swashes that have been modified in shape and hydrology. Preliminary data indicate that nutrients and organic matter are most concentrated in coastal waters around the swashes, yet very little is known about how surface and ground waters mix and flow through swashes, or how they might transform the nutrients and organic matter passing through them into forms more likely to lead to hypoxia.

The North Inlet-Winyah Bay NERR lies south of the Grand Strand. The Reserve has identified the impacts of coastal growth as its top research and management priority. Through the LBWG, reserve staff have contributed to the research looking at hypoxia events off the Grand Strand and are also active participants in the Coastal Waccamaw Stormwater Education Consortium (CWSEC), a collaborative network of education providers and Small Municipal Separate Storm Sewer Systems (SMS4) stormwater managers.

Swashes are tidal creeks that drain the urbanized area directly into the coastal ocean.



Apache Pier (above) has a continuous monitoring station for oxygen levels. This project will explore the role of swashes (left) in hypoxia events that now occur in South Carolina's coastal waters.

Long Bay Hypoxia

Hypoxia or extremely low oxygen levels in the adjacent waters off the Grand Strand (Long Bay, from approximately North Myrtle Beach to Surfside Beach) has been observed for periods of up to a week in the summers of 2004 and 2009. Waters that reach hypoxic levels are no longer able to sustain most animal life. The Long Bay Working Group (LBWG) was formed as a collaborative effort between scientists and managers to understand the causes and consequences of hypoxia formation in Long Bay.

Ongoing research indicates that regional oceanic conditions and local terrestrial inputs both play a role in the formation of hypoxia near the coast. The oceanic conditions are the upwelling of cold bottom water driven by southwesterly winds in concert with high summertime temperatures. These are the natural pre-conditions necessary for the development of hypoxia. These conditions act to confine terrestrial nutrients and organic matter loading to the immediate nearshore waters. This results in elevated nutrients and organic matter concentrations that stimulate enhanced bacterial activity causing a depletion of oxygen in nearshore waters. Additional research is needed to further understand how and where these nutrients and organic matter are entering Long Bay as well as understanding the physical thresholds for when hypoxia occurs.

For more information on hypoxia in Long Bay, please contact:

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Water quality data at Apache Pier:

www.ysieconet.com/public/WebUI/Default.aspx?hidCustomerID=131

Project Goals

The project team aims to better understand how local land-use and stormwater management practices affect the flow and transformation of nutrient and organic matter as they move into, through, and out of swashes into coastal ocean waters. Ultimately, the project team hopes to provide the scientific information needed to make land-use and stormwater management decisions that improve and protect coastal water quality, particularly with respect to hypoxia, in South Carolina's Grand Strand.

Approach

Collaboration

This project's collaborative approach will build on successful working relationships between scientists, educators, and decision makers that were established through the LBWG and the CWSEC. The project team will follow the six-step Joint Fact Finding and collaborative process—already underway with these groups and other stakeholders—with activities that include a series of collaborative workshops with local and state intended users:

- Preliminary set of workshops with local and state stakeholders who will discuss hypoxia in Long Bay; research goals, methods, and limitations; current stormwater management activities; available data and information; swash classification; and changes in the project study design based on the discussions.
- Second workshop and follow-up discussions will vet the classification approach and selection of the first two swashes to study.
- Third workshop will discuss mid-project findings, the identification of the second set of swashes to study, and potential management implications.
- Final workshops will discuss research findings and their potential management implications and actions.

Sample Design

The project team will augment existing knowledge about the physical forces and human activities that impact coastal water quality in this area with a deeper understanding of the role of swashes in this context. Over the next three years, they will:

- Work with local partners to develop a method to categorize 14 swashes according to their physical characteristics and hydrology, and the stormwater infrastructure and land-use in the surrounding watershed.
- Use the classification scheme to select four swashes, the study of which will be most informative from a research and a management perspective.
- Measure the concentrations and forms of nutrient and organic matter that flow into the selected swashes from stormwater runoff and groundwater seepage.
- Characterize how the internal conditions and processes of the swashes impact the transport and transformation of organic matter within the selected swashes.
- Quantify the form and tidal export of nutrients and organic matter from swashes and understand how this influences the formation of coastal hypoxia.