Virginia Coast Reserve
Long Term Ecological Research

Satellite image of the Delmarva Peninsula: NASA.

Coastal Barrier Ecosystems in the Global Environment

The Virginia Coast Reserve is one of the few remaining undeveloped areas on the Atlantic seaboard and Gulf coast available for the study of the coastal barrier ecosystems. Found on every continent except Antarctica, these systems are irreplaceable—as a source of livelihood, as a refuge for wildlife, as a buffer for storms, and as a filter for nutrients in the groundwater. We are only beginning to learn how this complex and dynamic system works or how it is affected by forces of global change.

The goal of the Virginia Coast Reserve (VCR) LTER program is to develop a predictive understanding of how slow, progressive changes in climate, sea level, and land use, and short-term disturbances like hurricanes influence the dynamics and biotic structure of coastal barrier systems.

A Dynamic Natural Laboratory

The 35,000-acre Virginia Coast Reserve is an assemblage of 14 barrier islands, shallow lagoons with extensive mudflats, tidal marshes, and mainland watersheds extending 70 miles along the seaward margin of the Delmarva Peninsula. Created as a preserve by The Nature Conservancy in 1970, this barrier island and lagoon system has been designated a United Nations International Man and Biosphere Reserve. It supported one of the most prosperous farming and fishing-based communities in the country at the turn of the last century. Now all but one of the islands of the Virginia Coast Reserve are uninhabited.

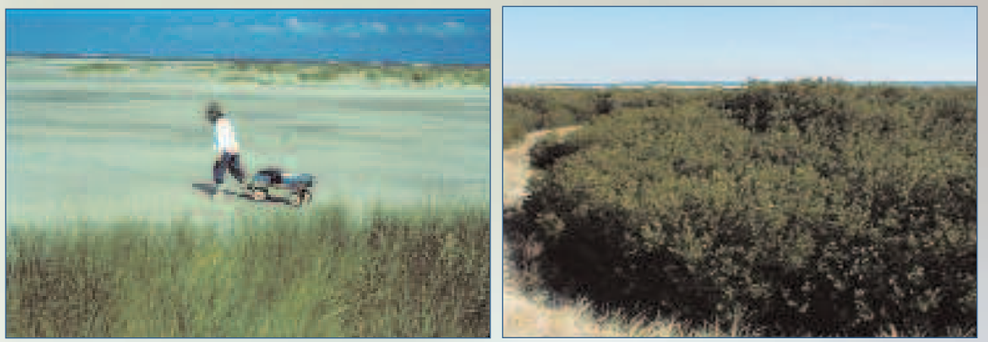
The close association of land and sea creates a dynamic environment on the barrier islands.

One reason that they have been abandoned is the dramatic rate of shoreline change—as much as 40 feet in a single year—as the islands migrate toward land in response to storms and rising sea level. While this makes human habitation difficult, it makes the reserve the ideal place to study natural processes of landscape change. Events that might take decades elsewhere can be observed over the span of just a few years.

Drivers of State Change

Although the long-term drivers of environmental change—climate, rising sea level, and land use—are common across the VCR landscape, their relative importance for the different landscape units varies. We continue to study progressive change within the landscape units, while identifying the threshold responses that might produce an abrupt transformation in ecosystem state.

An instance of a state change induced by a combination of short- and long-term effects occurred in the lagoons in 1933, when a storm wiped out a seagrass population already weakened by disease. The character of the lagoons changed immediately, and without seagrasses lining the bottom, the lagoons became turbid from sediment resuspension. We are now involved in a large-scale restoration of seagrasses to the lagoons.



Evidence of rapid ecological change: A broad sand flat in 1990 (left) is a shrub thicket in 2004 (right). Photos: Don Young.

Our state change research also addresses whether changing land use will affect water quality in the lagoons and the return of the seagrass, whether marshes can keep pace with increases in sea level, and whether spatial variations in species and community distribution patterns on the islands can be used to predict areas vulnerable to change.

Biotic Feedbacks

The activity of living organisms can modify an ecosystem's response to external drivers, either by promoting a stable state or facilitating change. We are investigating the biotic feedbacks of how marsh grass and seagrass affect turbidity and erosion rates in marshes and lagoons and the role of birds in the expansion of vegetation on the islands.

Fluxes of Materials and Organisms

Developing an understanding of the patterns and dynamics of ecosystem change requires us to determine the ways organisms and materials move across the landscape. Our research currently focuses on a number of key fluxes. They include the movement of groundwater nutrients from mainland watersheds to coastal lagoons, sediment transfer between lagoons and intertidal marshes, water exchange between lagoons and the coastal ocean, and seed transfer by birds among the barrier islands.

Student samples nitrogen-fixing microalgae in a marsh creek on Hog Island. Photo: Stephanie Gross.

Landscape Synthesis

We are taking a number of complementary approaches—including landscape modeling and network modeling—to synthesize the data gained through long-term monitoring and shorter-term process studies. Our goal is to identify the causes and consequences of state change on the landscape so that we will be able to predict how coastal systems respond to drivers of global change. This will enable us to provide policy makers with a solid scientific foundation for decisions related to planning, management, and restoration of this dynamic environment.

Education and Outreach

We involve about 200 students each year from the Northampton public schools in our Schoolyard LTER program through involvement in sampling and data collection. Thanks to the LTER connection, the Northampton School District has been able to enhance its high-speed Internet connection and purchase books and computers. LTER staff members collaborate with high school teachers in curriculum development.

A schoolyard LTER group learns plant identification. Photo: Randy Carlson.