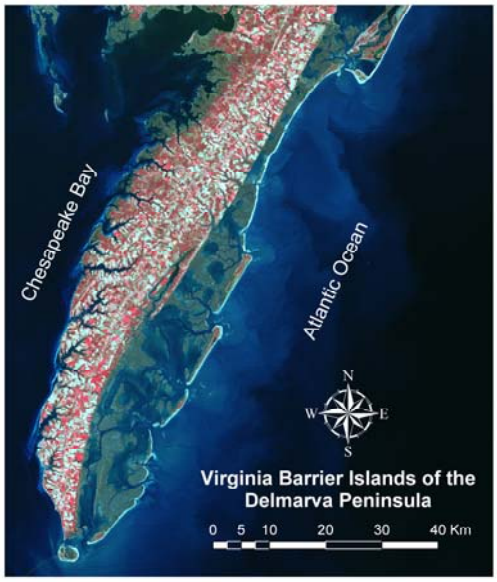
Virginia Coastal Reserve (VCR)

The goal of the Virginia Coast Reserve (VCR) LTER program is to develop a predictive understanding of how long-term environmental change and short-term disturbances control the dynamic nature of coastal barrier landscapes. The VCR is a heterogeneous landscape comprised of mainland watersheds, tidal marshes, lagoons, and barrier islands. The central hypothesis of the VCR LTER is that ecosystem dynamics and pattern on the landscape are controlled by the interaction between the vertical positions of the land, sea, and groundwater free surfaces, and the fluxes of organisms and materials across the landscape. Research at the VCR is organized around three synthetic questions: (A) How do long-term drivers of change (climate, rising sea level, and land-use change) and short-term disturbance events interact to alter ecosystem dynamics and state change, and how is their effect modified by internal processes and feedbacks at the local scale? (B) How do fluxes of organisms and materials across the landscape influence ecosystem dynamics and state change? (C) In the future, what will be the structure of the landscape and what processes will drive ecological state change? The project uses a combination of long-term monitoring and experiments, shorter-term process-level studies, and modeling. Patterns, processes and interactions are examined at three spatial scales: within landscape units (watershed, tidal marsh, lagoon, barrier island), within mainland-lagoon-island box transects, and across the entire system of islands and lagoons.



The VCR barrier island/lagoon system extends 110 km along the Atlantic shore of the Delmarva Peninsula. Sandy and dynamic barrier islands are backed by salt marshes and shallow lagoons and separated from one another by deep inlets.

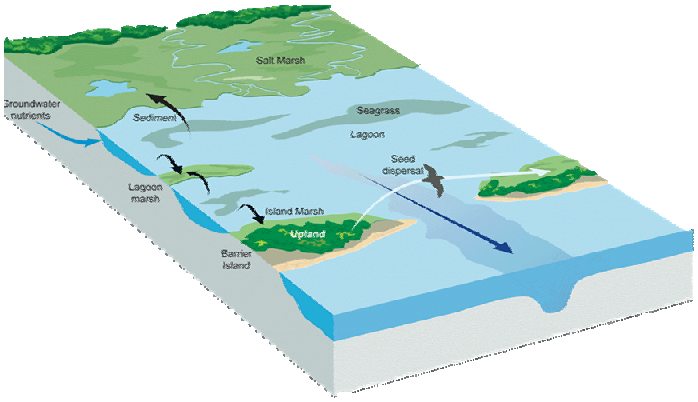
Site Characteristics: The Virginia Coast Reserve is located along the Atlantic side of the Delmarva Peninsula (37.0° - 38.0° N, 75.4° - 76.0° W, <20 m a.s.l.) and is characteristic of coastal barrier ecosystems that comprise much of the Atlantic and Gulf Coasts. It is an extremely dynamic, regularly disturbed landscape that includes an assemblage of 14 barrier islands, shallow lagoons with extensive mudflats, tidal marshes, and mainland watersheds extending 110 km along the seaward margin of the Delmarva Peninsula. The shallow seaward slope of the VCR coastal barrier landscape (<0.1%) makes this a particularly sensitive location for studying intertidal marsh dynamics in response to sea-level rise. The barrier island and lagoon system supported one of the most prosperous farming and fishing-based communities in the country at the turn of the last century. Now the islands of the VCR are uninhabited. The 14,000 ha reserve was established in 1970 by The Nature Conservancy and is a Man and the Biosphere Reserve. The contemporary landscape of the VCR took form during the late Holocene, although the underlying topographic framework can be traced back to relict drainage

basins of the antecedent Pleistocene land surface. Shoreline change on the modern islands is dramatic, typically characterized by lateral accretion and erosion at rates as high as 13 m/yr, and is the highest along the mid-Atlantic seaboard. This extreme rate of shoreline movement creates one of the most dynamic coastal landscapes in the United States.

Precipitation (average: 107 cm/yr, observed range: 85 to 150 cm/yr) is well distributed throughout the year with its source being cyclonic storms in winter and convectional storms in summer. The passage of a hurricane may be associated with large rainfall amounts. 80% of the hurricanes occur from August to October. An average of two hurricanes per year come close enough to influence the site.

Research Focus. The project seeks to understand the dynamic nature of coastal barrier landscapes in the context of long-term environmental change and short-term disturbance events. Our research since 1987 has focused on how long-term changes in climate (storms, temperature), sea-level, and land use affect the dynamics and biotic structure of coastal barrier systems and the services they provide. Long-term changes in the relative vertical positions of the land, sea, and groundwater free surfaces give rise to ecosystem state changes.

We view ecological changes as occurring non-linearly, with systematic progressive changes (succession) interrupted by abrupt transitions between ecosystem states (state change). Biotic feedbacks at the local scale contribute to the non-linear or threshold responses to environmental change.



The key fluxes of materials and organisms between landscape units influence ecosystem state change.

Current research focuses on whether changing land use will affect water quality in VCR coastal bays and the recolonization of the seagrass as the foundation species, whether marshes can keep pace with one of the highest recorded rates of sea-level rise on the Atlantic Coast, and whether spatial variations in species and community distribution patterns on the islands can be used to predict areas vulnerable to change. Understanding and predicting long-term change in this heterogeneous landscape requires that we examine processes at the local level as well as fluxes of materials and organisms between adjacent ecosystems.