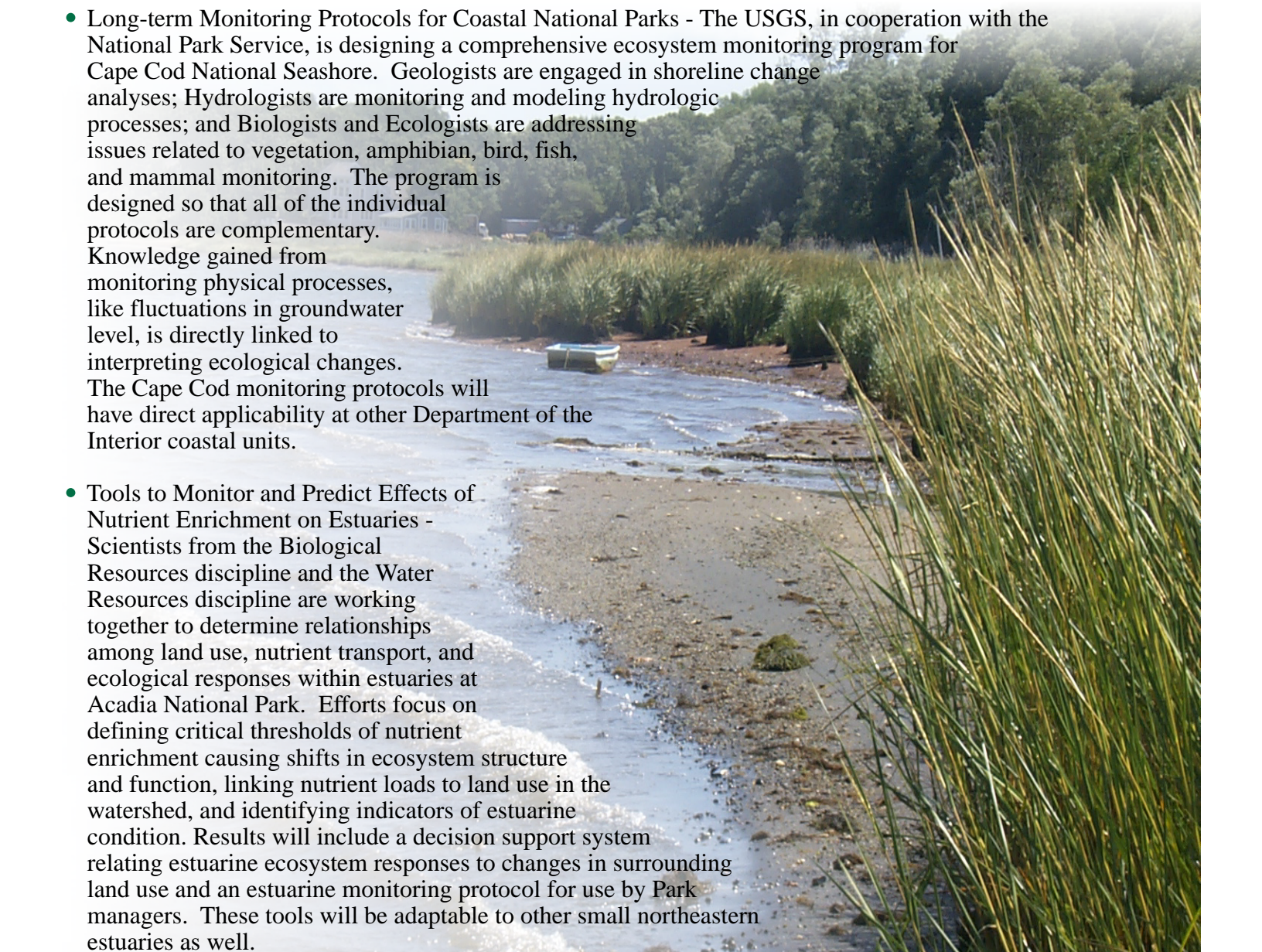




## Patuxent Wildlife Research Center Integrated Coastal Ecosystem Science in the Northeast

*The northeastern United States has the most densely populated coastal zone in the country, and the human population of this narrow fringe continues to grow. Expanding urban, residential, and agricultural development threatens coastal ecosystems with a multitude of stresses, including nutrient over-enrichment, habitat fragmentation, contaminants, and direct physical alterations. Natural resource management problems in the coastal zone arise from complex physical, chemical, and biological forces interacting across a variety of temporal and spatial scales, and they demand interdisciplinary approaches to solutions. The USGS Patuxent Wildlife Research Center is using integrated scientific teams to address the information needs of northeastern coastal managers from an ecosystem perspective.*

### Examples of Integrated Coastal Science in the Northeast

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- Long-term Monitoring Protocols for Coastal National Parks - The USGS, in cooperation with the National Park Service, is designing a comprehensive ecosystem monitoring program for Cape Cod National Seashore. Geologists are engaged in shoreline change analyses; Hydrologists are monitoring and modeling hydrologic processes; and Biologists and Ecologists are addressing issues related to vegetation, amphibian, bird, fish, and mammal monitoring. The program is designed so that all of the individual protocols are complementary. Knowledge gained from monitoring physical processes, like fluctuations in groundwater level, is directly linked to interpreting ecological changes. The Cape Cod monitoring protocols will have direct applicability at other Department of the Interior coastal units.
  - Tools to Monitor and Predict Effects of Nutrient Enrichment on Estuaries - Scientists from the Biological Resources discipline and the Water Resources discipline are working together to determine relationships among land use, nutrient transport, and ecological responses within estuaries at Acadia National Park. Efforts focus on defining critical thresholds of nutrient enrichment causing shifts in ecosystem structure and function, linking nutrient loads to land use in the watershed, and identifying indicators of estuarine condition. Results will include a decision support system relating estuarine ecosystem responses to changes in surrounding land use and an estuarine monitoring protocol for use by Park managers. These tools will be adaptable to other small northeastern estuaries as well.

- **Sea Level Change and Habitat Displacement -**

In many areas of the east coast, projected rates of sea level rise are thought to exceed the capacity of coastal wetlands to build vertically. An interdisciplinary approach is being used to investigate the impacts of sea level rise in National Parks, National Seashores, and National Wildlife Refuges along the Atlantic coast. Study sites include Forsythe National Wildlife Refuge in New Jersey, Blackwater National Wildlife Refuge in Maryland, Cape Cod National Seashore, and the Virginia Coast Reserve. USGS biologists and geologists are addressing the processes driving marsh surface elevation, ecosystem change, effects on

migratory bird habitats, and landscape structure. These projects are integrating physical and ecological information to document, understand, and predict coastal wetland responses to rates of sea level rise.



- **Evaluating the Success of Salt Marsh Restoration -** Most salt marshes throughout the northeastern US have been altered by ditching and other manipulations for mosquito control, salt hay farming practices, or restriction of tidal flow caused by roads, causeways, and impoundments. Efforts are now underway to restore natural tidal regimes to impacted marshes, and in turn, restore fish and wildlife support functions. Interdisciplinary teams of USGS scientists and collaborators are examining suites of hydrological, sediment, water chemistry, vegetation, and faunal indicators that can be monitored to evaluate the success of marsh restoration efforts. USGS Patuxent Wildlife Research Center scientists are engaged in marsh restoration efforts at Cape Cod National Seashore, Fish and Wildlife Service Refuges throughout the Northeast, and across the US-Canada Gulf of Maine region.

## **Emerging Issues and Capabilities**

Northeastern coastal managers require scientifically based information on nutrient enrichment and harmful algal blooms, cumulative effects of development within coastal watersheds, criteria for evaluating the success of restoration efforts, and responses of coastal ecosystems to short- and long-term geomorphic processes. An ultimate goal is to integrate physical and ecological models to provide a predictive framework for resource management planning. USGS scientists are uniquely poised to address these issues at a hierarchy of temporal and spatial scales. The Northeast encompasses a broad range of coastal ecosystems in a relatively small geographic area, within which each USGS discipline is well represented. The result is a cadre of USGS scientists in close proximity with the skills, capabilities, and infrastructure required to collaboratively address the complex scientific information needs for protection and management of coastal ecosystems.

