

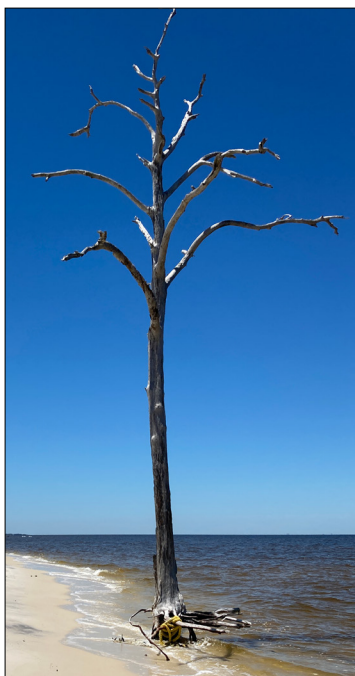


Inventory and Monitoring Data: Informing Climate Science at Parks

Cape Hatteras National Seashore in March 2019.
NPS photo

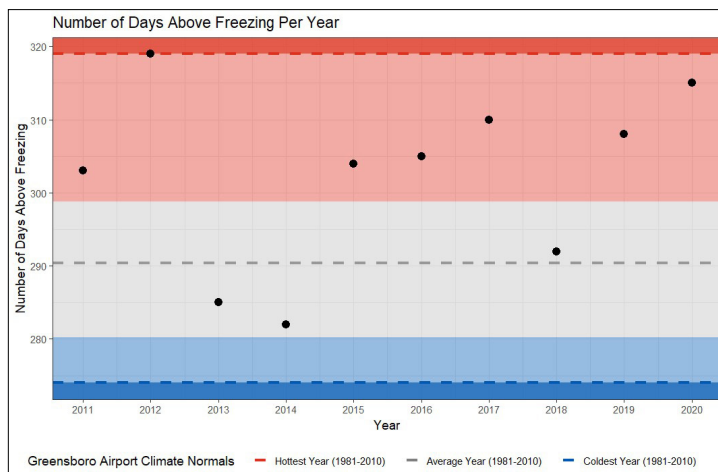
What It's All About

The National Park Service is responding to climate change through four main areas of emphasis including adapting to an uncertain future, mitigating our carbon footprint, and communicating to the public and NPS employees the current and future impacts. The final area of emphasis brings the NPS Inventory and Monitoring (I&M) Division and its 32 networks into the equation, by using science to help parks manage changes in their natural resources in response to new climate conditions. The Division's goals are to inventory and monitor important natural resources at parks using standardized methods, and integrate this information into park planning and decision making while sharing information and accomplishments with a broader



Exposed tree roots due to shoreline erosion on Horn Island at Gulf Islands National Seashore. NPS photo / GULN staff.

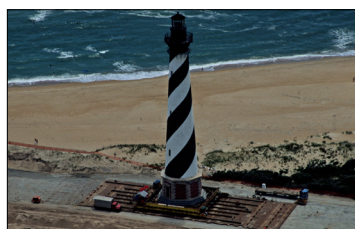
community. The I&M Division's national office is addressing landscape and large-scale climate science, while the monitoring networks, through their Vital Signs Monitoring efforts, track a suite of important natural resources across similarly situated parks. This program uses highly documented, repeatable and standardized sampling methods so data can be used to compare and contrast resource conditions both spatially and temporally and provide pertinent data to track the effects of changing climate conditions. The I&M Division's networks in the Southeast are currently operating in 52 NPS units and monitoring five broad categories of resources that encompass the range of natural resources found in parks across the Southeast. The networks use 39 different scientific monitoring protocols to target their efforts to the parks' individual needs and resource base. This brief highlights the ongoing I&M monitoring efforts across the region that are helping to inform parks about the ways resources are changing and how climate science can be used to inform resource management.



Weather station data shows the days above freezing increasing in seven of the past 10 years (1981–2010). Gray area represents normal range, red and blue shaded areas represent years that were much warmer and cooler.

Park Environmental Setting

Understanding the changing environmental setting of our parks—including their land cover, climate, and hydrologic context—is critical to interpreting long-term monitoring data for parks vital signs. The Environmental Settings Program provides historic data sets for all National Park Service units in I&M networks including all parks in the Southeast. Data can be provided for any place in the park or in its immediate vicinity and can be used to compare current park climate information to both historic and regional trends by integrating information from multiple sources (gridded Parameter-elevation Regressions on Independent Slopes Model [PRISM] data and weather station data). This information helps parks to understand how climate is changing. In addition to providing a historic context to recent climate trends, these data can also be used in analyses of other vital

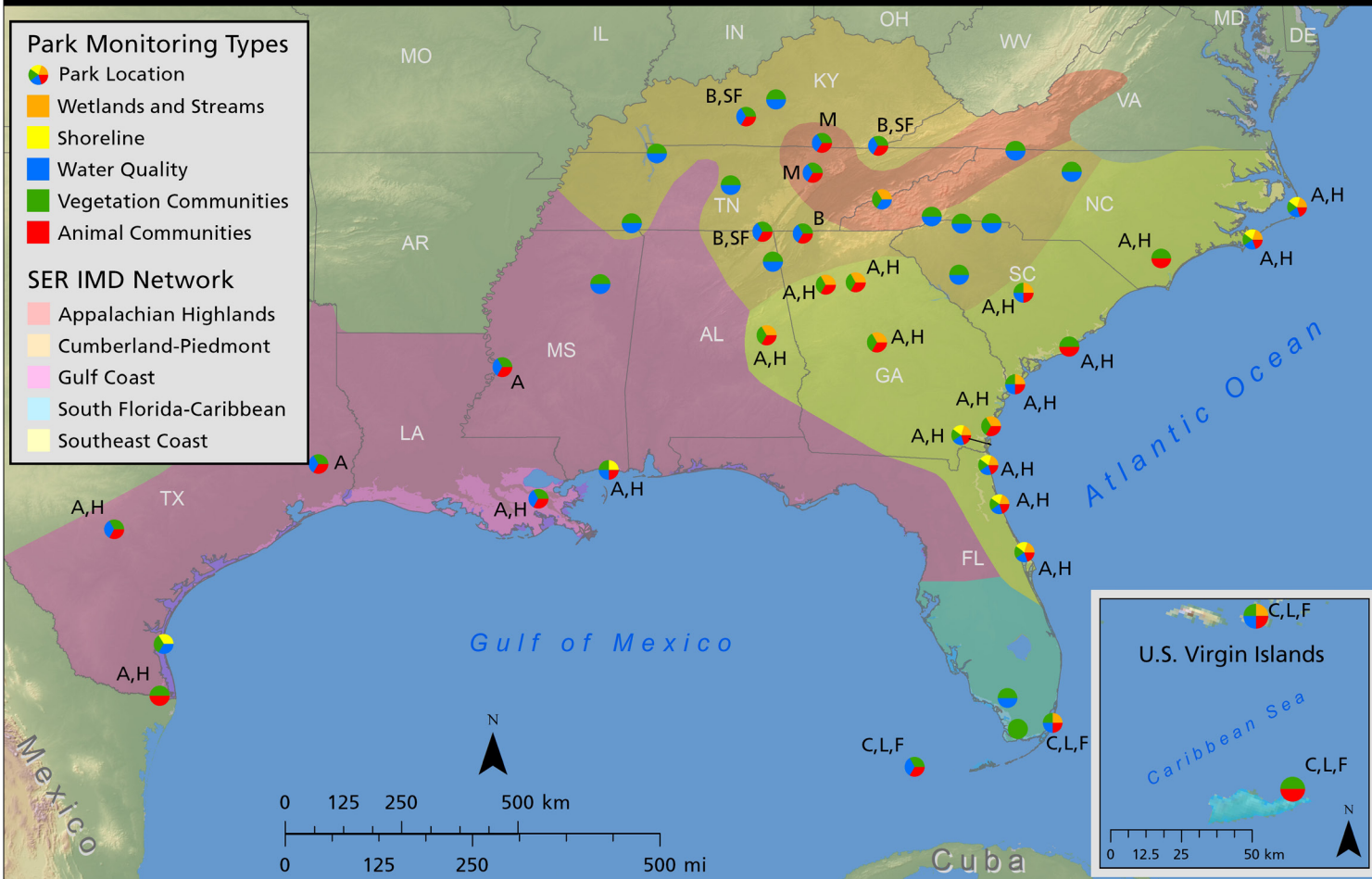


The Cape Hatteras Lighthouse was moved in 1999 due to changes in shoreline position. NPS gallery.

signs, such as investigating the relationships between climatic variables like temperature and precipitation with populations of animals such as reef fish or amphibians. The climate data could also be used to help inform managers about the likelihood of future disturbances including drought and flooding.

IMD Networks, Parks, and Monitoring Types Interior Region 2

Interior Region 2
National Park Service
U.S. Department of the Interior



Inventory and Monitoring Networks in the Southeast Region inform climate science by monitoring in five general resource areas. Various biological community monitoring efforts have been implemented depending on the species' occurrences and their importance at network parks. Animal monitoring codes: A—Birds, B—Bats, C—Coral, F—Fish, H—Herptiles (Amphibians and Reptiles), L—Lobsters, M—Mussels, and SF—Subterranean Fauna. NPS map / Stephen Cooper.

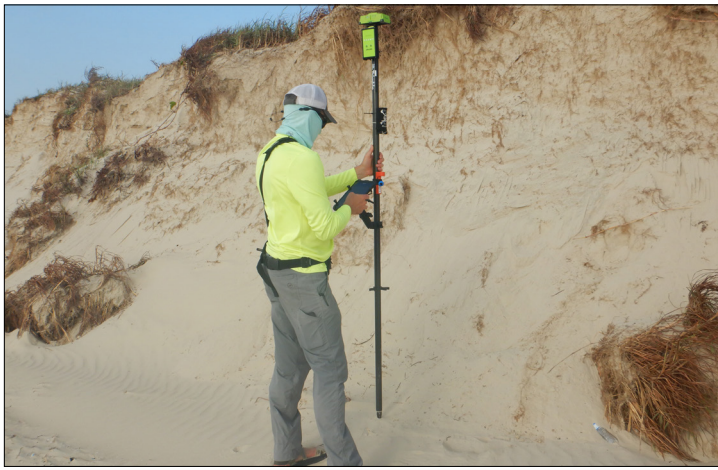
Wetlands, Rivers and Streams

Wetland areas and stream habitats are important natural areas and make up a large part of southeastern parks' natural resources. These areas include salt marshes and mangroves along the coast, and surface and underground streams and rivers. These areas are potentially impacted by changes in long-term physical processes such as erosion and sedimentation. Rates of change and conditions in these habitats are closely tied to long-term climate patterns and variations in hydrologic regimes, including changes from hurricanes and rainfall frequency and intensity. Southeastern I&M networks monitor these areas with a variety of approaches including general stream habitat and condition assessments, as well as monitoring specific communities (such as cobble bars). Salt marshes and mangroves are particularly vulnerable to rising sea levels and require precise measurements of the land surface to determine if the predicted rate of sea level rise will outpace the surface elevation of the wetland. The soil surface elevation table method has been employed by several networks to monitor the relative change in land elevation relative to sea level. The South Florida

/ Caribbean Network monitors the position of the mangrove marsh ecotone as an indicator of saltwater transgression into freshwater marshes.



Surface Elevation Tables are used to measure relative changes in land surface in salt marshes due to sediment accumulation and land subsidence. USGS photo / Staff.

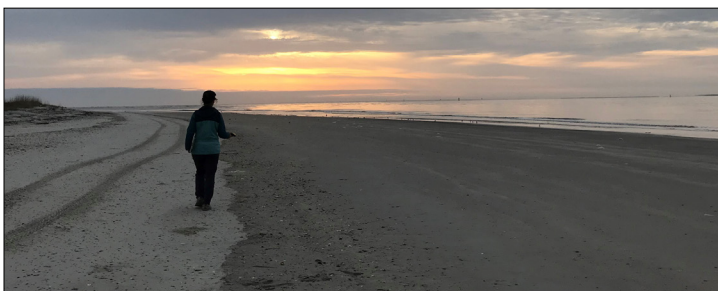


Recording topographic profiles of eroded dunes at Padre Island National Seashore after Hurricane Hanna in 2020. NPS photo / GULN staff.

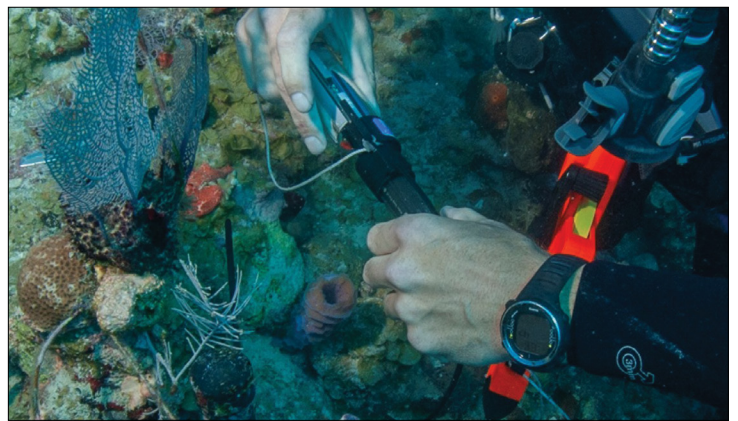
Shoreline

Shoreline change is a prime indicator of sea level rise resulting from warming ocean temperatures and increased melting of glaciers. Spatial variability is inherent in shoreline change, and early identification of changes is key to protecting cultural and natural resources near the coast. Shoreline change monitoring informs parks of specific locations of rapid coastal erosion and potential future threats. The southeastern coastlines have some of the highest rates of relative sea level rise in the nation, according to estimates from the National Oceanic and Atmospheric Administration, and these coastal systems will see increased impacts from tropical storms and winter frontal passages, simply because of sea level rise. Storm intensity or frequency increases that may come with climate change will only exacerbate the problem.

The Gulf Coast Network monitors changes in the elevations of near-shore dunes using GPS surveying equipment and has recently installed Continuously Operating Reference Stations (CORS) to provide better estimates of both land elevation and water level (relative sea level rise) at several coastal parks. These stations increase the accuracy of GPS-based surveying conducted by the parks and the network. Other networks monitor the position of actual high tides during reference tidal periods each year. Using GPS survey equipment, shorelines are traced each spring. After collecting the data, maps are produced that show gain or loss since the preceding years of data collection.



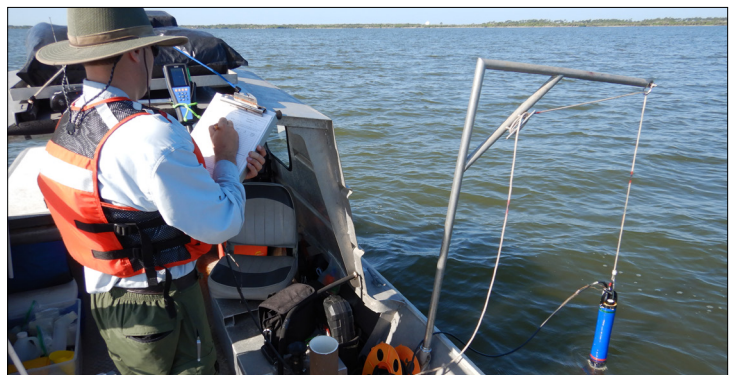
Shoreline positions are measured using accurate GPS surveying equipment and are then compared to previous positions. This allows detection of storm-specific changes as well as long-term trends. NPS photo / SECN staff.



Measuring water temperature tracks an important component of habitat for coral and other marine life. NPS photo / Rob Waara.

Water Quality

Water quality data are not typically used as a primary indicator of changing climate conditions due to the heavy influence of watershed and near-stream land use. However, water-quality data and information are needed by park resource management in decision making and will vary in response to changes in a park's environmental and hydrologic regime as well as to development in its watershed. All of the regional I&M networks monitor the quality of park water resources using varying approaches to meet goals of the network parks. Discreet, continuous, and spatially balanced sampling approaches are used and various partnerships with other federal, state, and local groups are used to expand programs or increase a program's efficiency.



Water-quality monitoring activities collect data that can be used to show short-term, seasonal variations in conditions or changes over a longer period of time, as well as in response to storms or other climatic conditions. NPS photo / SECN staff.

Vegetation Communities

Vegetation communities and plant species distributions reflect short and long-term climate related shifts in temperature, rainfall, and storms. Because a park's vegetation communities are integral to the function of many ecological and physical processes, all I&M networks monitor vegetation communities or individual species important to park resource management. Networks use standardized methods and approaches to monitor general conditions of vegetation communities to ensure comparability with other programs and allow for regional

data aggregation among networks. Some network monitoring activities focus on specific communities such as submerged aquatic vegetation; or mangrove communities or plants that are rare, easily exploited or unique to a park.



Vegetation communities are measured using standard plot designs and methods. NPS photo / GULN staff.

Animal Communities

Animal communities vary greatly across parks and networks and may respond directly to changing environmental conditions or indirectly to habitat changes due to new climate normals. All southeastern I&M networks have customized their approaches to monitoring animal communities based on their parks' settings and their specific resource base. Bird, bat, amphibian and reptile monitoring occurs across many of the inland and coastal parks with marine parks focusing on fishes, lobster, and coral monitoring efforts. Monitoring for unique keystone species such as freshwater mussels, cave crickets and cave aquatic biota are implemented at a number of parks.



Data loggers record cave air temperature and relative humidity to help document the effects of global climate change on the abundance, occupancy, and habitat use of several monitored cave dwelling taxa including federally listed Indiana bats (*Myotis sodalis*), hibernating below. NPS photo / CUPN staff.



Amphibians such as the Green treefrog (*Hyla cinerea*) are excellent terrestrial indicators of changing climate conditions. NPS photo / Michael Parrish.



Caribbean Spiny Lobster (*Panulirus argus*) in Dry Tortugas National Park respond to changes in water-quality conditions. NPS photo / Lee Richter.



Most of the known population and all the critical habitat of the Federally endangered Kentucky cave shrimp (*Palaemonias ganteri*) is found in Mammoth Cave National Park. Fragile cave shrimp are sensitive to alterations in the cave aquatic habitat due to increasingly intense flood pulses in the Southeast. NPS photo / Michael Durham.



Acropora cervicornis located in Biscayne National Park. Coral reefs are sensitive to altered climatic conditions. NPS photo / Rob Waara.

For more information contact I&M Regional Chief, Brian Mitchell (Brian_Mitchell@nps.gov) or any of these sites:

- Regional I&M Information: <http://go.nps.gov/sero-im>
- Appalachian Highlands Network: <http://go.nps.gov/aphn>
- Cumberland Piedmont Network: <http://go.nps.gov/cupn>
- Gulf Coast Network: <http://go.nps.gov/guln>
- Southeast Coast Network: <http://go.nps.gov/secn>
- South Florida / Caribbean Network: <http://go.nps.gov/sfcn>