

Timucuan Ecological and Historic Preserve

National Park Service
U.S. Department of the Interior

Inventory & Monitoring Program
Southeast Coast Network



Inventory & Monitoring Program Status Report, 2011

Program Overview

In 1999, the National Park Service (NPS) initiated a long-term ecological Inventory & Monitoring (I&M) program to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and determine how well current management practices are sustaining those ecosystems.

To accomplish this, 32 “networks” of park system units were created to develop or acquire key baseline natural resource datasets, and to begin long-term monitoring of select measurements of resource condition (Fancy et al. 2009). The overarching purpose of natural resource monitoring in parks is to support science-based management of NPS resources by:

- Determining the status and trends in selected indicators of the condition of park ecosystems.
- Providing early warning of abnormal conditions.
- Providing data to better understand the dynamic nature and condition of park ecosystems and provide reference points for comparisons with other, altered environments.
- Providing data to meet legal and Congressional mandates.
- Providing means for measuring progress towards management goals.

The Southeast Coast Network (SECN; Figure 1) is one of 32 NPS Networks established to implement an integrated monitoring program under the Natural Resource Challenge. In 2001, the SECN began planning and implementing its long-term Vital Signs Monitoring Program, and completed its long-term monitoring plan in 2008 (DeVivo et al., 2008, 2010). Timucuan Ecological and Historic Preserve (TIMU) and Fort Caroline National Memorial (FOCA) are two SECN parks on the northeast Florida coast (Figure 1).

About the Park

The 18,616-ha (46,000 ac) TIMU encompasses the mouth of the St. Johns River and the lower several miles of the Nassau River. The Preserve is a collection of landowners (private, The Nature Conservancy, City of Jacksonville, Florida State Parks,

federal), with approximately 3,440 ha (8,500 ac) of the Preserve under federal ownership. FOCA, also within the TIMU boundary, is 56 ha (138 ac). The Preserve consists of large areas of salt marsh that vary in degrees of salinity, but are generally dominated by smooth cordgrass (*Spartina alterniflora*) and needlegrass rush (*Juncus roemerianus*), some freshwater streams, ponds, and wetlands, and adjacent uplands. The uplands are a mosaic of maritime hammock, that contain species such as live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*), xeric hammock and coastal scrub [e.g., sand live oak (*Quercus geminata*), saw palmetto (*Serenoa repens*), rusty fetterbush (*Lyonia ferruginea*)], slash pine (*Pinus elliottii*) stands, and restored (*Pinus palustris*) longleaf pine stands.



Figure 1. Location of Timucuan Ecological and Historic Preserve and Fort Caroline National Memorial, FL.

During the last decade, the lands adjacent to the Preserve and Memorial have exhibited some of the most rapid growth and development in Florida. Consequently, the Preserve has a prominent wildland-urban interface and is host to many external stressors, including altered ecosystem function (e.g., fire suppression, hydrology), invasive species, and the direct and indirect effects of contaminants accrued throughout the watershed of the St. Johns River, Florida's longest river. Despite these threats, the Preserve remains quite diverse and plays a crucial role in providing habitat for many rare species, including West Indian manatee (*Trichechus manatus*), painted bunting (*Passerina ciris*), gopher tortoise (*Gopherus polyphemus*), loggerhead sea turtle (*Caretta caretta*), hooded pitcher plant (*Sarracenia minor*) and is the northernmost extent for some sub-tropical plant species such as wild coffee (*Psychotria nervosa*) and snowberry (*Chiococca alba*).

Baseline Inventories

The primary purpose of natural resource inventories is to document the presence of resources in parks, and to assess and document the current condition and knowledge of natural resources in the parks. Inventories allow comparison of existing conditions to the natural or desired state of parks and establish a solid baseline for making scientifically sound management decisions and for designing long-term monitoring plans that track the health of key park resources.

Table 1. Status of twelve baseline inventories at Timucuan Ecological Historic Preserve and Fort Caroline National Monument [● – Complete; ◐ – In Progress]

Inventory	TIMU	FOCA
Air Quality Data	●	●
Air Quality Related Values	●	●
Base Cartography Data	●	●
Baseline Water Quality Data	●	●
Climate Inventory	●	●
Geologic Resources Inventory	◐	◐
Natural Resource Bibliography	●	●
Soil Resources Inventory	●	●
Species Lists	●	●
Species Occurrence and Distribution	●	●
Vegetation Map Inventory	◐	◐
Water Body Location and Classification	●	●

The NPS I&M Program developed a strategy in 1992 for developing and delivering a minimal set of products for 12 “basic” natural resource inventories that were common to all

park units containing significant natural resources, all of which are either complete or underway for both TIMU and FOCA.

Additional Inventories

In addition to the twelve basic inventories, the SECN has conducted or contributed to two additional natural resource inventories at TIMU: Marine Benthic Invertebrates, and a Watershed Condition Assessment.

Marine Benthic Invertebrates

Hymel (2009) conducted a review of existing benthic macroinvertebrate (BMI) records found within or adjacent to SECN coastal parks. More than 350 taxa were documented at TIMU. The majority of stations reported moderate to high diversity with the highest diversity observed at Clapboard Creek, within TIMU boundaries. Dominant BMI taxa included polychaetes (*Sabellaria vulgaris*, *Tharyx* spp., *Aphelochaeta marioni*, *Paraonis fulgens*, *Caulleriella* spp., *Streblospio benedicti*, *Mediomastus* spp., *Marenzelleria viridis*, *Podarke* spp., *Paraprionospio pinnata*), gastropods (*Boonea impressa*, *Nassarius obsoletus*), bivalves (*Pleuromeris tridentata*, *Tellina versicolor*, *Gemma gemma*, *Abra aequalis*), amphipods (*Rhepoxynius hudsoni*, *Protohaustorius deichmannae*, *Apocorophium lacustre*), and phoronid worms (*Phoronis* spp.).

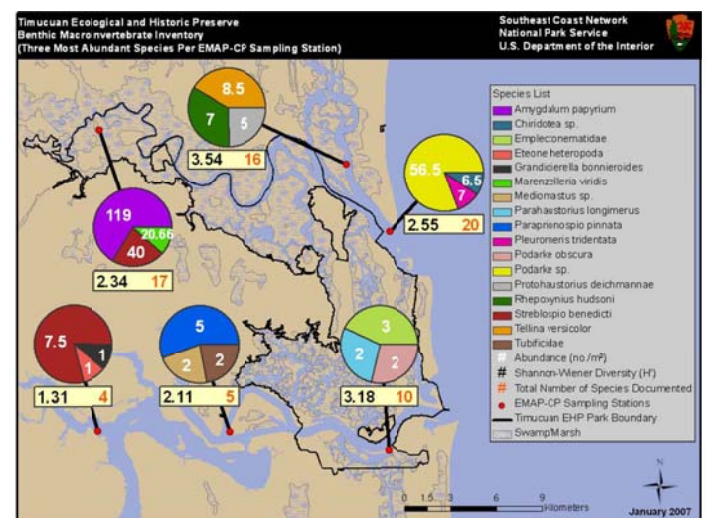


Figure 2. Example BMI abundance data from six Environmental Monitoring and Assessment Program (EMAP) stations near TIMU, showing the three most abundant taxa and Shannon-Wiener diversity index scores.

Watershed Condition Assessment

Water resources are an integral part of TIMU because approximately 75% of the area included within its boundaries is wetlands and open water (Anderson et al. 2005). These resources include numerous tidal creeks, portions of the Nassau and Saint John's Rivers, Sisters Creek/Intracoastal

Waterway (ICWW), Fort George River, and freshwater resources (Spanish Pond). TIMU's estuarine setting serves as a vital ecological link between freshwater habitats and the ocean. The waters of TIMU are impacted by land use in the surrounding watersheds. Examples of water quality issues applicable to TIMU include nonpoint source pollution from urban and agricultural areas, elevated metal concentrations in the sediments of the Saint John's River, impacts of several Superfund sites and landfills, and water pollution from malfunctioning septic systems within and adjacent to TIMU. Available water quality information was utilized to determine the current condition and possible impairments of TIMU's water resources, and to identify any information gaps that limit determination of whether or not TIMU's waters are degraded or impaired.

Generally, TIMU's water quality is considered good compared to other Florida surface waters. Tidal flushing is considered to be an important contributing factor because upstream areas of the Nassau and St. Johns River are degraded. However, recent continuous monitoring data collected in the Fort George River indicates that some of the tidal creeks are not well flushed (DiDonato et al., 2005). Residence times were on the order of months, indicating that pollution to these areas could have prolonged effects. In addition, there is a lack of descriptive information detailing the hydrodynamics and currents of the system. Circulation of water within the tidal creeks east of Blount Island are considered especially complex.

Vital Signs Monitoring

The SECN has selected nineteen indicators of ecosystem condition, or *Vital Signs*, to be monitored at TIMU/FOCA, of which twelve have been wholly or partially implemented by the Network. These Vital Signs include a combination of field efforts being conducted by NPS and its partners as well as the analysis and interpretation of data being collected by other state and federal programs.

Air Quality

Data from various air quality monitoring programs are summarized regularly including the National Atmospheric Deposition Program - National Trends Network (NADP/NTN), the Environmental Protection Agency's Clean Air Status and Trends Network (CASTNET), and the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. Data from 2005-2009 show that ozone and total-N wet deposition levels were considered to be of

moderate concern at TIMU, while Total-S deposition and visibility levels were considered to be of significant concern (Table 2).

Table 2. Air quality interpolation values for the period 2005-2009 at Timucuan Ecological and Historic Preserve. Yellow indicates values of moderate concern. Red indicates values of significant concern.

Ozone Concentration (ppb)	Total-N Wet Deposition (kg/ha/yr)	Total-S Wet Deposition (kg/ha/yr)	Group50 Visibility (dv)
70.3	2.92	3.65	11.5

Weather and Climate

Weather and climate are key drivers for ecosystem patterns and processes, affecting both biotic and abiotic components alike. Continuous weather monitoring is an important factor in separating the effects of climate from the effects of human-induced disturbance on other Vital Signs (e.g., plant and animal communities and population dynamics). In support of these efforts, the SECN has compiled and analyzed data from existing sources to (1) determine status, trends, and variability of precipitation and temperature over time inside and around SECN park units; (2) determine the status, trends, and variability of derived weather data (i.e., drought indices) inside and around SECN park units; (3) track the location, magnitude, and frequency of extreme weather events that affect SECN park resources.

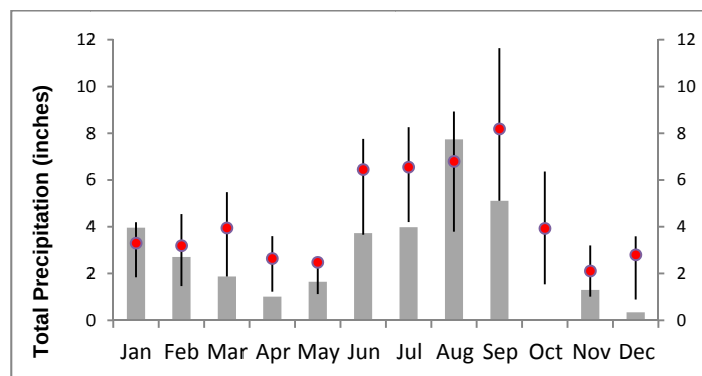


Figure 3. Total monthly precipitation during 2010 and the 30-year (1981 - 2010) monthly averages for Jacksonville International Airport weather station. The gray columns represent 2010 total monthly precipitation. The red circles represent the 30-year average; the lines indicate the 25th and 75th percentile of the 30-year normal data for each month.

Average monthly temperatures at weather stations near FOCA and TIMU ranged from a low of 46.1 °F to a high of 84.0 °F; temperatures were above normal at most locations during the spring, summer, and early fall months and below normal during the winter.

Total annual precipitation was 33.40 inches during 2010, which is 18.99 inches below normal. Average monthly precipitation was above average during January and August, but below average the rest of the year (Figure 3).



Figure 4. Painted bunting at Fort George, TIMU. Photo by Roger Clark, 2009.

Land Birds

Birds are an important component of park communities and their ecological position in most food webs allows them to be good indicators of local and regional ecosystem changes. Long-term trends in the community composition, relative abundance, distribution, and occurrences of breeding-bird populations provide a measure for assessing the ecological integrity and sustainability in southeastern systems. Further, long-term patterns in community composition, relative abundance, distribution, and occurrences in relation to current management practices will improve our ability to implement effective management strategies in the future.

More than 650 birds representing 50 species were detected at TIMU and FOCA during surveys in 2010 (Figure 4; Byrne et al. 2011).

- Carolina wren, Northern cardinal, and tufted titmouse were detected at 92% or more of sampling locations and were the most widely distributed species.
- House finch was the only non-native species detected.
- Several priority species were detected during the sampling effort including Acadian flycatcher, brown thrasher, Chuck-will's-widow, clapper rail, common moorhen, Eastern towhee, great egret, little blue heron, Northern bobwhite, Northern parula, pine warbler, prairie warbler, red-bellied woodpecker, red-shouldered hawk, snowy egret, summer tanager, white ibis, white-eyed vireo, yellow-billed cuckoo, and yellow-throated warbler.

Amphibians

The TIMU has 22 known amphibian species: 4 in Caudata (salamanders, newts, amphiumas, sirens), and 18 in Anura (frogs and toads) (Tuberville et al. 2005, Byrne et al. 2010). Because of their complex life histories, habitat requirements, anatomy, and physiology, amphibians are considered to be good indicators of changes in ecosystem conditions as they are affected by climate change, land use development and conversion, contaminants, and changes in hydrology.

During monitoring efforts conducted in 2009, we found 16 native amphibian species (Figure 5). One non-native amphibian, greenhouse frog, and one non-native reptile, brown anole, were detected. Two of the amphibians detected were the first recorded occurrences at the Preserve and additions to the species list; oak toad and bronze frog. Several amphibian species were widely distributed across the Preserve, but Southern leopard frog was the most widely distributed amphibian. Green anole was the most widely distributed reptile at the Preserve.

In addition to amphibians, monitoring efforts detected Eastern box turtle—the first recorded occurrence at the Preserve.



Figure 5. Squirrel Treefrog (*Hyla squirella*) found during monitoring efforts at TIMU, 2009. Photo by Sarah Corbett, SECN Botanist.

The SECN also conducted surveys for chytrid fungus (a pathogen linked to amphibian population declines around the world) and did not find evidence of its presence in any species (Byrne and Moore 2011).

Plant Communities

Plant communities are the primary drivers for a range of ecological processes and are integral to the proper function of park ecosystems. They serve as the foundation for food webs and wildlife habitat for many species, and function as a carbon sink, produce oxygen, cycle nutrients and energy through an ecosystem, influence the local climate, improve water quality, and moderate flooding and erosion. Given the widespread anthropogenic influences in SECN parks and the importance of vegetation communities, determining trends in vegetation communities is vital to understanding the ecological processes and identifying stressors and their impacts.

TIMU/FOCA has 624 known vascular-plant species, subspecies, and varieties (NPSpecies 2011), including five species, subspecies, and varieties added to the species based on 2009 monitoring efforts.

Fixed-Station Water Quality

In 2006 the SECN – in cooperation with the City of Jacksonville (COJ), Florida – established a jointly operated water quality monitoring network. This monitoring effort was designed to collect data so that managers are able to make informed decisions by understanding trends and variability of water quality conditions in park waters.

TIMU contains the seaward confluence of the Nassau and St. Johns Rivers and is located along the northeastern coast of Florida in Duval County and entirely within the city limits of Jacksonville. Water quality data collected were collected at sixteen sites (Figure 6) — twelve of which were monitored every other month for nutrients and chlorophyll a and four sites which are monitored continuously for dissolved oxygen, pH, specific conductivity, temperature, depth and turbidity. Data collected in 2010 showed:

- Elevated levels of nutrients were the most common cause of poor water quality ratings during 2010. Discrete bi-monthly water quality sampling indicated elevated phosphorus and nitrogen levels across all sites sampled in TIMU and throughout most of the year (Table 1).
- Despite the commonly observed elevated nutrient levels, most chlorophyll a levels were only slightly elevated — high levels of chlorophyll a were only measured at one site

on the upper reaches of the Nassau River (TIM02) during the summer.

- Discrete measurements of dissolved oxygen indicated good conditions year round. Lowest mean daily dissolved oxygen levels were observed from June to September at all sites when water temperatures were also highest. Mean daily dissolved oxygen levels less than 2 mg/L were occasionally observed at the Clapboard Creek stations.
- Water clarity conditions were generally good to fair across all sites. Highest mean daily turbidity values were observed during summer months although elevated mean daily levels occurred at each of the continuous sites throughout the year.

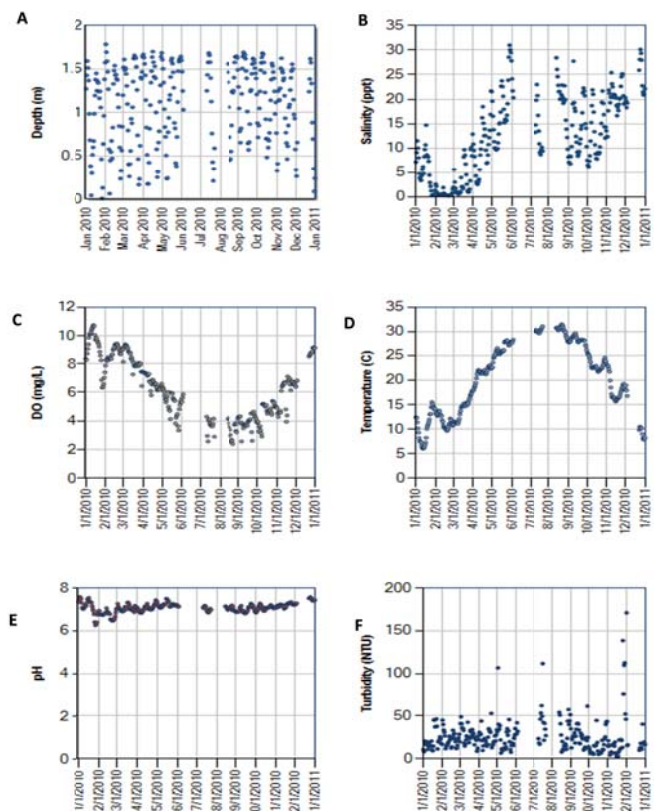


Figure 6. Mean daily water quality parameters at the Kingsley Plantation station, 2010.

Coastal Sediment and Water Quality Assessment

In July 2008, the SECN in cooperation with the University of Georgia, Marine Extension Service conducted a water quality assessment at selected sites at Timucuan Ecological and Historic Preserve as a part of the NPS Vital Signs Monitoring Program. Monitoring was conducted following methods developed by the U.S. Environmental Protection Agency as a part of the National Coastal Assessment Program and included laboratory analysis for chlorophyll a, total dissolved nitrogen and phosphorous concentrations and field

measurements of water temperature, pH, dissolved oxygen, and salinity. Estimates of water clarity were made using a secchi disk to estimate light extinction.

Overall surface waters conditions at TIMU were predominately *fair* with 93% of sites rated as being in *fair* condition. Only two sites were assessed as having either *good* or *poor* surface water quality conditions. Overall sediment conditions in the assessed benthic areas were predominately good with 83% of sites rating as being in *good* condition.

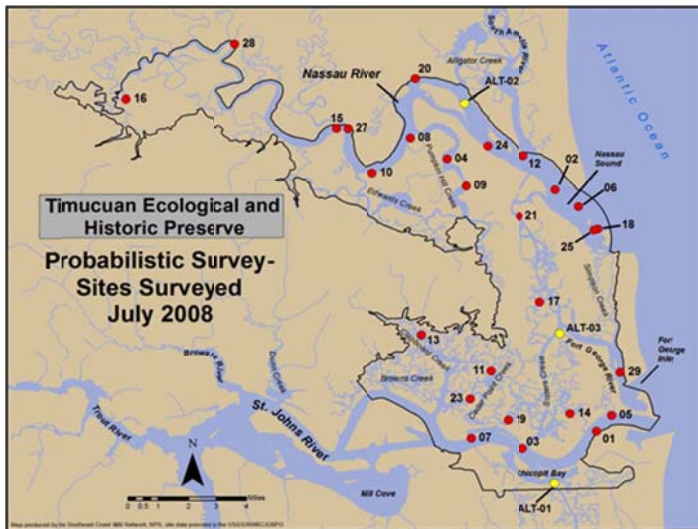


Figure 7. Locations of coastal sediment and water quality monitoring sites at Timucuan Ecological and Historic Preserve, 2008.

Groundwater

Groundwater dynamics are monitored primarily through data harvesting and has been completed for all parks. An inventory of existing wells that are within or in proximity to SECN parks has been conducted and applications to retrieve and analyze existing long-term periods of record have been developed. Data gaps in well coverage have been identified and funds from Enhanced Climate Monitoring funds will be used to either install new monitoring wells or equip existing wells with water level data loggers beginning in FY 2011.

Table 3. Summary of reported groundwater concerns at SECN park units (from Rasmussen et al. 2009).

Inactive Wells	Groundwater Contamination	Saltwater Intrusion	Flooding	Increased Demand
X	X	X		X

Salt Marsh Elevation

The Southeast region is characterized by vast expanses of coastal marshland, large beds of sea grasses, and some of the most highly productive fisheries in the country. Within SECN parks, these areas are threatened by visitor uses, commercial

and recreational fishing, as well as landscape changes inland and upstream.

Estuarine/marine tidal marsh is the most prevalent community in TIMU (Anderson et al. 2005). Four marsh community associations were identified in a study by the COJ in 1984: *Spartina* marsh, *Spartina/Juncus* marsh, short *Juncus* marsh (*Salicornia virginica*) being dominant in density, but limited in scope), and a transition zone that consisted of sea daisy (*Borrchia frutescens*) and sea blight (*Suaeda linearis*) (NPS, 1996a).

Changes in salt marsh elevation are being monitored at TIMU to evaluate the resilience of these systems to projected changes in freshwater inputs/ availability and sea-level rise. In 2010, the SECN completed installation of eight Rod-Set Elevation Tables (RSETs) at TIMU.



Figure 8. NPS staff installing a RSET monitoring station at Timucuan Ecological and Historic Preserve.

Other Monitoring Efforts

NPScape is a landscape dynamics monitoring project that produces and delivers to parks, a suite of landscape-scale data sets, maps, reports, and other products to inform resource management and planning at local, regional, and national scales. Changes in the composition and configuration of different land cover types within and adjacent to national parks has been shown to greatly affect biological and physical processes within those parks, such as habitat availability, animal movements, potential for invasion by exotic plants, water quality, and in-stream habitat for fish and other aquatic organisms. Information about changes and trends in landscape-scale indicators in and around parks can help park managers anticipate, plan for, and manage associated effects to park resources.

At its core, NPScape delivers a suite of products that focus on a set of information-rich, landscape-scale indicators for 270+ parks with significant natural resources. The initial analyses summarized and delivered measures in 6 major categories (population, housing, roads, land cover, pattern, and conservation status) that broadly address the environmental drivers, natural attributes, and conservation context of NPS units (Figure 9). In aggregate, these measures contribute to assessments of current natural resource status, potential threats, and conservation vulnerability and opportunity.

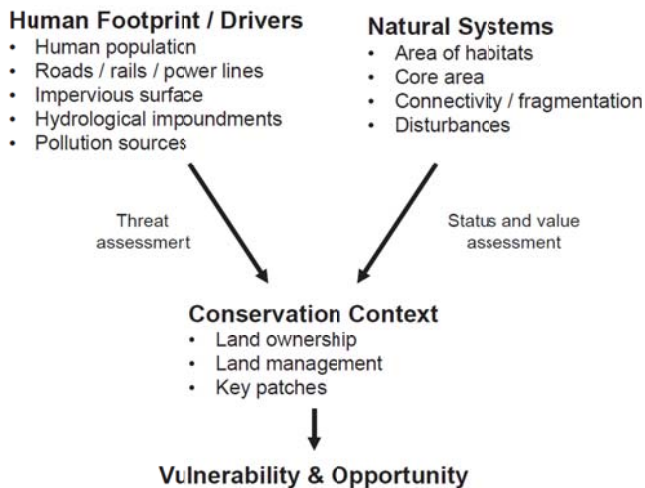


Figure 9. Example measures of landscape dynamics included in the NPScape program
<http://science.nature.nps.gov/im/monitor/npscape/>.

Where to Find Information

The NPS I&M Program was created as part of the National Park Service's effort to "improve park management through greater reliance on scientific knowledge." A primary role of the I&M Program is to collect, organize, and make available natural resource data and to contribute to the Service's institutional knowledge by facilitating the transformation of data into information through analysis, synthesis, and modeling. Information about the program can be found at <http://science.nature.nps.gov/im/index.cfm>.

About the Southeast Coast Network

The SECN includes twenty parks, seventeen of which contain significant and diverse natural resources. In total, SECN parks encompass more than 184,000 acres of federally-managed land across North Carolina, South Carolina, Georgia, Alabama, and Florida. The parks span a wide diversity of cultural missions also, including four national seashores, two national historic sites, two national memorials, seven national monuments, two national military parks, as well as a national recreation area, national battlefield and an ecological and

historic preserve. The parks range in size from slightly more than 20 to nearly 60,000 acres, and when considered with non-federal lands jointly managed with NPS, the Network encompasses more than 253,000 acres.

Information on activities of the SECN can be found at <http://science.nature.nps.gov/im/units/secn/>, including the Network's monitoring plan, descriptions of inventory and monitoring efforts, and links to data and final project reports.

Get Data

The NPS Integrated Resource Management Applications (IRMA) portal (<http://irma.nps.gov>) is the start of a web-based "one-stop" for data and information related to National Park Service natural and cultural resources. IRMA allows users to search, view, download, and print information from multiple sources and systems, all from a consistent user interface. No logins or passwords are required.

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