



Inventory & Monitoring Program Status Report, 2012

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) 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, 2011). Canaveral National Seashore (CANA) is one of 17 SECN parks and is on the east coast of Florida (Figure 1).

About the Park

Canaveral National Seashore’s natural resources include a diverse assemblage of wildlife, plant communities, geophysical features and natural processes reflecting the complexity of the land/lagoon/sea interface of east central Florida. Throughout the park, the relationship of land and water is paramount.

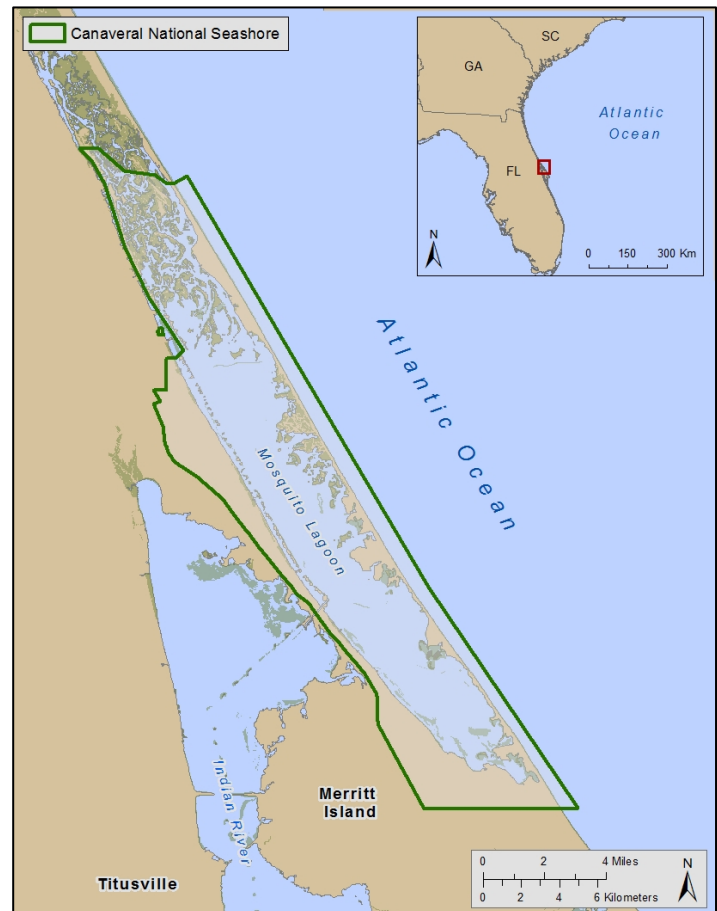


Figure 1. Location of Canaveral National Seashore, FL.

From ephemeral wetlands to Atlantic beaches, the natural processes shaping the coastal environment are constantly changing the habitat and landscape. Unlike many barrier islands, CANA has only a single dune ridge, averaging 12 ft in height. For the vast majority of its length the dune is quite stable, backed by a dense growth of saw palmetto (*Serenoa repens*) and several other species of hardy shrubs and grasses. Mosquito Lagoon, extending along the backside of Canaveral’s barrier island, is the northernmost part of the Indian River Lagoon. Containing the most diverse assemblage of aquatic species on the entire Eastern Seaboard, this 155-mile long lagoon has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. It contains one of the last significant populations of

oysters on the entire Atlantic Coast that has not been depleted by over harvesting or pollution. Commercial shell fishing is extremely important to the local economy; recreational fishing and shrimping in the lagoon support a multimillion-dollar tourism industry. The estuary also acts as an important nursery area for a number of commercially important ocean-going species such as flounder, mullet, black drum and shrimp. In addition to being a nursery area, the estuary harbors unique resident populations of redfish and spotted seatrout.

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 12 baseline inventories at Canaveral National Seashore [● – Complete; ◐ – In Progress]

Inventory	CANA
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 CANA (Table 1; see Webster 2010).

Additional Inventories

In addition to the 12 basic inventories, the SECN has conducted an additional natural resource inventory at CANA

documenting marine benthic invertebrates. Hymel (2009) conducted a review of existing benthic macroinvertebrate (BMI) records found within or adjacent to SECN coastal parks. More than 162 BMI taxa were identified, and diversity was high at CANA (Figure 2). Dominant taxa included amphipods (*Lysianopsis alba*, *Grandidierella bonnieroides*, *Ampelisca abdita*, *Erichthonius brasiliensis*, *Corophium baconi*), polychaetes (*Capitella capitata*, *Pectinaria gouldi*), oligochaetes, phoronid worms (*Phoronis architecta*, *Phoronis* spp.), sipunculids (*Phascolion strombi*), and cumaceans (*Oxyurostylis smithi*).

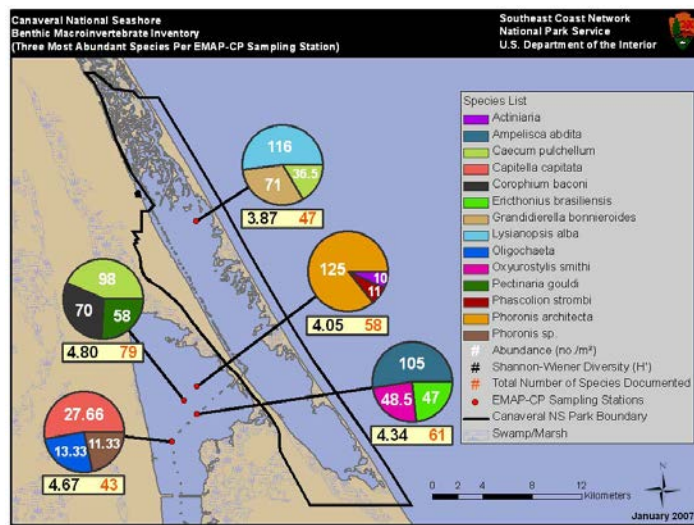


Figure 2. BMI abundance data from EMAP stations near CANA. Three most abundant taxa and Shannon-Wiener Diversity (H').

Vital Signs Monitoring

The SECN has selected nineteen indicators of ecosystem condition, or *Vital Signs*, to be monitored at CANA, of which fifteen 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 2006–2010 show that ozone and total-N wet deposition levels were considered to be of moderate concern at CANA, while total-S deposition and

visibility levels were considered to be of significant concern (Table 2).

A 2011 analysis of acid deposition showed CANA to be at high risk of pollutant exposure, and a moderate risk of acid deposition (Sullivan et al. 2011a). Although considered to be at a high risk of nutrient exposure, the overall risk of atmospheric nutrient enrichment at is only moderate at CANA. The overall moderate risk is due to the presence of a moderate amount of vegetation types expected to be sensitive to nutrient enrichment from nitrogen deposition (Sullivan et al. 2011b).

Table 2. Air quality interpolation values for the period 2006–2010 at Canaveral National Seashore. 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)
67.5	3	3.5	10.9

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). Furthermore, drought conditions during the past several springs have increased fire danger and have potentially stressed freshwater habitats.

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 (Wright et al. 2011).

Comparisons of 2011 temperature data to the 30-year average at Titusville station show that January, October and November were colder than average though not outside the range of variation for the long-term average. Temperatures for the rest of the year were warmer than average, though not outside the range of variation for the long-term average.

Comparisons of 2011 precipitation data to the 30-year average at Titusville station show that January, April, June, July, August and October experienced higher than average precipitation (Figure 3) with January, April, August and October having higher total precipitation than the 75th percentile of the 30-year average. Precipitation during the rest of 2011 was lower than average with February, September and December experiencing lower precipitation than the 25th percentile of the 30-year average. Total annual precipitation was 56.07 inches (1424.2 mm) during 2011, which is 2.08 inches (52.8 mm) above normal.

Average monthly maximum relative humidity ranged from 91% to 100% with the lowest occurring in January. Average monthly minimum relative humidity ranged from 31% to 49% with the lowest occurring in April and May.

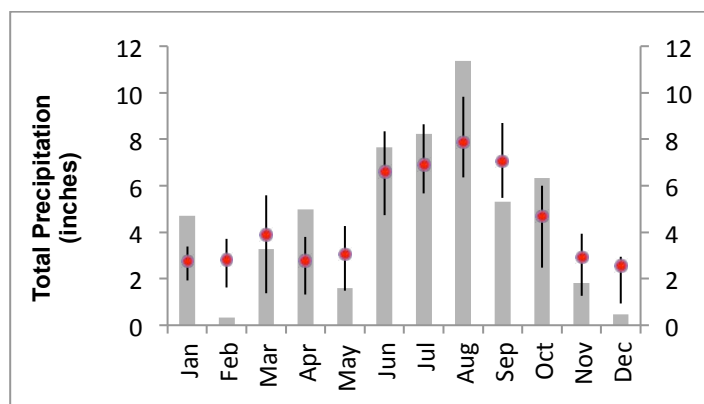


Figure 3. Total monthly precipitation during 2011 and the 30-year (1981 - 2010) monthly averages for Titusville station. The gray columns represent 2011 total monthly precipitation. The red circles represent the 30-year average; the lines indicate the 25th and 75th percentile of the 30-year normal data for each month.

Derivative climate measures indicated that the growing season length ranged 321–365 days across all weather stations used in this analysis and derived climate measures such as date of last spring freeze varied between stations.

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 700 birds representing 64 species were detected at CANA during surveys in 2010 (Byrne et al. 2011).

- Carolina wren, Northern cardinal, Eastern towhee, and red-bellied woodpecker were the most widely distributed species at the Seashore.
- No non-native species were detected.
- Several priority species were detected during the sampling effort including bald eagle, black-crowned night-heron, blue-winged teal, chimney swift, common ground-dove, Cooper's hawk, Chuck-will's-widow, Eastern meadowlark, glossy ibis (Figure 4), great egret, greater yellowlegs, indigo bunting, little blue heron, least sandpiper, mottled duck, Northern bobwhite, Northern flicker, Northern parula, painted bunting, prairie warbler, red-shouldered hawk, snowy egret, tricolored heron, white-eyed vireo, white ibis, wood stork, and yellow-throated warbler.



Figure 4. Glossy ibis (*Plegadis falcinellus*) was a priority species found at CANA in 2010. Photo by Darlene J. Moore.

Amphibians

CANA has 19 known amphibian species: four in Caudata (salamanders, newts, amphiumas, sirens) and 15 in Anura (frogs and toads; NPSpecies 2012). 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, SECN crew found 15 native amphibian species. The overall monitoring effort adequately characterized species richness, and the

sample was not dominated by any one species (Byrne et al. 2010).

The ratio of native to non-native reptiles was approximately 2.5 to 1, attributable to the non-native brown anole.

Three of the amphibians detected were the first recorded occurrences at the park and additions to the species list: the non-native Cuban tree frog, and the native spring peeper and green frog. Squirrel treefrog and green treefrog (Figure 5) were the most widely distributed amphibians at the park.

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 at CANA (Byrne and Moore 2011).



Figure 5. Green treefrog (*Hyla cinerea*). Photo by J.D. Wilson.

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.

CANA has 734 known vascular-plant species, subspecies, and varieties (NPSpecies 2012). Monitoring efforts resulted in the addition of 18 species, subspecies, or varieties to the

Seashore's species list. Absolute canopy cover across the study area was approximately 32% (Byrne et al. 2012).

Sabal palmetto had the largest average diameter of any canopy species sampled within the study area. Saw palmetto was the most frequently occurring species in the shrub stratum.

Dichantheium spp., Elliott's milkpea, saw palmetto, and muscadine were the most frequently occurring species in the groundcover stratum. No redbay seedlings were detected.

Saw palmetto had the highest absolute and relative cover in the shrub stratum. Sand cordgrass had the highest absolute and relative cover in the groundcover stratum.

No redbay seedlings were detected.

Coastal Sediment and Water Quality Assessment

In July 2009, the SECN in cooperation with the University of Georgia, Marine Extension Service conducted a water quality assessment at selected sites (Figure 6) at CANA 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 turbidity.

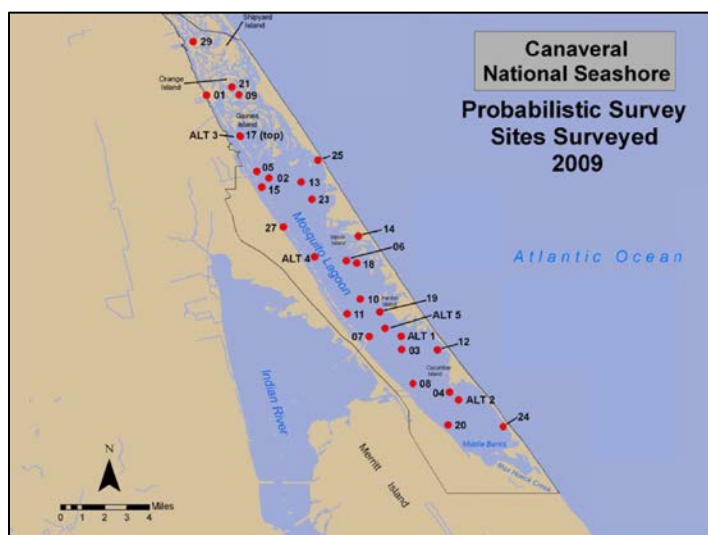


Figure 6. Location map showing estuarine water and sediment quality assessment sites sampled during July 2009 at Canaveral National Seashore.

Overall water quality at Canaveral National Seashore ranged from *good* to *poor* with the majority of sites found to be in *fair* condition (83%). Nitrogen levels were at concentrations

considered *poor* at 90% of the sites sampled. Consistently high concentrations indicate potential nonpoint sources of pollution in the watershed as well as an overall phosphorus limited system. Only one site was observed with concentrations of both nitrogen and phosphorus considered *poor*.

Overall sediment conditions were *good* at all sites sampled with most sites showing only trace amounts of metals and little or no measurable organic contamination. Relatively clean sediments at Canaveral National Seashore are potentially due to the high levels of sand and low levels of organic carbon—a combination that reduces the benthic materials' ability to bind contaminants.

Aside from the generally high levels of nitrogen found across the park, no distinctive spatial patterns in the data suggested sites of immediate concern or where specific management actions might be needed. Continued monitoring of nutrients might help detect future problems and would be prudent given the level of development in the surrounding watersheds.

The coastal assessment will be repeated in 2014.

Groundwater

All Southeast Coast Network parks and ecosystems are linked to the groundwater system (i.e., aquifers). These aquifers are affected by modifications to surface waters (e.g., impoundments), long-term weather patterns (e.g., flooding and drought), and extraction (e.g., anthropogenic influences). Because aquifers serve as a water supply for industrial, commercial, residential, and agricultural needs, anthropogenic demands on this freshwater resource are high. Aggregate influences of changes in groundwater can influence hydrologic processes, wetland function, freshwater availability

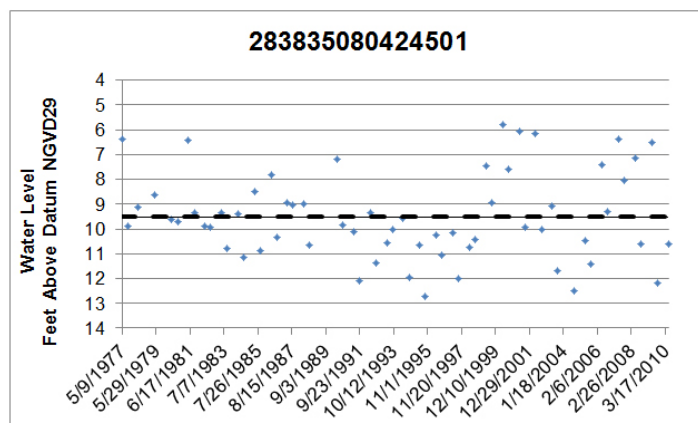


Figure 7. Water levels and calculated trend line for well 283835080424501 (Floridan Aquifer near CANA).

for fish and wildlife, plant-community species distribution, composition, diversity, and structure, and potentially affect the integrity of park ecosystems. 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 (Rasmussen et al. 2009).

The SECN assesses trends in groundwater dynamics at CANA annually using data from three wells in the vicinity of CANA (Wright and Byrne, 2012). None of the wells show a significant trend in groundwater level through 2010 (see Figure 7).

Fixed-Station Water Quality

In 2007, the SECN Inventory and Monitoring Program began collecting water-quality data in the estuarine waters near CANA as part of the NPS Vital Signs monitoring program. The scope of the monitoring program includes Mosquito Lagoon and is comprised of continuous water-quality monitoring conducted by the SECN at one site that is augmented with monthly data collected at an additional five stations by St. Johns River Water Management District (SJRWMD; Gregory et al. 2010). The continuous monitoring data station collects pH, dissolved oxygen, temperature, salinity, conductivity, turbidity, and water level data every 30 minutes (Figure 8). The five stations located throughout Mosquito Lagoon are sampled by Volusia County for the SJRWMD as part of the District's Indian River Lagoon Water Quality Monitoring Network.

Continuous and discrete water-quality data collected at CANA during 2011 showed:

- High levels of total dissolved nitrogen (TDN) were the most common cause of *poor* water-quality ratings across all sites and months. Higher concentrations of nutrients and chlorophyll *a* were most commonly observed during the late spring and summer months at all sites. Concentrations of nutrients and chlorophyll *a* were highest and most common at the two southernmost monitoring locations in Mosquito Lagoon.
- Dissolved oxygen concentrations measured during monthly sampling were all rated *good* although continuous data indicated a period between June and September when mean daily values commonly dropped below 5 mg/L. Mean daily values observed during these periods were primarily due to low dissolved oxygen levels during the night and early morning.

- Water clarity conditions ranged from *poor* to *good* across all sites with all of the *poor* observations occurring during late summer and fall. *Poor* and *fair* water clarity conditions tended to occur during periods with elevated nutrients and chlorophyll *a* levels.
- Salinity ranged from 27 to 44 parts per thousand (ppt) with the higher values occurring during the summer months.
- pH values ranged between 7.54 and 8.75 throughout the year with the most acidic conditions occurring episodically throughout the summer months.

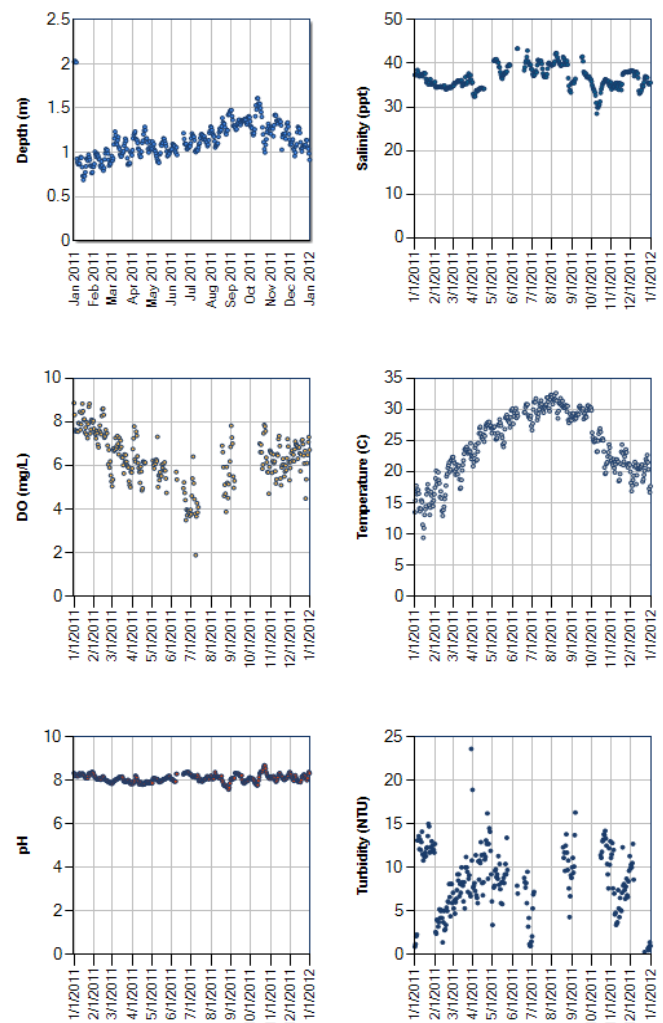


Figure 8. Mean daily water quality parameters at Canaveral National Seashore visitor's center dock at Canaveral National Seashore during 2011. Breaks in data record indicate missing and/or flagged data.

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.

Changes in salt marsh elevation will be monitored at CANA to evaluate the resilience of these systems to projected changes in freshwater inputs/availability and sea-level rise. In 2011, the SECN completed site assessments at CANA, and installations are scheduled for 2013 (Figure 9).



Figure 9. NPS staff installing a salt marsh elevation monitoring station.

Coastal Shoreline Change

Coastal slope and shoreline erosion/ accretion (in addition to tidal variables) are key variables used to evaluate inundation risk. Combined with human dimensions data, understanding coastal geomorphology is critical to evaluating risks of sea level rise to parks, their trust resources, and their surrounding communities.

The SECN has been working with USGS since 2005 to develop methods to monitor park-wide trends in shoreline slope and movement at all ocean-facing shorelines and selected sandy beach bay/estuarine areas within SECN coastal parks. These data will assist with the development of local inundation risk assessments for use in park adaptation planning efforts based on models currently available for the Atlantic coast.

The SECN will monitor shoreline position and geomorphology using the measurement system SWASH (Surveying Wide Area Shorelines). SWASH consists of GPS positioning and a GPS-based attitude sensor mounted on an amphibious all-terrain vehicle, which is driven along the beach foreshore at low tide. The SWASH system can survey up to 70 km of coast within the 3-4 hours bracketing low tide, and is ideal for rapid-response measurements of storm impacts as

well as for repetitive shoreline survey programs over longer periods.

Field tests of the SECN Coastal Shoreline Monitoring Unit have been conducted and data have been collected at one coastal park in the SECN (Cape Hatteras National Seashore). Completion of data analysis from CAHA to ensure data quality is expected by winter 2012 and data collection at the remaining coastal parks is scheduled to occur in 2013.

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 non-native 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 six 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 10). In aggregate, these measures contribute to assessments of current natural resource status, potential threats, and conservation vulnerability and opportunity.

Example products for the landscape surrounding CONG include:

- Source and processed GIS data and associated metadata,
- An interpretive guide report (under review) describing the ecological relevance of NPScape data and measures as they relate to our understanding of current and anticipated landscape dynamics,
- An example draft report demonstrating the applicability of NPScape to management and planning,

- A Standard Operating Procedure (SOP) for each metric consistent with I&M protocols, as well as data processing scripts and tools for parks and networks to efficiently generate new customized products,
- Park-based maps of each measure in multiple formats for non-GIS specialists, including interactive kml files for Google Earth and geo-pdf files for Adobe Acrobat, and
- Graphical summaries of the measures to enable parks and networks to understand their results in a comparative context.

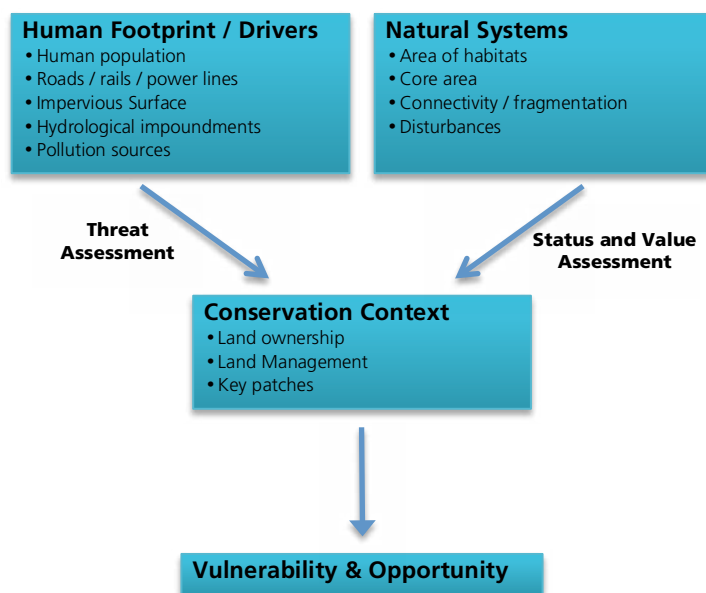


Figure 10. Example measures of landscape dynamics included in the NPScape program
(<http://science.nature.nps.gov/im/monitor/npscape/>).

Further information on NPScape, including access to all products, is available through the NPScape website (<http://science.nature.nps.gov/im/monitor/npscape/>) and the NPS Integrated Resource Management Applications (IRMA) data system (see below).

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 20 parks, 17 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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