Congaree National Park

National Park Service
U.S. Department of the Interior

Inventory & Monitoring Program
Southeast Coast Network

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 in addition to other park programs, determine how well 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 toward 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). Congaree National Park (CONG) is one of 17 parks in the SECN (Figure 1).

About the Park

Congaree National Park is situated adjacent to the Congaree and Wateree Rivers in southeast Richland County, South Carolina, approximately 20 miles southeast and downstream

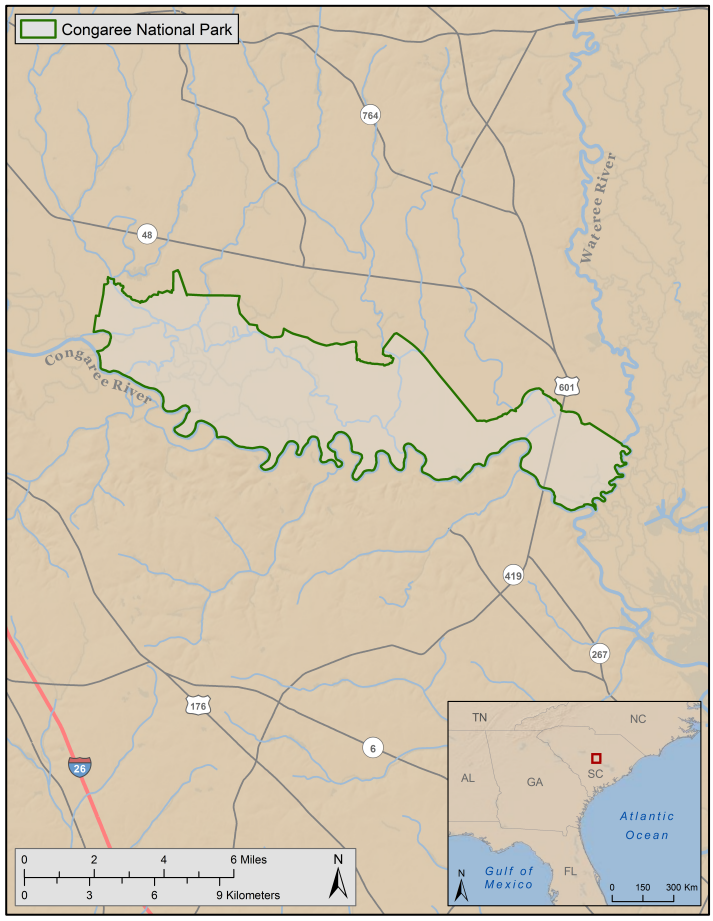


Figure 1. Location of Congaree National Park, SC.

of the capital city of Columbia. Encompassing 25,300 acres, the park protects towering old-growth trees and diverse plant and animal life within the largest intact expanse of old-growth bottomland hardwood forest remaining in the United States. Periodic flood waters from the adjacent rivers sweep through the bottomland forest in winter and spring, carrying the nutrients and sediments that nourish and rejuvenate this unique floodplain ecosystem. Nearly 90 species of trees grow within the park, with many that are recognized as national and state champions for their size. Forested wetlands, oxbow lakes, and slow moving creeks and sloughs provide superb habitat for fish, birds, reptiles, mammals and other aquatic life. The diversity of flora and fauna, tall tree canopy, champion trees, and intact floodplain ecosystem earned the park the designation of an International Biosphere Reserve, National

Natural Landmark, Globally Important Bird Area, and Congressionally designated Wilderness Area.

A wide variety of forest communities are represented at CONG, with dominant tree species ranging from upland pines to wetland cypress and tupelo. The Congaree River floodplain is characterized by silty clay soils, oxbow lakes, swales and sloughs, and meandering creeks. The Congaree and Wateree Rivers are the major source of floodwaters, sediment, and nutrients delivered to the Park, although several tributary creeks are also present. The significance of CONG lies in its: (a) unique old-growth bottomland hardwood forest community associated with the swamp-like floodplain, (b) remarkably large trees, including loblolly pine, bald cypress, tupelo, sweet gum, American sycamore, cottonwood, oak, and holly; (c) the intact floodplain ecosystem, and (d) high biodiversity.

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 conducted at Congaree National Park [● – Complete; ◒ – In Progress; × – Not Yet Scheduled]

Inventory	CONG
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 complete for CONG (Table 1; see Tuberville et al. 2005, Webster 2010). Although considered complete, the plant inventory for CONG is currently being updated by The Universities of Georgia and South Carolina and should be complete in 2012.

Watershed Condition Assessment

In addition to the 12 basic inventories, the SECN has also conducted a watershed condition assessment, designed to identify the current state of water resources within and upstream of CONG, as well as an evaluation of factors that might affect water resources in the future (Mallin and McIver 2010).

The assessment indicated that water quality within CONG is generally good, but there are several current and potential problems that should be either noted or addressed and, in some cases, investigated further. Upper Cedar Creek where it enters the park is generally considered to have excellent water quality. However, other research has shown lower Cedar Creek near Wise Lake to have elevated fecal bacteria counts; this is a human health concern. SCDHEC lists several areas adjoining the Park as impaired for use. These include Toms Creek (impaired for high fecal coliform counts and impaired biological community); the Congaree River at the west boundary of the park (impaired for high fecal coliform counts), and the Congaree River near the Bates Fork Tract at Highway 601 (impaired for high fecal coliform counts and elevated copper). Clearly, source tracking of fecal bacteria inputs is a major research need for CONG. In addition there is a fish consumption advisory for various species in the area due to mercury contamination. Various studies collectively indicate that there may be a problem with elevated metals in water and sediments of the park.

Vital Signs Monitoring

In addition to the baseline inventories, the SECN has selected 17 indicators of ecosystem condition, or Vital Signs, to be monitored at CONG. Long-term monitoring of 12 of these Vital Signs has been wholly or partially implemented by the Network at CONG. 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 to 2009 show that total-N wet deposition, total-S deposition and visibility levels at CONG were all considered to be of significant concern, while ozone was of moderate concern (Table 2).

Table 2. Air quality interpolation values for the period 2005–2009 at Congaree National Park. Red indicates values of significant concern. Yellow indicates values of moderate concern.

Ozone Concentration (ppb)	Total-N Wet Deposition (kg/ha/yr)	Total-S Wet Deposition (kg/ha/yr)	Group50 Visibility (dv)
72.8	3.44	4.54	11.5

A 2011 analysis of acid deposition showed CONG to be at high risk of pollutant exposure, and a moderate risk of acid deposition. Although considered to be at a high risk of nutrient exposure, the overall risk of atmospheric nutrient enrichment is very high at CONG due to the presence of resources with very high sensitivity to nutrient enrichment from nitrogen deposition (Sullivan et al. 2011a, b).

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 within and around SECN park units; (2) determine the status, trends, and variability of derived weather data (i.e., drought indices) within and around SECN park units; (3) track the location,

In 2010, average monthly temperatures at weather stations in the aarea around CONG ranged from a low of 39.6°F to a high of 84.4°F at Columbia Metro Airport. Average monthly temperatures were above normal at most locations during the summer months and below normal during the winter. Average monthly precipitation was above average during July and August, but below average the rest of the year (Figure 2).

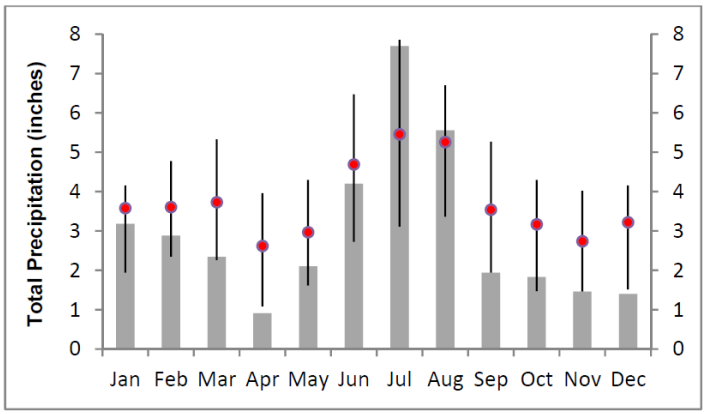


Figure 2. Total monthly precipitation during 2010 and the 30-year (1981 - 2010) monthly averages for Columbia Metro Airport station. The gray columns represent 2010 total monthly precipitation. The red circles represent the 30-year average; the lines indicate the 25th and 75th percentile of the 30-year normal data for each month.

Average monthly maximum relative humidity ranged 95–100%, with the lowest maximum occurring in January and the highest in the summer months. Average monthly minimum relative humidity ranged 32–64% with the lowest occurring during April and the highest occurring during August.

An additional Remote Autmated Weather Station (RAWS) is located at CONG, though with a shorter period of record (not included in the figures above). Derivative climate measures indicated that the growing season length was 244 days at both weather stations used in the analysis and little variation was present between weather stations in most of the derived climate measures examined (Wright et al. 2011).

Streamflow Characteristics

The SECN evaluated stream flow variability and the magnitude and timing of specific flow events at CONG during 2010 (Gregory et al., 2012). Flow patterns were characterized and put in historical context using U.S. Geological Survey stream flow data, The Nature Conservancy's Indicators of Hydrologic Alteration software, and Program Flow (Dowd 2011). This analysis was conducted for two stations near the park (Figure 3).

Flows on the Congaree and Wateree rivers near the Park were highest during the winter and early spring months from

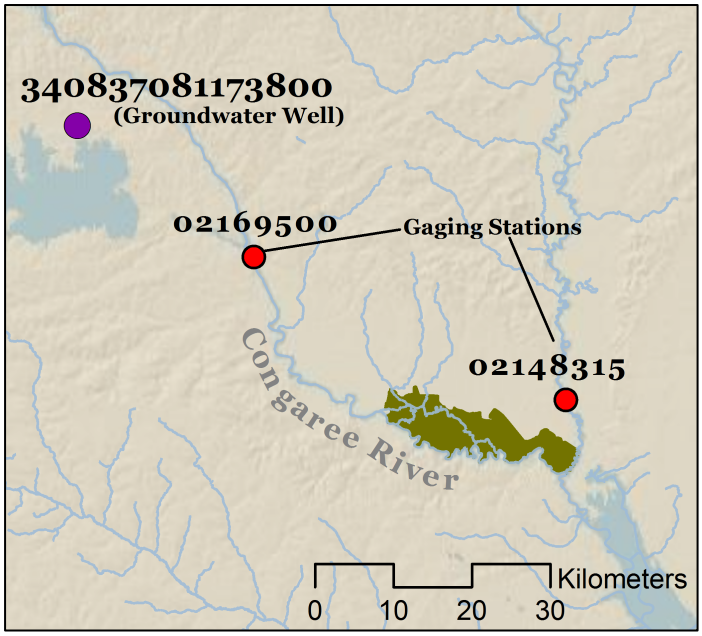


Figure 3. Surface water (red) and groundwater (purple) gaging stations near Congaree National Park, SC.

January–March. Flow on the Congaree River near CONG from January to February was well above the 75th percentile for flows typically observed during that time of year (Figure 4).

During the fall months from September to December, however, flow was below the 25th percentile for what is typically observed on the Congaree. A similar pattern was observed on the Wateree River. The first peak extreme low flows during the late summer and early fall occurred on August 30 for the Congaree and on November 5 for the Wateree River.

Groundwater

All SECN 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 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 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 CONG annually using data from one well in the vicinity of CONG (Figure 3; Wright et al., 2012). The well showed no significant trend in groundwater levels over the period of record (Figure 5). The well does not have a long period of record (>10 years), but it does have a significant number of observations (>12 per year).

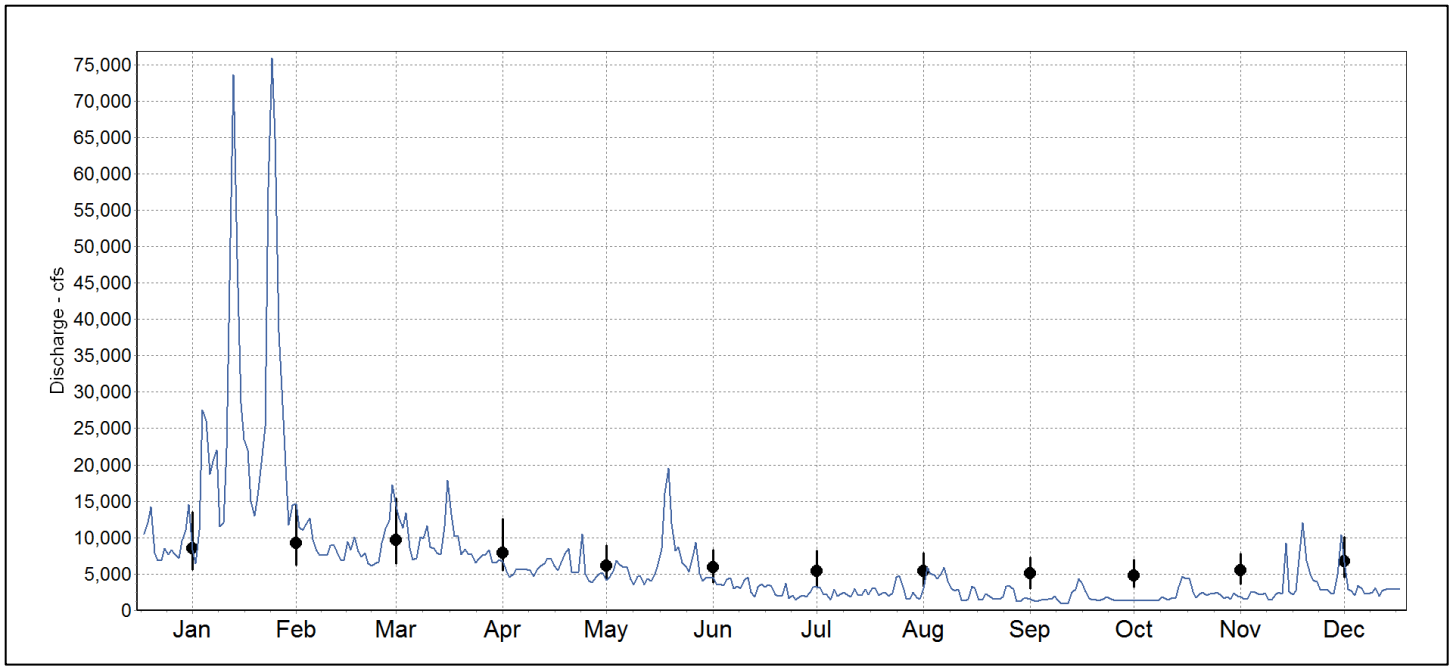


Figure 4. Daily flow (blue line), historical median monthly flow (dots) and interquartile range (25th and 75th percentiles; error bars) for the Congaree River at Columbia, SC during 2010.

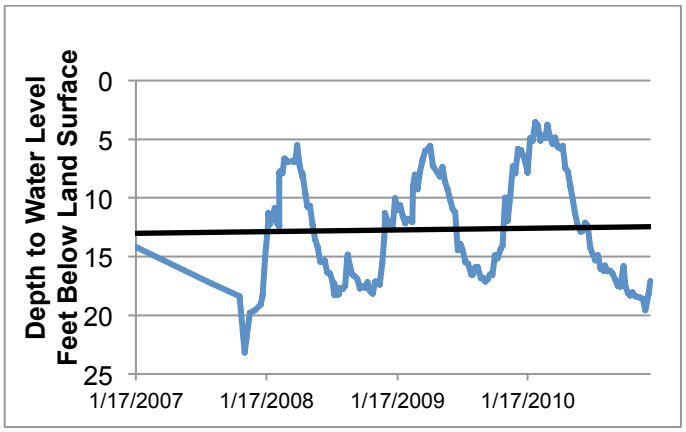


Figure 5. Water levels and calculated trend line for the Piedmont and Blue Ridge Crystalline Rock Acquifer near Congaree National Park, SC (Well 340837081173800).

Stream Habitat

Beginning in FY 2012, stream habitat monitoring will be conducted at CONG. The monitoring protocol is being developed by the USGS National Water Quality Assessment (NAWQA) program and is an extension of existing NAWQA and USDA protocols. A combination of reach- and transect-level flow, geomorphic, and physical instream and riparian habitat measurements will be included in the protocol. Watershed-scale monitoring efforts have been eliminated since the landscape dynamics vital sign currently addresses these issues.

In addition, panoramic 360° still photography will be conducted on timed intervals along the length of major park riverine waterbodies and will be synced with both GPS and core water quality parameters (temp, DO, pH, conductivity). This will allow the generation of a full-river map of potential sites of management concern (such as erosion features). This dataset also has many potential outreach uses such as virtual river tours. A video surveillance component is planned to augment data collected by traditional means and will consist of simultaneous filming of both banks with geotagged footage.

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 1000 birds representing 68 species were detected at Congaree National Park during surveys in 2009 (Byrne et al. 2011a). Carolina wren and Northern cardinal were the most widely distributed species at the Park and occurred at 97% of all sampling locations. No non-native species were detected.

Several priority species were detected during the sampling effort including Acadian flycatcher, bald eagle, blackpoll warbler, chimney swift, Eastern wood-pewee, hooded warbler, Kentucky warbler, Louisiana waterthrush, Mississippi kite, Northern parula, orchard oriole, prairie warbler, prothonotary warbler, red-headed woodpecker, red-shouldered hawk (Figure 6), solitary sandpiper, summer tanager, Swainson's warbler, white-eyed vireo, wood thrush, worm-eating warbler, yellow-billed cuckoo, yellow-throated vireo, and yellow-throated warbler.



Figure 6. Red-shouldered Hawk (*Buteo lineatus*) was a priority species detected at CONG in 2009.

Amphibians

Amphibian communities of the SECN are monitored because of their global importance as ecological indicators, documented population declines and extinctions, and their high level of diversity in the Southeast. With an estimated 140 amphibian species, the Southeast accounts for about half of the total number of amphibians in the United States.

CONG has 33 known amphibian species: 8 in Caudata (salamanders, newts, amphiumas, sirens), and 25 in Anura (frogs and toads; NPSpecies 2012). Because of their complex



Figure 7. Marbled Salamander (*Ambystoma opacum*).

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 sampling in 2011, more than 1,000 amphibians across 24 species and 58 reptiles across 18 species were detected (Byrne et al. 2011b). Monitoring efforts resulted in the addition of six new species/sub-species to the Park's official species list: two amphibians (dwarf salamander and bronze frog), and four reptiles (black rat snake, Eastern or yellow rat snake, red-bellied watersnake, and yellow-bellied slider).

Cope's gray treefrog, marbled salamander (Figure 7), and Southern leopard frog were the most widely distributed amphibians detected. No non-native amphibians or reptiles were detected.

The SECN also conducted surveys for chytrid fungus—a pathogen linked to amphibian population declines around the world (Byrne and Moore 2011). Evidence of the fungus was found in several larval and post-metamorphic pickerel frogs. None of the individuals showed clinical signs of the disease, however.

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.

CONG has 855 known vascular-plant species, subspecies, and varieties (NPSpecies 2012). Monitoring efforts resulted in the addition of six taxa to the Park's species list: bushy bluestem, Canadian horseweed, Elliott's milkpea, manyflower marshpennywort, bahiagrass, and American black nightshade (Byrne et al. 2012). Canopy cover across the study area was approximately 83%.

Water Tupelo had the largest average diameter of any canopy species sampled at the Park. Boxelder was the most frequently detected seedling. Paw-paw was the most frequently occurring species in the shrub stratum. Smilax and poison ivy were the most frequently occurring species in the groundcover stratum. Giant cane had the highest absolute and relative cover in the groundcover stratum.

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 8). In aggregate, these measures contribute to assessments of current natural resource status, potential threats, and conservation vulnerability and opportunity.

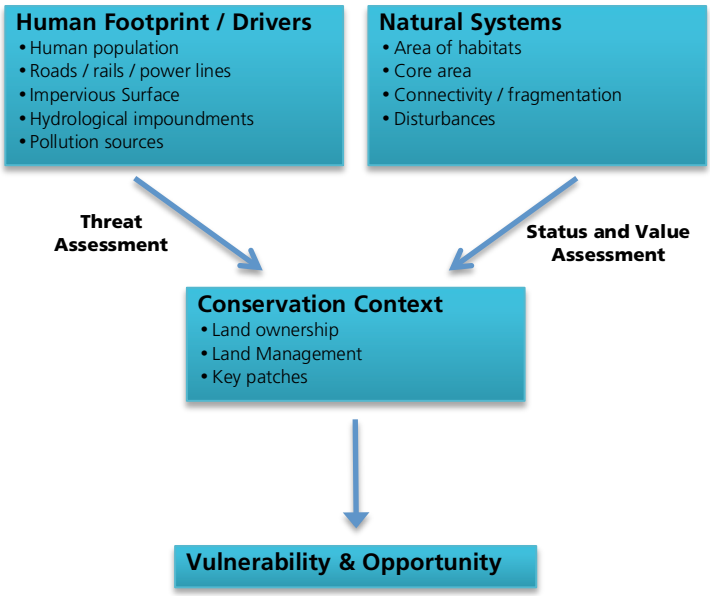


Figure 8. Example measures of landscape dynamics included in the NPScape program (http://science.nature.nps.gov/im/monitor/npscape/).

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.

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, 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 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.

Follow us on Twitter

For notification on the release of new reports from the SECN and job/internship opportunities follow us on Twitter @SECoastNetwkNPS or http://twitter.com/SECoastNetwkNPS.

Bibliography

Byrne, M. W., S. L. Corbett, and J. C. DeVivo. 2012. Vegetation community monitoring at Congaree National Park, 2010. Natural Resource Data Series NPS/SECN/NRDS—2012/259. National Park Service, Fort Collins, Colorado

Byrne, M. W., J. C. DeVivo, J. R. Asper, and B. A. Blankley. 2011a. Landbird monitoring at Congaree National Park, 2009. Natural Resource Data Series NPS/SECN/NRDS—2011/306. National Park Service, Fort Collins, Colorado

Byrne, M. W., B. D. Smrekar, M. N. Moore, C. S. Harris, and B. A. Blankley. 2011b. Summary of amphibian community monitoring at Congaree National Park, 2010. Natural Resource Data Series NPS/SECN/NRDS—2011/167. National Park Service, Fort Collins, Colorado.

Byrne, M. W., B. D. Smrekar, M. N. Moore, and C. S. Harris. 2011. Summary of vocal anuran monitoring at Horseshoe Bend National Military Park, 2009. Natural Resource Data Series NPS/SECN/NRDS—2011/156. National Park Service, Fort Collins, Colorado.

Byrne, M. W., and M. N. Moore. 2011. Incidence of chytrid fungus, *Batrachochytrium dendrobatidis*, in Southeast Coast Network parks. Natural Resource Technical Report NPS/SECN/NRTR—2011/477. National Park Service, Fort Collins, Colorado.

DeVivo, J. C., C. J. Wright, M. W. Byrne, E. DiDonato, and T. Curtis. 2008. Vital signs monitoring in the Southeast Coast Inventory & Monitoring Network. Natural Resource Report NPS/SECN/NRR—2008/061. National Park Service, Fort Collins, Colorado.

DeVivo, J. C., T. Curtis, M. W. Byrne, M. B. Gregory, and C. J. Wright. 2011. Southeast Coast Network Climate Science Strategy. Natural Resource Report NPS/SECN/NRR—2011/436. National Park Service, Fort Collins, Colorado.

Dowd, J. F. 2011. Program Flow. The University of Georgia. Athens, GA, USA.

Fancy, S. G., J. E. Gross, and S. L. Carter. 2009. Monitoring the condition of natural resources in US national parks. Environmental Monitoring and Assessment 151:161-174.

Gregory, M. Brian, C. Wright, J. C. DeVivo, and C. D. Jones. 2012. Summary of Stream Flow Conditions at Five River Parks in the Southeast Coast Network, 2010. Natural Resource Report NPS/SECN/NRDS—2012/313. National Park Service, Fort Collins, Colorado

Mallin, M. A., and M. R. McIver. 2010. Assessment of water resources and watershed conditions in Congaree National Park, South Carolina. Natural Resource Report NPS/SECN/NRR— 2010/267. National Park Service, Fort Collins, Colorado.

National Park Service. 2012. Integrated Resource Management Applications (IRMA) Portal. https://irma.nps.gov.

Rasmussen, T. C., J. F. Dowd, R. J. McKinnon, B. M. Price, and R. D. Sherrell. 2009. Southeast Coast Network groundwater monitoring: Protocol development and analysis of existing data. Natural Resource Report NPS/SECN/NRR–2009/126. National Park Service, Fort Collins, Colorado.

Sullivan, T. J., G. T. McPherson, T. C. McDonnell, S. D. Mackey, and D. Moore. 2011a. Evaluation of the sensitivity of inventory and monitoring national parks to acidification effects from atmospheric sulfur and nitrogen deposition: Southeast Coast Network (SECN). Natural Resource Report NPS/NRPC/ARD/NRR—2011/375. National Park Service, Denver, Colorado.

Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011b. Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: Southeast Coast Network (SECN). Natural Resource Report NPS/NRPC/ARD/NRR—2011/329. National Park Service, Denver, Colorado.

Tuberville, T. D., J. D. Willson, M. E. Dorcas, and J. W. Gibbons. 2005. Herpetofaunal Species Richness of Southeastern National Parks. Southeastern Naturalist 4(3): 537-569.

Webster, W. D. 2010. Mammalian Diversity in nineteen Southeast Coast Network parks. Natural Resource Report NPS/SECN/NRR—2010/263. National Park Service, Fort Collins, Colorado.

Wright, C. J. and M. W. Byrne. 2012. Groundwater Monitoring in Southeast Coast Network Parks, 2010. Natural Resource Data Series NPS/SECN/NRDS—2012/275. National Park Service, Fort Collins, Colorado.

Wright, C. J., E. Thompson, B. A. Blankley, M. W. Byrne, T. Curtis, and M. B. Gregory. 2011. Summary of weather and climate monitoring in Southeast Coast Network parks, 2010. Natural Resource Data Series NPS/SECN/NRDS—2011/309. National Park Service, Fort Collins, Colorado.



National Park Service. 2012. Inventory & Monitoring Program Status Report, 2012: Congaree National Park. Southeast Coast Network, National Park Service, Athens, GA.