

Kennesaw Mountain National Battlefield 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 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). Kennesaw Mountain National Battlefield Park (KEMO) is one of 17 parks in the SECN (Figure 1).

About the Park

Kennesaw Mountain National Battlefield Park (KEMO), a 2,923-acre park in the metropolitan Atlanta area, includes the 1,808-foot peak of Kennesaw Mountain, Little Kennesaw Mountain and hundreds of acres of mixed hardwood/pine forests intermixed with a number of grassy fields. Included are

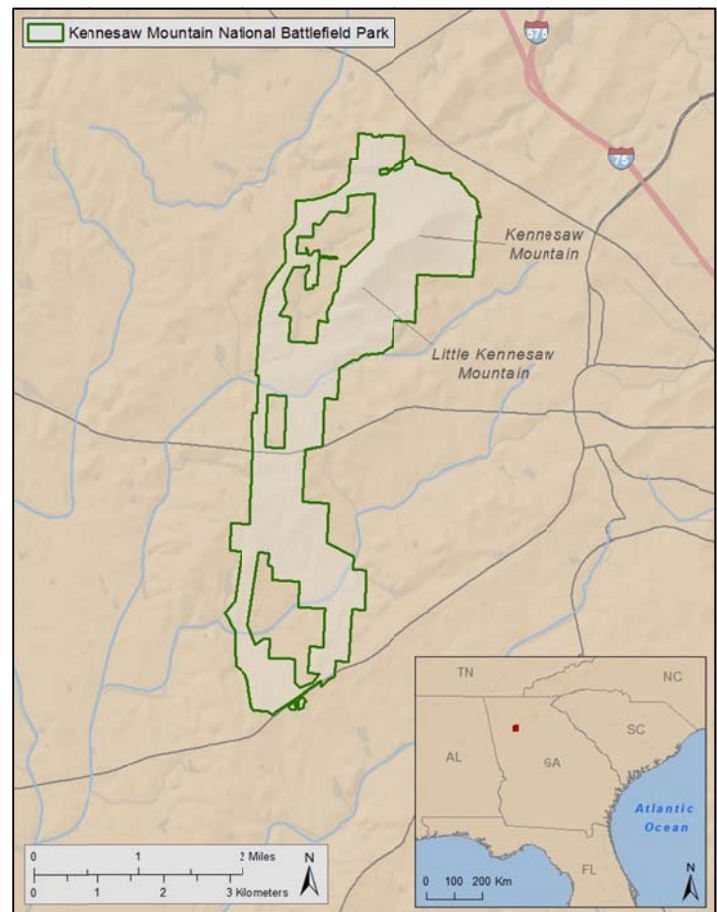


Figure 1. Location of Kennesaw Mountain National Battlefield Park, GA.

more than 22 miles of designated hiking trails that attract hundreds of recreational visitors daily. The Park's location in the metropolitan Atlanta area makes it the second-most visited battlefield in the National Park System and has earned it a position on the Secretary of Interior's list of 25 most threatened parks.

Largely because of its proximity to Atlanta, major threats to natural resources exist at KEMO. The development of Cobb County and greater metro Atlanta makes the lands within Kennesaw Mountain relatively valuable for natural habitats of localized plant and animal communities. Cobb County has plans to expand roads and highways that traverse the park and pose a potential threat to both cultural and natural resources. Air pollution also poses a major threat to the Park, which is

located in a designated ozone nonattainment area. Vegetation in KEMO is considered at high risk of injury from ozone.

Additionally, there are minor threats from encroachment of adjacent landowners, non-native invasive plant species, and industrial air and water pollution. Since 1993, pine beetle infestations have killed thousands of pine trees throughout the park and the resulting increase in fuels laying on the forest floor pose an increased fire risk. Natural succession to hardwood forest is expected. There appears to be an increase in the beaver population. As beavers create dams, distribution and water quality is altered. The mitigation of encroachments and the removal of non-native plants are ongoing programs.

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 conducted at Kennesaw Mountain National Battlefield Park [● – Complete; ● – In Progress; ✕ – Not Yet Scheduled]

Inventory	KEMO
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 are either complete or underway at KEMO (Table 1; see Tuberville et al. 2005, Webster 2010).

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 KEMO, as well as an evaluation of factors that might affect water resources in the future.

The overall findings of the assessment indicated that the Park’s water and cultural resources are seriously threatened by upstream and encroaching urbanization, and by the multitude of the water and air pollutants and other stressors associated with rapid human population growth, land development, and natural resource destruction. The two perennial streams that flow through the park have shown signs of degradation for more than 20 years. The causes of impairment have been identified as urban and other nonpoint source pollution, in particular, excessive sediment loading and high fecal coliform bacterial densities (Burkholder et al. 2010).

The airshed is in violation of federal ozone and fine particulate standards that threaten the health of park staff and frequent visitors, and the high ozone concentrations may be damaging terrestrial plant foliage. The park also lies in an area that is especially prone to atmospheric acid deposition, and acidification, especially acid spates, very likely is adversely affecting its surface waters. Invasive/exotic species are also adversely affecting the park’s land resources.

Other stressors to the Park’s natural and historic resources include heavy use and erosion of hiking trails, equestrian activities that occur within and upstream from the park, the creation of multiple “social” trails through sensitive park lands because of shared boundaries between the park and suburban developments, and frequent illegal dumping of trash and other refuse. The looming major factor that will exacerbate virtually all of these stresses is the rapid, extreme population growth of the Atlanta metropolitan area.

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 KEMO. Long-term monitoring of 12 of these Vital Signs has been wholly or partially implemented by the Network at KEMO. 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 ozone, total-N wet deposition, total-S deposition and visibility levels at KEMO were all considered to be of significant concern (Table 2).

Table 2. Air quality interpolation values for the period 2005–2009 at Kennesaw Mountain National Battlefield Park. 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)
82.9	4.28	4.83	12.6

A 2011 analysis of acid deposition showed KEMO to be at very high risk of pollutant exposure, and a high risk of acid deposition (Sullivan et al. 2011a). Although considered to be at a very high risk of nutrient exposure, the overall risk of atmospheric nutrient enrichment at is only moderate at KEMO. 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).

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 770 birds representing 60 species were detected at Kennesaw Mountain National Battlefield Park during surveys in 2009 (Byrne et al. 2011a).

Northern cardinal, Carolina wren, and tufted titmouse were the most widely distributed species at the Park; detected at 90-

93% of sampling locations. One non-native species was detected: house finch.



Figure 2. Cooper's hawk (*Accipiter cooperii*; juvenile) was a priority species detected at KEMO in 2009. Photo courtesy of USFWS.

Several priority species were detected during the sampling effort including Acadian flycatcher, brown-headed nuthatch, chimney swift, Cooper's hawk (Figure 2), Chuck-will's-widow, Eastern towhee, Eastern wood-pewee, hooded warbler, indigo bunting, mallard, Northern flicker, pine warbler, red-bellied woodpecker, red-headed woodpecker, red-shouldered hawk, summer tanager, white-eyed vireo, wood thrush, worm-eating warbler, yellow-billed cuckoo, and yellow-throated vireo.

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, magnitude, and frequency of extreme weather events that affect SECN park resources (Wright et al. 2011).

Average monthly temperatures at weather stations near KEMO ranged from a low of 35.4°F to a high of 82.8°F; temperatures were above normal at most locations during the spring, summer, and early fall months and below normal

during the winter, though not outside the range of variation for the 30-year history. Total annual precipitation at Atlanta Hartsfield International Airport was 48.15 inches, 41.31 inches at Dallas 7NE, and 48.88 inches at Gainesville during 2010, which is 1.56, 11.67, and 4.28 inches below normal respectively (Figure 3).

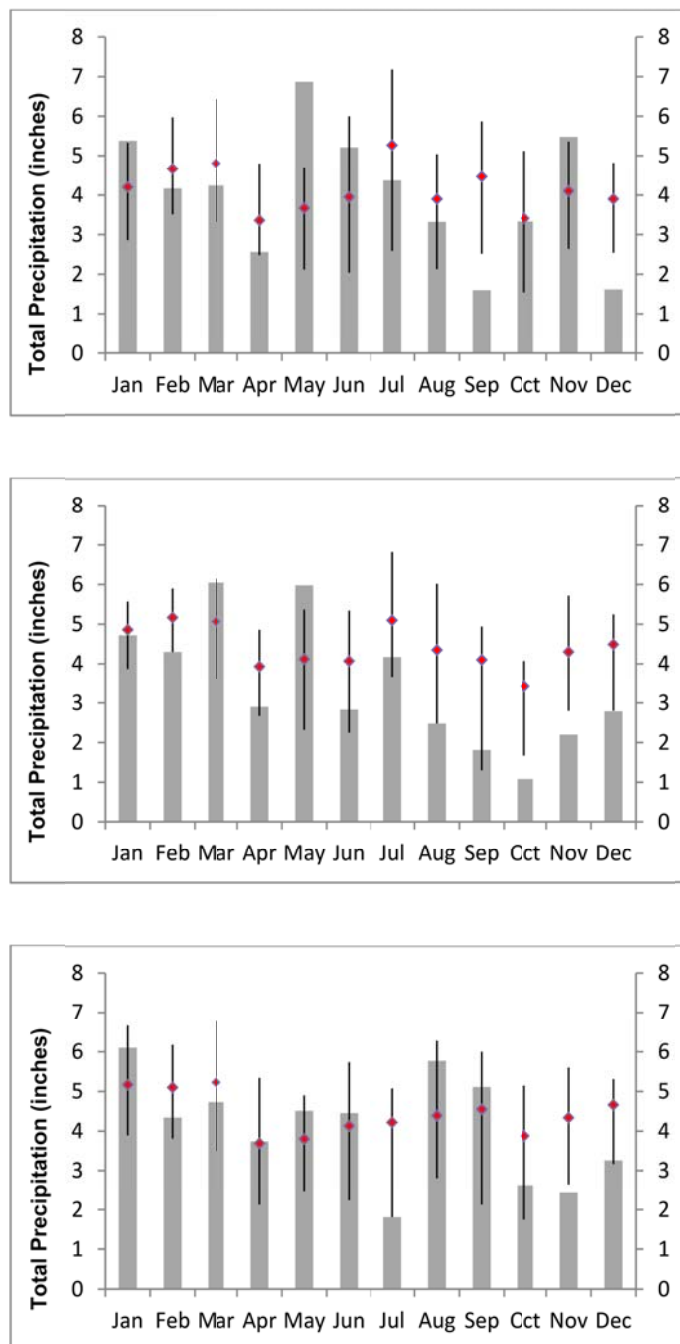


Figure 3. Total monthly precipitation during 2010 and the 30-year (1981-2010) monthly averages for Atlanta Hartsfield International Airport (top), Dallas 7NE (middle), and Gainesville (bottom) stations. The gray columns represent 2010 total monthly precipitation. The red circles represent the 30-year average; the lines indicated the 25th and 75th percentile of the 30-year normal data for each month.

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 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 KEMO annually using data from two wells in the vicinity of KEMO (Wright et al., *in review*). In 2010, both wells showed a significant, negative trend in groundwater levels over the period of record (see example for the Crystalline Rocks Aquifer, Figure 4).

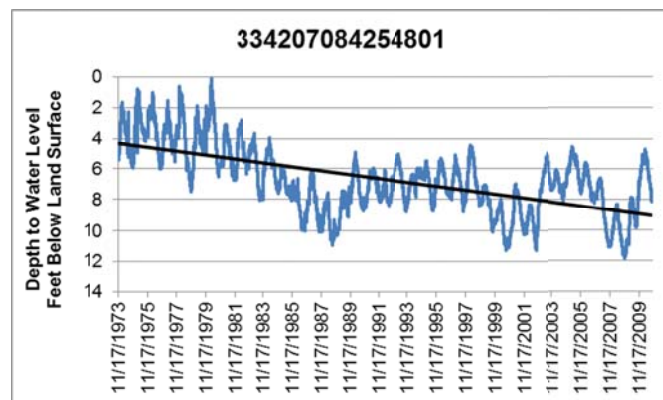


Figure 4. Water levels and calculated trend line for groundwater well 334207084254801 (Crystalline Rocks Aquifer near KEMO).

Streamflow Characteristics

The SECN evaluated stream flow variability and the magnitude and timing of specific flow events at KEMO during 2010 (Gregory et al., 2012). Flow patterns were characterized and put in historical context using U.S. Geological Survey stream flow data (Figure 5), The Nature Conservancy's Indicators of Hydrologic Alteration software, and program Flow (Dowd 2011).

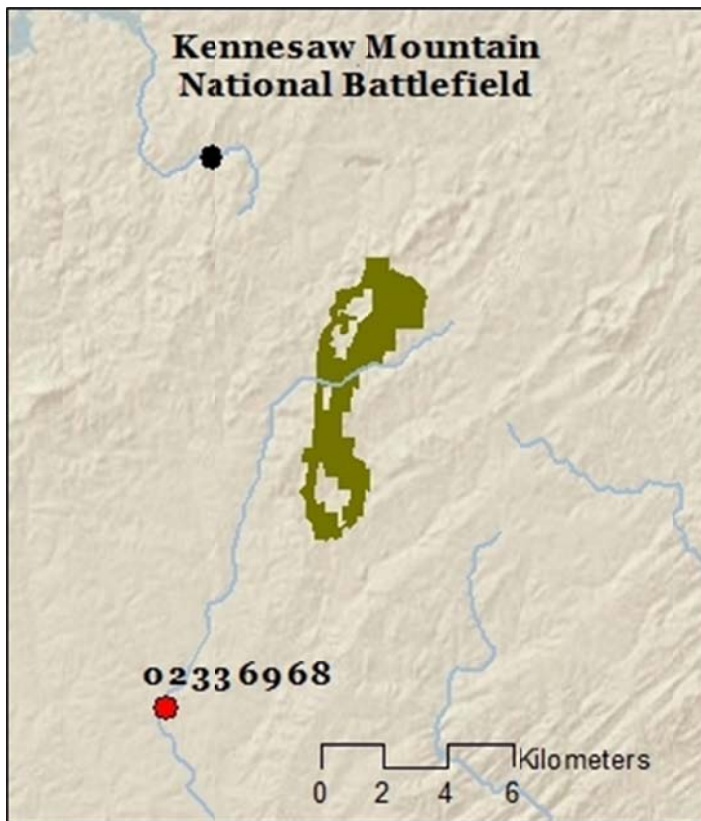


Figure 5. USGS gaging near Kennesaw Mountain National Battlefield Park near Atlanta, Georgia.

Monitored river flow values varied greatly across SECN parks which encompass rivers with drainage areas ranging from 44 to 7,850 sq mi. The USGS gage at Noses Creek, which was used in this analysis for Kennesaw Mountain National Battlefield Park (KEMO), had the lowest median flow of any park used in this analysis; however, this is due to its small size.

The lowest flows occurred from August to October when median flow dipped below 5 cfs (Figure 6). However, this is the normal pattern typically observed for Noses Creek and other streams in the Southeast. High flow pulses occurred 12 times throughout the year and a small flood even lasting 44 days occurred during the winter beginning on February 5.

Amphibians

KEMO has 22 known amphibian species: 11 in Caudata (salamanders, newts, amphiumas, sirens), and 11 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.

Six Anurans were detected in the 2009 sampling period (Byrne et al. 2011b), including five of the 11 known to occur at KEMO. One species, green treefrog (*Hyla cinerea*), was not previously known to occur at KEMO and represents a new species for this park. No non-native species were detected.

Spring peeper (*Pseudacris crucifer*; Figure 6) was the most widely distributed amphibian followed by Cope's gray treefrog (*Hyla chrysoscelis*) and green frog (*Rana clamitans*). Species accumulation curves indicated that additional sampling locations/methods are needed to adequately sample the amphibian community at KEMO.

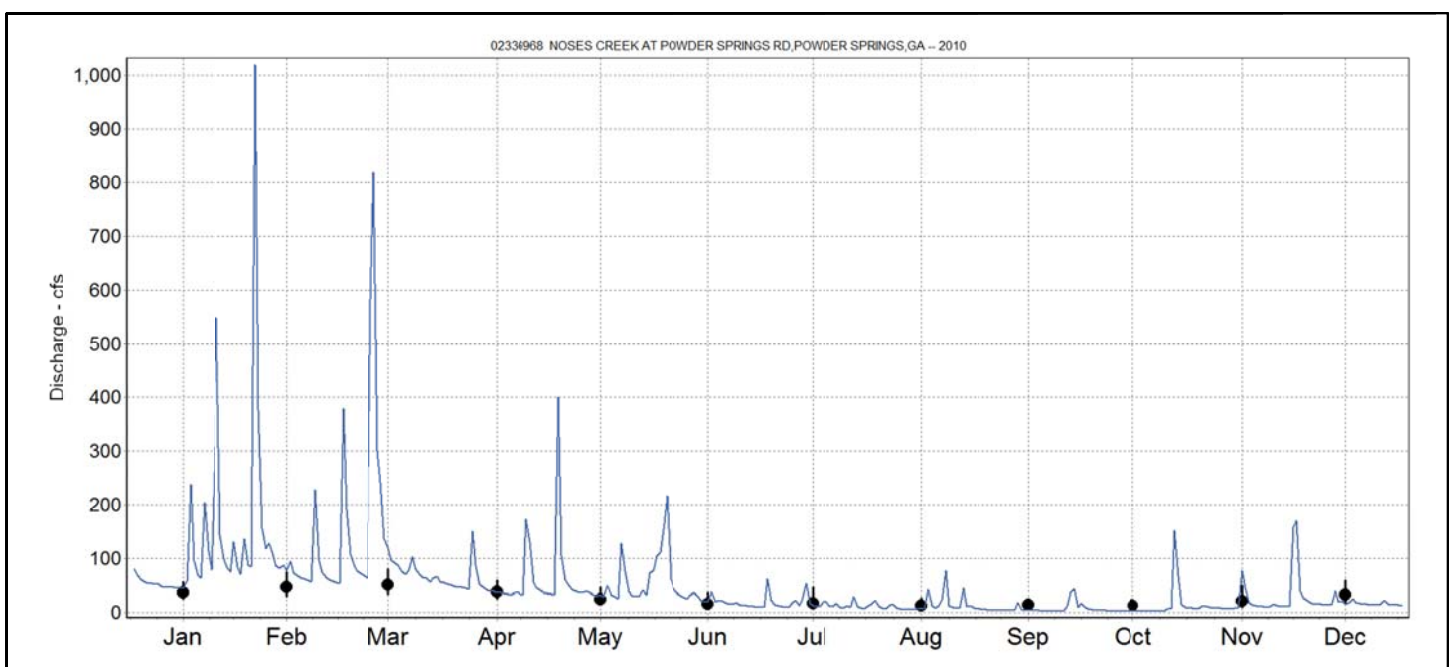


Figure 6. Daily flow (blue line), historical median monthly flow (dots) and interquartile range (25th and 75th percentiles; error bars) for Noses Creek at Powder Springs Rd, Powder Springs, GA during 2010.

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 frogs (*Lithobates* sp.). None of the individuals showed clinical signs of the disease, however.



Figure 7. Spring peeper (*Pseudacris crucifer*)

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.

KEMO has 844 known vascular-plant species, subspecies, and varieties (NPSpecies 2012). The SECN conducted plant surveys during the summer of 2011 and the data are currently being processed. The data summary report is expected to be complete in summer 2012.

Fire Fuels and Dynamics

The SECN conducted fire fuel surveys during the summer of 2011 and the data are currently being processed, and a summary data report is expected summer 2012.

Stream Habitat

Beginning in FY 2012, stream habitat monitoring will be conducted at KEMO. 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 taken along the length of streams within the park and will be synced with GPS. This will allow the generation of a stream map of potential sites of management concern (such as erosion features).

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.

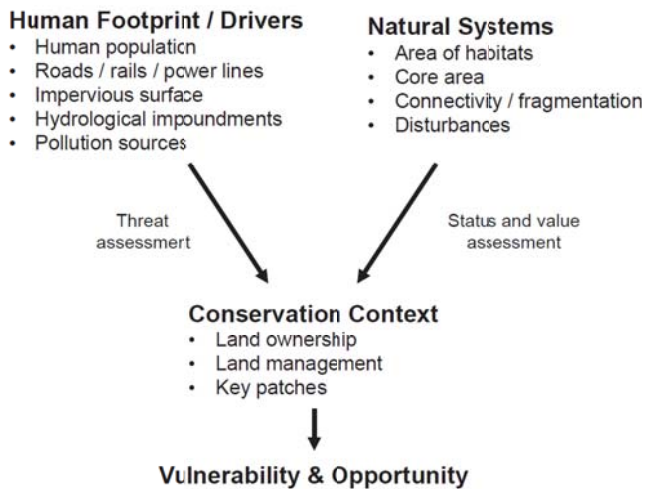


Figure 8. Example measures of landscape dynamics included in the NPScape program
(<http://science.nature.nps.gov/im/monitor/npscape/>).

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 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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