



**U.S. Department of the Interior  
National Park Service  
Natural Resource Information Division**



## Prototype Ecological Monitoring

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The Natural Resource Inventory and Monitoring (I&M) Program was established to gather information and develop techniques for maintaining the integrity of the ecological communities in the approximately 250 National Park System units with significant natural resources. The details of the program are outlined in *Natural Resource Inventory and Monitoring in National Parks*, available from the address listed below

Since its inception in 1992, the I&M Program has funded mapping of vegetation, soils, and geologic features; collection of base cartographic data; and compilation of automated park-based bibliographic databases; initiation of several prototype monitoring programs; and development of data management standards and protocols. The fact sheet series of the Natural Resource Information Division provides updated information on the progress in each of these areas.

### Prototype Ecological Monitoring

The tremendous variability in the ecological conditions, sizes, and management capabilities of national parks represents significant problems for ecological monitoring throughout the National Park Service. To deal with this ecological and managerial diversity, the I&M Program used a competitive process to select parks that represent *prototypes* for the experimental monitoring of each of 10 major biomes (Tables 1 and 2). To ensure that the broad range of managerial situations is adequately represented, three of the prototypes were selected as *clusters*, i.e., a grouping of 4-6 small units, each of which lacked the full range of staff and resident

expertise for long-range monitoring on its own.

Monitoring in the prototypes varies widely by structure and function of a park. However, the monitoring of trends in species abundance, population dynamics, watershed ecology, and other indicators of environmental change tends to be uniform throughout the prototypes. Notwithstanding, all monitoring is designed to provide ecological information that is useful for addressing questions beyond today's issues.

Protocols and expertise developed by the prototypes will be shared with other parks in similar ecological and managerial settings. The prototypes will also serve as training centers for natural-resource

design--usually a period of 3-5 years--funding and full-time employees are provided by the National Biological Resources Division. After completion of research and protocol designs, monitoring is considered to be operational. From then on, funding and full-time employees become the responsibilities of the National Park Service.

### Program Status

#### *Channel Islands National Park (Pacific Coast Biome)*

The Channel Islands National Park off the coast of California has served as a prototype since 1992. Monitoring in this park is based on the belief that organisms exhibit the effects of a vast array of ecological factors, including predation, competition, and other environmental factors that are expressed in changes in population dynamics such as abundance, distribution, growth rate, and mortality. A conceptual model of the park's ecosystems was used to identify mutually exclusive system components for monitoring. Protocols for monitoring weather, air quality (ozone), water quality, kelp forests, rocky intertidal communities, sandy beaches or lagoons, terrestrial vegetation, seabirds, pinnipeds, lands birds, and visitor numbers have been established.

Monitoring in the park is fully operational. Monitoring and the associated information management are done by the park's natural-resource management staff.

#### *Shenandoah National Park (Deciduous Forest Biome)*

The Shenandoah National Park in the northern Blue Ridge Mountains is the

Table 1. The seven initiated prototypes and the biomes they represent.

Prototype	Biome
Cape Cod National Seashore	Atlantic/Gulf Coast
Channel Island National Park	Pacific Coast
Denali National Park and Preserve	Arctic/Subarctic
Great Plains Cluster	Prairie and Grassland
Great Smoky Mountains National Park	Deciduous Forest
Shenandoah National Park	Deciduous Forest
Virgin Islands/Southern Florida Cluster	Tropical/Subtropical

managers throughout the National Park Service. A brief summary of the monitoring in the seven initiated prototypes is provided below.

### Partnerships

Prototype monitoring is being implemented in close partnership between the National Park Service and the National Biological Resources Division of the U. S. Geological Survey (USGS). During the initial phases of research and

largest protected area in the mid-Atlantic area. The park initiated several monitoring programs in the mid-1980s as a result of numerous threats to resources that included air pollution and gypsy moths. Other monitoring components were added when the park became a prototype. Monitoring focuses on populations, communities, and watersheds.

Although most of the monitoring is being conducted and considered operational, additional research is needed for completing several monitoring components. Inventory and monitoring programs are integrated into the park's resource management.

#### *Great Smoky Mountains National Park*

##### *(Deciduous Forest Biome)*

The Great Smoky Mountains National Park, which encompasses approximately 550,000 acres in the states of Tennessee and North Carolina, became a prototype in 1992. The floral and faunal species richness in this park is one of the greatest in the National Park System. However, this richness is threatened by the invasions of exotic forest insects, diseases, plants, and vertebrates; by high ozone and nitrate depositions at upper elevations; by fire suppression; and by the destruction of habitats on the peripheries of the park.

Long-term monitoring in very large parks presents a special problem with respect to spatial scales. Therefore, monitoring in the Great Smoky Mountains National Park is structured in a hierarchy of five spatial scales: landscapes, ecosystems, watersheds, communities, and species. Within these spatial levels, 13 key ecosystem processes and components identified in the park's resource management plan are being monitored. The monitoring at the landscape level primarily serves to determine the effects of air pollution and climatic change on the structure and dynamics of the spruce-fir (*Picea-Abies*) forests. At the species level,

the population dynamics of the black bear (*Ursus americanus*) and the white-tailed deer (*Odocoileus virginianus*) are being monitored. The monitored components in the park also include water quality, rare plants, exotic plants and animals, and brook trout (*Salvelinus fontinalis*) populations.

As in the Channel Islands and Shenandoah national parks, monitoring in the Great Smoky Mountains National Park is fully operational. All research and designs were completed, and the monitoring was integrated into the park's natural-resource management. A review of program thrusts will be completed in 1997.

#### *Denali National Park and Preserve*

##### *(Arctic/Subarctic Biome)*

In 1992, the Denali National Park and Preserve was selected as a prototype to evaluate a watershed strategy for monitoring in large Alaskan parks. Techniques that are developed in one watershed will eventually be replicated in other watersheds that exemplify the major terrestrial habitats, aquatic systems, and climatic regimes in the park. Communities, which are characterized by prevalent vegetation from lowest to highest elevation in a non-glaciated watershed, have been identified for study. Vegetation community structure and dynamics, aquatic community structure, and chemical and geophysical parameters, including water and soil characteristics, are being monitored in a series of permanent plots in the watershed. Associated plots with weather stations, small-mammal-productivity grids, and bird-productivity stations allow the integration of data from multiple disciplines. Other monitoring that transcends watershed boundaries includes air quality, glaciers, and breeding birds.

The development of a monitoring protocol in the Denali National Park and Preserve is nearing completion. Funding and support are currently provided by the

National Biological Resources Division, USGS, under a cooperative arrangement with the National Park Service. After completion of research and protocol designs, monitoring is considered to be operational. From then on, funding and full-time employees become the responsibilities of the National Park Service.

#### *Great Plains Cluster*

##### *(Prairies and Grasslands Biome)*

The first of three clusters was established in 1994 when monitoring in the Great Plains Prairie Cluster was funded. This monitoring is conducted in a cluster of five small prairie park units in the Midwest. The Wilson's Creek National Battlefield in southwestern Missouri serves as the focal park for the cluster. The overall goals of the monitoring are the development and implementation of protocols for resources that are enhanced or alternatively suppressed by management or threats to the park. The protocols address three high-priority management issues: (1) sustainability of small remnant and restored prairie ecosystems, (2) the effects of external land use and watersheds on small-prairie preserves, and (3) the effects of fragmentation on the biological diversity of small-prairie parks.

Monitoring in the Great Plains Cluster is still in the initial phase of protocol design and development and is therefore primarily funded and staffed by the National Biological Resources Division, USGS.

#### *Virgin Islands / Southern Florida Cluster*

##### *(Tropical/Sub-tropical Biome)*

Another cluster was initiated in 1996. It consists of three park units in the Caribbean Sea and southern Florida. Virgin Islands National Park serves as the lead park for the cluster. The monitoring is also funded and conducted by the National Biological Resources Division,

USGS. It is designed to expand existing and prior monitoring in the parks and to integrate them into a systematic, comprehensive program. The major emphasis is on monitoring coral reefs, marine fish communities, terrestrial forests, exotics, and vertebrate populations.

*Cape Cod National Seashore  
(Atlantic/Gulf Coast Biome)*

Monitoring on the Cape Cod National Seashore was initiated in 1996. It is currently funded and staffed primarily by the National Biological Resources Division, USGS, and addresses five major coastal ecosystem components: (1) shoreline margins, (2) barrier islands/spits/dunes, (3) estuaries, (4) kettle ponds and freshwater habitats, and (5) maritime forests. Monitoring in each ecosystem component will address

management that is specifically related to the Cape Cod National Seashore and other coastal parks. Currently, the National Biological Resources Division, USGS, and the park are in the early phases of staffing and establishing protocols. The University of Rhode Island and its associated National Biological Resources Division research center are the primary partners of the park.

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Table 2. Four targeted prototypes and the biomes they will represent.

Prototype	Biome
Mammoth Cave National Park	Caves
Olympic National Park	Coniferous Forest
North Cascades National Park	Rivers and Lakes
Colorado Plateau Cluster	Arid Lands

*Future Prototypes*

Four parks are targeted as prototypes (Table 2) to represent four major biomes. Monitoring will be initiated in these parks as soon as funding can be appropriated.

You may also consult our worldwide web page at:  
<http://www/aqd.nps.gov/natnet/proto.htm>

