

An Overview of Vital Signs Monitoring and its Central Role in Natural Resource Stewardship and Performance Management



Knowing the condition of natural resources in national parks is fundamental to the National Park Service's ability to manage park resources. National Park managers across the country are confronted with increasingly complex and challenging issues that require a broad-based understanding of the status and trends of park resources as a basis for making decisions, working with other agencies, and communicating with the public to protect park natural systems and native species. Vital signs monitoring is a key component in the Service's strategy to provide scientific data and information needed for management decision-making and education. Vital signs also contributes information needed to understand and to measure performance regarding the condition of watersheds, landscapes, and marine resources, and biological communities.

Park vital signs are selected physical, chemical, and biological elements and processes of park ecosystems that represent the overall health or condition of the park, known or hypothesized effects of stressors, or elements that have important human values. Monitoring data help to define the normal limits of natural variation in park resources and provide a basis for understanding observed changes and possible management connections. Understanding the dynamic nature of park ecosystems and the consequences of human activities is essential for management decision-making aimed to maintain, enhance, or restore the ecological integrity of park ecosystems and to avoid, minimize, or mitigate ecological threats to these systems.

The Vital Signs Monitoring Program reports directly to two strategic planning goals (Goal 1b3A, Vital Signs Identification, and Goal 1b3B, Vital Signs Implementation), and provides data and information systems needed to report to several other DOI goals. As described below, vital signs monitoring of selected resources, in combination with resource assessments based on the best available scientific information, will be used to report to the DOI Land Health goals. The monitoring program's emphasis on integration and coordination across programs and agencies, and the development of modern information systems and practices to build institutional knowledge and make the resulting information more available and useful, will have a major effect on the Service's ability to meet its mission and serve future generations. The monitoring program contributes also to the DOI goals for management excellence by implementing practices that promote efficiency, collaboration among programs and agencies, and accountability.

Program details

Under the program, 270 park units have been organized into 32 networks that share funding and a core professional staff to conduct long-term ecological monitoring. Each network links parks that share similar geographic and natural resource characteristics to improve efficiency and reduce costs. The amount of new funding available through the Natural Resource Challenge for vital signs monitoring would allow most parks to monitor only a few vital signs. To more efficiently and effectively track resource condition and address performance goals, the NPS adopted a strategic approach that leverages the new funding with existing park staffing, funding, and other park service programs, and encourages parks to partner with universities and federal and state agencies to monitor the condition of selected resources. This strategy is intended to maximize the use and relevance of the monitoring data for management decision-making and other park operations by allowing each network of parks to determine what they will monitor based on their most critical data needs and local partnership opportunities. This approach has resulted in major contributions of time, expertise, and money from more than 150 universities and other federal and state agencies that are allowing the networks to accomplish far more than what the NPS funding would allow. Parks are encouraged to use or modify standard protocols and partner with existing programs wherever possible to allow comparability and synthesis of data at multiple scales, but the primary use of the data is at the park level for management decision-making and integration with park operations.

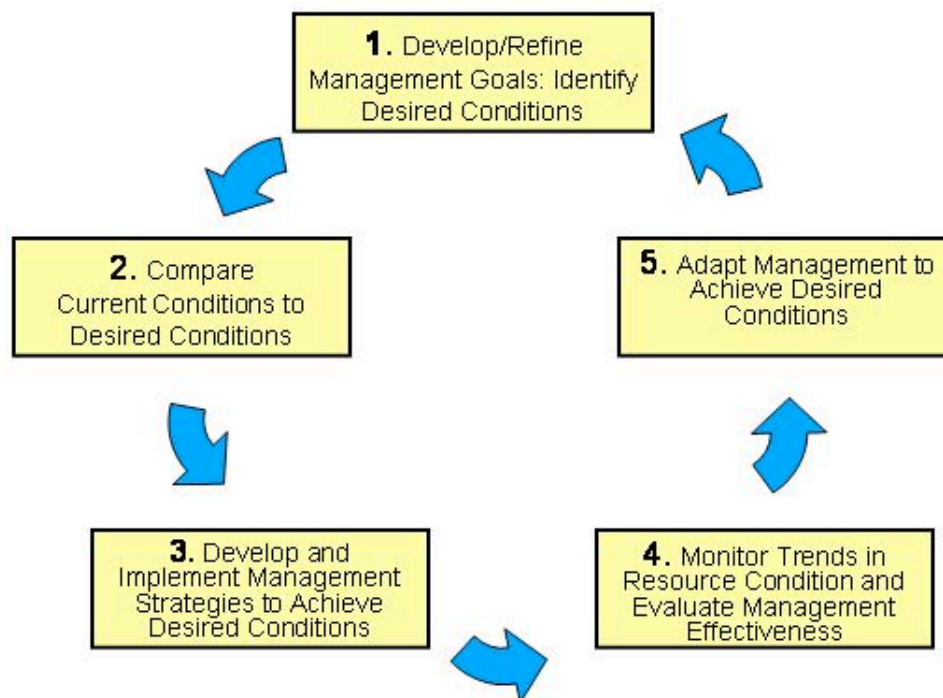
To guide the monitoring program, all 32 networks address the following five Goals of Vital Signs Monitoring as they plan, design, and implement integrated natural resource monitoring:

- Determine the status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources. Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.

- Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.
- Provide data to meet certain legal and Congressional mandates related to natural resource protection and visitor enjoyment.
- Provide a means of measuring progress towards performance goals.

Role of Monitoring in Resource Stewardship and Performance Management

Monitoring is an integral part of the adaptive management cycle (below) and a critical component of performance management; you can't have performance management without a monitoring component. As part of the Service's efforts to improve park management through greater reliance on scientific knowledge, a primary purpose of the monitoring program is to develop, organize, and make available natural resource data and to contribute to the Service's institutional knowledge by facilitating the transformation of data into information and knowledge through analysis, synthesis, and modeling. To help provide information needed at the park, network, regional, and national levels, the vital signs networks are designing a system for scientific data collection, analysis, and reporting that is unprecedented in the National Park Service and that directly contributes to the Department's strategy to "Improve information base, information management, and technical assistance".



Information and understanding provided through the vital signs program contributes to each step of the adaptive management cycle, as described in the following examples:

1. As part of the initial investment in monitoring planning and design, networks compile and summarize existing information and understanding of park ecosystems and develop an information base that is also used for park planning, performance management, identification of research and restoration needs, interpretation, and other park operations. Through scoping workshops, literature reviews, interviews with superintendents, and other means, networks identify important park resources and issues of concern, summarize existing understanding of park ecosystems using conceptual models and other products, and facilitate collaboration among parks, programs, and agencies that will help parks identify desired conditions for selected resources.
2. Information compiled and organized by the Inventory and Monitoring Program (e.g., GIS layers, vegetation maps, water quality data) contributes to assessments of resource conditions in relation to desired conditions.
3. Monitoring provides site-specific information needed to understand and identify meaningful change in natural systems characterized by complexity, variability, and surprises. Monitoring results help managers determine whether observed changes are within natural levels of variability or may be indicators of unwanted human influences. The improved understanding of trends in resource condition and "how park systems work" helps managers make decisions about how to allocate

- funding and staffing and implement management actions to address the most critical issues.
4. Quantitative trend data for a selected set of park vital signs and other scientific data, in combination with effectiveness monitoring by other programs (e.g., fire effects monitoring, exotic plant management teams) and qualitative resource assessments (e.g., to report on strategic land health goals), provides feedback on resource sustainability and the effectiveness of management practices.
 5. Scientific data and understanding collected by, or coordinated by, the vital signs monitoring program are used by managers to adjust management practices that sustain or improve the health of park resources, such as reallocating funding and staffing to achieve desired outcomes, initiating or modifying restoration activities, or working with State or federal partners to achieve desired outcomes.

For most parks, vital signs monitoring is the primary means of measuring the status and trends in the condition of park natural resources, and in conjunction with qualitative resource assessments done by the parks, will be used to report to the DOI strategic Land Health Goals. Periodic condition assessments using best available information and expert opinion can provide a rapid, qualitative “snapshot” of current resource conditions across an entire park or all resource categories, and may be used to demonstrate major changes in resource condition. Vital signs monitoring, in comparison, provides quantitative trend information with known confidence intervals for a subset of park resources or ecological processes, and is able to detect more subtle changes in resource condition and provide early warning of impending threats. However, because of funding and logistical realities, only a few selected resources can be monitored.

To promote collaboration among networks and with other programs and agencies, and to combine results for national reporting, vital signs being monitored by the parks are organized into a hierarchical Vital Signs Monitoring Framework that will also be used for reporting to the DOI Land Health Goals and for other purposes. Analysis and reporting of data will be done at several different scales (park, network, national) depending on the level of detail needed for the intended audiences. Examples of vital signs selected by the first 12 networks, and how they are grouped into higher-level resource categories, are shown in the following table.

Vital Signs Monitoring Framework		
Level 1 Category	Level 2 Category	Examples of Vital Signs Selected by First 12 Networks
Air and Climate	Air Quality	Ozone, wet and dry deposition, visibility and particulate matter, air contaminants
	Weather and Climate	Weather and climate
Geology and Soils	Geomorphology	Glaciers, shoreline change, channel morphology, physical habitat index
	Subsurface Geologic Processes	Cave air quality, seismic activity
	Soil Quality	Biological soil crusts, soil structure and stability, soil cover, permafrost
Water	Hydrology	Groundwater dynamics, surface water dynamics, stream flow, lake and pond elevation, saltwater marsh water table
	Water Quality	Water chemistry, chloride flux, kettle pond acidification, nutrient loading and eutrophication, pollutant metals, aquatic macroinvertebrates
Biological Integrity	Invasive Species	Invasive/Exotic plants early detection, areal extent of established populations, exotic aquatic assemblages
	Infestations and Disease	Whitebark pine disease, forest insect/disease outbreaks
	Focal Species or Communities	Landbirds, forest vegetation structure & composition, fish communities, intertidal communities, salt marsh vegetation, seagrass communities, wetland vegetation, riparian plant communities, prairie grassland communities, freshwater mussels, cave aquatic fauna, amphibians, white-tailed deer, caribou, wolves
	At-risk Biota	T&E plants, western prairie fringed orchid, northern spotted owl, western snowy plover, Ozark hellbender, Allegheny woodrat, Topeka shiner
Human use	Point-Source Human Effects	Contaminants, illegal roads and trails
	Non-point Source Human Effects	estuarine nutrient inputs
	Consumptive Use	Fisheries harvest, poaching of native plants and animals
	Visitor and Recreation Use	Visitor usage
Landscapes (Ecosystem Pattern and Processes)	Fire and fuel dynamics	Fire occurrence and extent, fuel loading
	Landscape Dynamics	Land cover and use
	Soundscape	Soundscape
	Nutrient Dynamics	Nutrient cycling
	Productivity	Productivity, plant phenology

To report to the DOI Land Health Goals, parks will use a combination of quantitative trend information from vital signs monitoring and other efforts, and qualitative assessments based on the best available scientific information and expert opinion, to report on the condition of resources within each land type (e.g., uplands, wetlands, marine and coastal) and resource category (Level 1; e.g., Air, Water, Biological Integrity). The details for a national “State of the Parks Report” for natural resources and how parks will identify desired conditions and report to the Land Health Goals are being developed, but we expect to summarize condition assessments for each park and resource category using a clear, simple message as in the following graphic. This graphic can also be used as an information gateway to the large body of detailed, complex scientific information that is used as the basis for the resource assessments.

