

Developing a plan for long-term ecological monitoring: A focused workshop approach

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Every day, resource managers throughout the national park system endeavor to fulfill the NPS mandate to preserve park resources. Yet, how do we measure and assess our success in meeting this charge? Resource conditions change over time due to the normal variation in the biophysical environment, but are the resources in better or worse condition during our tenure as stewards? Was the change induced by human activities or by "natural" processes?

Long-term ecological monitoring (LTEM) is attempting to answer such questions. Embraced by the National Park Service under its Inventory and Monitoring Program, LTEM is a fundamental aspect of park resource management as it ultimately helps us understand resource conditions. Parks designated as LTEM prototype parks have long recognized the importance of developing conceptual plans as an important first step in determining what to monitor. Since we cannot afford the time and money to monitor everything, we need to identify the key indicators of change or "vital signs" that we should concentrate on and which attributes to measure.

Recently, the LTEM concept has been combined with the Pacific West Region's initiative to identify and monitor natural and cultural resource vital signs. Vital signs are reliable, early warning signals by which we can measure and detect changes that will impair the structure and functions of ecosystems. During 1998, North Cascades National Park Service Complex (Washington) and Lake Mead National Recreation Area (Nevada and Arizona) conducted workshops with the goal of determining methods for taking vital signs of resource condition and detecting change over time. This effort can also assist us in promoting a teamwork approach to resource stewardship.

The North Cascades approach

North Cascades NPS Complex (includes North Cascades National Park and Lake Chelan and Ross Lake National Recreation Areas) began the LTEM conceptual plan as a logical step-down chart process, beginning with the NPS mandate. Based on the mandate and a guiding statement from the park's

enabling legislation "to preserve ... certain majestic mountain scenery, snow fields, glaciers, alpine meadows, and other unique natural features," we focused primarily on the relationship of monitoring (figure 1) to broad management responsibilities to conserve and protect the scenery, natural resources, and public use and enjoyment. A draft outline of the conceptual plan was completed before the workshop to provide the vision and foundation for our deliberations.

To ensure that our LTEM workshop in March 1998 was as productive as possible, we formulated clear, concise objectives and desired products before the gathering. Reed Glesne, an aquatic ecologist on our staff, and Dave Peterson, an ecologist with the USGS-BRD Forest and Rangeland Ecosystem Science Center, developed four goals for our conceptual step-down model and plan:

- Enhance basic resource knowledge (baseline resource inventories)
- Determine status and trends in resource condition (change over time)
- Utilize multiple indicators and metrics for early detection
- Maximize the utility of existing monitoring protocols and results

The specific workshop objectives were:

- Workshop participants will provide relevant information and scientific literature
- The North Cascades NPS Complex staff will review resource inventories and issues
- Scientists and resource management staff will jointly select indicators (*what*) for the early detection of change
- Workshop participants will justify *why* indicators were selected and prioritize them, quantify appropriate spatial and temporal scales (*where* and *when*), and (3) recommend strategies and metrics for implementation (*how*).

The workshop outcomes and products were used to develop the LTEM conceptual plan with prioritized resource management plan project statements, update the park's LTEM bibliography, and document workshop recommendations. This focused, product-oriented approach allowed us to develop a substantial amount of written documentation over a short period of time, while di-

rectly integrating the LTEM plan with the park's resource management plan.

Although most components of the LTEM program emphasize natural resources, we also included human resources and cultural resources because of their direct link to natural resources. Inventory, monitoring, assessment of resource conditions, and refinement of management strategies are adaptive management tools that the entire park staff—including human and cultural resource specialists—should be using. Federal monitoring programs are often not viable, because political and managerial priorities vary over time and divert funding from critical monitoring activities. If we incorporate LTEM programs with other park operations, we hope that long-term monitoring can become institutionalized and survive, thereby producing useful time series of data. For example, the trail maintenance crew in North Cascades has a strong environmental ethic but no monitoring responsibilities. They could monitor *limits of acceptable change* for designated trails and backcountry campsites (e.g., width of trails, number of social trails, soil bulk density). We anticipate that our entire Resource Management Division will have responsibilities in the LTEM program, rather than having a separate LTEM workforce. In fact, everyone in the division *wants* to be involved, which ensures ownership of the program by park staff.

The direct interaction of park staff and scientists before and during the workshop helped to focus workshop activities on a predetermined model for the LTEM plan and minimized discussions that were tangential to objectives for developing the plan. To facilitate an efficient workshop, we spent considerable time compiling information for workshop participants, including summaries of park resource issues, ecological processes potentially affected by environmental stress, potential monitoring parameters, criteria for monitoring components, and criteria for meeting monitoring goals. A conceptual model for LTEM at the watershed scale was developed and included in the workshop packet. Since then, Dave Peterson and Paige Eagle have helped us develop and publish on-line (www.nps.gov/noca/Ltem/Index.htm) the entire LTEM conceptual plan, including step-down charts, templates, and descriptions of natural and cultural resources.

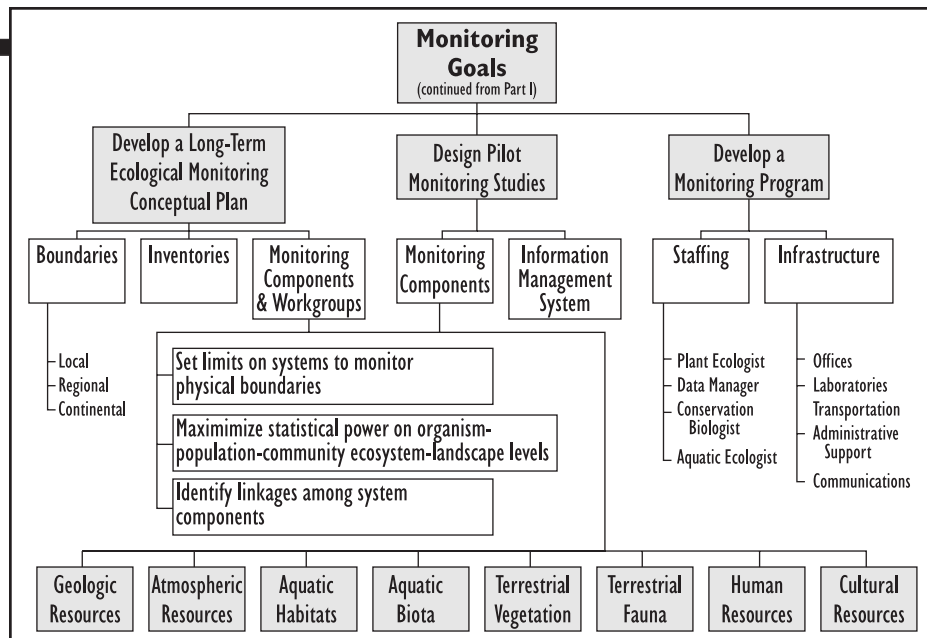


Figure 1. Development of an LTEM conceptual plan for the North Cascades complex grew out of the NPS mandate and the park's originating legislation (part I—not shown). The step-down process led to evolving criteria for meeting monitoring goals, shown in the chart (part II), and to identification of eight principal resource components requiring long-term ecological monitoring.

Resource specialists on the park staff led off the 2½-day workshop with brief overviews on specific park resources, including summaries of existing inventories and data. Workshop participants were divided into eight work groups, each of which addressed a different topic: aquatic biota, aquatic habitats, atmospheric resources, cultural resources, geologic resources, human resources, terrestrial biota, and terrestrial habitats (fig. 2, page 38). We employed facilitators—scientists Gary Davis (Channel Islands National Park) and Dave Peterson—who provided oversight of workshop proceedings, kept discussions on track, and ensured consistent output among work groups. They also encouraged discussions between work groups to ensure that appropriate resource linkages were recorded. Each work group had a subject-matter specialist as its team leader and a park staff member as its recorder. This organization gave specific individuals responsibility for group dynamics, focus, products, and documentation.

The work groups efficiently completed the component identification template designed by Lake Mead staff and developed them into draft conceptual models. Each template addressed a single monitoring component and detailed related information: (1) the monitoring/research questions to be addressed; (2) stressors on the resource and any related factors; (3) what to inventory; (4) what to monitor; (5) where to monitor; (6) justification for monitoring the resource and other information; and (7) potential partners. These draft materials were subsequently sent to every

workshop participant for review and revision, and the resulting draft was sent to subject-matter experts for further review. We also placed the draft LTEM plan on a website to facilitate wider review. The entire process, from planning through final product required approximately a year. We may establish an LTEM scientific review committee to help us to stay focused on the vital signs, improve data management and analysis, assure connection to management issues, and promote integration between various monitoring components. Our resource management staff should work closely with any committee to assess how well the LTEM program is meeting its objectives.

The Lake Mead approach

To guide the Lake Mead LTEM program, we adopted the goal of maintaining vital signs of ecosystem health within their “normal range of variation.” The goals of our vital signs workshop in January 1998 were:

- Provide a peer review of the current resource management program
- Ensure that staff are knowledgeable of all functions and processes necessary to maintain ecosystem integrity
- Provide direction for a long-term monitoring program for the assessment of resource conditions and ecosystem health

Similar to the North Cascades approach, we spent considerable time planning for the workshop. The planning team—Gary Davis;

USGS-BRD scientists Bill Halvorson, Kathryn Thomas, and Peter Stine; and Dave Van Cleeve (Superintendent, Colorado Desert District, California State Parks)—met with us to define goals, objectives, and products for the workshop and LTEM program.

Approximately 50 scientists and resource managers from a variety of disciplines around the Mojave Desert attended the workshop. Before the meeting, we provided each participant with an informational package that included a narrative on the workshop process; park resource information; the Lake Mead NRA conceptual ecological model; a model of the recreation area's resource management program; a sample component identification template; examples of vital signs and criteria for their selection; and the final templates to be completed during the workshop.

Resource management staff described the ecosystem model, outlining ecosystem components, drivers (e.g., climate, fire, geologic events), and stressors. We also presented a model of the resource management program at the recreation area, based on a previously developed step-down chart. Invited scientists gave presentations on selected features of the ecology of the Mojave Desert and limnology of Lake Mead.

We then divided into work groups that focused on air quality; groundwater hydrology; the lake ecosystem; soils and related microbiota; vegetation; and wildlife. The groups were asked to identify (1) significant ecosystem components not addressed in the park's conceptual model; (2) anthropogenic stressors affecting the ecosystem; (3) monitoring questions related to the stressors; and (4) vital signs related to the stressors. Next we prepared the standard template, documenting over 80 vital signs during this process.

The meeting summary was provided to each participant for review. Following the first comment period, the eight participating scientists provided a peer review of the results. We met with the peer review team in May 1998 to synthesize and integrate results, and developed priorities and strategies for implementing the long-term, vital signs monitoring plan. With the help of the review team, we established a framework for vital signs monitoring, goals for the monitoring program, an initial list of 15 high-priority vital signs, and strategies for implementation.

This progression led us to establish three major goals for long-term, vital signs monitoring:

“LTEM” continued on page 38

- Preserve underlying ecosystem integrity (ecosystem health)
- Understand the ecosystem, based on knowledge of resources
- Practice management performance monitoring (expected vs. actual results, refined through adaptive management). This goal includes compliance monitoring (mandated or special interest species), and monitoring to maintain the quality of visitor experiences (e.g., dark night sky, water clarity)

To implement long-term monitoring, we outlined a four-tier framework where tier 1 addresses those functions or processes related to maintaining ecosystem productivity (e.g., soil fertility, hydrological functions). Tier 2 applies to the maintenance of ecosystem health (e.g., plant community structure), and tier 3 relates to maintenance of biodiversity (species distribution and abundance). The quality of the visitor experience, and visitor interactions with the resource are outlined in tier 4.

Implementation strategies blended various approaches to monitoring with opportunities for interdisciplinary monitoring. They include monitoring a transect of intensive plots (leading to greater understanding and indices for predictive modeling) and extensive plots (greater spatial coverage); stratification of the park by soils and vegetation maps; change-detection monitoring (rapid assessment); and employing variable-return intervals. The use of interdisciplinary monitoring leads to the integration of vital sign components, providing more detailed understanding and greater efficiency. For example, we are considering establishing intensive plots that would combine monitoring of soil properties, nitrogen deposition, alien flora, invertebrates, and small mammals.

We are working with USGS-BRD staff to develop monitoring protocols for soils monitoring. We are also seeking funding to develop an interdisciplinary monitoring protocol (including hydrology, vegetation, birds, invertebrates, and amphibians) and a lake ecosystem/limnology protocol as our highest priorities.

Lessons and recommendations

North Cascades NPS Complex and Lake Mead NRA agree on the general approach to developing a long-term ecological monitoring plan, despite differences in biogeographic setting and in monitoring objectives. Both parks used a similar approach for plan-

ning, conducting, and summarizing the results of workshops. Each park ended up with a detailed, scientifically based plan that will guide future monitoring efforts.

We found that a 2½-day, focused workshop is a time-efficient and cost-effective means of developing a long-term monitoring plan. However, workshops are successful only if they are highly structured and well organized. We attribute the success of our workshops and subsequent monitoring plans to:

- extensive planning before the workshop, in which existing inventories, data, and issues were compiled;
- development of conceptual models to represent various park ecosystem functions and potential monitoring strategies;
- assemblage of all resource baseline inventories and selected presentations;
- clear statements of objectives and expected products for the workshop and monitoring plan, as well as a statement of management objectives and priorities;
- use of facilitators and focused work groups;
- use of a component identification template, which provided a consistent format for recording information and ideas;
- thinking in terms of monitoring suites of species, attributes, or their habitats;
- prompt synthesis and integration of workshop results, followed by additional scientific review;
- long-term commitment by park staff and a scientific-review team.

The importance of long-term commitment cannot be overstated. Monitoring responsibilities must be formally integrated with the resource management plan and operationally integrated with day-to-day resource management activities. Personnel and priorities may change over time, but park staff must have full participation in the development and implementation of the monitoring plan and data collection.

North Cascades NPS Complex included cultural resources and human resources work groups within its LTEM program, while Lake Mead NRA did not. Although the concept of vital signs monitoring is better suited to natural resources, we need to consider how

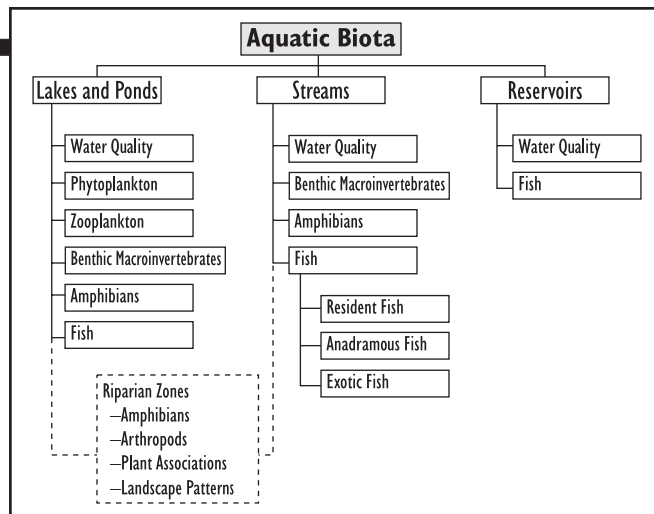


Figure 2. The North Cascades work groups developed a complete set of conceptual models for monitoring various park resources, including aquatic biota. The entire set of models is posted on the North Cascades website (www.nps.gov/noca/Ltem/Index.htm) along with the component identification templates. The templates identify what to monitor for each resource. For example, the key indicators or vital signs for phytoplankton are abundance, species composition, and chlorophyll.

assessments of cultural and natural resources can be integrated in a common framework. Parks that are planning long-term monitoring programs need to develop means to consider both cultural and natural resources in order to meet NPS Organic Act, General Authorities Act, National Historic Preservation Act, and Government Performance and Results Act requirements.

With the threat of increased environmental stress in many of our parks and protected areas, a long-term monitoring plan is one of the cornerstones of a sound resource management program. While there are many ways to develop a monitoring plan, our successful application of a similar workshop-based strategy suggests that this approach may lead to a favorable outcome, the development of a plan, and ultimately implementation of a monitoring program. Since our workshops in 1998, an additional six parks in the Pacific West Region have held similar vital signs workshops, with five more planned in fiscal year 2000. We offer our approach as a potential model for application in other parks that are interested in developing monitoring plans. We solicit your comments on how this approach can be improved. **P**

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