54 Managing data to bridge boundaries

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I want to start with an example of the complex situation we face in managing data today in the National Park Service (NPS). Consider a small plot of vegetation adjacent to a park trail. A plot containing species of concern—they could be frequently poached cacti, threatened or endangered species, an exotic plant invasion, a plant endemic to the park, or a plant of ethnological concern. The plot of ground in question is of interest to a broad range of audiences, within and outside NPS. Let us consider where data relevant to this plot might be kept.

First, let us assume that, through an inventory, the plant's location is loaded into the park's geographical information system (GIS). Since we are assuming this park has a GIS, it is safe to assume that the trail is plotted there, too. Information about the plant is also stored in the National Park Service's species database, NPSpecies. Along with identifying that the plant is present in the park, various quantitative and qualitative data and metadata are stored—such as the coordinates where the plant was found, the location of the voucher specimen and its catalog number, and information on any publications about the plant in the park. Being in NPSpecies, these data could easily be shared with the Association for Biodiversity Information (formerly in The Nature Conservancy), the U.S. Geological Survey Biological Resources Division, and others. When the database is more fully populated, it will be available on the Internet, except for certain fields, which will be protected. The voucher specimen for the plant is not only described in NPSpecies, but is also in the Automated National Catalog System, the NPS catalogue for all types of collections.

Trails are facilities, and the location and length of the trail will also be stored in the Maximo facility database, as will (one would hope) information about its condition, including the condition of the soils, such as whether erosion is occurring, and the condition of vegetation adjacent to the trail. Finally, Maximo will be used to plan and schedule work to be done on the trail, including, perhaps, pertinent information about revegetation prescriptions.

The presence of species of concern means that the species' presence creates a workload beyond a generic vegetation management workload. As such, the plant's presence in the park, and perhaps other data about it, are captured in the natural resource assessment program park profile for analyzing resource management workloads. So is the fact that there is a trail and information on the miles of trail.

Because both the plants and the trail are of specific management concern, unfunded activities related to them may be included in budget databases, the operations formulation system, and the project management information system, depending on whether the activities are operational or one-time projects. The unfunded needs related to the plants may not have high enough priority to be reflected in an increase request for base funds or a project. Nonetheless, the plant management strategy and any long-term needs should be reflected in the resource management plan and (when completed) its associate database, the resource activity management system. And, if significant enough, in management prescriptions or desired future conditions that are newly required parts of a general management plan.

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If the plant has been vandalized or if another illegal incident or accident took place at this point on the trail, the incident would be captured in the critical incident report system, or will be when a revised automated system is developed. There are other places where data on this plant and this trail may reside. If there are performance goals related to the trail or the plants, information will appear in the performance management data system. Perhaps the trail is historic or has a historic structure incorporated in it; if so, it might appear in the list of classified structures. I am certain I have missed some other important databases. We even have one mega-system in which to link all the databases and flat information with relevance to resources. We call this system "Synthesis."

Driving forces behind recent data management push

Why is information about this small plot stored—or provisions are made to store it—in so many places? Because we are charged as an agency to take care of both the plant resource and the recreational resource. And because this care-taking job is really a series of complex jobs that involves several specialized NPS components. And because we cannot do these jobs without information.

The need for information to do these jobs is becoming more and more widely understood and the magnitude of the need more widely appreciated. A primary basis of NPS's Natural Resource Challenge initiative is the provision of scientifically credible information for informed decision-making. Recently, the House Appropriations Subcommittee on Parks held an oversight hearing on the Challenge. At this hearing, the need for information was taken as a given. Detailed questions were asked about: how we collect information, how we prioritize needs for information, whether superintendents are required to update information, how we avoid duplication, and whether we can roll up and share data across parks with neighboring land managers.

The National Parks Omnibus Management Act of 1998, known familiarly as the Thomas bill, requires NPS to move forward with inventory and monitoring and to document the basis for its decisions. The new Director's Order 12, along with its reference manual, provide guidance on the level and scope of information needed to meet the legal standards set forth in the Omnibus Act, the National Environmental Policy Act, and the Historic Preservation Act, including as they have been interpreted by the courts. Failure to develop and base decisions on adequate information can and has resulted in legal challenges that NPS often has difficulty countering.

National Park Service and other mandates collectively require three things. First, before we take an action with the potential for adverse impact, we must have or develop enough information so that the decision is informed. Second, we must use that information in the decision-making process. Third, we must document how the information is used.

Need for Systemwide approach

The need for park managers to have park-specific data is by now, I would venture, pretty well a given. Most often, the decisions that receive the most public scrutiny entail a specific action in a specific park, such as a road widening or realignment or a visitor management plan that places specific sideboards on how, when, and where certain activities may take place, for example. And park managers will be successful in weathering public scrutiny when their planning and decisions are supported by scientifically viable information. But sometimes we are scrutinized for decisions about programs or policies that affect all parks, such as regulations. We need data about the National Park System to make decisions about the system.

Therefore, one use of data about the system is to support decisions that must pass public and legal scrutiny. Multi-park data also are used routinely to make and support decisions about how to prioritize and deploy limited resources across

programs, a region, or the system as a whole—the most obvious of these being budget decisions.

Just as the need for information, and using information, is becoming more and more widely understood, so too is the interconnectedness of parks and the need to act as a system. This interconnectedness and the need to act together apply to fairly routine local decisions and to the very big picture. The public compares each park's management action with those of other parks and views each such action as a precedent for other parks' actions. In this manner, each park's actions affect the management of other parks. The bigger picture, if we are to believe the eminent biologists E.O. Wilson and Peter Raven, is that the National Park System is and will become an increasingly important part of preserving the nation's and the world's biodiversity. For both of these reasons, we can't consider only our own park or other protected area anymore. We must consider the role of "our" park in the National Park System and the role of that system in preserving biodiversity nationally and globally—as well as preserving other nonbiological precious resources that are becoming ever more scarce.

To build on an important admonition, we must do more than think globally about these issues and act locally. To enable local actions to support global approaches to protecting the resources in our care, we sometimes need to act globally, too. This has implications not only for how we manage resources, but also for how we manage information about those resources.

Data need to meet national-level quality standards and need to be accessible to be used for wise and defensible decision-making at all levels. Data need to be able to be shared and aggregated with data from other parks and from adjacent lands to support landscape-level and national planning and decision-making. Indeed, international information standards are important for biodiversity conservation. At the same time, the burden for implementation of standards will rest largely at the park level, with smaller parks perhaps getting help. So it is exceedingly important that park personnel fully understand the utility and importance of resource-related data both to their park and beyond the park, so they can fully own the job they have to carry out. There is a tension here: having information that is useful to parks—which are primarily responsible for its management and upkeep—and at the same time demanding national standards and data-sharing that place requirements on parks that may not have local utility.

Learning from history

The history of the Park Service's attempts to maintain a national-level species database perhaps provide some lessons. In the 1980s, NPS first attempted to be able to talk nationally about what biota were in the parks. The controversy surrounding the publication of William D. Newmark's study on mammal extinctions (Newmark 1987) is illuminating. NPS criticized the study's conclusions about the loss of species within parks, in part on the basis that NPS data were used and we did not believe these were adequate to draw such conclusions. We also could not tell whether we, as an agency, were meeting mandates of the Endangered Species Act because we did not know which parks had endangered species—or thought they did.

To respond to these deficiencies, systems called NPFLORA and NPFAUNA were initially developed. It was the first attempt by a federal land management agency to develop an agency-wide inventory of its species and to attempt an agency-wide standard for plant taxonomy. NPFLORA came first, driven by the establishment of a Washington program to implement the Clean Air Act and to know what park resources—especially vulnerable flora—existed in parks. To make the data more accessible, they were converted to a NPS database called COMMON. COMMON was on a mainframe and required dialing in for use, which made it difficult to use for parks with the technology of the time. In addition to access problems, for example, rapid cross-indexing of differing taxonomies was not available on-line.

Parks felt that this database was constructed largely to meet the needs of the NPS Washington Office. There was limited consultation with the field on the database structure, although plant checklists to populate NPFLORA were always obtained from park staff. COMMON was finally abandoned as parks turned to personal computers and rebelled against centralized mainframes—especially those that they did not view as useful. We tried having a third party construct and manage our species databases. That did not work too well either. And the utility of the system still eluded parks. Large parks often developed their own sophisticated databases that met their local needs better.

Many data were lost over the years without a successful national database that served as a forcing mechanism to archive them. This was amply demonstrated by the recent "data mining" efforts. These took place as a first step in conducting biotic inventories using the Park Service's new inventory and monitoring network approach. Yellowstone National Park (Idaho, Montana and Wyoming), Grand Teton National Park (Wyoming), and Bighorn Canyon National Recreation Area (Montana) discovered 1,500 voucher specimens collected in their units—collections they did not have records of—including vouchers for species they did not know occurred in there. This story was repeated over and over again.

And, 20 years after NPS started trying to look at the species it manages across the National Park System, we still do not have the data to do this, with the possible exception of threatened and endangered species.

Conclusion

But progress is being made. With the NPS inventory and monitoring program facilitating the acquisition of ever more data, for the first time parks began asking for help in trying to figure out how to manage those data—even, in some cases, asking for nationally required standard data fields. Almost all of the 12 working groups established to consider how to implement various components of the Natural Resource Challenge echoed the same request: help with data management. The prototype monitoring parks have perhaps made their greatest contribution to other parks through the interactions of the prototype data managers who have pooled their experiences, needs, and knowledge to help direct the development of more strategic approaches to data management. Web-based, easier-to-use technology has made a difference as well. And so has the substantial growth of skilled resource managers in parks, managers who understand science and the need for scientific data.

A more constructive and cooperative era has hopefully been entered, one that will result in strategic approaches to data management systems that can meet needs locally and globally. The Washington Office divisions within the NPS natural resources directorate are working together to develop compatible software programs within a common framework for better integration and sharing of data. The Natural Resource Information Division and its inventory and monitoring program are developing a series of Web-based master databases that are interlinked. For most of these, it is possible to download the latest version of the database and create a version in Microsoft Access that can be used locally and modified to serve the needs of the park. A Natural Resource Information Division position will be stationed in the Information and Telecommunications Division to facilitate integration with databases in other NPS program areas. Data management is receiving major emphasis in the inventory and monitoring networks. Indeed, even the establishment of these networks will facilitate a more strategic approach to data management as well as data collection.

To fully succeed however, each component of NPS needs to appreciate its role and importance in a broader context. We do not have the luxury of operating as individual units anymore. We need support of other units and neighbors and the National Park System as a whole to make a difference.

Reference

Newmark, William D. 1987. A land-bridge island perspective on mammalian extinctions in western North American parks. *Nature* 325, 430-432.