CHAPTER 6: TOOLS FOR UNDERSTANDING AND ASSESSING ECOLOGICAL INTEGRITY

Tracking black bears in Riding Mountain National Park
C. Davar/Parks Canada

Assessing and understanding ecological integrity requires three interrelated tools: inventory, research and monitoring. Understanding ecological integrity is a complex task that will require significant investment in expertise as well as internal training. Parks Canada is already well along the road to an operational understanding of ecological integrity and has an opportunity to take on a leadership role in understanding the state of Canada's ecosystems.

Inventory, Research, and Monitoring

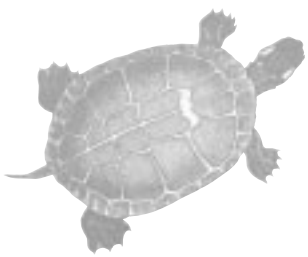
Inventory, research, and monitoring are interrelated parts of the same process, that of learning.

Inventory is a record of the state or condition of an ecosystem at a given point in time. Inventories provide baseline information on variables that change slowly, including topographic features, hydrological patterns, and species lists. Information gained through inventory is basic to managing ecological integrity.

Research is process by which hypotheses are generated and tested. Parks Canada is involved in two kinds of research:

- research oriented toward specific questions relevant to managing parks, done by park staff, a university or research agency;
- research conducted by external researchers and generally not oriented toward a specific park management concern or interest.

Monitoring is repeated observation, through time, of selected parameters to determine the state of systems. Monitoring provides information about complicated and complex systems and the effects of disturbances on those systems. Monitoring serves as an early warning mechanism to trigger management response or further research. The



key purpose of monitoring is to serve as the feedback mechanism that provides information on ecological integrity and to assist in determining whether or not a specific management action or policy has implications for ecological integrity.

Specifically with regard to national parks, the purpose of monitoring is:

- to track progress towards the maintenance or restoration of ecological integrity;
- to assess the effectiveness of specific management actions or policies;
- to incorporate acquired information and understanding into planning and management cycles;
- to identify more specific research needs;
- to serve as a tool to hold park managers accountable for progress towards achieving ecological integrity.

Aboriginal peoples have a large role in helping Parks Canada to incorporate naturalized knowledge in conducting inventories, research and monitoring in national parks.

Ecological Inventories

Ecological inventories are baselines for understanding the state of ecological integrity within national parks. We noted several problems respecting ecological inventories:

- Parks Canada had a sophisticated resource inventory program in the 1970s and early 1980s and was a leader in the field of ecosystem-based inventorying. Much of this information is now outdated. In particular, most of the southern parks have inventories but these are outdated;
- very little basic inventory is being done on new parks in northern Canada. Newly established parks have no program for creating ecological inventories, except to consolidate information that exists in universities and other government files;
- there are no guidelines for what type of inventory is required or when inventories become dated and need to be re-done;
- inventory methods are different between parks and it is often impossible to compare basic information, such as vegetation cover, between parks;
- lists of even the best-studied species, including mammals, reptiles, amphibians, birds and vascular plants, are incomplete in most parks;
- ecological inventories are not currently conducted as part of new park establishment because of lack of funds. Parks Canada lacks solid ecological information for negotiating park establishment agreements, including establishing park boundaries.

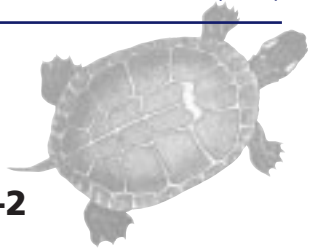
The intent of research and monitoring are already well-developed in Parks Canada's Guiding Principles and Operational Policies:

Principle 6. Management decisions are based on the best available knowledge, supported by a wide range of research, including a commitment to integrated scientific monitoring.

Parks Canada requires applied and basic research and monitoring activities to make responsible decisions in its management, planning and operating practices, as well as to broaden scientific understanding.

Operational Policy 3.0. Management must be guided by the establishment of clear, practical and measurable objectives that are consistent with the park management plan and by the rigorous application of science in the collection and interpretation of research and monitoring data.

Parks Canada, Guiding Principles and Operating Policies (1994)



Research in La Mauricie National Park
J. Pleau/Parks Canada

RECOMMENDATIONS

6-1. We recommend that Parks Canada develop national guidelines for ecological inventories: inventories specifying the type, scale, resolution and frequency of the information required. All parks should then review their current inventories against these guidelines.

6-2. We recommend that Parks Canada incorporate the costs of developing an adequate ecological inventory as part of new park establishment. As a general rule, the average cost of an inventory will be approximately $250,000 per park to cover a basic inventory of vegetation, topography, linear features, invertebrates and vascular plants. There are currently 14 unrepresented natural regions and five northern parks with inadequate basic inventories. The total cost to complete a basic inventory of each of these (14 new parks and five existing northern parks) would be $4.75 million.

Research

Parks Canada attracts some excellent external research and has some excellent internal research ongoing. However, there are considerable obstacles to properly developing and managing research, which are covered under the sections on internal and external science capacity in Chapter 4.

Currently, Parks Canada lacks the capacity and flexibility to research key questions as they arise. For example, an Agriculture Canada proposal to destroy the entire population of bison from Wood Buffalo National Park left Parks Canada groping for an adequate response. Parks Canada did not have the capability or the financial flexibility to quickly respond and to develop a research program to deal with the issue. A more recent example is the discovery of tuberculosis in elk populations in and around Riding Mountain National Park. Park staff have made heroic efforts to manage the issue but are hampered by a lack of funding and expertise to conduct the necessary research. If Parks Canada upgrades its external and internal scientific capacity, additional resources for research will be required. Parks Canada must also respond to emerging issues in a timely and flexible manner.

RECOMMENDATION

6-3. We recommend that Parks Canada establish an emerging issues research fund of $1 million per year to deal with threats to ecological integrity that occur outside the normal management planning and business planning cycles. The National Office should administer the fund, with proposals for access based on peer review and expressed emergency need.

Monitoring Ecological Integrity: Defining a Role

The Panel's definition of ecological integrity is in Chapter 1. Monitoring for ecological integrity is a key issue for Parks Canada. As the steward of Canada's national parks, Parks Canada has an obligation to monitor and assess the state of park ecosystems to ensure they are maintained unimpaired. Parks Canada also has a broader responsibility to evaluate the effectiveness of management actions and policies designed to conserve or restore ecological integrity. We noted several issues that are delaying the development of monitoring programs:

- monitoring requires long-term commitment, adequate resources and stability. Historically, however, monitoring has been seen as an extra, expensive program;
- the important relationship between monitoring and management is not clear. Monitoring must become an integral part of the management process, following the model of adaptive management;
- Parks Canada has devoted significant resources to monitoring activities, but monitoring programs have been driven largely by specific management issues, such as human-bear conflicts, or by the individual interests of park staff or university researchers. Monitoring has provided some useful information to help address specific management concerns but generally it has not provided a clear picture of the overall state of ecological integrity;
- funding for monitoring has been sporadic and methods have changed frequently, weakening the ability to use the information over time;
- monitoring has been patchy throughout the national parks, with some parks having comprehensive programs and others very little.

Changes Needed to the Monitoring Program

The role of monitoring and its utility to management decision-making is not well understood. Monitoring has not been linked to accountability measures. Consequently the design and implementation of a comprehensive monitoring program has not been a priority. This has resulted in several problems:

- monitoring programs are not integrated in planning and management cycles as feedback loops or as accountability tools;
- park managers are not asking for nor using the information from ecological monitoring;
- the linkage between park-level monitoring initiatives and national-level reporting requirements is often unclear. The National Ecological Indicator set, presented in the State

Monitoring the effect of prescribed burning on restoring native rough fescue in Riding Mountain National Park
K. Kingdon/Parks Canada

of Parks 1997 Report, is sometimes seen as an addition to existing programs and has not prompted a re-examination of the importance of existing monitoring;

- indicators selected for monitoring often do not appear to be logically related to one another in a systematic way and do not work together as a suite of indicators;
- the integration of park-level monitoring with other agencies' regional-level monitoring initiatives is rare but growing;
- better integration of a range of staff into the ecological integrity monitoring program is needed, especially in the warden service. Warden service staff are well qualified to conduct much of the required monitoring.

Principles, Criteria, Indicators and Targets: A Common Framework for Monitoring

Principles, criteria, indicators and targets have been proposed to provide a common framework for the ecological integrity monitoring processes. A framework can help to break the system into parameters that can be managed, planned for, or assessed. Ideally this hierarchical framework:

- increases the chance of complete coverage of all the important aspects to be monitored or assessed;
- avoids redundancy and limits the set to a minimum without extra parameters;
- results in a transparent relationship between the parameter that is measured and the compliance with the principle and criterion it refers to.

While commonly referred to as "criteria and indicators" (C&I) the framework consists of four major levels. Principles refer to goals; criteria translate these goals into elements of the system; indicators refer to specific parameters associated with the criterion; verifiers (targets) provide a specific measurement method and target or benchmark against which the indicator is assessed.

Example

Principle: Maintain and enhance ecosystem integrity

Criterion: Maintain all native species at viable levels

Indicator: Number of invertebrate species compared with historical values representative of the region

Target: Less than 1% loss of species compared with historical values over a 50 year period.

Figure 6-1. Parks Canada's Assessment Framework

BIODIVERSITY (characteristic of region)	ECOSYSTEM FUNCTION (resilient, evolutionary potential)	STRESSORS (unimpaired system)
Species Richness - change in species richness - numbers and extent of exotics	**Succession/Retrogression** - disturbance frequency and size (fire, insects, flooding) - vegetation age class distribution	**Human Land Use Patterns** - land use maps, road densities, population densities
Population Dynamics - mortality/natality rates of indicator species - immigration/emigration of indicator species - population variability of indicator species	**Productivity** - remote or by site	**Habitat Fragmentation** - patch size, interpatch distance, forest interior
Trophic Structure - size class distribution of all taxa - predation levels	**Decomposition** - by site	**Pollutants** - sewage, petrochemicals, etc - long-range transportation
	Nutrient Retention - Ca, N by site	**Climate** - weather data - frequency of extreme events
		Other - park-specific issues

State of the Parks 1997 Report

A New Monitoring Framework

In the State of Parks 1997 Report, Parks Canada adopted a framework for monitoring ecological integrity by adopting an assessment framework (Figure 6-1). The framework is designed such that each park will assess some measures of biodiversity, ecosystem functions and stressors at a range of ecological scales, but the specific components and protocols of each of these is allowed to vary according to local conditions. The Panel endorses this approach as a solid basis on which to proceed. Most parks have adopted this framework, but it has generally not been made operational by the development of specific protocols and measurable targets.

At the park level, implementation of the indicator framework is at various stages. Some parks have developed specific protocols and are working to integrate them into ongoing operations. Other parks have had one-time comprehensive assessments completed (for example, the State of Greater Fundy Ecosystem, State of the Crown of the Continent (Waterton) and the Banff-Bow Valley Study) but an ongoing operational monitoring program is not yet developed. McCanny et al. (1997) led a large effort to develop protocols for the northern parks, but these have generally not been made operational because of a lack of funding and staff. Even those parks that have protocols in place are still developing targets for measurement. Most parks have identified monitoring in their business plans as an item for upcoming attention or implementation.

Regional Integration and Monitoring Co-ordination

As outlined in Chapters 3 and 9, the Panel strongly advocates planning and management of Canada's national parks within the context of the greater park ecosystem, requiring the development of many regional linkages including monitoring. Monitoring of ecological integrity in national parks should be seen in the context of understanding changes in the larger region in which the park is situated. National parks have a wonderful opportunity to act as a Canadian network of sites that provide information on the ecological condition of Canada, not simply the lands inside park boundaries. This would be a redefined role for national parks.

Currently some parks are participating in programs external to Parks Canada, including regional, national and international monitoring programs. Parks Canada's participation in these programs varies. Parks Canada can both benefit from and contribute to such external monitoring programs to expand understanding of greater ecosystems and to contribute to understanding the state of regional and national systems. National parks can be centres of biological research and monitoring, regionally and nationally.

A weather data collection site in Wood Buffalo National Park
P. Wilkinson

Some parks have agreed to participate in these programs without a critical examination of the park's role (including financial/resource obligations) with respect to achieving park goals. In some cases, park management has not done a careful review of the applicability of protocols to the scale of decision making, the ecosystem type or the question being asked. For example, several parks have embraced Smithsonian biodiversity plots without being able to show how these fit into an overall monitoring strategy or what questions the plots will answer for the park.

The Need for Atmospheric Monitoring: New Technology Required

One of the significant voids in monitoring in national parks is the almost complete lack of information on atmospheric pollutants. Parks are being affected by acidic precipitation, ground-level ozone and long-range transport of pollutants such as mercury and persistent organic pesticides. However, the information base is incomplete and this deficiency inhibits Parks Canada from gaining a fuller understanding of the nature and magnitude of factors affecting ecological integrity. In the United States, national parks act

Ecological Integrity Monitoring Programming

Bruce Peninsula National Park/Fathom Five National Marine Park

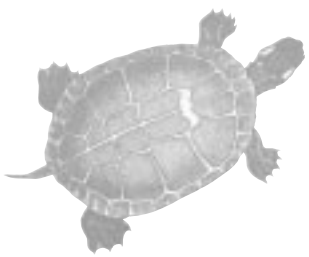
A two-phase Ecological Integrity Monitoring Program has been developed for both these parks. The first phase developed a park-based rationale for the selection of indicators. The second phase described the indicator protocols and provided all essential information, from equipment to analysis.

Indicators were selected that would help achieve the goals of assessing whether native biodiversity, and the processes that maintain native biodiversity, are being protected. To ensure success, screening criteria for the indicator criteria were developed based on these fundamental objectives.

Combined indicators must address all ecological components and scales of biological organization. Protocols must be financially possible. This program was designed to fit within the yearly operating budget, using capital funding only for major expenditures such as satellite imagery purchases. Protocols can be implemented with current staff and staff skill levels. Protocols must be scientifically repeatable.

In the process of implementation and subsequent review and analysis of the protocols, several key lessons were learned:

- park staff have been lost and staffing levels are now inadequate for conducting a full monitoring program;
- some protocols are difficult to establish because the data collection methods are in place but methods of analysis are not;
- it takes time to write, field test and revise protocols. This is a job that needs to be done by staff with strong writing skills, analytical and all-round ecological knowledge;
- protocols must be designed to meet statistical requirements;
- long-term commitment is essential; some protocols require 10 years of data collection before statistically valid changes can be detected;
- good baseline data are essential to apply sound scientific principles. The parks have a lot of data but not all can be used due to validity problems;
- an integrated database is essential for ease of storage and organization, however data must be exportable to ensure redundancy does not affect the parks' ability to do analysis using the most current software.



as benchmark monitoring sites for atmospheric monitoring and there are specific standards for air quality in the parks.

Atmospheric monitoring sites should be established in selected Canadian national parks to cover major ecozones of Canada, in co-operation with the Atmospheric Environment Branch of Environment Canada. Instrumentation and operating costs would vary but basic parameters should include visibility, particulate, organic pollutants and weather.

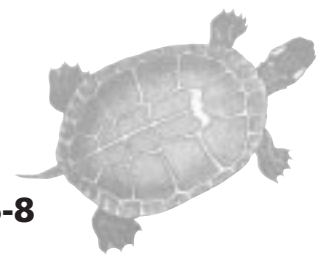
RECOMMENDATIONS

6-4. We recommend that Parks Canada integrate monitoring within the management accountability framework. Specifically, we recommend that Parks Canada:

- explicitly recognize monitoring as a tool for adaptive management;
- the lack of a complete suite of indicators or the inability to measure specific indicators (because of methods or costs) are not valid excuses to delay monitoring. All parks should begin reporting on at least some ecological integrity indicators immediately;
- at all levels of Parks Canada, link accountability to both implementation of a monitoring program and the results (outputs) obtained from the monitoring program.

6-5. We recommend that Parks Canada further develop the program for ecological monitoring and assessment in national parks. Specifically, we recommend the following actions:

- appoint a permanent, full-time national Ecological Integrity Monitoring Co-ordinator to assist and guide parks through the development and implementation of monitoring programs (Figure 4-1 in Chapter 4). This must include the development of an on-line catalogue of protocols that can be used by individual parks. Develop customized protocols for each park as needed;
- in each park, review and evaluate existing monitoring programs based on the national monitoring framework to identify current monitoring projects that fit the framework or can be modified to fit the framework and those that should be discontinued;
- base monitoring programs on a hypothesis of how monitored elements will change as a result of stresses;
- re-organize the existing ecological monitoring framework around the model of principles, criteria, indicators and targets;
- develop a clear understanding on which indicators of ecological integrity can be aggregated to national-level reporting; and which are unique to a given park and should be assessed at the park level. Develop corresponding mechanisms for measuring and aggregating these indicators;
- incorporate both quantitative and qualitative techniques in monitoring, as they best fit the measurement of the indicators;
- develop specific methods for incorporating naturalized knowledge and scientific knowledge to improve the comprehensiveness of monitoring programs;
- design monitoring protocols simultaneously with data management and retrieval strategies;
- ensure all monitoring protocols and the design of the basic program are subject to external peer review.



6-6. We recommend that Parks Canada support ongoing regional and national monitoring initiatives with monitoring data at the park level by:

- establishing a dedicated ecological integrity monitoring envelope of $3.9 million per year to allow parks to proceed with the development of their essential monitoring programs. This will vary from park to park but is based on an average cost of $100,000 annually for each park;
- working with other agencies, industries, universities, non-governmental organizations, Aboriginal peoples, park visitors and community groups for data collection and reporting. Where appropriate and feasible, design monitoring protocols for application (and in consideration of) across park boundaries and monitor accordingly;
- establishing a resource library of measurement protocols and targets (also called verifiers) for parks within their ecoregion and across regions. Co-ordinate development of measurement protocols and verifiers with other local and regional monitoring programs including provincial and federal state of the environment reporting and local, regional and national state of the forest reporting (such as Model Forest Criteria and Indicator projects).

6-7. Correct the absence of an atmospheric monitoring program by establishing a network of six monitoring stations in national parks, in co-operation with the Atmospheric Environment Branch of Environment Canada.

For sites with no existing instruments, the cost to establish a base monitoring station would be $200,000. Annual operating costs would be approximately $150,000 per year including staff. The total program costs would be $1.2 million for establishment and $1.2 million per year for operations. If split with the Atmospheric Environment Branch of Environment Canada, operating costs would be $600,000 for establishment and $600,000 per year for Parks Canada.

National- and Park-level Reporting

Currently, the status of ecological integrity in individual national parks is combined in the national-level State of the Parks Report. Information for the report is gained through some nationally reported monitoring data and through a questionnaire that is unrelated to park-level monitoring programs. While a new framework to guide monitoring programs has been developed, clear linkages between park-level and national-level reporting, and implications for measurement, have not been determined (Chapter 3).

No Link Between Monitoring and Reporting

With respect to the national State of Parks Report, the Panel observed:

- the Report is a substantial improvement on previous accountability mechanisms for ecological integrity. However the Report needs to be based on more actual measures and monitoring results obtained at the park level;
- State of the Parks Reports are legally required only for reporting the state of ecological integrity in national parks, but these reports are now used as a reporting mechanism for all aspects of Parks Canada. While an integrated reporting mechanism may be desirable, treating the State

of the Parks Report as a broad accountability tool creates potential for a loss of focus on the state of ecological integrity;

- there is no formal data collection for the State of the Parks Report. Any data collection is seen as an "add-on" and most efforts are neither rigorous, nor comparable.

As outlined in Chapter 3, monitoring, evaluation and feedback are essential parts of planning and are consistent with the process of adaptive management but are currently neglected aspects of park planning. Developing a rigorous system for monitoring aimed specifically at preparation of a park-level State of the Park Report and evaluation of the report's results should help to resolve the lack of feedback mechanisms identified in the current park planning system.

As outlined in Chapter 10, communicating the message that protecting ecological integrity is the first priority of national parks, in part through park-level State of the Park Reports, will help confirm the central role of ecological integrity protection among park staff and the public.

The Panel notes that the Inventory and Monitoring (I & M) Branch of the United States National Park Service annually produces a report similar to Parks Canada's national State of the Parks Report. Parks highlighted in the United States report are selected to represent various regions. The report provides *"a comprehensive account of the monitoring and status of natural resources in 13 National Park Service units that conduct prototype long-term ecological monitoring under the I&M program. Data management in the I&M program, and the I&M training program are also described."* In contrast to Parks Canada, the United States National Park Service has a national monitoring program to co-ordinate inventory and monitoring, and to provide technical assistance and training.

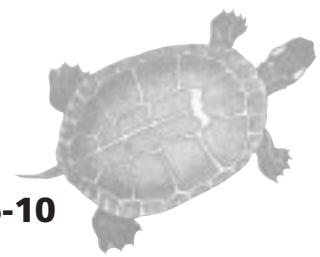
State of Greater Fundy Ecosystem Report

The State of the Greater Fundy Ecosystem Report is one of only three examples within Parks Canada of a comprehensive assessment of the state of a national park and its surrounding ecosystem. The report looked at a range of indicators of ecological integrity, basing its conclusions on the results of over 30 research projects and the efforts of a wide range of researchers.

The report concluded that the Greater Fundy Ecosystem is heavily affected by human use, with a demonstrated loss of ecological integrity. More importantly, trends are toward continued loss of ecological integrity as land use pressures intensify. Some of the ecosystem impacts are dramatic:

- few native fish species remain in the rivers, due to factors originating both inside and outside the park;
- older-aged forest communities are dramatically reduced, and the viability of sensitive species is doubtful. The remaining forest communities are highly fragmented by roads, clearcuts and plantations;
- the Greater Fundy Ecosystem has lost 14 species of vertebrates, one invertebrate species and 20 plants;
- there has been a widespread change in community structure, and many community types have been reduced in extent;
- forest harvest is currently the primary stress on the Greater Fundy Ecosystem; in the past, hunting, trapping, and land clearing for agriculture were also significant stresses.

The State of the Greater Fundy Ecosystem Report was only possible because of the contribution of a wide range of researchers from government, universities and the private sector. Parks Canada currently does not have the resources in place to repeat the report.



RECOMMENDATIONS

6-8. We recommend that Parks Canada establish an ongoing park-based monitoring report of the state of each individual park's ecological integrity (see for example the State of Greater Fundy Ecosystem Report or Waterton's State of the Crown of the Continent Report). As outlined in recommendation 3-3, these reports should be done every five years, prior to management plan review. In addition, these reports should undergo a third-party review/audit and be made publicly available as part of an annual public reporting process. In using this report, the revised Park Management Plan should demonstrate how the proposed direction and specific management actions respond to the state of ecological integrity within the park (Chapter 3).

The park-based State of the Park Report should include:

- a description of how the ecosystem functions and a list of the key drivers;
- a description of the current ecosystem conditions and stressors;
- a summary of changes of key indicators over time;
- an overview of the state of the regional ecosystem including a discussion on the most significant regional stressors;
- results of past management practices;
- a projection of future conditions in the absence of management changes;
- a proposed park zoning system based on ecological sensitivities;
- responses required by the management plan.

6-9 . We recommend that Parks Canada continue to produce the national-level State of Parks Report with the following changes. The Minister should affirm that the primary purpose of the State of the Parks Report is to report on ecological integrity, regardless of whether the State of the Parks Report includes other integrated information. In addition the State of Parks Report should:

- be subject to a third-party scientific review and audit;
- be reviewed by the House of Commons Standing Committee on Canadian Heritage.

6-10. We recommend that Parks Canada develop a formal and rigorous data collection approach for State of the Parks Reports. Specifically we recommend that Parks Canada:

- define linkages between park-level monitoring and national-level monitoring;
- develop common methodologies and protocols that are ecologically appropriate to each park but capable of being aggregated to national-level reporting;
- establish a national database for national State of the Parks Reports;
- dedicate staff at the National Office to the task assembling a national database for State of Parks Reports.

Data and Information Management

"An integrated data base will be developed and kept up for each national park to provide, along with research and environmental monitoring, the baseline information required to protect and maintain park ecosystems and contribute to State of the Parks reporting to Parliament."

Parks Canada, Guiding Principles and Operational Policies (1994) p. 35

Parks Canada often confuses data with information. Information is knowledge gained from the analysis of data. Information needs should be explicitly specified prior to data collection, but this is rarely the case. Data management and document archiving in national parks are in a very poor state. The preservation of valuable data are being neglected; data are not treated as an asset.

Parks Canada recognizes the need for an appropriate data and information base to support ecosystem conservation and consequently has made large investments in inventories and research over the past two decades. Unfortunately, the need to protect collected data and keep them available has not received the same national recognition. For example, the Natural Resources Management Process states the requirement for updating park data, but does not specify what to do with the old data.

At the regional level, significant efforts have been made to develop data management frameworks. Excellent examples include the Ecological and Heritage Resource Data Management Plan for northern parks (Blyth, 1998), and the Ecosystem Science Information Management System for Kejimkujik National Park (Drysdale and O'Grady, 1999).

Understanding ecological integrity requires an understanding of how the ecosystem is changing through time. Though methods such as pollen or tree-growth ring studies can help reconstruct an image of the past, historical data are still the best source for examining an ecosystem's evolution. Parks Canada often confuses data management and archiving systems with the supporting hardware and software tools. By themselves, such tools as geographic information systems do not assure persistent data sets.

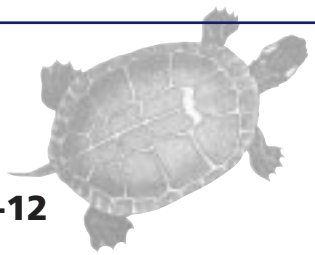
Data are Not Information

Information comes from the analysis of data. Most Parks Canada efforts have focused on the issue of data management rather than information management. An information needs analysis should be conducted prior to determining data needs. An information needs analysis should involve all users of ecological information and should ask the following basic questions:

- what kind of information is needed to understand or make decisions about the park?
- how accurate does the information need to be?
- how current does the information need to be?
- what resolution of the information is acceptable?
- what format is the most useful (maps, reports, databases)?

Information Needs vs. Data Collection: Jasper National Park

In the redesign of its geographic information, Jasper National Park conducted a formal information needs analysis that asked basic information-needs questions, instead of the more usual question, "what data do we need to collect?" The Jasper study took one year; typically, researchers worked with park managers to help identify information needs. In total, 60 information products were identified. After the information needs were known, data needs were relatively easy to delineate. Key questions regarding acceptable levels of variation and data collection frequency were also easier to answer.



Data are Being Lost

The Panel was told that 50 per cent of all studies done in national parks have been lost because of poor data management. Even today, many data sets are on floppy disks gathering dust in someone's desk drawer. There are few examples of data information catalogues or sufficient documentation, backup and storage of digital information. Poor data management has resulted in the loss of information costing millions of dollars. This is a completely unacceptable situation, both for the use of public funds and the management of good science.

> *"Everyone in the parks uses data, but few people are willing to manage it or maintain it. Some of the best data are lost daily. The challenge is to shift the perception that data management is nice to have to the reality that good data management is essential for maintenance of long term ecological integrity in parks."*
>
> *"I feel the key science issue is data management or rather the lack of it…Everyone agrees it is important [but] very few parks, if any, can show a documented data base for biological data. Some have an active Geographic Information System and consider this meets the requirements of a data management system."*
>
> submissions to the Panel

Written documentation is also poorly maintained. Park libraries are in disarray. During the downsizing of Parks Canada over the last five years, park libraries were often casualties. We were told of libraries, with hundreds of original reports, stored in boxes that were placed in damp storage. The document collection at the National Documentation Centre is incomplete due to poor collaboration from the Field Units.

Some parks have extensive and well-organized resource centres, others are in disarray
J. Pleau/Parks Canada

Sharing Data with Others

Ecosystem-based management requires the ability to share data with neighbouring jurisdictions and partners at scales that match the area of co-operation or concern. While Parks Canada has undertaken some initiatives related to sharing data, these initiatives have been inconsistent across the system. Individual parks have built some success in sharing information at the scale of the greater ecosystem. Parks Canada will need to work with provincial, national and international partners, and therefore needs to improve its ability to share data at such scales.

Poor Data Management Guidelines and Standards

The efficient implementation of data management requires the establishment of proper procedures, practices and standards. The Panel observed:

- a lack of national-level co-ordination, resulting in regional duplication of effort;
- no current national directives or standards to guide data management;
- at the park level, development and implementation of data management strategies are often postponed because of pressing data analysis demands. Data are being lost because there is no time to archive used data.

To support ecosystem-based management at the greater park ecosystem level, consolidation of regional ecological databases is needed — a task easier said than done. Data sharing frequently poses barriers even among federal agencies. In North America, the development of Conservation Data Centres has been a major breakthrough in regional data management. There are currently six Conservation Data Centres in Canada and they have considerable experience in setting data standards and managing conservation data. Parks Canada has much to learn form these organizations.

"In the last few years, parks and Service Centres producing reports have forgotten the existence of the Resource Centre, as well as its mandate, which is to provide information to users. Within a few years, reports at the Resource Centre often become the only copies available."

submission to the Panel

In addition, there are ongoing efforts to establish a national Biodiversity Resource Network. This network would be a partnership of governments, universities, industry, and non-governmental organizations, and would act as an independent information and distribution centre for the entire range of biodiversity information. The Network would consist of a series of Internet-linked nodes accessing biodiversity information of all kinds. Such a network would be an obvious partnership for Parks Canada and would help Canada meet its commitments to the Convention on Biological Diversity.

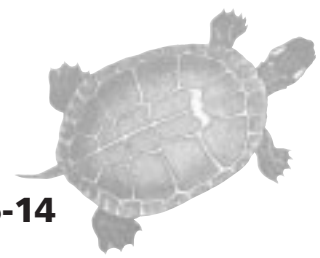
RECOMMENDATIONS

6-11. In recognition that data and information are different, we recommend that prior to any data collection program, Parks Canada formally define what information is required for management. Formally define information needs by asking what is required, what level of precision is required, how current does the information need to be and what scale of resolution is required. The information needs analysis should be conducted in all parks using the model established in Jasper National Park (Thomlinson, 1997).

6-12. We recommend that Parks Canada establish a system-wide data management and archiving system. These could include:

- establishing guidelines and standards that will ensure long-term survival of data and documentation and easy retrieval for all potential users;
- establishing national guidelines and standards for data repositories and for metadata description of all data sets;
- ensuring copies of all documents related to park management and ecosystem conservation are deposited at Parks Canada's National Documentation Centre. Develop a National Data Repository to complement the Documentation Centre;
- each park should ensure that in-house and contracted research data and reports are deposited at the Parks Canada National Documentation Centre and the regional Service Centres. Establish guidelines for the deposition of natural specimens at appropriate facilities.

6-13. We recommend that Parks Canada make Field Unit Superintendents responsible for the protection of park ecological data and documentation. Through regular audits, evaluate the state of ecological data sets and documentation. As a first step, Parks Canada should have Statistics Canada conduct an audit on data management and storage mechanisms.



6-14. We recommend that Parks Canada report the condition of ecological data sets in the national parks in the national and park-level State of the Park(s) Reports.

6-15. We recommend that in all national parks, Parks Canada design data management plans to organize, protect and make data accessible. These plans should be considered a key product of the ecosystem conservation program, while Park Management Plans should include the park's data management strategy.

6-16. We recommend that Parks Canada assign professional geographic information officers to each national park, to maintain a professional database and ensure public access. These data managers should work in close partnership with external partners in regional Conservation Data Centres.

6-17. We recommend that Parks Canada invest in the existing network of Canadian Conservation Data Centres, through direct funding, by:

- investing or becoming a partner with Conservation Data Centres. Parks Canada could ensure standardization and further the cause of ensuring the availability of conservation data in Canada. Parks Canada could also contribute to the evolving standards for spatial conservation data (estimated cost: $300,000 per year at $50,000 per centre);
- assist the development of Conservation Data Centres in the Yukon, Nunavut and Northwest Territories through provision of funding and expertise. In the long term, such regional databases will be an invaluable asset to Parks Canada. (Estimated cost: $150,000 per year at $50,000 per centre.)

6-18. We recommend that Parks Canada make suitable Parks Canada databases publicly available on the Internet. This will ensure data standards are maintained and allow researchers to conduct additional analysis that can benefit Parks Canada.

6-19. We recommend that Parks Canada enhance its ability to manage and share information at the National Office, Service Centres and national parks, so that Parks Canada can share data and information "vertically" within the organization and "horizontally," at appropriate scales, with external partners, as follows:

- the National Office requires the enhanced ability to share information with other federal departments and international agencies, and to provide information about national ecological integrity issues to Service Centres and national parks;
- Service Centres require the enhanced ability to share information with provincial ecosystem management agencies, non-governmental organizations, and private organizations, and to support data management and analysis in national parks;
- national parks require the ability to share information with partners on the scale of the greater ecosystem, and to send critical information up through the Parks Canada system.

6-20. We recommend that Parks Canada become an active partner in ongoing national efforts to establish a Biodiversity Resource Network. Parks Canada's involvement could range from cataloguing its databases for network access to participating in the design of the Network's structure to ensure the Network will meet Parks Canada's needs.