

An Example from Elsewhere: Meeting the Challenge of Ecological Research and Monitoring: The Case of Kejimikujik National Park and National Historic Site

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Abstract

This paper describes the ecosystem science management system at Kejimikujik National Park and National Historic Site in southwestern Nova Scotia. While Kejimikujik has been a site for multi-disciplinary ecological research since the 1970's, study activity and scope have increased since the park became part of Environment Canada's Ecological Monitoring and Assessment Network. The cooperative, site-based approach to the study of ecological function and associated stressors has necessitated incorporation of various strategies for research administration, data management, and liaison with partners in the public and private sector. The principles and practice of these elements are described in this presentation.

Introduction

Management of the ecological science program in Kejimikujik National Park and National Historic Site has undergone significant transformation (Figure 1). Changes are being driven by a variety of factors:

- Designation of Kejimikujik as part of Environment Canada's nation wide Ecological Monitoring and Assessment Network (EMAN) (Drysdale, 1995);
- Use of the microcomputer as a standard tool for data storage and analysis by a broad array of researchers in the scientific community;
- The evolving re-organization of Parks Canada, and more recently development of an Ecosystem Science Section at Kejimikujik.

This paper discusses elements of Kejimikujik's developing ecological science management system over the last 6 years in context with the challenges and opportunities which have arisen.

There is an important need for collection of data simultaneously from different elements in a given ecosystem, if relationships and stressors are to be empirically defined. The importance of protected areas serving as ecological benchmarks, when compared to "working landscapes", has become evident. Low cost microcomputers have facilitated ecosystem science conducted and assessed at dispersed loca-

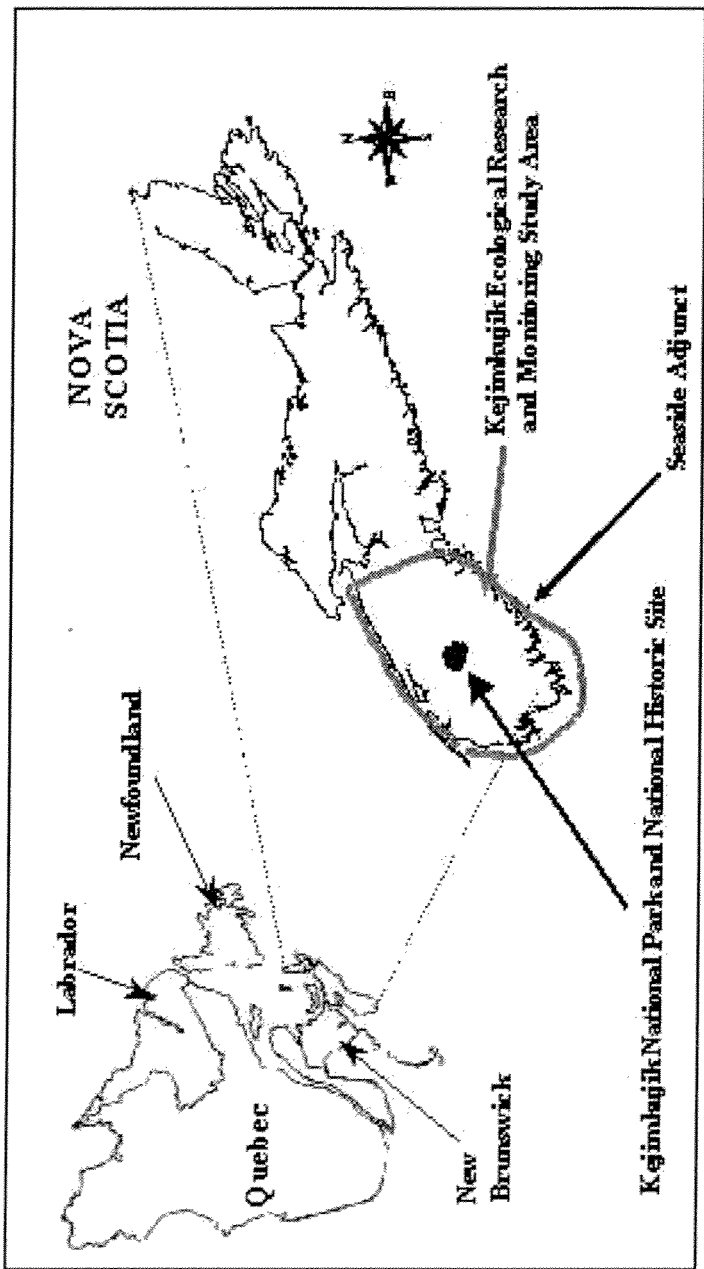


Figure 1. Kejimikujik National Park and National Historic Site

tions, as well as in centralized institutions. This has increased the opportunity for multi-partner, cooperative ecological research and monitoring at the park / community level.

Kejimkujik Ecosystem Science Management

While ecosystem-based research and monitoring began at Kejimkujik around 1978 in context with the Long Range Transport of Air Pollutants Program (LRTAP), the approach has developed more recently with the designation of the park as an EMAN site. Environment Canada research studies now include assessment of a broader array of airborne and aquatic pollutants such as mercury and its possible effects on ecosystem components, an evaluation of the UVb radiation impact, and analysis of natural sources of so-called greenhouse gases including methane and carbon dioxide. Parks Canada is increasing its research activity based on the principles of ecosystem integrity management. Kejimkujik features an Ecosystem Science Section whose manager serves at the Mainland Nova Scotia Field Unit management table. Kejimkujik study activities include rare fauna species management, forest bird population assessments, ecosystem restoration evaluation, mercury toxicity analysis in fish, and plot-based forest biodiversity measurement and monitoring.

Kejimkujik Ecosystem Science Mission Statement

- To develop and operate a cooperative ecological research and monitoring centre at Kejimkujik National Park to support study of ecological function and stressors, development of sustainable landscape management strategies and to promote excellence in the conduct of ecological science.
- The site will address appropriate ecological science study requirements of Parks Canada, and in doing so participate with the Ecological Monitoring and Assessment Network (EMAN), and other federal agencies, Government of Nova Scotia departments, local industry, a variety of education institutions, and international organizations such as UNESCO Programme on Man and the Biosphere, and the Smithsonian Institution.

Managing Research Activities to Optimize Benefit

The conduct of a variety of research studies in a given ecosystem does not necessarily ensure that ecologists can examine the potential relationships among parametric datasets, particularly if the studies are carried out by different scientists. Data may be stored in a variety of formats using different software, in different locations, with varying states of documentation. While obtaining final reports may not be problematic, carrying out relational analysis of data with due consideration for appropriate statistical analysis can be practically impossible unless there are common conventions used for methods description, digital acronym documentation, a cataloguing system of available data sets, and agreement among researchers that the data will be made available to others for use. Spatial data comparison necessitates a further set of variables to consider including map projection, datum, and image resolution (Aronoff, 1993). Appropriate archiving of essential infor-

mation is also necessary to protect and facilitate ecological assessment of long term data sets to determine temporary fluctuations, relationships and true trends.

Use of an Information Management Specialist

As a first step to address this complex set of issues, Kejimikujik, with the initial support of EMAN, employed the services of a qualified information management specialist. The information management specialist operates data management systems, provides guidance to researchers concerning documentation requirements, while carrying out digital data set and GIS application work for Parks Canada and its research partners.

Documentation System

Our philosophy is a simple one - record the minimum amount of essential documentation to register, understand and re-enact a research or monitoring project in Kejimikujik in its entirety, thereby maximizing the value of the initial study and its data. Upon this basis the following documentation components have been developed; a research proposal/permit application form, data catalogue, data dictionary and report of findings. These documents along with digital data sets and hardcopy printout of the data are archived together in a single binder. This results in a consolidated, comprehensive product accessible for future researchers/analysts who may use the data in ways unforeseen by the original researcher. Binders are stored in a secure place with additional backups of the data stored off site.

Research proposal/permit system:

Kejimikujik's research management system incorporates a digital research application package which is sent out annually to a variety of universities, government agencies, and others upon request. This package also includes a digital copy of the park's ecosystem conservation plan which describes park ecosystem management priority issues in a business plan tabular format, including stressors/issues, proposed actions and performance indicators/targets as appropriate.

The standardized research proposal form requires clear description of study objectives, hypotheses, methods, access, sampling techniques, research experience and staff participating in the study. The forms are designed so they can serve a multi-function role. For example the completed research application form can be used for the research permit, contract terms of reference, environmental assessment project description, and other purposes. Stated conditions for approval and issuance of a research permit include;

- The requirement that the researcher consult with park information management staff to develop appropriate documentation for digital data sets;
- A complete set of data in digital and hardcopy form be retained at the park subsequent to study completion;
- A requirement that the researcher may be obligated to participate in a project

evaluation to ensure a high standard of science and adherence to pre-established guidelines.

- The requirement to prepare a safety plan.

If during the course of the project deviations should occur, the ecologist and information manager must be alerted, in writing, with a detailed description of the changes and why they were undertaken, to be appended to the proposal. The proposal also serves as an evaluation tool to assess the potential environmental impact of a research project on park resource values. Mitigation measures are appended to the issued permit, assuming the study is approved.

Data Catalogue:

Preparation of this document provides information that will help researchers and park personnel define the characteristics, methods and results (both hardcopy and electronic data sets) of research that is undertaken. A catalogue questionnaire, based on a standards manual being developed by the Nova Scotia Committee on Standards for Geographical Information (1996), is filled out by the researchers during the project and finalized at its completion. In addition to assistance provided by the information manager to ensure the catalogue is filled out correctly, a text description is associated with each field, clarifying the type of information required. This catalogue thus also contributes to creation of a national directory of research projects.

Data Dictionary:

A data dictionary (Vasta, 1985; Senn, 1984; Stern, 1985) is then developed in consultation with the researcher to document specific data files within a given study. It lists and describes file structure, individual data fields, and includes an abstract, version of software used, and a log of data set modifications. It is imperative that all variables are described in commonly understood terms. Documentation of the individual data fields contain the name, length, type and description, along with an explanations of all codes. Established standardized naming conventions and codes adopted by the park are used when practical.

Research Audit:

A research audit system has been set up at Kejimikujik National Park to ensure projects are being carried out using agreed upon terms of reference, and compliance with the above noted procedures. A standard form is used by Park staff to facilitate assessment documentation, and complement research planning and field methods evaluation. This process is useful to ensure Parks Canada receives value for funds committed, but also to assist researchers to optimize study methods and application of appropriate quality assurance procedures. Particularly in the case of studies being carried out by inexperienced university undergraduate and graduate students, the evaluation process has served to identify, and subsequently help correct inconsistencies in sampling techniques, field note taking, and development of database structures and documentation. Results of such evaluations are prepared

in the spirit of constructive assessment, and are kept confidential, of course. This along with a later review and error checking of the completed digital datasets provides a level of quality assurance ensuring the integrity of the data.

Data Sharing:

A significant information management goal for a cooperative ecological research and monitoring centre is to make the data collected on site not only usable, but sharable. Usability necessitates correctness and understandability of the data, while share ability requires ease of accessibility to the data by others. Considerations for data sharing include the agreement for proprietary rights, use of standard protocols and documentation systems. Kejimikujik National Park has developed a data use application and agreement contract form which facilitates exchange of data sets while defining the proprietary rights and use constraints dictated by the owners and publication conventions (Figure 2). If an outside agency or individual holds the rights to the data, then the documentation describes the project and includes a sample of the data. The documentation system then serves as a pointer to the location where the owner and the complete data sets reside. If the data belongs solely to the park according to prior agreement, then it can be distributed as seen fit by the park.

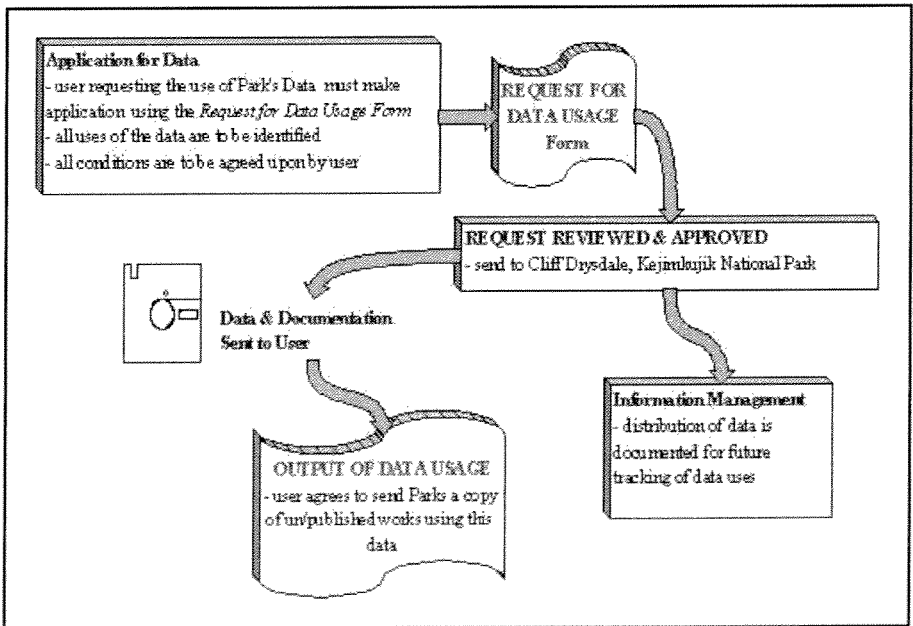


Figure 2. Kejimikujik Ecological Research and Monitoring Information Management System

Archiving:

Whether the data's ownership is the parks' or an affiliated agency, we have, at the onset of the project, stated that all documentation and data will be stored at

Kejimkujik. There is still a requirement, however, to develop an off site archiving centre to ensure that digital data sets, and their essential documentation are safely protected from catastrophes such as fire, flood, or even unintentional database corruption.

Conclusion

While the scientific information management system in Kejimkujik National Park and National Historic Site is still being refined, its utility is already becoming evident. Parks scientific staff are now able to assess and use data sets created by other researchers, thus increasing the power and confidence in our ecosystem analysis and resource management activities. Various other researchers who work in the park are indicating the value of the documentation system as an aid to their efforts, and requests are being made to obtain data sets on a variety of subjects. Faculty from several universities in the Maritimes are recognizing the training value of using the system at Kejimkujik, including the personalised instruction provided by the information management specialist, and are proposing this approach be integrated with cooperative graduate studies programs and field study classes they would like initiated at the park. Cooperative monitoring of forest ecosystems has begun in partnership with the corporate sector in working landscapes adjacent to Kejimkujik. Such activities at the agency, institution and industrial level, will in turn result in the gain of further information on the ecosystems associated with Kejimkujik, and advance the concepts of cooperative research and monitoring, and sustainable resource management in southwestern Nova Scotia.

Final Points to Consider

1. Serve and involve local communities, as well as your employer. Facilitate learning and use of traditional knowledge. Develop local and regional partnerships with other agencies, educational institutions, businesses and civic organizations.
2. A site based science programme with a small discretionary budget and minimal staff can "leverage" partnership funds and voluntary assistance to support significant study initiatives.
3. Clearly define information needs and design data collection strategies accordingly to support informed management decisions.
4. Use sound statistical design principles and sampling protocols when planning and implementing your research/monitoring programme. If you wait until after you have collected your data, it can be an expensive mistake.
5. With a disciplined information management approach, a distributed database system can offer significant "value added", including the ability to do increasingly complex ecological analysis, while attracting new researcher interest. The site based microcomputer and the internet will continue to revolutionize the conduct of field science.
6. While volunteers, students and multi-purpose park staff can provide valuable input for a park science programme, a core "purpose-built" scientific and technical team is essential to ensure high quality, consistent monitoring results.

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