Research Links
A Forum for Natural, Cultural and Social Studies

Whooping Crane Monitoring

in Wood Buffalo National Park

Adult Whooping Crane feeding a chick on a nest

Whooping crane chicks

Photos: Douglas Bergeson

Douglas Bergeson

Wetland marshes in Wood Buffalo National Park (WBNP) are the only remaining breeding grounds for the endangered whooping crane (*Grus americana*) in the world. Whooping crane nesting sites were first observed in WBNP in 1954 (Fuller 1955) when five pairs were located. Currently the WBNP population consists of 49 nesting pairs and approximately 190 individuals.

Parks Canada, the Canadian Wildlife Service (CWS), and the United States Fish and Wildlife Service conduct annual surveys over the nesting grounds to record the number of cranes, nest locations, chick production and fledgling success. Although these aerial surveys provide excellent trend information, the habitat requirements and diet of nesting cranes remain poorly understood. The Whooping Crane Recovery Team (see side bar) outlined that one of the next management steps is to identify potential nesting and wintering areas that could sustain viable (minimum of 25 pairs) whooping crane populations (Edwards et al. 1994). Before potential nesting areas can be evaluated adequately, the current nesting habitat and diet requirements of the whooping cranes in WBNP must be better understood. A three-year study *(1997-1999)* was initiated by Parks Canada and the CWS in WBNP to identify the main components in the cranes diet, and identify causes of chick mortality.

DIET

During the summer of 1997, 48 aerial surveys resulted in 1200 recorded observations of whooping cranes, including 450 feeding observations. Cranes fed primarily in small (less than 75 m in diameter) shallow diatom ponds (less than 50 cm deep). Diatoms are microscopic, unicellular organisms from the algal class Bacillariophyceae (Moser 1996). These ponds and the surrounding shorelines were sampled for potential prey items including: fish, invertebrates, amphibians and small mammals. Water parameters were also measured including: water depth; colour; percent and type of emergent vegetation; pH; dissolved oxygen; conductivity; salinity; chlorophyl a; phosphorus; and substrate cores were taken . In 1997, 54 ponds were sampled—27 where the cranes were observed feeding and 27 randomly selected ponds within the nesting area where the cranes were not observed feeding. Of the 27 ponds where the cranes were feeding, 22 contained fish, whereas nine out of 27 randomly selected ponds contained fish. In total, over 11,000 small-bodied fish were caught, identified, and released in the crane ponds. Brook stickleback (*Culaea inconstans*) and Dace species were the most common. This preliminary evidence suggests that cranes forage in ponds which contain fish.

Invertebrates caught during pond sampling included: pond snails (*Lymnae stagnalis*), wheel snails (*Helisoma sp.*), dragonfly larvae (*Aeshna sp.* and *Ophiogomphus sp.*), diving beetles(*Dysticus sp.*), water boatmen (*Corixid sp.*), backswimmers (*Buenoa confusa*) and giant water bugs (*Lethocerous americanus*).

In 1998, fixed wing flights occurred daily (over three 10-day sampling periods during June, July and August) to monitor the movements and feeding locations of 10 pairs of cranes. Feeding observations were recorded during these flights and ponds were again sampled for potential prey items. In total, 73 ponds were sampled, with similar results to 1997 as the majority of feeding ponds contained fish.

CHICK SURVIVAL

Whooping cranes usually lay a clutch of two eggs (Kuyt 1995). However, they rarely raise more than one young, despite hatching success of 70-80% (Kuyt 1996). Between 1964 and 1996, no whooping crane family arrived on their wintering

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Research Links

Volume 6 • Number 3 • WINTER 1998

FEATURE ARTICLES

DEPARTMENTS

FRANCOPHONES

Le texte de cette publication est offert en français. Vous pouvez l'obtenir en écrivant a l'adresse dans la p.16

EDITORIAL

In July 1998, Parks Canada released its latest State of the Parks Report. The report identified the key stress factors facing our system of protected areas and began the process of defining how we will measure our progress in ensuring that ecological and commemorative integrity are maintained. The report also recognizes the need to provide Canadians and visitors to Canada with opportunities to experience those qualities which make our parks and sites significant. Although informative books, talks and television programs can enable people to grasp the significance of parks and historic sites, many people opt for a more personal experience. It is a tall order for Parks Canada to live up to the ever increasing visitor demand given the state of our knowledge and resources. The past few issues of *Research Link*s focussed on some of the challenges and successes in monitoring components of protected areas, providing you with some examples of how researchers are helping parks Canada increase the base of knowledge and put it into practice.

Clearly there are many challenges ahead and monitoring our resources is one of the greatest. The majority of the national parks continue to report high numbers of stressors, resulting in significant ecological impacts. The national historic sites system has also compiled a list of threats to commemorative and protected area integrity. We must identify important structures (both man made and natural) and processes, monitor their "health" and reduce stress and threats to protect park resources. In parks and sites this will require a better understanding of all the components and their interactions.

Managing people and resources is an important part of obtaining the knowledge we need. Therefore research must be, and will be, a critical component of the management of protected areas and must form the basis of good decision making. However, this process requires more than simply obtaining information. Parks must focus on reconnecting the people to the landscape and controlling damaging activities. We also require new directions to ensure research is considered and used in management decision making. New initiatives depend on motivation beyond both protective areas boundaries and the research community. This will increase stakeholder support and enable Parks to pursue interdisciplinary collaborative approaches. By moving communication, understanding and support to all levels of decision making, we will increase the ownership of the issues and develop support for solutions.

Partnerships are critical to the support and success of monitoring, and to the success of our protection efforts. In this and the previous few issues, *Research Links* features many collaborative research projects. Management partnerships must continue to be enhanced to ensure protection and representivity. The challenge will come in finding common objectives on which to base these partnerships and a strong commitment to the long term goals on which they are based. We must continue to seek these partnerships, not only on the familiar science ground but on ones which are not so safe, where people and agencies do not believe, or do not trust, our research. Enhanced communication will be one of the most valuable tools. By cultivating this broader ground we will ensure that research remains a significant contributor to responsible environmental decision making.

Gail Harrison
Ecosystem Services, Western Canada Service Centre and Editor of Research Links

Feeling Sheepish?

Bill Swan of the Bighorn In Our Backyard (BIOB) project sent us an update regarding recent activities. Bill's article, "Bighorn In Our Backyard: Communities Working for Wildlife," was published in Research Links 6[1], Spring 1998.

Rick Taylor, BC sculptor, has confirmed that he will be sculpting and installing a life-size monument of three bighorn sheep in the community of Radium Hot Springs in the year 2000. The installation is valued at $100,000 but will take place at no cost the community. Small versions of the sculpture, called maquettes, will be available for purchase with some proceeds returning to the BIOB project.

The Great Canadian Parks program, which airs on Discovery Network, taped an interview with BIOB coordinators in August. The feature will air in the new year during Great Canadian Parks' focus on Kootenay National Park.

BIOB is currently planning for the winter field season (October to March). They intend to track bighorn and other species around Radium Hot Springs/Kootenay boundaries. Results will contribute to Radium's Official Community Plan, to help protect critical wildlife migration corridors in and around Radium.

For more information on the Bighorn In Our Backyard project, contact:

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Research Highlights

In the Spring 1999 issue of *Research Links*, we plan to re-introduce a section devoted to updating or highlighting research activities in Western Canada national parks and national historic sites. "Research Highlights" is intended to provide our readers with an overview of ongoing projects, and to introduce areas of research which may or may not develop into feature articles in future issues of *Research Links*.

If you are interested in contributing a short summary for "Research Highlights," please send your submission to: Research_Links@pch.gc.ca or to: *Research Links*, Parks Canada, #552, 220 - 4th Ave. SE, Calgary, AB, T2G 4X3

FEEDBACK

"I found this issue (6[2]) particularly interesting for several reasons. First it shows what interesting work Parks Canada is undertaking in the northern parks despite financial constraints... Second, it illustrates that there are definite possibilities for world heritage sites in the far north that Canada should consider (there are no natural world heritage sites yet in the arctic). Finally, the article on Nahanni National Park suggests that the case for expanding the park boundary...is compelling. Keep it up!

—Jim Thorsell, Senior Advisor, World Heritage (IUCN), Switzerland

Recent Publications

Two much anticipated publications, The State of the Parks 1997 report, and the Proceedings of the Third International Conference on Science and Management of Protected Areas (SAMPA III) are now available.

STATE OF THE PARKS REPORT

The State of the Parks 1997 Report

Catalogue No. R64-184/1997E
ISBN 0-662-26331-6

Available online at:
http://parkscanada.pch.gc.ca/library/DownloadDocuments/Documentse.htm

SAMPA III PROCEEDINGS

Linking Protected Areas with Working Landscapes Conserving Biodiversity: Proceedings of the Third International Conference on Science and Management of Protected Areas/12-16 May 1997

Editors: Neil W.P. Munro and J.H. Martin Willison
ISBN 09699338-4-3

Available through SAMPAA:
Science and Management of Protected Areas Association (SAMPAA)
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Species Probability Modelling

in The Georgian Bay Islands National Park Ecosystem

Paul Zorn and Justin Quirouette

Georgian Bay Islands National Park (GBINP), located approximately 165 km north of Toronto, is the closest national park to the highest human population density in Canada. GBINP's greater park ecosystem is, therefore, subject to a high level of stress due to development pressure that has resulted in habitat loss and fragmentation (Sportza, 1995). These stresses make it difficult to preserve the greater park ecosystem and the region's unique, sensitive, rare and endangered species, which are primary goals of GBINP's park management plan (Georgian Bay Islands National Park, 1997).

Figure 1. Eastern Massasauga Rattlesnake (Sistrurus catenatus catenatus)

Management for the preservation of ecological integrity is further constrained at GBINP as data on the distribution, abundance and habitat association of species is limited beyond park boundaries. Data deficiencies of this type are likely to be a common problem across Parks Canada as the Natural Resource Management Process has traditionally focused within park boundaries. Addressing these data gaps through ecological surveys, is unlikely as they are labour intensive and require a high level of resources and funding.

The need for cost-effective solutions for protecting species of concern within the greater park ecosystem is being addressed at GBINP through the development of species probability models. Species probability models attempt to prescribe the range of habitat conditions that will provide the requirements for a particular species. Habitat attributes associated with species presence are compared to attributes related to species absence. By integrating statistical models and geographical information systems (GIS), probability maps can be generated that predict the distribution of species across a landscape.

Researchers can use these probability maps to focus ground truthing, so additional species occurrences and associated habitat attribute data can be collected in a timely and effective manner. When species probability modeling is integrated with a park's research and monitoring program, additional demographic and behavioural information may be collected and used to study the spatial and temporal dynamics of species-habitat relationships (Dunning *et al.*, 1995). This approach provides management with information that can address questions of habitat fragmentation, isolation, shape, and patch size, providing the manager with a tool to determine not only what types of habitat are needed, but also how these habitats should be arranged across the landscape. Furthermore, the potential effects of no management, alternative management strategies, or natural events can be examined (Turner *et al.*, 1995).

GBINP, in association with its partner agencies and the regional *Integrated Heritage Areas Strategy*, is developing species probability models using logistic regression analysis and GIS. The initial spatial model was developed using existing park data on the Eastern Massasauga Rattlesnake *(Sistrurus catenatus catenatus)* (Figure 1). The massasauga was selected as the pilot to test methods for Beausoleil Island because the snake is listed as threatened by COSEWIC, it occurs in selected areas in the Lake Huron-Georgian Bay region, park staff are knowledgeable about the behaviour of this species, and GBINP possesses a rich database of occurrence information.

METHODS

Since GBINP was interested in the distribution of massasaugas, the probability of species presence and absence was tested using logistic regression. Logistic regression is a statistical modeling method suited for applications where the dependent variable has only two possible outcomes, in this instance, massasauga presence or absence. Logistic regression was also selected because it does not rely on distributional assumptions in the predictor variables (as some other approaches do), and because numerous diagnostic tools can test the validity of the resultant model (Norusis/SPSS Inc., 1997).

Using SPANS Explorer GIS 7.0, biophysical (e.g., vegetation cover, elevation, drainage, surficial material) and human use (e.g., road density) data were imported into a common study area with efforts made to ensure positional accuracy. These variables were selected because knowledgeable park staff hypothesized that these habitat attributes explained much of the variation in massasauga distribution (M. Villeneuve, *pers. comm.*). Map layers for these attributes were overlaid with occurrence and random point data to represent species presence and absence (Li *et al*., 1997) and a "point in polygon " table was generated and exported for analysis.

The data were tested for spatial auto-correlation and interdependence (multicollinearity) among the predictor variables using GS+ from Gamma Design Software and SPSS 7.5 for Windows. Spatial autocorrelation and multicollinearity were solved for as per Li *et al*. (1997), thereby reducing biased estimates and model inaccuracy. The the model was then developed using logistic regression with a factor-stepwise likelihood ratio iteration method, using SPSS 7.5 for Windows. This method selected and ranked, in order, the predictor variables that explained the highest degree of variation in massasauga presence or absence.[1]

The resultant model was validated using determination and calibration measures. Once validity was confirmed, map algebra functions within SPANS GIS 7.0 was used to translate the model output into a probability surface predicting massassauga

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[1] *This statistical approach eliminates the potential user input error that exists in many GIS models that are based on ranking or weighing various map classes.*

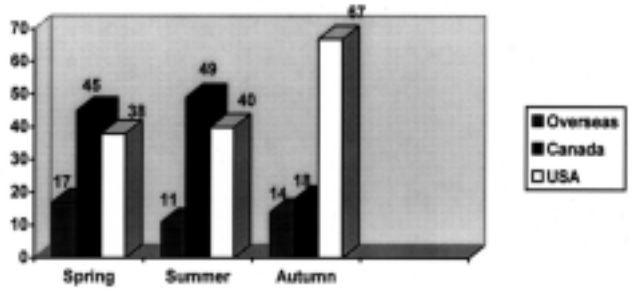
WHO GOES TO CHURCHILL?

A snapshot of tourists across the seasons

Kelly MacKay

The Churchill region of Manitoba is an internationally renowned tourist destination for wildlife viewing. Opportunities to see rare birds, beluga whales, and polar bears arise during three primary "seasons": May - June (birds), July - August (whales), and October - November (polar bears). The Churchill Visitor Study (CVS) was conducted as part of the joint research agreement between Canadian Heritage - Parks Canada and the University of Manitoba. Data were collected by researchers with the *Health, Leisure & Human Performance Research Institute* in the summer and autumn of 1995 and the spring of 1997. The study focused on non-residents (visitors) exiting Churchill. The Churchill Visitor Study primarily examined the characteristics of visitors to Churchill, their travel motivations, and how the unique Northern environment of Churchill satisfied visitor needs. This article is a synopsis of selected results that describe key visitor characteristics and travel patterns across the distinct visitor seasons.

Figure 1. Visitor Origin (%) by Season*



*Note: Categories may not =100% due to rounding error.

METHOD

The survey design was a combination of an on-site intercept questionnaire, and a self-administered mail questionnaire. Cluster samples were taken at the airport and train station on randomly selected stint days based on train and air traffic flows. Eligible respondents were nonresidents of Churchill, individuals who were not commuting to work or school or moving to a new residence, and individuals leaving Churchill for the last time. A package containing the short intercept questionnaire (to complete on site) and follow-up questionnaire (to return by mail) was distributed to eligible respondents. An incentive prize, postage paid envelope, and reminder postcards were used to enhance the mail survey return rate.

RESULTS

The 1995 CVS received 617 replies, for a response rate of 75%. The 1997 CVS response rate was 67% (N=142). For this article, respondents have been categorized by season of visit where: spring is May and June (n=142); summer is July, August, and September (n=278), and; autumn is October and November (n=325), unless otherwise noted.

Who Goes To Churchill?

Many Churchill visitors are international in origin, especially during autumn (81%: Figure 1). During autumn, Americans are the most likely to visit and Canadians the least likely. Visitors from overseas are equally likely to visit Churchill in all three seasons. Regardless of season, visitors to Churchill tend to be well educated and married. Both sexes are roughly equally represented. Over two-thirds of visitors have some university education. Autumn and spring visitors have higher annual household incomes with approximately one-third reporting $80,000 (Canadian) and over. Although the majority of visitors are employed, a higher percentage of summer and autumn visitors are retired. In spring, most visitors are under 55 years of age; whereas, in the autumn, most are over 55. (Table 1 provides visitor sociodemographic characteristics by sea-

Table 1. Sociodemographic Characteristics of Churchill Visitors

	Spring (%)	Summer (%)	Autumn (%)
Annual Household Inc.			
Cdn.>$20,000	6	16	9
$20,000 - 29,999	3	8	6
$30,000 - 39,999	16	14	16
$40,000 - 49,999	9	10	8
$50,000 - 59,999	13	16	12
$60,000 - 69,999	11	8	8
$70,000 - 79,999	5	8	5
$80,000+	38	20	36
Education			
Gr 9 - 13 (no diploma)	3	7	4
Gr 9 - 13 (diploma)	8	11	11
Trade Certificate	11	6	7
Other Non University	11	9	10
University w/o degree	7	13	12
University degree+	60	55	57
Marital status			
Married/com. law	59	61	65
Widowed	9	8	9
Divorced/separated	6	7	10
Single	25	24	17
Sex			
female	49	57	59
male	51	43	42
Age			
Under 19	2	2	0
19 - 24	3	7	1
25 - 34	17	13	10
35 - 44	20	13	14
45 - 54	21	21	19
55 - 64	18	17	27
65 - 74	18	22	20
75 and over	2	6	8
Employment status			
Employed	66	53	55
Unemployed	6	5	6
Retired	25	34	38
Student	3	9	2

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Whooping Crane Monitoring

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grounds in Texas with two young. A family arrived with both young in 1997 for the first time in 32 years. Brood reduction is a common strategy in many avian species. To ensure the survival of one offspring, females lay and incubate eggs over several days resulting in asynchronous hatching of the chicks. This staggered hatching is considered an adaptation for periods of food shortage during the nestling stage; broods can be reduced to match prevailing food conditions (Lack 1954). This usually results in the first chick having an advantage over its sibling(s).

It appears the first two weeks following hatching are critical and it is during this time frame that most of the chicks are going missing.

Eight pairs of whooping cranes were monitored throughout the summer of 1997. Each pair hatched out two chicks by mid June. By the end of June, only one pair had both their chicks. No direct causes for the losses of single chicks were determined as ground searches for the missing chicks were unsuccessful. However, aerial surveys provided valuable information on spatial movements of the young chicks. The chicks were quite precocial as the family groups departed the nest within 24 hours of the second chick hatching and moved between 200 m and 400 m per day in the first two weeks. The longest observed daily movement by a family during the first month following hatching was 1.5 km.

The 1998 field season has provided additional insight, in late May, a blind was moved in near a nest site and researchers established a small camp one km away. A nesting pair was observed for over 90 hours over two weeks, with some interesting results. Adults alternated their incubation every 2.5-3.5 hours and each time they exchanged positions they would fly off to feed, as they did not feed in the nest pond. Subsequent sampling of the nest pond revealed that it did not contain fish, however ponds where the cranes were observed flying to and foraging in, which were located 500m to 1 km away from the nest pond did contain fish. Following the hatching of the first egg, the adults focused on feeding the chick and ignored the second unhatched egg. The adults were observed to have fed the chick exclusively dragon fly larvae. Each day the chick was considerably stronger and more mobile and by the end of the second day it was following the adults off of the nest. On the morning of the chick's third day the family departed the nest pond leaving the second unhatched egg on the nest. Later that day a Raven (*Corvus corax*) was observed on the abandoned nest.

In early June, six pairs of whooping cranes that had two chicks were selected and six lightweight (1.45 g) transmitters were glued (using a cyanoacrylate tissue adhesive glue) onto the chick's backs. The transmitters helped to locate missing chicks. Only one chick from a set of twins had a transmitter attached, on three occasions it was the smaller (lighter) chick, while on three occasions it was the larger (heavier) chick. In addition to weighing and attaching transmitters, blood samples were taken from all the chicks (by Dr. Bob Cooper of the Calgary Zoo) to determine their blood counts and enzyme levels (basically their overall fitness) with each other and with captive chicks. Within three days of attaching the transmitters, all three of the smaller (lighter) chicks had perished. Based on the blood analysis, the three smaller chicks had lower blood counts and were generally not as "fit" as the larger chicks (Cooper pers. comm. 1998). A necropsy on one of the chicks revealed it had pneumonia, while another chick that died appeared to be under prolonged severe stress (based on the blood analysis). This particular chick was the only one handled that had visible trauma, as it had dried blood around its head and bill. The fate of the third chick is unknown although it's transmitter was located 2 km away from it's parents on a roosting location for Ravens. The three remaining transmitters either fell off or were pulled off the larger chicks with the last transmitter coming off nine days after attachment. Based on the monitoring of pairs with two chicks in 1997 and from the transmitter work this summer it appears

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WHOOPING CRANE RECOVERY TEAM

The Whooping Crane Recovery Team is comprised of agencies actively involved in whooping crane programs including: (Parks Canada, Canadian Wildlife Service, Calgary Zoo, Saskatchewan, Alberta, and Manitoba Provincial Governments, NWT Government, United States Fish and Wildlife Service, Unites States Biological Service, Florida State Wildlife Service, Whooping Crane Conservation Association, Patuxent Wildlife Research Center and the International Crane Foundation.

The WCRT's main objective is to maintain a stable or increasing Wood Buffalo-Aransas population with a minimum of 40 breeding pairs and to establish two other wild populations each with a minimum of 25 breeding pairs (Edwards 1994).

If you would like more information about the WCRT contact Mr. Brian Johns (Canadian Recovery Team Coordinator):

Brian Johns
115 Perimeter Road
Saskatoon, SK, S7N 0X4.
Tel 306-975-4109
Fax306-975-4089

WHOOPER FACTS

- The whooping crane is the tallest North American bird at 1.5 m.
- They are long lived 20-30 years.
- Average composite nesting area 5 km^2.
- Clutch size usually two eggs.
- Incubation 29-30 days.
- Chicks fledge at approx. 70 days of age.
- Migration from WBNP begins in late September and the cranes are usually in Aransas Wildlife Refuge on the Texas coast by November. Migration is approx. 4000 km.

COMPARISON OF REPRODUCTIVE SUCCESS

Year	1997	1998
• # of nests	50	49
• Date of first chick	June 4	May 24
• Total # of chicks	58	42
• # of pairs with twins*	16	12
• sets of twins* (end of June)	2	0
• # fledged chicks	35	24

*twins refer to a pair with two chicks.

Species Probability Monitoring

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occurrence throughout Beausoleil Island (Figure 2).

RESULTS

The regression selected seven of twelve variables significant predictors of massasauga occurrence. Overall, the model discriminated between massasauga presence and absence with 80.86% success. However, three variables (ranked in order of importance)—elevation, surficial material and habitat type—explained massasauga presence or absence with 76.05% success.

Perhaps the most important diagnostic in testing the validity of the model was presenting the probability map to knowledgeable staff with years of first-hand experience. In all cases, the probability map was consistent with their field observations and support was unanimous. In fact, the model identified a potentially significant area for local dispersal that is located near a high visitor use area (M. Villeneuve, *pers. comm.*). Since the development of this initial application, other natural resource management agencies have shown interest in collaborating with GBINP to apply this flexible approach on a number of different conservation initiatives (A. Liskauskas, K. Prior, *pers. comm.*).

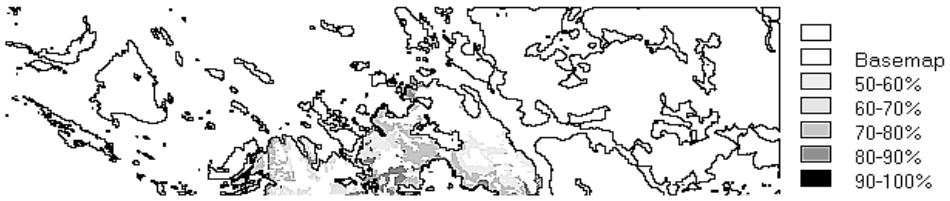

Figure 2. Eastern Massasauga Rattlesnake Probability Map

DISCUSSION

Every ecological model is an approximation of reality based on a set of assumptions. In this probability model for massasaugas in the greater GBINP ecosystem, it is assumed that species distribution can be explained by habitat attributes (e.g., habitat type, size, shape, dispersion) as defined by biophysical and human use characteristics. Habitat suitability models such as this do not directly include biotic interactions (e.g., predator-prey relationships, population demographics). However, results from logistic regression models can be used as tools to focus further research and monitoring to collect information on biotic interactions for subsequent spatially explicit population models and population viability analyses (Turner et al., 1995).

Multiple species probability modeling can be a valuable tool for park management to gain insights to species distribution in a cost-effective manner. When ground thruthed and coupled with research and monitoring activities, this approach can be highly useful in developing management strategies to preserve ecological integrity.

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Accounting for Nature:

The Northern National Parks Ecological Monitoring Program

Stephen McCanny

An accountant's job is to track the ebb and flow of money through an organization and to assess financial integrity. In the same way, it is the job of natural resource specialists in Parks Canada to assess the ecological integrity of our parks. We do this by tracking changes in the sizes of populations, the diversity of communities, the rate of natural processes and the level of human activity in a park ecosystem. This kind of accounting is called ecological monitoring .

Monitoring in the north might seem unnecessary. Northern parks are largely free of the landscape fragmentation and visitor traffic that are major concerns in southern parks. However, some of the special features of these vast landscapes could be lost to global warming, long distance transport of pollutants and local stressors. Without long-term monitoring, northern parks will be in a weak position to argue for legislative or societal changes to curb global change effects. In time, park managers will come to rely on the up-to-date information and analyses of resource specialists as much as they depend on the work of financial accountants.

The Northern National Parks Ecological Monitoring Program began in May 1996 to provide a common package of monitoring procedures for all the parks of the Northwest Territories. Specific procedures adapted to each park could be added to this common package to round out the monitoring programs. This collaborative effort involved staff from every park in the NWT as well as Western Canada Service Centre and National Office staff. In 1997, pilot studies worked out logistical and sampling problems for each procedure. This year, the three NWT field units are moving the program towards full operation. The Yukon and Manitoba field units (including Wapusk National Park near Churchill) have joined our steering committee, which now represents all the national parks north of 55 N. The managers and biologists involved are eager to include only the most relevant indicators for the ecosystems they manage. At the same time, they desire the benefits of a single, common program, including greater year-to-year consistency, reduced training and development costs, simplified data interpretation and regional data comparison.

The monitoring program began by identifying the most important aspects of an ecosystem. To make the program practical and efficient we considered the ease of measurement and the information content of selected indicators. In addition, we examined how the data would be used to inform decision-making.

Choosing the Indicators

Three questions are important in monitoring an ecosystem. What are the main elements (genes, species and landscapes) that give the system structure? What are the main activities or processes that allow the system to function? What controls the speed and prevalence of these processes? In Parks Canada, we answer these questions by examining the structures, functions and stressors of an ecosystem (Table 1). Stressors are human activities that tend to restrict the range of what can occur in an ecosystem. Though humans are definitely part of the ecosystem, it is important for our mandate that humans do not limit the ability of future generations to experience ecosystem structure and function. Table 1 lists the indicators selected in our monitoring program under the categories of the State of the Parks Monitoring Framework (see 1997 State of the Parks Report). The program covers all of the categories except decomposition, which can be estimated with good precision from climate data in our heat-limited ecosystems.

Biodiversity is the backbone of the program, especially where useful surrogate measures of species abundance (e.g. lemming nests, snow tracks) are available. High species diversity, essentially the number of species sharing a habitat, promotes efficient nutrient cycling and rapid recovery after disturbance. Monitoring small mammals, birds and plants is relatively inexpensive and provides considerable information about biodiversity.

Plant growth and natural disturbances (e.g. fire, polynyas—open water in sea ice) are the driving forces in an ecosystem. Large scale processes such as these are most easily observed using satellites. Seasonal thawing, flowering and freezing are monitored from satellites and from the ground.

Aquatic monitoring allows us to examine entire watersheds for their export of nutrients and pollutants. Fish parasite monitoring is a useful way of looking at relationships within a food chain. A shift in the load of parasites carried by Arctic char and other species serves as a warning of potential changes in their feeding patterns or general condition. We will also create an archive of tissue specimens for retrospective studies on the accumulation of toxins at this level of the food chain.

Cultural monitoring examines the integrity of the evidence for past human activity in ecosystems. It is an important part of our program. This makes sense in a cultural landscape that is physically inseparable from park ecosystems and where our co-management partners do not distinguish between the lessons of nature and the lessons of history. Contemporary human activities will remain the focus of our management actions, especially where we

Table 1. Northern National Parks Ecological Monitoring Program Indicators as part of the State of the Parks Monitoring Framework.

Ecosystem Structure

1. *Species Richness*
   mammals, birds, plants, landscape types
2. *Population Dynamics*
   lemmings, snowshoe hare, selected song birds
3. *Trophic Structure*
   fish parasites

Ecosystem Function

4. *Succession/Retrogression*
   regional fire map, polynyas, phenology
5. *Productivity*
   weather satellite growth index (NDVI)
6. *Decomposition*
   none
7. *Nutrient Retention*
   watershed discharge of Ca, N and decomposing organic matter

Stressors

8. *Land Use Patterns*
   visitor statistics, aircraft landings, roads
9. *Habitat Fragmentation*
   development
10. *Pollutants*
    heavy metals, selected petrochemicals
11. *Climate*
    year-long climate data

Other

Cultural Sites
artifacts, buildings, erosion

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LEMMING MONITORING

In Northern National Parks

Martin Raillard

Lemmings are keystone species in arctic ecosystems (Remarried 1980). They are the prey of many larger animals, strongly affect populations of fox (McPherson 1969) and ermine (McLean et al 1974, Kopimaki et al. 1991) and can induce significant changes in plants and soils (Schultz 1969). Changes in their population thus profoundly affect much of the arctic ecosystem. For this reason lemmings were chosen as one of the components of a monitoring system in Canada's Northern National Parks. This system has been designed to monitor key ecosystem variables to provide early warning to managers if significant changes occur. Ivvavik National Park has developed and tested a protocol for monitoring lemming populations. This protocol, together with some preliminary results, will be described here.

The long term objective of this project is to determine whether the populations of lemmings and their predators follow regular cycles. Years of lemming research have shown that population numbers in many arctic locations follow a four year cycle (Stenseth and Ims, 1993). However, some locations on the Western Arctic coastal plains have non-cyclic populations (Reid 1995). A possible reason for this trend is that lemmings are locked in a "predator pit," where predator numbers are so high due to the presence of other prey, that lemming numbers can never increase significantly. Long term monitoring will reveal if this is the case for lemming populations of some Northern National Parks.

MONITORING

The winter abundance of lemmings can be estimated relatively easily by surveying for winter nests. Lemmings build grass winter nests for warmth under the snow. The nests look like balls of cut grass, about 6 inches (15 cm) in diameter. Lemmings abandon these nests in the spring and do not re-use them, so the nests can be counted and picked up without harming the animals. Lemming abundance can also be monitored with snap traps and live traps. However, nest counts are non-lethal and very labour efficient, both of which are important for long-term monitoring in National Parks.

Nests are counted immediately after snow melts in spring because nests are easily scattered by high wind and rain. Two observers can normally count all winter nests within 10 m along a hiking route. By recording the distance hiked and the plant communities encountered, nest densities (nest per hectare) for the route and for different plant communities can be calculated. This method can be incorporated easily with other surveys on foot (bird surveys, vegetation mapping etc.). However, it is best to hike the same route every year for comparison.

Two kinds lemming species inhabit the western Canadian arctic. The brown lemming (*Lemmus sibiricus)* has brown/black fur, and the collared lemming (*Dycrostonyx torquatus)* has white fur in winter and gray fur in summer. Brown and collared lemming nests are identical on the outside, but the colour of the fur lining the inside of the nest identifies the species. Faecal pellets also differ, brown lemmings produce longer pellets than collared lemmings. Large winter nests (30 cm or more in diameter) may contain lemming skins and skulls, but are actually weasel (ermine) nests and are recorded separately.

A minimum of 14 hectares has to be surveyed to provide an adequate sample size for profile analysis (MANOVA). This analysis will detect if there are significant population changes between years, if a population cycle is maintained or if a population is indeed locked in a permanent predator pit.

PRELIMINARY RESULTS

The lemming nest survey method was tested in Ivvavik National Park during 1997 and in both Ivvavik and Tuktut Nogait National Parks in 1998. Lemming winter nest densities were 4.2 +/- 2.5 (SE) nest per hectare on the Yukon coastal plain in Ivvavik in 1997. The densities decreased to 3.09 +/- 0.9 (SE) nest per hectare in 1998. Lemmings concentrated in areas with deep winter snow drifts. They were found only on the Yukon coastal plain and were restricted to tussock tundra, sedge meadows and snow bed vegetation. No nests were found in large areas in the British Mountains or in other plant communities on the coastal plain. Nest densities recorded in Tuktut Nogait National Park during 1998 were as high as 53 nests per hectare. On average, densities were 21.5 +/- 10.6 nests per hectare in Tuktut Nogait. Again, lemmings were restricted to tussock tundra, wet and mesic meadows and snow bed vegetation. No nests were found in dry tundra, dwarf shrub tundra or sparsely vegetated areas.

Lemming nest densities have been very low in Ivvavik National Park for the past two years. There are several possible explanations: lemmings could be in the low phase of a population cycle; there may be limited forage or habitat; or, as Reid et al. (1995) suggest, lemming populations in some locations on the Arctic coast may be locked in a "predator pit" and kept at permanently low densities by intense predation. Predator populations could be at high levels in Ivvavik because of abundant prey at the calving ground of the Porcupine Caribou Herd.

Forage in Ivvavik seems to be as abundant in Ivvavik as in Tuktut Nogait. There are large areas of preferred lemming habitat (tussock tundra, snow bed vegetation, wet and mesic meadows) in both Parks (Hawkins, *pers. comm*., Raillard, 1998). Forage abundance does therefore likely not explain differences in lemming population densities.

It is not yet possible to determine if the lemming population density in Ivvavik is permanently low or just in the low phase of a population cycle. Monitoring during the coming two years will provide better evidence as to which of these two options applies. If the population is indeed permanently low, this would have a major impact on many components of the ecosystem, including vegetation and predator populations. If lemming populations are stable, then any significant changes in vegetation and in predator populations are due to reasons other than lemming population density, and further investigation is warranted.

If fluctuations in lemming numbers eventually do occur, they will cause significant changes in plants and soils (Schultz 1969). Heavy grazing by lemmings can reduce the plant and litter layer of tundra vegetation and cause increased permafrost thawing. Lemming grazing also affects the nutrient concentration of plants available to other grazers. For example, the phosphorus content of herbage during a four-year lemming cycle in Alaska changed

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Lemming Monitoring

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drastically and fell below the requirements of some mammalian grazers at certain times in the cycle (Schultz 1969).

Discerning the occurrence, magnitude and periodicity of a lemming cycle is therefore critical for the interpretation of other observed changes in this ecosystem. While we do not yet know if there is a regular lemming population cycle in Northern National Parks, we found winter nest counts to be a simple, efficient tool that will provide this type of information.

ACKNOWLEDGEMENTS

Methodology for lemming nest surveys was provided by Prof. Charles Krebs of the University of British Columbia and modified by Parks Canada.

Martin Raillard is the conservation biologist for Parks Canada, Western Arctic Field Unit.

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Whooping Crane Monitoring

- continued from page 6 -

identify suitable nesting habitat and potential range expansion within WBNP. It will also aid the Whooping Crane Recovery Teams in the Canada and the United States to select appropriate nesting areas for re-introductions.

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Photo: Douglas Bergeson

Adult whooping cranes calling in unison

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Accounting for Nature

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can show negative effects on biodiversity or ecosystem function. Existing monitoring programs quantify where and when visitors use the park. The larger issue of measuring the role of local residents in the park ecosystem will be resolved through park specific monitoring programs.

Cost and Information Content

A monitoring program must be economical and the data produced must be reliable to warrant continued funding. Ecosystems are notoriously variable. Detecting real trends in populations or processes is a difficult task. The main limiting factor is the number of samples used to represent the park - the more samples that are required, the more costly the program. However, sampling effort gives us diminishing returns. For example, a five-fold increase in precision for the snow track monitoring program requires seven times more sampling effort. As a minimum, we have designed our program to give us an even chance of detecting a 50% change in an indicator. This design accounts for both false alarms and detection failures. In the past, scientists have tended to ignore detection failures while insisting on a 5% chance of a false alarm before declaring a trend to be significant. The precautionary principle leads us to avoid disastrous detection failures (e.g. the collapse of the northern cod fishery) even if that means responding to more false alarms.

We have chosen a program that coarsely monitors a range of indicators. The cost of the program varies with the expense of travelling in the park. Travel costs are substantially higher in Ellesmere and Aulavik. Logistics aside, the program involves 148 person-days and $14,000 in operating costs for each park. The cost itself is not so much an obstacle as the coordination of training, operational requirements and data management to integrate monitoring into the overall program. This challenge is especially acute at present, when many staff in the north have recently moved to new positions.

Using the Data

There are four basic steps for interpreting and using monitoring results. They include i) setting targets, ii) getting the most from your data, iii) reaching a scientific consensus and iv) maintaining a public record. The first step is to describe which monitoring results the park will react to and what, in general terms, that reaction should be. We have found this step to be very difficult, leading to a never-ending series of inventory and baseline studies. The trick here is to keep things simple. Rather than be concerned with specific thresholds or management scenarios, we try to specify how the park would respond to a positive or negative trend. If the desired direction is not known, we focus on how the park would detect and respond to a change of any kind. This step is part of Parks Canada's normal planning cycle. The second step involves statistical design and secure data management. We use a flow chart to select the appropriate data analysis for a given number of samples. We are also applying a recently approved data management plan for the parks of the Northwest Territories to make sure our data lasts longer and provides better value. The third step involves an annual meeting of the monitoring team and their partners to discuss trends and to make recommendations. The final step is to maintain a document that records the goals, targets, recommendations, decisions and actions of the park. This document would be available to the general public, upon request, to evaluate each park's committment to ecological integrity. For more information on this approach, see the references below on the Natural Resource Management Process, Ecological Integrity Statements and ecosystem-based management.

Across the north, a new appreciation of the ecology of our parks is developing and a proactive approach to managing them is taking hold. Inevitably, there will be differences between parks in the application of this program. Parks with similar ecosystems will naturally have similar indicators. Field units will emphasize different indicators. In the long run, we believe that the value of a single approach to monitoring will be recognized. Northern park managers appreciate your feedback and suggestions on how to fulfill the mandate for ecological integrity in these great northern spaces.

The protocols of the Northern National Park Monitoring Program are available on Parks Canada's intranet at: http://167.33.224.244/ecosci/nmonitor.htm.

For more information contact:

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Who Goes to Churchill?

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son.) Previous visitation also varies by season. Autumn and summer travellers are almost exclusively first time visitors (90% and 83%, respectively). In contrast, 63% of spring visitors are on their first trip to Churchill.

Why Go To Churchill?

The main purpose for travelling to Churchill was reported as "holiday/vacation" by both summer (72%) and autumn (89%) visitors. In spring, the purpose of trip varied with 49% of respondents reporting "holiday/vacation" and 34% stating a combination of business related reasons (e.g. meetings, research, business, conference). Churchill visitors also rated the importance of several common tourist motives to their general travel decision. Regardless of season, the majority of these visitors were motivated to travel by opportunities to "see new things" and "go to new places". "Learning about culture and history" was more often cited as important by summer (56%) and autumn visitors (51%) than spring visitors (29%). The same pattern was true for "educational experiences" (summer 40%, autumn 41%, spring 24%), and "meeting local people" (summer 46%, autumn 42%, spring 17%).

More specific to Churchill, Table 2 presents importance ratings of certain features considered in visitors' vacation destination selection.

Opportunities for viewing wildlife and wilderness/nature were important destination features for travellers in all seasons, but especially the autumn. Scenery was more important for those who traveled in the summer and autumn. Spring visitors were more interested in viewing birds and summer visitors showed the strongest interest in historic sites.

Almost all autumn visitors (93%) participated in an organized wildlife (polar bear) tour (see Figure 2). Participation in vacation activities was generally higher in autumn and summer months. One exception was an "outdoor experience" which was mentioned most often by the spring visitors as bird watching. Shopping was least popular in the spring which may relate to the timing of seasonal retail businesses, focused activity participation (birdwatching) of spring visitors, or some other factor. Visiting the Eskimo Museum was the number one summer visitor activity. Visiting Cape Merry National Historic Site was one of the top five visitor activities in each of the three seasons.

Where do Visitors Obtain Information?

Tourists typically search for travel information at different phases of trip planning. Pre-trip sources refer to those used before travelling, and en route sources refer to those used while in Churchill. Tour operators and travel agents were particularly well-used pre-trip information sources for autumn visitors (65%). Past experience was most relevant for spring visitors (39%) who were also more likely to be repeat visitors. Summer travellers most often used advice from family and/or friends (45%). Parks Canada publications were sought in advance by 10% of visitors overall. Common sources that respondents listed on their own included TV documentaries, National Geographic, their business/work, "Birder's Guide to Churchill", Elderhostel, and Churchill tour operators. Visitors indicated that past experience and tour operators/travel agents were the two most useful advanced planning sources. In 1995, only 2.3% of visitors reported using the internet for destination information; however, in 1997, 19% reported using the internet.

In every season, Churchill residents were cited as the most popular and useful source of en route information. Frequently used sources at the destination included places of accommodation, the Eskimo Museum, Parks Canada Visitor Reception Centre (VRC), and restaurants. Overall, 38% of visitors to Churchill frequented the VRC. Regardless of the season, the opportunity to talk to staff ranked as the most important service provided by the Parks Canada VRC. (Figure 3 details visitors' reasons for stopping at the VRC.)

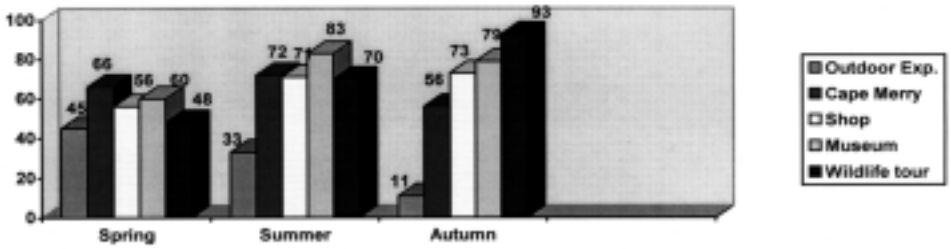
Autumn and spring visitors were the most interested in information on Churchill's natural environment. Spring and summer visitors also stopped at the VRC for general information on the town of Churchill. Historical and cultural information needs are evident in all three seasons. Only a small percentage of visitors in all three seasons sought information specifically on Parks Canada sites. However, viewing the displays and exhibits was a common reason for stopping at the VRC, especially in the summer months.

What are the Characteristics of a Trip to Churchill?

The number of nights spent in Churchill differs by season. Summer visitors most often stay 1-2 nights (42%). Half of all autumn visitors stay 3-4 nights. Length of stay varies more for spring visitors, with 24% staying 1-2 nights, 34% staying 3-4 nights, and 20% staying 5-7 nights.

Autumn travel parties recorded the highest trip expenditures at $2013.00 compared to summer ($803.00) and spring ($797.00) spending. These totals included typical vacation expenses such as accommodation, food and beverages, private transportation, retail purchases, recreation, wildlife tours, and pre-paid tour expenses. If the pre-paid tour expenses are excluded from the totals, the average party trip expenditures decrease to $459.00 in autumn, $511.00 in summer, and $473.00 in spring.

Figure 2. Participation (%) in Popular Vacation Activities by Season*



*Note: Categories do not = 100%; respondents could indicate more than one item.

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Almost every respondent would recommend a trip to Churchill to their friends and/or family. This suggests a high degree of overall satisfaction with their experience in Churchill. Irrespective of season, three out of four people surveyed stated that they were "very satisfied" with their visit to Churchill. Opinions on individual aspects of Churchill as a vacation destination suggested high satisfaction with feelings of personal safety and friendliness of local merchants.

As the results presented in this paper show, there are both commonalities and differences associated with visitors to Churchill across the seasons. In spring more than the other seasons, visitors to Churchill are not travelling to satisfy educational motives. They are more likely to be repeat visitors, travelling for business, and using their past experience as an information source. Those travelling on vacation are interested in bird watching and use the Parks Canada VRC for information on nature. During summer, visitors to Churchill are often here for the first time, on a short vacation travelling to meet local people, and satisfy educational and cultural/historical learning motives. These visitors use a variety of information sources before their trip, rely on Churchill residents for information during their trip, and stop at the Parks Canada VRC for information on Churchill, history, and to see displays. During autumn, visitors to Churchill are typically first time visitors on a pre-booked holiday. They are in Churchill for 3-4 nights to view wildlife (polar bears), meet local people and satisfy educational and cultural/historical learning motives. These travellers use tour operators/travel agents as information sources before their trip and Churchill residents for information during their trip. They visit the Parks Canada VRC for information on nature, history, and to see displays. These unique, seasonally-based profiles have implications for tourism planning and destination marketing.

Table 2. Important Destination Features

	Spring	Summer	Autumn
viewing wildlife	3.23	3.42	3.80
wilderness/nature	3.39	3.42	3.70
to increase knowledge	3.06	3.39	3.41
interesting scenery	2.30	3.35	3.43
viewing birds	3.02	2.60	2.48
friendly local people	2.94	3.20	3.20
environmental quality	3.01	3.17	3.14
safe environment	2.92	3.03	3.08
native culture	2.48	2.93	2.85
health/cleanliness	2.71	2.76	2.77
viewing historical sites	2.27	2.91	2.43

** Average values based on a 4-point scale where 1 is not at all important and 4 is very important.

IMPLICATIONS

Results of the Churchill Visitor Study are being used by Parks Canada to assist in policy and planning decisions that relate to the Manitoba North National Historic Sites, the Parks Canada Visitor Reception Centre, and Wapusk National Park. They are also being used by government and industry partners involved in heritage and nature based tourism. More specifically for Parks Canada purposes, this information has been integrated into the management plan for the Prince of Wales Fort and served as a springboard for more in-depth interviews of Prince of Wales Fort visitors. The detailed results regarding VRC programs and services (not fully presented here) have been used to determine priorities for service delivery, including hours of operation. Further, the CVS results have been presented to the Wapusk Management Board to provide background on current and potential visitor markets, and information regarding visitor reception needs associated with a new national park.

Information from the Churchill Visitor Study recently served as a catalyst for discussions at a tourism forum organized by Manitoba Industry Trade and Tourism in cooperation with the Town of Churchill, the Chamber of Commerce, and Parks Canada. At this forum, seasonal profiles of visitors were shown as one way to segment the market. Discussions ensued regarding development of appropriate communications, products, and services through a destination marketing strategy, and the need for continued research in this area.

ACKNOWLEDGEMENTS

Many thanks are extended to Pam Doyle and members of the Manitoba North office who provided support and cooperation throughout the Churchill Visitor Study.

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POD

Theory and Practice of

C.J. Taylor

Historic sites are being discussed a lot these days by the program that creates them. Do they represent Canadian society well enough, do they properly represent the original reasons for their designation, can we use them to better educate Canadians about a common heritage? To this end the program has initiated planning and thematic studies to sound the completeness of the historic sites system and drafted policies to direct their development. And yet much of this analysis has ignored the complexities of the resource they are discussing. Historic sites stem from two dynamics—the process of selection and interpretation of Canadian history and the historic resource itself. Sometimes the resource gets forgotten in the larger scheme of applying policy to historic sites.

National Historic Sites have been created in Canada since the early 1920s and there are now more than 800 of them scattered across the country commemorating a wide variety of people, places and events from Canadian history. They are designated by the minister responsible for the Historic Sites and Monuments Act on the advice of the Historic Sites and Monuments Board of Canada. Historic sites used to be distinguished from national historic parks, the latter being historic sites that were owned and operated by Parks Canada with interpretive programs and protection under the legislation of the National Parks Act. Although this legislative authority still exists, the current policy prefers not to use the term national historic park. "The term national historic site," explains the policy, "embraces the entire spectrum of nationally significant historic places . . . ." It does not matter whether a place is a restored complex operated as a living history museum such as Louisbourg, a cost-shared project such as McLean Mill, or merely a downtown bank with a plaque on the wall, all are deemed national historic sites in the eyes of the policy and equally as important. Although people and events are recognized for their contribution to the nation's history, they are not defined as national historic sites unless designated along with a particular associated place. Thus William Lyon Mackenzie King is commemorated at Woodside in Kitchener. Woodside is the national historic site, not King even though the former prime minister is considered to be of national historic significance. The site is owned and managed by Parks Canada and there is a well-developed program of conservation and preservation in place. In contrast, J.B. Harkin, the first commissioner of the national parks service, is also commemorated by means of a plaque beside a building. But the building is the headquarters of Banff National Park which, although managed by Parks Canada like Woodside, it is not considered to be a national historic site. The former headquarters at Jasper National Park, however, is a national historic site, designated as being a nationally significant example of the Rustic architectural style.

> *"The term national historic site embraces the entire spectrum of nationally significant historic places . . . ."*

National historic sites share two common attributes: they are connected to recommendations of the Historic Sites and Monuments Board and are usually identified with an historic place.[1] They can therefore be divided up in two ways. There are sites represented by plaques alone and there are sites represented by protected heritage areas. The plaque subjects are selected by the Historic Sites and Monuments Board which usually recommends where the plaque will be erected. Often the site location is obvious, but not always. In 1936, for example, the Historic Sites and Monuments Board decided to commemorate French-English rivalry on Hudson Bay. A plaque was prepared and possible sites were scouted. York Factory was selected as the appropriate place for this commemoration. Only when the site was acquired by the program did it become a protected heritage area. With this activity, the place became important for other things. It was a well-preserved example of fur trade architecture and it presented opportunity for explaining various aspects of fur trade history.[2] Similarly, Batoche was originally selected to accommodate a plaque commemorating an event from the 1885 Rebellion but when the site was acquired it came with resources from Metis settlement and provided many opportunities to present Metis culture. The act of site development, then, changed the aspect of the national historic site. Sometimes this is a good thing, but the program has regularly worried that local development could get out of control. The introduction of the concept of "commemorative integrity" was partly an attempt to reconcile this conflict.[3]

But commemorative integrity statements are designed to give primacy to the original Board recommendation, subordinating the potential of the resource for presenting other themes of Canadian history. This sometimes leads to confusion, especially when national historic sites get mixed up with other cultural resources in protected heritage areas. This can be particularly apparent and sometimes confusing in national parks. Banff is the location of Sulphur Mountain Cosmic Ray Station National Historic Site. This was the place where, in 1957-58 a simple observatory operated as part of International Geophysi-

[1] *There are some exceptions. Alexander Graham Bell National Historic site is located across the river from the famous inventor's birthplace.*

[2] *I am grateful to Bob Coutts, Parks Canada, Winnipeg, for telling me of this case.*

[3] *See Bill Yeo, "What is Commemorative Integrity?" Research Links, vol.5, no.3 (Winter 1997) for an explanation of this term.*

cal Year. The building has long since disappeared and all that remains is a concrete foundation. Less than 50 metres away is situated a stone observatory built in 1903 and that has a long association with the park's history. Yet, according to the national historic site CRM policy, the concrete foundation is deemed to be a Level I resource while the Sanson observatory is considered to be of secondary importance.

The nature of the resource should be considered along with motives of commemorative intent in planning appropriate activity and the range of possible historical presentation. Different kinds of sites are

Research Links

Winter 1998
Volume 6 • Number 3

WRITE TO

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RESEARCH_LINKS@
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MEETINGS OF INTEREST

November 19-22, 1998

Working Together on Innovative Approaches to Sustaining Protected Areas, Vancouver, BC. Hosted by the BC Chapter of the Canadian Parks and Wilderness Society (CPAWS). This conference will focus on practical approaches and new ideas for maintaining ecological integrity, educating parks users, paying for parks and working on stewardship initiatives to maintain parks. This is an excellent opportunity to learn from other participants and speakers from across Canada and internationally about developing innovative tools, models and partnerships that will help ensure the future of our parks. Contact: CPAWS—BC, #611 - 207 W. Hastings St. Vancouver, BC, V6B 1H7. Tel: (604)685-7445, e-mail: communication@cpawsbc.org

February 15-19, 1999

The Biology and Management of Species at Risk. University College of the Cariboo, Kamloops, BC. This is a challenging time for the management of sensitive species and habitats. We have a growing body of research and knowledge, but a limited amount of extension and application. The lack of accessible information has become a barrier to incorporating new data into working practice. This conference will focus on the biology and management of species and habitats at risk in the Pacific Northwest. The event will highlight research and action taken on sensitive species and habitats though an impressive line up of speakers by facilitating stronger communication between researchers and user groups. Contact: Karl Larsen, Tel: (250)828-5456, e-mail: klarsen@cariboo.bc.ca or Tom Rankin, Tel: (250)371-5773, e-mail: speciesatrisk@cariboo.bc.ca. Web site: http://www.caribou.bc.ca/speciesatrisk

May 17-22, 1999

Wilderness Science in a Time of Change. Missoula Montana. This conference will present research results and synthesize knowledge and its management implications. This conference should result in a state-of-the-art understanding of wilderness related research. It will also improve our understanding of how research can contribute to the protection of wilderness in the 21st century. Considerable attention will be devoted to the ever-changing role of wilderness in society and the need to better integrate diverse social and biophysical sciences. Plenary sessions will explore: the values of the transactions between science and wilderness, the need to precisely define "wilderness" so scientific process can be effectively applied to wilderness management, the implications of increasing technological development and external pressures. For information contact: Natural Resources Management Division, Centre for Continuing Education, The University of Montana, Missoula, MT 59812. Tel: (406)243-4623 or (888)254-2544; e-mail: ckelly@selway.umt.edu

May 22-26, 1999

George Wright Society (GWS) Biennial Conference. Great Smokies Holiday Inn SunSpree Resort, Asheville, North Carolina. The concurrent sessions of this GWS conference will be divided in three tracks: a Management track, to highlight case studies and practical applications; an Analysis/Synthesis track, for research findings and policy discussions,; and a regionally focused Appalacian Issues track. Abstracts will be accepted until October 15, 1998. An on-line abstract submission form is available at the conference website: http://www.portup.com/~gws/gws99.html

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