Parks and Protected Areas: Dynamic Landscape or Museum?

2005 Proceedings

September 29 & 30, 2005
Holiday Inn South
Winnipeg, Manitoba

Parks and Protected Areas Research

Winnipeg Manitoba website http://www.umanitoba.ca/outreach/pparfm/index.html

2005 Forum Proceedings

PARKS AND PROTECTED AREAS: DYNAMIC LANDSCAPE OR MUSEUM?

Parks and Protected Areas Research Forum of Manitoba
(PPARFM)
September 29-30, 2005
Winnipeg, Manitoba, Canada

Edited by:
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Using Research to Help Manage Manitoba's Parks

The Parks and Protected Areas Research Forum of Manitoba (PPARFM) was established in 2001 by the University of Manitoba, Brandon University, Parks Canada, and Manitoba Conservation as a vehicle to encourage research, support scientific approaches to parks and protected areas management, and develop the skills of professionals in the area. PPARFM's objectives are:

- to promote research to improve understanding, planning, management and decision making for parks and protected areas
- to encourage educational and training activities related to parks and protected areas
- to facilitate more cooperation in parks and protected areas research
- to establish a meeting place for people involved in parks and protected areas research
- to exchange information on a regular basis among people involved in parks and protected areas research, and
- to monitor and report on research in parks and protected areas.

Since 2002, PPARFM has held an annual event to address these objectives. Previous Forum themes have been:

2002 Inside the Outside - Managing Backcountry Recreation.
2003 Challenges in Parks and Protected Areas: Advancing Knowledge and Practice through Research.
2004 What is the Meaning of a Protected Area? A Diversity of Perspectives.

This year's Fourth Annual Forum focussed on the theme "Parks and Protected Areas: Dynamic Landscape or Museum?". The theme was chosen to enhance our understanding of working and cultural landscapes with respect to protected areas. These Proceedings from the 2005 Forum include papers on research and practice in natural and social science settings, that may aid in the planning and management of ecological resources and human use at parks and protected areas in Manitoba and elsewhere.

Thank-you for your contributions.

Congratulations to 2005 Student Research Paper/Poster Award Recipients:

Jennifer Smith; Lakehead University:
Wild Wolves? Understanding Human-wolf Interactions in the Broken Group Islands of Pacific Rim National Park Reserve

Jane Driedger; University of Manitoba:
Plants, Stories and the Cultural Landscapes of the Whitefeather Forest, Ontario, Canada

Janene Shearer; University of Manitoba:
Cheekahnahwaydahmungk Keetahkeemeenaan "Keeping the Land": Aboriginal Values of Custodianship in the Whitefeather Forest Cultural Landscape

Thank You to Our Sponsors and Supporters

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2005 PPARFM Event Highlights

"Parks and Protected Areas: Dynamic Landscape or Museum?"

The 4th Annual Parks and Protected Areas Research Forum of Manitoba (PPARFM) was held on September 29-30, 2005 at the Holiday Inn South in Winnipeg. Over 70 delegates from Saskatchewan, Manitoba, and Ontario attended the two-day Forum. Participants appreciated the opportunity to network with people from other organizations and gain insights on current research. Thank you to our event sponsors - Parks Canada, Manitoba Conservation, Manitoba Model Forest, the Health Leisure and Human Performance Research Institute and Faculty of Environment of the University of Manitoba, Nature Conservancy of Canada, Brandon University, and Mountain Equipment Co-op. The Forum would not have taken place without your generous support.

Dr. Janis Alcorn receives a gift from Dr. Iain Davidson-Hunt

The morning began with a thought provoking presentation by the keynote speaker, Dr. Janis Alcorn. Dr. Alcorn is an independent consultant serving as Advisor to The Garfield Foundation and a Research Associate with The Field Museum's Anthropology Department. Dr. Alcorn challenged our traditional notions of protected areas through the examination of public and private heritage.


Delegates at the Holiday Inn South

Following this, David Neufeld, an Arctic Historian for Parks Canada, moderated the panel presentation, titled "Writing Our Histories into the Land: First Nation Initiatives". Alestine Andre and Ingrid Kritsch of the Gwich'in Social and Cultural Institute presented the Gwich'in Tribal Council initiative in the Northwest Territories. Oliver Hill from the Whitefeather Forest Management Corporation and Andrew Chapeskie from the Taiga Institue for Land, Culture and Economy presented the Whitefeather Forest Initiative of Pikangikum First Nation. Both initiatives were examples of areas protected through partnerships and a sharing of knowledge.


Fort Whyte Centre field trip

This year delegates ventured out of the hotel for a field trip to the Fort Whyte Centre. Aynsley Toews gave a wonderful overview and history of the Fort Whyte Centre and then delegates were off. The group was divided into three separate dynamic interpretative sessions; Urban Wildlife Mangement, Fort Whyte Green Corridor Master Plan, and the Wetland Walking Tour. The field trip ended with a relaxing wine and cheese reception held in the Fort Whyte Café.

Understanding Protected Areas Through Research was the focus of the second day of the Forum with presentations and posters highlighting the broad range of research that is being conducted within parks and protected areas. Delegates enjoyed the chance to learn about new and upcoming research and to network with other delegates.

The afternoon was dedicated to an interesting problem solving exercise entitled, "Museum or Dynamic Landscape: A Case Study". Delegates were divided into groups and were given background information on a fictional case study. Each group had to come up with a solution with residents and stakeholders of "Paradise Park and Town Site" arguing each of their points. Each group had a good time debating and coming up with radical solutions.


Student Award winners with Dave McVetty of Parks Canada

At the end of the day the Student Research Awards were announced. Dave McVetty, Manager, Social Science Unit, Western & Northern Service Centre, Parks Canada, presented Jennifer Smith (Lakehead University) with the Best Student Presentation, and Jane Driedger and Janene Shearer (Natural Resources Institute, University of Manitoba) with the Best Student Poster Award. The three winners received an award certificate, funds to assist with their research and free registration for next years' Forum.

PPARFM was Co-chaired by Dr. Kelly MacKay, Joint Appointment of Parks Canada and the University of Manitoba, and Maureen Peniuk, Parks Canada. For more information on PPARFM, visit our website at www.umanitoba.ca/outreach/pparfm/ .

2005 Forum Program

Day 1: September 29

8:30-8:45 **Registration**

9:00-10:00 **Opening Keynote: Dr. Janis Bristol Alcorn,**
The Garfield Foundation and The Field Museum of Chicago

"Heritage Dynamics – Responding to Global Change Challenges"

Janis Bristol Alcorn is currently an independent consultant serving as Advisor to The Garfield Foundation and a Research Associate with The Field Museum's Anthropology Department. She has a PhD in Botany with a minor in Anthropology. She has held Fellow positions at the United States Agency for International Development and the World Resources Institute, directed a conservation and development program at World Wildlife Fund, and taught at Tulane University. Dr. Alcorn has done research and applied fieldwork in Mexico, Peru, Bolivia, Panama, Namibia, Tanzania, India, Nepal, Bangladesh, Thailand, Indonesia, Philippines, Papua New Guinea, and North America. She has published five books, and over ninety articles on ecology, conservation, ethnobotany, resource management, governance, Indigenous Peoples, traditional medicine, donor best practices, and public policy. Dr. Alcorn is currently supporting collaborative conservation projects with local governments and communities in Bolivia.

Sponsored by the Health, Leisure, and Human Performance Research Institute, University of Manitoba & Canada Research Chair, Centre for Community- based Resource Management (CBRM), University of Manitoba.

10:00-10:30 **Coffee break**

10:30-12:00 **Panel:**
"Writing Our Histories into the Land: First Nation Initiatives"
Panel Presentation moderated by, **David Neufeld,** Parks Canada

How can indigenous cultural landscapes be adaptive over time while safeguarding important land-based values? **Alex Peters**, Whitefeather Forest Management Corp., and **Andrew Chapeskie**, Taiga Institute for Land, Culture and Economy will present the Whitefeather Forest Initiative of Pikangikum First Nation located in Northwestern Ontario. **Alestine Andre** and **Ingrid Kritsch** of Gwich'in Social and Cultural Institute will present the Gwich'in Tribal Council initiative in the Northwest Territories.

Sponsored by Canada Research Chair, Centre for Community-based Resource Management, University of Manitoba, Whitefeather Forest Research Cooperative, Pikangikum First Nation, Parks Canada, Sustainable Forest Management Network.

12:00-1:00 **Lunch**

1:00-1:30 **Introduction to Fort Whyte Centre:**
Aynsley Toews; *Director of Programs*

1:30-2:00 **Transportation to Fort Whyte Centre**

2:00-4:00 **Interpretative sessions at Fort Whyte Centre**
1. Urban Wildlife Management
2. Fort Whyte Green Corridor Master Plan
3. Wetland Walking Tour

4:00-4:45 **Reception wine and cheese**

4:45 **Return to hotel**

Day 2: September 30

8:30-8:45 **Registration**

8:45-9:00 **Committee Welcome**

9:00-10:00 **Research Paper Presentations (3)**

Sean Frey - Aerial Beaver 2004 Survey RMNP

Astrid Vik Stronen - Farmer Attitudes toward Wolves in the Riding Mountain Ecosystem: Implications for the Role of Predators in Managing Disease.

R. Harvey Lemelin -The Integration of Human Dimensions with the Environmental Context: A Study of Specialization in Polar Bear Observers in Churchill, Manitoba.

10:00-10:30 **Coffee break**

10:30-11:30 **Research Paper Presentations continued… (3)**

Matthew Bowes -Mapping Landscape Meanings in The Broughton Archipelago

Jennifer Smith - Wild wolves? Understanding Human-Wolf Interactions in the Broken Group Islands of Pacific Rim National Park Reserve

David Smith - Prudent Use of Grazing by Cattle to Maintain Remnant Tallgrass Prairie Patches

11:30-12:00 **Research Poster Introductions**

Jonathan Wiens - Habitat use and abundance of the common garter snake at the northern limit of its range in Manitoba

Jane Driedger - Plants, Stories and the Cultural Landscapes of the Whitefeather Forest, Ontario, Canada

Jason D. Kelly - Communities for Conservation: Creating a Framework for Plains Bison Conservation in Central Saskatchewan

Janene M. Shearer - Keeping the Landscape: Aboriginal Values of Custodianship in the Cultural Landscape of the Whitefeather Forest

Jacques Tardif - Natural disturbance dynamics in the Duck Mountain Provincial Forest, western Manitoba

12:00-1:30 **Lunch Buffet & Poster Viewing**

1:30-2:45 **"Museum or Dynamic Landscape: A Case Study"**
Many factors can affect our ability to meet natural landscape objectives. What are these factors and to what degree do they influence land management decisions?

2:45-3:00 **Coffee break**

3:00-3:15 **Student Research Award – Presented by Parks Canada**

3:15-4:00 **Closing**

Dr. Janis Bristol Alcorn, The Garfield Foundation and The Field Museum of Chicago

Committee Farewell

Writing Our Histories into the Land: First Nation Initiatives

A Panel Presentation

Introduction for Gwich'in Social and Cultural Institute and Whitefeather Forest Initiative
David Neufeld, Yukon & Western Arctic Historian, Parks Canada

Human societies draw meaning from the place where they live and, through their experiences there, attribute values to it. That is, it is their home. Narratives of meaning underlie cultural landscapes.

Earlier this summer I was introduced to the Accord on Protected Areas and First Nation Resource Stewardship and the Pikangikum First Nation's Whitefeather Forest Initiative integrated with it. The Accord notes the central role of the Creator in sustaining life. The Creator not only gives life, he has given "our First Nation way of life as a precious gift." Finally the Creator has given responsibility for the care of the land to the people who must rely on their long experience on the land, "the teachings and wisdom of our Elders".

The accord describes an Anishinaabe / Ojibway cultural landscape, a landscape with manomin fields, pictographs, relationships with woodland caribou, with wolverine, with sturgeon and lake trout, with sandhill cranes, with loons and with special plants. The Whitefeather Forest Initiative describes how people can live a life in this place. This cultural landscape, for that is what is being described, defines a vision of the future - "we are to stand together and work with each other and all peoples for the well-being of life on Mother Earth both for the present and the future. Today we are honoured to have Pikangikum Elder Oliver Hill to tell us how "Our land is our life". He is joined by Alex Peters, President of the Whitefeather Forest Management Corporation, and Andrew Chapeskie, of the Taiga Research Institute, to explain this initiative.

For the Gwich'in Tribal Council, on land straddling the Mackenzie River in the Northwest Territories, their land has similar meanings and values. They rely on their long term relationship to the land to give meaning to, as well as to sustain, their lives. It is their stories about places along the rivers, it is the way they live on the land that directs their stewardship of their traditional territory. I have been priviledged to work with Alestine Andree and Ingrid Kritsch on identifying and highlighting the Gwich'in values of a portion of their traditional territory. My role in this work to try and bring a better understanding of a First Nation approach to resource stewardship to Parks Canada, to Canada.

One of the challenges government conservation and land management agencies face in this work is that there are multiple visions of the future for the lands that make up Canada. Parks Canada, like other agencies, represents the state's visions through protected heritage areas - national and provincial parks and historic sites. What is this vision? Like the First Nation approach it acknowledges the Creator and speaks to his handiwork on earth. However, what Europeans saw when they explored North America, a place where they did not have long term relationships, were dramatic landscapes, the raw elements of creation, the primitive and the untamed - the wilderness. That is, they did not see anything familiar and bent their backs to transforming their "New World" into a version that fulfilled their vision of the future. They did see value in protecting some special places from this transformation, partly to ensure that people could visit and re-energize through contact with nature, but also so they could see how hard their ancestors had worked to change the continent and make it theirs. This was a vision of the future that denied aboriginal people any role in the modern world. They are "invisible Indians" as Alex Peters has said. Andrew Chapeskie has noted this stark choice offered by the new states in his writings - land is either exploited or dehumanized, that is, made into a wilderness.

Parks Canada, through accepting concepts like the aboriginal cultural landscape, is coming around to alternative ways of seeing land management. Perhaps "wilderness" or "pristine nature" are only western

fabrications denying human presence, perhaps other cultures, cultures with a much longer residency, can legitmately offer real alternatives.

However, the full implications of applying this in a grand way such as the Pikangikum First Nation propose in the Whitefeather Forest Initiative and the Accord First Nations forward in their interest in pursuing a Boreal Forest World Heritage Site are yet to be comprehended. These initiatives challenge deeply held visions of the future that have shaped the western understanding of both the nature of the state and protected heritage areas in North America. I think the Gwich'in Social and Cultural Institute experience, and others like it across the country, have begun to make significant changes in how our country understands the need to understand and accept multiple views of the future. A vision of the future where all the nations in Canada work towards mutual recognition of each others' existence, a future where cultural continuity is recognized as a primary value and a future where with consent amongst nations for change means that crafting a future will take time and care, as it always has.

Research Paper Presentations

1. Riding Mountain National Park Aerial Beaver Survey 2004

Sean Frey
Riding Mountain National Park
Resource Conservation
Parks Canada

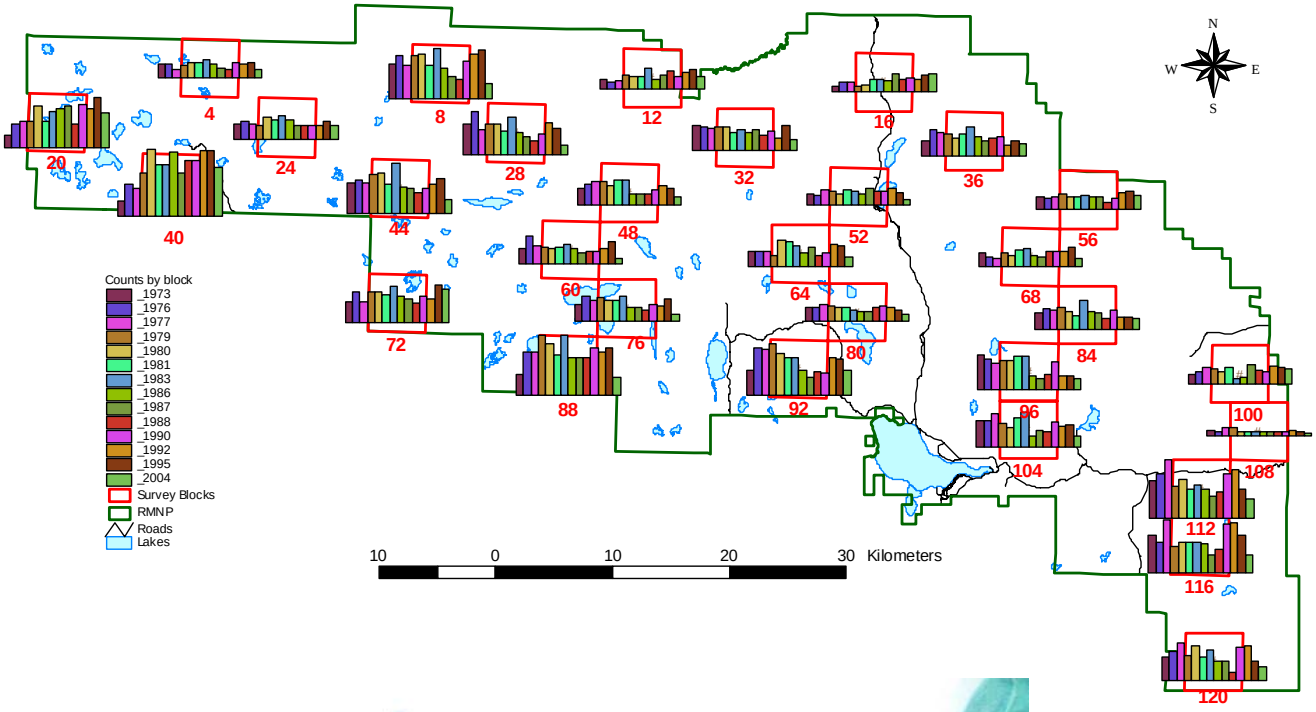
Abstract
Beaver (*Castor canadensis*) have been identified in numerous park management documents, both as a key component of the greater Riding Mountain ecosystem and as cause for concern among people inside and outside the park who are impacted by the landscapes beavers create. Beavers were thought to be abundant in the area prior to European settlement, but through trapping and poaching their numbers declined to an estimated low of 5 or 6 families by 1936. Through reintroduction efforts and natural colonization the population appears to have increased and stabilized in the last few decades at around 3000 colonies (caches), which roughly equates to 17000 beaver at the Canadian average colony size of 5.7 beaver.

The Canadian Wildlife Service initiated systematic aerial surveys of caches in 1973 in order to obtain population trends within Riding Mountain National Park (RMNP). The data provides a trend for colonies distributed across the park within watersheds and ecological land districts, which allow managers to gain a sense of how prevalent beaver are in the ecosystem.

The 2004 aerial beaver survey was the 15th survey to be completed, since 1973 and was flown in a fixed wing aircraft. Navigation was conducted by the pilot with the aid of a GPS unit and verified by the recorder who had real-time mapping and data collection capabilities on a laptop computer. The survey covers 725 square km or 23.4 % of the area of Riding Mountain National Park and takes 5 days of flying.

It is evident that the beaver population in Riding Mountain has decreased in the period from the 1995 survey and is below the historic range of variation in the cache estimates from the past 15 surveys since 1973. Whether the decrease is from a series of dry, warm years with reduced precipitation; increased predation; vegetation and habitat change; or disease is unknown. Spatially it appears that the greatest decreases in population occurred in the highest reaches of the watersheds in the highland plateau district, which is also the most susceptible to drought, therefore it would be reasonable to assume that the lack of water is a factor in the decline. It is also clear that nine years between surveys is inadequate temporal resolution to be able to monitor trends in the beaver population or to make conclusions.

Graphing map showing count per block for each year surveyed between 1973 and 2004.



Robert Watson using navigation and recording laptop inside Cutlass aircraft (photo: Tim Sallows).

Appendix A

STATISTICAL TREATMENT OF 2004 DATA

Total number of sample units in the population (total blocks in the park)	N =	127.555
Number of sample units in Aerial Survey (number of sample blocks)	n =	30
Number of colonies sampled per block.		

Problem: Calculate the estimated number of beaver caches (Y) in Riding Mountain National Park based on 2004 Aerial Beaver Survey data.

Y = Average caches per block x total blocks in the park.

$$= \frac{Y^1 + Y^2 \ldots Y^{30} \times N}{n}$$

$$= \frac{\text{total caches counted on survey} \times 127.555}{30}$$

$$417 \frac{\times 127.555}{30} = 1773.015$$

Therefore, the estimated park cache number is: 1773

Problem: Calculate the 95% confidence limits of the cache estimate (Y) for 2004.

The following statistical treatment is carried out to establish confidence limits of the cache estimate (Y). Please remember that the cache estimate is not the absolute true number in the park, but the true number will very likely lie within the 95% confidence limits. Also note that each cache may represent anywhere from 4 to 11 beaver.

Total number of sample units	N =	127.555	blocks
Number of units in the sample	n =	30	blocks
Number of caches counted/block	y =		
Sample estimate (cache estimate)	Y =	1773	

Step 1: Calculate sample variance Sy^2

Sum of small y $\Sigma y =$ 417

Sum of small y squared $(\Sigma y)^2 =$ 173889

Sum of small y squared $\Sigma y^2 =$ 10285

Sample variance $Sy^2 = \frac{1}{n-1} \left(\Sigma y^2 - \frac{(\Sigma y)^2}{n}\right)$

Sample variance $Sy^2 =$ 155

Step 2: Calculate the population variance Var (Y)

$$\text{Var}(Y) = \frac{N(N-n)}{n} \times Sy^2$$

Var (Y) = 64292.08

Step 3: Calculate population standard error SE (Y)

$$\text{SE}(Y) = \sqrt{\text{Var}(Y)} = 253.56$$

$\frac{n(N-N)}{n}$ = A correction factor which expresses the intensity of sampling, being a form of weighting: the higher the sampling intensity, the smaller this term becomes, so that if all blocks in the park were surveyed, this function would become 0.

Step 4: Calculate the 95% confidence limits.

95% confidence limits of y

$= \pm 2.04 * SE\ (y)$

$= \pm 2.04 \times 253.56 = 517.26$

Therefore, the cache estimate with 95% confidence limits is:

Minimum 1256 Likely 1773 Maximum 2290

Note: This calculation was set up within the Excel workbook (2004BeaverSurveyData) for the survey data under the sheet tab labelled 'Estimate'.

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2. Farmer Attitudes Toward Wolves in the Riding Mountain Ecosystem: Implications for Managing Bovine Tuberculosis

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Stéphane McLachlan
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Abstract
The potential for disease transmission between wild and domestic animals may interfere with efforts to conserve wildlife and associated habitat and movement corridors on lands surrounding protected areas. The possible transmission of bovine tuberculosis (*Mycobacterium bovis*) from elk (*Cervus elaphus manitobensis*), deer (*Odocoileus virginianus*) and other wildlife to domestic livestock has recently become a contentious issue in the Riding Mountain National Park region in Manitoba, Canada. Wolf *(Canis lupus)* predation, combined with winter severity and hunter harvest likely reduces cervid populations inside the park and on surrounding farmlands, which may help lessen the risk of disease transmission to livestock. This study examined farmer attitudes toward wolves and conducted an exploratory analysis of causal factors associated with tolerance of wolves on their farms. We mailed a survey of 4,220 farms within 50 km of Riding Mountain and 546 responses were usable and complete, resulting in an adjusted response rate of 21%. We constructed several logistic regression models with factors hypothesized to influence whether farmers agreed with the statement “I enjoy seeing wolves on my land”. Although 52 % of farmers felt they had never experienced serious damage from wolves, 44 % did not enjoy seeing wolves on their land. Over half of livestock owners (52%) disagreed with the statement ‘I enjoy seeing wolves on my land’, while only 26 % agreed with the statement. For the 26 % of farmers that reported not owning any livestock, the results were opposite, with 26 % disagreeing with the statement and 54 % enjoying seeing wolves on their land. Positive attitudes towards wolves were, in order of importance, associated with less frequent sightings of wolves, less perceived damage from wolves, and with perceived lower wolf population size. More positive attitudes were also associated with increasing distance from RMNP or the Duck Mountains, and with owning fewer beef cattle (*Bos taurus*). Of respondents who perceived the wolf

population as “too high”, 25 % had low, moderate or high concern about bovine tuberculosis in wild elk, while 60 % were extremely concerned about the disease. This indicates that concern regarding TB currently has little influence on attitudes toward wolf population size, which suggests that the role of wolf predation as a potential natural regulator of elk in the Riding Mountain ecosystem may not be widely recognized. Farmers, especially those that own livestock, may be more positive towards wolves occupying the national park, or wolves in general, than wolves observed on their own land. Should this be the case, this attitude may compromise the long-term viability of the RMNP wolf population. While attitudes towards wolves may be generally positive as long as animals remain inside the park boundary, wolves will need to disperse between RMNP and surrounding areas to maintain genetic variation in the park population.

The relationship between wolf predation and wildlife disease could also be affected by other ecological links. In RMNP, wolves are important predators on beavers, which comprise over 33 % of their summer diet. Many farmers in the region feel that the beaver population in and around the park is too high, and it is generally believed that beaver flooding in RMNP has largely destroyed elk habitat in the park, forcing elk out onto agricultural lands. Wolf predation on beaver may help maintain elk habitat within RMNP, which could increase the number of elk that can forage within park boundaries and thus avoid direct contact with cattle. While elk may leave the park to find forage, farmland may also provide them with a refuge from predators such as wolves, which are generally discouraged or controlled in agricultural areas.

Based on written comments and subsequent discussion with farmers, we believe that some observations may actually have been of coyotes and not wolves, and the likelihood of this probably increases with distance from the parks. However, it is important to realize that the essential factor influencing attitude is not whether the farmer actually saw and/or experienced financial damage from a wolf, but whether the person *believed* that it was a wolf. While the relationship between actual and perceived levels of damage may be unclear, perceptions are important for farmer attitudes to wildlife. Manitoba farmers have received compensation for livestock killed or injured by black bears *(Ursus americanus)*, cougars (*Felis concolor)*, wolves, foxes (*Vulpes vulpes)* and coyotes since 1997. However, situations where livestock are missing with no direct evidence of predation could cause discrepancy between official wolf predation data and the number of losses that farmers believe are caused by wolves and other predators. In our survey, we asked farmers to what degree they felt wolves had caused financial damage on their land, so answers likely reflect both confirmed and suspected losses.

We believe that the potentially positive role of wolves in reducing bovine tuberculosis in ungulate populations provides a unique opportunity to promote wolves as a beneficial ecosystem component. Increasing communication between rural residents and the various levels of government about wildlife concerns, including disease and predation, will be important in this regard. The recent establishment of multi-stakeholder groups including Parks Canada and local resident representatives to discuss wildlife and disease concern in the RMNP area is encouraging. These forums may provide opportunities for ongoing communication about a range of concerns related to wildlife and agriculture. Future research and education efforts could help clarify the role of wolves as regulators of ungulate populations, and thus, represent an opportunity to mitigate the impacts of bovine tuberculosis on livestock operations, while simultaneously promoting conservation of a wide-ranging carnivore.

3. Mapping Landscape Meanings in the Broughton Archipelago

Matthew Bowes
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Abstract
Exploring the human dimensions of ecosystems has become an integral part of "ecosystem based management" (Deardon, 2004) in parks and protected areas, illustrating "a response to the limitations of scientific and technical information which seeks rational, comprehensive, but often placeless understandings of the world abstracted and removed from specific contexts" (Galliano & Loeffler, 1999, p.3). Difficult to express meanings and values people have for places, or senses of place, significantly reflect a particular aspect of the human dimensions of ecosystems (Galliano & Loeffler, 1999). Place based meanings also serve as an addition, or complement to scientific and technical information, but also, as a connection between social experiences and geographic areas (Galliano & Loeffler, 1999). Understanding the concepts of place can enable managers to better understand the relationships people have to the land (Kruger, 2005). A better understanding of how people interact with the land and how they value certain places can help to identify stakeholders and opportunities for collaboration and anticipate potential conflict (Kruger, 2005). Understanding place meanings can help managers to mitigate impacts on places important to people (Kruger, 2005).

An ecosystem based approach that recognizes people as a part of ecosystems in natural resource and recreation management has been around and evolved since the early 1970's (Slocombe, 2004). Currently, in British Columbia this can be illustrated in grand overarching land use planning strategies such as the Central Coast Management Plan and the current social science program in Pacific Rim National Park Reserve (Coastal Zone Strategic Plan, 2004; Sparkes, 2004). In the Broughton Archipelago Provincial Marine Park, ecosystem management has placed importance on people as part of ecosystems, demonstrated in a 2003 Purpose Statement and Zoning Plan (BC Parks, 2004). There is however, a noted lack of detailed knowledge and awareness of natural and cultural values, acknowledged conflict issues for both commercial and private kayak operators, impact issues with fish farms and a need for improved park community relations (BC Parks, 2004). Consequently, a management plan is of high priority however government cutbacks resulting in small staffing and minimal funding challenge the policy process. The purpose of this study is to better understand recreational place based landscape meanings, or senses of place among stakeholders in the Broughton Archipelago Provincial Marine Park.

Over the past ten years of living and working in the area as a kayak guide and in forestry, I have come to know the Broughton Archipelago on an intimate level. I also have come to know it as a confluence of contested meanings of places among recreational, cultural, extractive and touristic interests. Place based meaning and values can add another "layer" conceptually to the existing baseline bio–physical inventory used in park planning.

Places are containers of varied and multiple histories through which people affirm multiple and conflicting place identities (Williams, 2002). While use infers importance to a "place," we also need to know how these places are being used and the meanings/values different individuals attach to them. In terms of landscapes, places can refer to the "symbolic environments created by human acts of conferring meaning to nature and the environment, of giving definition and form from a particular angle of vision and through a special filter of values and beliefs" (Greider & Garkovich, 1994, p. 1). For example, a white shell midden beach can carry multiple meanings in relationship to the "self definition of people in a particular cultural context" (Greider & Garkovich, 1994, p. 1). To a kayaker slowly moving by at the end of a long day on the water, this midden offers an ideal place to land and set up camp for the evening. It is "home" in leisure oriented context or perhaps it is a favourite place based on personal or emotional ties through familiarity

(Williams, Patterson, & Roggenbuck, 1992). To an aboriginal person, a midden indicates a traditional food-gathering site demonstrated by the sloping broken white shell surface from possibly thousands of years of harvesting clams at a particular time of year. “Landscapes are a reflection of these cultural identities which are about us, rather than the natural environment” and an interaction of the two (Greider, & Garkovich, 1994, p.2).

Sense of place meaning and values have been widely used in a variety of contexts since the early 1970’s (Williams and Stewart, 1998) and are fundamental to the way we value and enjoy the environment (Kruger & Jakes, 2003; Norton & Hannon, 1997). Currently, the ideas of place, attachment to place and place based planning are becoming more common in academic and agency practice (Kruger & Jakes, 2003). Accordingly, natural resource managers are using an array of methods to explore the meanings, experiences and actions that help them to understand “place” and relationships people have to their surrounding environments (Cheng, Kruger, & Daniels, 2003; Kruger & Jakes, 2003). These ideas are being used to create place based frameworks and for incorporation into planning and management (Bengston, 1994; Brandenberg & Carroll, 1995; Galliano & Loeffler, 1999; Greider & Garkovich, 1994; Satterfield, 2001; Williams and Patterson, 1994; Williams and Stewart, 1998).

In a recreation, leisure and tourism context, parks and protected areas, wilderness zones and multi-use areas pose interesting problems for appropriate and sensitive definitions of places. For example, multiple claims to an area and the culturally specific use of a shell midden beach in the above example illustrate the differing meanings of places in the Broughton Archipelago and form a fertile field for contestation over place meanings. In the same multi-dimensional way that different people and cultures define themselves through landscape, similar pluralistic, multi-dimensional techniques must be adapted to elicit information about and probe deeper into the meanings and values that people assign to places. The predominant theme displayed in the elicitation of “place” meanings is the importance of accessing textually rich data through innovative techniques that determine thoughts and feelings which are difficult to express (Satterfield, 2001) and represent in the technical milleux of planning.

Place meanings have practical and symbolic value. The cultural landscape of social history, scenic beauty, community identity, family heritage and spiritual values can also be illustrated as social and cultural features on a map (Williams & Stewart, 1998). Including social and cultural relationships that people have with landscapes on maps embeds their imprint on the land (Tobias, 2000). Linking this with qualitative narrative elicitation techniques tells an individual’s life story on the land and incorporating this into computer mapping techniques (GIS) can provide a technical tool commonly used in natural resource planning and management to spatially represent multiple layers of meaning and use (Williams & Stewart, 1998; Tobias, 2000).

My research consists of five phases. In phase one, a background literature review framed the project and helped to create elicitation techniques for interviews with stakeholders. Individuals were selected from a number of interest groups including kayak guides, kayakers in private self-guided groups, and First Nations tourism interests in the park. Phase two consisted of data collection through informal and open ended tape recorded interviews and “map biographies” with the above informants. Map biographies are created by locating places on maps during the interview process, enabling narrative data to spatially represent sense of place or landscape meanings and values. They also served as an effective catalyst for conversation for the mariner, guide, or people whose lives revolve around the ocean.

During phase three, data analysis will be conducted using In Vivo, a qualitative data computer analysis program to help organize and draw out emergent themes of place meanings, or important and special places, from the “conversations” and the “map biographies” that have been digitized onto a GIS database. Phase four will include a more extensive literature review to support the analysis in the final writing segment. During phase five, results will be presented to BC Parks as a contribution to a developing management plan.

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4. Wild Wolves? Understanding Human-Wolf Interactions in the Broken Group Islands of Pacific Rim National Park Reserve

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Abstract
Human-wildlife conflicts have become an internationally recognized concern for management agencies and stakeholders of multi-use wilderness areas (Madden, 2004). In 2004, the International Union for the Conservation of Nature (IUCN) World Parks Congress reported that viable wildlife habitat areas are becoming "islands" surrounded by a sea of development and cultivation, which leads to humans and wildlife occupying much of the same areas (Madden, 2004). Human-wildlife conflicts have intensified in areas around the world where human sprawl has destroyed wildlife habitat and exacerbated the rapid decline in species diversity and ecological integrity (Sanderson, Jaiteh, Levy, Redford, Wannebo, & Woolmer, 2002).

Academic interest in the human dimensions of wildlife management has grown in the past decade along with the knowledge that "protecting wildlife may conflict with expanding recreational disturbance in shrinking wildlands, so the need for understanding and managing recreational impacts on wildlife will continue" (Knight & Gutzwiller, 1995, p. XV). Humans are capable of modifying ecosystems on local to global scales (Alessa, Bennett, & Kliskey, 2003; Sanderson, et al., 2002). These environmental modifications have led natural resource and tourism researchers as well as managers of parks and protected areas to advocate that reducing human-wildlife conflicts involves managing people and understanding our surrounding environments (Alessa et al., 2003; Anderies, Janssen, and Ostrom, 2004; Bath & Enck, 2003; Burns & Howard, 2003; Decker, Brown & Siemer, 2001; Forbes, 2004; Madden, 2004; Noble, 2004; Orams, 2002; Roggenbuck, 1992; Slocombe, 2004).

Studying the human dimensions of wildlife management can yield insights into the issues of managing people versus trying to control wildlife that are oblivious to the boundaries we create in an attempt to keep them safe. The first step, therefore, is to gain a better understanding of the dynamic relationship that we have with our environment and the intricate connections that occur between diverse ecological systems.

Complementary to, and indeed part of, the human dimensions of wildlife management is the growing interest in social ecological systems, an emerging field of study within academia and wildlife management. Anderies, et. al (2004) and Sparkes (2005) are currently using social ecological systems (SES) to describe the ways in which "people are viewed as one of many biological units that influence other units, and are influenced by those other units" (Sparkes, 2005, p.1). Understanding the dynamics of how our social systems (human society) interact with each other and with the diverse array of ecological systems that surround us is a key component when using a social ecological systems approach (Sparkes, 2005).

In Pacific Rim National Park Reserve, for example, there are increasing accounts of wolf-human interactions (Sparkes, 2005) due to the recent establishment of wolves (*Canis lupus)* onto the Broken Group Islands (the only large carnivore present on these islands). These wolves were not re-established onto the islands as a result of park led re-introductions, but as a result of pursuing the large populations of black-tailed deer that are present on the islands. Wolves have been inconsistently present throughout the Broken Group Islands (BGI) since the 1980's. It was not until 2002 that the wolves in this area became permanent residents. In 2003, Parks officials reported the presence of the first litter of pups on Gibraltar Island, which they consequently closed to campers with the intention of reducing human-wolf interactions.

The establishment of this wolf population coupled with the high rates of visitation to the park has created a situation where the potential for negative interactions between wolves and people significantly increases. According to the BGI park warden, the wolves that inhabit the islands have begun exhibiting less wariness of humans and are learning to forage for food in areas that are highly frequented by people (Dan Vedova, personal communication, October 26, 2004). These actions not only create a safety hazard to visitors, but also to the wolves themselves. For example, if a wolf were to exhibit aggression toward a human, in response to being hand-fed, the situation would most likely result in the destruction of the wolf without any legal consequences, such as fines or charges, to the human. Since the establishment of wolves onto the islands, one case of human-caused wolf mortality has occurred in the BGI, where a food-conditioned wolf was destroyed after being hand fed by people.

This situation has prompted management actions to reduce risks to both people and wolves (Dan Vedova, personal communication, October 26, 2004). It is important for the park's ecological integrity that the natural dynamics of predators and prey develop without human hindrance (Bath & Enck, 2003). Therefore, park managers, field staff and stakeholders feel the need to ensure that visitors do not interfere with the life processes of the wolves, while visitors' exposure to risk as a result of the wolves' presence is minimized (Dan Vedova, personal communication, October 26, 2004).

In the BGI, it remains unclear if habituation and food-conditioning are solely the result of human influences. It is possible that wolves, being social creatures, are coming into contact with people as a result of their inherent curiosity, exposing them to a higher degree of risk (Bob Hansen, personal communication, October 22, 2004). Nevertheless, given the possibility that wolf habituation and food-conditioning could be caused by people, it is important to explore the human dimensions of this situation. Pacific Rim National Park Reserve is implementing a social ecological approach to better understand the dynamics at play between wolves and people within the park boundaries and in the adjacent areas including (but not limited to) Clayoquot, Tofino and Ucluelet. Appendix A illustrates the management framework for the SES research process that Pacific Rim National Park Reserve has implemented to "help identify any major shifts" in the areas of study and to highlight the importance of ongoing monitoring (Sparkes, 2005, p. 3).

As part of a broader initiative to explore both the human dimensions of human-wildlife interactions and the biology of cougar, bear and wolf populations and behaviours in and around Pacific Rim National Park Reserve, my research uses social science to explore kayakers' attitudes toward wolves and what wolves mean to them while visiting the BGI. According to Kellert (1980), "attitudes are broadly integrated feelings, beliefs and values…" (p. 31), while meanings are expressive, intangible and symbolic; differing from attitudes because they "cannot be tied to measurable (tangible) environmental features" (Williams & Patterson, 1999, p. 152). Once established, these attitudes and meanings will conceivably provide more insight into the complex dynamics at play in wolf-human interactions within the BGI unit of Pacific Rim National Park Reserve. The results from this research will act as baseline data upon which Parks Canada can build in order to produce more effective visitor education programs and possible behaviour modification strategies.

Pursued within a qualitative methodological paradigm, this study uses a mixed methods approach for data collection. The qualitative paradigm is congruent with my interest in a constrained constructivist understanding of human/wolf relations. Both the qualitative paradigm and constrained constructivism recognize that reality is composed of multiple truths and that individuals develop subjective meanings about objects or experiences (Demeritt, 2002; Eden, 2001; Gerber, 1997; Proctor, 1998; Russell, 2001).

My research consists of four phases; the first two phases have been carried out and the last two will be completed by April 2006. Phase I included an extensive literature review on topics such as: human dimensions of wildlife; attitudes toward wolves and other carnivores; constrained constructivism and the co-construction of nature; wild carnivore conservation; and carnivore habituation and food conditioning. During phase II, 395 questionnaires were collected and 13 interviews were conducted with kayakers in the

Broken Group Islands throughout July and August, 2005. In Phase III, data will be analysed using descriptive, multivariate statistics and thematic coding, as appropriate. The writing of a preliminary report will also be included in Phase III. The last phase will involve a public defence of the research findings and a final thesis submitted to Lakehead University and Parks Canada. All participants and stakeholders who have requested a summary of the report will be sent a synopsis of the findings.

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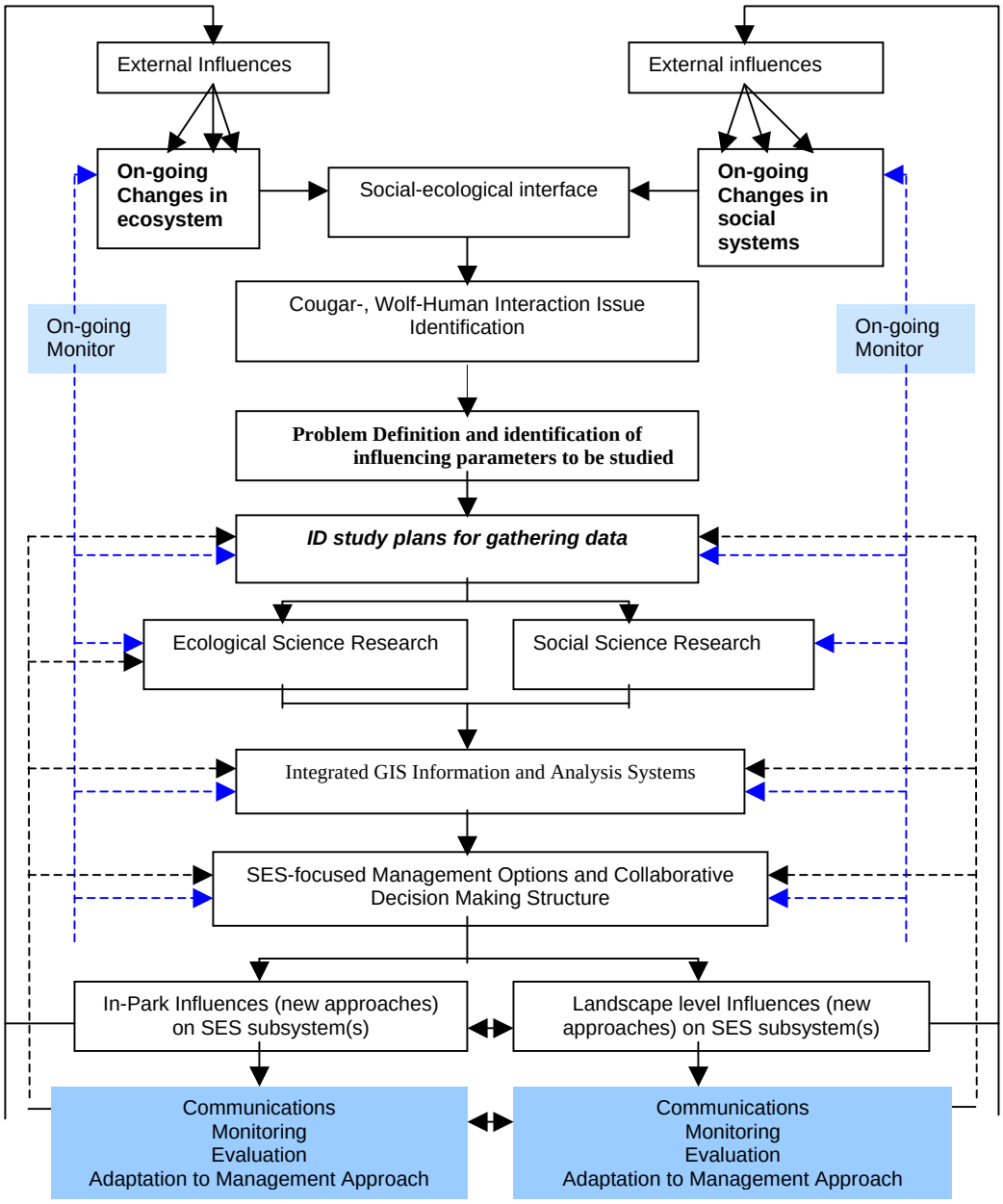
Appendix A



Project Process for Researching and Influencing the SES Dynamics of Pacific Rim National Park Reserve's Carnivore-Human Interactions (Sparkes, 2005).

5. Prudent Use of Grazing by Cattle to Maintain Remnant Tallgrass Prairie Patches

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Abstract

Prior to the late 1980's the native tall grass prairie was thought to be nearly eliminated in Canada. A review of satellite imagery by amateur naturalists revealed what appeared to be fairly large tracts of grasslands in southeastern Manitoba. Ground truthing confirmed the presence of a series of patches of native tall grass prairie interspersed with wet meadows and burr oak/aspen forest. By the early 1990's five conservation agencies formed a partnership known as the Critical Wildlife Habitat Program to ensure the long-term protection and maintenance of these prairie remnants. A research program was initiated in 1994 to complement existing conservation efforts by the Critical Wildlife Habitat Program.

Management of the Manitoba Tall Grass Prairie Preserve included site clean up, mowing of weed and brush patches, prescribed burning, girdling of aspen and research on a managed grazing system. A twice over rotational grazing project was established on three 65 ha parcels of land in cooperation with local ranchers. The primary objective of the experiment was to quantify and qualify the response of tallgrass prairie vegetation to a twice-over rotational grazing system using cattle. It was hypothesized that grazing by cattle would maintain the tallgrass prairie remnants as long as overgrazing was not occurring. Local ranchers generally apply season-long grazing at high stocking rates to their land which results in overgrazing and range deterioration.

Four exclosures (A, B, C, and D) were set up to monitor the vegetative response to the grazing system. The exclosures were divided into three 5m x 15m treatment units. The first unit was permanently closed off to grazing (ungrazed = UG), the second was closed off after the first rotation (grazed once = G1), and the third was open during both rotations (grazed twice = G2). The first rotation was grazed for 15 days from June 1 to July 15 and the second rotation was grazed for 20 days from July 15 to September 30. Stocking rate was 30 cow/calf pairs per paddock. Vegetative cover and biomass sampling were conducted regularly since 1994. Only the data collected through vegetative cover sampling will be addressed in this abstract. Vegetative cover sampling was conducted using the point-frame method. Ten transects, spaced one meter apart, were run across each treatment unit for all four exclosures. A 10-point frame was placed every half-meter (ten frames per transect) along each transect. Plant species, litter, or bare ground was recorded at the point of contact for each pin.

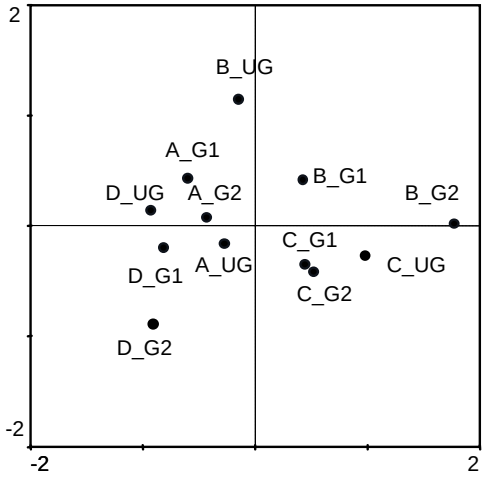

Figure 1: Principal component analysis (PCA) ordination diagram of species collected in 1995 showing site scores (•). The exclosures are labelled as A, B, C, and D and then subdivided into treatment units: UG=ungrazed, G1=once grazed, and G2=twice grazed. The first axis (horizontal) has an eigenvalue of 0.645=64.5%, and the second axis (vertical) has an eigenvalue of 0.244=24.4%.

Approximately 130 plant species were collected within the study area and confirmed with voucher specimens between

1995 and 2003. Species identified include: *Andropogon gerardi* (Big Bluestem), *Sporobolus heterolepis* (Prairie Dropseed), *Liatris ligulistylis* (Meadow Blazing Star) *Zizia aurea* (Golden Alexanders) and *Potentilla fruticosa* (Shrubby Cinquefoil).

Principal component analysis (PCA) was used to determine the affinity of each of the treatment units in tallgrass species space. The PCA of species identified in 1995 produced an ordination diagram in which all three treatments grouped closely to their respective exclosures (Figure 1). Therefore at the beginning of the experiment proximity of the treatment units in the study area was more important in determining plant species composition and diversity than the effect of grazing. Three years into the experiment (1998), the effect of grazing peaked and became more important in distributing the treatment units. The PCA ordination diagram from 1998 showed the treatment units grouping in accordance to the grazing treatment rather than location (Figure 2). The ungrazed and grazed once treatments were found to group closely, and had more species in common than with the twice grazed treatment. Therefore grazing for two periods produced a more noticeable change in plant species composition and abundance than if the prairie had not been grazed at all. After 1998 the effects of grazing declined as the effect of location increased and peaked in 2000. From 2001 to 2003 the effect of grazing showed a steady increase while the effect of location showed a steady decline. The PCA ordinations were also used to determine which plant species showed affinities to which treatment. After 1995, the PCA analysis indicated that the following species were positively correlated with the twice grazed treatment: *Andropogon gerardii*, *Deschampsia caespitose*, *Juncus balticus*, *Eleocharus sp*., *Hypoxis hirsute*, *Parnassia glauca*, *Prunella vulgaris*, and *Krigia biflora*. Plant species, *Glycyrrhiza lepidota*, *Thalictrum venulosum*, *Populus tremuloides*, and *Helianthus nuttallii* were positively correlated with the ungrazed treatment and once grazed treatment.

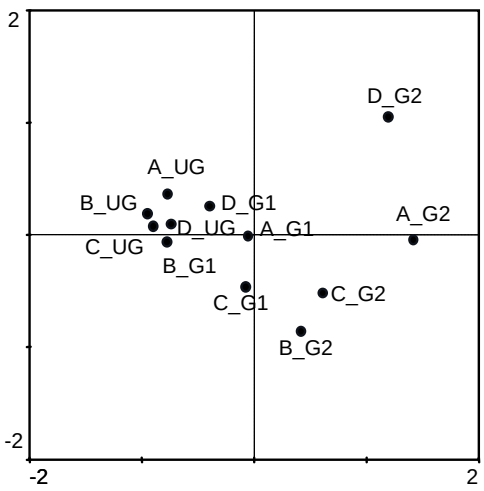

Figure 2: Principal component analysis (PCA) ordination diagram of species collected in 1998 showing site scores (•). The exclosures are labelled as A, B, C, and D and then subdivided into treatment units: UG=ungrazed, G1=once grazed, and G2=twice grazed. The first axis (horizontal) has an eigenvalue of 0.635=63.5%, and the second axis (vertical) has an eigenvalue of 0.208=20.8%.

Redundancy analysis (RDA) was performed on the data sets to quantify the effect of treatment and location for the treatment units throughout the experimental years. As suggested by the PCA ordinations, the effects of treatment and location were found to oscillate inversely with respect to one another between the years 1995 to 2003 (Figure 3). In 1995, the cumulative percentage of variance accounted for by location of the treatment units was 62.2%, whereas the grazing only accounted for 9.4% of species variation. In 1998, the variance in respect to grazing peaked, accounting for 56.9%, whereas location accounted for a lesser 18.4%. The variance accounted for by treatment declined steadily into the year 2000, and then showed an increase through to 2003, whereas the variance accounted for by location showed an inverse trend. Species richness was examined between the treatments throughout the years 1995 through to 2003. Exclosures grazed twice had the highest number of species, followed by the grazed once treatment, and ungrazed treatments respectively.

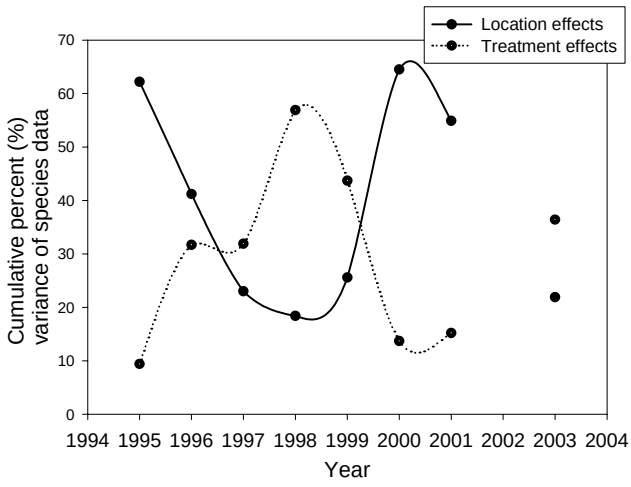

Figure 3: The cumulative percent variance of plant species data accounted for by either exclosure location or grazing treatment throughout the experimental years, 1995-2003.

The cyclical nature of the response of tallgrass prairie range to grazing suggests that other factors besides grazing are influencing plant species composition and abundance in tallgrass prairie range communities. Future research should incorporate precipitation, fire and other environmental data into the analysis. A season-long grazing treatment will also be added to the experimental design in the future to assess the effects of local ranches on the range. Well represented tallgrass prairie flora in the twice grazed treatment indicates that this method of grazing is consistent with the long-term maintenance of these communities. There is no evidence that overgrazing has occurred in any grazing treatment during this study or that the lack of grazing in control treatments has harmed the vegetation. Resources will also have to be secured to fund the analysis of existing biomass data.

In conclusion, it is generally acknowledged that some kind of disturbance (e.g. fire and/or grazing) is beneficial to the maintenance and enhancement of grasslands. One potential problem with a disturbance/management technique is to achieve appropriate data about its impact. Grassland remnants have become increasingly island-like in their distribution with limited opportunities for immigration and emigration due to lack of connectivity among these “islands”. Therefore, management techniques such as grazing become important to grassland managers. In this example, we have demonstrated that plant species richness increases with grazing intensity (zero grazing to once over to twice over) with individual species responding to the grazing intensity. There was considerable variation between and among location of sites and treatments. Grazing is an effective tool for remnant prairie enhancement.

Research Poster Presentations

1. Habitat Use and Abundance of the Common Garter Snake (*Thamnophis sirtalis*) at the Northern Limit of its Range in Manitoba

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Abstract

Introduction

Garter snakes are the most widespread and abundant snakes in North America (Rossman *et al*. 1996). Their extensive range stretches from northern Canada to the southern tip of Mexico. Thirty species of garter snakes have been identified in the literature with the common garter snake (*Thamnophis sirtalis)*, being the best studied (Rossman *et al*. 1996). Although *Thamnophis sirtalis* (and especially the subspecies *parietalis)* has been the subject of intense biological research, little is known about the ecology of this species at the northern limit of its range. Many studies have been published from southern regions including the large hibernacula sites near Narcisse and Inwood, Manitoba. Some researchers have suggested that concentrated research of these atypical aggregations might be biasing our understanding of *Thamnophis* snake biology (Shine *et al.* 2001). Therefore, it is important to expand our research efforts into other parts of the province where wildlife conservation is a concern and basic questions remain unanswered. Information from this study will benefit the conservation efforts of landscape managers, including Manitoba Hydro and the proposed Manitoba Lowlands National Park.

This study examines the ecology of a population of garter snakes near Jenpeg, Manitoba (54º30 N, 98º03 W). The snakes were captured and analysed for biological characteristics during May to September of 2005. The specific objectives of the study are:

1. To describe the general life-history characteristics of this species at the northern limit of its range in Manitoba.
2. To learn the population dynamics of snakes at a northern hibernacula site.
3. To examine the habitat use of snakes in the surrounding environment.
4. To gather traditional local knowledge from the surrounding communities.

Methods

A total of 134 snakes were captured on (or near) Manitoba Hydro's Kiskitto dam. The 600 meter long dam is located approximately 500 kilometres north of Winnipeg and was built in the early 1970's to separate the Nelson River from Kiskitto Lake. The large stones used in construction of the dam have created overwintering habitat for a population of garter snakes. On a general scale, this region is classified as Precambrian Shield boreal forest (Preston 1982), and notably is not comprised of any limestone/karst topography, which is prevalent further south and west.

Snakes were captured during searches on foot in the spring and summer. Drift fencing and funnel traps were added for sampling in the fall. Upon capture, snakes were examined for mass, snout-vent length, tail length, sex, diet, colour variation, and disease (Fitch 1987).

Mass, snout-vent length, and tail length were monitored to determine average size and rate of growth over the active season. Sex ratios were compared from spring and fall sampling. Dietary information was obtained through gentle stomach palping of snakes in summer and fall. Data was examined based on

prey type and frequency-of-occurrence. Colour variation was analyzed based on colour markings on the ventral stripes and inter-scales. A gradient scale of 1-4 was used to record absence of red colouration (1) or total red colouration (4). The Kiskitto dam population will be analyzed with Peterson statistical estimates after snake emergence in the spring. Preliminary estimates were derived from total snakes caught at the den site. Artificial coverboard placement and foot searches were conducted to identify habitat usage. Surrounding habitats were searched within twelve kilometres of the den site. UTM coordinates and habitat/environmental conditions were noted at each capture point. Traditional local knowledge is being gathered through interviews with hunters, fishers, trappers and Manitoba Hydro employees. Surrounding communities who have been approached to participate include Pimicikamak Cree Nation and Norway House Cree Nation.

Preliminary Results

Six females captured in the spring were recaptured in the fall. Their average mass in spring was 178.0 grams. Over the summer months, this increased by an average of 75.0 grams (±37.0 s.d.). Their average snout-vent length was 82.0 cm, which was increased by an average of 5.9 cm (±3.3 s.d.). Only two males captured in the spring were recaptured in the fall. Their average mass was 42.5 grams in the spring, which increased by an average of 17.5 grams (± 3.5 s.d.). Average snout-vent length was 49.6 cm, with an average increase of 5.6 cm (±3.4 s.d.). The largest snake captured was a 325 gram female with a snout-vent length of 95.5 cm, and a total length of 115.5 cm.

Twenty-eight individuals were captured during the summer months, but only six contained prey items (23%). Wood frogs (*Rana sylvatica*) constituted the most common food source (45%). Other foods identified included leeches and partially digested small fish.

Colour variations of snakes were classified into five categories. 38% of snakes were anerythristic (no red colouration). 41% of snakes showed a small amount of red flecks when their skin was stretched (i.e. inter-scales). 11% of snakes had substantial red colouration visible on the inter-scales and ventral stripe. 8% of snakes demonstrated a highly unusual erythristic (bright red) colouration. 2% of snakes were melanistic (very dark colouration with no striping).

At the den site, forty-three snakes were caught in spring and fifty-two snakes were caught in fall. Nineteen percent of the population marked in spring was recaptured in the fall. The population sex ratio was similar in both sampling periods with females making up approximately 57% of the population.

No snakes were found under the artificial coverboards or any other natural cover objects. Large varieties of habitats (with varying rates of canopy cover) were explored this field season. Most snakes were found near wetlands.

Eight interviews have been conducted with people who have a long-term knowledge of Kiskitto Lake and the surrounding area. Fisherman and other community members have seen snakes for as long as they can remember. Most people are familiar with the large body sizes of some snakes, but very few have seen the erythristic snakes.

Discussion

The sample size of recaptured snakes was too small to consider any statistical analysis of growth rates. Based on the results of other studies (Larsen 1986)(Gregory 1977) some females do not reproduce annually and require one or two years recovery before reaching reproductive state again. This reproductive cycle will affect growth rates and requires a larger sample.

Garter snakes from the Jenpeg area appear to have similar feeding habits to snakes from other populations. The percentage of snakes with food in their stomach (23%) coincides closely to populations from northern Alberta (27%)(Larsen 1986), southern Manitoba (37%)(Gregory and Stewart 1975), and Michigan (26%)(Carpenter 1952). Wood frogs (*Rana sylvatica*) are the most abundant frog in this study

area and were the most common food source found in snake stomachs. Other possible food sources include boreal chorus frogs (*Pseudacris triseriata*), northern spring peepers (*Hyla crucifer*), toads (*Bufo americanus*), leopard frogs (*Rana pipens)*, mice (*Peromyscus*), voles (*Microtus*), small fish, and various invertebrates (earthworms, leeches, slugs) (Preston 1982).

Although common garter snakes have the most varied colour patterns of all garter snakes (Rossman *et al.* 1996), it is nonetheless significant to find five colour variations in one small population (Mason per.comm. 2005). Only 11% of the snakes had red colour patterns similar to snakes from Narcisse, Manitoba. 38% of the snakes were anerythristic (no red colouration), which is uncharacteristic of this subspecies (i.e. red-sided garter snake - *Thamnophis sirtalis parietalis*). Melanistic snakes were found in very low numbers (2%), but may be related to the melanistic snakes of Lake Winnipegosis (Westphal per. comm. 2005). The erythristic snakes (bright red) are the most remarkable because this colouration has not been seen anywhere else in Manitoba (Mason per comm. 2005). It is difficult to conclude whether this unique erythristic colour is the result of a genetic adaptation (or mutation) maintained by a small breeding pool, or simply a morphological anomaly.

Statistical population estimates will only be possible in the spring of 2006 when snakes re-emerge. However based on the number of snakes caught at the den site in the spring and fall of 2005, it is probable that the total den population is between 70-100 snakes.

Snake habitat use is likely controlled by three factors; canopy cover, thermal sites, and prey availability (Rossman *et al.* 1996). In this study, snake habitat use appears to be focused around wetlands. This is similar to what has been found in other populations including Kansas (Fitch 1965), northern Alberta (Larsen 1986), and southern Manitoba (Gregory and Stewart 1975). In northern climates, the growing season is short so snakes are required to spend most of their time in areas of high prey populations. In the summer months, snakes were commonly found basking on beaver (*Castor canadenis*) dams, lodges and trails. The 2006 field season will include funnel trapping in various habitats and radiotelemetry.

Gathering traditional local knowledge adds a larger timeline to this study and provides a richer understanding of snake ecology in the area. Traditional local knowledge has demonstrated that snakes are not recent colonizers of this environment. However, I have yet to meet anyone who has seen the spring ritual of garter snake “mating balls”. This provides evidence that local populations sizes are small and hibernacula sites are widely dispersed.

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2. Learning Through Cultural Landscapes: Teaching Journeys of the Whitefeather Forest, Ontario

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Abstract
The Whitefeather Forest Initiative is a community-based land use planning process based on the principles of sharing, cooperation, respect, and bringing together Indigenous knowledge and western science. It was initiated by Pikangikum First Nation (PFN) in cooperation with the Ontario Ministry of Natural Resources (MNR) in this region beginning in 1996. Goals of the initiative are to secure forest management tenure, establish protected areas, and diversify the PFN economy while ensuring conservation of biodiversity and resource abundance.

The purpose of this research was to work cooperatively with Pikangikum community members to identify and document a sub-set of values and meanings of their cultural landscape. The results were used to create examples of teaching journeys at the landscape level which would involve elders and others visiting sites on the land that offer valuable teaching opportunities.

Fieldwork was conducted in the Whitefeather forest surrounding Pikangikum from August to November, 2004. Methods used to collect data included participation in land-based activities during various day and multi-day trips on the land with elders and a local translator, journal keeping, photography, informal interviews, and video.

Examples of teaching journeys on the landscape with stops at teaching places were created with this data to educate Pikangikum youth and outside visitors about the cultural landscape of the Whitefeather Forest. These teaching journeys were developed by visiting each place with elders and a community researcher and documenting all values, identified on the map, through interviews and photography. We then reviewed the Ontario curriculum for elementary schools and put together teaching journeys based upon the knowledge of Pikangikum elders as recorded on maps and interviews that would also meet the specific grade-based objectives. For example, visiting a wetland can offer the opportunity to learn from

elders the planting, harvesting, collecting, and the cultural significance of manoomiin (wild rice; *Zizania aquatica*). As well, to meet objectives of the grade 4 Science and Technology curriculum, students could learn about interrelationships between plants and animals through a hands-on experience. Similar journeys can be developed to cater to tourists and other visitors.

At least three practical outcomes can be met through the process of weaving teaching sites into teaching journeys: education, tourism, and landscape protection. The closest parallel to this approach can be found within the literature and practice of experiential environmental education. This approach considers the land as a classroom that is revealed to the learner by knowledgeable teachers including Pikangikum elders and others. Such teaching journeys could be used to recognize and support local language and knowledge of Pikangikum people within the formal educational system of the community while meeting specified units of the Ontario curriculum. In addition, ecotourism, rooted in local language and knowledge, can provide a livelihood opportunity that supports the transmission from elders to youth, and subsequently to other visitors, of both knowledge and a love of the land.

The process of having elders teach youth of Pikangikum can provide people with contemporary livelihoods as they utilize English, to guide visitors along teaching journeys that can build their own love of the land and a respect for Pikangikum people.

3. COMMUNITIES FOR CONSERVATION: Creating a Framework for Plains Bison Conservation in Central Saskatchewan

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Abstract

Research Questions

This study endeavors to determine how to best promote stakeholder collaboration for the conservation of the Sturgeon River plains bison *(Bison bison)* herd located primarily in Prince Albert National Park (PANP). Particularly, the study focus is to develop the framework for a collaborative conservation initiative that encourages diverse interest groups to take on an active role in promoting the social, economic and environmental benefits of conservation. Two questions are posed; “What can we learn from other examples of bison conservation processes that can be adopted for bison conservation around PANP” and “What issues do stakeholders feel need to be addressed for a collaborative conservation initiative to work?” These questions enable the making of a blueprint for the beginnings of a collaborative conservation initiative.

Context

Prince Albert National Park (PANP) is home to the Sturgeon River plains bison herd (Bergeson 1992). It is one of the last hopes for wild plains bison in its natural range in Canada. The foundation for the Sturgeon River herd was a population of an estimated 10 or more individuals that wandered into the park from Thunder Hills, Saskatchewan, in 1969 (Frandsen 2004a). Since then the herd has been growing at a rate of 10-14% per year, and has a current population of approximately 320 individuals (Daniel Fortin 2004; Frandsen 2004b). Until recently few bison have ventured outside of the park in large numbers. However such incidents have been increasing, resulting in some damage to crops and hay bales that are adjacent to the park (Bergeson 1992; Frandsen 2004b). Damage to fences is also of concern to landowners (Bergeson 1992). There is also concern that the herd will interact with livestock, increasing the risk of spreading disease and exchanging genetic material between domestic and wild populations (Bergeson 1992; Frandsen 2004b).

The lands around the periphery of the southwest corner of PANP, where the bison occur, are primarily used for crop production or pasture (Bergeson 1992). However, not all the land is being used for agriculture. The Northern Provincial Forest lies to the northwest while to the southeast lies a community pasture and a Wildlife Management Unit (Bergeson 1992). A number of communities are located within 100k km of the Park including Big River, Debden, Canwood, Mayview, Cookson and Big River First Nation, and Ahathakoop First Nation. Thus, the groups that may be directly concerned with promoting the conservation of bison include local, provincial and national residents, business owners (such as outfitters), ranchers, farmers, First Nations, provincial and federal government. This does not include those who may have a stake from an indirect perspective, which includes NGO's and other local and provincial citizens.


Plate 1: Plains Bison

Problem Statement

If the current growth rate continues, the herd will soon surpass the capacity of its current range and expansion into surrounding lands in and out of the Park will likely occur (Frandsen 2004b). Currently, Parks Canada is not engaged in significant active management of the herd, preferring to let nature take its course (Frandsen 2004b). A Strategy Development Team has been formed to develop a collaborative management strategy to deal with growing concerns (Frandsen 2004b). The objectives of this plan are to reduce the negative effects of the growing herd and take advantage of the benefits of having the herd in the area. The formation of a collaborative conservation initiative, or a non-government organization, based on various interest groups would not only take advantage of potential benefits as they arise, but actively look for, and promote more intangible benefits.

Objectives

There are three primary objectives for this study:

- To determine the key processes involved in the creation and continuance of other conservation initiatives and their applicability in this case;
- To create the framework for an organizational structure that fosters bison conservation and promotes social, biological and economic benefits from bison conservation; and
- To make recommendations for the development of conservation initiatives for plain bison in Saskatchewan based on the principles of collaborative resource conservation.
- To document the development of a conservation initiative and develop a means of evaluating its effectiveness over time.

Methods

This study will involve learning from other similar collaborative management efforts, meeting different interest groups and conducting individual interviews. Prior to conducting any field work, a level of trust needs to be established between the researcher and various stakeholders. This is accomplished by immersion into a variety of internships including spending time with researchers conducting bison research, ranchers and government officials. These internships not only help develop a sense of legitimacy, they also help develop a better understanding of the issues involving bison conservation in the area.

Semi-structured interviews are then conducted with ranchers, landowners, various levels of government and First Nations to allow for a more individualistic perspective on the bison herd and issues that must be addressed in promoting its conservation. Interview questions are based on a variety of topics including stakeholder involvement, fairness, consensus and power sharing and transparency; all designed to elicit information to achieve the second and third objectives of this project. The end result is expected to be the beginning of a process for creating collaborative conservation initiatives for the bison herd with the

express intent of diverse interest groups. Furthermore, this collaborative conservation initiative blueprint has the prospect of applicability for the conservation of other species and could be of considerable importance to species at risk conservation.

Finally, a means to measure and monitor stakeholder feelings and opinions on free ranging bison over time will be developed to track changes as various components of the strategy are implemented. This could play a vital role in managing the herd if it is conducted at specific intervals to track the effectiveness of the organization, where the organization should be headed, and the attitude towards bison. The information gathered could then be used to adapt the plan as the managers see fit in order to address concerns. Currently a survey exists that attempts to accomplish this and could be used as a skeleton on which to build.

To date, 42 interviews have been conducted, including ranchers/farmers, ecotourism operators, bison ranchers, Provincial and Government employees (SERM and Parks Canada) and regional municipality councilors. Both Big River and Ahtahkakoop First Nations have been contacted, but due to a busy schedule have been unable to commit time for participating in this study. Instead, interviews will be scheduled in the winter when they are more able to commit their time.

Interviews conducted to date have led to some interesting insights, one of which involves the roles of the government and public. There is a trend for members of the public to want and expect some involvement from both federal and provincial governments, however both groups feel that the role for these levels of government is one of an advisory position, not decision-making. People have also stressed the importance of ensuring a good representation of the people most affected by the bison.

There also appears to be a difference of opinion between generations, where the younger generation of landowners are more accepting of bison and have more faith that the development of alternative economies such as ecotourism, can work. Members of the community have stated that this is because most of the younger generation do not rely on farming or ranching for their primary income but instead work other jobs. In addition, members of the younger generation say that they have grown up with the bison and accept them as part of the landscape. This is not to say that older generations are intolerant of bison; they like having the herd in the area but are concerned over increasing impacts.

Contribution

Canada is a growing nation that is rich in both wildlife and resources. As our nation continues to develop, the pressure on the environment will continue to increase. The proposed research will be a step in understanding the process of involving communities in conservation that focuses on promoting the social, biological and economical benefits. Without effective partnerships between stakeholders, conservation initiatives will be missing some of the most important factors that influence wildlife populations, specifically the concerns and attitudes of stakeholders (Borrini-Feyerabend, 1999).

In this case, effective conservation of the bison herd has the potential for positive social, biological and economic impacts for local communities (Bergeson 1992; Frandsen 2004b). If the herd does not become truly regional in nature, communities will not be able to utilize the benefits of the herd. Thus, the development of an active collaborative conservation operation may ultimately help preserve and protect the way of life for First Nations peoples and enhance that of local communities.

4.. Cheekahnahwaydahmungk Keetahkeemeenaan "Keeping the Land": Aboriginal Values of Custodianship in the Whitefeather Forest Cultural Landscape

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Abstract
There is a growing body of knowledge emphasizing the importance and value of different culturally derived cognitions of the environment (Davidson-Hunt and Berkes 2003a; Stoffle et al. 2003; Toledo et al. 2003; Toupal et al. 2001). As such, cultural landscapes have now become a useful concept in the realm of natural resources management as this concept exemplifies the key elements of this field: environment, people and perceptions (Buggey 1999; Davidson-Hunt 2003). Aboriginal cultural landscapes, which embody the knowledge of spirits, places, land uses, and ecology, are not discrete but rather comprised of overlapping nodes and networks with a diversity of values throughout (Buggey 1999). Stoffle et al. (2003) termed this phenomena "cultural landscape layering" where the landscapes of one culture will have different meanings, and may not even be perceptible to another culture due to differing perceptions, values and political economies (Davidson-Hunt 2003).

Historically, conservation efforts have been riddled with the misappropriation of indigenous lands to fulfill colonial, Eurocentric objectives of centralized "wilderness preservation" (Gomez-Pompa and Kaus 1992), resulting in the alienation of local populations (Lane 2001). Top-down management regimes have been unsuccessful in fulfilling environmental preservation objectives, while also failing to protect cultural landscapes, which sustain indigenous livelihoods (Gadgil et al. 1993; Wilshusen et al. 2002; Lane 2001). Conservation areas established by centralized institutional authorities typically result in the loss of aboriginal lands, rights, governance powers and eventually culture due to the antiquated notion that an inverse relationship exists between human activities and the well-being of the natural environment (Borrini-Feyerabend 2004). The designation of protected areas resulting in the loss of traditional lands is perceived by many aboriginal groups not as a loss of "property", but as a spiritual deprivation as many indigenous peoples consider themselves to have been placed upon the land as custodians by the Creator. This notion of custodianship is not rooted in western concepts such as "tenure", "property" and "ownership", but a duty to take care of the land (Davidson-Hunt and O'Flaherty, unpublished), an expression of values unlike those of current natural resource management systems.

However, indigenous peoples have practiced customary conservation and resource management since time immemorial. These practices are based upon traditional ecological systems and adaptive learning, which promotes social-ecological resilience and sustainability (Davidson-Hunt and Berkes 2003b; Berkes et al. 2003). Compliance is based upon internal self-regulation, community sanctions, teachings and social learning as opposed to external rules and enforcement (Sherry and Myers 2001; Overholtz and Callicott 1982).

The 1.2 million hectares of boreal land in northwestern Ontario, delineated as the Whitefeather Forest Planning Area (WFPA), encompasses the majority of Pikangikum traditional territory; *biikanjikamiing bimaadiziwaat o'daakiimiwum*, which since time immemorial *Ahneesheenahbay* have inhabited and cared for these lands. Pikangikum First Nation (PFN), with a population of approximately 2,100, is located 120 kilometers north of Red Lake, nestled in the centre of the WFPA (WFI online).

The Whitefeather Forest Initiative (WFI) is a community based economic renewal and resource stewardship enterprise initiated by PFN, in partnership with the Ontario Ministry of Natural Resources (OMNR), for the purpose of providing livelihood opportunities for their youth while keeping with their indigenous cultural teachings, values and customs (PFN and OMNR 2003). This well-preserved cultural

landscape, coupled with the extensive traditional ecological knowledge and traditional livelihood practices of this community, presents a unique opportunity to learn about indigenous systems of conservation and develop meaningful partnerships to promote cross-cultural learning, and new ways of "*keeping the land*".

Integrated management frameworks rarely emerge out of indigenous values. Yet, traditional knowledge, management systems, practices and beliefs of indigenous peoples inherently ensures the conservation of resources and biodiversity (Gadgil et al. 1993; Berkes et al. 2000; Alcorn et al. 2003) and the rights and concerns of indigenous and local communities are likely to be compatible with conservation objectives if and when equitable and effective protected area governance mechanisms are in place (Borrini-Feyerabend 2004). Therefore, where resource use and governance is shared amongst many cultural groups, such as with the Whitefeather Forest, it is necessary to develop a "common currency" upon which a dialog for land use planning and management can be based (Davidson-Hunt, 2003).

This research project, undertaken in partnership with PFN and the Whitefeather Forest Management Corporation (WFMC), aims to identify indigenous values for "*keeping the land*" and to develop a common lexicon that can be used to formulate a management framework that: respects the values and rights of the community, fulfills provincial obligations and conserves the resources of the Whitefeather Forest cultural landscape.
Narrative analysis is the primary method being utilized in the first phase of this research, which has been ongoing since May 2005. Data for this research has been acquired primarily through transcripts collected by WFMC during the land use planning process, as well as other sources of data including the land-use plan itself, maps, narratives and other archival materials. A database of statements of "*keeping the land*" arising from these documents has been assembled, and utilizing the qualitative data processing software N-Vivo, this data is being coded and emerging patterns of value statements recorded.

It became apparent early in this research that a perspective on aboriginal worldviews is essential for understanding the institutions which guide the relationships between people and the land. The incentives for "conserving" resources greatly differ from that of western utilitarian or environmental ideology. Cultural landscapes house the history and ancestors of a community, and will become the home to future generations; protection of these places is essential for spiritual and cultural survival (Buggey 1999), as well as for the conservation of resources and maintenance of ecosystem integrity and biodiversity. A values matrix was developed for evaluation purposes based upon an interpretation of Ojibway worldview. These values for "*keeping the land*" were formulated through a review of literature and studies that utilized indigenous narratives and stories, as well as through land-based values arising from the transcript documents themselves.

This research will have practical significance to PFN and the WFMC in that it will provide a perspective of the land-based values that are important to the people inhabiting the Whitefeather Forest cultural landscape. This will contribute to the emerging lexicon upon which equitable planning for protected areas between the WFMC and OMNR can be based, rather than working within the scientifically-biased paradigm which currently presides.

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5. Natural Disturbance Dynamics in the Duck Mountain Provincial Forest, Western Manitoba.

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Abstract
Worldwide concerns about climate change and its potential impact on the boreal forest are increasing (Kasischke & Stocks 2000). Predictions about warmer climate leading to shorter fire cycle and increasing forest disturbances have been made. Flannigan et al. (2001) suggested that an increase in dry conditions may occur in both western and central Canada whereas in the eastern Canadian boreal forest the increase in precipitation may overcome the effect of warming with respect to fire weather severity. However, empirical fire history data suggest that fire frequency and area burned have decreased since about 1850 and this both in eastern and western Canada (Bergeron et al. 2004). At the same time, public concerns about forest management practices are growing (Burton et al. 2003). Policies and practices related to forest management are targeted and many oppose the ideas of clear-cutting, road building and temporary loss of habitats / mature old-growth forests.

A growing interest in the development of management practices that are based on an understanding of natural disturbances is observed. Natural disturbances in ecological systems are however complex and include an array of characteristics such as spatial distribution, frequency, predictability, synergisms (Attiwill 1994). Major differences also exist across the Canadian boreal forests and preclude making large sweep generalisations. In the boreal forest, wildfire constitutes the primary disturbance in areas where short fire cycle prevails. Fire cycles vary with estimates ranging from 50 years in western Canada to 500 years in the east (Bergeron et al. 2004). In regions where a longer fire cycle prevails the role of secondary disturbances (insect outbreak and wind throw) becomes more important. Despite the crucial role of fires, fire suppression has been one of the main goals of forest management in Canada (Kasischke & Stocks 2000). The recent developments in harvesting techniques and the onset of large mechanized clear cuts have also dramatically changed the natural disturbance regime of the forest.

There is a growing consensus that, to be sustainable, forest management should be based upon a good understanding of forest dynamics and its natural disturbance regimes (Burton et al 2003). Our current understanding of fire dynamics and other disturbances across the Canadian boreal forest is however fragmentary. For instance, little research has been conducted in Manitoba with regards to natural disturbances (Tardif 2004). We present here a 300-year fire history reconstruction and a 150-year reconstruction of the forest tent caterpillar (FTC) outbreaks for the Duck Mountain Provincial Forest (DMPF) located in the boreal plains of western Manitoba. Standard dendrochronological methods were used. Fire history was documented by determining the time-since-fire distribution of forest stands within DMPF. The presence of white rings in conjunction with periods of growth suppression in trembling aspen, balsam poplar and paper birch were used to identify periods of FTC outbreaks. White rings have small, thin cell walled fibers (Sutton & Tardif 2005) and their formation has been associated with historical surveys of FTC defoliation and with severe defoliation early in the growing season (Hogg et al. 2002).

Fire History: Results indicated that the fire cycle in DMPF has dramatically changed since the early 1700s. In the pre-settlement period (1700-1880), the fire cycle may have been around 55-years with, on average, up to 1.8% of the area burning each year. Throughout that period, we speculated that large, infrequent fires have occurred in conjunction with prolonged droughts. Such an extreme drought was observed from 1885 to 1895 and coincided with about 83% of DMPF burning. During settlement, numerous small fires were observed at the periphery of DMPF and were speculated to origin from land clearing. Despite these frequent fires, the length of the fire cycle has increased to about 200 years. Since the last major fire to occur in 1961 the length of the fire cycle has been estimated to be over 15,000 years.

The year 1961 coincided with the most severe drought in the 20th century for that region of Manitoba. At no other time in the 300-year record was there a period of 40-years or so with so little area burned. The impact of fire suppression needs to be further investigated but is speculated to play a major role in the lengthening of the fire cycle. Overall, the fire cycle in the 20th century was approximately 455 years. The current time-since-fire distribution and forest age structure in DMPF are probably unprecedented. Forests are aging with a mean age of 108 years. A longer fire cycle will favour late successionnal species like black spruce, white spruce and balsam fir resulting in a higher proportion of older age, uneven-aged stands.

Forest Tent Caterpillar: Results indicated that three important periods of forest tent caterpillar outbreaks, from 1939 to 1948, 1961 to 1965 and 1982 to 1985, occurred in the 20th century with an additional large-scale outbreak suspected during the 1870s. The major outbreaks of the 20th century started in the north and spread into DMPF at different rates. The prolonged 1940s outbreak spread slowly, whereas the 1960s outbreak spread quickly following a year of extreme drought. The outbreak of the 1980s was also short, but did not reach widespread proportions. Analysis by stand types indicated that during the dry outbreak of the 1960s, mixed trembling aspen/ jack pine stands registered stronger growth suppression and produced more white rings. In DMPF, the pioneer cohorts recruited after the 1885-1895 fires are entering a transitional phase. An increase in the dominance of shade-tolerant species is expected to occur as a consequence of increasing mortality of shorter-lived pioneer species. With time and in the absence of fire, the importance of jack pine and trembling aspen in the landscape will decrease. In absence of fire, secondary disturbances like insect outbreak and wind throw will increase. FTC outbreaks may play a role in “speeding-up” succession toward a larger dominance of white spruce. Further research is needed to document this role as well as that of FTC break-up of the initial post-fire aspen cohorts. The susceptibility to disease and mortality of aspen trees after repeated outbreaks needs to be better assessed as well as the response of white spruce to “delayed” gap formation.

Conclusion: In DMPF, the historical role of fire has been to rejuvenate the forests and to create a dynamic mosaic of forest structure and composition at the landscape level. Today, in the near absence of fire, forest harvesting may be the only larger-scale disturbance occurring in the landscape. In the absence of fires, the DMPF forests will follow new successionnal pathways leading to unpredictable impacts on the flora and fauna. The majority of the forested stands in DMPF are now in a transitional phase and it is believed that major changes will occur in the landscape as a consequence of fire suppression. The current/future characteristics of this landscape may also affect in unpredictable ways the ability of the system to recover from future catastrophic fires if such fires were to occur. Our study questions the use of the current state of DMPF as a benchmark on which to evaluate future anthropogenic impacts. It also emphasizes the need to re-introduce larger scale disturbances in DMPF and questions our ability to cope with potential risk associated with large, infrequent disturbances. In regards to increased risks or uncertainties associated with global warming and fire suppression, managers should explicitly incorporate the risk of large, infrequent catastrophic fires in their long-term management plan. Given the specificity of DMPF, this may mean establishing firebreaks or controlling fuel build-up. Other alternatives may also be examined. Our next step will be to evaluate the role that forest harvesting has in the rejuvenation of the forested landscape.

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