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Fire, Plants and People: Exploring environmental relations through local knowledge of postfire ecology at Wemindji, Quebec

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Abstract

In the forests of Wemindji Cree Territory on the eastern shores of James Bay, north-western Quebec, forest fires burn frequently, human interventions are rare, and fire is the key agent of forest transformation. This thesis examines Cree perceptions of spatial and temporal postfire ecosystem processes, more specifically, the interactions of plants, animals, people and the physical landscape. Western scientific studies have focused on the complex actions of fire in shaping these ecosystems. I interviewed Cree forest experts in Wemindji and reviewed the literature on forest fire in this area. The knowledge that both hunters and scientists have acquired is in many ways neatly parallel. I suggest some ways in which the different perspectives of Cree and western scientists might complement each other and contribute to new knowledge of postfire ecology.

Sur le territoire des Cris de Wemindji, sur la rive est de la Baie James au Nord-Ouest du Québec, les incendies de forêt surviennent fréquemment, les interventions humaines sont rares et le feu est l'acteur clef des transformations touchant la forêt. Ce mémoire examine les conceptions des Cris face aux processus spatio-temporels affectant l'écosystème après un feu et, plus spécifiquement, les interactions entre plantes, animaux, humains et contexte physique. Les études scientifiques occidentales se focalisent sur les rôles complexes du feu dans le façonnement des écosystèmes. J'ai interrogé à Wemindji des experts cris de la forêt et revu la littérature sur les incendies de la région. Un parallèle net peut être établi à plusieurs égards entre les connaissances des chasseurs et celles des scientifiques. Je suggère des moyens pour rendre les perspectives respectives des Cris et des scientifiques occidentaux complémentaires et contribuer à l'acquisition de nouvelles connaissances concernant l'impact écologique des feux de forêt.

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Chapter 1 - Introduction:

Stand at almost any point within the forests near Wemindji, Quebec and you might remark upon the sameness of your surroundings - spruce trees, jack pines, nothing but conifers, rising from the carpet of pale green lichens. This landscape on the eastern coast of James Bay evokes an impression of unchanging stillness, an impression, one soon discovers, that rests only on a lack of familiarity. Fire has altered these forests over and over again since the last Ice Age and the vegetation shows much diversity in age and species distribution. Fire is the key process for landscape renewal in this part of the world. It sweeps through subarctic forests every hundred or so years, clearing the ground for succeeding generations of growth. Each patch of trees or shrubs or rocks has stories to tell, stories about the last fire, its size and its intensity, the length of time since its passage, and what happened before and after that fire. The stories stem from the countless imbricate interactions of geology, topography, soil, climate, fire and all the beings, from microbes to black bears and the winds, who inhabit the land. Fire plays a central role in human narratives of the boreal forest, for it shapes the plant communities that support the animal populations that humans rely on for subsistence. The people who know the stories of this land best are the Wemindji iviyuuch (Cree people) who have lived on iviyuuschii (Cree land) for generations.

In 1989, the largest fires on record in the province of Quebec burned over 2,086,600 hectares of taiga east of James Bay (Couturier and Saint-Martin 1990:44; Lavoie and Sirois 1998; Le Goff and Sirois 2004). I canoed along 90 km of *Paakumshumwaau* (the Old Factory River) to the coast of James Bay fourteen years later through woodlands recovering from that fire. A few days into the trip, one team member expressed her wish to get quickly past the surrounding burnt landscape she found so depressing. Another replied without hesitation that he saw something very different. The circle of life, he said, beautifully illustrated in the profusion of young pines filling the gaps between dead tree trunks. That exchange stayed with me, and my project in visiting James Bay and Wemindji three years later was to learn about the ecological impacts of fire and about East Cree understandings of the processes at work in their land. I was curious about how forest fire, a force I saw at the time as mostly random and destructive, impacts the ways that landscape is understood in Wemindji territory. People depend on animals, animals depend on plants, and fire, I thought,

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destroys those plants. My questions about what the people do after fires and about the recovery of plants and animals launched this research project.

Research Questions

This thesis is an exploration of fire's role at the northern edges of the boreal forest in western Quebec. The regenerating forest is an excellent place to learn about postfire ecology and local strategies for managing the changes that are fire's legacy. It also presents us with opportunities to learn about Cree forest science and Cree perceptions and evaluations of ecological processes. Cree hunters and their families know that environmental change is a given and that it is unpredictable. They also know that forest fire, *muustaau* in Cree, is a necessary part of their world. It is an essential process that 'keeps the forest young', as one hunter expressed it, and it maintains a diversity of forest patches at different stages of recovery. Each species of game animal that the Cree hunt for food has unique habitat requirements that are met by the mosaic of forest stands created by fires.

The fires that occur so often in the north are not controlled by Quebec's fire protection agency, *La Société de protection des forêts contre le feu* (SOPFEU), as they are in more southern regions. Because the forests of northern Quebec present a kind of 'natural laboratory' where fire and its effects can be studied, many scientists have based their research in the forests near Wemindji. Climate change, fire, and the forest's role in carbon storage are another reason. The boreal forest covers more than 30% of the earth's surface, much of it in Canada, and its role in carbon storage is crucial. When forests burn the carbon stored there is released into the atmosphere. Warming is occurring rapidly, especially at higher latitudes, and warmer temperatures are likely to result in more frequent fires. Interest in the dynamics of fire in boreal forest is therefore intense at present.

I am interested in forest plants and the ecosystem dynamics that follow wildfires in the boreal forest. My study focuses on Cree perceptions of spatial and temporal ecosystem processes, more specifically the interactions of plants, animals, people and the physical landscape in a framework of dynamic transformations: disturbance, reorganization, and succession, where forest fire is the key agent of transformation. What are the perspectives of people who live close to the land regarding forest fire? How do fire and the processes of succession that follow fire affect the animal communities that people depend on and the plants communities that sustain those animals? Are fires viewed as beneficial, necessary for forest plant and animal cycles of renewal and regeneration or as destructive catastrophes? Many western scientific studies have been aimed at understanding the complex interactions of boreal ecosystems and the role of forest fire in shaping those ecosystems. Some have focused on the social-ecological interactions. Few scientific studies in north-western Quebec, however, have included Cree knowledge of fire ecology. The knowledge that both hunters and scientists have acquired through observation of the forest as it recovers from fire, are in many ways neatly parallel. The long term perspective of the people who know this fire prone landscape so well is surely one that can contribute new understandings.

Map of the thesis

The balance of this chapter describes the research methods and the study location. Chapter Two provides the theoretical framework that informs my project. In Chapter Three, I examine western scientific literature on fire in the boreal forest and review postfire ecology work carried out in *iyiyuuschii*. Chapter Four presents the Cree view of fire's impacts on the forest and its inhabitants that was shared with me in Wemindji. I conclude the discussion in the final chapter with a summary of my findings that ties the varied threads of the analysis loosely together by suggesting ways in which Cree and western scientists could combine their expertise to produce new knowledge of forest and postfire ecology.

How and where the study was done

This thesis represents just one facet of a much larger collaborative effort initiated by the Cree Nation of Wemindji and a group of university researchers.¹ The larger project's goal is to explore the possibilities of balancing environmental protection and continuity in Cree hunting, fishing and trapping culture and livelihood with long term economic development. One major aspect of the project is the creation of a protected area on portions of the territory's lands and coastal areas that will enhance Cree land tenure practices and be built on Cree values of respect and relationship². The protected area includes the watershed of *Paakumshumwaau* (Old Factory River) mentioned above. A further aim is meaningful engagement in an exchange of knowledge between community members and academic

¹ A SSHRC Community-University Research Alliance (CURA) grant titled "Protected area creation, culture, and development at the Cree community of Wemindji James Bay, Quebec", led by Chief Rodney Mark (Cree Nation of Wemindji) and Professor Colin H. Scott (McGill University), 2005-2010.

² Website of the Cree Nation of Wemindji accessed at: <u>http://www.wemindji-nation.qc.ca/vision2.html</u>

scholars that is beneficial to both. The goal of this knowledge exchange is to enhance and expand understandings of both socio-cultural environmental values and bio-geophysical data regarding the territory (Scott 2004).

Most of the fieldwork for this thesis was carried out from June to August, 2006 in the Cree Territory of Wemindji. I spent three months during the summer working in Wemindji and learning from the people there. A two week trip in September that year, much of it spent in hunting camps, provided the opportunities to complete the research. Twelve interviews were arranged with men and women, my local consultants, who possess expert knowledge about the forest. Interviews were scheduled before or after work and on weekends and evenings there were many opportunities for more casual conversation. Most of the people interviewed either presently spend, or in the past have spent, large portions of their time living on the land and several are the *uchiimaauch* or 'tallymen', the heads of family hunting territories. A few have other special knowledge of forest fire - they include members of the Fire Department and Cree Hunters and Trappers Association. Interviews took place around kitchen tables, sometimes the interviewees', and sometimes my own; others were held in the consultants' offices. Often husbands and wives both engaged in the conversation. Although many Wemindji people speak fluent English sometimes a grown child or family friend was present to help with translation from Cree to English. Interviews were recorded if the participants agreed. These conversations were largely unstructured, guided in part by openended questions prepared in advance. Often conversation turned to topics that seemed at the time to be entirely unrelated to fire and ecology.

The interviews were supplemented with many unplanned conversations around town or at camps with people representative of the many facets of contemporary life in Wemindji. I worked as the coordinator of a summer science program for Wemindji's elementary school children, a program created with the intention of awakening a greater interest in science studies in Wemindji's youth. Through the 'science camp' I met children's parents and other relatives who helpfully suggested more people who might be of assistance. From the children I learned all kinds of things, including Cree words and phrases, the importance of families and of self reliance, and more, about life and education in Wemindji. Learning about Cree science from elders while teaching western science concepts to Cree children, underscored the complexities involved in trying to understand diverse ways of learning and knowing. My attempts to untangle those complexities and sort out assumptions have taken many months.

In addition to all the interactions and conversations in town, I was sometimes invited to spend time with families at their camps. Out of town, on the land, it was possible to learn more directly about plants and trees and their uses, about hunting and fishing practices, about the fish and land animals and the interactions between plants, animals and people. More relaxed and meaningful exchanges about ecological processes are possible in the bush. On the land the traces of previous fires, place names, and particular trees, plants and activities kindle discussion. Memories and stories are often less accessible in other settings. Iain Davidson-Hunt (2005), who has worked with Anishinaabe people in western Ontario, describes *in situ* discussions as the most comfortable and productive ways to learn because traditional teaching and learning occurred in the context of work, i.e. hunting, trapping and fishing. In the old days a student would learn through watching, doing, trying and making mistakes, rather than by asking endless questions. This type of learning was described by many of the people I asked questions of in Wemindji, and it was often illustrated with a story. It has also been described by a number of northern researchers who work with native experts (Aikenhead 1997; Gearheard, et al. 2006).

Successful outcomes in collaborative projects are often attributed to the hours of active work spent together in the bush rather than to the hours spent in interview sessions, meetings and workshops (Huntington, et al. 2006; Nadasdy 1999). It was not often possible to arrange ideal research conditions and I had hoped to have more time learning in the forest. However, I found that indoor conversations were also very focused and productive, for my teachers in Wemindji were extremely generous and patient. The set of interviews, conversations and experiences in Wemindji inform my understanding of Cree postfire ecology and provide the basis of the analysis offered here. Julie Cruikshank's work with Yukon elders' oral histories demonstrates how ethnography involves developing relationships that sometimes continue to grow in many directions and to yield new insights over long periods of time (1997; 1998; 2001). The friendships that I have enjoyed in Wemindji for just a few short years are growing and evolving and they too inform, transform and enrich my understanding. What appears on these pages is simply what I have been able to distil and

articulate at this particular moment from all that was generously shared by so many people during those weeks of learning in Wemindji.

Cree hunters and western scientists tell their stories very differently While the Cree tradition is an oral one, scientists publish their findings. Field work was supplemented with a review of the science literature on the ecological dynamics of fire in the boreal forest. I searched the library catalogue and the 'Web of Science' for studies of fire and the boreal forest, and animals and fire in the boreal forest, narrowing the search to specific species and to North America. The search was further focused on articles from eastern Canada and northern Quebec. Data on fire history in Wemindji territory was kindly provided by the *Ministère des Ressources naturelles et de la faune du Québec*.

Research Setting: Wemindji Territory, a Biogeographical Review

The approximately 15,000 square kilometres of the Cree Nation of Wemindji lie on the eastern shore of James Bay (52°39' to 53°10', 74°27' to 78°57') in north-western Quebec. Figure 1 is a map of the study area. The town itself, population ~1300, is situated on the Maquatua River, 1300 km north-west of Montréal³. This land is divided into 20 traditional family hunting territories (also known as traplines). The winters are cold and longer than the short warm summers. Environment Canada climate records for 1976-2000 indicate an average annual temperature of $-3.1^{\circ}C^{4}$. Winds from James Bay cause maritime fogs and cooler temperatures near the coast. Inland areas experience warmer summer and colder winter temperatures (Dignard, et al. 1991). About 40% of the average annual precipitation of 600mm falls as snow⁵. Recent changes in climate are noticeable in this region and are often commented upon by Wemindji people. Eastern subarctic temperatures warmed slightly over the past 600 years (Thomas 1957 in Feit 1969:59), but recent (the past 30 years) Environment Canada from the La Grande airport weather station show that average annual temperatures are now rising more rapidly, i.e. approximately 3°C for those 30 years (Samson n.d.). According to Samson, fall temperatures have shown the greatest changes, and the fall season appears to be lengthening. Similar increases (~1 °C per decade for the past 3 decades) have been reported for south-eastern Hudson's Bay (Gagnon and Gough 2005).

³ <u>http://www.wemindji-nation.qc.ca/</u>

⁴Environment Canada 2004 http://climate.weatheroffice.ec.gc.ca/climateData/monthlydata e.html

⁵ Environment Canada2004 <u>http://climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html</u>.

Figure 1: Territory of the Cree Nation of Wemindji, eastern James Bay, Quebec. The inset shows the location of the territory within eastern Canada.



The coastline of eastern James Bay is rocky and irregular. Eastward from the shore, the land rises gently to scattered hills and granite outcrops. Further inland the topography of this segment of the Canadian Shield becomes more rugged (Couturier and Saint-Martin 1990). Drumlins, eskers and moraines trace the movements of the Laurentian Ice sheet which retreated some 8000 years ago. As the ice sheet melted it left the area submerged beneath the Tyrell Sea and Glacial Lake Ojibway for approximately two thousand years (Hillaire-Marcel, et al. 1981). When the Tyrell Sea drained suddenly, marine clay sediments were left behind in low-lying areas. Dense networks of lakes, rivers, fens and bogs now occupy these depressions (Gérardin 1980).

Taiga -Northern edge of the Boreal Forest

As a member of project survey teams on the Paakumshumwaau River from 2003 through 2005, I participated in vegetation sampling of the many plant communities along the river and coastline. The following description, and much of my personal understanding of

the region's flora that forms the background of this study, is the result of that work. Detailed descriptions of each vegetative community and a summary of the findings are available in the reports of those trips, on the internet at <u>http://www.wemindjiprotectedarea.org</u>.

The open spruce woodlands that dominate the northern edges of the boreal forest have been termed "taiga". The taiga is characterized by widely spaced single or clumped coniferous trees that punctuate the thick mat of reindeer lichens (*Cladonia* spp.) (Larsen 1980). Although spruce-lichen forest is most characteristic of eastern James Bay, vegetative communities are surprisingly diverse, ranging from dense forest to muskeg, ericaceous heaths, tundra, bogs and salt marshes (Dignard, et al. 1991; Gérardin 1980; Larsen 1980). Vegetation varies according to many factors that include fire history, proximity to the coast, topography, soil, and moisture conditions (Benessaiah, et al. 2003; Chapin, et al. 2002; Payette and Delwaide 2004). These plant communities sustain a variety of animal species as well as the people who have lived here for millennia.

White spruce alone dominates a longitudinal strip, less than a kilometre wide, along the entire coast of James Bay, its growth favoured by the humid maritime climate (Ducruc, et al. 1976; Dutilly, et al. 1958; Hustich 1950; Parisien and Sirois 2003). A little further from the coast white spruce mixes with black spruce, aspen and balsam poplar. Due to its intolerance to fire, white spruce is infrequent inland where it is mostly restricted to the edges of watercourses (Parisien and Sirois 2003). Tamarack, trembling aspen, balsam poplar, white birch and balsam fir are scattered throughout the region. None of these five tree species is abundant except in the fairly limited areas that meet their specific requirements for growth and tolerance to fire (Payette, et al. 1989). Balsam fir is the least common of these and is very close to its northern limit in Wemindji (Gérardin 1980; Sirois 1997). It is found near the coast, and in old growth stands along the shores of rivers and large lakes (Payette 1993). Tamaracks commonly inhabit muskeg (peat lands) and are numerous along roadsides (Busque and Arseneault 2005; Girardin, et al. 2001). Trembling aspens which often form large clonal colonies and white birch occur sporadically, often but not always on south facing slopes and in pockets of nutrient rich soil (Payette 1993).

Black spruce, the region's dominant tree species, thrives in a range of very different habitat types in this part of Canada. It is abundant in poorly drained areas, appears in muskeg and on the edges of bogs, but also appears in dry and sandy upland areas. Different names for this tree that reflect the type of habitat are sometimes used by the Cree (Cuerrier 2008, pers. com). In drier upland areas black spruce forms mixed stands with jack pine (Desponts and Payette 1993; Le Goff and Sirois 2004; Sirois 1993). Large monospecific stands of jack pine occur inland, mostly to the east of the James Bay Highway, on sandy well-drained sites that have seen fires in the past 50 years.

On the forest floors dense carpets of either moss, in humid locations, or lichens, in drier places, are ubiquitous. Ericaceous shrubs such as Labrador tea, kalmia and blueberries are common, sometimes densely massed in open areas of muskeg, more thinly on burnt slopes or sparsely amongst trees in open woodland. Willows and alders crowd the banks of streams, rivers and ponds. Both shrubs and herbaceous plants are more abundant on floodplains, along watercourses and in other places where the soil is humid. The understory is often very sparse unless the soil moisture is high. It includes a variety of grasses and *Carex* species, equisetums, bunchberry, twinflower, cloudberry, *Vaccinium* species and others. The presence of tiny tamarack trees and spruces, small ericaceous shrubs, grassy plants and flowers (including colourful pitcher plants and bladderworts) make the peat bogs and fens especially beautiful in mid-summer. Nearly 430 species of plants have been reported for the Wemindji area including the vegetation of the salt marshes, other coastal habitats and some of the coastal islands (Benessaiah, et al. 2003; Berryman, et al. 2004; Blondeau 2008).

Black bear, grey wolf, moose, caribou, wolverine, fisher, arctic and red fox, lynx, beaver, porcupine, skunk, mink, muskrat, otter, snowshoe hare, red and northern flying squirrel, moles, mice and voles inhabit Wemindji territory (Bider 1976; Gérardin 1980). There are few toads and frogs, one species of snake and no turtles (Bider 1976). Twenty-seven species of fish are reported for the bay and its rivers (Morin, et al. 1992; Morin, et al. 1980). Waterfowl migrate in large numbers through the region and many nest in this area. Canada geese, brants and snow geese are abundant, as are ducks, common and red-throated loons, and other shore birds (Dignard, et al. 1991; Reed, et al. 1996). These birds, fish and mammals have provided food, clothing, and medicines for the Cree for thousands of years.

Iyiyuuschii

Recent archaeology finds at sites near Wemindji suggest that the human history of

eastern Cree territory may be more than three to four thousand years long⁶ (Denton 2001). In the past people lived in small family groups traveling from winter hunting grounds to summer fish camps. The town of Wemindji was established in 1959 when the community moved there from a small semi-permanent settlement at the mouth of the Old Factory River because it was no longer accessible to supply boats. Today the town is linked to the James Bay highway by gravel road and by daily scheduled air service to and from the south and the north. Most people work in municipal services, education, health, building and maintenance of community infrastructure, regional construction contracting, and a variety of local businesses and community development projects. Some people are employed by Hydro-Québec and companies in the mining industry. The community has been working to build strategies that will ensure its economic autonomy. Jobs for the growing numbers of young people are a priority. Partnerships with companies investing in mineral exploration are currently of prime importance as a large gold strike has been made and is being developed in the territory. Outfitting and tourism are also growing in importance.

Families no longer spend most of the year away from town. However, about a fifth of the adult population still engages in fulltime subsistence hunting and fishing activities. Many other residents spend some part of the year on the land⁷. An Income Security Program, initiated within the James Bay Agreement, was designed to help preserve the hunting, fishing and trapping way of life with cash supplements to hunters' subsistence incomes (Scott and Feit 1992). Continuity of hunting, fishing and trapping livelihoods is important to individual and community identity and well being in Wemindji and elsewhere in the Cree territories (Benessaiah et al. 2003). Crees continue to maintain strong ties to their land and to integrate traditional values with contemporary ways of life (Adelson 2000; Niezen 1998; Scott 1996). These ties are sustained by living and working, hunting, fishing and trapping on lands where family and community histories and are deeply rooted (Feit 2004a).

⁶ A. Costopoulos, Report of the 2006 field season at Old Factory Lake, Wemindji Quebec, at <u>http://scenop.googlepages.com/wemindji</u>

⁷ http://www.wemindji-nation.qc.ca/

Chapter 2 - A theoretical framework

The weeks spent completing vegetation surveys along the river and on the coast stimulated my interest in learning more about how the watershed came to look as it does. Fire became the focus of my study because of its central role in shaping the unique vegetation structure of this landscape⁸. While my interests lie in exploring postfire ecology in Wemindji territory as explained by Cree experts whose voices have not appeared in the scientific accounts, I also review western scientific perspectives. Productive knowledge exchange can occur in an atmosphere open to the views of all the parties involved. This is an anthropological study, but it draws on work in many fields, and can contribute to ecology, environmental science and resource management studies. To think the project through, some "interdisciplinary borrowing" has been required (Dove 2001). The approaches of these disciplines, from landscape studies to ethnoecology, are briefly explored in this chapter. The chapter also reviews literature on the Cree world view, indigenous knowledge and the intersections of indigenous and scientific knowledge which provide the foundation for the analysis.

Landscape has been used by anthropologists and historians to connect a wide range of disciplines and themes in environmental sciences and the humanities to examine social relations in the context of environmental processes (Rival 2006). Dove suggests that borrowing between disciplines, especially between anthropology and environmental science, prepares fertile ground for re-thinking socio-environmental relations, an exercise that requires reflexive questions about where concepts come from and why we use them (2001:104). In the next section I briefly review overlapping theoretical strands from ethnobotany/ethnoecology, knowledge studies, historical ecology, and landscape and postfire ecology that further inform this project.

A range of disciplines

I have turned to landscape ecology to learn about western scientific theories of landscape evolution. This relatively new field is described by Monica Turner and her colleagues as focusing on the study of "the causes and ecological consequences of spatial

⁸ Other processes are of course at work, the most noticeable being isostatic rebound. The entire watershed has risen over the past 8000 years from the Tyrell Sea and continues to rise from James Bay now at a rate of nearly a meter/ century. The result is a landscape in successive stages of evolution from coastline to taiga.

heterogeneity" that can link "populations and ecosystem processes and services...at every spatial scale from individual plants to landscapes" (2005: 319). The concept of natural or ecological disturbance has been loosely defined by ecologists as events or processes that change "ecosystem, community or population structure...resources, substrate availability, or the physical environment" (White and Pickett 1985: 7). Disturbance processes are natural events that range in magnitude from the wind throw of a single tree to huge forest fires and volcanic eruptions, as well as to human interventions at all scales from the felling of one tree to massive hydroelectric dams and reservoirs.

Landscape ecology, a discipline that recognizes the interactions of humans as important landscape elements, is linked closely to ecosystem ecology (VanWey, et al. 2005). Ecosystem ecology examines interactions between physical and biological factors, to try to understand how whole ecosystems operate. A recent textbook describes the field this way: "The flow of energy and materials through organisms and the physical environment provides a framework for understanding the diversity of form and functioning of Earth's physical and biological processes" (Chapin, et al. 2002:3). Postfire ecology can be defined as the study of the processes that follow fire with an emphasis on plant community dynamics such as succession, structure and composition, and animal interactions with postfire vegetative communities.

Threads from the fields of history, anthropology and ecology are interlaced in historical ecology and ecological anthropology. Human roles in environmental change and landscape's influences on humans over time are subjects of historical ecology studies (Crumley 2001). Winthrop describes the approach as rooted in place and adding an "historical dimension to ecological anthropology" (2001: 206). "Writing the history of a particular landscape allows us to develop a form of anthropological inquiry that is more attentive to historical detail, as well as a kind of history which contains more holistic cultural and environmental data " (Rival 2006:S91). Parallel themes appear in Bassos's study of the importance of Apache place name narratives (1996) and Cronon's environmental history interweaving changes in the land with human actions and reactions in New England and the mid-west (1983; 1992). Rival further notes, in the same article, that ethnobotanists and ethnoecologists have made important contributions to recognizing that human and environmental histories are inextricably linked.

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Pursuing interests in ethnoecology and ethnohistory, Harvey Feit linked environmental and social processes in his 1969 Master's thesis. He queried the possible influences of boreal forest dynamics on Mistissini hunter's socio-economic institutions, in particular the development of hunting territories before European contact. He outlined a detailed model relating animal species to vegetation succession from immediately after a burn to the development of mature forest stands. This was related to speculations on the impact of fire on hunters (Feit 1969). Changes in the distribution and availability of populations of animals relied on by hunters were attributed to the recurrent cycles of destruction and regeneration of the forest by fire. Social groups were also determined by fire as they were formed on the basis of animal abundance. Families would have been obliged to leave an area ravaged by fire and to hunt on neighbouring lands that had not burned. This forced mobility would have precluded the formation of pre-colonial hunting territories. In a recent review, Feit (2004b) revisited the possible socio-economic changes caused by very large and intense fires on pre-colonial social institutions, this time in Waswanipi where he carried out much of his field work. When fires caused the displacement of hunting groups for long periods of time (it takes more than a decade for a heavily burned forest to recover), hunting bosses on neighbouring territories would have had the ability to reallocate resources on their lands well enough to minimize the impacts of intensified resource use. He concludes that a very flexible form of hunting territories was therefore likely to have been in existence in some form long before the beginning of the fur trade.

Ethnoecology/ethnobiology

Ethnoecology can be explained as the study of the ways that people understand the 'natural world' - plants, animals, landforms, geology, and so on. Ethnobotany focuses specifically on plants and people. These fields question the character of "language, cognition, knowledge and human subsistence, and how these interact" (Ellen 2006b). Interest within this field has shifted over the years, from an early search for the "useful plant and animal knowledge from indigenous traditions" (Hunn 2002: 719) to the study of biological classification and comparative studies of classification, and later to linguistics and human cognition (see for example Atran 1998; D'Andrade 1995; Ellen 2004; Lopez, et al. 1997). More recently, studies of traditional knowledge systems, the links between resource management and traditional ecological knowledge, cultural diversity, biodiversity and

conservation, and the transmission of environmental knowledge have become more relevant (Dolan 2007; Maffie 2003; Nazarea 2006). Current definitions of ethnobotany tend to be as open-ended and as brief as "the study of the relationship between plants and people", though this understates the importance of ethnobiological research (Davidson-Hunt 2000: 5; Marles, et al. 2000; Turner, et al. 2003c). Hunn (2006) and Toledo (2000) expand their definitions of ethnoecology to further emphasize the significance of this human-plant relationship. These scholars and others emphasize the importance of understanding humans as not separate but as integral components of ecosystems (Berkes 1999). The integrated approach of ethnoecology to explore both "human understandings of the world 'through a screen of beliefs and knowledge', and how humans use and/or manage natural resources" are important for the recognition of people's values and beliefs as they inform practices of "resource" use (2000: 456).

Research involving indigenous peoples' botanical knowledge has been highly contested. Debates that began more than a decade ago over the exploitation and unauthorized use of knowledge were triggered by a rush of botanical collecting intended to uncover new cures before tropical rainforests were all destroyed (Alcorn 1995; Bannister 2004; Brown 2003; Nicholas and Bannister 2004; Shiva 2001). Pharmaceutical enterprises and the botanists who worked with them were accused of exploiting traditional resources and the knowledge of local communities for profit (see Berlin and Berlin 2004; Hayden 2004). Linked issues of biological resources, cultural/intellectual property, indigenous selfdetermination and human rights became active fields for political action that attracted global attention (Conklin and Graham 1995; Greene 2004; Posey and Dutfield 1996). Ethnobiologists have since been instrumental in the development of more effective guidelines for the responsible collection of data and of collaborative programs that include opportunities for sustainable economic development for communities (Coombe 1999; Ellen 2007; Nicholas and Bannister 2004; Posey 2003). But intellectual property issues related to plant and medical knowledge are still extremely sensitive. Researchers interested in these fields must be able to work with sensitive and respectful understanding of the rights and needs of the people from whom they wish to learn (Thom 2007). First Nations communities and regional entities across Canada have devoted considerable time and energy to the careful development of ethical guidelines and procedures for researchers.

A focus on classification and local knowledge of the natural environment in ethnobiology, as noted above, has helped link anthropology to the natural sciences, to biodiversity and conservation, and to indigenous rights and knowledge (Berkes 1999; Ellen 2006a). Nazarea terms local knowledge a "reservoir of strength and resilience" and reviews its transformations as subject matter in anthropology in a recent review article (2006:323). Early studies of local indigenous knowledge often attempted to evaluate its veracity against scientific knowledge or explored its uses in supplementing resource management studies. Later indigenous knowledge studies explore the role of local knowledge in development programs and in the empowerment of local people in these initiatives (Nazarea 2006).

Indigenous knowledge/Traditional ecological knowledge

The dynamic and adaptive nature of traditional knowledge systems is underlined in reviews by Ellen (2006), Nazarea (2006), Dove (2006), and Ellis (2005). Indigenous science, they agree, is embedded in particular places and in the practices of daily life. Indigenous knowledge is also said to be flexible and adaptable to successfully contend with everchanging social, political and environmental conditions. The word "traditional", therefore, in the context of traditional environmental knowledge can be confusing and problematic for it implies a certain fixedness through time. Aboriginal knowledge of the environment, however, is described by aboriginal scholars as situated, contextual and "born from rooted experience" (Ellis 2005). It is continuous with knowledge of previous generations and therefore "traditional", but it is never static (Agrawal 1995; Raffles 2002; Turnbull 1997).

Indigenous knowledge is also dynamic in that it is about process and learning - "what you have learned and how you have learned it" is important according to McGregor (2004: 404). Learners must be attentive to what teachers do if they wish to develop their own expertise (Ellis 2005). Learning occurs through observing and doing rather than through the more western approach to knowledge acquisition of questions and explanations. People in Wemindji often tell stories about how they learned to hunt, prepare animals for cooking and build shelters by watching their parents that illustrate this type of knowledge transmission. Story-telling is a fundamental process in the transmission of knowledge everywhere, but their function is especially apparent in Cree communities. Stories, told and retold, provide lessons for life and possible solutions to problems as they arise. This passage explains the nature of Cree stories well, though it is from the west coast of James Bay:

A fundamental aspect of this approach is open-endedness. My grandfather never said what the points of his stories were; he forced the listeners to discover this for themselves. Consequently, people make up their own minds about what they think about something; they have to decide what they believe to be... (McLeod 2007:13).

Precise definitions of traditional knowledge are not likely to be established, but there are areas of agreement on distinguishing characteristics in the growing body of literature on the subject. One of these is the significance of context and of place. Anishinaabe knowledge of plants, for example "resides in the plants of a place and the relationships of that place" (Davidson-Hunt, et al. 2005). Basso (1996) eloquently describes the centrality of placebased knowledge in Apache ways of knowing. Apache stories, layered into places, provide each new generation with information about proper behaviour and keys to survival on the land. A second point is that aboriginal knowledge is tightly woven into both the physical and spiritual fabric of interactions with the environment (Berkes 1999; Fienup-Riordan 2001; McGregor 2004a). Objecting to descriptions that depict aboriginal knowledge as an object or "body of knowledge", McGregor agrees that knowledge cannot be uncoupled from its holders, and reiterates that the "people, the knowledge and the land [are]...a single, integrated whole". (2004:a 82 italics original). In a similar vein, Battiste and Henderson (2000) underscore the interrelatedness of traditional knowledge and the places it comes from using an image of webs that link humans and non humans in social interaction. Povinelli (1995), Cruikshank (1998; 2005), and Nadasdy (2003; 2007) each show how ignoring the local knowledge that references social relations, beliefs, values and other elements in stories, for example, that sit uncomfortably with western notions of science, limits the possibilities for both new cross cultural understandings and the creation of new knowledge.

The importance of traditional ecological knowledge in northern resource and wildlife management contexts has been legislated in Canada. As Cruikshank points out, this gives the impression that "indigenous knowledge is essentially uncomplicated, that acquiring it is primarily a technocratic classification exercise," with managers best equipped to decide on which elements are important (1998:53). Nadasdy (1999) critiques those academics and wildlife managers who "compartmentalize" and "distil" the knowledge they collect or freeze it in databases, stripping away the context that makes it meaningful. In land claims and resource conflicts it is often necessary to demonstrate continuity (and authenticity) of

traditional practices and knowledge to prove ownership. In the context of such conflicts, Ingold and Kurttila (2000) outline the significance of how state administrations and local people think of tradition in very different ways. The former view is "embedded in the modernist frameworks of the state apparatus, the other in the everyday life of local people" (*Ibid*:184). Traditional knowledge, in local terms, is not an object or package of data handed from one generation to the next but an understanding that grows out of the relationships that connect people to place.

According to Sandra Harding and others, all knowledges are local, but important differences between them are evident in the questions that are asked and in the reasons for asking those questions (Harding 2003; Maffie 2003; Turnbull 1997). The roots of all sciences, are embedded in multiple traditions and have grown into a "complex heterogeneous blend of practice, values and local social and cultural organization" (Turnbull 1997: 555). Agrawal argues that the creation of distinctions between western and indigenous knowledge is counterproductive for indigenous peoples, though he recognizes the "multiplicity of logics and practices" that exist amongst knowledge holders (1995:432).

Indigenous knowledge systems have not been valued equally with western knowledge and, Agrawal contends, the idea of any real divide only reinforces and maintains existing unequal power relationships. Different ways of learning and knowing, however, are to be expected both within and between knowledge sets. Hunn agrees that the use of terms such as 'traditional knowledge' or 'folk biologies" highlights the contrast between western and indigenous lifeways, but sees no reason to "to apologize for upholding this dichotomy nor for taking sides" (2006: 144). Denying all difference or choosing one and rejecting the other, is not productive - meaningful exchange rooted in respect is sought by members of all groups. Recognition of the value of other knowledges creates a common ground for productive dialogue between equal partners (Agrawal 1995). A fundamental challenge for those who work at the interface between different ways of knowing is to understand and explain the knowledge of one system from the standpoint of the other, without losing either the relevance or unique contributions of both in the translation.

Cross cultural science studies

In her study of workshops held by aboriginal people for scientists interested in working together on prescribed burning, Helen Verran suggests an interesting approach for cross-cultural knowledge studies (Verran 2002). She attributes the profoundly different firing practices of each group, scientists and local people, to ways of knowing the world that are widely divergent. She proposes that the gulf between these understandings however, does not have to work against collaborative efforts. The conscious recognition of and respect for both "sameness" and difference, she claims, provides a more level playing field, one with opportunities to open new conversations and to re-examine old assumptions (*ibid* :730). In the case study of firing practices that Verran offers, her own work in thinking and writing and the practice of each group is examined in precise detail. What is normally taken for granted (and therefore invisible), suddenly comes to the foreground. At the same time all the usual explanations for why each action in the firing process occurs are left out (*ibid* :757). The goal is to identify a common ground of activity, what she terms "embodied practice", where mutual trust and negotiation are possible. Verran's methodological symmetry is thorough and provides useful guidance for untangling the reasons why cross-cultural resource management projects don't always succeed. The attentive researcher might also find some useful tools here for building effective knowledge exchange projects.

Also reflecting on cross-cultural science studies, Eugene Hunn takes a very different approach in a recent essay on 'writing ethnobotany' (2006). He has understood collaboration between ethnobiologists and native people as an essential element of ethnobiological research. The work he does in the field is based on shared enthusiasms for plants and animals. He describes it this way: "[w]e meet our indigenous colleagues on the common ground of our shared fascination with the natural world" (Hunn 2006:S156). It was in this spirit, I think, that people in Wemindji shared with me their knowledge of how the forest and its creatures are affected by *muustaau* (forest fire). The next section of this chapter examines what has been written by anthropologists about Cree ways of understanding the natural world.

Cree world views

The Cree worldview has been described as one in which the environment is made up of a community of beings who are all members of a social network based in respectful and reciprocal relationships (Berkes 1989; Berkes 1999; Feit 1986; Feit 1988; Feit 2004a; Preston 2002; Scott 1996; Scott 2006; Speck 1977; Tanner 1979). Hallowell (1992), Ridington (1997), Nadasdy (1999), Cruikshank (2005) and others, provide accounts showing that

comparable, though definitely not identical, ideas of reciprocal interactions with nonhuman entities are shared to varying degrees by hunters living in other areas of the Canadian north. Although the Wemindji Cree world has changed dramatically over the past 50 years, fundamental understandings that characterize Cree approaches to their relations with each other, the world at large, and the natural environment have not (Berkes 1999, Feit 2004). Speck's account of the his visits to the Naskapi, the term then applied to all of the non-Inuit groups living in the Ungava Peninsula, refers to the religious nature of hunting and describes the view that animals and all natural elements were seen as "tangible embodiments of volitional beings" (1935:50). Similar descriptions of the Cree world view have been reported since the 17th Century (Speck 1935). This idea of the world as a community of partners, both human and nonhuman, is fundamental to any attempt at acquiring an understanding of Cree ontology and environmental theory.

The landscape and its non-human inhabitants are sentient, they communicate and their interactions are social interactions (Feit 1986; Feit 1997; Whiteman and Cooper 2000). The animals people depend on, including fish are known to have intelligence and agency. Scott explains that the Wemindji "Cree perception of geese suggests that objective understanding of nature requires not just a comprehension of environmental forces, but an understanding of geese as thinking, learning, communicating social beings" (1983:52). Feit agrees that in Waswanipi, too, "animals are social beings, not cut off from humans" who understand the actions of humans (1988:77). Interactions with animals are social interactions, and animals are thought of as persons: "It is not as if animals were persons -they are persons in literal usage, albeit not human persons" (Scott 1983: 100; see also Ingold and Kurttila 2000 and Nadasdy 2007). Animals, including fish and birds, know about what people think and do and therefore act in ways that are responsive to human intentions; in this way they can communicate with people (Feit 1985; Berkes 1999). Other entities, from winds, water, geophysical features, to rocks and trees, are also sentient. They too communicate with and engage in relationships with each other and with humans in one way or another (Feit 1986).

Hunters' relations with animals provide a good illustration for understanding the significance of reciprocal networks of interactions. Cree hunters understand that while their skills are essential to their success, it is animals who decide on the results of the hunt (Tanner

1979, Preston 2002). Animals consciously engage in social relations with humans. They cooperate with hunters who are respectful and willing to interact on the same terms, and animals will give themselves to hunters when they chose to do so (Scott 1983, 2004). The relationship is one of reciprocity. Moral obligations are incurred with the gift of food from animals. In return for hunting success, responsible action requires that care is taken in butchering, cooking and storage of the meat. Every part of the animal must be eaten or used and any remains must be disposed of respectfully (Bearskin, et al. 1989; Scott 1983; Tanner 1979). It is still common practice to hang animal skulls and the trachea of geese from tree branches at a camp to honour the lives given by these beings (Scott 1996, Preston, 2002). In addition, there is a responsibility to share the gifts of food with other families (Feit 1986). According to Scott (1983, 1996), animals' cooperation with hunters mirrors some of the ways that humans need to cooperate with each other. Failure to maintain hunting practices that are respectful can have negative consequences for a hunter, including starvation and death (Feit 1986; Scott 1996, 2006). Humans who do take these other persons seriously can live well and in right relations with the world.

Hunters cooperate within this community of varied persons in other ways as well. They know the lands where they hunt intimately, and they look after those lands. They track the health of the animals who live there by examining their fat content when they are killed or the quality and kinds of vegetation they are eating (Bearskin et al 1989, Tanner 1979). After intense use of an area, hunting may be restrained for several years so as to let the area rest until the animals come back and a variety of different strategies and rotations are employed (Berkes 1982; Berkes 1993; Feit 1988). Animals are known to be more abundant and in better health when they are hunted, so too little hunting can be as harmful as too much (Berkes 1999:88). The aim is to "maintain an ongoing balance between harvests and game" (Feit 1986:186). An uuchimaau ('tallyman' or 'hunting boss') is head of each family hunting territory (also referred to as a trapline). It is the *uuchimaau* who is responsible for maintaining that 'ongoing balance' and ensuring that the animals are treated with respect. Similarly, activities like hunting, berry picking and the gathering of spruce boughs (used for flooring in traditional structures) that engage people and help connect them to their surroundings are good for both the land and the people as they strengthen the relationships between them (Benessaiah, et al. 2003; Berkes and Davidson-Hunt 2006; Parlee and Berkes

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2006)(). The health and well being of the land and the well being of the people are interdependent (Adelson 2000). Respectful relationships between people and place, like those between people and animals, ensure benefits for all.

Knowledge and a "basic quality of contingency"

Knowledge acquired through a lasting relationship with particular places is what hunters rely on for wise decision making and choice of strategies (Scott 1996; Peloquin 2007). Ecologists who study northern ecosystems point out that subarctic ecosystems are complex and highly variable (Elmqvist et al 2004) and "possibly unique in the extent to which local regions vary over time" (Feit 1969). Animal populations oscillate from year to year and decade to decade. Storms, disease, fires and disruptions, sometimes arising from changes in distant places, affect plants, animals and people (Chapin, et al. 2006; Pastor, et al. 1998). Ridington (1994) writes that northern hunters must be flexible, adaptable and ready to take advantage of opportunities that are present: "[t]he essence of hunting technology is to retain and be able to act upon information about the possible relationships between people and the natural environment" (Ridington 1994:284). Hunting success depends on detailed observations, awareness of changes both large and small over different spans of time and the careful evaluation of these observations (Davidson-Hunt 2006). Knowledge gathered is about specific places in Wemindji territory, and people are reluctant to generalize from what they know about their own hunting territories to other places.

Although people must rely on knowledge, it is never presumed to be absolute or unchanging; instead it is based in continuously changing relationships (Preston 2002). Preston describes the Cree relationship with the world as characterized "by a basic quality of contingency" (2002:152). Attempts to control the environment on a large scale would disrupt the balance of relationships, so the Waswanipi Cree, according to Preston, tend to find ways to work *with* the processes of the environment. Fikret Berkes agrees that the James Bay Cree do not assume that "human management of animals and environment is possible" (1999:80). Rather than seeking to change or control events, a person tries to understand what is happening through close observation, the acquisition of knowledge of specific places and discussion of that knowledge with others who are knowledgeable and experienced (Brody 2000: 260). One waits until the wind dies down to travel on James Bay or on big lakes, and one waits until there are windy conditions to hunt for geese (Peloquin 2007). Attempts to manipulate environmental process are rarely considered options that will lead to better outcomes than adapting, adjusting and finding ways to work with change.

Cree and Western Sciences: possibilities and challenges for collaboration

In the north, of the importance of building research partnerships between scientists and indigenous people is being recognized. Local participation is a requirement of Canadian environmental assessment projects (Ellis 2005; Usher 2000). Collaborative cross-cultural research is moving northern science in new directions that are, among other things, more responsive to local interests than in the past (Laidler 2006). Although the success of collaborative work to date has been uneven, both researchers and indigenous people seem optimistic about the possibilities of future outcomes (Ellis 2005; Nadasdy 1999; Nadasdy 2005). Indigenous people are interested in scientific knowledge that complements local understandings, and have found that it in some contexts (land and resource claims, for example) it lends authority to their own expertise (McGregor 2004b). Scientific reports have often been helpful in producing favourable outcomes for contested resources (Fernandez-Gimenez, et al. 2006; McGregor 2004a). At the same time, scientific researchers have realized that indigenous knowledge adds a depth, breadth and range of observation to their own studies that could not be acquired otherwise (Couzin 2007; Laidler 2006).

The correspondence between observations and descriptions of postfire ecology made by Euro-American scientists and by Cree hunters and their families is very close. This is not unexpected as both are based in descriptions of the same phenomena and both sets of observers rely on careful attention to details. Indigenous environmental knowledge can be of great value to anyone seeking to understand ecosystems processes. Scientists rarely have access to the kind of long term data bases in remote regions that are equivalent to those that arise from generations of life on the land (Gearheard, et al. 2006; Laidler 2006). Nevertheless, local knowledge does not always fit easily with scientific studies (Agrawal 2002; Raffles 2002; Roots 1998). The databases are not easily translatable. Some writers have described the difficulty of reconciling different knowledges based in different world views as one of "incommensurability" (Maffie 2003; Nazarea 2006). Others have argued that the differences are artificial and serve only to reinforce unequal power relationships (Agrawal 1995; Escobar 1998; Nadasdy 2003). Nadasdy points out that in working out comanagement policies, to "accommodate northern hunters ontological assumptions, is

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warranted theoretically as well as politically" (2007:25). This approach, he says, could lead to new understandings of human-animal relationships and better wildlife management policies.

In the next section I examine the literature on indigenous science and uses of fire in North America and discuss the use, or rather the non-use of fire in *Iyiyuuschii*. The last section of this chapter reviews non-native attitudes towards fire in North America.

Fire and indigenous people – (historical) uses of fire

Native people across North America used fire as a tool for reasons (other than cooking and heating) that ranged from the maintenance of useful plant and animal habitats to the creation of travel routes, forests and meadows and to facilitate the hunt for game (Lewis 1982; Lewis and Ferguson 1988; Storm 2004; Turner 1999; Turner, et al. 2000). Among well known examples are the large fires that were set on the prairies to maintain the grasslands and influence the distribution of bison (Anderson and Barbour 2003; Kimmerer and Lake 2001; Storm 2004; Williams 2000). Frequent ground fires in what became the eastern United States created the open forests of large trees, sparse understory plants and grassy openings that were described by early European settlers as attractive habitats for animals such as deer, hare, turkey and, grouse (Cronon 1983; Day 1953). In north-western Canada, controlled burning maintained the floral diversity of meadows and mountain slopes where roots, bulbs, leaves and berries were harvested (Anderson and Barbour 2003; Turner, et al. 2000). Natcher and his colleagues report that in the interior of Alaska the Gwich'in burned the undergrowth to facilitate moose hunting and travel and to create caribou fencing (Natcher, et al. 2007). In northern Alberta people developed strategies for keeping meadows open, and grassy areas around lakes and along rivers that would be more attractive to moose and other animals (Lewis and Ferguson 1988). According to Lewis & Ferguson, "fires were used throughout the drainage areas of the boreal forest to affect the relative abundance of both herbivores and their predators" (1988: 69).

Techniques for controlling the size and intensity of burns have been described as sophisticated and effective (Lewis 1982; Lewis and Ferguson 1988; Kimmerer and Lake 2001). Timing was important, as areas needed to be dry enough to burn but not so dry that neighbouring forests would be ignited. Berkes and Davidson-Hunt (2006) indicate that the Anishinaabe people of western Ontario limited their use of fire to very small patches in early spring, when fires would not be intense and would be unlikely to spread out of control. Similarly in Alaska, people knew that small fires in wet seasons could be controlled and set them when they saw a need to diminish fuel loads and the likelihood of larger fires in later years (Natcher 2007). Akwesasne Mohawks waited for winter to prune the vegetation around lakes and marshes when snow effectively prevented the spread of fire. Snow protected the root systems of the shrubs pruned and the result was abundant growth in the spring to attract many kinds of game (Cuerrier 2003).

The use of fire was widespread, but there is some controversy over the extent of prescribed burning in North America. Was its use as ubiquitous as some have claimed? Pyne and others contend that burning practices were employed throughout the continent before the arrival of Europeans, that nearly all ecosystems were altered at some time by indigenous burning (Pyne 1982; Stewart, et al. 2002). Others counter that fire was used routinely in some places, but that most people did not practice controlled burning (Vale 2002). Wild fires can enhance ecosystems in many of the same ways that prescribed fires do, so often natural ignitions alone are sufficient to maintain important types of landscapes (Griffin 2002: 89). Natcher and his colleagues present an interesting case study based on historical documents and interviews with two First Nations in Alaska whose neighbouring lands lie in very different ecosystems and whose attitudes toward burning vary considerably (Natcher, et al. 2007). The Birch Creek Gwich'in of eastern interior Alaska welcome ecological changes brought by forest fires. In the past, they used prescribed burning as an essential strategy of habitat maintenance to support their moose and caribou hunting practices. Their landscape is subject to frequent small lightning fires and is highly diverse in terms of physical features and vegetation. Koyukon people, who have been more sedentary salmon fishers, live in Huslia to the west of Birch Creek, where natural forest fire is less common. They describe fire as a powerful and dangerous force and say that they see no need for the intentional use of fire in landscape modification (Natcher, et al. 2007). The contrasting attitudes appear to be based in dissimilar terrain and ecological process, as well as in different patterns of subsistence and settlement.

Almost without exception, Wemindji people say that landscape burning practices were not employed in the past. When asked about using small scale fires to manage berry patches for example, no one I spoke to had ever heard of employing fire in this way. Most

people indicated that it would be an unsafe practice with possibly disastrous consequences. "We don't do that; it's not what we do!" a Cree hunter from a neighbouring community emphatically explained, adding that setting fires to the forest would be far too dangerous an activity (AGC 10/28/2006). Preston's (2002) depiction mentioned above, of the East Cree as tending to work with the processes of the environment, supports the idea that fire was not a regular landscape management tool. The Cree view is that attempts to control the environment on a large scale could only disrupt the balance of complex ecological and social relationships. Confirming this, people often point out that the flooding of their land for the hydroelectric dams resulted in high mercury levels in the fish there. However, this philosophy does not explain why quite small-scale burning is not practiced. Localized burns would not be larger in impact than, for example, the construction of dikes or cutting of flyways for goose hunting (Scott 1983; Peloquin 2007). Anishinaabe people hold similar views about not trying to control the environment. Nonetheless, they used fire, in the old days before government fire control intervention became the norm, on a small scale to enhance the productivity of particular kinds of places (Berkes & Davidson-Hunt 2004). Perhaps the fact that fires occur so frequently in northern Quebec would have made firing unnecessary for Wemindji people. Possibly the combination of climate and forest type, density and flammability of the vegetation, much as Natcher describes for Alaska, precluded a need for controlled burning. It may be that the very high risk of small fires becoming dangerously large ones during the short dry spring and summer months discouraged the use or experimentation with fire. It is also possible that berry patches, for example, were pruned with small fires or that fire was used in winter or early spring, but that these practices were abandoned long ago and have been forgotten.

There is little in the historical record of eastern James Bay regarding the use of fire. Lowe's 1895 geological survey report makes several references to fires set by the Cree. At least half of the forest in northern Quebec had been destroyed by fire between 1850 and 1895, according his report. Although he attributed some of these fires to lightning, he was convinced that the Indians' "careless camp fires in dry seasons" (Low, et al. 1896: 37) and sparks from fires set for signalling on small islands in lakes (1896: 55) were more frequent causes of fire. Feit suggests that rather than interpreting this as evidence of carelessness, Crees' apparent lack of concern over forest fires might indicate an awareness of fire's beneficial role in maintaining vegetation types that attract game (1969). Lowe also writes briefly that:

at times the Nichicun (now the northern section of Mistissini territory) "purposely burned large areas in order to prepare the ground for bear hunting; for within a few years after a fire, in this region, the surface becomes thickly covered with blueberries and other small fruits, forming feeding grounds for bears during the autumn months (Lowe:86).

No indication of the source for this information is given in the text. Tanner (1979) worked in this area in the 1970's and does not report any reference to the intentional use of fire. However, both Tanner and Richardson (1991) report conversations with people in the wider area about some of the ways that the results of fire can be beneficial to people, such as providing varied habitat for animals and the availability of building materials.

Recently, some Wemindji residents have discussed the merits of experimenting with very small fires on the coast to clear dense shrub vegetation and encourage the growth of grasses in hunting sites that are no longer attracting waterfowl (J Sayles pers comm. November 2007). Sayles has also heard that fire may have been used to clear the ground around campsites on islands. In spite of this limited evidence to the contrary, it does not appear that fire was a management tool used often in *Iyiyuuschii*.

Non-natives and forest fires in North America

In this section I briefly explore some North American attitudes towards forest fire as well as some of the science literature on fire in the boreal forest. This body of work is wide ranging and touches on such subjects as timber management and policies or the effects of natural disturbances, resilience, and complexity. The next presents a review of scientific studies carried out during the past two decades and specifically devoted to fire and postfire ecology in north-western Quebec and the Wemindji area.

In Canada today, human activities cause the ignition of more than 65% of fires and the figures rise where population numbers are higher (Fauria and Johnson 2006). Early European settlers in North America viewed fire as a useful tool for land clearing. In contemporary Euro-American contexts fire is commonly portrayed as destructive, hazardous to humans, a threat to homes, towns and business, and a problem for the forestry industry (Pyne 2007). In media portrayals wildfires are disasters, forests are "ravaged" as "raging infernos" roar through them, the damage is catastrophic and millions of dollars are spent on battling the flames (Associated 1988; Reid 1989; Robbins and Special to The New York 1988). Negative perceptions were fostered partly by fire prevention campaigns such as the United State's 'Smokey the Bear' (Jacobson, et al. 2001). Fire control programs were gauged reasonably effective until the 1970's, when spiralling costs⁹ became untenable and evidence of some of the negative consequences of fire suppression surfaced (Pyne 2001). In the late 1970's fire management policies turned towards the accommodation of fire as a natural process (Arno and Brown 1989; DellaSala, et al. 2004; Pyne 2004; Turner, et al. 2003a). When fires are suppressed dead wood and other combustible plant materials accumulate on the forest floor, resulting in much larger and more intense fires that resist control efforts. Although fires near residential properties and managed timberland are still actively suppressed, control is now often described as self-defeating so fires are monitored but left to burn themselves out when possible (Pyne 2004, Turner, et al. 2003a).

Wildfire is currently understood as a fundamental component of boreal (and other) forest dynamics. Both loggers and ecologists recognize fire's role in maintaining stand diversity and driving essential cycles of renewal and regeneration. The forestry industry is now trying in many places to match timber harvesting to fire dynamics. New logging practices that imitate the effects of fire are intended to encourage healthier and more rapid regeneration of forest stands (Bergeron, et al. 2002; Gauthier and de Grandpré 2003; Purdon 2003). The outcomes are positive so far but the boreal system is complex and depends on many processes that are as yet poorly understood. The complexity limits predictability (Fyles, pers. com. 2007). For example, "Observing fires at only a single scale of space and time inevitably presents an incomplete picture. Moreover, fire interacts with other ecosystem disturbance processes at multiple scales. Complex interactions of fuels, topography, and climate influence the behaviour and effects of individual fires...." (Falk, et al. 2007: 811). Uncertainty, complexity, cycles of change and recovery, resilience, variability at many scales; these terms have become the dominant themes in the literature on postfire ecology. As we will see, similar themes recur in Cree understandings of fire dynamics.

⁹ Annual costs have exceeded 1 billion dollars in the US (Donovan et al. 2008) and over 400 million in Canada (<u>http://canadaforests.nrcan.gc.ca/articletopic/33</u>).

Chapter 3 - Western science and fire in iyiyuuschii

This chapter provides an overview of some representative scholarly literature on fire ecology in the coniferous forests of northern Canada. It begins with a general discussion of scientific understandings of fire in the boreal forest with reference to Wemindji territory and then narrows the focus to review research that has been carried out within or close to the Wemindji region and its environs. Forest fire as a driver of vegetation change and the implications of climate change for forest fire frequency are two central themes for the research that has been carried out in this region. The chapter ends with a Cree legend that illustrates observations of phenomena (fire-governed longitudinal variation in vegetation types) similar to those described in the last ecology article reviewed in this chapter.

Fire's role in the boreal forest

The key agent of change and renewal in sub-arctic ecosystem is wildfire (Stocks, et al. 2002). In Wemindji territory, where fires occur annually and the fire cycle is estimated at 100 to110 years, inland forests are well adjusted to the disturbance and transformations that are the result of fire activity (Couturier, et al. 1989; Payette, et al. 1989; Payette and Delwaide 2004). Most of the landscape has burned repeatedly since the glacial retreat, although some very humid habitats remain nearly untouched by fire for centuries (Busque and Arseneault 2005). The two most abundant tree species, black spruce and jack pine, are not only well adapted to fire, they depend on it. The serotinous cones of jack pine must be exposed to high heat for the release of seed to occur. Black spruce cones are 'semiserotinous' which means that they hold their seeds and disperse them over time, but the heat of a fire can stimulate full dispersal (Arseneault 2001). The post-fire release of large amounts of seed permits the establishment of dense stands of trees that persist until the next burn. These stands of different age classes give a "patchy" look to the landscape which is often referred to as a "mosaic" of stands (Rowe and Scotter 1973). In very recent burns new grasses and small herbaceous plants sprout quickly from underground parts that were well insulated from the flames. Ten years later young jack pines typically dominate a sparse understory of ericaceous shrubs and spruce seedlings. More open stands of tall spruce with thick carpets of lichen or moss indicate areas of old growth.

In north-western Quebec, nearly all forest fires are ignited by lightning (Payette, et al. 1989). Resinous coniferous trees and the ubiquitous ground lichens are highly combustible, increasingly so when dry summer conditions persist (Fauria and Johnson 2006). The requirements for a burn are dry forest floor materials and a bolt of lightning strong enough to ignite that dry ground layer, though the occurrence of these factors at the same time is relatively rare (Krawchuk, et al. 2006; Nash and Johnson 1996). The ground layer can smoulder for several days before it bursts into flame and ignites larger fuels (Anderson 2002). Weather that follows a lightning strike, especially the strength of the wind and amount of rainfall, is also significant in determining how far a fire will spread (Kochtubajda, et al. 2006). Thunderstorms are not unusual in the Wemindji area, though the convective storm season in James Bay is short (mid-June to mid-August) (Payette, et al. 1989). Rising autumn temperatures, the result of global warming, may mean longer, and more active, fire seasons in the future (Bond-Lamberty, et al. 2007; Kochtubajda, et al. 2006; Le Goff, et al. 2005).

Fire suppression or rather the lack of it in north-western Quebec.

In Canada, forest management and forest fire control are a provincial responsibility (Pyne 2007). In Quebec, provincial fire management policy does not include the suppression of forest fires in Wemindji territory or anywhere else north of the 52nd parallel. Since no commercial logging takes place this far north, the extremely high costs of fire control in remote areas are deemed unnecessary unless a settlement is threatened (SOPFEU 2007). Only in past few decades have fires in this region even been monitored by the provincial *Société de protection des forêts contre le feu* (Payette, et al. 1989; SOPFEU 2007).

When a community is endangered by the proximity of a blaze or thick smoke becomes a health hazard, community members are moved to towns in the south or to unaffected communities within the James Bay area. People with asthma or other respiratory and heath problems, old people and families with young children are moved out quickly when air quality is affected even if the town itself is in no danger. Evacuations of whole towns have been relatively rare, though in Mistissini emergency procedures were required not once but several times in the summer season of 2006 (Bonspiel 2006). Several people I spoke to in Wemindji had vivid memories of a fire that came close to town. Fire fighters were flown in and local men were recruited to put it out before it moved close enough to threaten the village. During the big fires in 1989, many people were evacuated because the air was so thick with smoke and ash (DS 07/2005). Smoke from even a small forest fire carries far and can often be detected in the air during the summer months in Wemindji. Smoke turns the sun red and the horizon noticeably hazy though the fire may be miles away. Sunsets are spectacularly colourful when fires are burning.

Fires and changing climate

People in Wemindji have observed that the frequency of forest fire seems to be increasing with the warmer summer weather. Provincial fire data for the last hundred years does not exist, but records do indicate a slight increase for the last fifty years¹⁰. Fire frequency, intensity and duration are all closely linked to climate (Bond-Lamberty, et al. 2007). Scientists agree that warming temperatures are increasing fire activity in the boreal forest across Canada (Flannigan, et al. 2001; Kimball, et al. 2007; Stocks, et al. 1998). It has also been suggested, however, that changing climatic conditions could increase precipitation in eastern Canada, including north-western Quebec, and therefore a decrease in fire frequency is possible (Flannigan, et al. 2001; Parisien, et al. 2006). Boreal systems and changing precipitation patterns together are present more complexity than allows for accurate predictions, even with the use of highly sophisticated modelling techniques.

Changes in fire frequency, even in the sparsely populated north, are presently of particular interest to scientists because of the boreal forests' important role in carbon dioxide storage. Because burning fires release carbon dioxide (and other gases) they have the potential to transform northern forests which are presently significant carbon sinks into carbon sources (Amiro, et al. 2003; Bond-Lamberty, et al. 2007). Alterations in the fire regime are also of keen interest in Wemindji. Increased fire frequency and a warming climate in combination could alter forest renewal processes, animal habitat and therefore local hunting patterns (Le Goff, et al. 2005; Nelson, et al. 2008; Rupp, et al. 2007).

Big fires, little fires, and the 1989 fire

Most fires in subarctic forests are small blazes that burn for a few hours or days over just a few hectares. Throughout the boreal forest small fires are the norm. However, about 3 percent of fires are very large and these account for 97 percent of the area burned in northern

¹⁰ Spatial fire data (1960-2004) provided by the *Ministère des ressources naturelles et de la faune*, 2/2007.
Canada (Parisien, et al. 2006; Payette, et al. 1989; Weber and Stocks 1998). Large fires occur during prolonged periods of low precipitation and may persist for many weeks, or even months. In 1989, the largest fires on record in Quebec consumed more than 2,086,600 hectares of the province including a large portion of Wemindji territory, much of it within the boundaries of the proposed protected area (Lavoie and Sirois 1998). Three dry summers followed by a fourth with meteorological (lightning, wind and drought) conditions favourable to the ignition and spread of fires culminated in that big blaze (Couturier and Saint-Martin 1990; Stocks, et al. 2002). Several people in Wemindji told me about the fires in those years. One person remembered seeing lightning strike a tall tree that summer as he stepped out of the church one afternoon (RA 08/04/2005). Another described three dry summers with fires every summer including the big one. "Burned all the way to Sakami Lake and the highway. Crossed the river. It was a dry summer, hardly rained, an early spring, lots of thunder. That's why it burned".

At the time of the fires, there unusually large size was not generally recognized and very few reports from that year are available, perhaps because so many large fires were burning in more densely populated regions of Canada. But a few newspapers did describe the smoke and heat of the 'innumerable' fires 'ignited by the incandescent sparks... scattered to the four winds' near the hydro-electric installations and construction sites at LG-1 (Fortin 1989:B7). The emergency evacuation of Radisson and the hazards faced by fire fighters as the flames threatened to consume the hydro installations also made the news (Montreal Gazette1989a; 1989b; 1989c; Fortin 1989). Since then several research projects have examined the aftermath of the fires, their effects on vegetation and animals (Arseneault, et al. 1997; Couturier, et al. 1989; Lavoie and Sirois 1998; Le Goff and Sirois 2004)

The attached map (**Figure 2**) based on data supplied by the *Ministère des Ressources naturelles et de la faune du Québec* (MNRF) traces the fires that were observed and recorded for Wemindji Territory by decade since 1960. The fires in 1989 are marked off from other fires in that decade. **Figure 3** shows the extent of the fires that burned in 1989. So much of Wemindji territory was burned in 1989 that traces of earlier fires are now hard to find. The map is not a complete picture. Not only does it leave out fires that went unrecorded each decade, it also gives the impression that burnt areas were uniformly burned to the ground. Burns are never uniform, and burnt patches of forest are all affected to different degrees.



Figure 2: Fires recorded for Wemindji Territory by decade, 1960-2004

Figure 3: Total area burned by 1989 forest fires in Wemindji Territory



Review of literature on fire in the Wemindji region

The postfire dynamics of vegetation of the James Bay area have been well studied. Early studies were often primarily planned for geological exploration. At the end of the 19th century Alfred Low canoed some of the region's big rivers with Cree guides and reported his observations of people, vegetation and fire as well as the geology which was his main interest and mandate (Lowe 1896). James Macoun, the famous botanist, visited the coasts and larger islands of James Bay in 1887 (Macoun 1888). In the 1950's and 1960's, botanists Hustich (1950), Baldwin (1953), Dutilly, Lepage and Duman (1958) travelled the coast of James Bay in a freighter canoe with Cree guides, making botanical collections and recording the effects of fire. Wide-ranging environmental surveys were carried out in the 1970's and 1980's to assess the impacts of the hydroelectric projects (see, for example, Ducruc, et al. 1976; and Gérardin 1980; Hayeur 2001 includes an extensive bibliography of the surveys). Many of these reports also include observations of fire and its role as an important determinant of forest structure.

A large series of recent projects have focused specifically on postfire ecology and climate change in the area stretching north from Chisasibi and south from Chisasibi to Wemindji. Although a few of these studies have examined the effect of fires on animals of interest to sports hunters (see for example Couturier and St-Martin 1990¹¹), most of the work has been aimed at understanding forest dynamics. One of the most important impacts of the James Bay hydro project on the region's ecology¹² was the new and easy access to this previously isolated area by road, originally built to facilitate construction. It has made research projects more feasible, less expensive, and more frequent (Parisien and Sirois 2003).

Currently a small research base has been maintained by an inter-university research network¹³ near Radisson, 100 km northwest of the town of Wemindji. Scientists there explore forest changes, climate change and the ways that climate and natural disturbance affect landscape processes in subarctic forest zones¹⁴. The forest at this latitude is extremely sensitive to climatic change so studies here provide some early indications of changes that might be expected in other sectors of the boreal forest. In 1989 a team of investigators mapped the 20th century fire history of northern Quebec from the northern edge of Wemindji territory to the tree-line nearly 450km to the north, using aerial reconnaissance and groundtruthing (Payette, et al. 1989). They established that the fire rotation period in the forested southern section is relatively short at 109 years. Further north, where shrub tundra vegetation dominates, the cycle increases to several thousand years. At this transition between forest and tundra, trees are stressed and rarely produce viable seed, but the charcoal evidence shows the area was formerly forested (Arseneault and Sirois 2004). The occurrence of just one fire since deglaciation caused long-term shifts from forest to open tundra vegetation (Arseneault and Sirois 2004; Caccianiga and Payette 2006; Hustich 1979; Payette 1993; Payette, et al. 2001). Fire frequency was higher than expected in the southern region given the fire weather index and vegetation types, and variability in the size of fires was also a surprise (Payette, et al. 1989:669).

¹¹ Couturier & St-Martin 1991, studied fire ecology of northern caribou for *the Ministère du loisir, de la chasse et de la pêche*, following the large fires in 1989, the first year caribou hunting was opened in Quebec. They concluded that because lichens, important caribou food sources, regenerate very slowly, large fires could affect the distribution and abundance of caribou populations near Radisson, Chisasibi and Wemindji.

¹² See for example Plourde et al (1997) on methyl mercury contamination of the food chain that resulted from unforeseen chemical reactions that occurred when vegetation decomposed in hydroelectric reservoirs.

 ¹³ Centre d'études nordiques <u>http://www.cen.ulaval.ca/english/ecologie.html</u>. Accessed December 15, 2007.
¹⁴ Ibid.

Since 1989, researchers have expanded earlier work on fire history and climate change. Arseneault and Sirois (2004) analyzed well-preserved woody debris (tree stumps, trunks and branches) excavated from peat bogs near Sakami Lake to uncover some 5000 years of fire history. Forest composition has remained quite stable through millennia, although alterations in relative species abundance have occurred with climate and fire interval variations (Arseneault and Sirois 2004:520). Changes in fire intervals combined with large fires and postfire dry weather, however, can contribute to enduring modifications in vegetation such as larger forest gaps and increased shrub-tundra and tundra (Lavoie and Sirois 1998: 490). In Wemindji, people who spend time out on the land point to places on maps of their traplines where long lasting transformations from closed forest to bare rock or low heath have occurred after very intense fires or series of fires at short intervals.

Lavoie and Sirois monitored the regeneration at the site described above after the large 1989 fires, and found that drought and hot weather in 1988 and 1989 combined with the high fire intensity retarded the usual rate of postfire seedling establishment (1998). Uneven damage to seed banks along with topography, drainage and fuel conditions explain variation in recovery on different sites (Arseneault 2001). Le Goff and Sirois (2004) show that variations in black spruce and jack pine are also the result of changing climate and fire cycles. Black spruce populations decline with shortened fire intervals while jack pine disappear when the time between fires lengthens to more than 200 years (Le Goff and Sirois 2004:2405). Extreme conditions, especially in combination, can prompt long term shifts in plant communities, themes that were echoed in Wemindji conversations. An elder in Wemindji, for example, spoke about areas on his trapline that had been completely deforested by a series of fires in the1920's. Others have observed that jack pine is becoming more abundant after recent fires on their hunting territories. At the coast, where a very hot fire burned to the shore, jack pine is appearing where it has not been seen previously. These examples will be discussed in more depth in the next chapter.

Bouchon & Arsenault (2004) pursued the subject of vegetation shifts further with data from both living trees and preserved woody remains to determine the reasons for a lack of recovery on floodplain severely burned in 1941. Patterns of postfire recovery, they found, depend on seedling survival in the first five years after a fire. When increasing winter precipitation in the 20th century caused spring floods, seedlings did not survive at this site (Bouchon and Arseneault 2004). They predict that other areas will be transformed. In less flood-prone areas different changes are predicted. If fire frequency does not change, denser forests may result as warmer temperatures enhance tree establishment by seed (Gamache and Payette 2004; Gamache and Payette 2005; Meunier, et al. 2007). Unburned remnants of the forest are important seed sources for forest recovery (Arseneault, et al. 2007). In a related project, fossilized beetles exhumed from excavated trunks and branches did not reveal any significant cooling of summer temperatures during the last 1000 years (Lavoie and Arseneault 2001). Changes were linked instead to variability of precipitation and fire frequency (Lavoie and Arseneault 2001: 17).

Variations in forest structure along a 100km gradient from the coast to the James Bay Highway were investigated by Parisien and Sirois (2003). The longitudinal pattern of differences in the distribution of vegetation that are apparent along the entire length of the coast had been previously recorded, but not well explained in the literature (but see the Cree version below). Aerial photos and transect data used in this study show the very narrow strip of pure white spruce along the coast that gives way to mixed stands and then pure stands of black spruce inland. Jack pine mingles with the black spruce at about 22 km from the shore. The pattern is attributed to fire cycle length - jack pine flourishes where the fire cycle is short. Black spruce, which grows more slowly and has a longer life span, survives in areas with short fire cycles as well as in areas with longer fire-free periods. White spruce, which is intolerant of fire, flourishes on the narrow ribbon of the humid coastline where fire is a rare occurrence (Parisien and Sirois 2003).

The longitudinal forest pattern described by Parisien and Sirois is well known in *Iyiyuuschii*. A Cree legend describes how the trees that populate the forests there were named. The narrative places the trees in the same geographic order from the coast as Parisien's study. I summarize the story here to introduce Chapter 4 on Cree understandings of postfire ecology. It illustrates, among other things, a broader focus than that of scientists. Cree narratives often refer to precise observations of the world and at the same time to broader lessons that include the practical as well as the spiritual. The story teaches, (see Preston 2002 for a thorough analysis and the complete tale), the names of the main species set within the same patterns that the scientists above have studied.

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Richard Preston includes this story, as told to him by John Blackned in the late 1960's, in *Cree Narrative* (Preston 2002:159-162). In the story, which I abridge here, Wolverine fights Giant Skunk who has frightened all the other animals. At the end of the battle Wolverine is sprayed in the eyes and blinded by Skunk's musk. He must rush from the inland site of the battle to the coast in order to wash the musk from his eyes in the hope that he will be able to see again. As he runs blindly, he bumps into obstacles, the trees along the route. He questions each one about what kind of tree it is (**Figure 4**). They respond, one of each species, with their names: *wishkui* (white birch), *uchisk* (jack pine), *iiyaahtikw* (black spruce), *miitus* (poplar), *waachinaakin* (tamarack), *iyaashiht* (balsam fir), and finally *minihiikw* (white spruce). "And the last one told him that he was the only tree that stands around the bay" so Wolverine knew that he was going in the right direction, even though he could not see (Preston 2002:161). When at last he reached the bay, he plunged in to wash his eyes and turned the water salty for ever after.

Figure 4: What Wolverine might have run into on his way to the coast of James Bay, a body of water large enough to wash Giant Skunk's spray from his eyes.



Chapter 4 - Wemindji lyiyuuch Postfire Ecology

This chapter outlines what I learned about fire ecology from the people of Wemindji and includes some of their stories. Conversations in Wemindji almost always include a story, whether about fire, about animals and fire, or about other aspects of life on the land. Experts weave insights on post fire forest regeneration and faunal succession together with glimpses of life long ago, of the rapid changes since Hydro-Quebec construction began in the 1970's, of traditional values, beliefs and a way of living with change that works in this dynamic landscape. Always interesting, some of the stories seemed as immediately relevant as Wolverine's tale above, but others seemed to lack any clear connection with our discussion or to my questions about forest fires.

My understandings of these stories have shifted, expanding and contracting over the five years that I have been hearing them. What appeared, on first hearing, to be digressions were later understood as central to the essence of what was being conveyed. The narratives are many-layered and they offer keys to what people want to share. They are about, though perhaps not always directly, the way the forest works, about their lives, about the way the landscape works together, for and with the community of people, plants, animals and other beings that reside there. I think the stories are meant to leave one with the 'rules of thumb', lessons that can lead to new conclusions, new knowledge that can be used when one is confronted with new situations and ready to consider the possibilities. Stories of life on traplines, in town, and in the places people remember from their childhoods can contribute to any individual's ongoing efforts to learn about and understand dynamics of this variable and largely unpredictable environment. Sometimes referred to in the literature on resource management and traditional ecological knowledge as 'difficult' or incompatible, anecdotes that appear on the surface to be diversions are easily and often left out of scientific accounts (Nadasdy 1999, McGregor 2004). But ignoring the differences in presentation or looking only for the information that neatly confirms the data, as Helen Verran (2002) makes clear, does not lead either to new knowledge or to productive collaborative work.

The scientific articles reviewed in earlier chapters often focus on particular species (see for example: Busque and Arseneault 2005; Caccianiga and Payette 2006; Gamache and Payette 2004; Meunier, et al. 2007; Parisien and Sirois 2003) or specialized technical procedures and fairly isolated events (Arseneault and Payette 1992; Arseneault and Sirois

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2004; Boucher, et al. 2006). These are used to generalize about broader processes. For example, several of those studies, have examined preserved wood excavated from peat bogs, and the insects preserved in that wood to determine changes in species composition, fire history, and climate patterns and to predict future trends (Arseneault and Sirois 2004; Lavoie and Arseneault 2001).

People in Wemindji have also used attentive observation to study changes in the environment in particular places to understand general processes over varied lengths of time. Though using techniques that are different than those of Western science, people from Wemindji often arrive at similar conclusions about their local environment. In this chapter, we will see that, while both Western and Cree scientists' are keenly attuned to changes revealed in landscape histories and current forest conditions, the underlying reasons for those observations are different (Jacqmain, et al. 2005). Cree hunters are more concerned with the effects of environmental variability on animal populations and how it impacts subsistence activities on their traplines. Changes that affect the continuity of hunting, trapping and fishing practices, that is, the relationships between land, animals, plants and hunters are the focus of Wemindji people's interest in environmental change. Huntingdon and his colleagues describe a similar holistic view in their Alaskan research context:

"Researchers and agency personnel tend to have a very narrow focus with specific goals, in this case specific to the impact of fire on the social-ecological system. However, the villagers have a much broader perspective on the entire socialecological system, including its history and political landscape. When they speak of fire, they are also discussing the larger political, spiritual, and epistemological settings of their lives and their culture (Huntington, et al. 2006: 9).

This chapter is loosely divided into four parts based on themes that emerged in conversations with people from Wemindji about fire. The themes, which have become section headings, were devised simply to organize the discussion. Conversations, of course, were not divided into sections. Our discussions ranged over many topics and cohesive pictures of fire's effects on particular traplines were present. However, each expert communicated observations, memories, and other information that touched on several of the themes and linked them together. The section headings are therefore based on discussions of the interrelated effects of fire on plants, animals, fish, and people. Stories people told are scattered through the text as they were through our conversations. I have credited information from individuals with some form of their initials and the specific date the knowledge was shared. In other cases, at the request for anonymity of the speaker, I include no more than dates. Every effort has been made to accurately reproduce what was said, though it has not been possible to include the full context of the conversation. I regret any errors in representation that have escaped me, they are entirely my own.

Fire and plants

For several years after a fire, the new growth often looks as if it had been carefully planted. As we drove towards Wemindji along the 100 km gravel access from the James Bay Highway, the driver, who spends most weekends out on the land hunting, talked about the ways that fires have left their histories clearly mapped on the land. The heights of adjacent stands of trees record the details of previous fire events (HS 11/08/2006). Even-aged stands of trees persist until the next burn clears some part of the patch and resets the age of the forest to zero at that location. The result is a varied landscape that includes grassy expanses of soggy muskeg, low heaths of shrubby Labrador tea (*Rhododendron groenlandica*) or sheep laurel (*Kalmia angustifolia*), and the patchwork of young and older forests punctuated by very dead but stubbornly erect trunks. Some edges of the patchwork were so clear and abrupt that the driver, as he swerved to miss a spruce grouse he hoped "to meet again in the fall", wondered what had stopped the fire. His speculations included wet soil, a temperature drop at the end of the day, or sudden change in wind direction that could have prevented the flames from penetrating a foot further into the next stand of trees.

Burnt trees often remain standing for a long time after a forest fire; once fallen, they decompose extremely slowly in this subarctic climate. In the Wemindji area it usually takes several years for the bark to fall from snags (standing dead trees). Without bark, a trunk dries out and will eventually be blown over or knocked down by passing animals or other falling snags (SG 27/9/2006). Old burns provide a source of easily harvested firewood that is thoroughly dry and burns well. Campsites are chosen partly on the basis of their proximity to accessible firewood and building materials for shelters (AV 3/08/2006, Tanner 1979). The ease of collecting good dry wood from these sites must have been especially appreciated in the days when steel axes and chainsaws were not readily available. Another benefit of fallen trees recently reported by a group of scientists studying postfire succession in Yellowstone Park is the protection from browsing animals they provide to aspen, and likely, other

seedlings. Smal aspen seedlings are so tasty a treat for moose and other animals that they do not survive more than a few years when they germinate in open areas (Turner, et al. 2003b).

When timber falls, travel in a burn becomes quite arduous for people and some animals (EH 23/06/2006, JM 10/07/2006). Moose are rarely hindered by brush as they "have their own trails" and can get to areas they need to access. For people, it is a different matter. Wood decomposes slowly in this relatively cold and dry climate so even many years after a fire, navigation through the maze of tangled deadfall is difficult (AV 3/08/2006). Direct routes for snow-mobiles are impossible to locate and formerly short walks become longer and more arduous treks.

Not only trees are affected by fire. Nearly everyone mentioned the links between fire and berries. That berry bushes and other shrubs grow vigorously after being "pruned" by fire – abundant new growth sprouts quickly from the root stock just below the ground – is noted in the scientific literature (Hart and Chen 2006; Hart and Chen 2008; Hautala, et al. 2001). The fact that fire-pruned bushes become more productive is also common knowledge in Wemindji: "Well after a few years, it all starts to grow, especially berries...maybe two, three years after a forest fire" (FA 16/07/2006). Also, "...if it's not too burnt, it's like the growth is better and there are lots of berries ...Way at the top of that burnt area there, there are good berries (22/09/2006). "Look at the trees in this picture," one woman said pointing to a hillside photo of her daughters amidst knee-high jack pines, "we were picking lots of cranberries there. We were picking lots of cranberries, lots of blue berries too…After a fire there's more berries and after three or four years they get bigger" (AM 16/07/2006).

Berries are important to Wemindji people and are therefore closely observed. They are one of the few local sources of plant food for people, treats to be eaten directly off the bush, mixed with meat or fish, or preserved for winter. In the old days blueberries and crowberries were dried, or stewed and stored in spruce bark containers for later use (DS 22/07/05, WA 22/09/2006). Cranberries (*Vaccinium vitis-idaea, wiisichimin* in Cree) could be harvested from under the snow in the spring and have important medicinal properties (AG 26/09/2006, WA 22/09/2006, SB 18/08/2006). The social significance of berries was referred to in many conversations that started with mention of fire's benefits for berry bushes. Family outings to collect berries are fondly remembered and jam-making to preserve them appears often appear in reminiscences as a pleasant task. An elder spoke at length one morning about

the role of berries in learning to be a contributing member of the family when she was a small child:

... if there were lots of fish they'd send the kids out to get berries to make shikumin [a much appreciated dish made of pounded boiled whitefish and berries].. When a child is old enough to hold your hand - that's how old I was when I started helping with picking berries. I don't remember, but I was told that. And everyone had to help out, so that's why I had to learn early. Because my father was always gone hunting, to survive we all had to do something. We used to dry some berries and then we would have them in the winter. (WA 22/09/2006).

Local people speak of berries as indicators of changes in the health of the land. Discussions of berries and fire turned to the condition of berries growing on the islands in James Bay. The ill health of island berries is often cited as further evidence of a warming climate (SM 19/08/06 and DA 28/07/2007). For at least the past five years, according to tallyman Fred Stewart and others who spend time on the islands in summer, the berries are "not doing well", (18/08/04, 27/07/2005). Hot sun and a lack of rain at the right time means that berries are drying up before they ripen. "In the past there used to be a lot of black berries [these are *aschiiminh (Empetrum nigrum or* Crowberries)] on the islands, and the [goose] hunting was good, but it's not the same thing now. Only a few grow now on the islands" (JM 10/07/2006). A second family confirmed this: "we noticed that the berries (*iiyiyuminh*) is in the bushes, but in the open areas they are damaged by the sun. It doesn't rain as much now" (IM 27/06/2006).

Inland, however, berries seem to have been less affected by the recent weather variations (JM 10/07/2006). When the shade normally provided by trees is eliminated or reduced by fire, sunlight warms the soil, stimulating rapid growth and encouraging the production of fruit. Drought conditions following fire can slow the regeneration of herbaceous plants for many years (Hart and Chen 2006; Hautala, et al. 2001). One woman expanded on this theme in recollections of the combined effects of weather conditions and fire. She explained that she has not kept track of exactly how many years before the berries are ready to pick after a burn, but she is certain that "when there's a fire and everything starts growing, the berries come back and grow well. It's the weather too, sometimes the

temperature drops and then there aren't many, but when there is lots of rain they grow really well and there are so many berries!" (AG 26/09/2006)¹⁵.

The importance of abundant crops of different kinds of berries as food for both animals and people is reflected in the names of different species. Many of the berries are named for the animals that favour them: There are *muusiminh* ("moose berries", *Viburnum edule*) (WA 22/09/2009), *chishaayakuminh* ("bearberries", *Cornus canadensis*), *nichikuminh* ("otterberries", a variety of blueberry that is very small and sweet and grows close to the ground) (SM and IM 19/08/2006), and *kaakaachiminh ("raven berries" Juniperus communis*) (IM 19/08/2006, WA). An elder described many kinds of berries and concluded that there are "*iiyiminh* [blueberries], and *nischiminh* [*Vaccinium uliginosum*] that the geese eat and we eat them too... Berries for the Cree and berries for the geese" (WA 22/09/2006).

Because animals are attracted to berry patches, hunting is often very good a few years after a fire. "More bears, I guess if you have more berries" one hunter told me. Another added that "...there are good berries there now - I saw one bear there last summer, probably because of the berries there". Not only bears come for the berries in a recent burn. Many animals "...eat berries. Probably bears come first or those partridge, they eat berries too. Those spruce grouse, and porcupines they eat berries too" (JM 10/07/2006).

Grasses and perennials will sprout within a month of a burn in late spring or early summer (JM 10/07/2006). Regeneration occurs quickly from seeds and roots that were protected from the heat of fire by a thick soil cover. The rapid growth of new vegetation and the immediate return of wildlife can be surprising: "When there's forest fire, the next summer you can see the plants. That's one thing that amazes me. The spruce pine, the jack pine, they grow fast after forest fires!" (FA 16/07/2006). Very intense fires, however, burn the organic soil and the underground roots and rhizomes of perennial plants and shrubs, as we saw in the last chapter.

Short fire intervals can also slow or halt regeneration, as noted above in Chapter 3. Many people pointed out places on the maps that are still deforested decades after a fire. On one trapline, in a hilly area, the ground was burned away to the underlying rock surface 30 years ago and the wind blew any remaining soil away (AV 08/08/2006). Sometimes new

¹⁵Blueberry cultivators in Maine, Ontario, Quebec and other places burn their fields periodically to increase production and control pests and diseases (DeGomez 1988).

growth is retarded for long periods in severely burned places, until the soil becomes healthier as the plants come back (SG 25/09/2006). Over 60 years ago a big fire on another trapline cleared all the trees near a lake. This area was described as looking like the forest-tundra region farther north where trees are unable to regain a foothold after fire, an area much studied by members of the *Centre d'études nordiques* (see Chapter 3). This hunter suggested that the local effects of global warming are such that tree growth is being enhanced and this area will likely be reforested in the next decade or two (AG 27/09/2009). Some scientists agree and have reported "[e]vidence of a small, but widespread, positive trend in vegetation gross and net primary" at the northwestern edges of the boreal forest (Kimball, et al. 2007:1).

Closer to Wemindji however, Gamache and Payette (2004:835) have suggested that reforestation of tundra hilltops and northward expansion of the boreal forest predicted under doubled CO_2 conditions could be delayed" due a variety of factors that include increased winter precipitation, decreased summer rainfall and variations at the local level such as topography, slope and exposure. The hunter who noted the effects of global warming would likely agree with this conclusion regarding the significance of local conditions. He was referring to a particular local site with specific conditions where he has seen evidence of recent tree growth rather than generalizing to all deforested areas.

Many people spoke of the way the forest eventually recovers from fire, with an understanding of fire as an essential process of rejuvenation in their part of the world. Their relationship with fire, however is not one-dimensional¹⁶. The way one talks about fire at a particular time always depends on the context, as we shall see again later in this chapter. One elder had seen long term deforestation on his trapline where series of large fires that burned more than 80 years ago have left sandy areas completely barren (SH 23/06/2006). He remembered that the fires had occurred after a time of sickness, a time when many elders had died. He spoke of the fires as an expression of the Earth's sadness at the passing of so many elders; he said the earth was weeping for them.

Shifts in the relative abundance of jack pine and black spruce have been noted by Cree observers in Wemindji as well as by scientists working in the region. Some of the scientific studies of these changes were reviewed in the previous chapter. Scientists have attributed the shifts to fire intensity which may have reduced the availability of spruce seeds,

¹⁶ Thanks to Annick Thomassin and Jessica Dolan for discussions regarding this point.

postfire weather which may have slowed the growth of spruce seedling and/or competition from fast growing pines (Lavoie and Sirois 1998). Wemindji people say that jack pine stands are replacing black spruce in many upland areas, and that recent postfire re-growth of pines is denser than it used to be (AV 08/08/2006). One consultant remarked that there are pines growing now in places that had no pines at all before the last fire. He was curious about how they had managed to move into these new places, and speculated that seed might have been blown in by the wind (FA 16/07/2006). Jack pine has also been spotted in a 20 year old burn on the coast where fires are extremely rare occurrences. The observer expressed great surprise at this anomalous growth on land that normally hosts only white spruce, as the history of Wolverine and Giant Skunk demonstrated in the previous chapter.

Jack pine is the second most abundant tree species in Wemindji territory, and the species most dependent on fire for regeneration. The following excerpt from my field notes is about the importance of jack pine. It links again to the story of Wolverine and Giant Skunk. The quote illustrates that the relationship between trees and people is significant for many reasons:

Where the river curves past banks that burned a few years, dense stands of dead jack pines stand shoulder-to-shoulder; higher up the hillside the growth is densely shrubby. My host agrees that berry bushes must be very thick up there. As we travel up river by boat, he points out spruces and pines that porcupines have stripped of their bark. He will collect some dead pine snags later that day to cook a porcupine he caught the day before. The wood of old jack pine trees makes a hot cook fire that is good for some kinds of food preparation, such as burning the fur off game (like that porcupine) that will be roasted with its skin on beside the fire. He appreciates having opportunities to hear many stories from the older hunters. They say that everything has a spirit, even the trees and plants; the elders have told him this. Uschiskw (pine), for example, takes pity on tired hunters making their way home through the forest in the depths of winter. It flames up then to offer warmth and comfort the cold, lets them rest a bit and make hot tea so they can journey the rest of the way home safely. Pine wood is quite dense resinous, he says, and burns very hot, ideal for campfires when the weather is really cold. (EG 9/29/06).

Fire and Animals

Some animals return within months to a recently burned forest, attracted by the fresh vegetation that appears so quickly and is, apparently, more nutritious than older growth (Nelson, et al. 2008). Mistissini, a community to the south of Wemindji, experienced several

large fires in 2006. A hunter whose trapline is near this area reported that after the fires that year, moose were browsing the new growth amongst charred trees not far from town (AG3 26/10/06). He added that the moose wouldn't likely have stayed around for long though; they would want to be in more sheltered places (AG3 26/10/06). "Moose, they come back soon after a fire" (JM 10/07/2006), was a statement I heard more than once.

Jacqmain reports that hunters he interviewed about logging around Waswanipi, another James Bay Cree community south of Wemindji, strongly linked any forest event that leads to habitat loss, including forest fires, to hardship and starvation conditions for large animals (2005:152). This view seems to have shifted somewhat since 1969 when Harvey Feit was told by a Waswanipi hunter that moose are attracted to the growth that follows forest fires (Morantz 2002:53). Most people in Wemindji did not seem to think that fires were necessarily detrimental for moose, caribou or bear. They were convinced, however, that moose will move away from high impact human developments. The forest disruption and loss caused by the construction of hydroelectric dams, reservoirs and transmission corridors, for example, has played a role in the movements of moose from inland areas near the reservoirs to coastal forests they had not previously occupied. Across Canada moose populations have gradually shifted north, partly, scientists report, in response to climate change and partly in response to the urbanization and industrialization of the country (Darimont, et al. 2005). Wemindji people agree that the big ungulates have migrated north to Wemindji territory and closer to the coast over the past 100 years because they were provoked by clear-cutting, mining, reservoir construction, urbanization and other intense and widespread land use changes in other regions.

Near the northern limits of their range in Wemindji, moose travels throughout the year are determined by the availability of food and good habitat (Julien 1985). They spend brief periods foraging in recent burns in search for succulent new growth, and roam the edges of streams and lakes for the water and dense browse that flourishes there. They also require areas with mature growth for protection from predators and from hot sun and stormy weather (Dussault, et al. 2005; Jacqmain, et al. 2005; Maier, et al. 2005; Nelson, et al. 2008). At about 15 years after a burn, areas around Wemindji recover enough to attract moose (JM 10/07/2006). Sections of the forest burned in 1989 have been supporting small populations for several years now and the population is said to be growing (22/09/2006).

Some areas are especially attractive to moose. One hilly area east of the highway has been described as a special habitat for moose and other animals including lynx, porcupine and otter. The abundant birch and aspen vegetation at this location contrasts noticeably with the surrounding pine and spruce woodlands. The elderly head of the family territory there says that so many moose and other animals reside in that forest "because there is a lot to eat there. A long time ago there weren't any trees there - forest fire. After that, it was good for moose to eat". The hills, he says, were burned some years before he was born, and ever since that time, this rich area has remained an attractive refuge for animals large and small. After a fire, trembling aspens (*Populus tremuloides*, known as poplars in Wemindji) and white birch sprout very quickly in favourable locations, sometimes with a few months after an early fire. Willows grow faster than any of the bigger trees, (AV 08/08/2006; JN 10/07/2006). Both hunters and scientists have observed that the diversity of forest types and ages created by fires provides the varied resources required by moose and other animals.

Under ordinary circumstances, people and animals stay as far as possible from burning fires¹⁷. When I asked if there were any Cree words to describe different kinds of fires, the quick response was that no one goes close enough to see the differences and or to name them: "they're just fires!" (*muushtaau*) (AV 08/08/2009). As we have seen in this chapter, however, the diverse consequences of fires are always noted. Most people said they are confident that animals are rarely harmed by fire (FA 07/16/2006, SG 26/09/2006, SH 23/06/2006). After the large fires in Yellowstone Park, the fact that only small numbers of large animals were directly killed by was reported as one of the 'surprise' findings (Turner, et al. 2003b). Animals are intelligent and know what to do when fire occurs, they move quickly from hazardous locations to safer places such as the coast (SG 26/09/2006). Moose and beaver actions when fire breaks out were described this way:

"...maybe he [moose] comes around, and when he sees the forest fire he goes the other way. Beaver, he's about the same. I've noticed in the area around our camp, in one creek used to be a lot of beaver. Since it burned down, there are no more. So beaver must know that they can't get food there. They don't bother to go there, [they] stay in the lake. (FA 07/16/2006).

¹⁷ Occasionally of course people, like animals, can be trapped in a fire zone. A few years ago one family flew over fires at their camp and across their trapline with a video camera - it makes for dramatic viewing.

Geese are not disturbed by fires, even those that burn close to staging areas near the coast "[T]here was a forest fire in the night and the geese were still on the Bay. People hunted in the morning, and in the evening they have killed geese. They [the geese] are not afraid of forest fire" (SH 23/06/2006). Animals and birds (loons for example), can detect the smell of humans and the smell of campfire smoke (06/08/2004), so it clear that they have an early warning system. "The Creator takes care of the animals when there is a forest fire" (SH 23/06/2006).

Several people also mentioned beaver. One hunter said that beaver return quite soon after a fire and that they do not suffer much from fires as they can swim quickly to safer places (SG 26/09/2006). "I've hunted soon after a fire, after a big fire. Beaver move if there is a big fire. Shortly after that they start coming back. There's lots of vegetation after a forest fire, so they come back" (JM 10/07/208). Some hunters, however, say that beaver, a much-prized food, doesn't taste good for as long as ten years after fire . The size and intensity of a fire are important variables for animals of this size, but even in a very large, intense fire of long duration not all of the landscape is consumed. Remnants of habitat of various sizes remain unburnt during a fire and these provide safe refugia where animal like beaver can sometimes find shelter.

Some people hunt in places that have recently been burnt, for after fire, when the vegetation "grows back, the animals come back again" but people rarely stay in these areas for long (AV 08/08/2006). Ptarmigan come for the new willow shoots and grouse return to search for seeds (FA 07/16/2006). Birds and small rodents are attracted to the abundant crops of seed released from serotinous pine and spruce cones (AV 08/08/06). Rabbits (snowshoe hare) return to burn sites soon after fires (FA 07/16/2006). One hunter said it would take about three years before he would find rabbits after a burn (SG 26/09/2006). Cree hunters in Waswanipi agree that hare, like moose, do not spend a lot of time in areas where the shelter provided by vegetation is minimal (Jacqmain, et al. 2007). This corresponds closely to findings in the scientific literature that indicate that hares avoid open areas and return to burns only when the shrub layer is re-established (Fisher and Wilkinson 2005). On one trapline, hare populations have grown very slowly since a fire that occurred some ten years ago (AV 8/08/2006). Rowe and Scotter found that the rate of increase for hare populations often drops for several years after a burn (Rowe and Scotter 1973).

Caribou populations rise and fall unpredictably over long periods of time (Berkes 1999). The slow growing lichen cover on which caribou depend for winter forage is quickly consumed by fire, but these migratory animals can shift their travel routes to search out better habitat (Couturier and St-Michel 1992). The George River herd, which migrates south through Wemindji territory in winter, is very large at present and people in Wemindji do not believe that big fires have been detrimental to their health (AM 16/07/2006, JM, SG).

The scientific literature is divided on the effects of fire on caribou. Recent work from western Canada and Alaska indicates that caribou avoid burned areas for several decades after fire because of the long period, 30 years or more, required for lichen recovery (Rupp, et al. 2006; Couturier and St-Michel 1992). The population that winters around Wemindji has fluctuated in size since the extensive 1989 fires, but generally the numbers have remained high since then. There is some evidence in the literature that multiple fires with short intervals between them have had more serious negative consequences for caribou populations in other locations (Gulig 2002; Klein 1991; Rupp, et al. 2006). On one Wemindji territory, however, there have been numerous fires in the past 30 years yet caribou numbers remain so high that they are said to "scare away" other species (AM 06, SG 26/09/2006). The current high numbers have not been accounted for. Ecologists point out that in the long term, fire is likely to contribute to caribou health because it renews the lichen cover and increases the diversity of different types of habitat patches (Joly, et al. 2003). Hunters maintain that population fluctuations are to be expected, that animals "come and go" over various periods of time.

Fish and Fire

Fire's effects on fish are described differently by Cree hunters and fishers and by scientists, and I have included information from both in this section. Changing weather patterns and increasing fire frequency in western Canada have stimulated research interest in fire's impacts on aquatic environments (Kelly, et al. 2006; Spencer, et al. 2003). Postfire fish mortality was not noted by the people with whom I spoke. They said that they "never see any dead fish". Fish deaths resulting from forest fires are mentioned in the literature (see Bisson, et al. 2003; Gresswell 1999; Minshall, et al. 1989). The effects of fire on fish physiology and taste, however, were discussed at length in Wemindji. Fire's impact on fish populations have been studied by scientists in other parts of the boreal forest (Nelson, et al 2008).

Fire can cause physical, chemical and/or biological changes in rivers and streams and, usually to a lesser extent, in lakes. The woody debris that washes into streams after fires physically changes stream flows and alters aquatic habitats (Arseneault, et al. 2007). Erosion washes exposed soils and ash into streams increasing nutrient levels, especially those of potassium and nitrogen, for two or three years immediately after fire (Spencer et al 2003). Warmer temperatures and increased nutrients cause changes in the food webs of aquatic organisms (Kelly, et al. 2006). The effects on fish populations vary, but changes in aquatic ecosystems are not usually long-term (Gresswell 1999; Tonn, et al. 2004). Fire does play an important role over time in maintaining and creating a diversity of habitats required for healthy fish populations as well as for mammals and birds.

... in burned sites, more pools will form than in corresponding reference streams. In turn, an increase in adult fish density should accompany habitat development for up to 50 years following catchment fires...this suggests that wildfire may play an integral role in creating more optimal habitat for fishes. (Gresswell 1999:212)

An interesting project in a remote watershed in Alberta showed increased levels of the neurotoxin methyl mercury in lake fish after fire (Kelly, et al. 2006). According to the authors, high levels in the lake water and its fish (rainbow trout) were unanticipated, though they were aware of the mercury released into the atmosphere by burning forests. Their research shows that with warmer temperatures and plentiful food that follow fire, fish produce more young and eggs incubate more rapidly (Kelly, et al. 2006). Adult fish abandon their usual diets of zooplankton and invertebrates and begin to feed on the abundant young. This lengthens the food chain. One result is increased concentrations of mercury in the larger fish, and the levels remained high for at least 3 years (Kelly, et al. 2006). Human consumption of large amounts of species such as trout, walleye, pike and sturgeon from recently burned catchments is therefore not recommended.

Since fish are a significant part of the diet of people in Wemindji, there is a wealth of knowledge about fish ecology is available. People say that when there is a big fire that burns the vegetation around a lake, the fish become unpalatable and people do not eat them. (AM 16/07/2006, FA 16/07/2006). The change is not attributed to mercury which would not be detectable without lab work. Changes are explained instead by the large amounts of ash that wash into the waters as follows: "Even the fish are affected by forest fires, because of the trees and ash. The fish are there, but they aren't very good to eat. It takes, maybe if there's a

big fire or lots of fires, it's maybe 10 years before they taste as good as before the fire "(JM 10/07/2006). This was confirmed by another remark: "Older guys say it affects the fish, they're not so good to eat. It's because of that stuff, the soot, that washes into the lake and affects the fish. No one sees dead fish though. But usually you don't go in there right after a fire" (AV 08/08/2006).

Although Kelly (2006) found postfire increases in fish size and more rapid growth, Wemindji fishers report that fires make fish "skinny" for a few years (AM 16/-7/2006, SG 27/-9/2006, FA 16/07/2007). The word "skinny" in this case, however, does not refer to the fishes' girth, but to a lack of the fat under the skin, an indicator for the Cree of the animal's good health. As a fisherman explained:

"It changes with big forest fires like that, the fish seems to be not very good. We say that the fat of the fish is going down. The fat is good, some people like fat fish, I like fat fish, not skinny fish. Fires make them skinny and it takes time to be normal. I don't know how many years. Now they are good in my area [17 years after the fire]" (FA 16/07/2006).

Fish flesh is said to be watery rather than firm after a fire, bodies are sometimes misshapen and the skin is sometimes very rough (SG 25/09/06). Another fisherman said he had not noticed any changes in fish taste or physiology after fire, but he knew that such changes were often reported (09/2006). Most people don't eat the fish from a burned catchment for two or three years or more after a fire. They wait until the fish look normal and healthy again. The researchers in Alberta found increased water content in fish flesh after a fire (Kelly pers. comm. 2007), but they did not report on taste or any other physiological abnormalities. Wemindji fishers suggest that the taste of fish from lakes in burned catchments returns to normal after about ten years.

At the end of one discussion about fish and fire, and how long it takes for fish to taste good after a fire, the elder with whom I was speaking smiled and offered an interesting account of sharing and maintaining good relationships. After some reflection, and a useful discussion with my supervisor, I began to understand this to be a suggestion for one way that respectful actions can help to maintain the good health of fish and lakes. He began, slowly:

You know, there's an old... ah, I've been hearing this since a long time ago, since I was growing up. You know [when you kill a bear], the bear's eyeballs, you take the eyes out, and you put them in the lake. After you put bear eyes in the lake, then the fish is going to be good. I don't know if it's true. (FA 16/07/2006)

Fires and people

Forest fires have major impacts on animal habitats, as we have seen, and therefore also have major impacts on the people who depend on those animals. Fire-related changes can be small and short-lived, or they can persist for a human generation, or longer. Several people told me about hunting cabins and camp-sites where they returned only to find them completely burned to the ground. For example, one man transported all the materials he needed for a new cabin to the chosen site by skidoo a few years ago:

....we thought we were going to build in the summertime. The forest fire started at Sakami Lake and it spread all the way to Yasinski Lake. So the cabin burnt down, right down to the ground, and we hadn't even started it yet! (FA 16/07/2006).

Another family has lost several cabins in the past few decades, but they laugh a lot in telling the stories. Arrival at a camp where essential equipment and other belongings were stored to find it all burned away, however, must be very difficult. Recently an insurance program has been organized by the Regional Cree Hunters and Trappers Association to address the problems caused by lost equipment and cabins.

For many people the occurrence of fire marks important events. Changes in the height of trees since the last fire serve as reminders of the passage of time. For example, "my father talked about big fires along this lake, a long time ago. In 1967 we saw some trees when we landed on this lake that had been burned and the trees had already started to grow. Now there are lots there" (JM 10/07/2006). People spoke of the absence of trees as a reminder of other events such as the flooding of traplines and river diversions for hydro-electric development. This theme echoes in the following lines from the same tallyman about land that has since vanished under the waters of a hydro reservoir: "And here, I never saw fires over here, but my mother used to talk about that lake where they spent the spring [pointing at the map]. Before she was born [early in the 20th Century] there was a big fire ...Lots of tall trees grew back, but they're all floating now" (JM 10/07/2006).

None of the people I interviewed would wish for a fire on their land any time soon. Fire causes hardship, cabins and equipment must be replaced, new hunting areas must be identified. Nearly everyone seemed to agree, though, that there are benefits to fire, that it contributes to the health of their territory. The benefits to animals of the diverse habitats created by fire are obvious to hunters and their families. One woman told me that there had been a fire on the land where the village of Wemindji is now located in the years before the community moved there. "Now, just look around you, look at the trees down by the clinic, look at how big the trees are!" (AG 26/09/2006). And from another, "Old people used to say that god created the land this way, with fire, one year here, one year there" (SG 27/09/2006).

Chapter 5 - Conclusions

A picture of the highly dynamic and variable character of subarctic ecosystems emerges from this review of Cree and scientific knowledge of forest fire and its effects on north-western Quebec. Wild fires are the key agents of landscape change at this northern edge of the boreal forest and key agents in the production of landscape heterogeneity. The landscapes of Wemindji territory are always changing, always coming in to being - forest plants germinate, mature, burn and sprout again in approximately one hundred year cycles. Cree knowledge of these ecosystems and disturbance processes and of their influence on game animals and fish is detailed and wide-ranging. Fire is recognized here for its power to create change and bring renewal to the forest. It is seen as an essential process that 'keeps the forest young' and able to provide the diverse habitats required by its many occupants. Scientists are also interested in forest dynamics and climate in boreal regions. They too have studied many aspects of postfire ecology in *iyiyuuschii* and their findings correspond closely with those of Wemindji *iyiyuuch*.

Across Canada forest fires have been instrumental in shaping forest structure, but in many places fires are no longer allowed to burn. In Wemindji territory, lightning ignited fires remain important factors for they blaze almost without intervention. Fires are frequent, but most are very small. Large fires, responsible for most of the area burned, occur only once in 50 to 100 years (Parisien and Sirois 2003). Burns result in varied habitat development and diverse age stands that are home to northern birds and animals. Usually woodland of similar composition replaces what was burned, but sometimes there are surprises, changes in direction or long delays in forest recovery. Patterns of response cannot be predicted with any certainty in complex boreal systems.

As we learned in Chapter 2, many indigenous people in the past used fire to create and maintain specific habitats for a range plants and animals (Stewart 2002, Kimmerer and Lake 2001). People in Wemindji say they have not used fire to any extent for the management of resources. They are, however, keenly aware of the effects and benefits of fire. They are aware of fire's importance in creating the landscape heterogeneity required by the animals they hunt. The many forest types and diversity of stand ages created by fires provide food, open areas, shelter and protection from predators. A variety of habitats results in healthy populations of diverse animal species with whom hunters can interact. Human disturbances such as logging, flooding and dam building can be far more disruptive to animal habitat and populations than the impacts of fire. Animals abandon regions that are repeatedly clear cut, too industrialized or built up, but they return to burned forests.

Immediately after a burn new plant growth begins to attract birds and animals. Return times, as we have seen, vary depending on the species requirements; some birds, for example, come back very early and moose will forage in open burns for short periods of time, but it may take 30 years before the thick lichen carpets are re-established. Hunters adapt their activities to fire, usually avoiding very recent burns. They hunt in other areas, perhaps with relatives or neighbours on other hunting territories if necessary (Feit 2004). They wait until plants and animals begin to recover and have re-established themselves in a burn before they hunt there again.

Cree observers in Wemindji and some scientists in western Canada have noted that fires have major impacts on fish. Nutrients in the ash that washes into lakes and rivers after a fire increase the length of aquatic food chains. One result of changed diet and nutrient levels is unhealthy looking fish that scientists say may have high levels of methyl mercury in their systems. Cree fishers often wait as a long as decade to fish again in lakes heavily affected by fire. People avoid eating fish (and other animals) that look sick, even though they are not aware of the toxins that can accumulate in fish after fire. This is a particularly striking situation where an exchange of Cree knowledge and observations of fish after fire and scientific analysis of water, soil, plant and fish tissues could produce new information regarding poorly understood interactions of fire and aquatic systems.

Subarctic forest ecosystems, as we have seen, are highly variable. For hunters as well as for scientists, flexibility is essential in dealing with such multi-layered systems. The possibility of building reliable models and making accurate predictions is limited, for the intricate relationships and interactions between patterns and processes from geology and hydrology to food webs and human activities is high. In order to adapt to global change and evolving conditions, diversity and flexibility in terms of knowledge are also an advantage. Diverse approaches, multiple sets of observations and varied ways of knowing, both Cree and western scientific, have the potential to enhance understandings of ecosystem processes. Nonetheless, finding ways to facilitate productive exchange between scientists with different world views remains an enormous challenge.

In the preceding pages, perspectives from the science literature and those from experts interviewed in Wemindji were examined to uncover what the two sets of stories might yield. The exercise has shown a remarkable and significant degree of similarity between Cree and western scientific knowledge of postfire ecology in north-western Quebec. Pursuing a line of further inquiry into how the two ways of knowing compare or diverge, seems of limited utility to me. Both sets of observers make valuable and effective contributions to understanding fire's effects on the landscape. This learning is useful regardless of where it comes from; its value and its validity are independent of the culture its experts belong to. We can discover different kinds of things from each set of understandings, although they may be presented in very different ways. It seems to me that the close similarity of the two, suggests enormous potential for collaborative exchange and growth. Exchange and collaboration between these scientists might yield greater depths of understanding, new questions to pursue and novel approaches to the acquisition of new knowledge about post ecology. Many areas where conversations between Cree and scientific experts could lead to novel results come to mind; I suggest a few below. New knowledge achieved through combined efforts could open avenues of inquiry of mutual interest and benefit to members of both scientific and local communities.

The mapping of fire histories is clearly an area that would benefit from collaboration. A partnership effort in fire reconstruction would most certainly produce interesting results from which to begin other studies. As mentioned in the last section of Chapter 3, which reviews scientific studies carried out in or near the Wemindji area, western researchers have invested heavily in locating and dating the evidence of past fires. Their work has provided the baseline data for numerous studies of ecosystem change over time that have been carried out in the area. Effective protocols were developed to create a picture of fire sizes and dates. With a substantial outlay of time and funds (and, sadly, two lives), data from aerial reconnaissance, aerial photographs, dendrochronology and fire scar identifications at predetermined sites were complied to create a comprehensive history of a century's worth of burns from the northern edge Wemindji to Whapmagoostui (Payette, et al. 1989). Quebec's Ministry of Natural Resources has compiled available data for fires that have burned since 1960 in northern Quebec, as shown in Figures 2 and 3, but earlier records, from the first half of the 20th century, do not exist. As I listened to tallymen and others talk about fire on their

territories, it became very apparent that these experts possess extensive and detailed information that could make accurate fire mapping possible. Although people are not always able to pinpoint the exact year of a fire they do remember in which decade fires occurred in specific places, back to at least the 1920's, sometimes longer, especially for larger fires in places that were important to their families. They remember or have heard many details regarding these fires including size and locations and whether old camps or favourite hunting sites had been affected. Working with maps and family members from each hunting territory, a thorough inventory and timeline for 20th century wildfires could be compiled. It would require an investment of time and sustained effort on the part of the community and the researchers, but the results would be far more complete than the record that now exists. Furthermore, this is an exercise that could be of real interest to local people. People in Wemindji are intensely interested in the past and in preserving their history. The amount of knowledge about past human and 'environmental' events on their land is wide-ranging and detailed but opportunities to pass it on to the next generation are growing more limited than they used to be. In the recollection of past fires and reconstruction of fire history, other aspects of life in "the old days" would also be brought to mind and these too could be recorded for the benefit of future generations. Fire timelines for the territory would be of use for biologists, ecologists, and other scientists as well as local residents. Their development could also be starting points for larger community environmental history projects.

A second area of common concern and interest for future research follows from the fire mapping. This would involve further exploration of the myriad interactions and feedbacks of climate change and ecosystem dynamics. The impacts of change on animals and on the land and waters are being felt perhaps more keenly in Wemindji, where for example the traditional goose harvest has been affected, than they are further south (Peloquin 2007). Possible increases in the frequency of large fires due to climate change, for example, may begin to produce forests that are less diverse in age or species. Shifts in the relative numbers of plant and animal species, local incidents of deforestation or delayed recovery, are subjects have been examined by scientists in working northern Quebec, but these studies have only rarely included local knowledge.

Local hunters continuously take note of changes they observe in the forest. They are aware of shifts in dominance of one tree species to another, as we have seen, and they are also keenly aware of exceptional events such as a rare appearance of jack pine on the coast. This kind of long term observation of events and awareness of change is simply not available to the researcher who studies an area for one season or even for five or ten consecutive seasons. Sometimes local experts know the reasons for change because they have observed this ("the soil there dried up and blew away") or they make multiple educated guesses, conjectures based on local observation and they suggest a range of possible links (see for example, Peloquin 2007). Conversations between scientists studying the effects of change, and hunters who are keenly aware of what is happening on their land, could lead to new questions from both sides, new methods for monitoring change, and novel approaches grounded in broader data sets. Studies of shifts in species dominance, from black spruce to jack pine for example, would benefit from the wider range of observations that Cree hunters could provide.

The study of succession following large infrequent disturbances (LIDs) has been receiving increased attention from ecologists (Turner and Dale 1998; Turner, et al. 2003a, 2003b). According to Turner and Dale (1998), the lasting effects of large disturbances have not been adequately studied and the few studies that have been completed have shown surprising results. Studies of succession following the Mount-St-Helen's eruption or the Yellowstone fires are examples where unexpected results have led to new knowledge. The 1989 fires in Wemindji were much larger than the Yellowstone fires and they occurred on lands that are at least as carefully monitored by hunters and their families as the Yellowstone parklands were. Again, the observations of tallymen would add new data to that which has already been accumulated by biologists and ecologists. Hunters and other experts in dialogue with scientists often come up with unexpected questions and new directions for further investigation. For instance Cree observations of the deforestation that sometimes follows fire combined with scientific observations and measurements would certainly provide a more deeply textured and detailed picture than now exists in a number of studies (some of them are reviewed in Chapter 3) that have examined this phenomenon in the area.

Long term responses of animal populations and animal habitat (both terrestrial and aquatic) to fire also provide rich opportunities for opening fruitful dialogues between hunters and scientists. Nelson, Zavaleta and Chapin (2008) reviewed the literature to determine the "responses of key boreal subsistence species to variation and change in post-fire stand age

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and other characteristics" in the Alaskan boreal forest (2008 :156). Their findings are quite similar to the information I have gathered from the literature and from conversations in Wemindji, i.e. that mixed habitats are beneficial to the maintenance of a diverse array of subsistence species. Based on my interview experiences, I would suggest that a study with goals similar to those of Nelson and her colleagues, based entirely on questions about a few key animal species' responses to fire would generate great interest in Wemindji. In this way scarce data on the effects of fire on caribou habitat could be expanded. This would tie into current local interest in changes in related marten, hare and caribou populations. Fire's effects on beaver have been studied recently by McGill University researchers and Wemindji hunters. The results are not yet available but promise to yield interesting new insights. Wemindji hunters have also been involved in winter tracking studies that are part of a larger wildlife biology project integrating Cree and scientific knowledge regarding faunal habitat in the north. These animal projects tap into all of the lines of research suggested above merging a wide range of information from local experts and from wildlife ecologists. The pooled observations should generate productive synergies.

Regrettably, well designed research projects that accommodate cross cultural differences have not been abundant and are not always successful. Their potential for contributing to significant advances, however, is being recognized. Building the respectful relationships that facilitate such ventures is a long term effort that cannot be hurried. Such relationships require attentive listening and the ability to accept new and different way of thinking about the world. It also requires, perhaps, a "softening of the authoritative voice of science" that often accompanies academic pursuits (Forrest 2006:92). When very different ways of knowing intersect, learning to understand requires time to review and assimilate what has been presented (see Huntington et al. 2004). Yet time itself is often the single element that is in shortest supply on a funded research project. Investigators would surely describe their approaches as direct, honest, and open, qualities required for cross-cultural understanding. These qualities, though, may be put aside when deadlines are not met, and confusing findings require further consideration and inquiry. Respect for difference is more elusive when differences are large enough to leave either party feeling that they have missed something or that they haven't been understood (see for example Verran, 2002). Impatience often surfaces on all sides, as Verran points out, when decisions are made based on

assumptions that aren't clear to everyone involved. Cross-cultural research projects, when they work well, produce exceptional results, but they require research skills perhaps not previously honed. Such projects may be as complex as the ecosystem processes they describe.

A last point regarding collaboration concerns the importance of stories, the lessons they contain and the contexts in which they are set. Cree stories, as I have discussed them here, represent ways of knowing and ways of presenting knowledge that are very different from western-European and western scientific ways of knowing and imparting knowledge. The knowledge captured in stories and passed on from generation to generation has contributed to the survival, over thousands of years, of the Wemindji Cree. Stories often contain lessons that relate to the values that are most important in Cree society: respect, relationship, reciprocity and humility (Mark 2004). The lessons are not explicit, they are there to be understood when the listener is ready, and to be interpreted and reinterpreted as the listener's understanding evolves (DS 22/7/2007). Thus social memory preserves knowledge that will be available when needed to help negotiate solutions to new challenges. A few of the stories I was told have been included in the preceding pages to illustrate this alternative way of learning. I hoped to convey what the people shared more clearly than own my re-interpretations and translations into academic language can. Separating knowledge from the context of social relations and agendas that make it meaningful, as we have said, creates barriers to genuine exchange. Once again, I return to the idea that recognition and respect for difference can serve as a solid foundation for collaborative efforts.

The Cree word for life is *pimaatisiiwin*. It has been locally translated as "the continuous birthing of the world" (Scott 1996:72), an apt description, that fits this landscape where the cycles of life and regeneration make themselves so apparent over time. Successful strategies for survival, for maintaining life, in *Iyiyuuschii* are flexible and adaptable to match the somewhat uncertain and unpredictable character of this ever-changing environment. Cree ways of living and working with the ecological processes they cannot control are indeed flexible and dynamic as the environment in which these strategies have evolved. A willingness to engage in open dialogue with other experts and accommodate new knowledge is also characteristic of Cree ways of learning. Combining Cree and western science of fire

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ecology may help maintain the diversity and heterogeneity so important to life in *Iyiyuuschii*, much as the passage of fire helps maintain the same across the landscape.

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