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Impacts des changements socio-environnementaux sur deux espèces alimentaires traditionnelles de la Première Nation Crie de la Baie James
Impactos de los cambios socio ambientales sobre dos especies alimenticias tradicionales de la Primera Nación Crie de la Baie James

Marie-Jeanne S. Royer and Thora Martina Herrmann

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Article abstract

Socioenvironmental changes in Canada's northern regions are likely to have wide-ranging implications for the health of its residents. Aboriginal communities are among the first to face the direct impacts of changes, as their lifestyles tend to be more closely tied to and reliant upon the natural environment. Based on field research, this paper documents observations of socio-environmental changes made by members of the Cree Trappers Association (CTA) of the Cree of Eeyou Istchee (the traditional homeland of the Cree located in the eastern James Bay area). It also analyses their impact on hunting behaviour and consumption levels associated with two traditional food species – the Canada Goose and the woodland caribou. CTA members are witnessing changes in animal behaviour and the migration patterns of species. These in turn are affecting the consumption of traditional food, causing dietary changes at the society level, and, ultimately, impacting on human health and overall well-being.

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Marie-Jeanne S. ROYER et
Thora Martina HERRMANN
Département de géographie,
Université de Montréal
Marie-Jeanne.S.Royer@umontreal.ca
Thora.Martina.Herrmann@umontreal.ca

Abstract

Socioenvironmental changes in Canada's northern regions are likely to have wide-ranging implications for the health of its residents. Aboriginal communities are among the first to face the direct impacts of changes, as their lifestyles tend to be more closely tied to and reliant upon the natural environment. Based on field research, this paper documents observations of socio-environmental changes made by members of the Cree Trappers Association (CTA) of the Cree of Eeyou Istchee (the traditional homeland of the Cree located in the eastern James Bay area). It also analyses their impact on hunting behaviour and consumption levels associated with two traditional food species – the Canada Goose and the woodland caribou. CTA members are witnessing changes in animal behaviour and the migration patterns of species. These in turn are affecting the consumption of traditional food, causing dietary changes at the society level, and, ultimately, impacting on human health and overall well-being.

Keywords

Socioenvironmental change, traditional food species, Cree First Nations, James Bay, Canadian subarctic.

Résumé

Les changements socioenvironnementaux dans les régions nordiques du Canada pourraient avoir des répercussions sur la santé de leurs résidents. Les communautés autochtones sont parmi les premières à en ressentir les impacts, car leurs modes de vie sont étroitement liés au milieu naturel. Cet article présente les changements socioenvironnementaux observés par des membres de l'Association des trappeurs crie (CTA) d'Eeyou Istchee (le territoire traditionnel des Crie situé dans la zone orientale de la Baie James). Il analyse les impacts de ces changements sur leur comportement de chasse et les niveaux de consommation associés à deux espèces alimentaires traditionnelles, la bernache du Canada et le caribou des bois. Les membres du CTA observent des changements dans la migration des espèces, dans le comportement animalier ce qui affecte la consommation de ces aliments traditionnels et entraîne des changements alimentaires au niveau de la société, influençant la santé et le bien-être.

Mots-clés

Changements socioenvironnementaux, espèces alimentaires traditionnelles, Première Nation Crie, Baie-James, subarctique canadien.



Resumen

Los cambios socio ambientales de las regiones nórdicas del Canadá podrían tener repercusiones sobre la salud de sus habitantes. Las comunidades autóctonas son las primeras a sentir los impactos ya que sus modos de vida son estrechamente ligados al medio natural. Este artículo presenta los cambios socio ambientales observados por los miembros de la Asociación de tramperos Cris (CTA) de Eeyou Istchee (territorio tradicional de los Cris situado en la zona oriental de la Baie James). Se analizan los impactos de esos cambios sobre el comportamiento de caza, así como los niveles de consumo asociados a dos especies alimenticias tradicionales: la oca del Canadá y el caribú de bosque. Los miembros de la CTA observan cambios en la migración de esas especies y en el comportamiento animal, lo que afecta el consumo de esos alimentos tradicionales y acarrea cambios alimenticios en la sociedad, influenciando la salud y el bienestar de los habitantes.

Palabras claves

Cambios socio-medio ambientales, especies alimenticias tradicionales, Primea Nación Crie, Baie James, sub-ártico canadiense.

Introduction

Food systems and nutritional health are an integral part of human health and overall well-being and are susceptible to socioenvironmental changes. A food system comprises “dynamic interactions between and within biophysical and human environments which result in the production, processing, distribution, preparation and consumption of food.” (Gregory *et al.*, 2005: 2141 cited in Ford 2009: 84; Kuhnlein *et al.*, 2009). Traditional food systems are an integral part of the traditional way of life (ritual, sharing, reciprocity, etc.). However, the integrity of these systems is undermined when access to and availability of certain foods are threatened as a result of change, be it anthropogenic, biophysical or climatic in nature. These changes can affect water and ice, modify a species’ distribution, disturb the species’ habitat (which can lead to positive or negative consequences for animals), impact on animal health, and alter plant productivity (Cavaliere, 2009). These impacts can have implications for access to the traditional food harvest (e.g. hunting, fishing and trapping), as well as the availability and quality of certain foods (Chan *et al.*, 2006). Ultimately, important changes in food resources can increase human health risks. Changes to the socio-economic and cultural make-up of aboriginal communities also affect traditional food systems. Currently, there is strong evidence of a trend away from traditional diet and culture which is affecting both the physical, mental and cultural health of the Aboriginal communities living in the Canadian Arctic and subarctic, including increased rates of obesity and chronic diseases. Though this trend is related to several socio-economic and cultural factors, climate and environmental change further exacerbate it (Adler *et al.*, 1994; Campbell *et al.*, 1994; Kuhnlein and Chan 2000; Chan *et al.*, 2006).

The nature and extent of factors related to socio-environmental change and their implications for the nutritional health of communities need to be better understood. This would allow us to implement appropriate strategies at the community level to enhance



food security, reinforce traditional food systems and reduce vulnerability (Duerden, 2004). This paper aims to document observations and perceptions of Cree participants from the Cree Trappers' Association (CTA) concerning socioenvironmental changes to traditional food harvest. It focuses particularly on hunting behaviour and changes in consumption levels associated with two traditional food species – the Canada Goose (*Branta canadensis*) and the woodland caribou (*Rangifer tarandus caribou*).

The second objective of this paper is to contribute to the emerging literature on food security in the Canadian subarctic. Food security, as defined by the Food and Agriculture Organization (FAO, 2011): “exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” Although the impact of climate change on the security of traditional food systems and related health outcomes among hunting, fishing and gathering societies has been explored in the Arctic (Chan *et al.*, 2006; Furgal and Seguin, 2006; Ford, 2009; Baumier and Ford, 2010), literature on subarctic ecosystems is still quite limited.

Aboriginal health and the Cree First Nation

Canada is home to 614 indigenous communities representing 50 languages belonging to 11 language families. According to the 2006 census, Aboriginal peoples accounted for 3.8% of Canada's population, numbering 1,172,790 people (Statistics Canada, 2006). The Aboriginal population has been growing faster than the non-Aboriginal population with a population increase of 45% from 1996 to 2006 compared to only 8% for the non-Aboriginal population in the same period (Statistics Canada, 2008). The Cree show a similar growth pattern, the population having almost tripled from 1971 to 2011 (Salisbury, 1986; MAMROT, 2011).

There is a relative disproportionate burden of disease on the Aboriginal populations of Canada. Numerous studies have highlighted that Aboriginal people in Canada, when compared to non-Aboriginal populations, have lower life expectancy, high rates of obesity, higher incidence of chronic diseases, higher rates of cancer, higher rates of infectious diseases (e.g. tuberculosis), and high rates of alcohol abuse, smoking, substance abuse and suicide (Mah and Fanning, 1991; Waldram *et al.*, 1995; Adelson, 2005; Frohlich *et al.*, 2006; Scott *et al.*, 2006; Ford *et al.*, 2010; Macdonald *et al.*, 2010; McDonald and Trenholm, 2010). BMI (body mass index in kg/m²) estimates for Aboriginal people are generally higher than for the Canadian population as a whole. Delormier and Kuhnlein (1999), in their study of Cree women in the Province of Quebec, found that 30% had a BMI of 25-9.9, and 57% were in the obese category with a BMI of more than 30. A study of Aboriginal people aged 19 to 50 in Ontario and the western provinces (excluding reserves) found that, in 2004, they were 2.5 times more likely to be obese or overweight than non-Aboriginal Canadians. Furthermore, the study showed that Aboriginal people are more likely than other Canadians to report chronic health problems, notably conditions such as diabetes, hypertension and arthritis, which have all been linked to obesity. Besides eating habits, the differences in obesity and overweight rates may also reflect differences in income, education and leisure-time physical activity. A particular problem has been the growing incidence of type II diabetes among the Cree of Eeyou Istchee (James Bay area of northern Quebec, Canada). This, according to Baldea *et al.* (2010), is possibly due to a genetic



predisposition (Zimmet *et al.*, 1997) and to social and environmental factors such as excessive energy intake and physical inactivity (Campbell *et al.*, 1994). Chronic hyperglycemia of diabetes causes glucose toxicity that can result in neuropathy and in renal or retinal microvascular complications (Bonadonna, 2004; Baldea *et al.*, 2010). The high incidence rates of these complications that have been reported among the Cree of Eeyou Istchee (Thouez *et al.*, 1990) are due, in part, to the cultural inadequacy of modern therapies (Young *et al.*, 2000).

The Cree food system and the Cree natural resources management system in James Bay, Quebec

The traditional foods of the Cree of Eeyou Istchee (Figure 1) comprise a variety of locally harvested non-domesticated wildlife species (Salisbury, 1972 and 1986).

Figure 1 The Cree Nation



The most common staple meat sources include beaver, woodland caribou, moose, bear, deer, a variety of fish (e.g. whitefish, lake trout, grayling), a variety of birds (ducks, Canada Goose, ptarmigan) and a diversity of wild berries and other plants such as Labrador Tea (Berkes and Farkas, 1978; Feit, 1982; Kuhnlein and Chan, 2000). Because the eastern James Bay is such a vast territory, there is variation in the quantity and types of meats available to the various Cree communities and in the period when the majority of the hunting occurs (Scott and Feit, 1992). The communities located in the interior of the territory (ie.: Mistissini, Nemaska, Oujé-Bougoumou and Waswanipi) hunt and trap more intensively during the winter months, therefore relying more on moose and beaver meat, whereas for the coastal communities (ie.: Chisasibi, Eastmain, Waskaganish, Wemindji), the spring and fall goose hunts are as important as the winter hunting and trapping season. For the northern most Cree community, Whapmagoostui, and the northern traplines of Mistissini, caribou meat represents the largest food source. However the amount of each type of meat harvested can vary annually since it is based on many factors including the location and quantity of each species.

Wild foods often have a higher concentration of such nutrients as iron, vitamin C and riboflavin than store bought products do, and their consumption allows people to easily meet their dietary requirements (Berkes, 1999; Gebhardt and Thomas, 2002; Samson and Pretty, 2006). In addition to its contribution to nutrition, Cree wildlife harvesting has also been evaluated for its socioeconomic importance (Feit, 1991). For many Cree, personal identity and cultural values are all associated with the traditional lifestyle in obtaining wild game meat and fish (Power, 2008). Leaders of Cree communities believe harvesting (e.g. hunting, fishing, trapping and gathering) to be an integral part of their cultural and social health (Ohmagari and Berkes, 1997). Tanner (2007) and Feit (1995) described how Cree hunters engaged in rituals as part of their everyday hunting activities and/or participation in hunting camp life. A number of scholars have analyzed management practices and Cree rules surrounding the goose hunt during spring and fall, looking into their importance in resource management (e.g. diffusing hunting pressure in space and time in order to minimize disturbance of migratory geese: hunters should not shoot into the main flock, should not shoot after dusk, etc.) and in Cree culture (e.g. meat sharing) (Preston, 1978; Scott, 1986 and 1996; Peloquin and Berkes, 2009).

Historically a semi-nomadic, kinship-based group pursuing a subsistence way of life based on hunting, fishing and trapping, the Cree people moved around their land from place to place, depending on the seasons and animal movements. According to Morantz (1978), the Eastern James Bay Cree have had hunting territories since at least the 18th century. Tanner (1983) described how the Hudson's Bay Company (HBC) incorporated the established hunting territories into a system of beaver preserves and registered traplines. Today, the James Bay Cree region is divided up into territorial units – so-called traplines – of family hunting groups which are used year round in the harvesting of wildlife and other forest resources. Each trapline is under the leadership and guidance of a senior hunting territory leader, or trapline “tallyman,” who is given responsibility for land management and resource sustainability. He decides how the land will be passed on to the next generation and who can come onto the territories from other traplines to fish, trap and hunt (Scott, 1986 and 1988).



Bush food is distributed to other Cree families through the key practices of reciprocal sharing and gift giving (Scott, 1988; Feit, 1991). The tallyman and each hunter continually monitor shifts and changes in hunting conditions and observe the effects of various biophysical and anthropogenic disturbances. This allows them to adapt their hunting practices accordingly and ultimately establish a management system that goes in hand with the variability of the resources (Sayles and Mulrennan, 2010). Cree subsistence activities are historically divided along gender lines. While the men generally do the hunting, trapping and fishing, the women specialize in harvesting plants and in processing the slain animals. This includes not only butchering the meat but also tanning the skins for future use.

There are various traditions involved in the hunting of caribou and geese. While caribou are considered large fur mammals and are thus under the supervision of the tallymen, the goose hunt is a special occasion which is supervised by the “goose boss.” This position is often filled by the tallyman. The goose boss has special rules which he applies during the spring and fall goose hunts (CTA, 2009a). As he is in charge, he must assure the sustainable management of geese populations. He must make sure that the quotas are respected and that all takes are equally separated among all hunters. An essential aspect of the goose boss’s position is the sharing of his knowledge of the traditional way of life so that it is transmitted from generation to generation. The goose boss’s wife also has a very important position. She is in charge of all the women at the camp and is required to maintain the camp, assure that knowledge of preparation methods is transmitted to the younger generations, and to correctly prepare the slain birds. This last task is vital, as there must be no spoiling of meat. Because of her crucial position, she has the power to stop the hunt, with consent from the goose boss, so that the already harvested geese can be appropriately cleaned and conserved (Figures 2 and 3).

Figure 2 Cree kitchen Tipi, Eastmain



Source: © Marie-Jeanne Royer, 2010

The Cree played an important role in the fur trade in the 18th, 19th and 20th centuries. Now however, the changing human-environment relationships in northern Quebec along with evolving social, economic and cultural circumstances have caused the Cree to become increasingly involved in wage labour. The community relocation and sedentarization process – a consequence of hydro-electric construction on the La Grande River which began in the 1970s – has resulted in a transformation from independent and self-sufficient livelihoods to lives of wage labour, greater dependency on formal institutions, and increasing drug and alcohol abuse and violent and self-destructive behaviour (Niesen, 1993). Given that mobility was engrained in their lifestyle and that the land provided the basis for their

social, economic and spiritual practices, sedentarization has had an impact on the Cree's relationship with their hunting culture and weakened the values of the forest economy. Notwithstanding the numerous changes in Cree society, many Cree families are still engaged in part-time hunting, trapping and fishing activities (bush activities), supported by an income-security program.

Figure 3 Community kitchen: Geese Cooking, Waswanipi



Source: © Marie-Jeanne Royer, 2010

Hand in hand with the above mentioned societal changes that have occurred over the past 50 years, a nutrition transition can be discerned in the shift from consumption of wild foods to processed foods. Grocery-bought foods or “white-foods” make up an increasing component in the diet of the Cree of Eeyou Istchee. The contribution of traditional and store-bought food varies through the year and by community, household, and individual. This transition in nutrition is likewise paralleled by a transition in physical activity, from regular exercise to a much less demanding set of activities in the village. This shift combined with high prices for fresh fruit and vegetables in the James Bay area has had an impact on Cree health, with rising levels of obesity and diabetes throughout the communities (Thouez *et al.*, 1990). Similar trends have also been found among other subarctic Aboriginal populations, such as the Innu (Samson and Pretty, 2006), and among Arctic populations, such as the Inuit (Kuhnlein and Receveur, 2007; Ford, 2009).

A decline in a traditional food source may not only impact the physical health of an Aboriginal community (Archibalt, 1991) but may also affect the representation of their culture. These environmental and societal changes, accompanied by radical changes in diet and new disease patterns, need to be understood as interrelated processes and therefore need to be studied together. Previous declines in caribou at the beginning of the 1900s coincided with a period of starvation and an increase in epidemic diseases which had severe effects on the Cree people of eastern James Bay (Berkes and Farkas, 1978). Although we do not expect a similarly drastic occurrence because of the current decrease in the caribou herds, it can be reasonably proposed that a modification in diet due to a rapid change in the availability of traditional foods will be noticed and have an effect on Cree health.



Canada Goose (*Branta canadensis*) and woodland caribou (*Rangifer tarandus caribou*)

The Canada Goose is subdivided into seven (7) subspecies: Atlantic (*B.c. canadensis*), Dusky (*B.c. occidentalis*), Giant (*B.c. maxima*), Interior (*B.c. interior*), Lesser (*B.c. parvipes*), Moffit's (*B.c. moffiti*) and Vancouver (*B.c. fulva*). Their range covers North America and parts of Europe and Asia. In North America, Canada Geese maintain partially closed colonies during the reproductive and wintering seasons. This phenomenon has created a subspecies division among migratory trajectories, which have been used by various governmental agencies to allow for better species management by breaking up the large territory covered by the birds into more manageable "flyways" (Dickson, 2000; Palmer, 1976). No matter how definite the distinctions on paper, these divisions are in reality fluid and respond to changes in water levels, climate and bird behaviour (Hine and Schoenfeld, 1968). The eastern James Bay is part of the Atlantic Flyway defined by the Interior Canada Goose subspecies. This subspecies is a medium sized goose typical of the rest of the species.

Traditionally, its reproductive area includes the north-western boreal forest of Québec and the Ungava tundra. Researchers have noticed a variation in its size based on the north-south location of its reproduction area, the Interior Canada geese nesting further north being smaller than the same goose nesting on the southern border of their nesting area (Dickson, 2000; Leafloor, 1998). This variation has been linked to environmental stress factors such as harsher weather conditions and less abundant food. The coastal area of eastern James Bay is particularly important as a stop-over point to build up food reserves for the geese journeying further north into the tundra and as the southern limit to the reproductive area. The Canada goose is a highly adaptable species and any change to its territory can influence its migration patterns as well as its choice of reproduction or wintering areas (Hine and Schoenfeld, 1968).

The caribou (*Rangifer tarandus L.*) is divided into five (5) subspecies, one of them being the woodland caribou, which is the only caribou subspecies in Québec. Biologists have proposed various divisions inside this subspecies based on animal behaviour. However, genetic tests have so far failed to corroborate these distinctions or to provide any justification to change the taxonomy. In eastern James Bay, the woodland caribou are separated into boreal forest caribou, which as the name implies, inhabit the boreal forests, and migratory caribou, which inhabit the tundra and migrate south to James Bay during the winter season. The boreal forest caribou is currently on the list of the *Species at Risk Act* of the Canadian federal government and on the endangered list of the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC).

Study Area

The Cree are members of the Algonquian language family and represent the largest Aboriginal population group in Canada, numbering over 77, 970 individuals across the country (Statistics Canada, 2006). The Cree of Eeyou Istchee number more than 14,500 people and constitute a subpopulation of the greater Cree Nation. They are spread out over nine villages in the James Bay territory (Figure 1): Chisasibi (3,300 inhab.), Eastmain (606 inhab.), Mistissini (3,467 inhab.), Nemaska (560 inhab.), Oujé-

Bougoumou (606 inhab.), Waskaganish (2,000 inhab.), Waswanipi (1,250 inhab.), Wemindji (1,267 inhab.) and Whapmagoostui (778 inhab.). There is a tenth community named Washaw Sibi that is located in the Abitibi-Témiscamingue administrative region. It is currently in the process of being recognized.

Eeyou Istchee is located in the James Bay territory of Quebec. This territory combined with the Kativik territory make up the largest administrative region of Québec, covering 55% of the province (860,553 km²). However, it is also the least populated region having only 0.5% of the province's population (41,479 people in 2009). The James Bay territory covers the southern part of this administrative region. It extends from 49°N to 55°N and from the James and Hudson bays to 68°W; it extends over 297,330 km². Being part of the Canadian Shield, the James Bay territory is rich in minerals (e.g. gold, silver, copper, etc.). After the last ice age, the territory was submerged under the Tyrrell Sea, the predecessor to Hudson Bay. This explains the large expanses of marine clays in the area (Richard, 1979; Bider, 1976). The retreating glaciers also helped form numerous lakes and rivers.

The James Bay Territory is covered by vast swaths of boreal forest composed mainly of black spruce (*Picea mariana*) and tamarack larch (*Larix laricina*), with lesser amounts of white spruce (*Picea glauca*), dwarf birch (*Betula nana*) and a variety of rhododendrons (*Rhododendron sp.*) (Berkes and Farkas, 1978). Various berry producing shrubs are harvested by the Cree (e.g. raspberries (*Rubus idaeus*), blueberries (*Vaccinium sp.*) and cloudberry (*Rubus chamaemorus*)). Coastal areas are rich in seagrass such as eelgrass (*Zostera marina*) and carex (*Carex paleacea*), both a key component of the geese's diet. The boreal forest thins out further north, becoming taiga and then fading away completely, giving way to tundra at the northern limit of the territory. The taiga is covered by vast expanses of lichens which are the main source of food for the migratory caribou. Even though it is sparsely populated by animals, there is a large species diversity: large mammals (e.g. moose (*Alces alces*), woodland caribou (*Rangifer tarandus caribou*), bear (*Ursus americanus*)); small mammals (e.g. porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*)); fur mammals (e.g. beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*)); marine mammals (e.g. polar bear (*Ursus maritimus*)); geese (e.g. Canada Goose (*Branta canadensis*), snow goose (*Chen caerulescens*)); and fish (e.g. lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), walleye (*Sander vitreus*)).

In 1975, the Cree signed, along with the Inuit and the governments of Québec and Canada (extended to the Naskapi in 1978), the *James Bay and Northern Québec Agreement* (JBNQA) – regarded as the first of the modern day land claim agreements in Canada. This agreement stipulates privileged land tenure rights to areas around the Cree communities, exclusive hunting and fishing rights over a certain part of the territory, regional self-government powers and cash compensation in exchange for allowing the Quebec government to proceed with the James Bay hydroelectric megaproject. The JBNQA establishes three new land categories: Category I lands (approx. 14,000 km²) are granted to each Cree, Inuit and Naskapi community for their exclusive use and benefit; Category II lands (approx. 159,880 km²) are under provincial jurisdiction over which aboriginal communities have exclusive hunting, fishing and trapping rights and over which forestry, mining and tourism development authority is shared; and Category III lands (approx. 907,772 km²) are Quebec public lands on



which the aboriginal communities are allowed specific hunting (e.g. some wildlife species) and harvesting rights. The JBNQA also sets in motion the creation of a new administrative structure for the James Bay Cree Nation. The agreement touches on many aspects of daily life including personal rights, health, education and environment protection. The CTA, the Cree Income Security Board, the Cree Regional Authority, the Cree School Board and the Cree Board of Health and Social Services are some of the many organizations put in place following the signing of the JBNQA. The CTA and the Cree Income Security Board have been instrumental in maintaining and promoting traditional subsistence activities, as well as sharing research and knowledge among its members. The *Agreement Concerning a New Relationship between le Gouvernement du Québec and the Crees of Québec* (“*Paix des Braves*”) was signed in 2002. It fortifies Cree influence over the management of their territory and provides for the sharing of revenues and for the establishment of more equitable partnerships between the Cree and the Québec government in the management of mining, forestry and hydroelectric resources on traditional Cree lands (Mulrennan and Scott 2005). With regard to resource co-management in the forestry sector, the agreement sets out a new forestry regime (i.e. laws and regulations) that calls for: “a) adaptation to better take into account the Cree traditional way of life; b) greater integration of concerns relating to sustainable development; c) participation, in the form of consultation, by the James Bay Cree in the various forest activities[,] operations planning and management processes.” (Agreement 3.1). The Québec forestry regime is better adapted to Cree needs and environmental and cultural priorities (Dörrenbecher, 2005). Forest cuts and General Forest Management Plans must recognize historical and ecological factors as well as factors related to the forest structures (i.e. traplines become the basis for delimiting the territorial reference units for forestry activities). According to Salée and Levesque (2010), the *Paix des Braves* empowers the Cree to participate fully in the decision making process regarding land and natural resources management, thereby helping them to ensure that the socio-cultural meaning they attach to the land will be given prominence.

Although modified and reduced in size, the James Bay hydroelectric megaproject still includes large scale landscape alterations (Savard, 2009; Chapelier, 2006). The La Grande hydroelectric complex (the only part of the megaproject to be created) was divided into three phases. The first two phases included the creation of eight hydroelectric stations (i.e. Robert-Bourassa, La Grande-1, La Grande-2A, La Grande-3, La Grande-4, Laforge-1, Laforge-2 and Brisay) and eight reservoirs. The Eastmain, Opinaca and Caniapiscou rivers were diverted. In the case of the Eastmain River, this diversion resulted in a loss of 90% of the river’s output (Hernandez-Henriquez *et al.*, 2010). The eight reservoirs flooded 9,900 km² of land and now cover a total of 13,575 km² (Hydro-Québec, 2003). The watershed of the La Grande hydroelectric power stations stretches over 176,000 km²; the power stations drain a catchment area of 97,400 km² (CRA and Hydro-Québec, unpublished). Additionally, the La Grande power stations required the creation of the following: an employee village, Radisson; three major roadways (i.e. the James Bay Road, the Transtaiga Road, the Route du Nord); six high-tension transmission lines (735kV) which run on a north-south axis from the La Grande River to the larger cities in the south (e.g. Montreal, Quebec City); numerous airports, smaller roads, and transmission lines (315kV). These infrastructures have had and continue to have important repercussions on the local ecosystems (Hornig, 1999).

Work started on the complex's third phase in 2007. The project includes the diversion of 51.7% of the Rupert River's output towards reservoirs for two new stations (i.e. Eastmain-1A and Sarcelle).

All these changes have been exacerbated by climate change, which has been identified as the major global health threat of the 21st century (Costello *et al.*, 2009). This situation stresses, in turn, the need for improved understanding of the risks to human health (GHF, 2009). There is strong evidence that Canada's Arctic and subarctic are already experiencing significant changes in climate – changes that are having both positive and negative impacts on the lives of Aboriginal people living in these regions (Nickels *et al.*, 2006; Ford *et al.*, 2008). The health of northern communities (Aboriginal and non-Aboriginal) is closely linked to environmental conditions, and there is evidence that climate change poses new risks for human health (Furgal 2008; Seguin, 2008; Ford and Furgal, 2009). According to Ford *et al.* (2010: 670) in the Arctic: "Warmer weather [and] summers have the potential to increase the incidence of water and insect borne disease (e.g. *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium parvum*) (Hennessy *et al.*, 2008; Martin *et al.*, 2007), while rising temperatures are expected to increase the incidence of temperature-dependant, food-borne diseases, including *Salmonella*, as well as toxins produced by *Staphylococcus aureus* and *Clostridium botulinum* (Parkinson *et al.*, 2008)." According to studies carried out by various scholars (Archibald *et al.*, 1991; Turner and Turner, 2008; Turner and Clifton, 2009; Kuhnlein *et al.*, 2009), communities in the subarctic and boreal latitudes have reported anthropogenic, ecological and climate change impacts associated with access to safe drinking water and traditional foods, reduced physical activity, changing ice conditions, and unpredictable weather patterns, all of which impact health (physical, mental, and spiritual) and well-being.

Methodology

The information presented in this paper is part of a larger research project which includes sections pertaining directly to observations of climate change and environmental conditions, and to perceptions of changes in animal behaviour and Cree subsistence activities. The data discussed in this article is based on a field study carried out during the summer of 2010 with the help of the CTA and members of the nine established Cree communities. Though this was an independent research project, it coincided with similar research undertaken in part by the CTA (The Climate Change Project). CTA members were therefore interested in participating in the data collection and obtaining the results. The project was also presented during the CTA's annual assembly. The research was carried out with the consent of the Ethics Committee of the Université de Montréal, Canada. Our research combined several social research methods: extended field stays within the communities and participation in community meetings, blind sample questionnaires with the members of the CTA, short interviews with the general Cree population and in-depth interviews with tallyman and key-respondents identified by the CTA. In addition, interviews were carried out with key actors at the administrative, development and research levels within the Cree Regional Authority (CRA).



We stayed in four communities in the James Bay area: Mistissini, Nemaska, Eastmain and Waswanipi. The Grand Council of the Cree annual meeting was held during our stay in Nemaska. In addition, we attended the CTA annual assembly in Waswanipi. This gave us the opportunity to extend our research to all members of the James Bay Cree and not limit ourselves to the communities visited.

Our questionnaires were mainly composed of closed-ended questions, asking the respondent to identify their observations according to a gradient. We also included selected open-ended questions to allow the respondents to explain their choices. Our questionnaires were divided into three specific sections. The first one asked the participants about their personal hunting and eating habits pertaining to Canada Geese. The second part asked about the same habits in relation to woodland caribou. The third asked about their perceptions of the younger generations' habits concerning these two species, thus allowing us to shed light on intergenerational differences. The questionnaires (n=100) which were distributed among the population had a low but acceptable return (n=30/100). We selected an accidental sampling approach among members of the CTA for many reasons, including the high homogeneity of the population, which heightens the reliability of this technique (Gumuchian and Marois, 2000). The questionnaire respondents were n=2/30 female, n=27/30 male and n=1/30 unknown (did not indicate their gender), and aged from 30 to 69 years of age. The majority of the respondents (n=21/30) came from coastal communities (i.e. Chisasibi, Eastmain, Waskaganish, Wemindji and Whapmagoostui) and n=9/30 from inland communities (i.e. Mistissini, Nemaska, Waswanipi).

The questionnaires were distributed randomly among the sexes; however, because certain questions pertained to hunting, a majority of women refused to answer. The absence of women among our respondents was due to the traditional gender division. In Cree traditional society, it is the men who hunt while the women are responsible for the home and food preparation. This division is still present and explains their refusal to answer questions that were perceived as being linked to hunting. Therefore, the two women participants identified themselves as hunters on our questionnaires. This refusal to answer was also seen with men who did not hunt; Cree usually refuse to answer questions on topics about which they are not knowledgeable. As some members of the community explained: "I can't answer that, I am too old to hunt. I don't know anymore."

We combined the information obtained from the questionnaires with individual in-depth interviews (n=4) using a snow-ball technique. These were carried out with CTA members who possessed extended knowledge about local fauna and flora as well as the traditional Cree way of life (tallyman). Informal open-ended interviews were also undertaken with members of the communities (n=20), using an accidental sampling technique. As we wished to identify the perceptions of the Cree communities about the effects of environmental changes, this technique allowed us to compare the results obtained by different segments of the population to see if there was a consensus. All the in-depth and informal interview respondents were male, ranging from 20 to 65 in age. Our findings allowed us to conduct an exploratory study using mostly qualitative data. Further studies on the subject should be pursued using a broader population sample so as to improve knowledge of the issues revealed by the current study. In the following section, we will discuss the questionnaire results. The answers from the interviews will be used to qualify the questionnaire answers where need be.

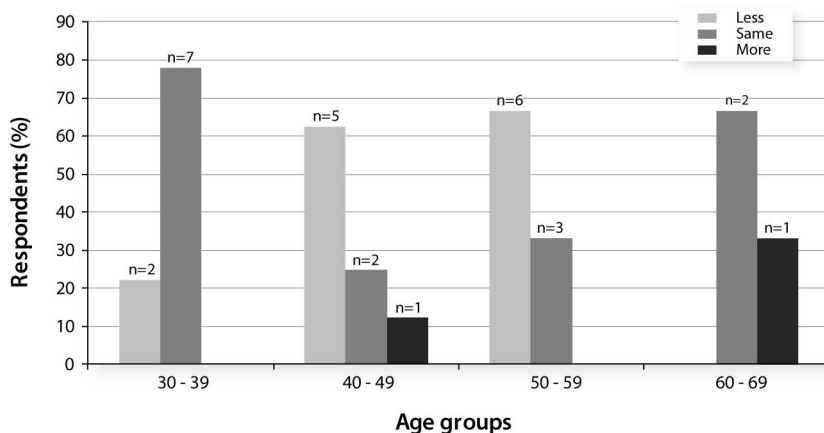
Results and discussion

Cree perceptions of socioenvironmental impacts on Canada Goose, and the implications for nutritional health

As mentioned above, Canada Geese are a staple of the Cree diet. All questionnaire participants (n=30/30) indicated that they did indeed consume Canada Geese meat as adults and all but one (n=29/30) admitted to eating it when younger. This was also confirmed in informal interviews and by observations in the field. The average goose kill ratio in 1975 was of 10.5 geese per person, the average harvest having been listed at 66,135 geese for 6267 community members (Scott and Feit, 1992). Goose meat is prized by the Cree for its taste and nutritional content (Adelson, 1998).

Questions pertaining to their perception of goose meat consumption were included on the questionnaires. We asked them to rate their current Canada Goose consumption compared to when they were younger: 46.7% (n=14/30) of the participants confirmed eating the same amount, whereas 43.3% (n=13/30) indicated eating less, 6.7% (n=2/30) answered that they ate more geese, and one (n=1/30) person abstained from answering. When this data was separated by age group (Figure 4), a clear division could be seen. The majority of participants aged 30-39 (n=7/9) and 60-69 (n=3/3) reported consuming the same amount of or more Canada Geese. However, respondents belonging to age groups 40-49 (n=5/8) and 50-59 (n=6/9) showed a reverse trend, indicating that they ate less goose meat than when they were younger. We also saw a variation based on community location: a majority of participants who indicated a decrease in consumption (n=12/13) came from coastal communities. A majority of participants from inland communities (n=6/9) reported no change in their consumption, n=1/9 indicated consuming fewer geese and n=1/9 indicated consuming more geese. During informal field interviews, a variety of reasons were reported that might explain these differences. People between the ages of 40-59, who were the most economically active in the population, often reported having less time to hunt and often shared the hunted food with their family.

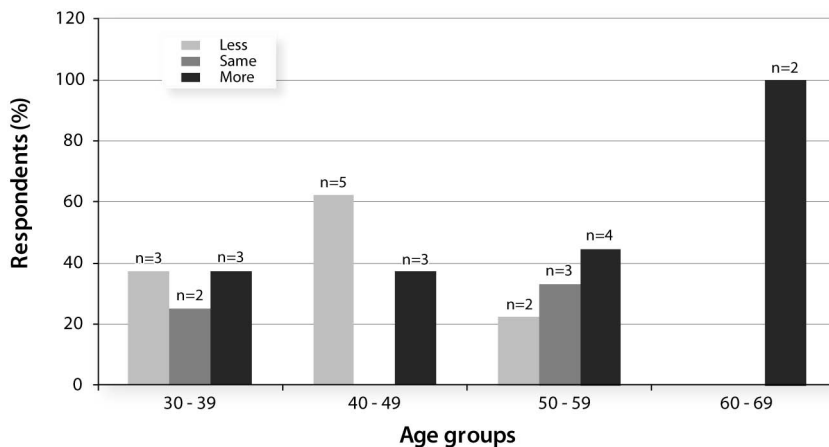
Figure 4 Canada Geese consumption compared to when 16 years old, by age group



As for their Canada Goose hunting habits, the large majority of questionnaire participants (93.3%, n=28/30) indicated that they hunted Canada Geese. It can be inferred that most Cree hunters hunt Canada Geese. This trend carries over when asked about their hunting as a young adult, as a majority of questionnaire participants (86.7%, n=26/30) answered that they also hunted geese in the past.

When asked to evaluate their kill ratio compared to when they were young, 40% (n=12/30) of questionnaire participants answered that they killed more geese, 33.3% (n=10/30) harvested less, 16.7% (n=5/30) killed the same amount, and 10% (n=3/30) did not answer this question. Once again a variation based on community location can be seen: all participants who indicated hunting less lived in coastal communities. Asked to explain the change in harvest, 26.7% (n=8/30) of the participants listed changes to geese flight paths as the main reason. Another 26.7% (n=8/30) listed human factors such as quotas, having become more experienced hunters, etc. We again divided the data by age group (Figure 5) This chart does not follow the chart on geese consumption changes, with the 30-39 and 50-59 age groups being evenly distributed among the categories. However, the differences between the two charts seem to corroborate the findings that food was redistributed among family members and the community.

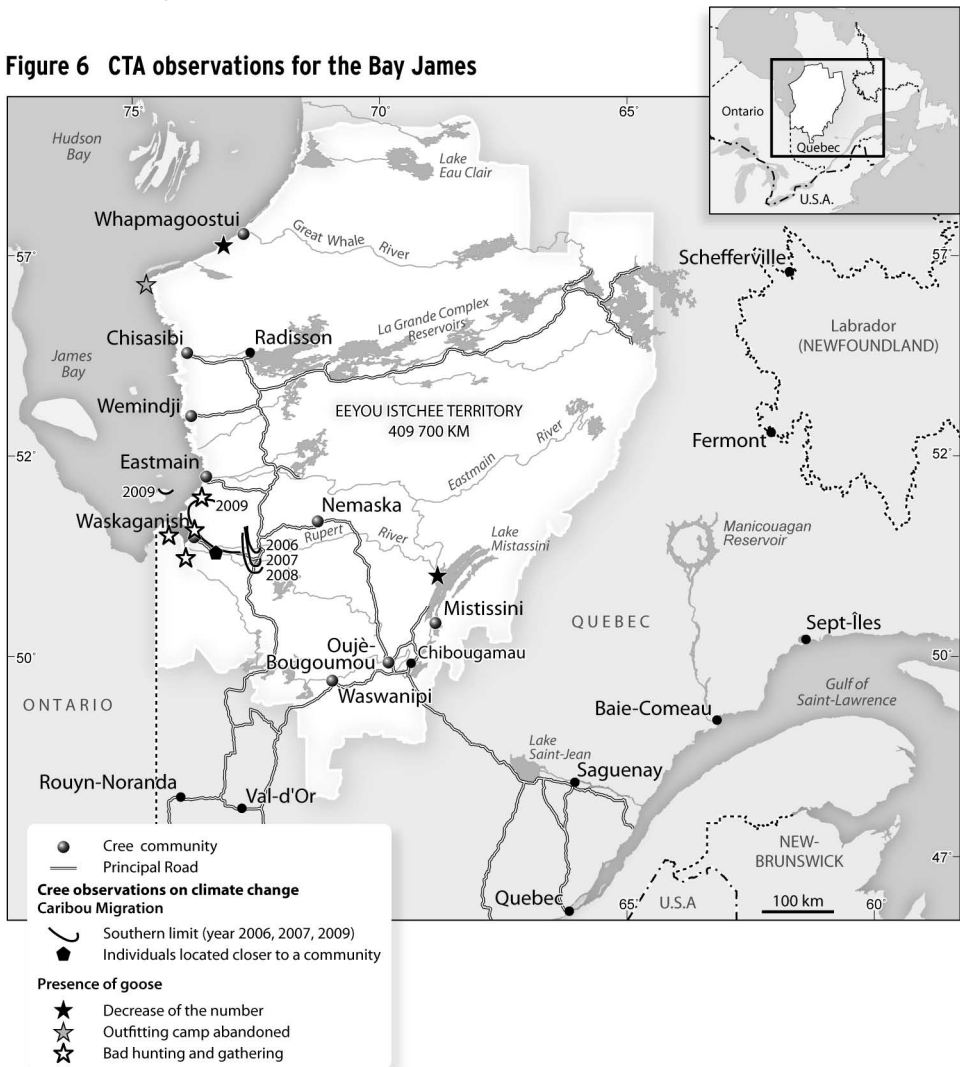
Figure 5 Canada Geese kill ratio compared to when 16 years old, by age group



On our questionnaires, we asked participants about the abundance of geese compared to when they were younger. Of the 56.7% (n=17/30) of participants who indicated that geese were less abundant, n=15/17 were located in coastal villages. Another 20% (n=6/30) of participants indicated no change in the abundance of geese, and 16.7% (n=5/30) of participants indicated that there were more geese. Of this latter group, n=4/5 participants came from inland communities. These findings corresponded to similar data regarding migration behaviour which have been reported by Peloquin and Berkes (2010) in which Cree hunters observed that the geese were increasingly choosing migration routes that were further inland (100+ km from the coast) as opposed to the coastal route. In their study, the Cree hunters further noticed the migration across the territory took place over a shorter period than in the past, as geese were leaving the territory earlier. In our study, no significant trend could be

reported: 33.3% (n=10/30) of questionnaire participants indicated that the fall migration occurred earlier; an equal number of participants (33.3%, n=10/30) indicated that they did not notice any change; and 20% (n=6/30) noted that geese migrated later in the year. N=4/30 participants did not answer. As for spring migration, 40% (n=12/30) of questionnaire participants perceived that it happened earlier than in the past, while 33.3% (n=10/30) of participants indicated that it occurred later and 23.3% (n=7/30) of participants said there was no change. N=1/30 participant did not answer this question. Among these answers, 10% (n=3/30) of participants pointed out that Canada Geese now tended to migrate at the same time as the Lesser Snow Goose. Peloquin and Berkes (2010) reported further that Cree observed that the geese were increasingly avoiding hunting by flying higher, flying at night, or not landing in certain territories. On the questionnaires, a shift in the geographical distribution of geese was visible: Cree hunters from coastal communities (n=15/21) observed a decrease in the geese population, while half of participants from inland communities (n=4/8) indicated an increase in geese population. This matches observations mapped by the CTA for the Bay James (Figure 6).

Figure 6 CTA observations for the Bay James



Alterations in geese migration patterns and geographical population distribution have implications for families and their hunting activities. Some Cree hunters reported to the CTA that they had to abandon goose camps for lack of geese (camps comprise several male hunters, women and some children; each camp hunts and traps in a territory divided into traplines). This in turn has implications on the consumption of goose meat. Since hunting territories are fixed and divided among the different family groups, people who have to abandon their goose camps now only have two options: ask permission to hunt on another family's territory or replace the game meat with store-bought food. This latter option may affect their dietary habits, nutritional health and overall well-being. Peloquin and Berkes (2009) similarly described how some hunting techniques now have diminished success: for instance, geese often do not return to a site after being hunted, whereas key techniques directly rely on the historically correct view that geese are better hunted upon their return to a site where they have been hunted.

The questionnaires included a section on geese morphology: 46.7% (n=14/30) participants indicated that there was a difference in the type of Canada Geese present in the territory: n=6/30 hunters observed "more long-necked geese than in the past." As most Canada Geese subspecies are morphologically very similar, it is unclear if this is a different subspecies or a physical change in the *B.c. interior* subspecies. If the long-neck geese are from the same subspecies as the short-neck geese, then an increase in their numbers would imply changes to environmental conditions based on Leafloor *et al.* (1998) which, as we have already noted, indicated a decrease in *B.c. interior* size in relation to environmental stress factors. During both our long and short interviews, multiple participants (n=3/4 of long interviews and n=8/20 of short interviews) mentioned preferring the meat of short-neck geese; the presence of the long-neck geese was often seen as an undesirable consequence of climate and environmental change. Several of our field interviews stressed changes in geese habitat conditions, highlighting that there was "less eelgrass" in Hudson Bay and there was "more open water, but the geese do not land on open water where no vegetation grows." Such ecological changes in habitat conditions can alter the geese's flight path as has been reported elsewhere (Hine and Schoenfeld, 1968; Hestbeck *et al.*, 1991; Bairlein and Hüppop, 2006).

The above described biophysical factors affecting geese habitat, migration patterns and goose hunts go hand in hand with societal, cultural, economic and climatic changes which, all together, have an influence on hunters' practices (Peloquin and Berkes, 2010). Carlson (2008) illustrated how new institutional arrangements, shifts in the economic and social organization of Cree societies, and changes in cultural identity and aspirations can all be linked to these hydroelectric power stations. As mentioned earlier in this paper, industrial development and the Cree's increased involvement in wage labour has resulted in less time for hunting. As a consequence, as has been shown by Peloquin and Berkes (2010), some hunters now hunt even when conditions are not optimal, and some count on helicopters to travel between their hunting camp and town. Peloquin and Berkes (2010) established a link between changing goose behaviour and negative changes in hunting behaviour which disturb the geese (e.g. hunting after dusk, with motorboats, on calm days when echoes are produced, or on continuous days without taking breaks). This was also confirmed in our study, where hunters expressed concern about intensified hunting and sport hunting in their territories.



Concerns over climate change are now adding to the many above stated challenges the Cree face. Cree hunters in our study reported having observed long-term changes in their traditional territories, namely: weather conditions (i.e. warmer weather in general and winters in particular); snowfall (i.e. delayed arrival of the first snow, less annual snow); ice (decrease in ice thickness); freeze-up and break-up time (rivers and lakes freeze later); and climate hazard phenomena (i.e. more storms). According to interview participants (n=9/20 informal interviews and n=3/4 in-depth interviews), these weather patterns were making it difficult for hunters to rely on climate-sensitive variables such as snow, ice, seasonal and weather conditions to predict weather conditions and to determine whether it was safe to go hunting in the bush. These factors not only impacted directly on goose availability but also on the hunters' safety, which ultimately influenced their hunting methods.

Cree perceptions of socioenvironmental impacts on woodland caribou, and the implications for nutritional health

Since woodland caribou are not evenly distributed over the Bay James territory, it was expected that a percentage of the respondents would not be able to answer the questions pertaining to caribou hunting. Indeed, 53.3% (n=16/30) of the questionnaire participants had hunted woodland caribou in the past but only 36.7% (n=11/30) of all the participants still did. When asked to compare the amount of caribou the hunters now killed to the amount they killed as young adults, only 60% (n=18/30) of the participants answered; of these, 66.7% (n=12/18) killed less woodland caribou, 22.2% (n=4/18) did not notice a difference and 11.1% (n=2/18) indicated killing more caribou. Coastal communities had a higher incidence of reporting smaller caribou harvests, with n=9/21 participants from coastal communities saying they harvested fewer caribou as compared to n=2/21 saying they harvested the same amount. The distribution was more even for inland community participants, with n=3/9 participants harvesting less, n=2/9 participants harvesting the same amount and n=2/9 participants harvesting more caribou. Tanner (1979) writes that during the winter of 1969-70, Mistissini hunters harvested 142 caribou for 570 people. Data from the CTA (2009b and 2010) for the winter of 2008-09 indicates 85 caribou harvested in Mistissini for 874 members. During the following winter of 2009-10 however, there was a drastic drop, with only one caribou listed as harvested along Mistissini traplines by the 878 members. This represents a drop from 1 caribou for 4 people in 1970 to less than 1 caribou for 10 in 2009. In 2008-09, the average for the whole of Eeyou Istchee was less than 1 caribou for 7 members. In 2009-10, this dropped to 1 caribou for 31 members. This sharp drop in numbers could be linked to a noticeable decrease in migratory caribou populations, with the most drastic decrease occurring in Whapmagoostui where 173 caribou were killed in 2009-10 as compared to 758 caribou in 2008-09. However, this exceeded the annual mean harvest for 1972-73, which was 216 caribou (Scott and Feit, 1992). A decrease in migratory caribou numbers has recently been noted by the Québec government, with one herd, the Rivière-George population, losing 80.8% of its population from 2001 to 2010 (MRNF, 2010). A similar decrease is expected for the second migratory population of northern Québec, but data are not yet available.

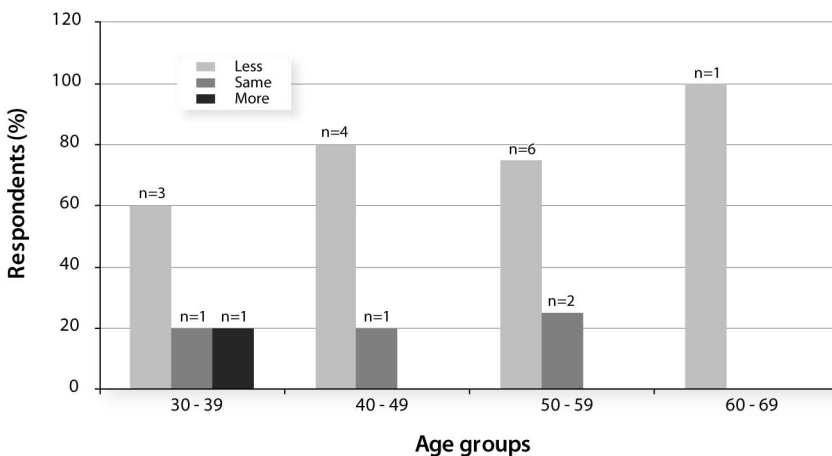
The answers given on the questionnaires for the drop in kill ratio involve both human and environmental factors. It should be noted that only half of the participants (n=15/30) answered this question; these answers should therefore only be used to



qualify the information and should not be applied to the Cree population as a whole. The major environmental factor identified by the participants was a greater presence of migratory caribou in the region (n=4/15). According to participants, this animal was now descending further south than had previously been the case (Figure 6). We can therefore expect an even larger drop in caribou harvests and consumption with the aforementioned decrease in caribou populations. Other factors included a change in caribou distribution (i.e. more caribou, less caribou, smaller groups) (n=3/15), and a complete lack of caribou on the participants' traplines (n=2/15). Among the human factors identified were a kill quota and family needs (n=2/15), an increased consumption of store-bought foods (n=1/15), an increase in hunters (n=1/15) and commitments to salaried work resulting in a lack of time to go hunting (n=2/15). The latter leads to lower physical activity and, consequently, has the potential to further increase the already high obesity rate in the Cree population. Similarly, a diet shift to more store-bought foods high in calories (fat and sugar) and low in nutritional value might further impact the nutritional health of the people.

As could be expected from the hunting information, half (n=14/30) of questionnaire participants who responded to this question did not eat caribou meat and half (n=14/30) did; n=2/30 people did not answer. As young adults, 36.7% (n=11/30) of the participants did not eat any as compared to 56.7% (n=17/30) who did. Again n=2/30 participants did not answer. Of those that had previously consumed woodland caribou meat, 73.7% (n=14/19) consumed less, 21.1% (n=4/19) consumed the same amount and 5.3% (n=1/19) consumed more. The answers given on the questionnaires for this change were the same as those identified for the change in kill ratio. When divided by age group, the consumption of woodland caribou meat showed a decline for all categories (Figure 7). The growing consumption of grocery-bought food – often composed of partially or totally transformed food products in place of game meat – is further altering their dietary habits and is a contributing factor to the growing epidemic of obesity and obesity related diseases (i.e. type II diabetes and coronary heart disease). This was also emphasized by several in-depth interview participants (n=3/4). For example, one participant in the long interview stated: “The people [...] they need real food. I remember some people, they receive a few sickness and they really want to eat the real food. And when they eat the real food, in two days, the pain is gone. (sic)”

Figure 7 Woodland caribou consumption compared to when 16 years old, by age group



Intergenerational dynamics

We asked hunters to compare the younger generation's hunting habits to their own to obtain their perceptions on intergenerational changes. During informal interviews, many elders complained that the younger Cree did not go out into the woods often enough. On the questionnaires however, participants answered that the younger generation hunted Canada Geese as much (50%, $n=15/30$) if not more (26.7%, $n=8/30$) than their own generation. Only 16.7% ($n=5/30$) of participants thought the younger generations hunted less. Another 6.7% ($n=2/30$) of participants did not answer this question. This percentage dropped only slightly when questionnaire participants were asked about the consumption of goose meat, with 56.7% ($n=17/30$) answering that the younger generation ate the same amount and 16.7% ($n=5/30$) more. Another 20% ($n=6/30$) of participants noted a decrease in geese consumption in the younger generations and 6.7% ($n=2/30$) did not answer. When compared to the participants' answers about their own consumption levels, these results did not reflect a stark decrease in consumption levels with the younger generations. The desire to keep up traditions was listed as the main reason for the continued consumption and hunting of Canada Geese. This question received a low response rate ($n=5/30$) however. This corresponds with findings by Power (2008), who illustrated that aboriginal identity, cultural values and spirituality are strongly associated with the traditional lifestyle and the hunting of wild game.

However, this tendency was reversed for woodland caribou, with 36.7% ($n=11/30$) of questionnaire participants saying that the younger generations hunted less; 23.3% ($n=7/30$) saying they hunted the same amount; 6.7% ($n=2/30$) answering that the younger generations hunted more; and 33.3% ($n=10/30$) not answering. Participants also indicated on our questionnaires that they considered that the younger generations ate the same amount of (30%, $n=9/30$) or less (36.7%, $n=11/30$) caribou meat as themselves. Another 3.3% ($n=1/30$) of participants thought the younger generations ate more caribou meat and 30% ($n=9/30$) of participants did not answer. These responses seem to echo the changes that the questionnaire participants observed in their own caribou consumption. This information leads us to believe that this change in caribou consumption spans multiple generations, affecting the Cree society as a whole. With climate change expected to become more significant in the subarctic in the near future, food security and related health outcomes will very likely become a major concern for the Cree First Nation.

Conclusion

This paper documents observation of socioenvironmental changes made by members of the Cree Trappers' Association and examines changes in Cree hunting and consumption of two traditional key food species – the Canada Goose and the woodland caribou. Our paper likewise explores what impact these changes might have on traditional food, nutritional health and ultimately food security. Explanations from the Cree participants illustrated that the Cree food system depends on both locally harvested and store-bought food, and that the socioenvironmental context is changing. The perceptions of the participants also provided insights into current food security issues in the James Bay. The Cree are witnessing a variety of changes that are affecting their local traditional food harvest, thus altering consumption levels. This relates in part to



fluctuations in habitat usage, population dynamics and behaviour of traditional food species (i.e. change of the Canada Goose flight path, decrease in the goose population in the southern part of James Bay, decrease in the woodland caribou populating in the area, more southerly migration of tundra caribou). These fluctuations are due to modified environmental conditions (i.e. hydroelectric development, road construction, land clearing for high-voltage transport lines, etc.) and climatic conditions (i.e. warmer weather, change in rainfall, etc.). Accordingly, people have been forced to change their hunting habits (i.e. abandon their hunting camps because of a lack of game, hunt on other families' traplines) in order to ensure a constant supply of traditional food to the community (i.e. hunting more tundra caribou to replace the woodland caribou, whose population has diminished in the region) and to change their dietary habits (i.e. buying more grocery food to replace game meat). All of this has implications for the nutritional health and the overall well-being of the communities.

Cree food insecurity will probably increase due to the sensitivity of subarctic environments to socio-economic, environmental and climatic changes. These changes and the way they are perceived by the Cree hunters, as shown in the present study, require greater understanding and involvement by individuals and institutions to define effective adaptation strategies. Currently, various Cree-led initiatives and collaborative research are underway in Eeyou Istchee, which are tackling the multiple challenges posed by the anthropogenic, environmental and climatic changes that the communities are facing. One such project is the Climate Change Project, which is a joint initiative of the Cree Trappers Association, the James Bay Advisory Committee on the Environment and the Cree Regional Authority, and which is funded by the Indian and Northern Affairs Canada. Another initiative, funded by the Northern Ecosystem Initiative, is the Migratory Bird Project which places a particular emphasis on community based monitoring of migratory bird harvests. A third such initiative, funded by Niskamoon Corporation, is a community fishing program which aims to support family fishing camps and to make the harvested fish available to all community members. All these projects and other similar ones allow for a better understanding of the multiple dynamics and relations in play in the eastern James Bay area. These local initiatives are exploring community adaptation strategies to cope with the effects of climate and environmental changes. With changing environmental conditions becoming more frequent and intense due to climate change in northern regions of Canada and probably still more so in the future due to major planned socio-environmental development projects, we would argue that additional efforts in research and community program funding are crucial to ensure that traditional food remains available and accessible. This is all the more true given that it is an essential part of the Cree culture in the James Bay region. This premise also holds true for other aboriginal communities living in the Canadian Arctic and subarctic (Kuhnlein *et al.*, 2009). Traditional food valorization programs such as the Nuxalk Food and Nutrition Program and the Gwich'in Traditional Food for Health Program have shown great potential in addressing, in a socially and culturally adapted manner, the needs created by a society experiencing vast socioenvironmental changes. Therefore similar studies identifying the current perceptions and concerns of local aboriginal communities about environmental change and its impacts on their traditional way of life would greatly benefit all future adaptive measures.

Acknowledgments

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