Identifying barriers to traditional game consumption in First Nation adolescents in remote northern communities in Ontario, Canada

by

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A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Environmental Studies
in
Environment and Resource Studies

Waterloo, Ontario, Canada, 2011

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Objectives: To investigate game (e.g., wild meats, fish) consumption behaviour, frequency and concern of environmental contaminants (e.g., heavy metals, organochlorines) among First Nations Cree schoolchildren residing in five isolated coastal communities in western James Bay and southwestern Hudson Bay, Ontario, Canada: Moose Factory, Fort Albany, Kashechewan, Attawapiskat and Peawanuck.

Methods: Frequency of traditional food consumption, consumption behaviour and perceptions regarding environmental contaminants were collected between 2004-2009 using a validated Web-Based Eating Behaviour Questionnaire (WEB-Q). The WEB-Q was administered among 262 schoolchildren (boys n=131; girls n=131), aged 10-17, in grades 6-12. Four questions were used from the food behaviour questionnaire portion of the WEB-Q: 1. Do you eat game? [yes, no], 2. How often do you eat game? [at least once a day, at least once a week, rarely or never], 3. How concerned are you about potential environmental contaminants in the game, fish or other meats that you eat? [not concerned, concerned], and I would eat more game if…[six response options: my friends ate it more often, my parents ate it more often, my family knew how to properly prepare it, it was more available at home, it was available at school, none of the above]) regarding traditional food consumption. Hierarchical log-linear modelling was used for statistical analyses of the multi-way frequency data, in addition to descriptive statistics.

Results: This manuscript-based thesis found that of 262 participants, 174 of 194 respondents reported consuming game; 95 of 173 respondents reported concern about potential contaminants in game; and 84 schoolchildren said they would increase their game consumption if it was more available at home. Log-linear modelling revealed significant differences between communities;

schoolchildren in Moose Factory consumed game "rarely or never" at greater than expected frequency, and fewer than expected consumed game "at least once a day." Schoolchildren in Kashechewan had greater frequency of daily game consumption and few were not concerned about contaminants in game. Further, log-linear modelling, found that sex is an inconsequential variable and that it does not affect game consumption, game consumption frequency or environmental contaminant concern.

Conclusions: Game consumption frequency is relatively low among First Nations adolescents, especially in more southern communities like Moose Factory. Relatively low game consumption may be partially attributable to perceptions regarding environmental contaminants in game. There is the need to assess the actual risk of exposure to contaminants in wild meats in the children. Subsequently, enhanced dissemination of risk management and communication strategies regarding environmental contaminants in traditional foods should be employed, taking a balanced approach that also accounts for the benefits (e.g., nutritional, social, cultural) of wild game procurement, processing, and consumption.

Acknowledgements

This thesis would not be possible without the encouragement, support and advice that I received from my advisor, Dr. Len Tsuji and my committee member Dr. Dan McCarthy. Thank you to Kelly Skinner, Eric Liberda, Allison Gates and Michelle Gates for help regarding all aspects of this research and for assistance in data collection. Thanks to Dr. Ian Martin for his patience and guidance in all statistical analyses and Dr. Rhona Hanning for allowing me to partake in this significant research project and utilize data from the WEB-Q. I would also like to acknowledge and thank the schoolchildren, Chiefs and Councils, Education Authorities, and school personnel from the participating communities: Moose Factory, Fort Albany, Kashechewan, Attawapiskat and Peawanuck. This study was funded by the Social Sciences and Humanities Research Council of Canada, the Canadian Institutes of Health Research, the Ontario Ministry of Research and Innovation and the Danone Institute of Canada.

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Abbreviations

ASR	Adjusted Standardized Residual
FNRHS	First Nations Regional Health Survey
INAC	Indian and Northern Affairs Canada
LLM	Log-linear modelling
PCB	Polychlorinated Biphenyl
POP	Persistent Organic Pollutant
RfD	Reference Dose
TDI	Tolerable Daily Intake
T2DM	Type 2 diabetes mellitus
WEB-Q	Web-based Eating Behaviour Questionnaire

1.0 Chapter 1: Introduction and Overview

1.1 Research Questions

What is the frequency and behavioural patterns of traditional food consumption among First Nations Cree schoolchildren of the Mushkegowuk Territory? Do potential environmental contaminants (e.g., organochlorines, toxic metals) in game (e.g., wild meats, fish) instigate barriers to traditional food consumption among these schoolchildren?

1.2 Research Objective

With the purpose of answering the aforementioned questions, the following research objective was developed:

- To determine game consumption behaviour, frequency and concern of potential environmental contaminants among schoolchildren of the Mushkegowuk Territory through use of a Web-Based Eating Behaviour Questionnaire (WEB-Q).

1.3 Statement of Problem

Many First Nations lack adequate information on the nutritional inadequacies of market foods which may be a contributing factor to poor health (R. Hanning, Tsuji, & Skinner, 2005). Many are also unaware of the local barriers to traditional food consumption. Food security exists when individuals and communities have physical and economic access to food that is culturally appropriate, meets dietary needs, and helps them embrace an active and healthy life (availability, accessibility, acceptability) (FAO, 2009). Furthermore, food security has been recognized as a determinant of health (Willows, 1996). Among children and adults, food insecurity may have adverse effects on education (e.g., punctuality, impaired learning, poor grades), impact social skills, increase rates of obesity (Jyoti, Frongillo, & Jones, 2005), instigate chronic diseases (e.g., Type 2 diabetes mellitus [T2DM]) (Shubair & Tobin, 2010), result in cardiovascular disease (Young, 2003a), generate food anxiety (Willows, Iserhoff, Napash, Leclerc, & Verrall, 2005) and lead to cultural erosion (Young, 2003a). Factors determining accessibility to traditional foods (e.g., wild game, game birds, and fish) are varied. For example, the introduction of a cash-based economy in many northern communities made it challenging to allocate time towards subsistence living due to waged employment and the inability to go to the bush for prolonged periods of time to hunt or fish. Less time for hunting means that many families purchase nutritionally inadequate market foods (Downs et al., 2009). In addition, it has been widely reported in the media (CBC, 2010) that unforeseen barriers to food security have arisen including ubiquitous environmental contaminants (e.g., persistent organic pollutants, toxic metals). This concern has also increased the reliance on market foods (Kuhnlein & Chan, 2000). This phenomenon is alarming because traditional foods provide a critical source of sustenance supplying nutrients not often present in market foods, in addition to having immense social and cultural importance (Loring & Gerlach, 2009). Adolescents are at the epicentre of the nutrition transition; Aboriginal children consume market foods loaded with saturated fats and refined sugars at a greater frequency than adults (Damman, Eide, & Kuhnlein, 2008; Nakano, Fediuk, Kassi, & Kuhnlein, 2005). Although food insecurity issues are widespread among northern Aboriginal adolescents in Canada (Kuperberg & Evers, 2006), this thesis will focus on First Nation Cree adolescents of the Mushkegowuk Territory, as past development projects (e.g., Mid-Canada Radar Line sites) and recent resource development (e.g., De Beers Victor Diamond mine) in the region has further heightened food security concerns.

1.4 Rationale

Data pertaining to on-reserve children in Canada is scarce (Young, 2003b); in regards to dietetics and health, various studies state that more research is required (Assembly of First Nations, 2002-2007; Kuperberg & Evers, 2006). Much of the health research on children and adolescents has focused on 24-hour dietary recalls (what was consumed on the previous day), obesity and chronic illnesses including T2DM and anemia. Health research pertaining to children is imperative as one-third of the Aboriginal population is under the age of 14 (Statistics Canada, 2011). Further, few studies have focused on schoolchildren's traditional food consumption behaviour and concern for environmental contaminants in game; there have been no studies examining environmental contaminant exposure in schoolchildren based on their body mass. Traditional food is still an important source of sustenance for the Mushkegowuk Cree. Tsuji and colleagues (2001) found that 98% or 46/47 of schoolchildren surveyed in their study on dentine-lead levels consumed a type of wild meat (Tsuji, Karagatzides, Katapatuk, & Young, 2001). Given the prevalence of game consumption, contaminant exposure research among children and adolescents is important, because this demographic has a greater susceptibility to low doses of contaminants than adults (Wright & Welbourn, 2002). Elevated susceptibility to toxins is exacerbated by rapid physical growth, potential for elevated contact relative to weight and height and under-developed toxin detoxification systems (e.g. metabolizing enzymes and kidney functions)(Schwenk et al., 2003; Woodruff, Axelrad, Kyle, Nweke, & Miller, 2003). Children also have greater physical contact with the surrounding environment, which increases pathways for further contamination (e.g., hand-to-mouth activities and contact with contaminated soil or sand). Studies have found that up to 500 mg of soil or dust can be consumed daily by a child of 15 kg (Schwenk et al., 2003). Further, children's bodies absorb greater amounts of contaminants, such as lead (<8 year; 40-50%), compared to adults (15-20%) (Gustavsson & Gerhardsson, 2005; Health Canada, 2009).

The presence of contaminants in northern regions of Canada fuels anxiety and confusion among subsistence hunters and fishers. A plethora of ill-advised information regarding traditional food contamination has sparked confusion and fear about whether traditional foods are safe to eat. Exposure to contaminants from traditional food presents a unique problem from both a toxicological and a nutritional perspective. The health risks posed by contaminants in wild meats and fish must be balanced against the nutritional benefits of this food, and in the case of Aboriginal populations, against the loss of traditional lifestyles (B. Wheatley & Paradis, 1996; M. A. Wheatley, 1996). Therefore, this thesis will investigate traditional food behaviour, consumption frequency and concern of contaminants among First Nations schoolchildren in the western James Bay and south-western Hudson Bay region of Northern Ontario, Canada.

2.0 Chapter 2: Literature Review

The proceeding literature review will examine Canadian Aboriginal peoples' (Inuit, First Nations, and Métis) current health status. It will broadly examine food security issues by investigating health and nutritional disparities between the Aboriginal population and the non-Aboriginal population, specifically First Nations peoples. The presence of toxic metals and persistent organic pollutants (POPs) in traditional foods will also be reviewed in addition to behaviours and perceptions, and risk management and communication approaches regarding environmental contaminants.

2.1 Demographic and Population Statistics of Aboriginal People in Canada

The 2006 Canadian Census lists 1,172, 790 people who identify as Aboriginal. Based on the respondents who specified their lineage (1,138,295), 698,025 (59.5%) are North American Indians or First Nations, 389,785 (33.2%) are Métis and 50,485 or (4.3%) are Inuit (Statistics Canada, 2009). Between 1901 and 2001, the Aboriginal population in Canada rapidly increased, growing 10 times faster than the non-Aboriginal Canadian population (Statistics Canada, 2011). As a result, one third of the Aboriginal population is under the age of 14 and the median age is 24.7 years, compared to the non-Aboriginal median age of 37.7 years (Statistics Canada, 2011). The on-reserve life-expectancy for Aboriginal men is 67.1 years and women 73.1 years (off reserve men 72.1 years; off-reserve women 77.7 years) compared to the non-Aboriginal life expectancy for men of 76 years and women of 81.5 years in Canada (Frolich, Ross, & Richmond, 2006).

Data from the 2006 census reveals that Ontario has the largest population of Aboriginal peoples at 242,495 individuals; accounting for 2% of the province's total population (Statistics Canada, 2010; Statistics Canada, 2011). Approximately 65% (158,395) are of First Nations ancestry and reside south of the tree-line, making it the largest First Nations population of any province or territory in Canada, followed by British Colombia at 129,580 (Statistics Canada, 2010). Nationally, Aboriginal children (0-14 years) number 348,900 individuals. The majority of Aboriginal children reside (64,325; 18%) in Ontario, including the majority of First Nations children at 46,470 individuals. Between the ages of 15-24, there are 212,010 Aboriginal adolescents and young adults, with the majority in Ontario (40,880) and the majority of First Nations adolescents and young adults in Ontario (26,055) (Statistics Canada, 2010).

2.2 Health Status of Aboriginal Peoples in Canada

In comparison to the general Canadian populace, Aboriginal peoples, both on and off-reserve, are continuously falling behind in health status (AMAP, 2009; Waldram, Herring, & Young, 1995). Diseases and illnesses that were previously unknown or rare in remote and isolated Aboriginal communities have become rampant (e.g., T2DM, anemia, cancer) (Marrett & Chaudhry, 2003; Young, Reading, Elias, & O'Neil, 2000). Many of the health inequalities are attributable to the westernization of dietary habits (the shift away from the traditional subsistence lifestyle) and the lower socio-economic status of Aboriginal peoples, compared to the non-Aboriginal population (Lambden, Receveur, Marshall, & Kuhnlein, 2006). At present, acute health predicaments facing Aboriginal peoples and leading to death are injury, poisoning, circulatory diseases, cancer, and respiratory diseases (Adelson, 2003). Moreover, chronic health disparities in Arctic and sub-arctic regions of Canada are further exacerbated by the long-range transport of environmental contaminants to these regions (AMAP, 2009). Contaminants, including toxic metals and organochlorines bioaccumulate in northern environments and enter the food chain; hence, it is not unusual for confusion to revolve around traditional food consumption. In numerous cases, individuals have ceased game consumption and have ill-advisedly switched to a diet of low-nutrient market foods to avoid contaminated foods (H. V. Kuhnlein, Receveur, Muir, Chan, & Soueida, 1995).

In addition to the known health disparities between Aboriginal and non-Aboriginal peoples, there is likewise a health disparity within the First Nations population (e.g., between on-reserve and off-reserve). Research indicates that there is a literature gap between First Nations, Inuit and Metis, in addition to demographic and gender variances within the groups. A literature review by Young (2003), found that of 254 peer-reviewed papers over 60% or 158 papers addressed on-reserve First Nations people; while, two addressed off-reserve First Nations. The National Chief of the Congress of Aboriginal Peoples, Dwight Dorey confirmed this finding. He claims that the off-reserve Aboriginal population is rarely studied, and that there remains a paucity of information on their health status (Sibbald, 2002). It has been suggested that off-reserve First Nations people have the greatest burden of health inequalities, compared to both on-reserve residents and the non-Aboriginal Canadian population (Health Canada, 2000; Tjepkema, 2002). Although off-reserve Aboriginal communities are an important topic, which deserve further research, they will not be further addressed in this thesis.

The majority of government health funding is allocated toward on-reserve residents (Sibbald, 2002). Young (2003) found that the Cree and Ojibwa were the most studied Aboriginal group, yet there remains a disparity between age and sex. Approximately one-half of the peer-reviewed papers address women and children, yet few focus on the health needs of women and children (Young, 2003b). Therefore, the majority of studies have been conducted on adult, male subjects, hence the need for health and nutrition research with children and adolescents.

2.2.2 Health Status of First Nations Children

There is an overall lack of health data regarding Aboriginal children (Young, 2003b). Data collection for hospitalization and child mortality rates for Aboriginal people in Canada are non-existent; therefore, health inequities cannot be measured, alleviated or reversed. Inequities may include accidents, and infectious diseases of the gastrointestinal or respiratory systems (Silversides, 2010). Lack of data can be attributed to logistics issues, for example, First Nations, Inuit or Métis are not given the option of self-identification when admitted to hospitals (Smylie & Adomako, 2009). Further, the available health data on children predominantly focus on obesity, nutrition, T2DM, physical activity, anemia, and mental health.

Nutrition plays a large role in the health of First Nations children and may contribute immensely to mental health. The First Nations Regional Health Survey (FNRHS); (Assembly of First Nations, 2002-2007)) determined that those who stay active and consume a balanced diet are less prone to having suicidal thoughts. Moreover, a study by Silvers and Scott (2001) found that there is a significant negative relationship between fish consumption in Aboriginal adults and mental health status. Polyunsaturated fatty acids in fish have been found to act as a mood stabilizer (Silvers & Scott, 2001). This is a significant finding as Kirmayer et al. (1999) found that Aboriginal youth are 5-6 times more likely to commit suicide than non-Aboriginal youth (Kirmayer, Boothroyd, Laliberté, & Simpson, 1999). The correlation between traditional food intake and decreased suicide prevalence may be a result of associated factors relating to food security including a nurturing and social environment (e.g., hunting/fishing with family). Further, the FNRHS found that 62% of First Nations adolescents self-reported “sometimes” eating a nutritious and balanced diet; while, 20% said “rarely”, and 4% said “never” (Assembly of First Nations, 2002-2007).

Despite the innumerable benefits of game consumption, market foods are often the primary energy source for Aboriginal children and adolescents (AMAP, 2009; Khalil, Johnson-Down, & Egeland, 2010). In a study by Nakano and colleagues (2005) on the food use of Dene, Métis and Yukon children, traditional food contributed 4.3% to 4.7% to total energy in children aged 10 to 12 (Nakano et al., 2005). Not surprisingly, on days when children consumed traditional food, they had a higher intake of protein, iron, zinc, copper, magnesium, phosphorus, potassium, riboflavin, and vitamins E and B-6 than on days when they did not. The study also found that children from the more northern communities consumed greater quantities of traditional foods and had lower intakes of saturated fats and sodium (Nakano et al., 2005). On days when traditional foods are not eaten, there is an increase in total fat, saturated fat and sugar intake; all above recommended levels (AMAP, 2009).

It is necessary that the benefits of traditional foods are examined taking into account the ubiquitous environmental contaminants permeating the northern food systems and subsequently being consumed by Aboriginal people who are at the top food chain. The literature on Aboriginal contaminant exposure from the consumption of contaminated game has only been conducted among adult subjects (MacMillan, MacMillan, Offord, & Dingle, 1996; Waldram et al., 1995); this includes exposure research conducted in the Mushkegowuk Territory (Tsuji et al., 2001;

Tsuji, Wainman, Martin, & et al., 2005; Tsuji et al., 2006; Tsuji et al., 2008). To date, no exposure studies have been conducted on children. Damstra and his colleagues (2002) state “The lack of adequate exposure data during infancy and childhood is of particular concern” (Damstra, Page, Herrman, & Meredith, 2002). Children and adolescents’ developing organ systems often lack the ability to cope with high chemical burdens (Eskenazi, Bradman, & Castorina, 1999). For example, children’s gastrointestinal systems are far more efficient than adults at absorbing lead (Mahaffey, 1990; Ziegler, Edwards, Jensen, Mahaffey, & Fomon, 1978) and nutritional deficits, from a lack of wild meats and fish, can aid lead absorption. Anemia can further facilitate the absorption of lead in the gastrointestinal system (Mahaffey, 1990; Willows, Morel, & Gray-Donald, 2000). This is worrisome, because anemia is prevalent in northern Aboriginal communities (Whalen, Caulfield, & Harris, 1997; Willows et al., 2000).

2.3 Food Security

Food security, which is often cited as a determinant of health consists of several pillars: availability, accessibility and utilization (Willows, 1996). Aboriginal peoples are often food insecure as a result of barriers to the aforementioned pillars (Table 2.1). For example, heavily contaminated traditional foods may be considered inadequate, but transboundary pollution is not a structural local or national issue which can easily be resolved. The matter is transboundary; hence mitigation strategies may be the only solution. An additional food security pillar (Chan et al., 2006; Lambden, Receveur, & Kuhnlein, 2007) is food use or sufficient knowledge of food preparation, which is quickly eroding in numerous Aboriginal communities (WHO, 2011). Food preparation skills are not transmitted to the same extent as they were historically, among Cree in the Western James Bay region; this is attributable to the education system, wage-based economy, lack of time in the bush, and changes in values (Ohmagari & Berkes, 1997). The nutrition transition from a subsistence diet, to one based heavily on western foods, is a complex problem plaguing indigenous communities globally (Gracey & King, 2009). Shifting dietary patterns are

Table 2.1: A list of opportunities and barriers for traditional food consumption in arctic and sub-arctic Aboriginal communities. Sources**:** (Arnold et al., 2003; Chan et al., 2006; Ford & Berrang-Ford, 2009; Lambden et al., 2006; Lambden et al., 2007)

Opportunities	Barriers
• Healthy food • Spiritual health • Connection to the land • Nutritional benefits • Physical Activity • Rich source of nutrients not often found in market foods • Embraces social cohesion • Promotes cooperation • Oftentimes perceived as being “natural” or having “no chemicals” “no steroids” and “no preservatives” • Allows adults to teach children about socio-cultural importance and responsibilities • Builds self-confidence and pride of culture • Hunting teaches patience and develops various other personal qualities • Teaches survival skills • Educates individuals about the natural environment	• Elevated market food consumption by younger generation • Market foods are perceived as convenient Environmental contaminants in food chain • Wide availability of low-nutrient market foods • Lack of community freezers • Lack of hunting education • High cost of equipment (e.g., shotshell, snowmobiles, gasoline etc.) • Lack of male head in the family to go on hunting trips and provide game • Less female hunting • Perceived lack of hunting skills, food preparation, budgeting, nutrition • Single mother households • Lack of sharing networks which minimize hunting costs • Wage-based economy and difficulty allocating time toward hunting activities • Lack of knowledge transfer between elders/adults to adolescents concerning hunting and fishing • Traditional food often less available in larger communities • Some stores require hunting licenses to purchase ammunition • Climate change

an outcome of lifestyle changes undertaken as a result of colonization, industrialization, urbanization, economic development and market globalization (George, Berkes, & Preston, 1995; Gracey, 2000; Lambden et al., 2006). The westernization of dietary habits has consequently resulted in “western diseases” which were previously unknown in remote and isolated indigenous communities. Denis Burkitt, a famous medical doctor working in Africa during World War II stated that “the only way we’re going to reduce disease is to go backwards to the diet and lifestyle of our ancestors” (Burkitt, 1994). Further, Kuhnlein (1995) cites two major factors for a decline in traditional food consumption among Canadian Aboriginals: first, the deteriorating environmental quality of flora and fauna; and secondly, the shift toward a wage-based economy in most northern communities (H. V. Kuhnlein, 1995).

Prior to industrialization, the hunter-gatherer subsistence lifestyle protected Aboriginal peoples against degenerative and chronic illnesses which were generally low or rare. Cultural erosion from various assimilation projects globally have regrettably eroded the traditional way of life in numerous Aboriginal communities, hence shifting dietary habits and patterns of physical activity, resulting in the mounting prevalence of chronic illnesses including obesity, T2DM, anemia and metabolic syndromes (Damman et al., 2008). Genetic factors interacting with lifestyle changes have also contributed to the elevated prevalence of chronic illnesses (Arnold et al., 2003; Milburn, 2004); the Oji-Cree of Northwestern Ontario and Manitoba have the highest recorded occurrence of T2DM in the world because of environmental and genetic factors (Hegele et al., 2003).

Numerous studies indicate the importance of traditional food consumption for promoting and maintaining food security. In a study of 50 Inuit community members in Igloolik, Nunavut, Ford and Berrang-Ford (2009), found that that those who obtained more than half of their nutrition from traditional food sources were more likely to be food secure. There was a direct correlation between consistent traditional food consumption and food security (Ford & Berrang-Ford, 2009). Despite the health and cultural benefits, traditional foods contribute to less than 40% of energy intake in adults, and less than 15% of the energy intake in children. The shift to market foods has resulted in lower intakes of critical nutrients such as vitamins A, C, D, E, iron, calcium and fibre (AMAP, 2009). As previously mentioned, Nakano (2005) discovered that children had higher intakes of protein, iron, zinc, copper, magnesium, phosphorus, potassium, riboflavin, and vitamins E and B6 on days when they consumed traditional foods (Nakano et al., 2005).

Food insecurity in northern regions of Canada has been "addressed" through the *Food Mail Program*. The government subsidized program delivered parcels containing nutritious perishable foods (e.g., fresh and frozen fruits and vegetables, eggs, milk, cheese, yogurt, frozen juice concentrate etc.) to isolated communities, which could not be accessed year-round. The program's principle objective was to lessen the financial burden of paying for perishable foods and essentials items for Aboriginal peoples living in remote northern communities. Pilot projects were first launched by Indian and Northern Affairs Canada (INAC) between 2001-2003 in Kugaaruk, Nunavut, Kangiqsujuaq, Nunavik and Fort Severn, Ontario. Food insecurity was alleviated during the pilot phases (Glacken & Hill, 2009). As of 2011, the Food Mail program has been replaced by *Nutrition North Canada*, which similarly promotes healthy foods in northern remote communities; focusing only on the "most nutritious perishable foods" listed in

Canada's Food Guide (Appendix A, B). However, there are many issues with this program at the community level. Nevertheless, the program is also working toward improving access to commercially produced traditional foods (INAC, 2011). This may help ease the Arctic Dilemma. Individuals who are concerned about traditional foods contamination may increase their reliance on healthy, subsidized, market foods.

2.4 Environmental Contaminants

It has been assumed that:

"Chemical contamination places Tribes in a lose-lose situation: either eat the fish and suffer the health effects from contaminants, or do not eat the fish and suffer the health and cultural effects of lost fish. (B. L. Harper & Harris, 2008b)

Circumpolar regions of Canada, although seemingly pristine, are teeming with a plethora of semi-volatile environmental contaminants (e.g., toxic metals, organochlorines) which are transported by long-range atmospheric and oceanic pathways and deposited into rivers, lakes, and terrestrial areas. This phenomenon is known as the "grasshopper effect" (Semeena & Lammel, 2005).

Terrestrial and aquatic organisms exposed to environmental contaminants accumulate toxins based on exposure duration, species size and species age. At harmful levels toxins bio-concentrate in organisms resulting in greater tissue concentration relative to the surrounding environment. Toxins are subsequently passed on and magnified through succeeding trophic levels. The bioaccumulation, bio-concentration and biomagnification of contaminants can drastically alter traditional food systems for northern Aboriginal peoples. Contaminants are often persistent and do not transform or undergo degradation after being released into the surrounding atmosphere (Wright & Welbourn, 2002). The Stockholm Convention on Persistent Organic Pollutants defines persistent as having a chemical half-life of more than two months in water, greater than six months in soil, or greater than six months in sediment (Greenpeace, 2003) .The "Arctic paradox", a term coined by journalist Marla Cone, highlights the irony that the Arctic, a place seemingly serene, primitive, and pristine, is one of the most contaminated places in the world, in terms of human body burden (Cone, 2005b). Dewailly et al. (1989) serendipitously discovered high PCB concentrations in Arctic women's breast milk in the mid-1980s. The Nunavik (northern Quebec, Inuit) women were supposed to be an uncontaminated "control" population in a comparative study to southern women (Dewailly, Nantel, Weber, & Meyer, 1989; Lougheed, 2010). Contrary to popular belief, environmental contaminants are globally ubiquitous. Since the majority of people do not rely on subsistence

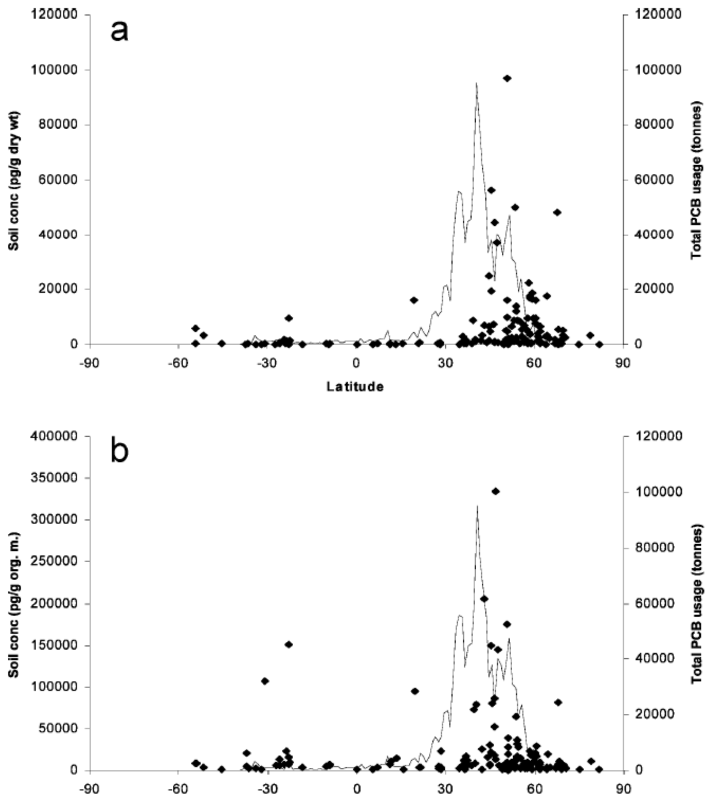


Figure 2.1: Soil PCB concentrations globally. Note that concentrations increases substantially latitudinally, between 40° and 60° N. Therefore including the Mushkegowuk Territory. [Copyright from the American Chemical Society, Environmental Science & Technology, Global Distribution and Budget of PCBs and HCB in Processes, by Meijer, Ockenden et al. 2003. Used with permission.]

hunting for their sustenance, they are not exposed to contaminants at the same rate as Aboriginal peoples (Furgal, Kalhok, Loring, & Smith, 2003). Contaminants have been found at higher concentrations in the east coast of Canada in biota and sediments, compared to the west coast (Pierce, Whittle, & Bramwell, 1998); thus, also accounting for a longitudinal difference. This phenomenon has also been found latitudinally, with increasing PCB contaminants in soil from the southern to northern hemisphere (See Figure 2.1).

Point source pollution sources include the Mid-Canada Radar Line (MCRL). Sixteen of these sites, located in northern Ontario were abandoned without proper decommissioning (OAG, 2004). The MCRL has been contributing to PCB exposure in communities, such as Fort Albany First Nation (Site 050; Anderson Island), where PCB contamination in soil has been measured up to 21,000 ppm (ESG, 1999). The Anderson Island MCRL was decommissioned in 2001 and included the removal of contaminated equipment and soils.

More recently Cree have expressed anxiety over methylmercury production as a result of the De Beers Victor Diamond Mine in Attawapiskat, Ontario. The mine relies heavily on surrounding muskeg for water and drainage; thus, there is potential for mercury release and methylmercury production from the altered hydrology and chemical transformations. Furthermore, commercial logging in Boreal regions of Canada - including the Mushkegowuk Territory - releases mercury into the surrounding environment (Lintner, MacDonald, & Baggio, 2008). It should be emphasized that the dietary consumption of contaminants can negatively impact human health (ATSDR, 2010).

2.4.1 Toxic Metals

Metals are naturally occurring compounds found in surface waters, soils, rocks, vegetation and volcanic regions, in addition to many other places (Friberg, Nordberg, & Vouk, 1979). Anthropogenic releases of metals include industrial sources (e.g., fossil fuel combusting, mining, smelting etc.) and agricultural processes (e.g., fertilizer use) (Friberg et al., 1979). Metals may persist in the environment and may not break down once absorbed into the body, but can be removed via secretion and excretion (Friberg et al., 1979).

Mertz (1981) divides metals into three groups: a) those that are essential; b) metals which have metabolic effects but are nonetheless essential; and c) metals which are ubiquitous in the environment but are unessential for biotic entities, thus considered contaminants (Mertz, 1981). Essential metals are often micronutrients needed for biological functioning, they include cobalt, copper, chromium, iron, manganese, nickel, molybdenum, selenium, tin and zinc (Kieffer, 1991). Non-essential metals include mercury and lead, which in chronic or acute doses can result in harmful effects in human beings. Mercury and lead are largely by-products of industrial pollution (e.g., coal fire power plants). Atmospheric lead concentrations have significantly decreased since the introduction of unleaded gasoline in 1975. Point sources include lead ammunition which is a major source of lead exposure in the Mushkegowuk Territory. Toxic lead ammunition is slow to be phased out due to its low-cost and its perceived effectiveness compared to alternatives including “non-toxic” bismuth and steel shotshell (Fahey & Tsuji, 2006; Tsuji, 1998; Tsuji, Wainman, Martin, & et al., 2008). Lead shotshell was banned for waterfowl hunting in 1991 in the United States (Thomas, 1997) and for migratory birds in Canada in September of 1999 (Environment Canada, 2010), however, there still is no ban on lead shot shell for the hunting of upland game birds. Lead bullets can fragment into pieces when shot into game, contaminating the meat (Frank, 1986; Madsen, Skjodt, Jorgensen, & Grandjean, 1988; Tsuji, Wainman, Martin, & et al., 2008). Tsuji and colleagues (2009) recommend that the adjacent areas around lead shot penetration are discarded as they have the highest traces of lead contamination (Tsuji, Wainman, Jayasinghe, VanSpronsen, & Liberda, 2009). Children are at greater risk of lead exposure due to their increased contact with dust, soil (Lanphear et al., 1996) and hand-in-mouth behaviours (Charney, Sayre, & Coulter, 1980). Exposure can stem from aging, deteriorating and renovated houses, toys and lead based paints (Meyer, Brown, & Falk, 2008).

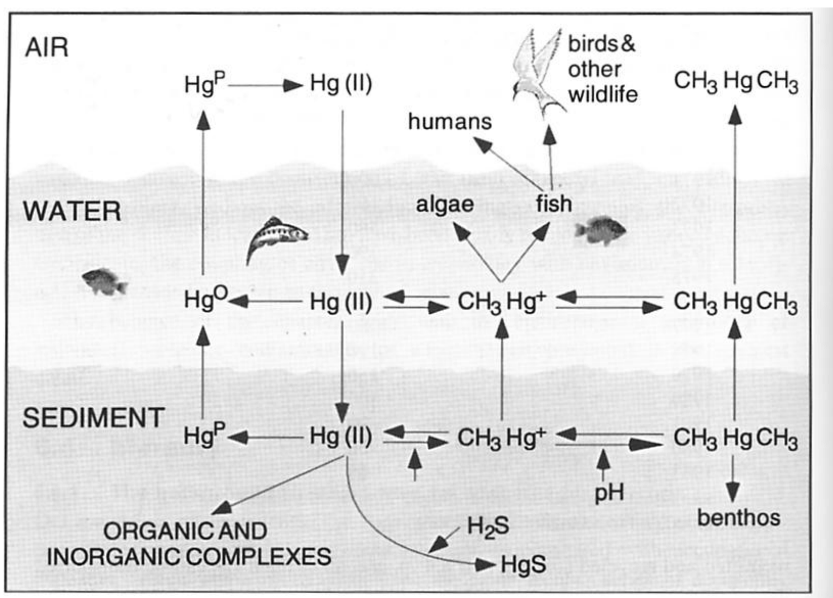


Figure 2.2: Mercury biogeochemical cycle in aquatic and terrestrial environment. Emphasis is placed on aquatic environment. Mercury methylation occurs principally in the sediment and water column, under anaerobic conditions (Used with permission from (Wright & Welbourn, 2002) p.276].

Another non-essential ubiquitous metal is mercury; it is present in the air, water, and soil as a result of natural and anthropogenic emissions. Mercury is predominantly released in northern environments by resource development projects including mining, hydroelectricity, logging, and effluent discharge (Wright & Welbourn, 2002). An infamous case of mercury contamination, exposure and destruction of subsistence fishing is the damming of rivers in the Eastern James Bay region of Quebec in the 1970s. The damming and inundation of vegetation resulted in the output of inorganic mercury, which was methylated to form organic methylmercury which bioaccumulated and biomagnified in the food chain and affected subsistence Cree First Nations (Verdon et al., 1991) (Figure 2.2, 2.3). The nutrition transition and decreased dependence on traditional foods has not reduced mercury exposure in Aboriginal peoples as would be expected.

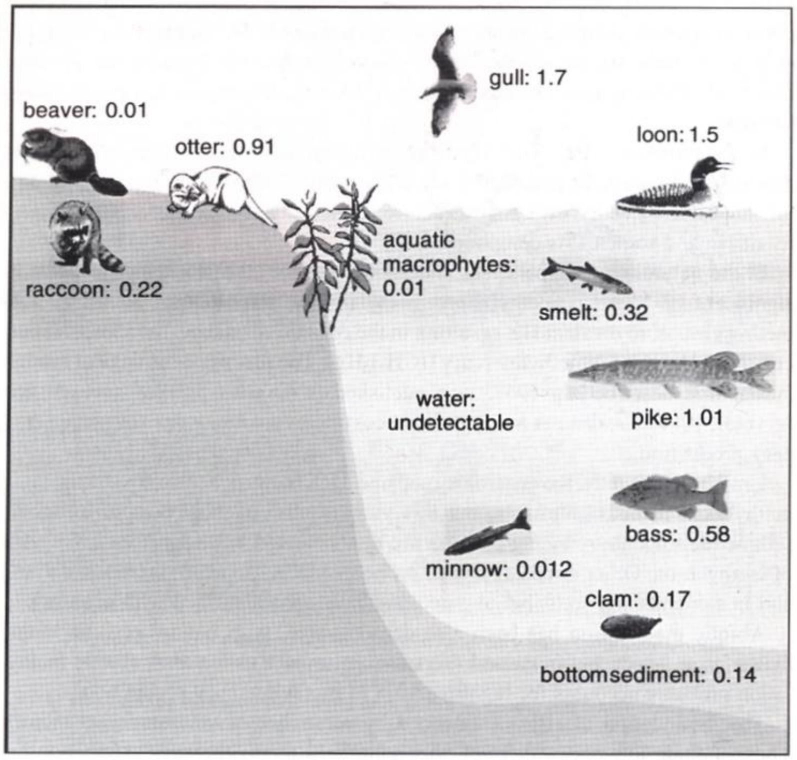


Figure 2.3: Depicts mercury biomagnification principally in the aquatic environment. Mercury concentrations increase with trophic levels, contaminants in species are presented in µg/g wet weight. Sediments contamination is presented in µg/g on a dry weight basis. [Used with permission from (Wright & Welbourn, 2002) p. 278].

Extensive studies by Birgit Braune, a research scientist at the Canadian Wildlife Service have found that mercury concentrations are increasing in Arctic biota due to greater anthropogenic mercury emissions from southern regions (Braune, Outridge, Wilson, Bignert, & Riget, 2002; Brooks et al., 2002). Heavy metals, like lead and mercury, are not the only contaminants of concern in circumpolar regions; industralization has led to the development of numerous synethic persistent organic pollutants.

2.4.2 Persistent Organic Pollutants

Persistent organic pollutants (POPs) are a group of chlorinated, lipophilic and synthetically produced ubiquitous compounds developed following World War II. They were used to manufacture paints, lubricants and electrical transformer fluids. Prior to discontinued use in the 1970s, organochlorines were used for multiple purposes. DDT (dichlorodiphenyltrichloroethane), proved beneficial as an insecticide and thereby as a protector from malaria and typhus. Polychlorinated biphenyls (PBCs), polychlorinated dibenzodioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were used as transformer liquid coolants, and TCDD (2,2,7,8 Tetrachlorodibenzo-p-dioxin) was used as a commercial defoliant (EPA, 2011). Since being phased out in the 1970s in most of North America, POPs have been addressed by the 1979 Convention on Long-range Transboundary Air Pollution. The Convention consists of eight protocols which include measures (e.g., policy and strategy development) that the 51 parties are encouraged to take, in order to cut their atmospheric pollutants and decrease long-range transboundary pollution (UNECE, 2010). There is also the 2001 United Nations Stockholm Convention on Persistent Organic Pollutants, which covers the “dirty dozen” organic pollutants including eight pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, and toxaphene), two industrial chemicals (polychlorinated biphenyls and hexachlorobenzene), and two industrial by-products (dioxins and furans) (Stockholm Convention on POPs, 2008).

The Stockholm Convention requires member states to eliminate or reduce POP emissions, but unfortunately, it is not a legally binding international treaty (Harrad, 2010; Stockholm Convention on POPs, 2008). The ban or phasing out of POPs in the 1970s (B. M. Braune, Donaldson, & Hobson, 2001) in addition to the Stockholm Convention, have resulted in a noticeable decrease in organochlorines in the environment. Research by Braune, Donaldson and Hobson (2001) on seabirds from a period spanning 1975 to 1998, confirm the environmental decline of many legacy POPs. Despite the decrease of dispersed POPs, there still remain numerous stockpiles of POPs globally. For example, most cities are POP hotspots for polychlorinated biphenyls (PCBs), that are constituents of capacitors, switches, electrical transformers, wiring and sealants among other material installed prior to the 1970s. There are likewise significant stockpiles of organochlorines in developing countries, donated by developed countries under certain falsifications (e.g., food production growth, insect control for malaria, typhoid fever and cholera) (Harrad, 2010).

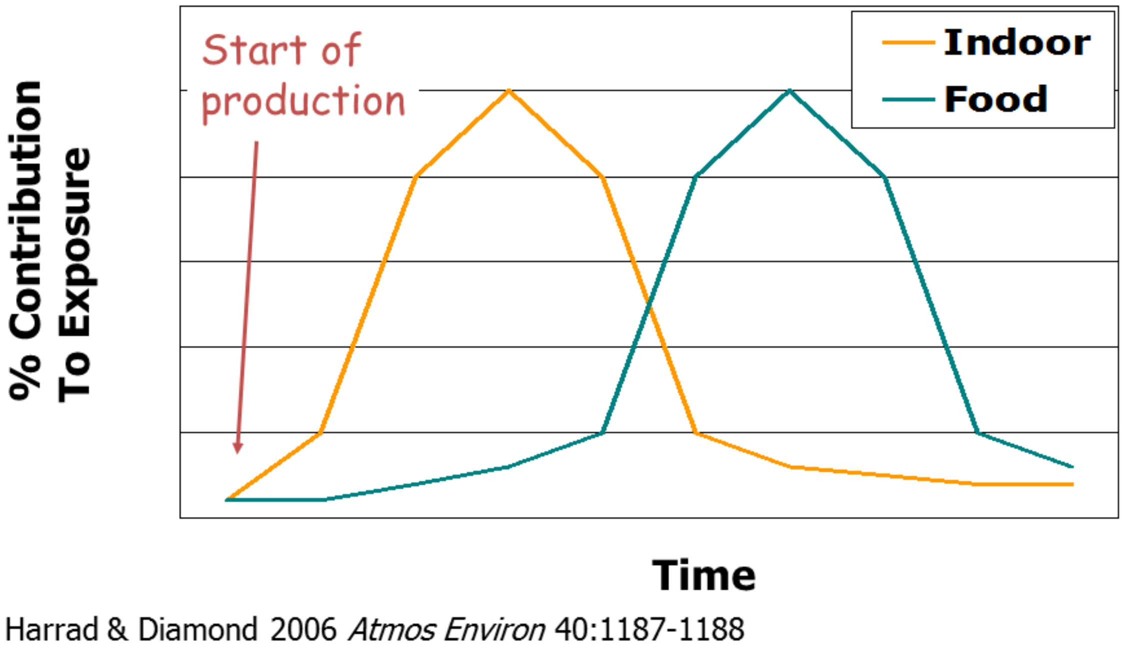


Figure 2.4: Routes of exposure of persistent organic pollutants with hypothetical timeline, showing that lag in time between chemical introduction and bioaccumulation in food sources. [Copyright from Atmospheric Environment, New Direction: Exposure to polybrominated diphenyl ethers (PBDE) and polychlorinated biphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs): Current and future scenarios, by Harrad & Diamond 2006. Used with permission.]

These prevailing stockpiles consequently act as modern forms of point source contamination and have global implications, and often end up entering the food supply through bioaccumulation and biomagnification (Harrad, 2010) (Figure 2.4). Contrary to metals (e.g., mercury), which disperse relatively homogeneously in tissue, POPs bioaccumulate in the fatty or adipose tissue of organisms. A study by Davidson and Jones (1994) found that an average (42 kg) fish-based diet for one year would result in greater PCB body burden (1.5 µg/day) compared to the average meat diet in the UK which is 36 kg of meat and a body burden of 0.37 µg/day (Duarte-Davidson & Jones, 1994). Therefore, fish tend to bioaccumulate larger amounts of PCBs compared to terrestrial livestock. Numerous studies have labelled polybrominated diphenyl ethers (PBDEs) as an emerging POP (Hooper & McDonald, 2000; Liberda et al., 2011). PBDE's presence in fish and seafood is higher than in livestock meats; therefore placing Aboriginal subsistence hunters at risk due to their greater reliance on aquatic marine species (Anderson et al., 2008; Domingo, Marti-Cid, Castell, & Llobet, 2008; Morland et al., 2005). However, a recently published study by Liberda and colleagues (2011) reveals that First Nations from the Hudson Bay Lowlands communities of Oujé-Bougoumou and Fort Albany did not have significant PBDE exposure levels in excess of the Environmental Protection Agency's (EPA) Reference Dose (RfD) despite relying heavily on wild meats and fish (mostly freshwater species) for their sustenance (Liberda et al., 2011). PBDEs are currently not included in the Stockholm Convention, but there have been talks to include nine new chemicals, including tetrabromodiphenyl ether and pentabromodiphenyl ether, which would be added to Annex A, (chemicals which must be eliminated), this includes PBDEs and BDEs (Stockholm Convention on POPs, 2009). The banning of PDBEs is crucial, as there is a steady increase in brominated diphenyl ethers (BDE) in the environment. The EU has banned all three PBDE compounds but no such ban exists in North America (Harrad, 2010).

2.5 Benefits of a Traditional Diet

First Nations believe that health is holistic and consists of physical, emotional, mental and spiritual well-being, which are depicted by the four quadrants of the medicine wheel (Wilson, 2003). Good health is achieved when all four categories are in sync and balanced. Traditional foods are undeniably an integral part of each category; they contribute to physical well-being, emotional and mental health as well as spiritual health due to the hunter's connection with the biophysical environment. In addition, hunting and gathering promote physical activity and traditional foods have an abundance of nutrients not often found in market foods (Redwood et al., 2008). Traditional foods also embrace social cohesion when community members participate in collective activity. This strengthens cultural ties, maintain social norms and expectations, build skills and provide an abundance of harvested foods which is often shared. Economic remunerations are also available for skills associated with hunting, angling or gathering, such individuals can work as guides in the tourism sector.

Despite the benefits of traditional foods, specific economic barriers prevent traditional food consumption, such as, the widespread emergence of a two-tiered wage-based economy in numerous northern Aboriginal communities, hence, limiting the time allocated for hunting and gathering. Climate change is another factor, which is significantly affecting circumpolar areas. Variance in long-term temperatures may result in increased frequencies of accidents from thinning ice, reduced travel safety, shorter hunting trips, greater strain on terrestrial and aquatic species regularly depended upon for food, and the loss or erosion of native species (e.g., shifting animal migration routes) (C. Furgal & Seguin, 2006). Climate change is predicted to result in a reduction of caribou, fish species (e.g., whitefish), ducks, geese, etc. In contrast, moose and beaver among other species are predicted to increase in northern regions of Canada (Wesche & Chan, 2010). Climate change will impact storage of traditional foods while hunting; traditional foods will rapidly decay, smoked or dried fish will no longer be able to be prepared in the same way, resulting in a decreased intake of traditional foods (C. Furgal & Seguin, 2006). Contaminant pathways are also affected by climate change through fluctuations in wind and weather patterns, ice cover, ice thickness, snow drift pattern, permafrost, hydrology, oceancurrents, and precipitation and temperature patterns (Indian and Northern Affairs Canada, 2003). Preliminary studies have found that Arctic Char (*Salvelinus alpinus*) are very susceptible to rising water temperatures which results in greater metabolic activities in the species, water is pumped over the gill surface at a faster rate, and the uptake of metals in surrounding waters also increases, resulting in greater metal bioaccumulation (e.g., methylmercury) (Kock, Triendl, & Hofer, 1996). Other than these noticeable changes, climate change and contaminant pathways are a new field that require more research.

2.6 Behaviour and Perception of Aboriginals toward Environmental Contaminants

"It is likely that Crees have changed the type of fish eaten, from contaminated to less contaminated fish, or have decreased their total fish consumption considerably, or both." (Clarkson, 1998)

There are a multitude of perspectives pertaining to environmental contaminants in traditional foods. Some Aboriginals will disregard contaminants advisories and continue to eat their traditional foods, whereas other will cease consumption and increase reliance on market foods. As a result, there are differences in perception regarding risks and benefits; they stem from pre-existing knowledge, understanding of the problem, involvement in the issue and various other factors. Affected individuals oftentimes do not view the risks of contaminants in the same light as technical experts and scientists (Barke & Jenkins-Smith, 1993; Kasperson, 1986; Savadori et al., 2004). In light of this complex issue, it is important that Aboriginal peoples' perceptions regarding contaminants are taken into consideration so that public health officials and decision makers may effectively reduce risks (C. Furgal et al., 2003).

“The Arctic Dilemma” was first suggested in the mid-1980s when it was discovered that the breast milk of Nunavik mothers, a nutritious energy source for infants, was heavily contaminated with POPs (Dewailly et al., 1989). Following this discovery numerous warnings were issued advising Aboriginal mothers not to breastfeed their children. The logic was and still is that infants are at the top of the food chain and will accumulate the greatest extent of “poisonous” contaminants from their mother’s breast milk. An expert in chemical safety from the World Health Organization (WHO) told Dewailly, after his discovery, that the affected women should immediately cease breastfeeding their babies (Cone, 2005a). Further, Eric Loring, a Senior Environment/Health Researcher at Inuit Tapiriit Kanatami, stated that in the 1980s “when Inuit communities first became aware of potential contaminants in their traditional foods people stopped eating their country foods; people stopped breastfeeding […] People stopped hunting, because they were scared of potentially harming their children” (Chung, 2010). Dewailly discovered that since learning about contamination in traditional foods, one in seven Inuit, reported a decrease in marine mammals or fish, some ceasing consumption all together (Wormworth, 1995).

The advice of game cessation has time and again been issued without consideration for the multitude of health repercussions. For example, breast milk contains essential micronutrients and minerals (e.g., vitamin A, D, E, K, C and B complex) which aid in gastrointestinal nutrient absorption and are imperative for the healthy growth and development of infants. Numerous protective anti-bodies are also present in breast milk which helps protect newborn immune systems from infections (LaKind, Wilkins, & Berlin, 2004). Given the harsh climate of circumpolar areas, it is recommended to a greater extent that infants are breast fed (Nickerson, 2006).

The Arctic Dilemma has undeniably generated much confusion as scientists, policymakers, academics, health officials and government workers have independently advised northern Aboriginals, resulting in a sea of mixed-messages. Miscommunication, alarmism and drastic public health measures have resulted in confusion for many Aboriginal peoples; the public, understandably, often have trouble understanding the technical jargon (O'Neil, Elias, & Yassi, 1997). Academic publications, government websites and grey literature often do not adequately take a balanced approach comparing nutritional (and other) benefits against contaminant exposure (Assembly of First Nations, 2007; CBC, 2007; CBC, 2010; Chung, 2010; Cone, 2004). Peter Bjerregaard, the former health officer for Greenland and member of the Greenland Health Research Council believes that there is no substantial proof that Aboriginal peoples are being harmed as a result of the exceedingly high contaminant levels in circumpolar regions. He states "There are no demonstrated human effects of this contamination […] There are some researchers who claim that there are effects . . . but epidemiologists like me tend to agree that the benefits of the traditional diet far outweigh the possible ill effects of the contaminants" (Tenenbaum, 1998). Further, Eric Dewailly believes that the nutritional benefits in traditional foods outweigh the health risks posed by environmental contaminants (Wormworth, 1995). These perspectives need to be balanced, and based on the best information on hand (Wormworth, 1995).

Since the majority of health information is obtained through the media, radio, pamphlets, posters, health professionals, family and friends, health centers and health foods stores in northern communities, there is a greater chance for miscommunication or false guidance (Graham & Stamler, 2010). Sensationalist headlines add to the confusion, with titles like “Inuit Diet Polluted, Scientist Reports" by the Winnipeg Free Press (Lowery, 1994), and more recently "Pollutants drift north, making Inuits’ traditional diet toxic" by the Boston Sunday Globe (Cone, 2004).

In addition to various outlets providing information on contaminants, once the conflicting information reaches Aboriginal peoples, there is a tendency for the messages to warp and result in “contaminant gossip”; a widespread phenomenon in Canadian Aboriginal communities (Usher et al., 1995). The first detrimental case of contaminant gossip was with the Inuit of Broughton Island in the Davis Strait. In 1988, they discovered that much of the community was exposed to PCB levels in excess of the TDI by the Department of National Health and Welfare. The Inuit community learned about contaminants in their traditional foods from the local newspaper; before scientists conducting the study had a chance to disseminate their results with the community. Confusion arose when health officials deemed the food safe and urged the public to continue eating their traditional foods. During this time, worried and anxious adjacent communities labelled the people of Broughton Island Inuit “PCB people” and avoided them for fear of becoming contaminated (Wormworth, 1995).

Kuntz and colleagues (2009) have also reported that fish advisory information focusing on methylmercury was disseminated predominantly through word of mouth (Kuntz, Hill, Linkenbach, Lande, & Larsson, 2009) instead of formal pathways among Aboriginal women in northwest Montana. Despite the contradictory and confusing information, numerous northern

Aboriginal individuals claim that they would still continue to eat traditional foods, regardless of warnings from health officials because of the cultural significance, connection to livelihood and health benefits (O'Neil et al., 1997).

Additional impediments to traditional food consumption stem from language barriers between English and Aboriginal languages regarding risk advisories or warnings about contaminants in game. Aboriginal languages often lack synonymous words for scientific concepts, such as environmental contaminants or chemical toxin (Cone, 2005a). This is one of the fundamental sources of confusion; words which cannot be directly translated (Cass et al., 2002). The closest Inuit Inuktitut word for describing contaminated animals or meat is “sukkutarsisungutsutillu” which means that game has something that makes it bad. This sub-standard translation heightens confusion on what is safe to eat (O'Neil et al., 1997). During the mid-1970s, the La Grande Complex hydroelectricity project in Eastern Quebec created large quantities of methylmercury from reservoir creation, which subsequently bioaccumulated and biomagnified in the aquatic food chain. The surrounding Cree population lacked a word to describe this phenomenon, so they developed the term “nemasahkosiwin”, meaning the “fish is sick.” This phenomenon was allocated this designation because the Cree considered mercury contamination to be transient like an infectious disease and deduced that the problem would eventually disappear. Following the release of 10 metric tonnes of mercury (between 1962-1970) from an upstream paper mill into the English-Wabigoon River, the Grassy Narrow Ojibway of Western Ontario used the term “pijibowin” meaning “poison” to describe the methylmercury contaminated fish (Erikson, 1994; Hydro-Quebec, 2006; Kinghorn, Solomon, & Chan, 2007; Penn, 2006). Since northern Aboriginal peoples have had little exposure to contaminants, historically, there was never any necessity to create words to designate contaminant until post-industrialization and discovery of contaminants by scientists in northern regions.

Environmental contaminants are a huge predicament for Canadian Aboriginal peoples. They can eat wild game meats and risk exposure (if game meats are contaminated), or avoid wild meats and fish and be impacted in other ways (e.g., nutritional health, social and cultural consequences). This along, with the Arctic Dilemma, is known as “chemical assimilation” which is connected to environmental justice theory, signifying that national and international policies are too lax, consequently permitting natural resources, or game, to become very contaminated making it no longer safe to eat, reflecting a colonialist assimilative government past (Harper & Harris, 2008a; Langston, 2010).

Effective risk management strategies in northern Aboriginal communities are necessary to clear any miscommunication regarding contamination of traditional food sources. Effective strategies should aim to reduce anxiety, confusion, misunderstanding, mistrust, and should foster a productive environment for effective risk reduction strategies (Arnold et al., 2003).

3.0 Chapter 3: Traditional Food Consumption Behaviour and Concern with Environmental Contaminants among Cree Schoolchildren of the Mushkegowuk Territory

3.1 Overview

Objectives. To investigate factors influencing consumption of traditional foods (e.g., wild game, fish) and concerns about environmental contaminants among schoolchildren of the Mushkegowuk Territory First Nations (Moose Factory, Fort Albany, Kashechewan, Attawapiskat, and Peawanuck).

Study Design. Cross-sectional data collection from a Web-based Eating Behaviour Questionnaire (WEB-Q).

Methods. Schoolchildren in grades 6-12 (n = 262) responded to four of the WEB-Q questions: (1) Do you eat game? (2) How often do you eat game? (3) How concerned are you about the environmental contaminants in the wild game and fish that you eat? (4) I would eat more game if...[six response options]. Data were collected from 2004-2009. Hierarchical log-linear modelling (LLM) was used for analyses of multi-way frequency data.

Results. Of the school children answering the specific questions: 174 consumed game; 95 reported concerns about contaminants in game; and 84 would increase their game consumption if it were more available in their homes. LLM revealed significant differences between communities; schoolchildren in Moose Factory consumed game “rarely or never” at greater than expected frequency, and fewer than expected consumed game “at least once a day.” Schoolchildren in Kashechewan had greater frequency of daily game consumption and few were concerned about contaminants in game. Using LLM, we found that sex was an insignificant variable and did not affect game consumption frequency or environmental contaminant concern.

Conclusion. The decreasing importance of the traditional diet was most evident in Moose Factory, possibly due to its more southerly location relative to the other First Nations examined.

Keywords: First Nations, adolescents, environmental contaminants, food insecurity, hierarchical log-linear modelling

3.2 Introduction

In recent years, it has become apparent that Aboriginal Peoples (First Nations, Inuit, and Métis) have significant health disparities in contrast to the non-Aboriginal Canadian population (Adelson, 2005; Frolich et al., 2006; Health Canada, 2005). Among First Nations, this is especially true of remote, northern communities (Downs et al., 2009; Wilson & Rosenberg, 2002). Poor nutritional status and food insecurity are prevalent due to the westernization of dietary habits, and socio-economic, environmental and behavioural factors (Powers, 2005). For example, several studies indicate relatively high consumption of nutrient-poor market foods, which often are loaded with saturated fats and refined sugars (H. V. Kuhnlein & Receveur, 1996; Receveur, Boulay, & Kuhnlein, 1997). Poor dietary habits are especially common among First Nations adolescents (Downs et al., 2009; H. V. Kuhnlein & Receveur, 2007) and, in addition to genetics, (Hegele et al., 2003; Pollex et al., 2006), contribute to their high prevalence of overweight, T2DM, anemia (Chateau-Degat, Pereg, Egeland, & et al., 2009; Whalen et al., 1997) and risk of adult chronic disease (17).

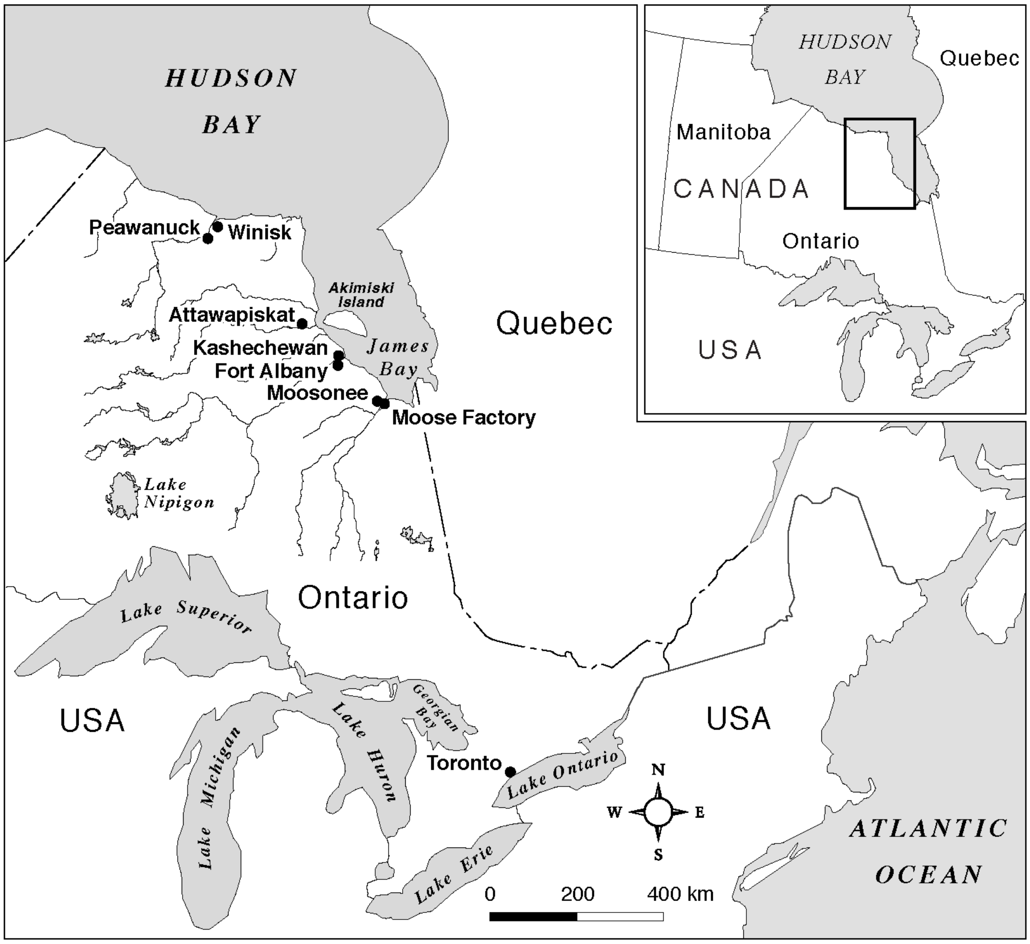


Figure 3.1: Map of participating communities.

The westernization of dietary habits in First Nations communities is of concern, as traditional foods have higher nutrient densities than market foods (Wein, 1996). Traditional food acquisition also promotes physical activity, and minimizes food costs and cultural erosion (H. V. Kuhnlein & Chan, 2000). First Nations adolescents, in particular, have increased susceptibility to chronic lifestyle diseases; unhealthy dietary behaviours may be the most frequently occurring risk behaviour in adolescents aged 12-17 years (Lowry, Kann, Collins, & Kolbe, 1996) and often persist into adulthood (Serdula et al., 1993). Traditional lifestyles are further compromised in northern First Nations communities by concerns about ubiquitously dispersed environmental contaminants in the food chain (e.g., organochlorines, toxic metals) from the bioaccumulation of point-source (e.g., abandoned radar lines, mining projects) and non-point sources (H. V. Kuhnlein & Chan, 2000; Tsuji & Martin, 2009). The latter are transported to northern regions via atmospheric, terrestrial, oceanic and freshwater routes (H. V. Kuhnlein & Chan, 2000). Perceptions and opinions about potential environmental contaminants in game (e.g., wild game, fish) may contribute to decreased traditional food consumption (Furgal, Powell, & Myers, 2005; H. V. Kuhnlein & Chan, 2000). Consequently, the availability of low-nutrient market foods combined with potential concerns regarding game contamination may serve as barriers to traditional food consumption among First Nations adolescents. Such barriers may produce household food insecurity which can be defined as the lack of domestic access to nutritionally wholesome foods, which are safe (e.g., free of contaminants), culturally acceptable (e.g., wild game and fish) and accessible to individuals at all times (Agriculture and Agri-Food Canada, 1998). The literature on First Nations adolescents' dietary patterns and traditional food consumption behaviour is limited (Assembly of First Nations, 2007; Kuperberg & Evers, 2006; Young, 2003b). The present study addresses this gap in knowledge, by examining patterns of game consumption and contaminant perception among First Nations adolescents using a selection of food frequency and perceptions questions from a Web-based Eating Behaviour Questionnaire (WEB-Q). The WEB-Q was administered in five Cree schools in the Mushkegowuk Territory which encompasses south-western Hudson Bay and the western James Bay region of northern Ontario, Canada (Figure 3.1).

3.3 Material and Methods

3.3.1 Study population

The coastal First Nations Cree of the Mushkegowuk Territory number approximately 10,000 people living in five communities. A cross-sectional study was conducted among Cree schoolchildren living in these five remote, sub-arctic communities of the Mushkegowuk Territory: Moose Factory (sample n=82; community population =~3,000), Fort Albany (n=63; population = ~850), Kashechewan (n=44, population = ~1,400), Attawapiskat (n=62, population = ~1,600) and Peawanuck (n=11; population = ~250) (Figure 1). In total, 131 (50%) boys and 131 (50%) girls participated. The mean age of the 262 participants was 13.4 years (SD= 1.7) with a range of 10-17 years. One-hundred-and-eighty-eight (72%) of the adolescents in this study were in grades 6-8 of elementary school; while, the remaining 74 (28%) were in grades 9-12 of secondary school.

3.3.2 Dietary Study Method

First Nations adolescents participated in the WEB-Q, which was developed and validated at the University of Waterloo (R. M. Hanning et al., 2009). This study was approved by the Office of Research Ethics at the University of Waterloo and at each participating school; passive parental consent was assumed if there was no response to letters sent to each home. Student assent was obtained at the start of the online survey. The WEB-Q was employed as an inexpensive and effective way of collecting nutritional behaviour data from adolescents in remote communities (Probst & Tapsell, 2005). First Nations community advisory groups examined the WEB-Q for cultural appropriateness and appropriate modifications were made to the WEB-Q. Modifications included the creation of four additional questions related to game consumption and concern toward potential environmental contamination of wild game and fish. Sampling was based on a convenience sample of children present at school on the day of data collection. A trained research assistant was present during data collection.

3.3.3 Data Collection

Data were collected in the winter and spring of 2004, 2005 2006, 2007 and 2009. In total, the WEB-Q consisted of 43 questions, of which the following four were examined: (1) Do you eat game? (possible answers: “no” or “yes”) (2) How often do you eat game? (Initially this question had six categories: “rarely or never”, “2-4 times a month”, “2-4 times a week”, “5-6 times a week”, “once a day” and “at least twice a day”. These response options were collapsed into three categories for ease of computation to form: “rarely or never”, “at least once a week” and “at least once a day.”) (3) How concerned are you about the environmental contaminants in the game, fish or other meats that you eat? (Initially this question had three categories: “not concerned,” “somewhat concerned” and “very concerned.” The response options of “somewhat concerned” and “very concerned” were collapsed to form “concerned.”) (4) I would eat more game if... (with six possible response options: a) My friends ate more game, b) My parents ate more game, c) My family knew how to properly prepare it, d) It was more available in my home, e) It was more available at school and f) None of the above. Students could choose as many responses as applied).

3.3.4 Statistical Analyses

Questionnaire data were compiled in Excel spreadsheets (Microsoft Corp. Bellevue WA) and analyses of frequency data were carried out using hierarchical log-linear contingency modeling (PASW, formerly SPSS, Version 18; SPSS, Chicago IL); hereafter referred to as LLM. The latter allowed for valid multi-way frequency data comparisons of specific combinations of variables. Analysis commences with a "fully saturated" model which tests all possible main and interaction effects and provides a perfect fit to the data. Thus, the Chi-square value and the coinciding *p* value are both zero. The deletion of any interaction or variable from the model will create an unsaturated or reduced model and a positive Chi-square value, but these more parsimonious models may still provide an adequate fit to the data. The hierarchical nature of this model necessitates that the highest order term is tested first by deletion of the 3-way interaction, followed by each of the various 2-way interactions. Interactions are selectively eliminated to test the influence of each variable of interest, and significance of influence is judged by resultant "badness of fit" as quantified by increased value of the Chi-square and decrease in associated p-value. Examination of the adjusted standardized residual (ASR) in each cell of the table shows the departure from expected value for each cell. Any ASR with an absolute value greater than 1.96 is considered significant because it confirms a dependent relationship between the excluded variables (see Tsuji et al. (Tsuji et al., 2005) for a detailed discussion). LLM could not be conducted on question 4 owing to its multiple-response format.

3.4 Results

Frequency data are reported individually or entirely by community, sex and question. The elimination of the 3-way interaction (COMMUNITY x SEX x RESPONSE) LLM had inconsequential effects on model fit; therefore, testing continued to examine the 2-way interactions testing the effects of subject SEX (boy, girl) or geographic COMMUNITY (Moose Factory, Fort Albany, Kashechewan, Attawapiskat, Peawanuck) on CONSUMPTION, FREQUENCY and CONCERN. Since some of the 262 participants chose not to respond to specific questions, the number of respondents per question varies as indicated.

3.4.1 Question 1: Do you eat game?

Of 194 respondents, 174 (90%) answered "yes" indicating that most schoolchildren consumed game (Figure 3.2). In total, 93 (53%) boys reported consuming game compared to 81(47%) of the girls. The fitted LLM for game consumption was not significant for the test of the 2-way interaction of SEX with CONSUMPTION (Chi-square = 10.086, $p = 0.756$), or for COMMUNITY with CONSUMPTION (Chi-square = 10.086, $p = 0.756$).

3.4.2 Question 2: How often do you eat game?

Two-way LLM testing the interaction of SEX with FREQUENCY was not significant (Chi-square = 17.864, $p = 0.270$), showing that boys and girls consumed game at similar frequency. However, the interaction of COMMUNITY with FREQUENCY was significant (Chi-square = 51.078, $p < 0.05$) and revealed that significantly more schoolchildren in Moose Factory than expected "rarely or never" (ASR = 2.428***)*** consume game and that significantly fewer than expected consume game frequently ("at least once a day") (ASR = -2.420). In Kashechewan, significantly more subjects than expected reported game consumption “at least once a day” (ASR = 2.427) and in Peawanuck, more children than expected consume game “at least once a week” (ASR = 3.242) (Table 3.1; Figure 3.3).

3.4.3 Question 3: How concerned are you about the environmental contaminants in the game, fish or other meats that you eat?

Overall, 95 of 173 (55%) respondents to this question were concerned about potential environmental contaminants in game (Figure 3.4). The LLM 2-way interaction testing SEX on CONCERN was not significant (Chi-square = 5.642, $p = 0.844$). However, the 2-way interaction testing COMMUNITY on CONCERN proved significant (Chi-square = 18.012, $p = 0.021$) as fewer children than expected in Kashechewan were “not concerned” (ASR = - 2.031) about potential contaminants in game (Table 3.2). Figure 3.4 suggests that there was no significant community influence.

3.4.4 Question 4: I would eat more game if....

Two-hundred-and-forty-six students answered this question and the number of responses totalled 1476. Thirty-four percent (n=84) of the schoolchildren who answered this question would increase their game consumption if it were more available in their homes; while, 33% (n=82) would increase game consumption if their parents ate it more often. Many students would also choose to consume more game if their family knew to properly prepare it (23%; n=56). Few schoolchildren would eat more game if their friends ate it more often (16%; n= 39). LLM could not be conducted on this question owing to its multiple-response format.

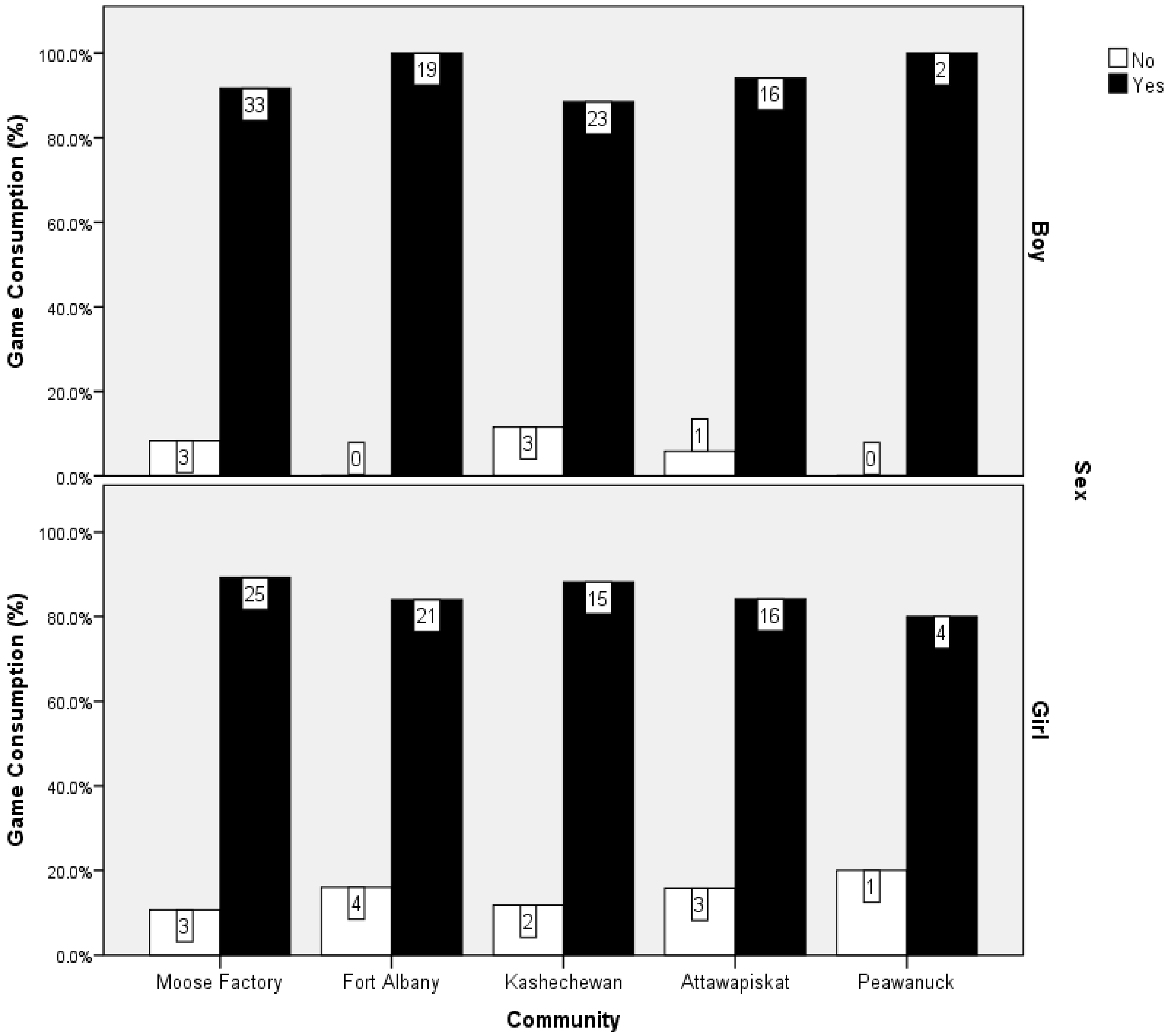


Figure 3.2: Percentage of schoolchildren who responded "yes" and "no" to eating game for each community and for each sex. The number inside the bar indicates the sample number "n". Of 194 students, 174 (90%) answered "yes" to game consumption. No significant differences ($p < 0.05$) were found for gender or community using log-linear contingency modelling

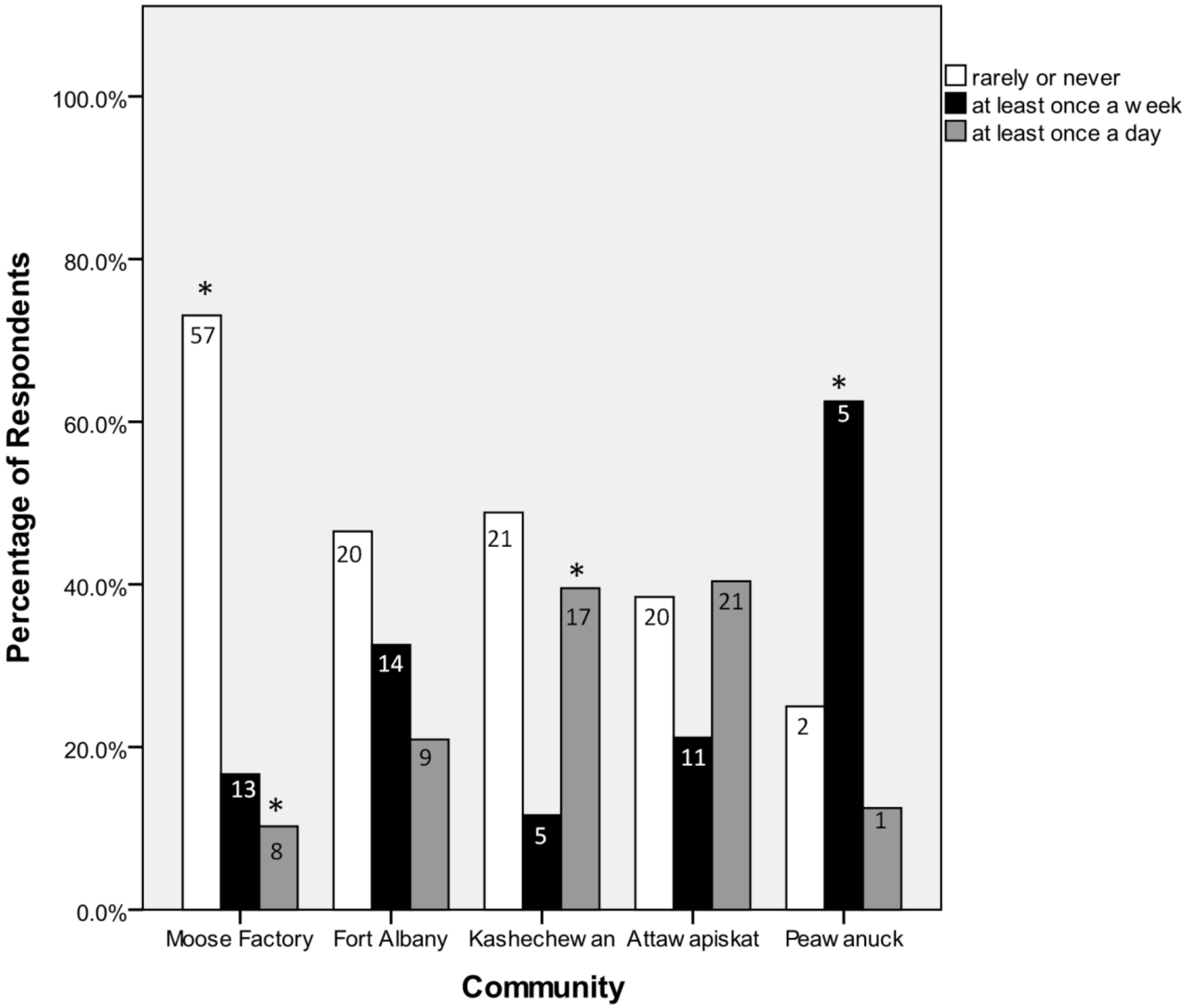


Figure 3.3: Frequency of game consumption among schoolchildren by community. The number inside the bar indicates the sample number "n" of a total of 224 and an asterisk indicates a significant ($p < 0.05$) adjusted standardized residual, or an absolute value greater than 1.96, between consumption categories.

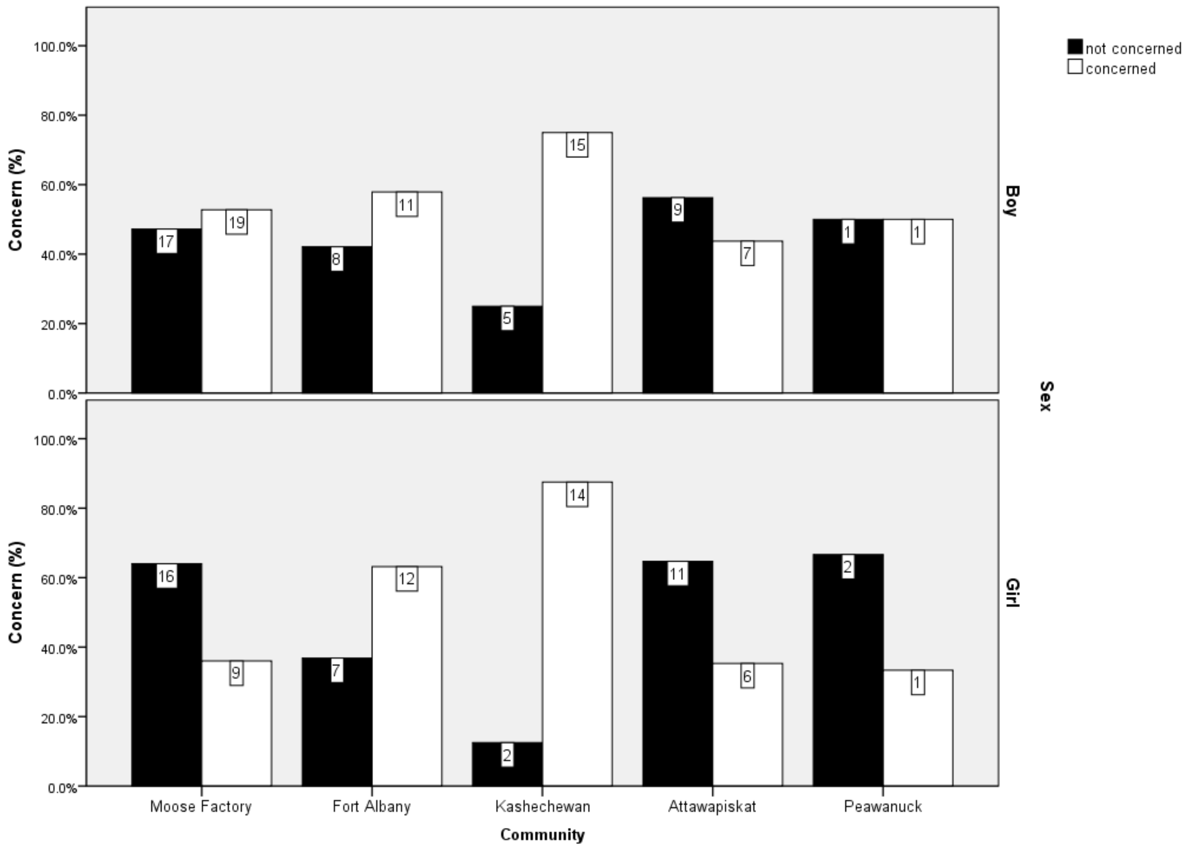


Figure 3.4: Percentage of schoolchildren "concerned" and "not concerned" with potential environmental contaminants in game. The number inside the bar indicates the sample number "n". One hundred and seventy-three schoolchildren responded to this question, a total of 95 reported being concern. No significant differences ($p < 0.05$) were found for gender or community using log-linear contingency modelling.

3.5 Discussion

3.5.1 Game and Fish Consumption and Frequency of Consumption

The majority of Mushkegowuk Territory schoolchildren responded "yes" to game consumption, similar to results reported by Tsuji and colleagues (Tsuji et al., 2001). Although it has been reported that geographical differences and distinctive community characteristics, such as, transport access, animal migration routes, population size, demographics, and variation in dual economies can generate varying access to traditional food (Goldhar, Ford, & Berrang-Ford, 2010; Receveur et al., 1997; Wein & Freeman, 1995), in the present study, we did not find significant differences between communities in the percent and number of children who said they ate game (Figure 2).

By contrast, frequency of game consumption did differ significantly across communities. As Moose Factory is the most southerly of the coastal First Nations of the Mushkegowuk Territory, it was not surprising that Moose Factory schoolchildren were found to have reported consuming game and fish less frequently than the other communities. A more southern location has often been associated with a less traditional lifestyle (Ohmagari & Berkes, 1997; Tsuji & Nieboer, 1999). Decreasing frequency of game consumption in communities like Moose Factory may prove problematic for schoolchildren, as decreasing frequency of consumption may produce or exacerbate the risk of chronic illnesses, such as, anemia, a prevalent condition among adolescents of First Nations ancestry (Whalen et al., 1997). Low game consumption has also been reported to be linked to obesity; Cree children who consume an adequate portion of traditional foods "at least once a week" have been found to have a lower body mass index compared to those who do not (Khalil et al., 2010). Low game intake among adolescents combined with economic factors may also instigate adverse social and developmental outcomes, if not supplemented with healthy market foods (e.g., dairy products, fruits, vegetables), such as, anxiety, short attention span, increased school absences and unpunctuality (Jyoti et al., 2005; Kleinman, Murphy, Little, & et al., 1998).

The results of the present study for frequency of game consumption in Kashechewan – where schoolchildren reported frequency of game consumption “at least once a day” significantly different (higher) than the other communities – supports a 1994 harvest study (Berkes et al., 1994) in the Mushkegowuk Territory which reported that Kashechewan had the highest game and fish consumption frequency in the region. In addition, schoolchildren in Kashechewan may have a greater daily game consumption frequency comparative to other Mushkegowuk Territory First Nations due to a greater game sharing network and the superior preservation of their traditional lifestyle (Berkes et al., 1994; Berkes et al., 1995; Tsuji et al., 2006). Figure 3, however, depicts Attawapiskat to have a higher daily game consumption, in comparison to Kashechewan, but it is not statistically greater than expected.

Community location and northern latitude is often analogous with increased daily game consumption frequency (Receveur et al., 1997). Of the schoolchildren in Peawanuck who consumed wild game and/or fish - consumption frequency of “at least once a week” was found to be significant different (higher) compared to the other First Nations – supporting this argument. However, Kashechewan is located at lower latitude, but has a higher frequency of game consumption than Peawanuck, suggesting that other factors, such as socio-economic issues may also be of importance.

Table 3.1: Adjusted standardized residuals (ASR) from log-linear model testing effect of COMMUNITY on FREQUENCY of consumption of game among First Nations schoolchildren. Significant ASRs are italicised and in bold.

Community	Sex	Frequency of consumption	ASR
Moose Factory	Boy	rarely or never	1.006
		at least once a week	.041
		at least once a day	-1.435
	Girl	rarely or never	***2.428***
		at least once a week	-1.341
		at least once a day	***-2.420***
Fort Albany	Boy	rarely or never	-.779
		at least once a week	1.476
		at least once a day	-.188
	Girl	rarely or never	-.154
		at least once a week	.775
		at least once a day	-.537
Kashechewan	Boy	rarely or never	.232
		at least once a week	-.910
		at least once a day	.461
	Girl	rarely or never	-.899
		at least once a week	-1.034
		at least once a day	***2.427***
Attawapiskat	Boy	rarely or never	-.918
		at least once a week	-.601
		at least once a day	1.795
	Girl	rarely or never	-1.194
		at least once a week	.360
		at least once a day	1.490
Peawanuck	Boy	rarely or never	-.073
		at least once a week	.215
		at least once a day	-.084
	Girl	rarely or never	-1.477
		at least once a week	***3.242***
		at least once a day	-.953
Pearson Chi-square		51.078	
	DF	16	
	***p*=**	**< 0.05**	

Table 3.2: Adjusted standardized residuals (ASR) from log-linear model testing effect of COMMUNITY on CONCERN about potential environmental contaminants in game among First Nations schoolchildren. Significant ASRs are italicised and in bold.

Community	Sex	Concern	ASR
Moose Factory	Boy	not concerned	.385
		concerned	-.335
	Girl	not concerned	1.197
		concerned	-1.139
Fort Albany	Boy	not concerned	-.060
		concerned	.052
	Girl	not concerned	-.674
		concerned	.641
Kashechewan	Boy	not concerned	-1.228
		concerned	1.067
	Girl	not concerned	***-2.031***
		concerned	1.932
Attawapiskat	Boy	not concerned	.807
		concerned	-.701
	Girl	not concerned	1.029
		concerned	-.979
Peawanuck	Boy	not concerned	.151
		concerned	-.131
	Girl	not concerned	.482
		concerned	-.458
Pearson Chi-square		18.012	
	DF	8	
	***p*=**	**0.021**	

3.5.2 Contaminant Concern

Concern of potential environmental contaminants in game and fish is a predicament facing northern Aboriginal communities, as game food consumption is beneficial from nutritional and cultural aspects, but these benefits are not realized if Aboriginal people lose trust in their traditional foods (Indian and Northern Affairs Canada, 2003). It is interesting to note that in Kashechewan – we found a daily game consumption frequency significantly different (higher) than the other communities – plus, a significantly higher frequency of schoolchildren who were "not concerned" about potential contaminants in game. These findings suggest that when children are not concerned about contaminants in game and fish, their game and fish consumption increases.

Adding further, it appears as if the increased availability (and affordability) of low-nutrient market foods available in the more southerly Mushkegowuk Territory First Nations combined with concerns over potential environmental contamination has resulted in some barriers to game and fish consumption among First Nations schoolchildren. In some instances, contaminant concern may stem from disadvantageous risk management and communication strategies in northern First Nations communities regarding environmental contaminants and their bioaccumulation in traditional foods (C. M. Furgal et al., 2005; Tyrrell, 2006). Moreover, new research is consistently modifying contaminant intervention strategies, hence heightening confusion (Tyrrell, 2006). A study by Chan and colleagues (Chan, Trifonopoulos, Ing, Receveur, & Johnson, 1999) found that Kahnawake fishermen were decreasing their fish intake due to the misperception that the fish may contain unsafe levels of contaminants. Their perception was proven erroneous by laboratory tests which revealed minimal contaminant risks. Although

Kahnawake is a southern First Nations community located on the south shore of the Saint Lawrence River by Montreal, Quebec, Canada, it is nevertheless a relevant case study as it presents the common concern of First Nations toward possible environmental contaminants in game. Therefore, effective contaminant reduction measures should be communicated to First Nations to decrease anxiety and increase game consumption (Chan et al., 1999; C. M. Furgal et al., 2005). Contaminant reduction measures may include game preparation techniques, such as, trimming fat and/or boiling meat (H. V. Kuhnlein & Chan, 2000) for organohalogens - avoiding eating the liver and kidney of large game (Berti, Receveur, Chan, & Kuhnlein, 1998; Van Oostdam, Donaldson, Feeley, & et al., 2005) with respect to toxic metals - and smoking game which has proven to reduce PCB contaminants in fish by 40-50% (Zabik, Booren, Zabik, Welch, & Humphrey, 1996). Enhanced food-sharing networks for game preservation and storage facilities (e.g., community freezers) may also prove useful in increasing consumption (H. Kuhnlein, Erasmus, & Creed-Kanashiro, 2006). It is furthermore essential to educate First Nations adolescents and adults about the nutritional benefits of healthy market foods (H. V. Kuhnlein & Receveur, 1996) to evade apprehension concerning game consumption due either to personal choice or concern of contaminants in game.

3.5.3 Increasing Consumption

The adolescents in this study reported they would increase game intake if it were eaten more regularly by their parents or it was more available at home. This multiple response question highlights the importance of traditional food availability. Barriers to household availability of wild game and fish may predominantly comprise of financial constraints (Lambden et al., 2006) and lone-parent households (Hamelin, Beaudry, & Habicht, 2002; McIntyre et al., 2003). Intervention strategies to increase traditional food consumption include greater game sharing initiatives, for instance food co-operatives within communities (Condon, Collings, & Wenzel, 1995), the encouragement of local food consumption (Macaulay, Paradis, Potvin, & et al., 1997), a school curriculum component focused on healthy eating (Saksvig et al., 2005), environmental education about the risks and benefits of game consumption for parents and schoolchildren and food preparation workshops in community centres and schools (Macaulay et al., 1997).

3.5.4 Limitations

Seasonality (winter and spring; 2004-2009), though not specified in the questions, may have influenced schoolchildren's responses with respect to game consumption frequency, and harvests vary year-to-year.

3.6 Conclusion

The frequency of game/fish consumption was found to differ among communities examined in the present study - and this finding may be attributable, in part, to concern with respect to contamination of game/fish and the westernization of dietary habits. Other factors affecting the availability of game/fish include economic variables and climate change. Overall, the results highlight the requirement for enhanced dissemination of risk management and communication strategies regarding potential environmental contaminants in traditional foods - and the nutritional benefits of game/fish - that is, a balanced approach should be employed.

4.0 Chapter 4: Conclusions and Future Directions

4.1 Opportunities for Further Research

The Arctic Dilemma (when health-promoting traditional foods are also vectors of health threatening environmental contaminants) needs to be addressed thoroughly. There is no research on whether the nutrients in game outweigh the potential health risks posed by environmental contaminants. It is often said that the nutritional benefits of game are superior, without adequately examining contaminants in game and exposure in adults and children in order to make an informed decision. Therefore, the next logical step would be to compare the nutritional benefits obtained from game consumption and compare them to environmental contaminants in game. This could be done through obtaining donated tissue samples (wild meat and fish) from the Mushkegowuk Territory and sending samples for laboratory analyses, to measure levels of critical contaminants including total mercury (metallic mercury, methylmercury), cadmium, total arsenic (specifically arsenobetaine, which is the predominant non-toxic type found in fish species) (Amlund, Francesconi, Bethune, Lundebye, & Berntssen, 2006; Kaise, Watanabe, & Itoh, 1985; Vahter, Marafante, & Dencker, 1983), lead, antimony and organochlorines including Arcolor 1260, and the sum of the 14 PCB congeners. Exposure from contaminants could be calculated using body mass (µg/kg) and contaminant concentration levels in game meats and could be compared to the tolerable daily intake (TDI) in µg/kg set forth by Health Canada or the Environmental Protection Agency's (EPA) Reference doses (Rfd). This way, a balanced approach is taken to the traditional food consumption question.

The results and discussion from Chapters 3 highlight the necessity for further research on contaminants. This includes whether the fish caught in the James Bay tributaries are part of a complex or simple food chain. This is an imperative question which would allow us to further understand contaminants in the food chain and in particular species. Research by Rasmussen and colleagues (1990) found low PCB levels in trout that were collected from lakes with simple food chains compared to food chains which were far more complex (Rasmussen, Rowan, Lean, & Carey, 1990). A similar study conducted by Cabana et al. (1994), found that similar, simpler, food chains had lower levels of mercury in fish, compared to more complex ones (Cabana, Tremblay, Kalff, & Rasmussen, 1994). Therefore, it may be worthwhile to study lakes and rivers commonly used for fishing in the Mushkegowuk territory to understand food chain dynamics and contaminant pathways.

Food security in northern, remote communities is likewise a pertinent issue which needs to be addressed. An area of research which is lacking but is central to preserving community food security is examining the local food provider in the study communities. Food providers and associated store managers must be examined along with policies regarding healthy foods. Skinner (2006) found through research conducted in Fort Albany, Ontario, that community members felt disempowered with the local food provider and their limited access to healthy foods. Inquiries and demands for healthy foods, in addition to complaints to the manager have often gone unheard or unheeded. Shortages in northern reserve communities are a frequent occurrence. Fresh produce received at local stores often sell out within hours or days of arrival. Therefore, many individuals cannot purchase fresh produce until the next shipment (Skinner, Hanning, & Tsuji, 2006). There seems to be an emphasis on the business aspect of northern food stores, instead of community and individual well-being.

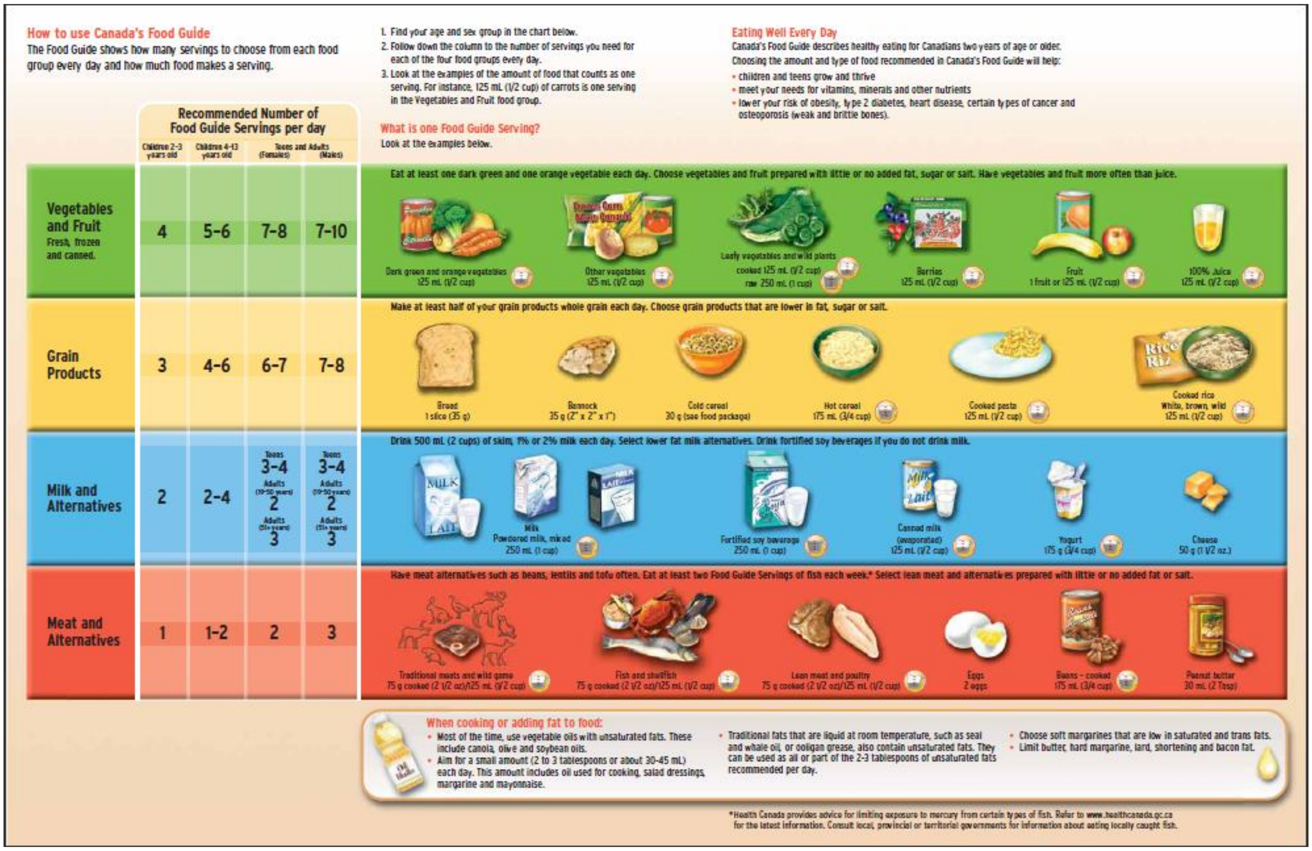
Lee and colleagues (1996) conducted a comparative study in the Northern Territory of Australia examining the management of two stores with a predominantly Aborigine clientele. The nutritional benefits in the communities were high when the stores were run by a manager who was genuinely interested in indigenous health and was previously involved in nutrition-intervention projects. The manager ensured the constant availability of healthy produce and refused perishable products of poor quality, in addition to damaged goods. In cases of disempowerment Aboriginal peoples can utilize purchasing power to demonstrate the type of food they are most interested in purchasing. One suggestion by Lee et al. (1996) to promote healthful market foods which may also prove useful for the Mushkegowuk Territory is to devise and implement a store food and nutritional policy. This may ensure that there is open participation about the types of food which are ordered and available at the local stores, thereby necessitating dialogue and collaboration between health professionals, Aboriginal customers and store managers (Lee, Bonson, & Powers, 1996).

4.2 Conclusion

This study examined traditional food consumption behaviour and concern with environmental contaminants among Cree schoolchildren of the Mushkegowuk Territory. The use of four questions pertaining to wild meat and fish consumption resulted in significant outcomes. Most children reported consuming game most of the time ("Do you eat game"?), signifying that traditional food are still an important part of these coastal First Nation schoolchildren's identity and diet. Game consumption, frequency of consumption and concern were inconsequential when tested against sex, signifying that both boys and girls eat similar amounts of wild meats and fish. Significant findings from Chapter 3 include the variation in game consumption frequency across the communities. Schoolchildren in Moose Factory, the most southern and westernized community consume a lower frequency of wild meat and fish, whereas schoolchildren in Kashechewan, a community which has withstood acculturation to a greater degree has a significant game consumption frequency. However, Peawanuck was found to consume game at a higher frequency "at least once a week" but Kashechewan had a higher daily game consumption frequency; this may be a result of socio-economic factors. Despite this, the majority of the results point to latitudinal differences in traditional food consumption; latitudinal variation has been documented in past studies in northern Aboriginal communities. Further, the results suggest that concern about environmental contaminants is inconsequential based on sex, but that schoolchildren in Kashechewan who consume the highest frequency of wild meats and fish have the least amount of concern. Therefore, exposure research is required and critical as it will allow researchers to demystify the Arctic Dilemma in the Mushkegowuk Territory.

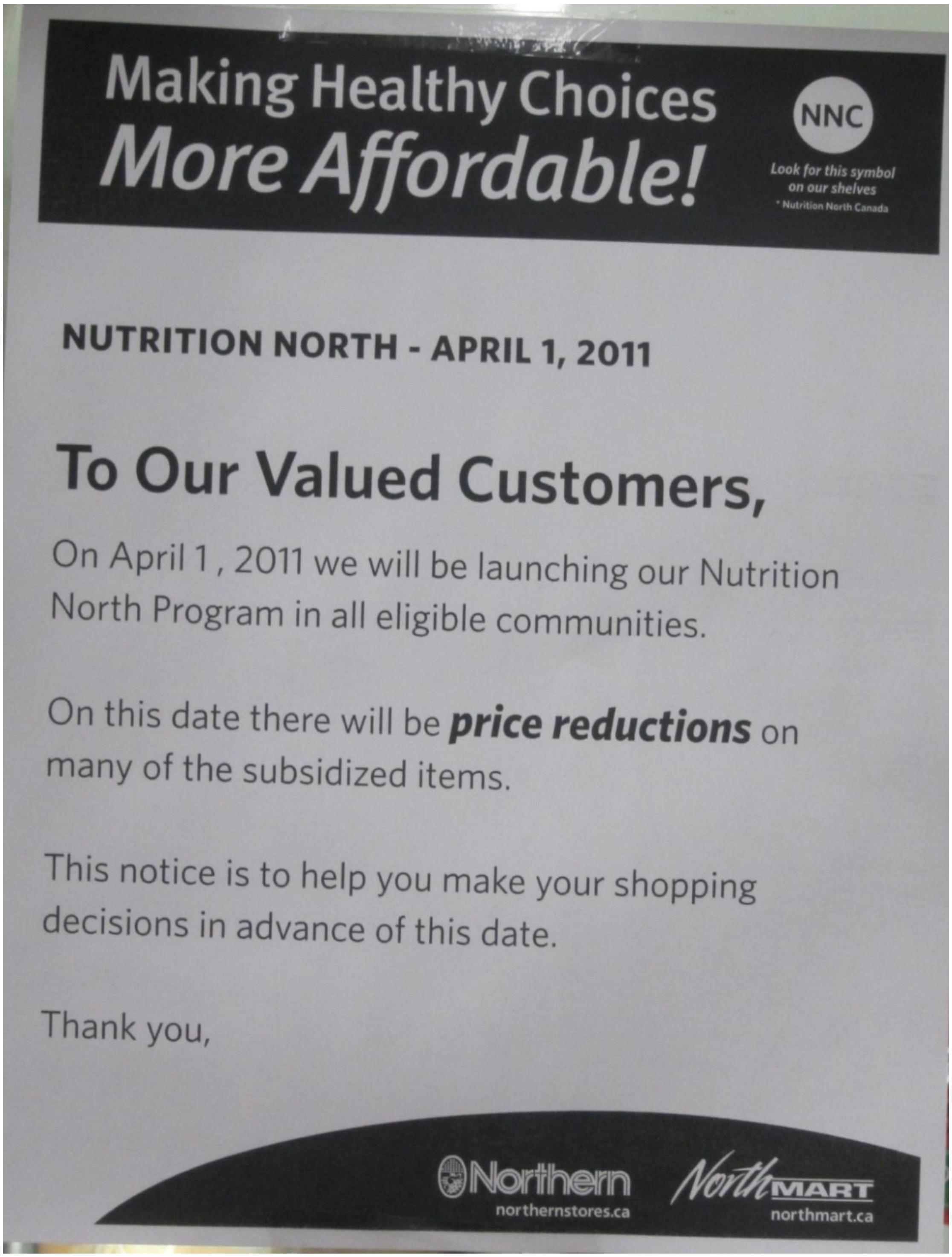
APPENDICES

Appendix A: Canada’s Food Guide First Nations, Inuit and Métis

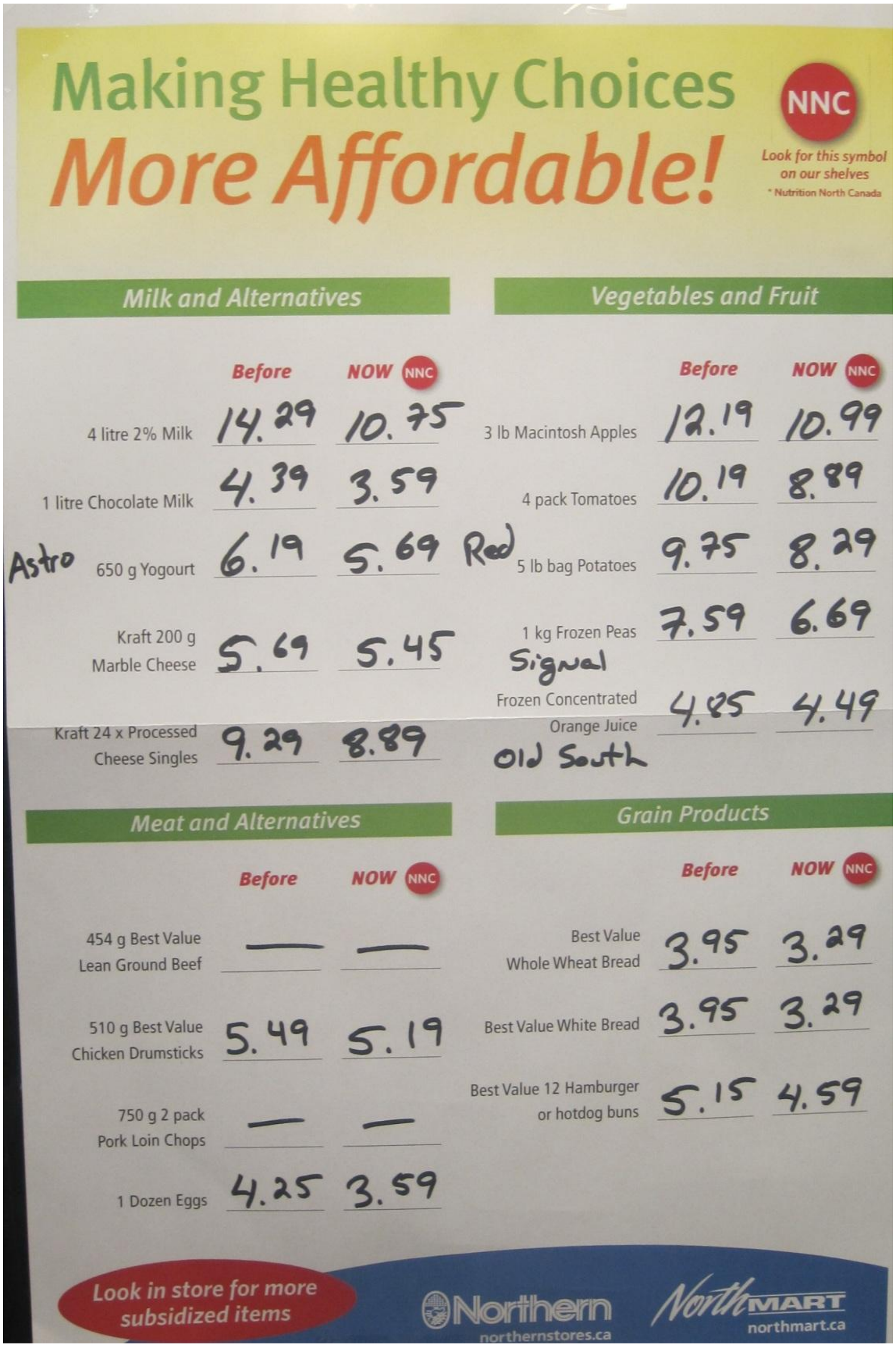


Appendix B: Nutrition North posters

Nutrition North posters in the Fort Albany *Northern*. The poster introduces the program, compares regular and subsidized prices for varying food groups in Canada's Food Guide, and lists the included foods.




Making Healthy Choices
More Affordable!
NNC
Look for this symbol on our shelves
* Nutrition North Canada
Here is a small sampling of your favourite subsidized items:
Sun Maid Raisins
Kraft Peanut Butter Smoot
Old El Paso Flour Tortilla
Best Value Bread White
Country Harvest Bread Cin
Best Value Buns Hamburge
Best Value Buns Hot Dog
DItaliano Buns Crustini
Wonder Muffins English
Country Harvest Tortillas
Gerber Foods Bananas
Heinz Juice Apple
BV Select Eggs
Milk
Milk Chocolate
Yop Yogourt Drink Blueberry
Yoplait Tubes
Cottage Cheese
Kraft Singles Cheese Slices
Kraft Cracker Barrel Cheese Marble
Kraft Cheese Shredded Tex Mex Nacho
Becel Margarine
Best Value French Fries
Best Value Hash Browns
McCain Potato Patties
Green Giant Vegetables
Moov Blueberries
Moov Strawberries
Old South Juice Apple
Old South Juice Orange
Best Value Half Ham
Johnsonville Sausage Mild Italian
Best Value Wieners
Best Value Cooked Ham Sliced
Best Value Bologna Sliced
Best Value Bologna Chunk
Best Value Garlic Sausage Ring
Best Value Pepperoni Chub
Burns Bologna Chunks
JMS Pepperettes Original
Value Max Beef Steak Ribeye
Premium Beef Striploin Steak
Best Value Burgers Beef
Burns Big Beef Burgers
Premier Pork Loin Chops
Best Value Brkfst Sausage Pork
Grade A Turkey
BV Select Meatballs
BV Select Cooked Shrimp
BlueWater Fish Sticks
Atlantic Salmon
Mia Pizza Bella Pepperoni
Apples
Bananas
Blueberries
Grapefruit
Grapes
Melons Honeydew
Oranges
Strawberries
Watermelon
Cabbage
Carrots
Celery Hearts
Corn On The Cob
Cucumber
Lettuce
Mushrooms
Onions
Peppers
Potatoes
Tomatoes
Northern
northernstores.ca
NorthMART
northmart.ca



Making Healthy Choices
More Affordable!
NNC
Look for this symbol on our shelves
* Nutrition North Canada
Milk and Alternatives
Before
NOW
4 litre 2% Milk 14.29 10.75
1 litre Chocolate Milk 4.39 3.59
Astro 650 g Yogourt 6.19 5.69 Red
Kraft 200 g Marble Cheese 5.69 5.45
Kraft 24 x Processed Cheese Singles 9.29 8.89
Vegetables and Fruit
Before
NOW
3 lb Macintosh Apples 12.19 10.99
4 pack Tomatoes 10.19 8.89
5 lb bag Potatoes 9.75 8.29
1 kg Frozen Peas 7.59 6.69
Signal
Frozen Concentrated Orange Juice 4.85 4.49
Old South
Meat and Alternatives
Before
NOW
454 g Best Value Lean Ground Beef — —
510 g Best Value Chicken Drumsticks 5.49 5.19
750 g 2 pack Pork Loin Chops — —
1 Dozen Eggs 4.25 3.59
Grain Products
Before
NOW
Best Value Whole Wheat Bread 3.95 3.29
Best Value White Bread 3.95 3.29
Best Value 12 Hamburger or hotdog buns 5.15 4.59
Look in store for more subsidized items
Northern
northernstores.ca
NorthMART
northmart.ca

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