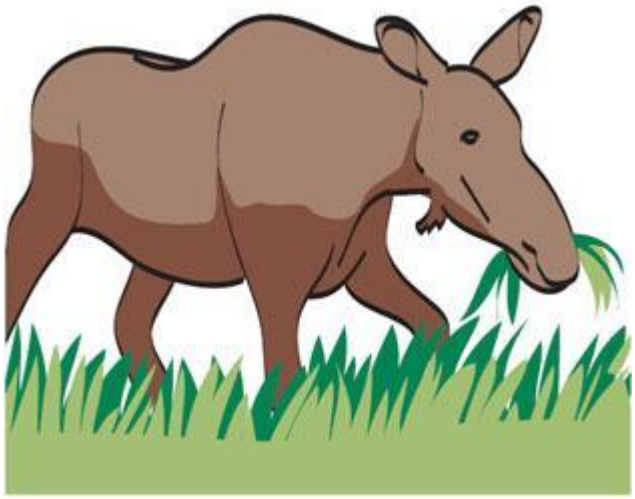
Evaluation of the level of contaminants, cadmium, mercury and arsenic in the muscle tissue and the organs of moose



Maliseet Nation Conservation Council

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Summary

Moose samples from different parts of New Brunswick were analysed for environmental contaminants, cadmium, arsenic and mercury. The estimated mercury and arsenic contents for the samples of moose analysed during the present study were less than 0.01mg/kg and 0.05mg/kg respectively. The samples of moose (meat and liver) analysed contained reasonably higher levels of cadmium. The estimated cadmium level for the muscle tissue of moose varied from 0.005 – 5.23mg/kg. Muscle tissue samples of males contained higher level of cadmium than that of females. The mean cadmium contents estimated for males and females were 0.25 and 0.014 mg/kg respectively. In addition a few samples of liver analysed during the study also contained a reasonably high level of cadmium (range=0.01 – 4.53, mean=2.9 mg/kg). In accordance with the guidelines formulated by Health Canada (Jin et al. 2004), maximum tolerable intake of moose liver/month was estimated at 362g for an adult of 20 – 70 years old based on the cadmium levels (liver) reported during the present study. The traditional knowledge study revealed that moose has been an integral part of the traditional lives of Maliseet Indians. It was also used for ceremonial purposes. Maliseet elders interviewed during the present study shared their traditional knowledge in terms of biology and the life cycle of the animal. They were of the view that the moose population in the province had been declining and there were many contributory factors for current condition of the moose population in the province. The elders/knowledge holders participated in the traditional knowledge indicated that they have not had health issues due to consumption of moose.

Introduction

For thousands of years, Aboriginal people in Canada have relied on different species of wildlife as traditional food. These include caribou, musk ox, deer, moose and various other mammals and birds. In a landscape where conventional farming is limited for a short period, exploitation of wildlife including fish has become traditionally the only viable option for survival especially during the long dark winters (Maundrell and Roe, 2008). With the increasing pressure on wildlife due to commercial and recreational harvesting upon arrival of European settlers, most of the wildlife populations have been depleted to critically low levels limiting even the traditional hunting opportunities for Aboriginal people. However, even today, meat of different species harvested in wild has been staple in the diet of many indigenous groups living in Canada.

Moose were considered the most valuable animal for Maliseet First Nation in the eastern Canada whose lands and culture have been and are still centered on the Saint John River, New Brunswick. It is interesting to note that every piece of the animal from the traditional hunt was consumed or employed for some use. In accordance with the traditional practices, a young boy was considered a man after he successfully hunted a moose or a bear. Moose are an important part of their health, culture and economy.

Deterioration of water quality as a result of the disposal of untreated organic and toxic wastes into the Saint John River basin began when the river was first settled in 1604, and the amount of waste entering the river has increased substantially over the past few decades (Dominy, 1973). The watershed is historically used for agriculture and forestry and the current major sources of effluents in the river were urbanization, industrialization and agriculture. The Aboriginal people of New Brunswick are becoming more aware of contaminants, though moose, like many other land based animals, are less likely to build up elevated levels of contaminants. Since moose are plant eaters they are low on the food chain. Unlike in predators, contaminants do not get accumulated in the meat of moose due to their plant eating habit. However, if the animal continues to eat foods with contaminants, the levels of contaminants in an animal can slowly build up over the time (Jin et al. 2004). There is a tendency that contaminants such as heavy metals be accumulated in organs of certain land animals. This is because the organs act as filters for the body. As these contaminants are capable of adversely impacting the human health, it is advisable to determine the heavy metal contents in different organs and muscle tissue of moose that are consumed by the Maliseet First nations and the other people living in the province.

The proposed investigation is therefore, formulated to evaluate the heavy metals, cadmium, arsenic and mercury contents in different organs and muscle tissue of moose. The proposed study will also be included a preliminary assessment to map the impacts of contamination on different Maliseet First Nation communities based on the knowledge of exploitation of moose in different regions of the province.

Methodology

Forty four samples of moose (muscle – 37, liver – 3 and brain – 4) (Table 1) collected during the present study from twelve hunting zones in New Brunswick (Fig. 1) were analyzed for cadmium, arsenic and mercury at the Research and Productivity Council (RPC), Fredericton. Samples were collected from traditional hunters of all Maliseet First Nation communities in New Brunswick except Madawaska. The information such as hunting location, approximate age, weight and sex of the animal were also collected by the time of sample collection. The samples were frozen till they were transported to the laboratory (RPC) for analysis in January 2012. In the laboratory, sub samples of each specimen were homogenized and portions of homogenates were prepared by Microwave Assisted Digestion in nitric acid. The resulting solutions were analyzed for arsenic and cadmium by ICP – MS. Mercury was analyzed by cold vapour AAS.

Table 2 – Total number of samples analysed during the study

Hunting Zone	Number of samples (muscle tissue)	Liver	Brain
4	3		
6	7		
7	2		
11	5		
12	3	1	1
13	1		
14	1	1	1
15	1		
16	9		
17	2	1	1
20	1		1
21	2		

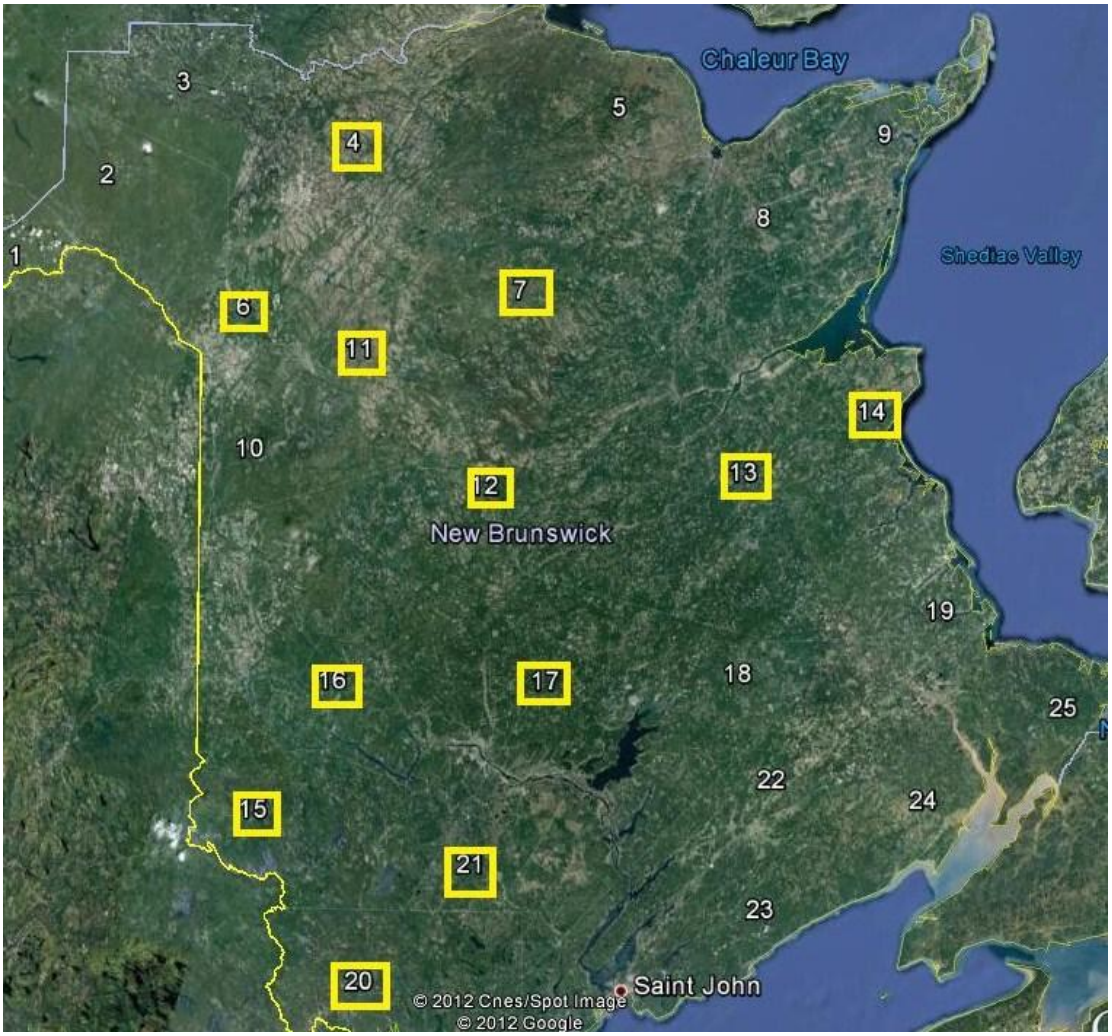

Fig. 1 – Sampling locations in New Brunswick

A traditional knowledge study was also conducted during the present analysis to gather Aboriginal Traditional Knowledge (ATK) about the moose hunt of Maliseet First Nation to evaluate traditional hunting methods and techniques, historical distribution of moose in the province, nutrition aspects, health issues ever developed due to consumption of moose, socioeconomics of the moose hunt etc. In March (2012), a workshop was held in Fredericton to disseminate the outcome of the study. In addition to that results of the study were also disseminated using the newsletter and the website of MNCC.

Results

During the present investigation, samples of 6 females, aged 2 – 6 years (weight: 430 – 780lb) and 31 males, aged 2 – 5 years (weight: 400 – 900lb) were tested for mercury, arsenic and cadmium. The estimated mercury and arsenic contents for the samples of moose analysed during the present study were less than 0.01mg/kg and 0.05mg/kg respectively. However, the samples (muscle tissue) contained reasonably high level of cadmium (range=0.005 – 5.23mg/kg – Table 2). The estimated cadmium content for males were higher than that for females with mean values were estimated at 0.25 and 0.014 mg/kg respectively. As revealed during the present study, a few samples of moose liver analysed also contained a reasonably high level of cadmium (range=0.01 – 4.53, mean=2.9 mg/kg). On the other hand, the estimated cadmium content in brain was relatively low (mean=0.0095 mg/kg). The study indicated that the estimated cadmium contents for the samples of moose (muscle tissue) from the hunting zones 2 and 14 were relatively high (2.76 and 0.022 mg/kg respectively). Interestingly samples of liver from the same hunting zones were also found to contain high level of cadmium (4.26 and 4.53 mg/kg respectively).

Table 2 – Estimated mean Cadmium contents (muscle tissue – moose) for different hunting zones

Hunting Zone	Cadmium content (mg/kg)
4	0.0075
6	0.0074
7	0.0065
11	0.0077
12	2.76
13	0.009
14	0.022
15	0.016
16	0.0181
17	0.0205
20	<0.005
21	0.007

Many Maliseet hunters interviewed during the present study indicated that most of them have taken part in both big game and small game. They targeted wildlife such as moose, deer, bear, muskrat, beaver, porcupine, partridge, rabbit and ducks. They also provided Maliseet names for most of these animals. According to them moose is historically abundant in the province of New Brunswick and was more abundant in the past than present. Especially older moose are getting gradually less abundant in the watershed. There are a number of contributory factors for deterioration of the moose population in the province such as over hunting, pollution, urbanization and deforestation. The noticeable reduction of moose population has reasonably impacted their traditional life style and livelihood since moose meat has traditionally been a vital component of their diet. In addition to that the ceremonial value of moose to Maliseet Indians was invaluable. They also shared their traditional knowledge about biology of the species. Moose is an herbivorous animal, with a life span of around 10 – 20 years. Their opinion is divided in terms of breeding grounds and hunting locations of the animal. In accordance with some of the elders participated in the traditional knowledge study, hunting locations are different from breeding and nursery areas of the animal, whereas certain people were of the view that there was a little difference between breeding and the hunting locations. The breeding season of moose extends from early to late fall and during the breeding season bull is very aggressive. They described this specific behaviour of bull during breeding season as rutting. In general females give birth to young ones in spring. In accordance

with them moose live close to water during warm months of the year and move to higher grounds in winter. The current hunting locations for moose were York, Charlotte and St. John Counties, Durham Area, Anderson Road, Mount Pleasant and Gage Town.

Moose has been a significant component of the lives of Maliseet Indians. It is a protein rich food which also used for ceremonial purposes. The survey revealed that in addition to the moose meat, they consume organs of the animal such as liver, brain and heart. According to them they have not had health issues due to consumption of moose. However, some of them have noticed a worm in the brain of the animal and believed that it might have impacted existence of the moose population in the province. According to the survey moose meat is prepared as sausage, steaks, jerky and burger.

Concluding Remarks

The heavy metal toxicity in human diet and the impacts on human health are very well understood. The common health issues of low level arsenic exposure includes irritation of stomach, lungs and intestine, increased risk of lung cancer, brain damage and reduced productions of Red Blood Cells (RBC) and White Blood Cells (WBC). Exposure to high level of Methyl mercury can lead to permanent brain and kidney damage. It can also cause personality changes, deafness and damage to stomach and intestine (Chowdhury and Chandra, 1987).

As revealed during the present study, moose samples (including brain and liver) contained <0.01mg/kg of mercury and <0.05mg/kg of arsenic. In other words above elements were present in the samples in undetectable levels. Although consumption guidelines for mercury are not frequently reported in the literature, maximum limits for permissible arsenic in food generally range from 0.2μg/kg in accordance with FAO and People's Republic of China guidelines (Gawalko et al. 2009). However, study indicated that the moose liver and muscle tissue samples contained reasonably higher levels of cadmium. In accordance with the guidelines formulated by Health Canada (Jin et al. 2004), maximum tolerable intake of moose liver/month was estimated at 362g for an adult of 20 – 70 years old based on the cadmium levels (liver) reported during the present study. On the other hand maximum tolerable intake of moose meat was estimated at 81kg for the same age group following the same procedure. Although above conclusions were drawn based on an analysis of a few samples of liver, it was noted that all the liver samples with high cadmium levels were provided by the hunters of the Maliseet Community, St. Mary's. Potential health effects of cadmium and the communities at risk were comprehensively discussed during the awareness meeting held in Fredericton in March 2012. Prior to make a final conclusion in terms of communities at risk and contaminated areas of the watershed, it is advisable to confirm the findings of the present analysis based on a comprehensive study. Outcome of the present investigation would provide the basis for such a comprehensive study programme.

Acknowledgement

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