

## **NCP – Synopsis Report**

### **Title: Arctic Caribou and Moose Contaminant Monitoring Program**

#### **Project Leaders**

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#### **Abstract**

Moose and caribou provide an important food resource for Northerners across the Arctic, and have been designated in the NCP blueprint as key species for monitoring contaminants in the terrestrial Arctic ecosystem. Two barren-ground caribou herds, one from the eastern Arctic and one from the western Arctic, have been designated for annual sampling, and five additional caribou herds and two moose populations have been designated for sampling every five years. In 2007/8 tissue samples were collected from the Beverly, George River, Porcupine and Qamanirjuaq caribou. Samples were also collected from the Bathurst and West Greenland caribou as adjuncts to the program. Analysis of samples collected in 2006/7 showed that concentrations of renal cadmium, copper, lead, mercury and zinc were higher in spring-collected animals than those taken in the fall, likely due to seasonal differences in diet. Female Qamanirjuaq caribou had significantly higher concentrations of renal arsenic than males, while female Porcupine caribou had higher concentrations of cadmium, lead and selenium than males. There was no difference in mercury concentrations between 1993 and 2006 in the Dolphin and Union caribou herd, while renal mercury levels in Qamanirjuaq caribou collected in late spring, 1992 were markedly higher than the concentrations found in animals from the same herd collected in early fall of 2006. It is unclear whether there has been a decline in mercury concentrations in this herd or whether this is normal seasonal variation. Renal mercury increased in female Porcupine caribou herd over time, but not in a consistent

manner. Annual monitoring of the Qamanirjuaq and Porcupine caribou herds should give us a better idea of the role of global vs local drivers of these variations in mercury in caribou. None of the elements measured were present at levels that would be expected to have toxic effects in caribou.

### **Key Messages**

- Some elements (cadmium, copper, lead, mercury and zinc) are higher in kidneys of spring-hunted caribou than in those taken in the fall.
- Mercury concentrations are changing over time in some herds, and increasing in female Porcupine caribou. Ongoing studies will help to determine why this trend is occurring.
- None of the elements measured were present at levels that would be expected to have toxic effects in caribou.

### **Objectives**

To determine levels of and temporal trends in contaminants in Arctic caribou and moose in order to:

- Provide information to Northerners regarding contaminants in these traditional foods, so that:
  - They may be better able to make informed choices about food consumption. This includes providing information for health assessments and/or advisories as required.
  - Wildlife managers can assess possible health effects of contaminants on Arctic moose and caribou populations.
- Further understand the fate and effects of contaminant deposition and transport to the Canadian Arctic.

### **Introduction**

Moose and caribou provide an important food resource for Northerners across the Arctic, and have been designated in the NCP blueprint as key species for monitoring contaminants in the terrestrial Arctic ecosystem. Two barren-ground caribou herds, one from the eastern Arctic and one from the western Arctic, have been designated for annual sampling, and five additional caribou herds and two moose populations have been designated for sampling every five years.

### **Activities in 2007-8**

Tissue samples were collected from the George River, Beverly, Porcupine and Qamanirjuaq caribou herds. Samples were also collected from the Bathurst and West Greenland caribou as adjuncts to the program. Details of collections are shown in Table 1. Sampling information was also collected for each animal, including gender, date and location of collection.

The Bathurst caribou were sampled in the fall of 2007 and the spring of 2008 by local hunters under the supervision of NWT biologist Bruno Croft. Although this herd is not

Table 1. Number of samples collected from caribou 2007/8

<b>Caribou</b>	<b>Year of Collection</b>	<b>Kidney</b>	<b>Liver</b>	<b>Muscle</b>	<b>Tooth</b>
Bathurst*	2007	46	46	46	46
	2008	60	60	60	60
Beverly	2008	11	11	11	11
George River	2007	20	20	20	20
West Greenland*	2008	47	47	47	47
Porcupine	2007	11	13	11	12
Qamanirjuaq	2007	20	20	20	20
<b>Total</b>		<b>215</b>	<b>217</b>	<b>215</b>	<b>216</b>

\* Adjunct to the program

part of the NCP program, the samples were included in the process of the program to ensure comparability of data among caribou herds. All analyses were funded by the CARMA.

The Beverly caribou were sampled by the Natural Resources Technology Program of Aurora College in Fort Smith, NWT during their winter camp for students in the spring of 2008. Only 11 animals were sampled at this time, and there is potential that an additional 9-10 will be sampled either by hunters in the fall of 2008 or again by Aurora College in the spring of 2009.

The West Greenland caribou were sampled under a CARMA program by Wendy Nixon (Canadian Wildlife Service) and Christine Cuyler (Greenland Institute of Natural Resources). As with the Bathurst caribou, although this herd is not part of the NCP program, the samples were included in the process of the program to ensure comparability of data among caribou herds. A number of body condition indices were also taken for these animals.

The Porcupine caribou were sampled by local hunters as part of the ongoing Yukon Hunter Survey Program. Each hunter submitting samples was sent a letter with the background and results of the program, and the age of their animal. As an incentive, all hunters submitting samples had their name put in a draw to win a charter flight with a local airline. Because of a change in migration patterns, these caribou were not as available to hunters as is usual, so only 11 sets of samples were received this year.

Samples from the Qamanirjuaq caribou herd were taken by one local hunter, Frank Nutarasungnik, under the supervision of Nunavut biologist Mitch Campbell. The hunter was paid \$50/sample set, and complete sample sets were received from 20 caribou.

All samples were prepared for analysis in Whitehorse, YT by the program coordinator and analyzed at the National Laboratory for Environmental Testing (Environment

Canada) using the inductively coupled plasma technique with mass spectroscopy, and for total mercury using cold vapour atomic absorption spectroscopy, under the supervision of Dr. Derek Muir. Remaining liver and muscle samples were archived at  $-50^{\circ}\text{C}$  at the INAC facility in Whitehorse, YT. Caribou teeth were aged by a YTG technician in Whitehorse using the tooth cementum technique.

## Results and Discussion

Laboratory analyses of samples collected from 2007/8 are expected to be available by fall, 2008. Results for samples collected 2005-7 are presented here, with the exception of the DehCho moose results, which will be presented with the 2007/8 data. Samples from the Bluenose East and Bathurst herds from 2005-2007 have been analyzed and interpretation of results is continuing. For the remaining herds, (Porcupine, Qamanirjuaq and Dolphin and Union), although 31 elements were measured, only 7 elements of concern are discussed in detail (arsenic, cadmium, copper, lead, mercury, selenium and zinc). These are presented in Table 2.

The Qamanirjuaq caribou herd was previously sampled for contaminants in 1992 and the Dolphin and Union herd in 1993 by GNWT and those data have been made available for comparison (Elkin and Bethke 1995; Elkin, unpublished data). Neither arsenic nor selenium was measured in these collections. The Dolphin and Union herd was sampled in the fall of 1993 and again in the fall of 2006, so comparing element concentrations between years does not have to take in the effect of season. However, the Qamanirjuaq herd was sampled in early spring of 1992 and in the early fall of 2006, so it is impossible to determine whether differences between datasets are attributable to a change in concentration of an element over time or natural seasonal fluctuations of the element. Ongoing annual monitoring of this herd should clarify this ambiguity. The Porcupine caribou herd has been sampled annually since 1994, with both seasons represented in some years, making it an ideal data set for evaluating temporal trends.

Table 2. Renal element concentrations ( $\mu\text{g/g}$  dry weight) in caribou herds collected in fall, 2006 (Mean  $\pm$  standard deviation).

Herd	Dolphin and Union		Qamanirjuaq		Porcupine	
	Female	Male	Female	Male	Female	Male
<b>N</b>	17	3	7	14	3	11
<b>Age</b>	$5.8 \pm 3.1$	$3.7 \pm 1.5$	$7.3 \pm 3.4$	$5.8 \pm 2.8$	$4.0 \pm 1.4$	$4.9 \pm 1.5$
<b>As</b>	$0.05 \pm 0.01$	$0.05 \pm 0.02$	$0.03 \pm 0.02$	$0.01 \pm 0.01$	$0.07 \pm 0.00$	$0.07 \pm 0.03$
<b>Cd</b>	$8.4 \pm 6.7$	$5.3 \pm 4.1$	$18.7 \pm 13.9$	$14.0 \pm 8.9$	$41.4 \pm 22.9$	$38.7 \pm 22.3$
<b>Cu</b>	$25.5 \pm 5.0$	$22.5 \pm 2.2$	$26.3 \pm 2.0$	$25.8 \pm 1.8$	$22.8 \pm 2.7$	$25.3 \pm 3.0$
<b>Pb</b>	$0.2 \pm 0.1$	$0.1 \pm 0.1$	$0.6 \pm 0.8$	$0.3 \pm 0.2$	$0.1 \pm 0.1$	$1.2 \pm 3.2$
<b>Hg</b>	$3.8 \pm 1.5$	$2.7 \pm 0.2$	$3.4 \pm 1.0$	$2.6 \pm 0.9$	$3.2 \pm 1.7$	$2.1 \pm 0.5$
<b>Se</b>	$4.0 \pm 0.8$	$3.4 \pm 0.5$	$3.6 \pm 0.5$	$3.6 \pm 0.5$	$4.2 \pm 0.3$	$4.9 \pm 0.8$
<b>Zn</b>	$105.8 \pm 17.5$	$104.4 \pm 16.7$	$104.1 \pm 8.5$	$112.3 \pm 14.0$	$129.0 \pm 13.8$	$129.4 \pm 13.4$

Concentrations of renal cadmium, copper, lead, mercury and zinc were higher in spring-collected animals than those taken in the fall. This is likely because the winter diet of barren-ground caribou consists mostly of lichens, which are efficient at absorbing elements from the atmosphere. In the summer, the diet switches to more grasses and sedges, which generally have lower concentrations of these elements. In addition, fast growing herbaceous vegetation tends to have lower levels of some elements such as copper (Puls 1994). Higher cadmium levels in the 1992 spring samples from the Qamanirjuaq caribou as compared to the 2006 fall samples are likely a seasonal effect rather than a decline over time. A current NCP project is measuring element concentrations in caribou forage and will allow more in-depth understanding of these differences.

Female Qamanirjuaq caribou had significantly higher concentrations of renal arsenic than males, while female Porcupine caribou had higher concentrations of cadmium, lead and selenium than males. Female caribou eat proportionally more forage than males due to their smaller body size, particularly in spring when parturition and lactation make high energy demands on females. During most of this time they are still feeding on lichens, which likely have higher concentrations of some of these elements. This may account, at least in part, for the higher concentrations of some elements in females.

Renal cadmium and mercury concentrations increased with age in all three caribou herds while zinc increased with age in the Porcupine and Qamanirjuaq herds. The relationship between cadmium and age is well-known and has been documented in the literature for both moose and caribou (Gamberg and Scheuhammer, 1994; Glooschenko et al., 1994). It should be noted that tissue levels of zinc are poor indicators of nutritional status (Puls 1994).

Renal arsenic and lead declined while selenium increased over time in the Porcupine caribou herd. The absolute changes in all three elements were small and of little biological significance. Cadmium did not change over time in any of the herds analyzed, with the possible exception of the Qamanirjuaq herd. Higher cadmium levels in the 1992 spring samples as compared to the 2006 fall samples are likely a seasonal effect rather than a decline over time. Renal lead levels in the Qamanirjuaq caribou increased from the 1992 late spring collection to the 2006, fall collection. This difference is unlikely to be due to a seasonal difference, since the opposite trend was demonstrated by the Porcupine caribou (a much stronger dataset). Whether or not this is an overall increase in lead over time will be explored during the ongoing monitoring of this herd.

There was no difference in mercury concentrations between 1993 and 2006 in the Dolphin and Union caribou herd, while renal mercury levels in Qamanirjuaq caribou collected in late spring, 1992 were markedly higher than the concentrations found in animals from the same herd collected in early fall of 2006. From these data, it is unclear whether there has been a decline in mercury concentrations in this herd or whether this is normal seasonal variation (as demonstrated by the Porcupine herd). Ongoing monitoring of this herd should give us a better idea of whether or not they demonstrate a temporal

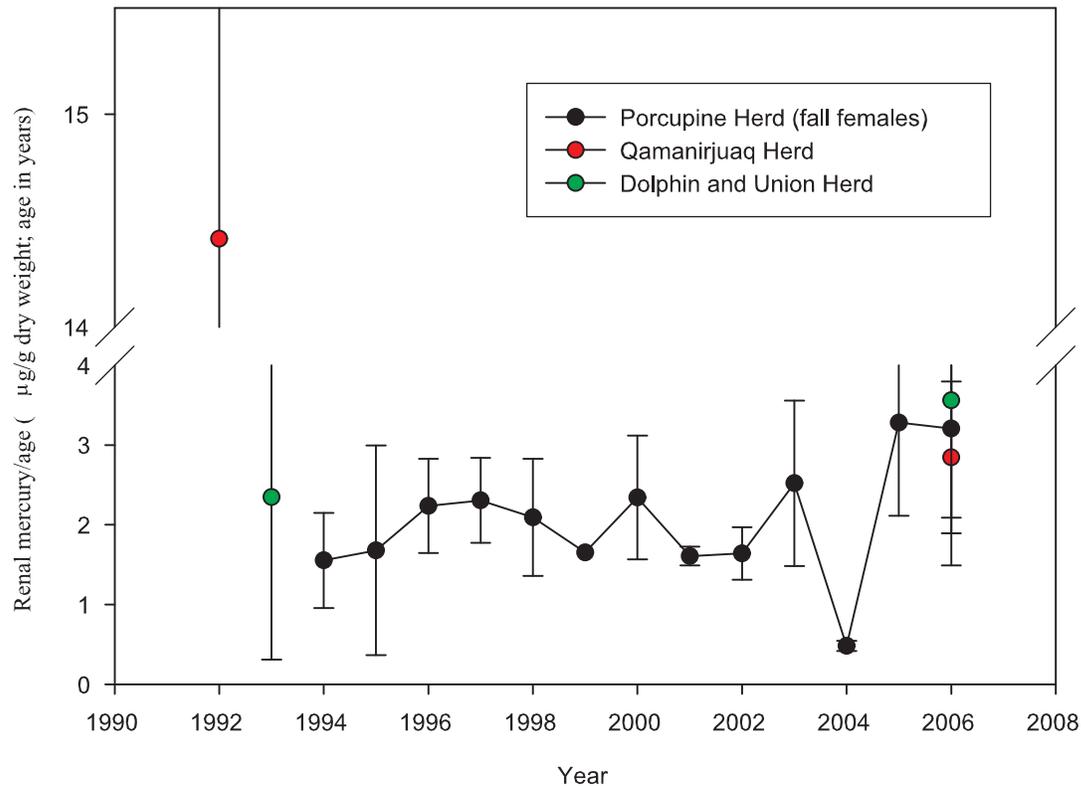


Figure 1. Total age-corrected renal mercury concentrations in three caribou herds collected from 1992 to 2006.

trend in mercury. Renal mercury increased over time in fall-collected female Porcupine caribou, but not in a consistent manner (Figure 1). It is unclear what is driving these variations, but it may be a combination of atmospheric input and climatic conditions (for example snow cover and ambient temperatures) and it may be affected by atmospheric mercury depletion events. Annual monitoring of the Qamanirjuaq as well as the Porcupine caribou herd should give us a better idea of the role of global vs local drivers of these annual variations in mercury in caribou.

Renal lead concentrations were lower in the Qamanirjuaq herd, but somewhat higher in the Dolphin and Union herd while renal cadmium was highest in the Porcupine caribou and lowest in the Dolphin and Union herd. Renal platinum and gallium were notably higher, and selenium notably lower in the Qamanirjuaq and Dolphin and Union caribou kidneys than in the Porcupine herd. It is unclear what 'normal' levels of platinum and gallium are for caribou. Renal thallium tended to be more variable in kidneys from the Qamanirjuaq herd than from the other herds. The differences in renal element concentrations among herds are likely indicative of geographic differences in naturally available minerals.

Those elements that are required in trace amounts for the normal functioning of the animal (copper, selenium and zinc) were found in adequate concentrations in all three caribou herds and there is no evidence that they reached toxic levels in any of the animals measured. The toxic elements (arsenic, cadmium, lead and mercury) were found in measurable amounts, but never higher than is considered 'normal to high' for domestic cattle (Puls 1994). None of these elements approached levels that would be expected to cause toxic effects in the caribou.

**Project Completion Date:** This project is ongoing.

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