



ENVIRONMENT YUKON
LIBRARY

**SURVEY OF CONTAMINANTS
IN THE FINLAYSON CARIBOU HERD**

ROSS RIVER, YUKON TERRITORY

Prepared for:
Fish and Wildlife Branch
Department of Renewable Resources
by Gamberg Consulting
March, 1993

QL
737.U55
G35
1993

TRC-93-2

QL 737
U55
G35
1993

**SURVEY OF CONTAMINANTS
IN THE FINLAYSON CARIBOU HERD**

ROSS RIVER, YUKON TERRITORY

**ENVIRONMENT YUKON
LIBRARY**

*Mary Gamberg
Gamberg Consulting*

Technical Report

March, 1993

Prepared for:
Fish and Wildlife Branch
Department of Renewable Resources

TRC-93-2

ABSTRACT

Of 26 metals measured in Finlayson caribou bone, muscle, liver and kidney, only high levels of cadmium in livers and kidneys were of concern. Cadmium levels were positively correlated with age, and kidney levels tended to be higher than liver. High total mercury was found in kidneys, but it was in the relatively non-toxic inorganic form. Cesium¹³⁷ in muscle and organochlorines in fat tissue were considered normal for Arctic caribou. An unusual pattern of dioxin and furan deposition in caribou fat was seen, and although not well understood, may indicate a combustion source, and transfer to the caribou through atmospheric deposition onto lichens.

ACKNOWLEDGEMENTS

This project was funded by the Arctic Environmental Strategy through the Department of Indian and Northern Affairs and by the Yukon Territorial Government, Renewable Resources. The author would like to thank Grant Lortie and the members of the Ross River Band for tissue collections, Robert Florckiewicz for organizing the collections and reviewing the report, Della Bond and Anton Scheuhammer for performing the methyl mercury analysis and Len Mychasiw for supporting the study.

CONTENTS

ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
LIST OF APPENDICES	viii
INTRODUCTION	1
METHODS	1
RESULTS	4
DISCUSSION	11
RECOMMENDATIONS	18
LITERATURE CITED	19

LIST OF FIGURES

- Figure 1. Home range of the Finlayson caribou herd in
east-central Yukon. 2
- Figure 2. The relationship between age and cadmium concentrations
in Finlayson caribou liver and kidney 7

LIST OF TABLES

Table 1. Mean metal concentrations in Finlayson caribou tissue ($\mu\text{g/g}$ dry weight).	5
Table 2. Mean cadmium concentrations in liver and kidney tissues from Finlayson caribou by age ($\mu\text{g/g}$ dry weight).	8
Table 3. Mean organochlorine concentrations in fat tissue from Finlayson caribou (ng/g wet weight). N=5 pooled samples, each of 4-5 individuals.	9
Table 4. Mean dioxin and furan concentrations in fat tissue from Finlayson caribou (pg/g). N=5 pooled samples, each of 4-5 individuals.	10
Table 5. Mean metal concentrations in livers and kidneys of Arctic caribou and muskoxen ($\mu\text{g/g}$ wet weight).	13
Table 6. Mean cadmium concentrations in (N) livers and kidneys from Arctic caribou ($\mu\text{g/g}$ wet wt).	14
Table 7. Mean Cesium ¹³⁷ in caribou muscle tissue from the Canadian Arctic (Bq/kg wet weight).	15
Table 8. Organochlorines in caribou fat tissue from the Canadian Arctic (ng/g wet weight).	16

LIST OF APPENDICES

Appendix 1. Composition of pooled Finlayson caribou muscle and fat samples.	21
Appendix 2. Analytical techniques used for organochlorines, dioxins and furans	23
Appendix 3. Mean metal concentrations in Finlayson caribou tissues ($\mu\text{g/g}$ wet weight).	28
Appendix 4. Metal concentrations in Finlayson caribou tissues: individual results ($\mu\text{g/g}$ wet weight).	31
Appendix 5. Estimated detection limits and recoveries of Standard Reference Materials for metal analysis of Finlayson caribou tissues.	46
Appendix 6. Ages and cadmium concentrations in individual Finlayson caribou livers and kidneys.	48
Appendix 7. Cesium ¹³⁷ levels in Finlayson caribou muscle tissue: individual results.	50
Appendix 8. Organochlorine concentrations in composite Finlayson caribou fat samples (ng/g wet weight).	52
Appendix 9. Dioxin and furan concentrations in composite Finlayson caribou fat samples (pg/g wet weight).	57

INTRODUCTION

Environmental contamination has become a major concern in North America, particularly in the Arctic where fragile ecosystems receive point source contamination, as well as atmospheric fallout from more industrialized parts of the continent. Chlorinated hydrocarbons and heavy metals were found in a variety of birds and mammals in the Northwest Territories and Greenland (Wong 1985). In the Yukon, high levels of cadmium were found in caribou (Gamberg and Scheuhammer in press), and toxaphene has been found in some fish species (M. Palmer pers. commun.). However, few other studies of contaminants in wildlife have been conducted in this Territory.

Caribou (*Rangifer tarandus*) are of particular concern as far as environmental contamination goes, because lichens, their major food source, readily absorb contaminants from the atmosphere and accumulate them over time. Of additional concern is the use of caribou as a food source by First Nations and other hunters. Caribou in the Northwest Territories have accumulated high levels of radioactive cesium (Taylor et al. 1988), and high cadmium levels in Quebec caribou have prompted recommendations against the consumption of the liver and kidney (Crete et al. 1989). Cadmium has been measured in barren-ground caribou from the Porcupine Herd in the northern part of the Territory, but other contaminants have not been measured in caribou from the Yukon, nor has cadmium been measured in woodland caribou from the Territory. Other contaminants may be present in these animals and may constitute potential health risks to the caribou population, and to people and animals consuming them.

This study was conducted to acquire baseline data on a variety of metals and potentially hazardous contaminants in woodland caribou from the Finlayson Caribou Herd, near Ross River, Yukon. This herd is an important food source for local First Nations, who are concerned about contaminants in their traditional foods.

METHODS

Sample collection

Tissue samples were taken from thirty-one adult female, one adult male and one juvenile male caribou from the Finlayson Herd between February 21, 1992 and March 21, 1992. Animals were taken from their traditional winter home range near Ross River, Yukon (Figure 1). Animals were shot, and tissues taken usually within one hour of the animal's death. Approximately 500g of liver, one entire kidney, approximately 500g of the gastrocnemius muscle and one metatarsal bone were collected from each animal and stored separately in plastic bags. All available kidney fat from one kidney was collected from each animal and stored separately in hexane and acetone-rinsed jars. The mandible was also collected from each animal and an incisor extracted for age determination by the tooth cementum technique. All samples were frozen at -20°C until processed for analysis.

Tissue preparation

A slice of bone weighing approximately 10 g was taken from the medial portion of the metatarsal after the bone marrow had been removed. A consistent subsample of this bone was then taken for analysis. Muscle tissue was pooled from individual animals (5-6 individuals/pooled sample), as was kidney fat (4-5 individuals/pool). Individual animals making up each pooled muscle sample

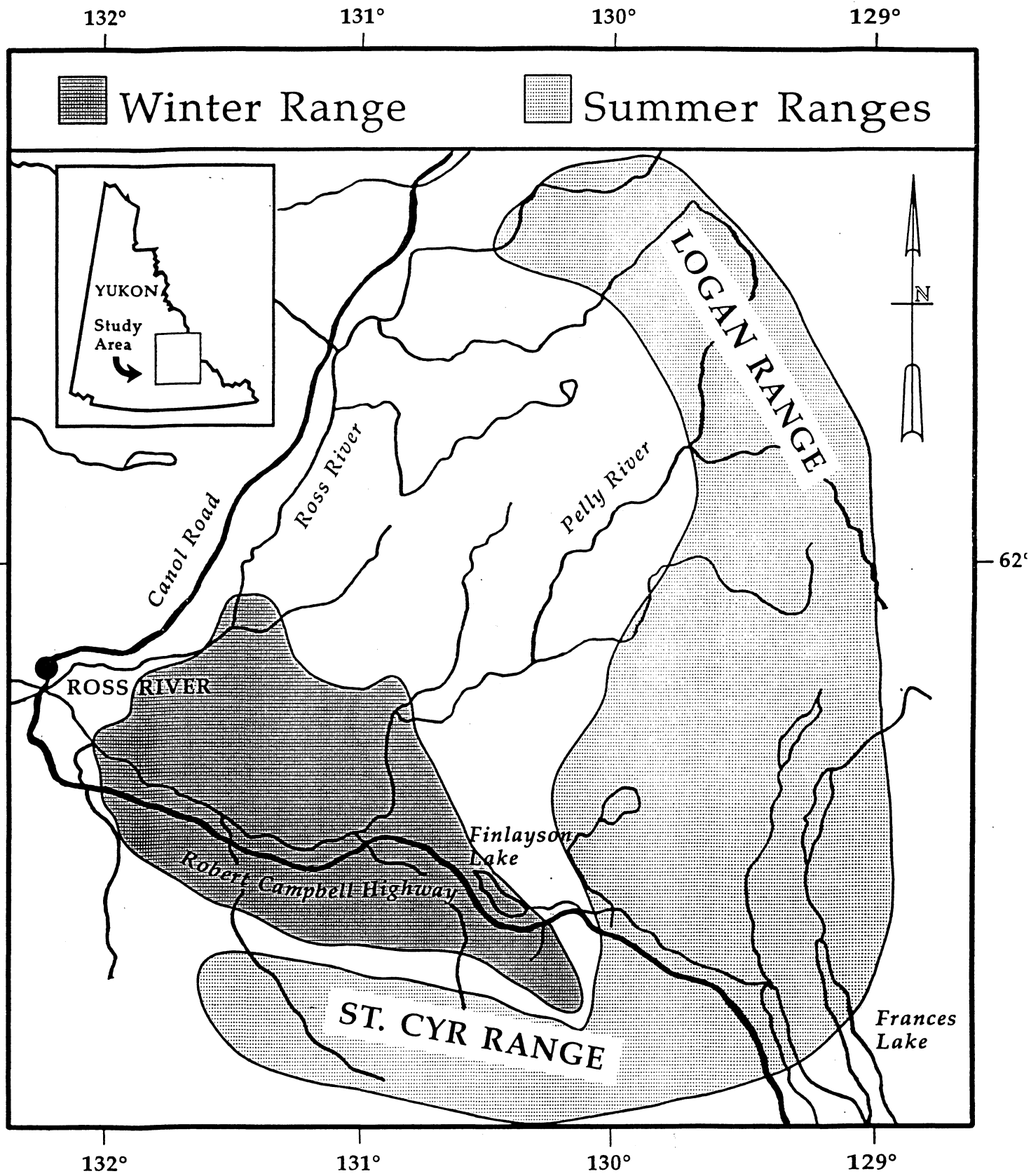


Fig. 1: Home range of the Finlayson Caribou Herd in east-central Yukon.

are reported in Appendix 1. Liver, kidney, muscle and fat tissues were homogenized prior to analysis.

Tissue analysis

Metals - analysis performed by Fenwick Laboratories, Halifax, Nova Scotia. Subsamples of bone, liver kidney and muscle tissue were digested with concentrated high purity nitric acid. Solutions were diluted to volume for trace metal analysis using Inductively Coupled Plasma-Mass Spectrometry. Separate portions of the kidney samples were also digested with sulphuric and nitric acids and potassium permanganate prior to mercury analysis by cold vapour atomic absorption spectroscopy (CVAAS). Eight samples each of liver and kidney containing high total mercury levels were subsequently analyzed for methyl mercury by the National Wildlife Research Centre, Hull, Quebec, using CVAAS on extracted samples. Standard Reference Materials were included in each analysis for quality control.

Cesium - analysis performed by The Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska. Individual muscle samples were assayed for radiocesium using a Nuclear Data ND-1100 Spectrometer coupled with a NaI (TL) detector that had been cross-calibrated with similar instruments in two other laboratories. The coefficient of variation was calculated for each sample as the standard deviation divided by the mean, and reflects variation due to sample counting.

PCBs and Organochlorines - analysis performed by Axys Analytical Services, Sidney, B.C. All samples were spiked with aliquots of ^{13}C -labelled surrogates and perdeuterated alpha-endosulphan prior to analysis. Tissue samples were ground with sodium sulphate, packed in a glass chromatographic column, and eluted with solvent prior to separation into two fractions (F1 and F2) on a Florisil column. F1 was analyzed by GC/MS for PCBs (as Aroclors), non-polar and moderately polar chlorinated pesticides. F2 was analyzed for the most polar chlorinated pesticides by GC/ECD.

Dioxins and Furans - analysis performed by Axys Analytical Services, Sidney, B.C. All samples were spiked with ^{13}C -labelled surrogates prior to analysis. Tissue samples were ground with sodium sulphate, packed in a glass chromatographic column and eluted with solvent. The extracts were subjected to a series of cleanup steps and then analyzed for dioxins and furans by high resolution gas chromatography with high resolution mass spectrometric detection (HRGC/HRMS). Surrogate standards were analyzed with each sample for quality control.

Details of PCB, organochlorine, dioxin and furan analysis are presented in Appendix 2.

Statistical analysis

When all results were less than the detection limit, standard deviations were not calculated, and the mean is reported as less than the detection limit. In cases where only a few results were below this level, one half the detection limit was used in calculating the mean and standard deviation.

A General Linear Model (GLM) was used to perform regressions on the data (SAS 1985). Natural logarithms were used to transform the data when necessary to ensure normal distribution of the residuals.

RESULTS

Metal concentrations in caribou bone, kidney, muscle and liver are summarized on a dry weight basis in Table 1 (and on a wet weight basis in Appendix 3). Raw data for metal analysis, along with blanks and standard reference materials are presented in Appendix 4. Recovery of metals was estimated using Bovine Liver and Fish Muscle Standard Reference Materials. Recoveries of metals with certified values in the reference materials ranged from 78% to 337%, with an average of 121%. It should be noted that the recovery of chromium was 337%, which skewed the average from 106%. Detection limits and recoveries for each metal are in Appendix 5.

Cadmium concentrations in kidney and liver were significantly correlated with age ($r=0.54$, $p=0.0015$; $r=0.39$, $p=0.027$), kidney levels averaging 12.5 times higher than liver (Fig. 1; Table 2). Cadmium levels in livers and kidneys of individual animals along with their ages are presented in Appendix 6. Methyl mercury was below the detection limit of $0.1 \mu\text{g/g}$ (wet weight) in all livers and kidneys measured.

Cesium¹³⁷ averaged 182.3 Bq/kg (SD=36.5) and ranged from 128.7 to 258.3. Individual results in Bq/kg and pCi/kg along with coefficients of variation are in Appendix 7.

PCBs (measured as Aroclors) and most organochlorines were not detectable in caribou fat tissue. Measurable levels of hexachlorobenzene (HCB) and the three isomers of hexachlorocyclohexane (HCH) were found, and are summarized in Table 3. Detection limits and results of a blank and individual samples are found in Appendix 8. Dioxin and furan concentrations in fat tissue ranged from non-detectable to 4700 pg/g for OCDD (Table 4). Raw data, including detection limits, surrogate standard recoveries and results for individual samples and blanks, are in Appendix 9.

Results of all contaminant analyses were submitted to Health and Welfare Canada for a human health risk assessment.

Table 1. Mean metal concentrations in Finlayson caribou tissue ($\mu\text{g/g}$ dry weight).

	Bone				Muscle			
	N	X	SD	Range	N ¹	X	SD	Range
Aluminum	33	1.47	0.70	0.55 - 4.83	6	1.97	0.58	0.90 - 3.06
Antimony	33	<0.006	-	<0.006 - 0.014	6	<0.008	-	<0.008 - 0.004
Arsenic	33	<0.04	-	<0.04 - 0.07	6	<0.04	-	<0.04 - 0.06
Barium	33	511	157	291 - 915	6	0.40	0.34	<0.38 - 1.11
Beryllium	33	<0.01	-	<0.01 - 0.02	6	<0.008	-	<0.008 - 0.01
Boron	33	0.49	0.10	0.32 - 0.68	6	0.313	0.048	0.266 - 0.403
Cadmium	33	0.019	0.010	0.007 - 0.047	6	0.113	0.060	0.059 - 0.337
Chromium	33	0.35	0.11	0.19 - 0.61	6	0.32	0.02	0.29 - 0.36
Cobalt	33	0.37	0.03	0.28 - 0.44	6	<0.04	-	<0.04 - <0.04
Copper	33	0.60	0.71	0.25 - 4.51	6	11.21	0.56	10.30 - 11.97
Iron	33	19.4	6.2	11.9 - 44.9	6	175.2	4.1	167.7 - 180.4
Lead	33	0.91	0.33	0.17 - 1.65	6	0.08	0.04	<0.04 - 0.14
Manganese	33	0.90	0.20	0.57 - 1.46	6	1.20	0.09	1.06 - 1.42
Mercury	-	-	-	-	-	-	-	-
Molybdenum	33	0.05	0.03	0.01 - 0.12	6	<0.04	-	<0.04 - 0.02
Nickel	33	0.80	1.74	0.05 - 7.86	6	0.11	0.04	<0.08 - 0.17
Selenium	33	0.15	0.08	<0.06 - 0.31	6	0.83	0.10	0.69 - 1.02
Silver	33	0.005	0.003	0.002 - 0.017	6	<0.004	-	<0.004 - <0.004
Strontium	33	247	41	179 - 317	6	0.08	0.01	0.07 - 0.11
Thallium	33	0.004	0.005	0.001 - 0.020	6	<0.004	-	<0.004 - 0.02
Tin	33	0.10	0.11	<0.02 - 0.54	6	0.24	0.31	0.03 - 0.92
Uranium	33	0.006	0.007	<0.001 - 0.028	6	0.009	0.011	<0.004 - 0.032
Vanadium	33	<0.02	-	<0.02 - 0.09	6	<0.08	-	<0.08 - <0.08
Zinc	33	81.4	11.5	57.3 - 110.2	6	172.8	22.1	135.2 - 207.1
Calcium	33	241442	15594	193729 - 262570	6	139	6	126 - 149
Magnesium	33	2899	266	2296 - 3542	6	946	34	892 - 1001

¹ Each muscle sample is a composite of 5-6 individual samples

Table 1 (Continued)

	Kidney				Liver			
	N	X	SD	Range	N	X	SD	Range
Aluminum	32	2.12	0.79	<0.96 - 4.20	32	1.07	0.47	<0.61 - 2.37
Antimony	32	<0.010	-	<0.010 - 0.031	32	<0.006	-	<0.006 - 0.012
Arsenic	32	0.10	0.13	<0.05 - 0.83	32	0.05	0.03	<0.03 - 0.12
Barium	32	4.02	2.41	1.97 - 15.60	32	0.55	0.18	<0.30 - 1.25
Beryllium	32	<0.010	-	<0.010 - 0.012	32	<0.006	-	<0.006 - <0.006
Boron	32	0.35	0.05	0.24 - 0.47	32	0.23	0.04	0.17 - 0.36
Cadmium	32	153.4	113.9	29.6 - 629.1	32	13.71	9.88	2.40 - 60.42
Chromium	32	0.35	0.17	0.23 - 1.24	32	0.25	0.03	0.22 - 0.32
Cobalt	32	0.17	0.04	0.12 - 0.27	32	0.18	0.03	0.12 - 0.25
Copper	32	24.68	6.54	19.51 - 58.67	32	79.20	37.07	23.74 - 170.40
Iron	32	171.3	41.5	96.5 - 249.7	32	851	367	373 - 1856
Lead	32	0.52	0.36	0.27 - 2.26	32	0.42	0.11	0.22 - 0.62
Manganese	32	7.79	1.20	5.01 - 10.42	32	10.32	1.54	7.63 - 15.14
Mercury	32	4.07	1.12	2.34 - 7.80	-	-	-	- -
Molybdenum	32	1.10	0.19	0.82 - 1.59	32	2.65	0.30	2.09 - 3.17
Nickel	32	0.27	0.67	<0.10 - 4.00	32	<0.06	-	<0.06 - <0.06
Selenium	32	4.91	0.43	4.13 - 5.69	32	1.40	0.27	0.81 - 2.12
Silver	32	0.007	0.005	<0.005 - 0.029	32	1.125	0.484	0.317 - 2.144
Strontium	32	0.6	0.3	0.3 - 2.2	32	0.1	0.0	0.1 - 0.2
Thallium	32	0.024	0.010	0.011 - 0.048	32	0.005	0.006	<0.003 - 0.033
Tin	32	0.13	0.12	<0.10 - 0.45	32	0.08	0.11	0.00 - 0.41
Uranium	32	<0.005	0.010	<0.005 - 0.039	32	<0.003	-	<0.003 - 0.049
Vanadium	32	<0.10	-	<0.10 - <0.05	32	<0.06	-	<0.06 - <0.06
Zinc	32	148.1	25.0	112.0 - 230.6	32	93.8	22.2	65.9 - 176.5
Calcium	32	444	185	309 - 1418	32	131	15	114 - 199
Magnesium	32	755	64	625 - 884	32	548	45	497 - 754

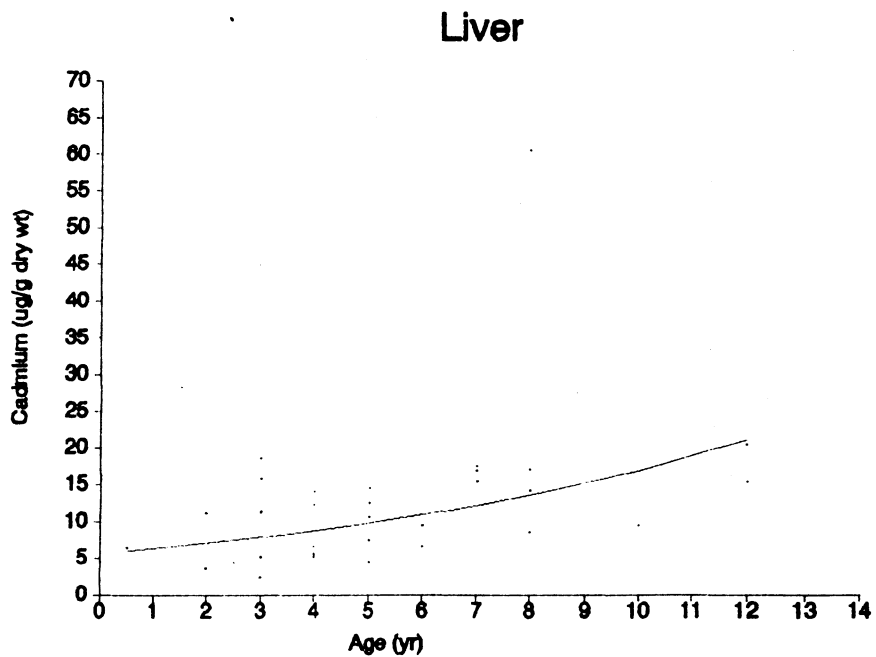
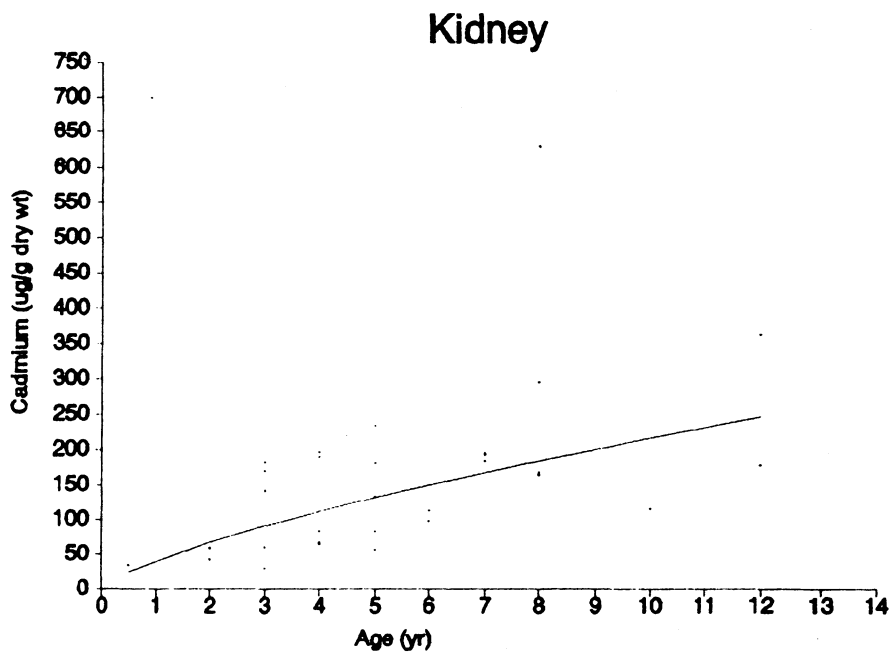


Fig. 2. The relationship between age and cadmium concentrations in Finlayson caribou liver and kidney.

Table 2. Mean cadmium concentrations in liver and kidney tissues from Finlayson caribou by age ($\mu\text{g/g}$ dry weight).

Age(yr)	N	Kidney			Liver		
		X	SD	Range	X	SD	Range
0.5	1	35.35	-	35.35 - 35.35	6.49	-	6.49 - 6.49
2.0	2	51.34	8.38	42.97 - 59.72	7.40	3.78	3.61 - 11.18
3.0	7	112.09	56.20	29.63 - 182.33	10.01	5.54	2.40 - 18.62
4.0	5	120.74	59.72	65.59 - 196.86	8.78	3.66	5.27 - 14.08
5.0	5	137.49	64.32	57.08 - 233.93	9.88	3.62	4.39 - 14.54
6.0	2	106.13	7.43	98.70 - 113.55	8.04	1.44	6.60 - 9.48
7.0	3	190.73	4.71	184.12 - 194.72	16.66	0.89	15.45 - 17.57
8.0	4	313.93	189.44	163.97 - 629.11	25.08	20.63	8.58 - 60.42
10.0	1	116.59	-	116.59 - 116.59	9.50	-	9.50 - 9.50
12.0	2	270.38	92.63	177.75 - 363.01	17.89	2.57	15.32 - 20.46

Table 3. Mean organochlorine concentrations in fat tissue from Finlayson caribou (ng/g wet weight). N=5 pooled samples, each of 4-5 individuals.

	X ¹	SD	Range	
Hexachlorobenzene	32.1	12.7	20	- 56.5
alpha-HCH	4.05	2.0	2.3	- 7.95
beta-HCH	0.655	0.3	0.70	- 2.30
gamma-HCH	0.33	0.2	ND	- 0.65
Heptachlor	ND	-	ND	- ND
Aldrin	ND	-	ND	- ND
Oxychlordane	ND	-	ND	- ND
trans-Chlordane	ND	-	ND	- ND
cis-Chlordane	ND	-	ND	- ND
trans-Nonachlor	ND	-	ND	- ND
cis-Nonachlor	ND	-	ND	- ND
o,p'-DDE	ND	-	ND	- ND
p,p'-DDE	ND	-	ND	- 0.5
o,p'-DDD	ND	-	ND	- ND
p,p'-DDD	ND	-	ND	- ND
o,p'-DDT	ND	-	ND	- ND
p,p'-DDT	ND	-	ND	- ND
Mirex	ND	-	ND	- 9.5
Heptachlor Epoxide	ND	-	ND	- ND
alpha-Endosulphan	ND	-	ND	- ND
Dieldrin	ND	-	ND	- ND
Endrin	ND	-	ND	- ND
Methoxychlor	ND	-	ND	- ND
Aroclor 1242	ND	-	ND	- ND
Aroclor 1254	ND	-	ND	- ND
Aroclor 1260	ND	-	ND	- ND

¹ ND = non-detectable (See appendix 8 for detection limits)

Table 4. Mean dioxin and furan concentrations in fat tissue from Finlayson caribou (pg/g). N=5 pooled samples, each of 4-5 individuals.

	X ¹	SD	Range		
Dioxins					
T ₄ CDD - Total	ND	-	ND	-	ND
2,3,7,8	ND	-	ND	-	ND
P ₅ CDD - Total	ND	-	ND	-	0.6
1,2,3,7,8	ND	-	ND	-	ND
H ₆ CDD - Total	124.8	80.5	34	-	270
1,2,3,4,7,8	ND	-	ND	-	<0.3
1,2,3,6,7,8	8.0	5.4	ND	-	18
1,2,3,7,8,9	0.6	0.3	ND	-	1.1
H ₇ CDD - Total	846	538.2	230	-	1800
1,2,3,4,6,7,8	225.8	145.3	69	-	490
O ₈ CDD - Total	2100	1410.0	700	-	4700
Furans					
T ₄ CDF - Total	ND	-	ND	-	5.5
2,3,7,8	ND	-	ND	-	1.4
P ₅ CDF - Total	10.12	14.5	1.0	-	39
1,2,3,7,8	ND	-	ND	-	0.4
2,3,4,7,8	ND	-	ND	-	0.5
H ₆ CDF - Total	44.36	34.9	9.8	-	110
1,2,3,4,7,8	ND	-	ND	-	1.3
1,2,3,6,7,8	ND	-	ND	-	0.5
2,3,4,6,7,8	ND	-	ND	-	0.7
1,2,3,7,8,9	ND	-	ND	-	ND
H ₇ CDF - Total	62.4	37.8	22.0	-	130
1,2,3,4,6,7,8	22.2	13.6	8.0	-	47
1,2,3,4,7,8,9	ND	-	ND	-	ND
O ₈ CDF	10.64	6.6	3.0	-	22

¹ND = non-detectable (See appendix 9 for detection limits)

DISCUSSION

High levels of some metals such as iron, zinc and magnesium, found in the muscle tissue of the Finlayson caribou, are considered normal. Because these metals are essential in the diet of most animals (including humans), they are not of toxicological importance at these levels. Metals of more concern, such as cadmium and arsenic, were found at very low levels in muscle tissue. For the most part, metal concentrations in liver and kidney from Finlayson caribou were comparable to levels found in caribou from Prince of Wales Island and in muskoxen (*Ovibos moschatus*) from Victoria Island (Table 5). There were, however, some exceptions.

Barium concentrations in liver and kidney were higher than in caribou from Prince of Wales Island (Shaw and Gunn 1981). Although barium levels in bone from other caribou were not available for comparison, the level in bone from the Finlayson herd was substantially higher than is considered normal for humans (Jaworski 1982). Because bone is the accumulator tissue for this metal, higher levels of barium are to be expected there than in the soft tissues. It is unlikely that these levels are indicative of health problems in the caribou or pose a health concern for humans using the caribou as food.

Total mercury in Finlayson caribou kidney was higher than was found in muskoxen from Victoria Island (Salisbury et al. 1992). The mercury content of kidneys from other caribou was unavailable for comparison. Further analysis of liver and kidneys from the Finlayson herd found no methyl mercury in either organ, indicating that all mercury present was in the relatively non-toxic inorganic form. In this case, mercury should not pose a hazard to humans consuming the caribou kidneys.

The positive correlation between age and organ cadmium levels that was seen in the Finlayson caribou has been demonstrated in other herds (Crete et al. 1989, Froslic et al. 1986, Gamberg and Scheuhammer *in press*). Higher cadmium levels in older animals reflect accumulation of the contaminant in tissue, over the lifespan of each animal. It is therefore essential to consider age when making inter- or intra-specific comparisons of tissue cadmium concentrations, or when estimating cadmium intake by human consumers of these caribou.

Cadmium levels in livers and kidneys from Finlayson caribou were considerably higher than in caribou from the Canadian Arctic and Norway (Table 6). The cadmium concentration in the kidney of one individual from the Finlayson herd was high enough to expect some renal damage, although this was not evaluated. In general, caribou from different herds across the Arctic have similar levels of cadmium, indicating contamination from long range atmospheric transport on a global basis. The higher cadmium load in the Finlayson herd may be indicative of a local source of contamination.

The high concentrations of barium, mercury and cadmium in livers and kidneys of Finlayson caribou may be a result of either anthropogenic activity or naturally high levels of these metals in the local environment. Barium is used in rodenticides and insecticides, and as an additive to diesel fuel to eliminate smoke (Jaworski 1982). Mercury may be released into the environment through incineration of municipal waste, sewage treatment, and the combustion of fossil fuels (Jaworski 1980). The major emissions of cadmium in Canada are the mining and refining of lead, zinc and copper, the manufacture of cadmium pigments and alloys and the use of motor vehicles (Jaworski 1980). While any of these sources may contribute to the contaminant loading of the area, only mining could explain why levels are higher here than in other communities (which would presumably have

similar uses of motor vehicles, insecticides, sewage treatment etc.) A large lead-zinc mine in Faro, near Ross River, has been operative since 1969, giving evidence to the high levels of natural mineralization in the area. Analysis of stream sediments and water in this region by the National Geologic Survey of Canada (Friske and Hornbrook 1988), shows the prevalence of a geological formation known as the 'Earn group' which includes black shales known to be rich in cadmium and barium. Cretaceous outcroppings are also common, although more localized, and are associated with elevated levels of mercury. These metals may become mobilized in the environment through normal weathering and erosion of the rock, and become incorporated into soil and plants, and subsequently into herbivores. This natural process may in itself account for the high concentrations of metals seen in Finlayson caribou. However, the mining of this mineral-rich rock may exacerbate the situation by liberating more of these metals in dust, emissions and effluents. Further research is required to determine what role, if any, mining plays in the contamination of the local environment.

The Finlayson herd had slightly more cesium¹³⁷ in muscle tissue than the Porcupine herd, but less than other woodland herds from the Yukon (Table 7). In general, the cesium levels found were well within the range found in caribou from the Arctic in the past decade (Thomas et al. 1992), and do not indicate health problems for the animals. The radioactive fallout that exists in the north at present is largely a result of atmospheric weapons tests of the early 1960's, and levels have been declining since that time (Thomas et al. 1992). No point sources of radioactivity in the Yukon are known.

Little information is available on organochlorines in Arctic terrestrial mammals. However, the data that exists suggest that the most abundant forms are HCB and the HCH isomers, and that concentrations tend to be similar among locations (Thomas et al. 1992). This indicates atmospheric contamination by long-range transport. Levels of these contaminants in fat tissue from the Finlayson herd are low compared with levels found in caribou from other locations in the north (Table 8), and do not appear to be high enough to affect the health of the caribou. All other organochlorines, including PCBs, measured in the Finlayson herd were below detection limits, indicating lower levels of organochlorine contamination than other caribou analyzed.

No data on dioxins and furans in Arctic terrestrial mammals other than the Finlayson caribou herd are available for comparison. However, the pattern of contamination in caribou fat is remarkably similar to patterns seen in air (Eitzer and Hites 1989), which may indicate an atmospheric vector and ultimately a combustion-related source (leaded gasoline engines, municipal waste incineration, forest fires). This pattern is not usually seen in animals and may be the result either of very high intake or contamination of the samples prior to or during analysis.

Table 5. Mean metal concentrations in livers and kidneys of Arctic caribou and muskoxen ($\mu\text{g/g}$ wet weight).

	Kidney			Liver		
	Yukon ¹ X (N=32)	NWT ^{2,4} X (N=5)	NWT ³ X (N=54)	Yukon ¹ X (N=32)	NWT ^{2,4} X(N=5)	NWT ³ X(N=37)
Aluminum	0.44	4.52	-	0.35	13.7	-
Antimony	<0.002	-	-	<0.002	-	-
Arsenic	0.02	-	0.03	0.02	-	0.05
Barium	0.83	0.05	-	0.18	0.09	-
Beryllium	<0.002	-	-	<0.002	-	-
Boron	0.07	-	-	0.07	-	-
Chromium	0.07	2.46	-	0.08	2.78	-
Cobalt	0.04	ND	-	0.06	0.76	-
Copper	5.18	5.19	2.92	26.13	17.2	66.5
Iron	36.1	43.6	-	281	319	-
Lead	0.11	2.8	0.10	0.14	3.00	0.12
Manganese	1.63	1.64	1.31	3.41	3.75	3.21
Mercury	0.85	-	0.23	-	-	0.07
Molybdenum	0.23	ND	-	0.87	4.00	-
Nickel	0.06	0.2	-	<0.02	ND	-
Selenium	1.02	-	0.36	0.46	-	0.10
Silver	0.002	ND	-	0.37	0.22	-
Strontium	0.1	0.05	-	0.03	0.04	-
Thallium	0.005	-	-	0.002	-	-
Tin	0.03	-	-	0.03	-	-
Uranium	<0.001	-	-	<0.001	-	-
Vanadium	<0.02	ND	-	<0.02	0.14	-
Zinc	30.9	28.8	27.6	30.9	28.8	28.1
Calcium	92	84.2	-	43	49.8	-
Magnesium	157	157	-	181	173	-

¹ Finlayson caribou herd; Data from this study

² Prince of Wales caribou herd (Shaw and Gunn 1981)

³ Victoria Island muskoxen herd (Salisbury et al. 1992)

⁴ ND = Non-detectable

- = not measured

Table 6. Mean cadmium concentrations in (N) livers and kidneys from Arctic caribou ($\mu\text{g/g}$ wet wt).

Age (yr)	Norway ¹	Yukon/NWT ²	Finlayson ³
Kidney			
<0.5	-	2.9 (12)	8.2 (1)
0.5-1.5	2.6 (35)	5.1 (16)	-
1.5-3.5	4.4 (24)	5.4 (25)	20.4 (9)
3.5-5.5	6.5 (29)	8.5 (16)	26.5 (10)
5.5-8.5	12.8 (19)	11.0 (9)	47.5 (9)
>8.5	19.8 (4)	19.0 (8)	47.3 (3)
Liver			
<0.5	-	0.5 (12)	2.0 (1)
0.5-1.5	0.7 (48)	0.9 (17)	-
1.5-3.5	1.0 (39)	1.1 (33)	3.2 (9)
3.5-5.5	1.2 (43)	1.6 (34)	3.0 (10)
5.5-8.5	1.8 (29)	1.8 (23)	6.1 (9)
>8.5	1.8 (10)	2.2 (22)	4.7 (3)

¹ Data from Froslic et al. 1986 (whole liver, whole kidney)

² Data from Gamberg and Scheuhammer 1993 (whole liver, renal cortex)

³ Data from this study (whole liver, whole kidney)

Table 7. Mean Cesium¹³⁷ in caribou muscle tissue from the Canadian Arctic (Bq/kg wet weight). (From Thomas et al. 1992)

Herd	Location	1986-1988	1962-1966
Barren-ground caribou			
<i>Western Arctic</i>			
Bathurst	Yellowknife	460	2000
Bluenose	Inuvik	140	800
Porcupine	Mackenzie delta	40	800
	Eagle Plains	50	-
	Old Crow	-	500
	Arctic Village	130	-
<i>Eastern Arctic and Islands</i>			
Baffin	Pond Inlet	40	400
Baffin	Iqaluit	290	-
Beverly	Tent Lake	320	1000
Kaminuriak	Baker Lake	220	-
	Rankin Inlet	210	2000
	Eskimo Point	350	2000
	Repulse Bay	350	2000
Melville	Cambridge Bay	45	-
Southampton Island	Coral Harbour	170	-
Belcher Islands	Sanikiluaq	55	-
Woodland caribou			
<i>Quebec and Labrador</i>			
George River	Caniapiscau	740	-
	George River	280	-
	Kuujjuak	10	-
	Riviere aux Feuilles	520	-
<i>Yukon</i>			
Several Herds	Yukon	250	1000

Table 8. Organochlorines in caribou fat tissue from the Canadian Arctic (ng/g wet weight).

Location	Ross River ¹ X (N=5)	Pond Inlet ² X (N=1)	Lake Hbr. ² X (N=1)	Iqaluit ² X (N=1)	Arctic Bay ² X (N=1)	Clyde Riv. ² X (N=1)	Broughton Is. ³ X (N=1)
HCB	32.1	30	47	84	57	57	25
alpha-HCH	4.05	9.8	22	25	39	6	18
beta-HCH	0.655	1.8	1.3	0.8	3.0	0.5	0.6
gamma-HCH	0.33	1.6	1.7	1.5	2.8	0.3	0.6
Heptachlor	<0.2	-	-	-	-	-	-
Aldrin	<.06	-	-	-	-	-	-
Oxychlorane	<0.45	3.0	3.8	1.2	2.9	2.8	2.5
trans-Chlordane	<0.03	-	-	-	-	-	-
cis-Chlordane	<0.04	-	-	-	-	-	-
Total	< 0.035	2.1	0.3	0.1	0.8	<0.1	<0.1
trans-Nonachlor	<0.03	-	-	-	-	-	-
cis-Nonachlor	<0.04	-	-	-	-	-	-
o,p'-DDE	<0.04	-	-	-	-	-	-
p,p'-DDE	<0.08	0.4	1.2	1.6	0.6	0.4	4.2
o,p'-DDD	<0.04	-	-	-	-	-	-
p,p'-DDD	<0.05	1.2	0.5	0.4	1.2	<0.3	0.7
o,p'-DDT	<0.25	-	-	-	-	-	-
p,p'-DDT	<0.25	1.3	1.5	<0.3	0.4	<0.4	0.9
Mirex	<0.04	0.2	0.1	0.3	0.08	0.4	<0.1

¹ Data from this study; means of composite samples (4-5 individuals/composite)² Data from Thomas and Hamilton 1988³ Data from Muir et al. 1988

Table 8 (Continued)

Location	Ross River ¹ X (N=5)	Pond Inlet ² X (N=1)	Lake Hr. ² X (N=1)	Iqaluit ² X (N=1)	Arctic Bay ² X (N=1)	Clyde Riv. ² X (N=1)	Broughton Is. ³ X (N=1)
Heptachlor Epoxide	<0.4	-	-	-	-	-	-
alpha-Endosulphan	<0.5	-	-	-	-	-	-
Dieldrin	<0.5	0.8	1.5	0.9	0.8	0.7	1.7
Endrin	<0.8	-	-	-	-	-	-
Methoxychlor	<2.8	-	-	-	-	-	-
Aroclor 1242	<0.9	-	-	-	-	-	-
Aroclor 1254	<1.2	-	-	-	-	-	-
Aroclor 1260	<1.8	-	-	-	-	-	-
Total PCBs	<1.3	11	25	52	12	23	33

¹ Data from this study; means of composite samples (4-5 individuals/composite)

² Data from Thomas and Hamilton 1988

³ Data from Muir et al. 1988

RECOMMENDATIONS

The Finlayson herd is one of only two caribou herds in the Yukon to be surveyed for contaminants, the other being the Porcupine herd. Because high levels of some contaminants were found in both herds, it is recommended that other caribou herds be surveyed to determine levels of metallic and organic contaminants.

Elevated cadmium levels are of concern in both the Finlayson and the Porcupine caribou herds. In order to confirm the suspected food chain transfer of cadmium, lichens should be collected and analyzed for this metal. In addition, caribou kidneys containing high concentrations of cadmium should be examined histologically to determine if renal damage has occurred.

The high levels of inorganic mercury and barium are of some interest, and could be compared with concentrations in other caribou from the Territory.

The unusual pattern of dioxin and furan deposition observed in Finlayson caribou is currently not well understood. Further analysis of this herd, analyzing individuals rather than composite samples, analysis of lichens as a food source, and comparisons with other caribou herds from the Territory, should increase our understanding of the source of contamination, and its geographical extent within the Territory.

As a result of contaminants found in caribou, people in the Yukon, particularly First Nations, are concerned about contaminants in other country foods. Other wildlife species that are commonly used as food should be surveyed for metals, organochlorines, dioxins and furans.

LITERATURE CITED

- Crete, M., Nault, R., Walsh, P., Benedetti, J.-L., Lefebvre, M.A., Weber, J.-P. and J. Gagnon. 1989. Variation in cadmium content of caribou tissues from northern Quebec. *Sci. Tot. Environ.* 80:103-112.
- Eitzer, B.D. and R.A. Hites. 1989. Dioxins and furans in the ambient atmosphere: a baseline study. *Chemosphere* 18:593-598.
- Frisk, P.W.B. and E.H.W. Hornbrook. 1988. Regional Stream Sediment and Water Geochemical Data, Southeast Yukon. Geological Survey of Canada Open File 1648 (105G).
- Froslie, A., Haugen, A., Holt, G. and G. Norheim. 1986. Levels of cadmium in liver and kidneys from Norwegian Cervides. *Bull. Environ. Contam. Toxicol.* 37:453-460.
- Gamberg, M. and A.M. Scheuhammer. (in press) Cadmium in caribou and muskoxen from the Canadian Yukon and Northwest Territories. *Sci. Tot. Environ.*
- Jaworski, J.F. 1982. Data sheets on selected toxic elements. National Research Council Canada Associate Committee on Scientific Criteria for Environmental Quality. 61 pp.
- Jaworski, J.F. 1980. Executive reports: Effects of chromium, alkali halides, arsenic, asbestos, mercury and cadmium in the Canadian environment. National Research Council Canada Associate Committee on Scientific Criteria for Environmental Quality. 80 pp.
- Muir, D., Ford, C. and B. Grift. 1988. Analysis of dietary samples from Broughton Island (NWT) for PCBs and related organochlorine contaminants. Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg. 22 pp.
- Salisbury, C.D.C., Fesser, A.C.E., MacNeil, J.D., Patterson, J.R., Adamczewski, J.Z., Flood, P.F. and A. Gunn. 1992. Trace metal and pesticide levels in muskoxen from Victoria Island, Northwest Territories, Canada. *Intern. J. Environ. Anal. Chem.* 48:209-215.
- SAS Institute Inc. SAS User's Guide: Statistics, Version 5 Edition. Cary, NC:SAS institute Inc., 1985. 956 pp.
- Shaw, G.G. and A. Gunn. 1981. Element concentrations in high Arctic vegetation and some Caribou and Lemmings. Unpublished manuscript, Canadian Wildlife Service. 28 pp.
- Taylor, H.W., Svoboda, J., Henry, G.H.R. and R.W. Wein. 1988. Post-Chernobyl ¹³⁴Cs and ¹³⁷Cs levels at some localities in northern Canada. *Arctic* 41:293.
- Thomas, D.J. and M.C. Hamilton. 1988. Organochlorine residues in biota of the Baffin Island region. Seakem Oceanography Ltd., Sidney, B.C., 148 pp.

Thomas, D.J., Tracey, B, Marshall, H. and R.J. Norstrom. 1992. Arctic terrestrial ecosystem contamination. *Sci. Tot. Environ.* 122:135-164.

Wong, M.P. 1985. Chemical residues in fish and wildlife harvested in northern Canada. *Environmental Studies No. 46*, Department of Indian and Northern Affairs.

Appendix 1. Composition of pooled Finlayson caribou muscle and fat samples.

Composite Muscle Samples

F92-1M:F92-28	F92-2M:F92-25	F92-3M:F92-22
F92-13	F92-29	F92-32
F92-30	F92-33	F92-17
F92-31	F92-26	F92-16
F92-27	F92-24	F92-07
F92-4M:F92-09	F92-5M:F92-06	F92-6M:F92-03
F92-20	F92-15	F92-19
F92-05	F92-11	F92-23
F92-21	F92-08	F92-02
F92-01	F92-04	F92-12
		F92-14

Composite Fat Samples

CF1:F92-21	CF2:F92-15	CF3:F92-19	CF4:F92-22	CF5:F92-12
F92-17	F92-31	F92-32	F92-13	F92-27
F92-25	F92-24	F92-18	F92-14	F92-30
F92-33	F92-16	F92-29	F92-23	F92-28
	F92-20			F92-26

Each pooled sample consisted of 10 ± 0.1 g of each randomly chosen individual sample for a total of 40g/sample (CF1, CF3, CF4), 50g/sample (F92-1M - F92-5M, CF2, CF5), or 60g/sample (F92-6M).

Appendix 2. Analytical techniques used for organochlorines,
dioxins and furans

ANALYSIS OF PCBs AND PESTICIDES IN TISSUES

Summary

All samples were spiked with aliquots of ^{13}C -labelled surrogates (hexachlorobenzene, PCB 101, PCB 180, and PCB 209) and perdeuterated alpha-endosulphan prior to analysis. Tissue samples were ground with sodium sulphate, packed in a glass chromatographic column, and eluted with solvent prior to separation into two fractions (F1 and F2) on a Florisil column. F1 was analyzed by GC/MS for PCBs (as Aroclors), non-polar and moderately polar chlorinated pesticides. F2 was analyzed for the most polar chlorinated pesticides by GC/ECD.

1. EXTRACTION METHOD

A subsample of tissue was dried to determine moisture content.

A homogenized wet tissue sample was spiked with an aliquot of surrogate standard solution, mixed with powdered anhydrous sodium sulphate and ground until the mixture was a free-flowing powder. The mixture was transferred to a glass chromatographic column containing 1:1 dichloromethane:hexane and eluted with additional solvent. The eluate was collected and concentrated. The extract was subsampled for gravimetric lipid analysis.

The remaining extract was loaded onto a calibrated Biobeads SX-3 column and eluted with 1:1 dichloromethane:hexane. The 140 - 290 mL fraction was collected and concentrated. The extract was ready for column cleanup procedures.

2. EXTRACT CLEANUP

The tissue extract from the Biobead column was applied to a Florisil column. The column was eluted with hexane followed by 15:85 dichloromethane:hexane. The eluates were combined (F1). The column was then eluted with 1:1 dichloromethane:hexane (F2). Each fraction was concentrated to a small volume.

F1 was transferred to a microvial and an aliquot of recovery standard (^{13}C -labelled PCB 153) added. The volume made to 100 μL and the microvial capped, ready for GC/MS analysis. F2 was transferred to a microvial and an aliquot of recovery standard (^{13}C -labelled PCB 153) added. The volume was made to 100 μL and the microvial capped, ready for GC/ECD analysis.

3. GC/MS ANALYSIS OF PCBs AND PESTICIDES

Fraction 1 was analyzed for PCBs as Aroclors and non-polar and moderately polar chlorinated pesticides using a Finnigan INCOS 50 mass spectrometer equipped with a Varian 3400 GC, a CTC autosampler and a DG 10 data system running Incos 50 (Rev 9) software. Chromatographic separation of PCBs and pesticides was achieved with a 60 metre DB-5 chromatography column (0.25 mm i.d., 0.10 μ m film thickness). The MS was operated at unit mass resolution in the MID mode acquiring two characteristic ions for each target analyte and surrogate standard.

4. GC/ECD ANALYSIS OF PESTICIDES

Polar chlorinated pesticides in F2 were analyzed (by GC/ECD) using a Hewlett Packard 5890 gas chromatograph, equipped with a 60 m x 0.25 mm, 0.10 μ m film DB5 Durabond Fused Silica capillary column and a ^{63}Ni electron capture detector.

**ANALYSIS OF POLYCHLORINATED DIBENZODIOXINS
AND DIBENZOFURANS IN TISSUE**

Summary

All samples were spiked with ^{13}C -labelled surrogates (tetrachlorodioxin, tetrachlorofuran, pentachlorodioxin, pentachlorofuran, hexachlorodioxin, hexachlorofuran, heptachlorodioxin, heptachlorofuran, and octachlorodioxin) prior to analysis. Tissue samples were ground with sodium sulphate, packed in a glass chromatographic column and eluted with solvent. The extracts were subject to a series of cleanup steps and then analyzed by high resolution gas chromatography with high resolution mass spectrometric detection (HRGC/HRMS).

1. EXTRACTION METHOD

A subsample of tissue was dried for moisture determination.

A wet tissue sample was spiked with an aliquot of surrogate standard and ground with anhydrous sodium sulphate to a free flowing powder. The mixture was loaded into a glass chromatographic column containing dichloromethane:hexane and the column eluted with additional solvent. The extract was concentrated, loaded onto a calibrated Biobeads SX-3 column and eluted with dichloromethane/hexane. The 150 - 300 mL fraction was retained and concentrated prior to chromatographic cleanup.

2. COLUMN CHROMATOGRAPHY

a) Silica Gel Column

The extract was transferred to a 10 gram layered silica gel column (layers: activated silica gel, silica gel treated with sodium hydroxide, activated silica gel, silica gel treated with sulfuric acid; activated silica gel) and eluted with hexane.

b) Alumina Column

The extract from the silica gel column was loaded onto a 10 gram basic alumina column. The first fraction, eluted with 3% dichloromethane/hexane was discarded. The next fraction, eluted with 1:1 dichloromethane/hexane was retained.

c) Carbon/Celite Column

The extract from the alumina column was loaded onto a carbon/celite column. The first fraction (F1), which eluted with cyclohexane/dichloromethane followed by toluene/ethyl acetate was discarded. The column was then inverted and eluted with toluene. This fraction (F2) was evaporated to near dryness and was redissolved in hexane.

d) Alumina Column

The extract from the carbon/celite column procedure was loaded onto the alumina column. The first fraction, eluted with 3% dichloromethane/hexane was discarded. The next fraction, eluted with 1:1 dichloromethane/hexane was retained and concentrated to 1 mL.

e) Preparation for GC/MS Analysis

The extract was evaporated just to dryness and an aliquot of ^{13}C -labelled recovery standards (1,2,3,4-tetrachlorodibenzodioxin and 1,2,3,7,8,9-hexachlorodibenzodioxin) was added.

3. GC/MS ANALYSIS

High resolution analysis of polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) was carried out using on a VG 70SE mass spectrometer equipped with a Hewlett Packard 5890 GC, a 60 m DB-5 chromatography column (0.25 mm i.d x 0.1 μm film thickness) and a CTC autosampler. Data were acquired in the Multiple Ion Detection (MID) mode to enhance sensitivity. At least three ions were monitored for each group of isomers. Two were from the parent cluster while the third was from the loss of COCl (i.e. M-COCl or M-63). Two ions were used to monitor each of the ^{13}C labelled surrogate standards and five additional ions were monitored to check for interference from chlorinated diphenyl ethers.

Appendix 3. Mean metal concentrations in Finlayson caribou tissues
($\mu\text{g/g}$ wet weight).

	Bone				Muscle			
	N	X	SD	Range	N ¹	X	SD	Range
Aluminum	33	1.28	0.61	0.47 - 4.19	6	0.52	0.18	0.23 - 0.95
Antimony	33	<0.005	-	<0.005 - 0.012	6	<0.002	-	<0.002 - 0.002
Arsenic	33	<0.04	-	<0.04 - 0.06	6	<0.01	-	<0.01 - 0.01
Barium	33	447	138	244 - 790	6	0.10	0.08	<0.10 - 0.27
Beryllium	33	<0.01	-	<0.01 - 0.02	6	<0.002	-	<0.002 - 0.002
Boron	33	0.42	0.09	0.28 - 0.60	6	0.08	0.01	0.06 - 0.10
Cadmium	33	0.017	0.008	0.006 - 0.041	6	0.031	0.019	0.015 - 0.104
Chromium	33	0.31	0.09	0.17 - 0.54	6	0.08	0.01	0.07 - 0.11
Cobalt	33	0.32	0.03	0.24 - 0.39	6	<0.01	-	<0.01 - <0.01
Copper	33	0.53	0.62	0.21 - 3.93	6	2.94	0.25	2.57 - 3.52
Iron	33	16.9	5.4	10.5 - 39.1	6	46.0	5.0	41.5 - 56.5
Lead	33	0.80	0.30	0.15 - 1.48	6	0.02	0.01	<0.01 - 0.04
Manganese	33	0.78	0.19	0.48 - 1.26	6	0.32	0.04	0.25 - 0.37
Mercury	-	-	-	-	-	-	-	-
Molybdenum	33	0.05	0.02	0.01 - 0.10	6	<0.01	-	<0.01 - 0.02
Nickel	33	0.69	1.48	0.04 - 6.85	6	0.03	0.01	<0.02 - 0.04
Selenium	33	0.13	0.07	<0.05 - 0.27	6	0.22	0.04	0.18 - 0.29
Silver	33	0.005	0.003	0.002 - 0.015	6	<0.001	-	<0.001 - <0.001
Strontium	33	216	36	157 - 272	6	0.02	0.004	0.02 - 0.03
Thallium	33	0.004	0.004	0.001 - 0.017	6	<0.001	-	<0.001 - 0.004
Tin	33	0.09	0.10	<0.02 - 0.46	6	0.06	0.08	<0.02 - 0.23
Uranium	33	0.006	0.006	<0.001 - 0.025	6	0.002	0.003	<0.001 - 0.008
Vanadium	33	<0.02	-	<0.02 - 0.08	6	<0.02	-	<0.02 - <0.02
Zinc	33	71.2	10.8	51.2 - 98.9	6	45.1	5.1	36.1 - 52.4
Calcium	33	210970	15357	173000 - 235000	6	36	3	31 - 42
Magnesium	33	2532	235	2050 - 3170	6	249	27	217 - 306

¹ Each muscle sample is a composite of 5-6 individual samples

	Kidney				Liver			
	N	X	SD	Range	N	X	SD	Range
Aluminum	32	0.44	0.17	<0.20 - 0.94	32	0.35	0.15	<0.20 - 0.74
Antimony	32	<0.002	-	<0.002 - 0.006	32	<0.002	-	<0.002 - 0.003
Arsenic	32	0.02	0.03	<0.01 - 0.17	32	0.02	0.01	<0.01 - 0.04
Barium	32	0.83	0.48	0.43 - 3.19	32	0.18	0.06	<0.10 - 0.43
Beryllium	32	<0.002	-	<0.002 - 0.003	32	<0.002	-	<0.002 - <0.002
Boron	32	0.07	0.01	0.06 - 0.09	32	0.07	0.01	0.06 - 0.10
Cadmium	32	32.0	25.1	5.4 - 141.1	32	4.53	3.23	0.78 - 19.69
Chromium	32	0.07	0.04	0.05 - 0.29	32	0.08	0.01	0.07 - 0.11
Cobalt	32	0.04	0.01	0.02 - 0.06	32	0.06	0.01	0.04 - 0.08
Copper	32	5.18	1.60	3.77 - 13.57	32	26.13	12.13	7.80 - 59.04
Iron	32	36.1	9.9	19.3 - 54.5	32	281	124	126 - 601
Lead	32	0.11	0.08	0.05 - 0.45	32	0.14	0.04	0.07 - 0.21
Manganese	32	1.63	0.29	1.11 - 2.23	32	3.41	0.60	2.30 - 5.25
Mercury	32	0.85	0.26	0.46 - 1.71	-	-	-	-
Molybdenum	32	0.23	0.04	0.16 - 0.31	32	0.87	0.09	0.69 - 1.05
Nickel	32	0.06	0.16	<0.02 - 0.93	32	<0.02	-	<0.02 - <0.02
Selenium	32	1.02	0.09	0.80 - 1.23	32	0.46	0.08	0.26 - 0.67
Silver	32	0.002	0.001	<0.001 - 0.006	32	0.370	0.156	0.111 - 0.678
Strontium	32	0.1	0.1	0.1 - 0.4	32	0.03	0.01	0.02 - 0.06
Thallium	32	0.005	0.002	0.002 - 0.011	32	0.002	0.002	<0.001 - 0.01
Tin	32	0.03	0.03	<0.02 - 0.10	32	0.03	0.03	<0.02 - 0.142
Uranium	32	<0.001	-	<0.001 - 0.009	32	<0.001	0.002	<0.001 - 0.014
Vanadium	32	<0.02	-	<0.02 - <0.02	32	<0.02	-	<0.02 - <0.02
Zinc	32	30.9	5.5	20.5 - 51.7	32	30.9	6.6	21.8 - 49.1
Calcium	32	92	37	64 - 290	32	43	5	36 - 55
Magnesium	32	157	12	137 - 194	32	181	14	162 - 212

Appendix 4. Metal concentrations in Finlayson caribou
tissues: individual results ($\mu\text{g/g}$ wet weight).

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22736A	92-22736B	92-22737	92-22738	92-22739	92-22740	92-22741	92-22742	92-22743	92-22744	92-22745A
Tissue Type	Bone	Duplicate	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone
	F92-01		F92-02	F92-03	F92-04	F92-05	F92-06	F92-07	F92-08	F92-09	F92-10
% H2O	13.2	13.2	10.2	11.5	13.1	14.0	17.0	11.9	13.3	11.5	11.9
Aluminum	3.90	4.19	1.99	1.38	1.57	1.51	1.07	1.59	0.85	1.56	1.81
Antimony	0.008	0.005	< 0.005	< 0.005	0.008	< 0.005	< 0.005	< 0.005	< 0.005	0.007	0.006
Arsenic	0.06	0.04	< 0.04	< 0.04	0.05	< 0.04	< 0.04	0.04	< 0.04	< 0.04	0.04
Barium	281	279	486	629	460	346	270	419	336	471	316
Beryllium	< 0.01	0.011	< 0.01	< 0.01	0.012	< 0.01	< 0.01	0.011	< 0.01	< 0.01	< 0.01
Boron	0.52	0.51	0.48	0.60	0.56	0.59	0.44	0.51	0.39	0.56	0.47
Cadmium	0.009	0.008	0.014	0.024	0.028	0.017	0.006	0.030	0.010	0.018	0.012
Chromium	0.43	0.43	0.45	0.54	0.43	0.39	0.36	0.49	0.37	0.38	0.30
Cobalt	0.38	0.38	0.39	0.37	0.34	0.33	0.31	0.35	0.33	0.35	0.33
Copper	0.28	0.30	0.48	0.34	0.56	0.36	0.21	0.64	0.58	0.54	0.60
Iron	28.6	20.3	19.0	16.8	22.4	16.6	16.2	25.9	18.5	20.1	18.0
Lead	0.78	0.76	1.48	0.81	0.59	0.51	0.49	1.26	0.90	1.07	0.59
Manganese	1.26	1.05	1.23	0.69	0.69	0.69	0.48	0.82	0.59	0.89	0.91
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	0.06	0.05	0.07	0.04	0.05	0.06	0.04	0.04	0.03	0.08	0.04
Nickel	0.37	0.38	0.15	0.63	0.59	0.27	6.11	0.58	0.26	0.14	0.35
Selenium	0.16	0.15	< 0.05	0.11	0.15	0.26	< 0.05	< 0.05	0.16	< 0.05	0.21
Silver	0.015	0.009	0.006	0.008	0.010	0.008	0.004	0.007	0.005	0.005	0.004
Strontium	160	158	209	199	211	188	186	183	250	200	259
Thallium	0.007	0.005	0.004	0.003	0.002	0.002	0.001	0.014	0.004	0.003	0.002
Tin	0.16	0.11	0.07	0.07	0.05	0.04	0.03	0.12	0.06	0.21	0.08
Uranium	0.007	0.006	0.005	0.002	0.005	0.004	0.002	0.010	0.004	0.013	0.006
Vanadium	0.07	0.06	0.05	0.03	0.05	0.02	0.02	0.03	< 0.02	< 0.02	0.02
Zinc	73.8	80.2	98.9	71.4	62.3	72.6	56.9	78.7	73.6	67.4	78.1
Calcium	220000	217000	235000	222000	214000	204000	190000	222000	206000	227000	214000
Magnesium	2810	2960	2680	2580	2630	2660	2730	2660	2440	2620	2550

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	92-22745B	92-22746	92-22747	92-22748	92-22749	92-22750	92-22751	92-22752	92-22753	92-22754	92-22755
Tissue Type	Duplicate	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone
		F92-11	F92-12	F92-13	F92-14	F92-15	F92-16	F92-17	F92-18	F92-19	F92-20
% H ₂ O	12.4	10.7	15.0	14.6	12.9	13.6	16.1	12.6	12.9	15.2	14.1
Aluminum	1.43	0.88	0.47	1.31	0.92	0.89	1.01	0.74	1.10	1.16	2.14
Antimony	< 0.005	< 0.005	0.012	0.007	< 0.005	< 0.005	< 0.005	< 0.005	0.007	0.005	0.005
Arsenic	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.05	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Barium	325	401	778	432	427	429	244	366	632	525	423
Beryllium	0.015	< 0.01	0.010	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Boron	0.56	0.35	0.51	0.39	0.38	0.45	0.35	0.32	0.42	0.29	0.28
Cadmium	0.016	0.008	0.025	0.030	0.015	0.011	0.010	0.012	0.015	0.028	0.041
Chromium	0.32	0.26	0.25	0.28	0.29	0.29	0.24	0.26	0.36	0.32	0.47
Cobalt	0.32	0.27	0.31	0.33	0.31	0.34	0.29	0.31	0.31	0.30	0.31
Copper	0.23	0.29	0.28	0.56	0.67	0.32	0.32	0.41	3.93	0.33	0.37
Iron	18.8	14.5	19.0	18.2	15.1	14.9	14.2	14.4	39.1	16.1	18.1
Lead	0.58	0.45	0.87	0.72	0.97	0.58	0.59	0.90	1.00	0.94	0.62
Manganese	0.95	0.72	0.77	0.59	0.78	0.65	0.59	0.87	0.73	0.70	0.55
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	0.03	0.03	0.09	0.05	0.03	0.10	0.02	0.04	0.05	0.05	0.01
Nickel	0.19	0.16	0.55	0.27	0.39	0.07	0.54	0.25	6.85	0.42	0.41
Selenium	< 0.05	0.16	0.26	0.18	0.12	0.06	0.23	0.20	0.27	0.12	0.25
Silver	0.005	0.008	0.005	0.006	0.004	0.004	0.004	0.002	0.004	0.004	0.006
Strontium	253	206	269	164	199	198	160	196	249	238	169
Thallium	0.002	0.001	0.017	0.005	0.003	0.002	0.002	0.001	0.002	0.001	0.002
Tin	0.08	0.19	0.46	0.17	0.10	0.04	< 0.02	< 0.02	0.27	0.09	0.09
Uranium	0.005	0.005	0.023	0.005	0.003	0.002	0.004	0.001	0.001	0.001	< 0.001
Vanadium	0.02	0.03	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	69.5	51.2	65.4	61.2	67.7	59.4	55.8	83.5	77.5	66.0	54.7
Calcium	215000	173000	204000	201000	211000	219000	193000	213000	212000	191000	203000
Magnesium	2690	2050	2450	2330	2320	2520	2650	2300	2050	2390	2330

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22756	92-22757	92-22758	92-22759	92-22760	92-22761	92-22762	92-22763	92-22764	92-22765A	92-22765B
Tissue Type	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone	Duplicate
	F92-21	F92-22	F92-23	F92-24	F92-25	F92-26	F92-27	F92-28	F92-29	F92-30	
% H2O	11.2	13.4	12.3	11.9	12.0	11.9	12.1	10.5	11.6	10.5	10.6
Aluminum	0.65	0.97	1.37	1.11	0.96	1.30	1.18	1.39	0.76	1.08	1.46
Antimony	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.008	0.006	< 0.005	< 0.005	< 0.005
Arsenic	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Barium	616	370	520	504	330	319	669	331	508	341	351
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Boron	0.35	0.35	0.38	0.38	0.39	0.34	0.53	0.46	0.42	0.41	0.47
Cadmium	0.013	0.015	0.012	0.024	0.034	0.012	0.015	0.016	0.011	0.007	0.007
Chromium	0.25	0.20	0.25	0.22	0.29	0.22	0.25	0.26	0.23	0.23	0.32
Cobalt	0.29	0.24	0.30	0.31	0.33	0.32	0.31	0.35	0.33	0.32	0.32
Copper	0.35	0.34	0.41	0.34	0.55	0.29	0.33	1.05	0.31	0.22	0.65
Iron	12.1	11.2	11.8	10.8	14.9	15.6	12.1	13.0	19.1	14.7	21.6
Lead	0.25	0.15	0.29	1.31	1.00	0.93	0.72	0.83	0.75	0.74	1.06
Manganese	0.70	0.65	1.11	0.98	0.82	0.67	0.67	1.12	0.62	1.03	0.99
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	0.01	0.02	0.08	0.06	0.04	0.03	0.08	0.05	0.05	0.02	0.02
Nickel	0.21	0.09	0.25	0.12	0.47	0.20	0.12	0.30	0.20	0.04	1.05
Selenium	0.08	0.08	0.14	0.08	0.06	0.12	0.11	0.14	0.07	< 0.05	0.21
Silver	0.003	0.002	0.008	0.003	0.003	0.003	0.003	0.003	0.002	0.003	0.002
Strontium	237	259	230	254	188	193	272	268	257	272	271
Thallium	0.002	0.001	0.002	0.001	0.002	0.001	0.015	0.004	0.003	0.002	0.002
Tin	0.05	0.04	0.03	< 0.02	< 0.02	< 0.02	0.28	0.11	0.05	0.06	0.09
Uranium	0.005	0.002	0.003	0.002	0.002	0.002	0.025	0.009	0.004	0.013	0.015
Vanadium	0.06	0.05	0.08	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02
Zinc	75.0	72.5	67.5	72.2	83.4	83.2	59.7	89.3	58.0	83.7	87.7
Calcium	188000	173000	201000	219000	223000	219000	220000	235000	221000	226000	226000
Magnesium	2480	2370	2640	2300	2490	2430	2810	3170	2310	2870	3100

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22766	92-22767	92-22768	92-22769	92-22770A	92-22770B	92-22771	92-22772	92-22773	92-22774	92-22775
Tissue Type	Bone	Bone	Bone	Kidney	Kidney	Duplicate	Kidney	Kidney	Kidney	Kidney	Kidney
	F92-31	F92-32	F92-33	F92-01	F92-02		F92-03	F92-04	F92-05	F92-06	F92-07
% H2O	11.4	12.0	11.0	76.9	78.1	78.1	76.9	76.9	78.6	81.7	79.5
Aluminum	1.09	0.95	1.44	0.46	0.31	0.44	0.31	< 0.2	0.53	0.24	0.27
Antimony	< 0.005	< 0.005	< 0.005	0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002
Arsenic	< 0.04	< 0.04	< 0.04	0.03	0.02	0.02	0.02	0.02	< 0.01	< 0.01	0.01
Barium	470	291	790	0.46	0.80	0.73	0.96	0.54	0.52	0.69	3.19
Beryllium	< 0.01	< 0.01	< 0.01	< 0.002	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.33	0.34	0.44	0.09	0.06	0.07	0.06	0.09	0.08	0.07	0.08
Cadmium	0.011	0.015	0.013	8.2	79.4	79.6	38.7	15.1	12.8	5.4	36.4
Chromium	0.17	0.17	0.22	0.29	0.07	0.06	0.06	0.07	0.06	0.07	0.06
Cobalt	0.33	0.31	0.32	0.06	0.05	0.06	0.04	0.03	0.03	0.03	0.04
Copper	0.35	0.41	0.37	13.57	4.96	5.10	6.02	5.04	4.91	3.77	5.55
Iron	12.3	10.5	14.5	54.5	42.4	43.5	48.8	46.7	22.9	24.3	34.9
Lead	1.01	0.82	1.19	0.36	0.13	0.13	0.07	0.10	0.08	0.06	0.14
Manganese	0.66	0.79	0.95	1.69	1.72	1.67	1.84	1.56	2.23	1.66	1.22
Mercury	-	-	-	0.79	1.41	1.71	0.99	0.71	1.09	0.46	1.04
Molybdenum	0.03	0.03	0.03	0.26	0.30	0.29	0.25	0.23	0.24	0.22	0.22
Nickel	0.27	0.59	0.08	0.93	0.03	0.04	0.05	0.03	< 0.02	< 0.02	0.07
Selenium	0.14	0.14	0.24	1.07	1.14	1.21	1.05	1.09	1.08	0.98	1.09
Silver	0.002	0.003	0.002	0.002	0.001	0.001	0.001	0.001	< 0.001	0.001	0.003
Strontium	197	157	249	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4
Thallium	0.002	0.002	0.002	0.004	0.005	0.005	0.011	0.009	0.004	0.003	0.005
Tin	0.03	0.03	0.02	0.10	0.03	0.03	0.04	0.10	0.03	0.03	0.02
Uranium	0.002	0.007	0.003	< 0.001	< 0.001	< 0.001	0.004	0.009	0.002	0.001	0.001
Vanadium	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	72.6	76.3	80.2	27.6	39.9	40.2	34.5	27.0	26.4	20.5	35.6
Calcium	222000	218000	224000	88	88	86	95	81	92	85	290
Magnesium	2450	2510	2710	147	145	156	163	160	158	147	177

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	92-22776	92-22777	92-22778	92-22779	92-22780	92-22781A	92-22781B	92-22782	92-22783	92-22784	92-22785
Tissue Type	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Duplicate	Kidney	Kidney	Kidney	Kidney
	F92-08	F92-09	F92-10	F92-11	F92-12	F92-13		F92-14	F92-15	F92-16	F92-17
% H2O	79.7	82.0	77.7	79.0	78.0	80.0	79.4	79.7	77.2	76.4	81.1
Aluminum	0.42	0.32	0.27	0.72	0.38	0.57	0.64	0.64	0.29	0.29	0.42
Antimony	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.006	0.004	< 0.002	< 0.002	< 0.002	< 0.002
Arsenic	0.02	0.02	0.02	0.03	< 0.01	0.15	0.17	0.01	0.02	0.03	0.02
Barium	0.48	0.52	0.78	0.79	0.66	0.43	0.46	0.76	0.83	0.66	0.80
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002
Boron	0.07	0.08	0.09	0.08	0.07	0.06	0.07	0.06	0.07	0.06	0.06
Cadmium	16.9	35.1	13.4	12.7	40.0	27.0	30.7	23.0	53.4	10.1	25.2
Chromium	0.07	0.06	0.05	0.08	0.06	0.07	0.06	0.08	0.06	0.07	0.06
Cobalt	0.03	0.02	0.04	0.03	0.03	0.04	0.05	0.04	0.05	0.03	0.03
Copper	4.35	4.60	4.85	4.15	4.81	5.17	5.95	5.74	5.14	5.30	4.17
Iron	33.0	22.3	34.3	41.8	35.3	19.3	20.9	23.1	43.3	40.9	47.1
Lead	0.11	0.12	0.08	0.07	0.11	0.45	0.38	0.12	0.14	0.08	0.10
Manganese	1.57	1.35	1.78	1.42	1.97	1.45	1.56	1.87	2.22	2.06	1.56
Mercury	0.77	0.70	0.72	0.49	0.77	0.51	0.52	1.15	1.08	0.67	0.80
Molybdenum	0.17	0.19	0.24	0.25	0.22	0.22	0.25	0.30	0.27	0.19	0.30
Nickel	0.04	< 0.02	0.03	0.05	< 0.02	0.03	0.03	0.02	< 0.02	< 0.02	0.02
Selenium	1.05	0.80	1.09	1.04	1.06	0.96	0.96	1.10	1.06	1.02	0.88
Silver	0.001	0.001	< 0.001	< 0.001	< 0.001	0.003	0.004	0.001	0.001	< 0.001	< 0.001
Strontium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Thallium	0.003	0.009	0.007	0.004	0.004	0.007	0.007	0.006	0.006	0.004	0.007
Tin	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.05
Uranium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	24.7	28.3	26.7	26.3	32.4	27.2	29.0	29.4	37.1	28.2	29.3
Calcium	70	98	86	74	82	84	87	87	82	75	64
Magnesium	154	153	188	156	137	151	150	166	156	174	141

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22786	92-22787	92-22788	92-22789	92-22790	92-22791	92-22792	92-22793	92-22794	92-22795	92-22796
Tissue Type	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney
	F92-19	F92-20	F92-21	F92-22	F92-23	F92-24	F92-25	F92-26	F92-27	F92-28	F92-29
% H ₂ O	81.6	77.5	79.9	79.4	81.2	77.6	80.5	77.6	81.4	77.8	79.3
Aluminum	0.33	0.38	0.46	0.57	0.37	0.68	0.57	0.94	0.49	0.35	0.44
Antimony	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Arsenic	0.02	0.01	0.02	0.02	0.01	0.02	0.03	0.03	0.02	0.01	< 0.01
Barium	0.68	0.62	1.36	0.73	0.74	0.83	0.67	0.66	0.84	0.85	0.73
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.08	0.07	0.06	0.06
Cadmium	31.1	22.2	39.7	29.1	35.8	141.1	32.0	26.1	33.7	15.1	60.9
Chromium	0.07	0.07	0.07	0.06	0.07	0.08	0.07	0.07	0.06	0.06	0.06
Cobalt	0.03	0.04	0.03	0.03	0.02	0.04	0.04	0.03	0.03	0.04	0.03
Copper	5.04	5.44	3.93	5.04	4.92	5.39	5.08	5.53	4.22	4.93	5.02
Iron	28.1	36.1	43.9	44.8	40.8	48.3	25.8	38.5	21.4	52.6	34.5
Lead	0.07	0.07	0.06	0.07	0.05	0.10	0.07	0.09	0.08	0.06	0.09
Manganese	1.48	1.13	1.41	1.39	1.49	2.04	1.85	1.72	1.11	1.67	1.80
Mercury	0.76	0.61	0.87	0.68	0.91	1.41	0.63	1.26	0.61	1.01	1.06
Molybdenum	0.24	0.22	0.19	0.18	0.19	0.31	0.26	0.19	0.19	0.24	0.23
Nickel	0.04	0.05	0.02	0.03	0.02	0.06	0.03	0.03	0.06	0.02	0.06
Selenium	1.04	0.94	0.84	1.18	0.98	1.23	0.96	0.92	1.03	1.06	1.03
Silver	< 0.001	0.006	0.001	0.001	0.002	0.002	0.002	0.001	0.002	< 0.001	0.001
Strontium	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Thallium	0.005	0.005	0.003	0.002	0.003	0.005	0.003	0.005	0.003	0.003	0.003
Tin	0.03	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02
Uranium	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	31.2	30.6	30.0	30.1	28.7	51.7	31.6	34.1	32.9	26.9	38.0
Calcium	76	76	106	76	82	106	99	100	81	86	90
Magnesium	145	165	147	147	156	159	152	194	165	162	159

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22797	92-22798	92-22799A	92-22799B	92-22800	92-22801A	92-22801B	92-22802	92-22803	92-22804	92-22805
Tissue Type	Kidney	Kidney	Kidney	Duplicate	Kidney	Muscle	Duplicate	Muscle	Muscle	Muscle	Muscle
	F92-30	F92-31	F92-32		F92-33	F92-1M		F92-2M	F92-3M	F92-4M	F92-5M
% H2O	78.7	80.0	78.4	78.3	80.8	69.0	67.7	73.8	76.7	75.2	74.7
Aluminum	0.42	0.52	0.66	0.71	0.29	0.95	0.60	0.74	0.35	0.52	0.48
Antimony	0.006	< 0.002	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002
Arsenic	0.01	0.01	0.02	0.01	0.02	0.01	< 0.01	0.01	0.01	0.01	0.01
Barium	0.71	1.63	0.71	0.72	1.00	< 0.1	< 0.1	0.14	< 0.1	0.27	< 0.1
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.08	0.07	0.06	0.07	0.07	0.10	0.09	0.07	0.06	0.07	0.10
Cadmium	12.1	38.8	17.8	17.8	35.4	0.104	0.027	0.048	0.018	0.015	0.016
Chromium	0.06	0.07	0.08	0.07	0.06	0.11	0.11	0.09	0.07	0.07	0.08
Cobalt	0.03	0.04	0.03	0.03	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Copper	4.50	3.95	5.50	5.37	4.77	3.23	3.52	3.05	2.57	2.97	2.92
Iron	37.5	27.5	37.9	39.1	19.9	56.0	56.5	47.1	41.5	42.7	42.4
Lead	0.07	0.07	0.09	0.09	0.13	0.03	0.02	0.02	< 0.01	0.02	0.04
Manganese	1.67	1.18	1.42	1.51	1.59	0.36	0.36	0.34	0.25	0.31	0.29
Mercury	0.74	0.74	0.88	1.19	0.70	-	-	-	-	-	-
Molybdenum	0.19	0.20	0.24	0.25	0.16	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02
Nickel	< 0.02	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03
Selenium	0.94	1.01	1.06	1.03	0.94	0.29	0.22	0.24	0.18	0.19	0.18
Silver	0.002	0.001	0.002	0.002	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Strontium	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Thallium	0.007	0.004	0.007	0.008	0.007	0.002	< 0.001	< 0.001	< 0.001	< 0.001	0.004
Tin	0.09	0.04	< 0.02	< 0.02	0.04	0.04	< 0.02	0.02	< 0.02	< 0.02	0.23
Uranium	0.008	0.002	< 0.001	< 0.001	0.005	0.003	0.001	< 0.001	< 0.001	< 0.001	0.008
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	27.0	30.2	35.9	35.9	28.4	44.0	43.6	49.2	36.1	44.1	52.4
Calcium	90	111	70	67	84	42	41	37	31	37	36
Magnesium	153	147	152	158	151	306	298	233	217	243	235

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22806A	92-22806B	92-22807	92-22808	92-22809	92-22810	92-22811	92-22812A	92-22812B	92-22813	92-22814
Tissue Type	Muscle	Duplicate	Liver	Liver	Liver	Liver	Liver	Liver	Duplicate	Liver	Liver
	F92-6M		F92-01	F92-02	F92-03	F92-04	F92-05	F92-06		F92-07	F92-08
% H2O	73.1	74.3	68.8	71.5	67.4	67.8	65.4	67.6	67.3	66.4	67.0
Aluminum	0.33	0.23	0.74	0.58	0.41	0.45	0.50	0.30	0.31	< 0.2	0.32
Antimony	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Arsenic	0.01	0.01	0.02	0.02	0.02	< 0.01	0.01	< 0.01	< 0.01	0.01	0.01
Barium	< 0.1	< 0.1	0.14	0.11	0.28	0.11	0.13	0.15	0.15	0.15	0.14
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.09	0.09	0.08	0.07	0.06	0.07	0.07	0.06	0.06	0.07	0.06
Cadmium	0.029	0.017	2.02	5.84	2.79	2.13	3.87	0.78	0.78	5.15	1.87
Chromium	0.08	0.09	0.09	0.08	0.07	0.07	0.08	0.08	0.09	0.09	0.08
Cobalt	< 0.01	< 0.01	0.06	0.05	0.06	0.04	0.07	0.06	0.06	0.07	0.05
Copper	2.78	2.70	47.46	26.63	16.27	30.78	22.05	30.80	30.89	10.41	26.43
Iron	46.4	46.2	388	216	308	209	138	601	586	411	494
Lead	0.03	0.02	0.16	0.15	0.12	0.07	0.08	0.14	0.14	0.13	0.16
Manganese	0.32	0.37	2.38	2.38	2.64	3.15	4.47	3.78	3.86	3.46	3.31
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	< 0.01	< 0.01	0.82	0.81	0.81	0.76	0.73	0.75	0.75	1.02	0.69
Nickel	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Selenium	0.27	0.25	0.43	0.52	0.38	0.42	0.51	0.31	0.26	0.45	0.37
Silver	< 0.001	< 0.001	0.668	0.285	0.214	0.370	0.148	0.121	0.118	0.246	0.358
Strontium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thallium	0.002	0.001	0.001	0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Tin	0.08	0.05	0.03	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Uranium	0.003	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	45.7	44.0	23.0	29.8	27.5	25.6	31.6	25.0	25.9	41.5	21.8
Calcium	36	37	40	37	46	45	42	44	40	45	39
Magnesium	263	258	172	171	168	164	195	176	171	201	180

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	92-22815	92-22816	92-22817A	92-22817B	92-22818	92-22819	92-22820	92-22821	92-22822	92-22823	92-22824A
Tissue Type	Liver	Liver	Liver	Duplicate	Liver	Liver	Liver	Liver	Liver	Liver	Liver
	F92-09	F92-11	F92-12		F92-13	F92-14	F92-15	F92-16	F92-17	F92-10	F92-19
% H2O	67.2	68.2	65.1	64.0	65.4	66.0	66.5	67.6	69.4	66.8	65.5
Aluminum	0.53	0.52	0.35	0.29	0.46	0.30	0.30	< 0.2	0.32	0.26	0.26
Antimony	< 0.002	0.003	0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	< 0.002
Arsenic	0.03	0.04	< 0.01	< 0.01	0.03	0.01	0.03	0.02	0.02	0.01	0.01
Barium	< 0.1	0.17	0.23	0.25	0.13	0.11	0.19	0.12	0.17	0.12	0.18
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.07	0.06	0.09	0.07	0.07	0.08	0.08	0.06	0.06	0.08	0.08
Cadmium	5.76	1.69	6.45	6.73	3.90	3.22	4.19	1.17	3.23	1.73	3.97
Chromium	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.08	0.07	0.07	0.09
Cobalt	0.07	0.06	0.06	0.06	0.07	0.05	0.07	0.07	0.05	0.06	0.06
Copper	20.47	23.46	21.64	21.88	59.04	17.36	31.96	29.07	31.73	51.99	27.77
Iron	138	281	323	353	276	236	236	245	156	240	499
Lead	0.19	0.10	0.12	0.12	0.16	0.20	0.18	0.10	0.12	0.11	0.19
Manganese	3.06	3.00	3.57	3.79	5.25	3.22	2.81	3.27	2.90	3.66	3.72
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	0.96	1.01	0.81	0.82	0.96	1.02	0.83	0.75	0.92	0.84	0.94
Nickel	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Selenium	0.35	0.55	0.43	0.41	0.67	0.43	0.52	0.34	0.50	0.39	0.50
Silver	0.301	0.294	0.111	0.118	0.572	0.333	0.566	0.499	0.311	0.583	0.360
Strontium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thallium	0.001	0.001	0.006	0.002	0.002	0.002	0.001	< 0.001	< 0.001	0.005	0.004
Tin	< 0.02	< 0.02	0.09	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.11	0.03
Uranium	< 0.001	< 0.001	0.009	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.004	0.004
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	30.7	25.3	34.5	35.2	27.5	27.9	29.8	23.7	35.8	26.8	33.5
Calcium	48	42	46	48	43	45	46	45	41	43	42
Magnesium	178	177	174	182	196	183	187	169	169	165	192

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	92-22824B	92-22825	92-22826	92-22827	92-22828	92-22829	92-22830A	92-22830B	92-22831	92-22832	92-22833
Tissue Type	Duplicate	Liver	Liver	Liver	Liver	Liver	Liver	Duplicate	Liver	Liver	Liver
		F92-20	F92-21	F92-22	F92-23	F92-24	F92-25		F92-26	F92-27	F92-28
% H2O	65.1	68.5	69.7	68.1	69.6	67.4	65.3	65.7	65.9	65.6	69.6
Aluminum	0.33	0.45	0.26	0.29	< 0.2	0.56	0.65	0.41	0.42	0.23	0.27
Antimony	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Arsenic	0.01	0.02	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.02	0.01
Barium	0.18	0.13	0.18	0.30	0.18	0.14	0.43	0.23	0.16	0.18	0.14
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.07	0.06	0.06	0.09	0.09	0.07	0.09	0.09	0.09	0.08	0.07
Cadmium	3.98	2.08	3.72	5.05	4.28	19.69	4.89	4.90	3.24	5.00	1.60
Chromium	0.09	0.08	0.08	0.10	0.08	0.09	0.10	0.09	0.09	0.09	0.07
Cobalt	0.05	0.04	0.06	0.05	0.05	0.05	0.08	0.07	0.08	0.06	0.06
Copper	29.56	7.80	18.50	30.86	9.76	22.32	20.76	20.68	18.86	9.18	28.98
Iron	488	241	211	267	321	145	184	177	395	438	182
Lead	0.19	0.11	0.10	0.15	0.14	0.11	0.12	0.12	0.19	0.19	0.08
Manganese	3.76	2.76	3.16	2.86	3.49	3.08	4.25	4.04	3.31	3.08	3.59
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	0.96	0.83	0.81	0.71	0.90	0.90	1.03	1.05	0.86	0.82	0.86
Nickel	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Selenium	0.52	0.36	0.35	0.42	0.64	0.58	0.45	0.46	0.48	0.41	0.44
Silver	0.383	0.244	0.302	0.467	0.299	0.315	0.676	0.678	0.422	0.142	0.253
Strontium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Thallium	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	< 0.001	0.001
Tin	< 0.02	< 0.02	< 0.02	0.06	0.04	0.05	< 0.02	< 0.02	0.07	0.14	< 0.02
Uranium	0.002	0.001	0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	34.7	23.8	30.9	36.7	29.2	40.4	34.4	34.7	42.0	42.2	23.2
Calcium	40	41	36	48	39	43	50	44	53	49	36
Magnesium	190	182	163	184	177	168	203	194	187	202	162

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	92-22834	92-22835	92-22836	92-22837	92-22838A	92-22838B
Tissue Type	Liver	Liver	Liver	Liver	Liver	Duplicate
	F92-29	F92-30	F92-31	F92-32	F92-33	
% H2O	66.3	64.4	67.7	72.2	65.8	66.1
Aluminum	0.29	0.34	0.35	0.22	< 0.2	0.23
Antimony	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002
Arsenic	0.01	< 0.01	0.03	0.01	0.02	0.01
Barium	0.14	0.19	0.16	0.18	0.29	0.30
Beryllium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Boron	0.08	0.08	0.09	0.10	0.08	0.08
Cadmium	5.77	1.56	5.00	2.06	5.73	5.84
Chromium	0.08	0.11	0.10	0.09	0.08	0.08
Cobalt	0.07	0.06	0.06	0.06	0.05	0.05
Copper	8.00	9.78	15.28	19.22	10.21	10.74
Iron	126	530	426	330	189	195
Lead	0.12	0.16	0.19	0.15	0.21	0.21
Manganese	3.61	3.60	2.67	2.30	3.49	3.49
Mercury	-	-	-	-	-	-
Molybdenum	0.99	0.84	0.97	0.85	0.83	0.83
Nickel	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Selenium	0.38	0.42	0.45	0.39	0.50	0.43
Silver	0.155	0.302	0.599	0.495	0.340	0.343
Strontium	0.0	0.0	0.0	0.0	0.0	0.0
Thallium	< 0.001	0.001	0.002	0.009	0.003	0.002
Tin	0.04	< 0.02	0.08	0.10	0.07	< 0.02
Uranium	< 0.001	< 0.001	0.002	0.014	0.001	< 0.001
Vanadium	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	27.2	28.0	36.9	49.1	32.6	33.3
Calcium	51	48	50	55	44	46
Magnesium	202	193	178	210	205	212

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NIST 1577	NRC DORM-1
Tissue Type	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Bovine Liver SPM	Fish Tissue SPM
% H2O	6.8	6.7	4.9	4.9	4.8	4.8	4.6	4.6	4.4		7.5
Aluminum	4.17	2.40	3.00	1.64	5.50	3.07	2.30	2.23	2.07		7.69
Antimony	0.008	0.009	0.009	0.006	0.005	0.008	0.011	0.006	0.010		0.029
Arsenic	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.07		16.69
Barium	0.21	0.27	0.10	0.09	0.12	0.09	0.07	0.09	0.09		0.19
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01
Boron	0.61	0.58	0.55	0.49	0.51	0.47	0.58	0.56	0.58		1.19
Cadmium	0.264	0.291	0.326	0.354	0.305	0.279	0.291	0.293	0.290		-
Chromium	0.50	0.50	0.41	0.36	0.34	0.38	0.32	0.37	0.39		2.89
Cobalt	0.21	0.19	0.21	0.22	0.21	0.22	0.21	0.23	0.23		0.03
Copper	188.53	181.16	183.89	188.56	194.91	192.58	193.68	197.81	196.57		5.07
Iron	247.4	232.1	251.1	265.5	262.2	253.1	259.9	278.2	266.7		52.5
Lead	0.38	0.46	0.32	0.32	0.40	0.31	0.30	0.31	0.31		0.36
Manganese	9.4	9.3	9.4	10.2	10.7	9.5	10.0	11.1	10.5		1.3
Mercury	0.02	0.02	-	-	-	-	-	-	-		-
Molybdenum	3.10	3.09	3.09	3.15	3.09	3.05	3.09	3.30	3.25		0.10
Nickel	0.16	0.11	0.05	0.06	0.07	0.09	0.05	0.05	0.04		0.88
Selenium	1.22	0.91	1.15	0.92	1.09	1.17	1.10	1.16	1.24		1.47
Silver	0.053	0.053	0.052	0.051	0.054	0.058	0.055	0.063	0.072		0.172
Strontium	0.21	1.30	0.11	0.12	0.12	0.13	0.11	0.13	0.11		6.70
Thallium	0.005	0.004	0.004	0.003	0.003	0.003	0.018	0.004	0.012		0.005
Tin	0.53	0.23	0.11	0.06	0.11	0.09	0.22	0.27	0.12		0.09
Uranium	0.006	0.004	0.002	0.001	0.002	0.001	0.043	0.003	0.012		0.005
Vanadium	0.17	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.05		0.05
Zinc	123.6	123.6	126.7	130.4	136.7	130.8	135.6	132.9	130.0		18.7
Calcium	176	230	132	126	115	103	128	131	134		1211
Magnesium	506	518	589	633	606	570	612	588	624		1202

Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)

November 06, 1992



Fenwick I.D.	NRC DORM-1	NRC DORM-1	NRC DORM-1	NRC DORM-1	Reagent Blank	Reagent Blank	Reagent Blank	Reagent Blank	Reagent Blank
Tissue Type	Fish Tissue SFM	Fish Tissue SFM	Fish Tissue SFM	Fish Tissue SFM					
% H2O	7.5	7.5	7.3	7.1	-	-	-	-	-
Aluminum	6.83	8.87	5.91	7.17	0.09	0.17	0.13	0.06	0.21
Antimony	0.034	0.029	0.028	0.026	0.001	0.001	0.000	0.005	0.001
Arsenic	17.50	18.15	18.75	19.13	0.00	0.00	0.00	0.00	0.00
Barium	0.19	0.14	0.14	0.13	0.02	0.07	0.01	0.00	0.01
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01	0.001	-0.001	0.000	-0.001	0.000
Boron	1.24	1.19	1.15	1.30	0.03	0.03	0.03	0.02	0.02
Cadmium	0.091	0.090	0.095	0.093	0.001	0.001	0.002	0.003	0.000
Chromium	2.63	3.18	3.07	2.46	0.06	0.03	0.03	0.03	0.02
Cobalt	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00
Copper	4.93	5.10	4.73	5.06	0.02	0.00	0.01	-0.01	0.00
Iron	57.5	64.1	62.9	55.6	-0.9	-1.4	-1.3	-1.6	-0.9
Lead	0.37	0.47	-	0.48	0.01	0.00	0.00	0.00	0.00
Manganese	1.4	1.5	1.2	1.2	0.0	0.0	0.0	0.0	0.0
Mercury	0.79	-	-	-	< 0.005	< 0.005	-	-	-
Molybdenum	0.14	0.10	0.11	0.08	0.00	0.00	0.00	0.00	0.00
Nickel	0.87	1.03	0.94	0.63	0.01	0.00	0.01	0.00	0.00
Selenium	1.44	1.85	1.76	1.62	0.01	0.02	0.03	0.01	0.03
Silver	0.150	0.169	0.180	0.171	0.001	0.000	0.001	0.000	0.000
Strontium	6.83	9.01	7.17	7.53	0.02	0.02	0.00	-0.01	0.00
Thallium	0.010	0.010	0.008	0.008	0.000	0.000	0.000	0.000	0.000
Tin	0.19	0.07	0.05	0.05	0.00	0.01	0.00	0.00	-0.01
Uranium	0.007	0.010	0.010	0.007	0.000	0.000	0.000	0.000	0.000
Vanadium	0.04	0.04	0.04	0.05	0.03	0.00	0.00	0.00	0.00
Zinc	18.9	19.2	20.0	19.0	0.1	0.0	0.1	0.0	0.0
Calcium	1251	1606	1317	1371	14	26	0	-1	-1
Magnesium	1238	1171	1170	1187	0	0	0	0	0

**Analysis of Caribou Tissue
Concentration mg/Kg (as Rec'd)**

November 06, 1992



Fenwick I.D.	Reagent Blank	Reagent Blank	Reagent Blank	Reagent Blank
Tissue Type				
% H2O	-	-	-	-
Aluminum	0.16	0.14	0.32	0.26
Antimony	0.000	0.010	0.001	0.001
Arsenic	0.00	0.00	0.00	0.00
Barium	0.01	0.00	0.00	0.01
Beryllium	-0.002	0.000	0.000	0.001
Boron	0.02	0.07	0.02	0.02
Cadmium	0.002	0.001	0.002	0.001
Chromium	0.03	0.05	0.03	0.05
Cobalt	0.00	0.00	0.00	0.00
Copper	0.06	0.00	0.04	0.04
Iron	-0.8	-1.6	-0.8	-0.8
Lead	0.00	0.00	0.00	0.00
Manganese	0.0	0.0	0.0	0.0
Mercury	-	-	-	-
Molybdenum	0.00	0.01	0.00	0.00
Nickel	0.00	0.00	0.00	0.00
Selenium	0.01	0.02	0.02	-0.02
Silver	0.003	0.001	0.002	0.003
Strontium	0.00	-0.01	0.00	0.00
Thallium	0.000	0.002	0.000	0.000
Tin	-0.01	0.07	-0.01	0.00
Uranium	0.000	0.004	0.001	0.001
Vanadium	0.00	0.00	0.00	0.00
Zinc	0.0	0.0	0.0	0.1
Calcium	1	-2	1	-1
Magnesium	0	0	1	1

Appendix 5. Estimated detection limits and recoveries of Standard Reference Materials for metal analysis of Finlayson caribou tissues.

Element	Est'd Det. Lim. (mg/kg wet weight)	% Recovery
Aluminum	0.2	-
Antimony	0.002	*168.88
Arsenic	0.01	111.07
Barium	0.1	-
Beryllium	0.002	*0.00
Boron	0.05	-
Cadmium	0.002	116.66
Chromium	0.02	337.37
Cobalt	0.01	103.87
Copper	0.02	103.83
Iron	0.2	100.77
Lead	0.01	109.53
Manganese	0.02	104.30
Mercury	0.01	125.13
Molybdenum	0.01	*97.37
Nickel	0.02	78.05
Selenium	0.02	106.96
Silver	0.001	*100.07
Strontium	0.01	*197.56
Thallium	0.001	*12.97
Tin	0.02	-
Uranium	0.001	*1070.61
Vanadium	0.02	-
Zinc	0.02	102.49
Calcium	-	120.96
Magnesium	-	103.45

* Standard reference materials not certified for these elements.

Note: The above detection limits apply to "wet" organ and muscle. Due to the high inorganic content and low moisture, detection limits for bone samples are 2 to 5 times higher for some elements.

Appendix 6. Ages and cadmium concentrations in individual
Finlayson caribou livers and kidneys.

ID #	Age (yr)	Cadmium concentrations ($\mu\text{g/g}$)			
		Kidney		Liver	
		wet wt	dry wt	wet wt	dry wt
F9201	0.5	8.2	35.35	2.02	6.49
F9202	12.0	79.5	363.01	5.84	20.46
F9203	8.0	38.7	167.77	2.79	8.58
F9204	4.0	15.1	65.59	2.13	6.61
F9205	2.0	12.8	59.72	3.87	11.18
F9206	3.0	5.4	29.63	0.78	2.40
F9207	12.0	36.4	177.75	5.15	15.32
F9208	4.0	16.9	83.29	1.87	5.66
F9209	7.0	35.1	194.72	5.76	17.57
F9210	3.0	13.4	59.98	1.73	5.21
F9211	3.0	12.7	60.50	1.69	5.31
F9212	3.0	40.0	182.33	6.59	18.62
F9213	3.0	28.8	141.87	3.90	11.24
F9214	6.0	23.0	113.55	3.22	9.48
F9215	5.0	53.4	233.93	4.19	12.51
F9216	2.0	10.1	42.97	1.17	3.61
F9217	5.0	25.2	133.34	3.23	10.56
F9219	3.0	31.1	169.34	3.97	11.51
F9220	6.0	22.2	98.70	2.08	6.60
F9221	4.0	39.7	196.86	3.72	12.29
F9222	3.0	29.1	140.96	5.05	15.82
F9223	4.0	35.8	190.05	4.28	14.08
F9224	8.0	141.1	629.11	19.69	60.42
F9225	8.0	32.0	163.97	4.90	14.20
F9226	10.0	26.1	116.59	3.24	9.50
F9227	5.0	33.7	180.71	5.00	14.54
F9228	4.0	15.1	67.91	1.60	5.27
F9229	8.0	60.9	294.87	5.77	17.12
F9230	5.0	12.1	57.08	1.56	4.39
F9231	7.0	38.8	193.35	5.00	15.45
F9232	5.0	17.8	82.41	2.06	7.42
F9233	7.0	35.4	184.12	5.78	16.95

Appendix 7. Cesium¹³⁷ levels in Finlayson caribou muscle tissue:
individual results.

ID#	Wt (g)	Cesium ¹³⁷ (wet wt)		
		Pci/kg	Bq/kg	Coeff. of Var
F9201	591	4412	163.3	1.8
F9202	393	3794	140.4	2.8
F9203	209	5298	196.0	3.1
F9204	270	3477	128.7	3.6
F9205	379	4291	158.8	2.6
F9206	347	4039	149.5	2.8
F9207	455	5241	193.9	2.1
F9208	531	6980	258.3	1.7
F9209	402	5840	216.1	2.1
F9210	404	3951	146.2	2.7
F9211	445	4727	174.9	2.3
F9212	469	4400	162.8	2.3
F9213	433	3921	145.1	2.6
F9214	512	4361	161.4	2.3
F9215	505	4765	176.3	2.2
F9216	542	4246	157.1	2.3
F9217	573	4054	150.0	2.3
F9219	599	4729	175.0	1.7
F9220	549	4046	149.7	1.9
F9221	543	6066	224.5	1.5
F9222	604	6561	242.8	1.4
F9223	456	4457	164.9	2.0
F9224	613	4281	158.4	1.8
F9225	616	3678	136.1	2.0
F9226	480	5125	189.6	1.8
F9227	618	6792	251.3	1.4
F9228	636	4723	174.8	1.7
F9229	573	5909	218.6	1.5
F9230	559	6639	245.6	1.4
F9231	434	4724	174.8	1.9
F9232	557	5950	220.2	1.5
F9233	640	6201	229.4	1.4

Appendix 8. Organochlorine concentrations in composite Finlayson caribou fat samples (ng/g wet weight).

ANALYSIS REPORT

Client: Yukon Renewable Resources

Our File: 2167
October 14, 1992

ORGANOCHLORINES

concentration in ng/g wet weight basis

Compound	2167-01 Cariboo Fat CF - 1	2167-02 Cariboo Fat CF - 2
% Lipid	77	84
Hexachlorobenzene	25 (0.04)	31 (0.06)
alpha-HCH	3.1 (0.09)	4.0 (0.2)
beta-HCH	NDR(1.1)(0.2)	NDR(2.3)(0.4)
gamma-HCH	0.3 (0.2)	ND (0.4)
Heptachlor	ND (0.1)	ND (0.2)
Aldrin	ND (0.04)	ND (0.05)
Oxychlordane	ND (0.3)	ND (0.4)
trans-Chlordane	ND (0.02)	ND (0.03)
cis-Chlordane	ND (0.02)	ND (0.03)
trans-Nonachlor	ND (0.02)	ND (0.03)
cis-Nonachlor	ND (0.03)	ND (0.04)
o,p'-DDE	ND (0.02)	ND (0.03)
p,p'-DDE	NDR(0.2)(0.03)	ND (0.04)
o,p'-DDD	ND (0.03)	ND (0.04)
p,p'-DDD	ND (0.03)	ND (0.05)
o,p'-DDT	ND (0.1)	ND (0.2)
p,p'-DDT	ND (0.1)	ND (0.2)
Mirex	ND (0.02)	ND (0.04)
Heptachlor Epoxide	ND (0.4)	ND (0.4)
alpha-Endosulphan	ND (0.5)	ND (0.4)
Dieldrin	ND (0.5)	ND (0.4)
Endrin	ND (0.8)	ND (0.7)
Methoxychlor	ND (2.8)	ND (2.4)
Aroclor 1242	ND (0.6)	ND (1.1)
Aroclor 1254	ND (0.9)	ND (1.5)
Aroclor 1260	ND (1.3)	ND (2.0)

ND = Not detected, detection limits given in brackets

NDR = Peak detected but did not meet quantification criteria

Approved by:


 M. Coreen Hamilton
 A. Dale Hoover

ANALYSIS REPORT

Client: Yukon Renewable Resources

Our File: 2167
October 14, 1992

ORGANOCHLORINES

concentration in ng/g wet weight basis

Compound	2167-03 Cariboo Fat CF - 3 67	2167-04 Cariboo Fat CF - 4 88
Hexachlorobenzene	20 (0.05)	28 (0.4)
alpha-HCH	2.3 (0.1)	2.9 (0.1)
beta-HCH	0.4 (0.3)	NDR(0.7)(0.03)
gamma-HCH	0.3 (0.2)	NDR(0.4)(0.2)
Heptachlor	ND (0.1)	ND (0.1)
Aldrin	ND (0.05)	ND (0.05)
Oxychlordane	ND (0.3)	ND (0.3)
trans-Chlordane	ND (0.02)	ND (0.02)
cis-Chlordane	ND (0.03)	ND (0.03)
Total Chlordane	ND	ND
trans-Nonachlor	ND (0.02)	ND (0.02)
cis-Nonachlor	ND (0.04)	ND (0.03)
Total Nonachlor	ND	ND
o,p'-DDE	ND (0.03)	ND (0.03)
p,p'-DDE	ND (0.2)	NDR(0.5)(0.04)
o,p'-DDD	ND (0.04)	ND (0.03)
p,p'-DDD	ND (0.04)	ND (0.04)
o,p'-DDT	ND (0.2)	ND (0.2)
p,p'-DDT	ND (0.2)	ND (0.2)
Mirex	ND (0.03)	ND (0.03)
Heptachlor Epoxide	ND (0.3)	ND (0.3)
alpha-Endosulphan	ND (0.4)	ND (0.4)
Dieldrin	ND (0.4)	ND (0.4)
Endrin	ND (0.5)	ND (0.6)
Methoxychlor	ND (2.0)	ND (2.1)
Aroclor 1242	ND (0.6)	ND (0.7)
Aroclor 1254	ND (0.7)	ND (0.9)
Aroclor 1260	ND (0.7)	ND (1.0)

ND = Not detected, detection limits given in brackets
NDR = Peak detected but did not meet quantification criteria

Approved by:


M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

Client: Yukon Renewable Resources

Our File: 2167
October 14, 1992

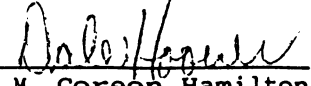
ORGANOCHLORINES

concentration in ng/g wet weight basis

Compound	2167-05A Cariboo Fat CF - 5	2167-05B Duplicate
% Lipid	78	84
Hexachlorobenzene	53 (0.09)	60 (0.09)
alpha-HCH	7.2 (0.2)	8.7 (0.2)
beta-HCH	NDR(1.6)(0.6)	NDR(1.7)(0.5)
gamma-HCH	NDR(1.0)(0.4)	NDR(1.6)(0.4)
Heptachlor	ND (0.3)	ND (0.3)
Aldrin	ND (0.1)	ND (0.1)
Oxychlorane	ND (0.7)	ND (0.7)
trans-Chlordane	ND (0.04)	ND (0.04)
cis-Chlordane	ND (0.06)	ND (0.06)
trans-Nonachlor	ND (0.04)	ND (0.04)
cis-Nonachlor	ND (0.06)	ND (0.06)
o,p'-DDE	ND (0.05)	ND (0.05)
p,p'-DDE	ND (0.07)	ND (0.07)
o,p'-DDD	ND (0.06)	ND (0.06)
p,p'-DDD	ND (0.07)	ND (0.07)
o,p'-DDT	ND (0.4)	ND (0.4)
p,p'-DDT	ND (0.4)	NDR(9.5)(0.4)
Mirex	ND (0.06)	ND (0.06)
Heptachlor Epoxide	ND (0.5)	ND (0.5)
alpha-Endosulphan	ND (0.6)	ND (0.6)
Dieldrin	ND (0.6)	ND (0.6)
Endrin	ND (1.0)	ND (1.0)
Methoxychlor	ND (3.7)	ND (3.7)
Aroclor 1242	ND (1.0)	ND (1.5)
Aroclor 1254	ND (1.2)	ND (1.9)
Aroclor 1260	ND (2.4)	ND (3.4)

ND = Not detected, detection limits given in brackets
 NDR = Peak detected but did not meet quantification criteria

Approved by:


 M. Coreen Hamilton
 A. Dale Hoover

ANALYSIS REPORT

Client: Yukon Renewable Resources

Our File: 2167
October 14, 1992

ORGANOCHLORINES

concentration in ng/g wet weight basis

Compound	2167-TBlk 354 Procedural Blank
Hexachlorobenzene	ND (0.2)
alpha-HCH	ND (0.7)
beta-HCH	ND (1.3)
gamma-HCH	ND (0.9)
Heptachlor	ND (0.3)
Aldrin	ND (0.08)
Oxychlordane	ND (0.6)
trans-Chlordane	ND (0.04)
cis-Chlordane	ND (0.05)
trans-Nonachlor	ND (0.05)
cis-Nonachlor	ND (0.07)
o,p'-DDE	ND (0.04)
p,p'-DDE	ND (0.06)
o,p'-DDD	ND (0.06)
p,p'-DDD	ND (0.08)
o,p'-DDT	ND (0.4)
p,p'-DDT	ND (0.4)
Mirex	ND (0.06)
Heptachlor Epoxide	ND (0.2)
alpha-Endosulphan	ND (0.3)
Dieldrin	ND (0.3)
Endrin	ND (0.4)
Methoxychlor	ND (1.6)
Aroclor 1242	ND (0.6)
Aroclor 1254	ND (0.3)
Aroclor 1260	ND (1.3)

ND = Not detected, detection limits given in brackets
 NDR = Peak detected but did not meet quantification criteria

Approved by: M. Coreen Hamilton
A. Dale Hoover

Appendix 9. Dioxin and furan concentrations in composite Finlayson caribou fat samples (pg/g wet weight).

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Tissue Procedural Blank

Axys ID: T-BLK 728

Sample Weight: 5.00 g wet

Date: January 21, 1993

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.3	T ₄ CDF - Total	ND	0.2
2,3,7,8	ND	0.3	2,3,7,8	ND	0.2
P ₅ CDD - Total	ND	0.6	P ₅ CDF - Total	ND	0.5
1,2,3,7,8	ND	0.6	1,2,3,7,8	ND	0.5
			2,3,4,7,8	ND	0.5
H ₆ CDD - Total	ND	0.5	H ₆ CDF - Total	ND	0.5
1,2,3,4,7,8	ND	0.5	1,2,3,4,7,8	ND	0.5
1,2,3,6,7,8	ND	0.5	1,2,3,6,7,8	ND	0.5
1,2,3,7,8,9	ND	0.5	2,3,4,6,7,8	ND	0.5
H ₇ CDD - Total	2.2	1.4	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	1.6	1.4			
O ₈ CDD	5.4	3.1	H ₇ CDF - Total	ND	0.8
			1,2,3,4,6,7,8	ND	0.8
			1,2,3,4,7,8,9	ND	0.8
			O ₈ CDF	ND	0.3

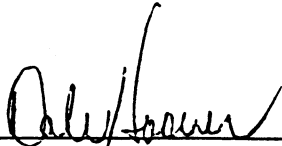
SDL = Sample Detection Limit

ND = Not Detected

Surrogate Standard Recovery (%)

¹³ C-T ₄ CDD:	100
¹³ C-T ₄ CDF:	48
¹³ C-P ₅ CDD:	39
¹³ C-H ₆ CDD:	39
¹³ C-H ₇ CDD:	26
¹³ C-O ₈ CDD:	12

Approved by:


M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Tissue Procedural Blank

Axys ID: T-BLK 665

Sample Weight: 8.00 g wet

Date: November 19, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.1	T ₄ CDF - Total	ND	0.1
2,3,7,8	ND	0.1	2,3,7,8	ND	0.1
P ₅ CDD - Total	ND	0.4	P ₅ CDF - Total	ND	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H ₆ CDD - Total	ND	0.4	H ₆ CDF - Total	ND	0.6
1,2,3,4,7,8	ND	0.4	1,2,3,4,7,8	ND	0.6
1,2,3,6,7,8	ND	0.4	1,2,3,6,7,8	ND	0.6
1,2,3,7,8,9	ND	0.4	2,3,4,6,7,8	ND	0.6
H ₇ CDD - Total	ND	1.2	1,2,3,7,8,9	ND	0.6
1,2,3,4,6,7,8	ND	1.2	H ₇ CDF - Total	ND	0.5
O ₈ CDD	ND	1.0	1,2,3,4,6,7,8	ND	0.5
			1,2,3,4,7,8,9	ND	0.5
			O ₈ CDF	ND	0.7

SDL = Sample Detection Limit

ND = Not Detected

Surrogate Standard Recovery (%)

¹³ C-T ₄ CDD:	64
¹³ C-T ₄ CDF:	65
¹³ C-P ₅ CDD:	74
¹³ C-H ₆ CDD:	75
¹³ C-H ₇ CDD:	63
¹³ C-O ₈ CDD:	50

Approved by:


 M. Coreen Hamilton
 A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Cariboo Fat CF-1

Axys ID: 2167-01

Sample Weight: 5.04 g wet

Date: January 21 1993

Revised: February 5, 1993

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.2	T ₄ CDF - Total	5.5	0.1
2,3,7,8	ND	0.2	2,3,7,8	1.4	0.1
P ₅ CDD - Total	0.6	0.3	P ₅ CDF - Total	39	0.1
1,2,3,7,8	ND	0.3	1,2,3,7,8	0.4	0.1
			2,3,4,7,8	0.5	0.1
H ₆ CDD - Total	270	0.1	H ₆ CDF - Total	110	0.3
1,2,3,4,7,8	NDR(0.3)	0.1	1,2,3,4,7,8	1.3	0.3
1,2,3,6,7,8	18	0.1	1,2,3,6,7,8	0.5	0.3
1,2,3,7,8,9	0.3	0.1	2,3,4,6,7,8	0.7	0.3
H ₇ CDD - Total	1800	0.5	1,2,3,7,8,9	ND	0.3
1,2,3,4,6,7,8	490	0.5			
O ₈ CDD	4700	0.4	H ₇ CDF - Total	130	0.4
			1,2,3,4,6,7,8	47	0.4
			1,2,3,4,7,8,9	ND	0.4
			O ₈ CDF	22	0.4

SDL = Sample Detection Limit


ND = Not Detected

NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery (%)

¹³ C-T ₄ CDD:	71
¹³ C-T ₄ CDF:	76
¹³ C-P ₅ CDD:	77
¹³ C-H ₆ CDD:	77
¹³ C-H ₇ CDD:	74
¹³ C-O ₈ CDD:	63

Approved by:


M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Cariboo Fat CF-2

Axys ID: 2167-02

Sample Weight: 4.37 g wet


Date: November 19, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.3	T ₄ CDF - Total	ND	0.2
2,3,7,8	ND	0.3	2,3,7,8	ND	0.2
P ₅ CDD - Total	ND	0.7	P ₅ CDF - Total	3.5	0.4
1,2,3,7,8	ND	0.7	1,2,3,7,8	ND	0.4
			2,3,4,7,8	ND	0.4
H ₆ CDD - Total	120	0.8	H ₆ CDF - Total	39	0.8
1,2,3,4,7,8	ND	0.8	1,2,3,4,7,8	ND	0.8
1,2,3,6,7,8	7.5	0.8	1,2,3,6,7,8	ND	0.8
1,2,3,7,8,9	ND	0.8	2,3,4,6,7,8	ND	0.8
H ₇ CDD - Total	880	0.9	1,2,3,7,8,9	ND	0.8
1,2,3,4,6,7,8	230	0.9	H ₇ CDF - Total	61	1.0
O ₈ CDD	2000	0.8	1,2,3,4,6,7,8	21	1.0
			1,2,3,4,7,8,9	ND	1.0
			O ₈ CDF	11	0.9

SDL = Sample Detection Limit
ND = Not Detected

Surrogate Standard Recovery	(%)
¹³ C-T ₄ CDD:	65
¹³ C-T ₄ CDF:	73
¹³ C-P ₅ CDD:	83
¹³ C-H ₆ CDD:	89
¹³ C-H ₇ CDD:	92
¹³ C-O ₈ CDD:	94

Approved by:


M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Cariboo Fat CF-3

Axys ID: 2167-03

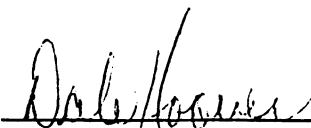
Sample Weight: 4.59 g wet

Date: November 19, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.2	T ₄ CDF - Total	ND	0.2
2,3,7,8	ND	0.2	2,3,7,8	ND	0.2
P ₅ CDD - Total	ND	0.4	P ₅ CDF - Total	2.2	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H ₆ CDD - Total	70	0.5	H ₆ CDF - Total	21	0.6
1,2,3,4,7,8	ND	0.5	1,2,3,4,7,8	ND	0.6
1,2,3,6,7,8	4.2	0.5	1,2,3,6,7,8	ND	0.6
1,2,3,7,8,9	0.9	0.5	2,3,4,6,7,8	ND	0.6
H ₇ CDD - Total	450	0.8	1,2,3,7,8,9	ND	0.6
1,2,3,4,6,7,8	120	0.8	H ₇ CDF - Total	32	0.7
O ₈ CDD	1000	1.0	1,2,3,4,6,7,8	12	0.7
			1,2,3,4,7,8,9	ND	0.7
			O ₈ CDF	5.2	0.8

SDL = Sample Detection Limit
 ND = Not Detected

Surrogate Standard Recovery	(%)
¹³ C-T ₄ CDD:	69
¹³ C-T ₄ CDF:	72
¹³ C-P ₅ CDD:	78
¹³ C-H ₆ CDD:	87
¹³ C-H ₇ CDD:	82
¹³ C-O ₈ CDD:	72

Approved by: 
 M. Coreen Hamilton
 A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Cariboo Fat CF-4

Axys ID: 2167-04

Sample Weight: 5.13 g wet

Date: November 19, 1992

Revised: February 5, 1993

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.2	T ₄ CDF - Total	ND	0.2
2,3,7,8	ND	0.2	2,3,7,8	ND	0.2
P ₅ CDD - Total	ND	0.6	P ₅ CDF - Total	1.0	0.3
1,2,3,7,8	ND	0.6	1,2,3,7,8	ND	0.3
			2,3,4,7,8	ND	0.3
H ₆ CDD - Total	34	0.6	H ₆ CDF - Total	9.8	0.7
1,2,3,4,7,8	ND	0.6	1,2,3,4,7,8	ND	0.7
1,2,3,6,7,8	2.2	0.6	1,2,3,6,7,8	ND	0.7
1,2,3,7,8,9	ND	0.6	2,3,4,6,7,8	ND	0.7
H ₇ CDD - Total	230	1.3	1,2,3,7,8,9	ND	0.7
1,2,3,4,6,7,8	69	1.3	H ₇ CDF - Total	22	1.1
O ₈ CDD	700	1.7	1,2,3,4,6,7,8	8.0	1.1
			1,2,3,4,7,8,9	ND	1.1
			O ₈ CDF	3.0	1.6

SDL = Sample Detection Limit

ND = Not Detected

Surrogate Standard Recovery	(%)
¹³ C-T ₄ CDD:	50
¹³ C-T ₄ CDF:	60
¹³ C-P ₅ CDD:	59
¹³ C-H ₆ CDD:	66
¹³ C-H ₇ CDD:	52
¹³ C-O ₈ CDD:	40

Approved by:


 M. Coreen Hamilton
 A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: Yukon Renewable Resources

Our File: 2167

Sample ID: Cariboo Fat CF-5

Axys ID: 2167-05

Sample Weight: 5.03 g wet

Date: November 19, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T ₄ CDD - Total	ND	0.2	T ₄ CDF - Total	ND	0.2
2,3,7,8	ND	0.2	2,3,7,8	NDR(0.4)	0.2
P ₅ CDD - Total	ND	0.4	P ₅ CDF - Total	4.9	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H ₆ CDD - Total	130	0.6	H ₆ CDF - Total	42	0.5
1,2,3,4,7,8	ND	0.6	1,2,3,4,7,8	ND	0.5
1,2,3,6,7,8	7.9	0.6	1,2,3,6,7,8	ND	0.5
1,2,3,7,8,9	1.1	0.6	2,3,4,6,7,8	ND	0.5
H ₇ CDD - Total	870	0.6	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	220	0.6			
O ₈ CDD	2100	0.8	H ₇ CDF - Total	67	0.6
			1,2,3,4,6,7,8	23	0.6
			1,2,3,4,7,8,9	ND	0.6
			O ₈ CDF	12	0.6


SDL = Sample Detection Limit

ND = Not Detected

NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
¹³ C-T ₄ CDD:	56
¹³ C-T ₄ CDF:	63
¹³ C-P ₅ CDD:	71
¹³ C-H ₆ CDD:	84
¹³ C-H ₇ CDD:	80
¹³ C-O ₈ CDD:	72

Approved by:


 M. Coreen Hamilton
 A. Dale Hoover