COUNTRY FOODS AND NATIVE DIETS IN NORTHERN CANADA

BY

MICHAEL P. WONG
Philip, 1956-
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Acknowledgements

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1.0 INTRODUCTION

1.1 Background

During the past decade, knowledge of chemical contamination in the Arctic food chain has increased with the acquisition of new residue information. The recent finding of elevated levels of toxic chemical residues in tissues of the Polar bear, *Ursus maritimus*, has focused attention on the diet of northern native populations who traditionally rely upon marine and terrestrial mammals, fish, birds and plants for food. Concern surrounding the possibility of chemical exposure has been heightened by the government encouraging the consumption of 'country foods' and breast-feeding of infants, rather than relying on the more expensive products from the south. Although the significance to human health is still not known, the situation has increased awareness of the potential of exposure to contaminants of northern natives.

In response to these concerns, the Department of Indian Affairs and Northern Development (DIAND), with the cooperation of other federal departments and the territorial governments, has initiated a review of the available information on native diets, residue levels in country foods, and the potential sources of pollutants in order to evaluate the implications of possible exposure of native groups to these contaminants.

At present, no systematic compilation of toxic chemical residues in traditional native foods exists and any data that have been documented have generally reflected an ecological, rather than a public health, interest. Routine health inspection procedures, employed in southern regions (i.e. Food Basket Surveys, Fish Inspection), are not conducted on a regular basis for most country food items. When testing has occurred, the programs are based on southern standards and may not be targeting the required information to aid in assessing the potential health hazards to northern natives. This circumstance is, in effect, depriving native people of the protective screening which is afforded to the rest of the Canadian population.

1.2 Objectives

As an initial evaluation, a review of our current knowledge of topics related to this potential problem was undertaken. The purpose of this communication is to assemble and collate the available information on:

1) Harvest studies from northern communities as an indicator of the importance of country foods in native diets.
2) Native diets with a focus on the species consumed, portions consumed, as well as the method(s) of preparation for evaluating the route and magnitude of chemical exposure.
3) Human health studies conducted in Greenland.
4) Contaminants in Canadian game birds.
5) Contaminants in Arctic terrestrial mammals.
6) Contaminants in Arctic marine mammals and fish.
7) Contaminants in Polar bears.
8) Potential sources of pollution in the Arctic environment.
9) Medical testing of northern native populations.

2.0 HARVEST INFORMATION

A thorough understanding of northern native food harvest, on a community or regional basis, is imperative for any assessment of potential contamination in traditional country foods. Yet, our comprehension of native subsistence has generally been qualitative. In the last five years, however, some quantitative information on the native harvests has been generated. Most of these counts or estimates of the species of fish and wildlife taken in the various regions are still in the unpublished form. Usher (1985) reviewed the methodology used in native harvest studies and evaluated the usefulness of the existing data. For the purpose of this review, it is acknowledged that the quantity of country foods consumed in a community should bear some relationship to the overall harvest data, but any inferences regarding the diet of a community being drawn from the harvest data must be made cautiously. Bearing in mind the limitations which exist in the harvest information, it is also realized that it represents the best or only available dataset at this time for which diet information can be deduced.

The harvest data of the three most complete surveys in the Northwest Territories were summarized (Appendix B). The three sets of data selected were: (1) the January to December, 1983 harvest survey from the Baffin Island Region, (2) the October 1982 to September 1983 harvest survey from the Kitikmeot Region and (3) the October 1983 to September 1984 harvest survey fom the Keewatin Region. These surveys provide coverage of the entire Nunavut Region over a 12 month period. Information on the species included in each harvest survey are not summarized in the same manner (Table 2.1). This variable, along with the fact that not all species were surveyed over the same time frame in the three harvest studies, does not allow for direct comparison between the regions. Yet, the data collected within each region should be directly comparable on a community basis.

Table 2.1 : Comparison of the Species Surveyed in the Harvest Studies Conducted in Three Regions in the Northwest Territories (from Usher 1985).

SPECIES	BAFFIN ISLAND	KEEWATIN	KITIKMEOT
Big Game			
Caribou	x	x	x
by sex	-	-	x
by herd	-	-	x
Musk-ox	x	x	x
by sex	-	x	x
Moose	-	x	x
Black Bear	-	x	-
Grizzly Bear	-	x	-
Fur Bearers			
Wolf	x	x	x
Fox	-	x	-
Arctic Fox	-	x	-
White Fox	x	-	-
Blue Fox	x	-	-
Red Fox	x	x	-
Muskrat	-	x	-
Marten	-	x	-
Wolverine	-	x	x
Small Game			
Arctic Hare	x	x	x
Rabbit	-	x	-
Marine Mammals			
Seals	-	x	x
Ringed Seal	x	x	-
Bearded Seal	x	x	-
Harp Seal	x	x	-
Harbour Seal	x	x	-
Unknown Seal	-	x	-
Walrus	x	x	-
Whale	-	-	x
Narwhal	x	x	-
Beluga	x	x	-
Polar Bear	x	x	-

Table 2.1 : Comparison of the Species Surveyed in the Harvest Studies Conducted in Three Regions in the Northwest Territories (from Usher 1985). continued

SPECIES	BAFFIN ISLAND	KEEWATIN	KITIKMEOT
Waterfowl			
Geese	-	x	x
Snow Goose	x	x	-
Canada Goose	x	x	-
Ross Goose	-	x	-
Brant	x	-	-
Geese Unknown	-	x	-
Ducks	-	x	x
Oldsquaw	x	x	-
Eider	x	x	-
Mallard	-	x	-
Swan	-	x	-
Other Birds			
Guillemot	x	x	-
Murres	x	-	-
Ptarmigan	-	x	x
Rock Ptarmigan	x	-	-
Sandhill Crane	-	x	-
Snowy Owl	-	x	-
Unknown other fowl	-	x	-
Eggs			
Fowl Eggs	-	x	-
Brant Eggs	-	x	-
Goose Eggs	-	x	-
Duck Eggs	-	x	-
Other Waterfowl eggs	-	x	-
Unknown fowl eggs	-	x	-
Fish			
Char	-	x	x
Searun Char	x	-	-
Landlocked Char	x	-	-
Lake Trout	-	x	x
Cod	-	x	-
Northern Pike	-	x	-
Grayling	-	x	-
Whitefish	-	x	x
Sucker	-	x	-
Sculpin	-	x	-
Other Fresh Water Fish	-	x	-
Other Marine Fish	-	x	-

(x) indicates that information was collected in the surveys.
(-) indicates that information was not collected in the survey.

The resulting tabulations of the harvest data are detailed, complex and difficult to interpret. A more concise version, showing the estimated or reported values of each species, is provided in Appendix B. In the Baffin Island and Keewatin Region surveys, estimated numbers of each species harvested were given. These figures are believed to be more representative of the total harvest than reported values, since not all hunters report their monthly harvests and not all communities provide harvest data for the 12 month period. In the Kitikmeot Region, only reported values, not estimates, were available for all species surveyed. The exception was Caribou where estimated values were provided. This likely signifies that for all species surveyed in the Kitikmeot Region, except Caribou, the actual number of animals harvested is likely higher. A further discussion of the limitations of reporting, compiling and estimating harvest data is found in Usher (1985).

Table 2.2 shows the number of each species or groups of species harvested in the various communities in 1983. Additionally, it provides the per-capita harvest of each community. Although knowledge of the dependence of a community on animal resources is gained by a review of the harvest data expressed in this way, it is misleading to assume that the total number of animals harvested is indicative of the total amount of country food available to the community. First, not all harvested animals are consumed, since some species are hunted or trapped for fur and other non-subsistence uses. Second, the biomass of each species varies widely, thereby the amount of edible meat from each species will differ (e.g. compare the quantity of meat from a Beluga whale and a ptarmigan). Both factors can lead to an inaccurate presumption. However, by estimating the available edible biomass from the number of animals for each species harvested and omitting the species not generally harvested for food (i.e. fur-bearers), one

Table 2.2: The Estimated or Reported Number (uppercase) and the Per-Capita Number (lowercase) of the Fish and Wildlife Harvest of Communities in the Northwest Territories.

	KEEWATIN							KITIKMEOT						
	0-83 S-84	0-83 S-84	0-83 S-84	0-83 S-84	0-83 S-84	0-83 S-84	0-83 S-84	J-83 0-83	0-82 N-83	F-83 0-83	S-82 N-83	0-82 N-83	0-82 N-83	S-82 N-83
Total harvest Per capita harvest	Baker Lake	Chesterfield Inlet	Coral Harbour	Eskimo Point	Rankin Inlet	Repulse Bay	Whale Cove	Bay Chimo/ Bathurst Inlet	Cambridge Bay	Coppermine	Gjoa Haven	Holman	Pelly Bay	Spence Bay
Ringed Seal	6 (0.01)	43 (0.2)	828 2	516 (0.5)	414 (0.4)	553 1.5	106 (0.5)	-		-	-	-	-	-
Polar Bear		9 (0.03)	34 (0.08)	21 (0.02)	9 (0.01)	14 (0.04)	8 (0.04)	*	*	*	*	*	*	*
Other Marine Mammals		23 (0.07)	137 (0.3)	56 (0.05)	25 (0.03)	36 (0.1)	16 (0.08)	26 (0.3)		549 (0.65)	371 1	1,665 5	339 1	1,044 2
Muskox	13 (0.01)							1 (0.01)	15 (0.02)	15 (0.02)	23 (0.04)	16 (0.05)	X	X
Arctic Hare				9 (.01)	7 (0.01)	6 (0.02)	8 (0.04)	103 1	26 (0.04)	89 (0.1)	37 (0.06)	100 (0.3)	4 (0.01)	99 (0.2)
Caribou	6,431 6.5	382 1.5	637 1.5	2,779 2	1,504 2	1,279 3	545 3	422 5	2,161 3	2,256 2.5	2,462 4	1,207 3.5	750 3	1,388 3
Rock Ptarmigan	349 3		1,269 3	367 (0.3)	291 (0.3)	82 (0.2)	12 (0.1)	99 1	830 1	477 (0.6)	63 (0.1)	37 (0.1)	6 (0.02)	345 1
Waterfowl	646 (0.7)	1 (0.03)	5,839 14	806 1	754 1	23 (0.1)	573 3	86 1	1,042 1.5	753 (0.9)	625 1	2,082 6	165 1	1,444 3
Seabirds								X	X	X	X	X	X	X
Char (Anadromous)	203 (0.2)	480 2	3,026 7	2,489 2	5,087 5	2,168 6	961 5	1,207[a] 15	6,657[a] 10	8,531[a] (10)	13,049[a] 21	9,150[a] 28	17,497[a] 66	24,142[a] 55
Other Marine Fish		1 (0.004)	170 (0.4)	3 (0.003)				X	X	X	X	X	X	X
Char (Landlocked)			12 (0.03)	10 (0.01)	27 (0.03)	31 (0.1)	1 (0.005)	X	X	X	X	X	X	X
Lake Trout	3,745 4	129 (0.5)		970 (0.90)	458 (0.5)	62 (0.2)	314 2	329 4	2,825 4	1,756 2	956 1.5	2,200 7	645 2	12,699 29
Other Freshwater Fish	687 (0.7)		19 (0.04)	629 (0.6)	8 (0.01)	216 1		195 2	720 1	5,188 6	1,355 2	4 (0.01)	156 (0.60)	997 2
Other spp.	1 (0.001)			4 (0.003)				2 (0.02)		7 (0.01)				
Whale spp.		12 (0.05)	116 (0.3)	50 (0.04)	69 (0.1)	56 (0.1)	24 (0.1)	X	X	X	7[b] (0.01)		X	15 (0.03)

( ) Parenthesis indicates less than one animal per person.
- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given to provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. Estimated number for this figure is provided in the test of ref. #9 as "20 narwhals".: total edible wt. - 9,922 kg; per cap harvest = (0.03) : per cap

Table 2.2: The Estimated or Reported Number (uppercase) and the Per-Capita Number (lowercase) of the Fish and Wildlife Harvest of Communities in the Northwest Territories. (continued)

BAFFIN REGION

Total harvest Per capita harvest	Apex J-83 0-83	Arctic Bay J-83 D-83	Broughton Island J-83 D-83	Cape Dorset J-83 0-83	Clyde River J-83 0-83	Frobisher Bay J-83 0-83	Grise Fiord J-83 0-83	Hall Beach J-83 0-83	Iglookik J-83 0-83	Lake Harbour J-83 0-83	Nanisivik J-83 0-83	Pangnirtung J-83 0-83	Pond Inlet J-83 0-83	Resolute Bay J-83 0-83	Sanikiluaq J-83 0-83
Ringed Seal	263 1.5	2,446 6	3,733 9	1,727 2	3,257 6.5	1,326 1	727 5	952 2.5	1,530 2	1,484 5.5	334 3	5,469 6	2,996 4	252 2	2,431 6
Polar Bear		15 (0.04)	22 (0.05)	11 0.01	51 (0.1)	11 (0.01)	20 (0.1)	7 (0.02)	18 (0.02)	13 (0.05)	1 (0.01)	10 (0.01)	7 (0.01)	25 (0.2)	28 .1
Other Marine Mammals	12 (0.1)	147 (0.4)	412 1	251 (0.3)		148 (0.1)	202 1.5	217 (0.6)	226 (0.3)	114 (0.4)	11 (0.1)	2,797 3	130 (0.2)	16 (0.1)	66 (0.2)
Muskox		3 (0.01)					5 (0.04)							2 (0.01)	
Arctic Hare	13 (0.1)	311 (0.8)	120 (0.3)	68 (0.1)	252 (0.5)	138 (0.1)	124 1	6 (0.02)	38 (0.05)	253 1	61 (0.6)	276 (0.3)	373 (0.6)		17 (0.04)
Caribou	246 1	891 2	586 1	1,836 2	765 2	2,368 2	31 (0.2)	1,113 3	1,940 2.5	4,81 2	127 1	2,413 2.7	1,880 2	155 1	26 (0.1)
Rock Ptarmigan	372 2	322 (0.8)	300 1	2,173 3	392 1	3,631 2	160 1	131 (0.4)	133 (0.2)	5,381 21	67 1	1,365 1.5	310 (0.4)	299 2	127 (0.3)
Waterfowl	9 (0.05)	478 1	421 1	3,898 5	609 1	301 (0.2)	341 2	201 1	303 (0.4)	1,340 5	185 1.7	2,289 3	1,278 2	55 (0.4)	7,626 19
Seabirds		56 (0.1)	113 (0.3)	832 1	15 (0.03)	12 (0.01)	16 (0.1)	8 (0.02)	1 (0.001)	327 1			3 (0.004)	39 (0.3)	506 1
Char (Anadromous)	206 1	9,782 25	15,205 38	13,340 16	9,914 20	5,369 4	2,850 21	4,984 14	23,772 30.5	2,427 9	128 1	18,484 21	7,489 10	633 4	8,785 22
Other Marine Fish		22 (0.05)	862 2	148 (0.2)	2,425 5	106 (0.1)			45 (0.05)	273 1		37 (0.04)	97 (0.1)	3 (0.02)	2,441 6
Char (LandLocked)		9 (0.02)	59 (0.1)	900 1	54 (0.1)	128 (0.1)		657 2	1,851 2	917 3		10 (0.01)	30 (0.04)	25 (0.2)	1,506 4
Lake Trout	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other FreshWater Fish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other spp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Whale spp.		81 (0.2)	23 (0.1)	65 (0.1)	49 (0.1)	9 (0.01)	10 (0.01)	12 (0.03)	84 (0.1)	9 (0.03)	1 (0.01)	126 (0.1)	81 (0.1)	17 (0.1)	4 (0.01)

( ) Parenthesis indicates less than one animal pers person.
\- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given to provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. Estimated number for this figure is provided in the test of ref. #9 as "20 narwhals".: total edible wt. - 9,922 kg; per cap harvest = (0.03) : per cap edible wt. 16kg.

can roughly calculate the total amount of country foods available to each community and therefore an indication of potential contaminant intake from this source.

In order to estimate the quantity of country food available to each community and the relative importance of the various species harvested , it is first necessary to calculate the total weight of the harvest by species. This requires information on the average edible biomass of each species harvested. The estimated individual weights used to calculate the total edible biomass in the Keewatin and Kitikmeot harvests are shown in Table 2.3. Those used to calculate the Baffin Island harvest are shown in Table 2.4. These figures do not take into consideration the variations which may exist in animal weight due to factors such as age, sex, season of harvest and region of harvest. The calculations assumed a uniform size distribution of the animals and that any inherent variations will not greatly affect the final estimates of the average edible yields. No alternatives are really available at this time unless more detailed information regarding the species is provided in the harvest surveys. Therefore, it was felt that these estimates of total subsistence production are sufficiently accurate in the context for which they are used in this report. Similar formulae were employed in the James Bay-Northern Quebec surveys (JBNQNHRC, 1976) as well as those in Keewatin (Gamble, 1984). Recently, Pattimore (1985) conducted a similar exercise with the Baffin region data. In this review, the total edible weights of the harvested animals were summarized according to species or groups of species in Table 2.5.

Following the calculation of total edible weight of harvested species, the figures were divided by the total native population of each community (Table 2.6)

Table 2.3: Estimated Individual Weights Used to Calculate the Total Edible Biomass of the Keewatin and Kitikmeot Fish and Wildlife Harvest.

Species or Grouping		Weight (kg)
(1) Ringed Seal		14.3
(2) Other Marine Mammals		
	Bearded seal	98.4
	Harp seal	43.1
	Harbour seal	27.7
	Walrus	185.1
(3) Whale		
	Beluga	481.4
	Narwhal	496.1
(4) Polar bear		158.8
(5) Muskox		110.0
(6) Caribou		48.0
(7) Arctic Hare		2.3
(8) Ptarmigan		0.4
(9) Waterfowl		
	Snow goose	1.6
	Canada goose	2.4
	Ross' goose	1.0
	Eider	1.5
	Oldsquaw	0.5
	Mallard	0.7
	Swan	6.8
	Sandhill crane	4.1
(9) Arctic char		2.5
(10) Lake trout		2.4
(11) Other Freshwater Fish		
	Whitefish	2.8
	Northern pike	2.1
	Grayling	0.9
(12) Other species		
	Moose	199
	Black Bear	45.4
	Grizzly bear	45.4

Source: Gamble, 1984.

Table 2.4: Estimated Individual Weights Used to Calculate the Total Edible Biomass of the Baffin Region Fish and Wildlife Harvest.

Species or Grouping		Weight (kg)
(1) Ringed seal		20*
(2) Other Marine Mammals		
	Bearded seal	98
	Harp seal	73
	Harbour seal	28
	Walrus	185
(3) Whale		
	Narwhal	496
	Beluga whale	372
(4) Polar Bear		159
(5) Muskox		110
(6) Caribou		48
(7) Arctic Hare		2
(8) Ptarmigan		0.63
(9) Waterfowl		
	Snow goose	1.6
	Canada goose	2.4
	Brant	1.4
	Oldsquaw	0.5
	Eider	1.5
(10) Seabirds		
	Thick-billed Murre	0.70
	Guillemot	0.40
(11) Char (anadromous)		2.0
(12) Char (landlocked)		1.0
(13) Cod		1.0
(14) Sculpin		0.23

Source: Pattimore (1985).

* The weight of the Ringed seal was changed to 20 kg rather than 59 kg following consultation with Kinloch (pers. comm.).

Table 2.5: The Total Amount (kg) of Edible Weight (uppercase) and Per-Capita Edible Weight (lowercase) of the Fish and Wildlife Harvest of Communities in the Northwest Territories.

Edible Wt. Per capita Edible Wt.	KEEWATIN Baker Lake	Chesterfield Inlet	Coral Harbour	Eskimo Point	Rankin Inlet	Repulse Bay	Whale Cove	KITIKMEOT Bay Chimo/ Bathurst Inlet	Cambridge Bay	Coppermine	Gjoa Haven	Holman	Pelly Bay	Spence Bay
Ringed Seal	88 (0.1)	622 3	11,839 28	7,424 7	5,907 6	7,890 21	1,516 8	-		-	-	-	-	
Polar Bear		1,451 6	5,399 13	3,390 3	1,542 2	2,338 6	1,296 (0.04	*	*	*	*	*	*	*
Other Marine Mammals		7,716	16,030 38	266 5	2,040 2	3,393 9	1,126 6	-		-	-	-	-	
Muskox	1430 1							110 1	1,650 2	1,650 2	2,530 4	1,760 5		
Arctic Hare				7 (.01)	11 (0.01)	9 (0.02)	19 (0.1)	237 3	60 (.1)	205 (0.2)	85 (0.1)	230 1	9 (0.03)	228 1
Caribou	308,569 312	18,295 75	30,495 72	134,096 121	71,980 76	61,221 165	26,209 131	20,256 247	103,728 154	108,288 129	118,176 191	57,936 178	36,000 136	66,624 152
Rock Ptarmigan	140 (0.1)		508 1	147 (.13)	117 (0.1)	33 (0.1)	5 (0.02	40 (0.5)	332 (0.5)	191 (0.2)	25 (0.04)	15 (0.05)	2 (0.01)	138 (0.3)
Waterfowl	1,271 1	20 (.1)	9,337 22	1,784 1.6	1,557 2	40 (0.1)	938 5	-	-	-	-	-	-	-
Seabirds								X	X	X	X	X	X	X
Char (Anadromous)	508 (0.5)	1,201 5	7,565 18	6,226 6	12,712 13	5,419 15	2,406 12	3,018 37	16,643 25	21,328 25	32,623 53	22,875 70	43,698 165	60,335 137
Other Marine Fish														
Char (Landlocked)			-	-	-	-								
Lake Trout	8,986 9	310 1		2,332 2	1,099 1	147 (0.4)	753 4	790 10	2,016 10	14,526 5	3,794 4	11 16	437 6	2,792 69
Other Freshwater Fish	1,858 2		-	857 1	22 (0.02)	-		546 7	6,780 3	4,214 17	2,294 6	5,280 (0.03)	1,548 2	30,478 6
Other spp.	45 (0.04)			802 1				398 5		1,393 2				
Whale spp.		5,923 24	55,868 132	24,407 22	33,081 35	27,305 73	11,660 58	-	X	X	-	X	X	-
Total Per Capita	322,845 327	29,538 121	137,041 325	186,758 168	130,068 138	107,795 290	45,940 230	25,395 310	131,209 195	151,795 181	159,527 258	88,107 270	81,694 308	160,615 366

() Parenthesis indicates less than one kg of edible weight per person.
- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given to provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. [redacted] for [redacted] the t[redacted] ref[redacted] "20[redacted]als" [redacted]l ed[redacted]t. - [redacted] kg; [redacted]p ha[redacted] (0.[redacted]per [redacted] wt. [redacted]

Table 2.5: The Total Amount (kg) of Edible Weight (uppercase) and Per-Capita Edible Weight (lowercase) of the Fish and Wildlife Harvest of Communities in the Northwest Territories. continued

BAFFIN ISLAND

Edible Wt. Per capita Edible Wt.	Apex	Arctic Bay	Broughton Island	Cape Dorset	Clyde River	Frobisher Bay	Grise Fiord	Hall Beach	Igloolik	Lake Harbour	Nanisivik	Pangnirtung	Pond Inlet	Resolute Bay	Sanikiluaq
Ringed Seal	5,260 30	48,920 121	7,466 186	34,540 42	65,140 135	26,520 18	14,540 108	19,040 53	30,600 39	29,680 114	6,680 62	109,380 124	59,920 78	5,040 34	48,620 122
Polar Bear		2,385 6	3,498 9	1,749 2	8,109 17	1,748 1	3,180 24	1,113 3	2,862 4	2,067 8	159 1	1,590 2	1,113 1	3,975 27	4,452 11
Other Marine Mammals	976 6	12,766 32	31,411 79	29,700 36	5,414 11	12,792 9	17,449 130	24,921 70	28,223 36	11,224 43	878 8	210,306 239	10,482 14	1,568 11	6,850 17
Muskox		330 1					550 4							220 1	
Arctic Hare	26 (0.1)	622 1	240 1	136 (0.2)	504 1	276 (0.2)	248 2	12 (0.03)	76 (0.1)	506 2	122 1	522 1	746 1		34 (0.1)
Caribou	11,808 68	42,768 106	28,128 70	88,128 108	36,720 76	113,664 78	1,488 11	53,424 150	93,120 120	23,088 89	6,096 57	115,824 132	90,240 118	7,440 50	1,248 3
Rock Ptarmigan	234 1	203 (0.5)	189 (0.5)	1,369 2	247 (0.5)	2,288 1	101 1	83 (0.2)	84 (0.1)	3,390 13	42 (0.4)	860 1	195 (0.2)	188 1	80 (0.2)
Waterfowl	16 (0.1)	753 2	730 2	6,215 6	923 2	431 (0.3)	514 4	321 1	474 1	2,104 8	295 3	3,423 4	2,028 3	82 (0.5)	12,967 32
Seabirds	832	38 (0.1)	77 (0.2)	518 1	8 (0.02)	6 (0.004)	11 (0.1)	4 (0.01)	0.4 (4.001)	203 1			2 (0.003)	21 (0.1)	214 (0.5)
Char (Anadromous)	412 2	19,564 48	30,410 76	26,680 33	19,828 41	10,738 7	5,700 42	9,968 28	47,544 61	4,854 19	256 2	36,968 42	14,978 20	1,266 8	17,570 44
Other Marine Fish		5 (0.01)	500 1	34 (0.04)	653 1	102 (0.1)			20 (0.02)	239 1		9 (0.01)	22 (0.03)	1 (0.01)	1,482 4
Char (Landlocked)		9 (0.02)	59 (0.1)	900 1	54 (0.1)	128 (0.1)		657 2	1,851 2	917 3		10 (0.01)	30 (0.04)	25 (0.2)	1,505 4
Lake Trout	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Freshwater Fish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other spp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Whale spp.		39,680 100	10,664 27	24,304 30	24,180 50	2,596 2	4,092 30	4,836 13	32,860 42	3,348 13	496 5	46,872 53	40,052 52	6,324 43	1,488 4
Total Per Capita	19,832 108	168,043 424	113,372 284	214,273 262	151,780 334	172,290 119	47,873 357	114,379 320	237,714 305	81,520 314	15,024 140	525,794 597	219,808 287	25,150 177	96,511 241

() Parenthesis indicates less than one kg of edible weight per person.
\- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given tc provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. Estimated number for this figure is provided in the test of ref. #9 as "20 narwhals".: total edible wt. - 9,922 kg; per cap harvest = (0.03) : per cap edible wt. 16kg.

Table 2.6: Population Estimates of Communities in the Northwest Territories (GNWT, Bureau of Statistics)

Baffin Region(1)	
Apex*	173
Arctic Bay	396
Broughton Island	399
Cape Dorset	818
Clyde River	484
Frobisher Bay**	1448
Grise Fiord	134
Hall Beach	357
Igloolik	778
Lake Harbour	260
Nanisivik**	107
Pangnirtung	880
Pond Inlet	766
Resolute	148
Sanikiluaq	400
Keewatin Region(2)	
Baker Lake	988
Chesterfield Inlet	243
Coral Harbour	422
Eskimo Point	1108
Rankin Inlet**	940
Repulse Bay	372
Whale Cove	200
Kitikmeot Region(1)	
Bathurst Inlet/Bay Chimo	82
Cambridge Bay**	672
Coppermine	839
Gjoa Haven	618
Holman	326
Pelly Bay	265
Spence Bay	439

(1) June, 1983 estimates
(2) December, 1983 estimates
* The Apex population estimate was calculated using the proportions found in the 1981 census for Apex/Frobisher Bay, and applying this ratio to the reported 1983 native population of Frobisher Bay.
** This number was derived by multiplying the total population (including non-natives) by the reported percentage of natives in these communities in the 1981 census: Frobisher Bay (36.2%), Nanisivik (59.6%), Rankin Inlet (22.1%) and Cambridge Bay (22.7%).

to determine the quantity of country food which can potentially be consumed by each individual within the community or the per capita consumption. These figures are also shown in Table 2.5. Outpost camps were excluded from these calculations because of the skewness in the data caused by the small population size and the high number of animals harvested in these camps.

Table 2.7 shows the rank of each community with respect to the amount of edible weight per capita, with 1 referring to the highest per capita consumption of that species or group of species. A zero designation indicates that the community does not harvest that particular animal resource or its utilization of the animal resource is insignificant relative to the other communities. The average rank and the order of the highest country food harvest communities of each community are shown at the bottom of the table.

The summary of the ranks provides the best indication of each community's dependence on the harvested species or groups of species. In addition, these ranks can be used to express the 'potential contaminant intake' of these communities. It must be kept in mind that the estimated figures used to compute the ranks assume that all individuals in the community consume equal proportions of the harvest, which is likely not true. (see Section 3.0). However, these ranks are useful benchmarks for comparing the country foods consumption pattern among the communities and to tentatively identify communities 'at risk'. This is a required exercise in this initial evaluation of contamination in country foods.

In the Keewatin region, Coral Harbour had the highest rank among the communities. This was attributed to this community's high per capita harvest of Ringed Seal, Polar bear, whales, waterfowl, ptarmigan and sea-run Arctic char.

Table 2.7: The Rank of Communities in the Three Regions Based on the Available Per Capita Edible Weight (kg) for Each Species or Group of Species.

Rank of Per capita edible wt/harvest	KEEWATIN: Baker Lake	Chesterfield Inlet	Coral Harbour	Eskimo Point	Rankin Inlet	Repulse Bay	Whale Cove	KITIKMEOT: Bay Chimo/ Bathurst Inlet	Cambridge Bay	Coppermine	Gjoa Haven	Holman	Pelly Bay	Spence Bay
Ringed Seal	7	6	1	4	5	2	3	-		-	-	-	-	
Polar Bear	0	2	1	3	4	2	5	*	*	*	*	*	*	*
Other Marine Mammals	0	6	1	4	5	2	3	0	3	3	3	1	3	2
Muskox	1	0	0	0	0	0	0	4	3	3	2	1	0	0
Arctic Hare	0	0	0	3	3	2	1	1	4	3	4	2	5	2
Caribou	1	6	7	4	5	2	3	1	4	7	2	3	6	5
Rock Ptarmigan	3	0	1	2	3	3	4	1	1	2	4	3	5	2
Waterfowl	5	6	1	4	3	6	2	3	3	3	3	1	3	2
Seabirds	0	0	0	0	0	0	0	X	X	X	X	X	X	X
Char (Anadromous)	7	6	1	5	3	2	4	5	6	6	4	3	1	2
Other Marine Fish	0	0	0	0	0	0	0	X	X	X	X	X	X	X
Char (Landlocked)	0[$]	0[$]	2[$]	3[$]	2[$]	1[$]	4[$]	X	X	X	X	X	X	X
Lake Trout	1	4	0	3	4	5	2	3	3	5	6	2	4	1
Other Freshwater Fish	1[$]	0[$]	2[$]	1[$]	3[$]	1[$]	0[$]	2	4	1	3	6	5	3
Other spp.	2	0	0	1	0	0	0	1	0	2	0	0	0	0
Whale spp.	0	5	1	6	4	2	3	X	X	X	2[$]		X	1[$]
Average Rank	3.1	5.1	1.8	3.3	3.7	2.5	3.0	2.3	3.4	3.5	3.3	2.4	4.0	2.2
Order of Highest Harvest	4	7	1	5	6	2	3	2	5	6	4	3	7	1

\- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given to provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. Estimated number for this figure is provided in the test of ref. #9 as "20 narwhals".: total edible wt. - 9,922 kg; per cap harvest = (0.03) : per cap edible wt. 16kg.

Table 2.7: The Rank of Communities in the Three Regions Based on the Available Per Capita Edible Weight (kg) for Each Species or Group of Species. continued

BAFFIN ISLAND

Rank of Per capita edible wt/harvest	Apex	Arctic Bay	Broughton Island	Cape Dorset	Clyde River	Frobisher Bay	Grise Fiord	Hall Beach	Igloolik	Lake Harbour	Nanisivik	Pangnirtung	Pond Inlet	Resolute Bay	Sanikiluaq
Ringed Seal	14	5	1	11	2	15	7	10	12	6	9	3	8	13	4
Polar Bear	0	7	5	10	3	11	2	10	8	6	11	9	11	1	4
Other Marine Mammals	13	7	3	6	10	11	2	4	6	5	12	1	9	10	8
Muskox	0	2	0	0	0	0	1	0	0	0	0	0	0	2	0
Arctic Hare	4	2	2	3	2	3	1	5	4	1	2	2	2	0	4
Caribou	11	6	10	5	9	8	14	1	3	7	12	2	4	13	15
Rock Ptarmigan	3	4	4	2	4	3	3	6	7	1	5	3	6	3	6
Waterfowl	9	6	6	3	6		4	7	7	2	5	4	5	8	1
Seabirds	0	4	3	1	5	7	4	6	8	1	0	0		4	2
Char (Anadromous)	13	3	1	7	6	12	5	8	2	10	13	5	9	11	4
Other Marine Fish	0	7	2	4	2	3	0	0	6	2	0	7	5	7	1
Char (Landlocked)	0	8	6	4	6	6	0	3	3	2	0	9	7	5	1
Lake Trout	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Freshwater Fish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Spp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Whale Spp.	0	1	8	7	4	12	7	9	6	9	10	2	3	5	11
Average Rank	9.6	4.8	4.25	5.25	4.91	8.27	4.54	6.27	6.0	4.33	8.77	4.27	6.27	6.83	5.08
Order of Highest Harvest	15	5	1	8	6	13	4	10	9	3	14	2	10	12	7

- This symbol signifies that there was a harvest of this species (or group of species) but insufficient detail was given to provide a quantitative estimate.
X indicates that this information was not collected in the surveys.
* Harvest data collected but not available at time of writing.
a. Not specified as to anadromus or land locked and therefore calculated as anadromus
b. Estimated number for this figure is provided in the test of ref. #9 as "20 narwhals".: total edible wt. - 9,922 kg: per cap harvest = (0.03) : per cap

Coral Harbour was followed in rank by Repulse Bay, Whale Cove, Baker Lake, Eskimo Point, Rankin Inlet and Chesterfield Inlet.

In the Kitikmeot region, Spence Bay, Bay Chimo/Bathurst Inlet and Holman were identified as the communities with the greatest per-capita harvest of country food. Spence Bay was found to rely heavily on whale, lake trout and marine mammal species while Bay Chimo/Bathurst Inlet residents harvested the highest quantities of Caribou, Arctic hare and ptarmigan. Holman had the highest ranking in its harvest of marine mammal species, Muskox and waterfowl. These communities were followed in rank by Gjoa Haven, Cambridge Bay, Coppermine and Pelly Bay.

In the Baffin Island region, Broughton Island, Pangnirtung, Lake Harbour, Grise Fiord, Arctic Bay and Clyde River had the highest rankings. Broughton Island, Clyde River and Pangnirtung were found to rely heavily on the Ringed Seal harvest. Broughton Island and Pangnirtung, along with Grise Fiord, had the highest harvest of other marine mammal species. The greatest volume of edible biomass from whales was collected at Arctic Bay and Pangnirtung. Broughton Island had the largest harvest of sea-run Arctic char. Lake Harbour also had a high ranking in the char harvest, in addition to its high reliance on Arctic hare, ptarmigan and seabirds. These communities were followed in rank by Sanikiluaq, Cape Dorset, Igloolik, Hall Beach, Pond Inlet, Resolute Bay, Frobisher Bay, Nanisivik, and Apex.

It should again be pointed out that comparisons between the three regions are not valid because of the non-uniform method of expression of harvest data in the respective surveys.

The harvest data from the Baffin Island, Keewatin and Kitikmeot Regions provide insight into animal resource utlization for a large portion of the Northwest Territories. The record of harvest from other northern areas have not been summarized. Some harvest reports in the Yukon are known to exist in the unpublished form (Lortie, 1975; Lortie, 1976; Lortie and McDonald, 1977), but these manuscripts were not retrieved at the time of preparation of this review. Additionally, insufficient time was available to include the James Bay-Northern Quebec harvest information (JBNQNHRC, 1976; JBNQNHRC, 1982), which are the most complete records of game harvest by natives compiled to date.

Other sources of fish and wildlife harvest records which have been identified include: (1) Area economic surveys conducted in the 1960s by the Industrial Division of the Department of Northern Affairs and Northern Development (Ottawa); (2) Socio-economic impact assessment reports; (3) Marine mammal harvest statistics going back to 1972 from the Department of Fisheries and Oceans; (4) Unpublished results of domestic fisheries in northern Canada from the Department of Fisheries and Oceans. Most of these references are found in Usher (1985). There is also a large volume of data for harvest of fur-bearers, but these animals are not relevant to the subject of harvesting for subsistence use. The above reports are useful for filling in the information gaps concerning harvests not covered by the three surveys summarized in this review. Moreover, data which overlap for some regions (i.e. marine mamal harvests) can be used to validate the reported harvest estimates. In addition, the historical data collected in the 1960s and 1970s can be employed for defining temporal trends of the past and present levels of harvest by northern natives, and thereby provide an indication of the pattern of country food use over the years.

3.0 DIET INFORMATION

In order to determine with some precision the potential level of exposure to contaminants in individuals residing in the northern communities, detailed qualitative and quantitative information regarding their diet must be obtained. Although the data generated in harvest surveys are clearly useful for ascertaining the total amount of edible food available to the various native communities, they were not designed to provide information on dietary patterns. The annual per capita estimates for the northern communities were based on edible weights of the total number of 'edible' animals harvested by hunters, so the actual per capita consumption figures would be somewhat lower if not all animals collected in the harvest (e.g. Polar bears, Walrus) and if not all edible portions are consumed by humans. The estimates of annual per capita food production for the Keewatin, Baffin island and Kitikmeot Regions range from 108 kg (Apex) to 597 kg (Pangnirtung) with a mean of 267 kg for the three regions (see Table 2.7). This figure is well above the national average consumption (117 kg) of meat and fish (Anon., 1985).

Certain species not found to be major components of the total annual harvest were also included in this analysis because their potential as a contaminant source can not be overlooked. This was pointed out in the study of the mercury problem in Sugluk, Quebec (Wheatley and Wheatley, 1981). The annual harvest of Lake trout up to 1976 was reported to represent only 3% of the total annual harvest by weight in this community. Arctic char (26.2%), Beluga whale (24.4%), Bearded seal (17.4%) and Ringed seal (15.9%) made significantly greater contributions. Therefore, the mercury load in Lake trout was not seriously considered as a potential source of this contaminant. However, eating pattern surveys showed a greater preference for fish in this community than originally anticipated. In addition, it was shown that 44% of the annual harvest of lake trout, corresponding to 10,880 lbs or 4945.5 kg of edible weight, were taken in November and December. This represents a large proportion (4790 lbs or 2177.3 kg) of the available meat during these months. Mercury in hair samples from Sugluk showed peak levels during the period between November and March. This focused attention on Lake trout as a major source of mercury in the diet. Subsequent testing reported Lake trout to contain a mean mercury level (0.85 ppm) which was lower only than levels found in Ringed seal liver (5.12 ppm) and Beluga whale meat (0.92 ppm).

Even when the amount of country food harvested by each community is known, the question still remains as to which parts or portions of the animal is actually consumed. To date, there has been little documentation of this aspect of northern native life (Schaefer, pers. comm.). Much of the published information on native diets has been concerned with the nutritional value of traditional country foods (see review by Schaefer et al. 1985). Information on the methods of preparation of country foods is also scarce. Schaefer et al. (1985) provided a table of the nutrient value of common foods used by Indian and Inuit of the Territories. In this summary, general descriptions of the types of foods and the methods of preparation are provided. The information relevant to the present review has been extracted (Table 3.1).

Another priority at this time is to more specifically determine the contemporary consumption pattern of individuals within the communities. It is not known if all residents of a community (i.e. men and women of different age groups) share a common diet. At present, there is a dearth of published

Table 3.1: Portions and Methods of Preparation of Country Foods by Indian and Inuit (Schaefer et al. 1985).

SPECIES	PORTIONS	PREPARATION METHODS
Mammals		
Black Bear	Meat	Stewed
Polar Bear	Meat	Stewed
Beaver	Meat	Cooked
Caribou	Meat	Cooked
	Meat	Dried
	Bone Marrow	Raw
	Stomach Contents	-
Deer	Meat	Fresh
	Meat	Roasted
	Liver	Cooked
Richardson's Ground Squirrel	Meat	Cooked
Groundhog	Meat	Cooked
Marine Mammals (Beluga, Narwhal)	Muktuk	-
Moose	Meat	Cooked
Muskrat	Meat	Cooked
Wild Rabbit/Hare	Meat	Stewed
Seal	Fat	-
	Meat	Cooked
	Meat	Raw
	Liver	Raw
Walrus	Meat	Cooked
Unspecified Animal	Blood	Coagulated
	Blood	Raw
	Intestines	Cooked

SPECIES	PORTIONS	PREPARATION METHODS
Birds		
Wild Duck	Eggs	-
	Flesh	-
	Meat	Raw
Wild Goose	Fat	-
	Liver	Raw
	Meat	Roasted
Pheasant	Meat	Cooked
Ptarmigan	Meat	Raw

SPECIES	PORTIONS	PREPARATION METHODS
Fish		
Carp	Eggs	Cooked
	Eggs	Raw
Arctic Char	Meat	Raw
Cod	Meat	Dried
	Meat	Salted
	Meat	Boiled
	Eggs	Cooked
	Eggs	Raw
Eel	Meat	Raw
Flounder (Sole)	Meat	Raw
Haddock	Meat	Pan Fried
	Eggs	Cooked
	Eggs	Raw
Herring	Meat	Broiled
	Meat	Baked
	Eggs	Cooked
	Eggs	Raw
	Eggs	On Dried Kelp
Lake Trout	Meat	Broiled
	Meat	Baked
Atlantic Mackerel	Meat	Raw
	Meat	Broiled with Butter
Ooligan (Eulachon)	Grease	-
	Meat	Raw
	Meat	Smoked
	Meat	Dried

SPECIES	PORTIONS	PREPARATION METHODS
Fish cont'd		
Pickerel	Meat	Raw
Pike	Meat	Steamed
	Eggs	Cooked
	Eggs	Raw
Atlantic Salmon	Meat	Broiled
	Meat	Baked
	Meat	Smoked
	Eggs	Cooked
Coho Salmon	Meat	Dried
	Meat	Smoked
	Eggs	Cooked
King Salmon	Liver	-
Shad	Eggs	Raw
	Eggs	Cooked
Smelt	Meat	Broiled
Sturgeon	Eggs	Cooked
Turbot	Eggs	Cooked
Whitefish	Meat	Broiled
	Meat	Smoked
	Liver	-
Unspecified	Whole Fish	Fish Head Soup (Fish Chowder)

SPECIES	PORTIONS	PREPARATION METHODS
Seafood		
Abalone	Meat	Raw
Black Sea Prunes	-	-
Clams	Meat Liquid	Raw
Crab	Meat	Steamed
Mussels	Meat	Cooked
Sea Urchins	Eggs	Raw
Shrimp	-	Raw

SPECIES	PORTIONS	PREPARATION METHODS
Plants (vegetables)		
Dandelion Greens	Young Leaves, Flower Buds	Cooked
	-	Raw
Dock (sp.)	Young Leaves, Shoots	Cooked
	-	Raw
Fiddelhead Greens	-	Frozen
	-	Cooked
Fireweed	Young Leaves	Raw
Lamb's Quarters	Leaves, Young Stems	Cooked
	-	Raw
Lichen (Black)	-	-
Purslane	Leaves, Shoots	Cooked
	-	Raw
Seaweed	-	Dried
(Porphyra sp.)	-	Dried
(Dulse)	-	Blanched

SPECIES	PORTIONS	PREPARATION METHODS
Plants (fruit)		
Bakeapple	-	Raw
Blackberries	-	Raw
Blueberries	-	Raw
Cranberries	-	Raw
Currants (Black)	-	Raw
Currants (Red/White)	-	Raw
Gooseberries	-	Raw
Huckleberries	-	Raw
Raspberries	-	Raw
Rosehips	-	Raw
Salmon-berries	-	Raw
Strawberries	-	Raw

information on domestic consumption patterns - only general observations and educated guesses. According to some opinions, age and sex difference in the consumption pattern of country foods do occur within a community (Rousseau, pers. comm.). Variations in eating habits with respect to age are related to the southern influence. Native households in many communities have access to a large variety and volume of imported foods and it appears that children and young adults have shifted their diet to include greater proportions of these imported items. Adults, particularly older individuals, have generally maintained their traditional diet. The health effects as result of changes in nutritional habits in Inuit and Dene from the Northwest Territories have been examined (Schaefer et al. 1985; Schaefer and Steckle, 1980), but no quantitative information on the contemporary diet on a regional basis was presented.

Schaefer et al. (1980) stated that communities in the Western Arctic (i.e. MacKenzie Delta) have more exposure to imported foods because of industrial development in the last twenty years. However, most communities in the more remote Central and Northeastern Arctic have continued to obtain a major proportion of their food from traditional sources. Differences in the intensity and history of acculturation among communities must be considered when examining the components which make up their contemporary diets.

Sex differences in the pattern of country food consumption have also been observed (Rousseau, pers. comm.). Energetics or calorific demand seem to play a key role in this distinction between men and women. It appears that males in the community who participate in hunting and trapping activities consume greater portions of harvested meat and fat, while women consume more organ meats. Other differences in eating habits may also occur, but have not been documented.

Cultural preferences will also play a role in eating habits. This factor will vary on a regional basis, according to the ethnicity of the community. Some general differences in the basic nutrient composition and nutritional habits between northern Indians and Inuit have been described (Schaefer and Steckle, 1980; Spady and Schaefer, 1982). For example, it appears that Indians (79.5%) consume more fish than the Inuit (55.6%). In addition, the former group rarely eats marine mammals (1.0%) while the Inuit (36.9%) frequently use these animals as a food source. Between the two groups, there were only minor differences in the frequency of consumption of Caribou. Of the individuals surveyed in the Territories, about 81.3% of the Inuit and 74.6% of the Indians frequently consume Caribou (Spady and Schaefer, 1982). Overall, there is little specific information on food resource utilization by northern native groups on a community and ethnicity basis at this time.

The inadequacy of our current knowledge of northern native food habits does not allow for a precise assessment of the degree of exposure to environmental contaminants via the diet. More detailed information on the consumption pattern of residents within a community is required in order to identify individuals who are potentially 'at risk'. It may be possible to obtain more anecdotal information on eating habits from community representatives or nutrition committees of the nursing stations in the community. From the fragmentary information that is available, differences in the potential level of contaminant exposure between individuals appear likely. For example, in the study of mercury contamination in natives, Wheatley (1979) reported a higher proportion of males in Northwestern Ontario - many working as guides - was found to be in the 'at risk' group compared to other individuals from the community.

A full evaluation of the possibility of a seasonal pattern of repeated exposure to environmental contaminants as a result of consuming country foods should be conducted. The consumption of country foods is dictated by their availability. From the harvest data (Appendix B), there are indications that certain species are collected at specific times during the year (e.g. eggs of birds, many fish, birds and mammals are harvested during their migration period). Seasonal exposure to contaminants was previously demonstrated in the mercury study. Wheatley (1979) reported seasonal variations in mercury levels in blood and hair of individuals from the Grassy Narrows Reserve in Ontario.

Eating pattern surveys using the individual recall interview method of the type employed by Wheatley and Wheatley (1981) is the only effective method of obtaining relatively accurate information on dietary habits of individuals within a community. A daily diary of consumption pattern involving a representative sample of households compiled for several months, or ideally for one year, would provide the best indication. This would take into account the seasonal variations in eating habits which are dictated by the availability of the food resource.

Wheatley and Wheatley (1981) drafted a questionnaire to obtain as much information as possible concerning: (a) the type of food eaten, (b) the time of year consumed, (3) where the food was harvested, (4) the frequency of consumption (e.g. more than once daily, daily, weekly, monthly, seldom), (5) the amount of food consumed at each time, (6) the preference for one food over another when given a choice. The final format of the questionnaire was translated into Inuktituk and bilingual (Inuktituk and English) field workers conducted the interviews in the community. The findings of the diet survey indicated that food preference can play a major role in mercury exposure in residents of Sugluk, Quebec. Forty-nine of the respondents listed fish as their number one choice of country food. Eleven individuals chose beluga, particularly muktuk, as their first preference, while eighteen preferred seals. Only one respondent showed a preference for store food when country food was available. When individuals categorized as 'at risk' were cross checked with the results of the diet survey, 26 of the 50 residents with high mercury levels in blood samples were found to have a preference for fish.

3.1 Residue Limits in Food

A listing of the maximum organic contaminant (Table 3.2) and metal (Table 3.3) residue limits in fish, poultry and other meats as established or recommended by the Health Protection Branch of Health and Welfare Canada and by the World Health Organization (WHO) have been tabulated (Bennett, pers. comm.). In order to avoid misconception of these 'residue limits', a brief explanation on how they are established is required.

First the 'acceptable daily intake' or ADI of a chemical residue, generally a pesticide, is determined through a review of available toxicity studies. The dose per unit of body weight which produces no observable adverse effect in animals in these toxicity studies is ascertained. This 'no-effect dose' is then divided by a safety factor which is usually 100. This factor, however, can range between 10 and 5000 depending on the chemical compound. The figure that prevails is regarded as an ADI for humans of that particular compound. The ADI is the quantity of a chemical which is considered by toxicologists to be safe for human consumption each day for an entire lifetime (Anon., 1980).

Table 3.2: Residue Limits Established or Recommended for Organic Contaminants in Foods (Bennett, pers. comm.).

	CANADA (ppm or mg/kg)			FAO/WHO (mg/kg)		
	FISH (in edible portion)	POULTRY (on fat basis)	MEAT (on fat) basis)	FISH	POULTRY (in carcass fat)	MEAT
Aldrin	-	0.1	0.2	-	0.2	0.2
BHC, except lindane	-	0.1	0.2	-	-	-
Chlordane isomers	-	0.1	0.1	-	0.05	0.05
Chlorophenols	-	-	-	-	-	-
DDT and metabolites	5.0	1.0	1.0	-	5.0	5.0
Dieldrin	-	0.2	0.2	-	0.2	0.2
Dioxins	20 ppt*	no residues permited (B.01.046)		-	-	-
Endrin	-	-	-	-	1.0	0.1
Furans	-	-	-	-	-	-
HCB	-	0.1(GL)		-	-	-
Heptachlor & metabolites	-	0.2	0.2	-	0.2	0.2
Lindane	-	0.7	2.0	-	0.7	2.0
Mirex	0.1 (GL)	-	-	-	-	-
PCB	2.0 (GL)	0.5 (GL)	0.2 (beef GL)	-	-	-
Toxaphene	-	-	-	-	-	-

* ppt = parts per trillion
GL = guideline level
\- = no limits established

Table 3.3: <u>Residue Limits Established or Recommended for Metal Residues in Foods (Bennett, pers. comm.).</u>

	CANADA (ppm or mg/kg)			FAO/WHO (mg/kg)		
	FISH	POULTRY	MEAT	FISH	POULTRY	MEAT
Arsenic	3.5 (fish protein)	-	-	-	-	-
Cadmium	-	-	-	-	-	-
Cesium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Fluoride	150(fish protein)	-	-	-	-	-
Iron	-	-	-	-	-	-
Lead	0.5(fish protein)	-	-	-	-	-
Mercury (total)	0.5 guideline level except for swordfish	-	-	-	-	-
Methylmercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Strontium	-	-	-	-	-	-
Tin	250 in these foods when canned; otherwise no limits established			-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

- = no limits established

The maximum residue limits for chemicals, such as pesticides, in foods are established by determining the quantity likely to remain in food at the point of sale. These limits are accepted only when the total consumption of residues from all food uses will not exceed the ADI determined for that chemical compound. The Health Protection Branch has established residue limits for about 100 of the 200 to 300 chemicals used in food production. The remaining include (1) chemicals considered too toxic for any residues to remain on foods, (2) chemicals which are not likely to leave residues on food because of their chemical nature or the method by which they are applied, and (3) chemicals exempted from the requirement to set residue limits because of their low toxicity (Anon., 1980).

The Field Operations Directorate of the Health Protection Branch monitors and inspects the residue levels in food samples. If excessive residues are found in food, an investigation is initiated to determine the source and extent of contamination. If the information indicates a violation of the Food and Drugs Act and Regulations, appropriate action, which may involve removal of foods for sale or seizure of foods, is initiated (Anon., 1980). The Health Protection Branch also performs research on the chemical residue intake of urban Canadians from food prepared for consumption in the "usual manner". The results of chemical analysis of the foods are used to calculate the average daily intake in the diet.

Maximum residue limits or acceptable levels of contaminants in fish, poultry and other meats are conservative estimates based on the assumption that the average Canadian consumes less than a certain quantity of the specific food on a weekly basis. The numbers are determined by Canada-wide food surveys. These numbers are not likely to be representative of the eating patterns of country foods in native populations since the harvest data indicate that natives usually consume greater proportions of fish, birds and other meats. For example, the Health Protection Branch guideline of 0.5 ppm acceptable level of mercury in commercial fish is based on an assumption that an individual consumes less than 1.0 lb (454 g) of fish per week. This was believed to be too high for natives and others who have greater amounts of fish in their diet. In 1976, the Medical Services Branch of Health and Welfare Canada recommended that the maximum acceptable level of mercury in fish should be lowered to 0.2 ppm for those who consume larger quantities of fish (Wheatley, 1979). Additionally, the 2.0 ppm guideline level for PCB residues established for commercial fish is based on a consumption pattern of 30 g per day and only the edible portion or fillet is consumed. This residue limit may be set too high for individuals eating more fish or eating portions other than the fillet (Kinloch, 1985). It appears that application of residue limits to country foods, based on southern consumption patterns, is not justified. This is particularly true in the absence of any consideration of the consumption patterns of country foods.

4.0 THE GREENLAND EXPERIENCE

Information on the surveillance of environmental contaminants in Greenland was assembled because it was thought these studies may be comparable to the situation which exists in northern Canada. Extensive searches on computerized databases were not performed, therefore, the coverage of this section can not be viewed as complete.

A survey was conducted in 1972 to investigate the chlorinated hydrocarbon content of birds (Braestrup et al., 1974), wild mammals (Clausen et al., 1974), and human subjects (Clausen and Berg, 1975) from southwest Greenland. The region studied was from Narssarssuaq in the south to Sukkertoppen in the north. In the first report, the p,pDDE, PCB and lindane concentrations in fat of nine bird species were determined (Table 4.1). Although the sample sizes were small (1 to 5) and large individual variations existed in the residue levels, some species trends were reported. The highest DDE levels were detected in adipose tissue of the non-migratory Raven (6.5 to 18.8 ppm, dry weight) and the Cormorant (6.5 to 15.0 ppm). The lowest DDE values were reported in fat of the waterfowl (0.8 to 2.8 ppm). A surprising finding was the occurrence of relatively high concentrations of DDE in fat of resident ptarmigans (1.9 to 4.0 ppm) which are primarily herbivorous. High levels of PCBs were also detected in ptarmigans (2.9 to 15.8 ppm). The order of accumulation of PCBs for the other bird species was similar to the pattern observed for DDE. Fat tissues of the Ravens (13.8 to 63.0 ppm), Cormorant (14 1 to 46.7 ppm) and Brunnich's guillemot (3.9 to 39.6 ppm) contained the highest values while low concentrations were found in fat of ducks and the sandpiper (1.1 to 6.0 ppm). Trace levels of a chemical residue, which was believed to be lindane, were detected in a few samples.

Table 4.1: Chlorinated Hydrocarbon Residues (ppm - dry weight) in Adipose Tissues of Birds, Arctic Mammals and Human Subjects of Greenland (adapted from Clausen and Berg, 1975).

Species	Age	Lindane	Hepta-chlor	Aldrin	Heptachlor epoxide	pp'DDE	PCB
King eider (*Somateria spectabilis*)	-	n.d.	-	-	-	1.1	1.1
	-	-	-	-	-	2.6	5.3
	-	0.02	-	-	-	1.3	3.5
Eider duck (*Somateria mollissima*)	-	0.12	-	-	-	0.8	2.0
Harlequin duck (*Histrionicus histrionicus*)	-	n.d.	-	-	-	1.1	2.2
	-	0.08	-	-	-	1.1	3.2
	-	n.d.	-	-	-	1.2	4.6
	-	-	-	-	-	0.7	2.9
	-	-	-	-	-	1.2	4.8
Long tailed duck (*Clangula hyemalis*)	-	-	-	-	-	1.3	4.1
	-	0.06	-	-	-	1.0	6.0
	-	-	-	-	-	0.8	2.9
Purple sandpiper (*Calidris maritimia*)	-	0.04	-	-	-	1.1	2.8
Brunnich's guillemot (*Uria lomvia*)	-	n.d.	-	-	-	3.6	8.5
	-	-	-	-	-	8.7	39.6
	-	-	-	-	-	2.4	6.3
	-	0.31	-	-	-	1.8	6.2
	-	-	-	-	-	1.2	3.9
Cormorant (*Phalocrocorax carbo*)	-	-	-	-	-	15.0	46.7
	-	-	-	-	-	6.5	18.0
	-	-	-	-	-	9.5	14.1
Ptarmigan (*Lagopus mutus*)	-	n.d.	-	-	-	3.6	9.1
	-	0.11	-	-	-	4.0	11.1
	-	0.40	-	-	-	3.0	12.0
	-	n.d.	-	-	-	1.9	2.9
	-	0.18	-	-	-	3.9	15.8
Raven (*Corvus corax*)	-	0.18	-	-	-	16.4	34.6
	-	n.d.	-	-	-	6.5	13.8
	-	n.d.	-	-	-	18.8	63.0
Bearded seal (*Erignatus barbatus*)	-	0.037	0.039	0.12	0.12	0.42	2.6
	-	0.064	n.d.	0.43	n.d.	0.67	0.6
	-	0.14	n.d.	1.60	n.d.	0.80	1.6
	-	0.019	0.017	0.042	0.045	0.24	3.0
	-	0.007	n.d.	0.029	0.022	0.20	1.2
Ringed seal (*Phoca hispida*)	-	0.002	0.003	0.008	0.005	0.025	1.0
	-	0.005	n.d.	0.020	0.021	0.083	1.3
	-	0.025	n.d.	0.14	0.050	0.26	0.6
	-	n.d.	n.d.	0.025	0.025	0.20	0.7
	-	n.d.	n.d.	0.025	0.028	0.20	0.9
Hooded seal (*Cystophora cristata*)	-	n.d.	n.d.	0.015	0.058	0.43	4.1
	-	0.017	n.d.	0.037	0.073	0.49	2.5
	-	n.d.	n.d.	0.029	0.062	0.31	1.9
	-	n.d.	n.d.	0.024	0.012	0.069	4.9
	-	n.d.	n.d.	0.035	n.d.	0.14	0.3
Common porpoise (*Phocaena phocaena*)	-	0.005	n.d.	0.043	n.d.	0.045	1.9
	-	0.018	n.d.	0.028	0.059	0.60	11.4
Polar bear (*Ursus maritimus*)	-	n.d.	n.d.	3.06	0.49	1.25	21.0
Arctic fox (*Alopex lagopus*)	-	0.019	n.d.	0.043	0.047	0.22	1.6
	-	n.d.	n.d.	0.032	0.080	0.052	3.9
Sheep (*Ovis aries*)	-	n.d.	n.d.	0.41	n.d.	0.19	1.2
Human	26	0.02	0.040	0.024	0.03	0.52	1.02
	57	0.02	0.03	0.05	0.09	0.39	5.58
	49	0.003	0.002	0.003	0.001	0.04	0.44
	52	0.02	-	0.02	0.05	0.61	2.46
	28	0.009	0.006	0.007	0.02	0.12	0.90
	27	-	-	0.02	-	0.33	0.25

n.d. - indicates not detected
(-) - indicates not analyzed

The chlorinated hydrocarbon content of wild mammals from the southwest coast of Greenland was also analyzed (Table 4.1). Similar to the previous study, the sample sizes were small (1 to 5) and large variances in the residue data were found. The highest DDE (1.25 ppm) and PCB (21.0 ppm) concentrations were reported in fat of the Polar bear. In addition, high amounts of what was believed to be aldrin (3.06) and heptachlor epoxide (0.49 ppm) were detected. The levels of lindane and heptachlor, were low or non-detectable.

The highest concentration of PCBs in other mammals was reported in a Common porpoise fat sample (11.4 ppm). A high amount of DDE residue was also found in this sample (0.60 ppm). Similar levels of DDE were detected in the Bearded seal samples (mean level of 0.47 ppm), but lower concentrations were found in the Hooded and Ringed seals. The PCB and DDE residue levels in these Arctic mammals, except the Polar bear, were about one order of magnitude lower than those reported in Arctic seabirds (Clausen et al., 1974). This was attributed to differential metabolism of chlorinated hydrocarbons by the various species or to different levels of exposure to these chemicals during the migration.

The measured chlorinated hydrocarbon residues in tissues of the birds and mammals were believed to have originated from their food resources from the polluted Gulf Stream waters or were accumulated during their winter migration to more contaminated sites (Clausen et al., 1974). This postulation, however, would not explain the levels found in the non-migratory, herbivorous species, such as the ptarmigan and sheep. From the available evidence, it does not appear that one can rule out the possibility of atmospheric input of these chemicals.

Adipose tissue collected operatively from six female human subjects were analyzed for chlorinated hydrocarbon residues (Table 4.1). These individuals were aged from 26 to 57 years and lived their whole life in Greenland. The highest PCB levels (2.46 and 5.58 ppm) were reported in fat of the two older subjects (ages 52 and 57, respectively). DDE concentrations ranged from 0.04 to 0.61 ppm and did not demonstrate any correlation with age. Comparing Greenlanders to individuals from industrialized areas, Clausen and Berg (1975) reported that the former appear to contain higher PCB loads than the latter. This was postulated to be related to the greater dependence of Greenlanders on locally-caught fish, birds and mammals for food. No speculation on the health risks these levels of contaminants may pose to humans was advanced.

A study was conducted between 1972 and 1978 to investigate the heavy metal intake from marine mammals by Greenland residents (Johansen, 1981). The survey was initiated because of concern that pollution from lead-zinc mine developments in west Greenland could affect human health. Upernavik, Umanaq, and Disko Bay in west Greenland and Daneborg in northeast Greenland were the sampling areas. Inorganic mercury and methylmercury residues were analyzed in muscle and liver of Harp seals, Hooded seals, Ringed seals, and a Minke whale (Table 4.2). Additionally, the cadmium, lead, and zinc levels were measured in tissues of Ringed seals (Table 4.3). Information on the heavy metal content of marine fish were also collected but not reported in this reference.

The human health implication of the high cadmium and mercury concentrations was assessed because of the importance of these animals as food resources to Greenland residents. The potential metal intake by humans was calculated based on the composition of the diet and the measured concentrations of metals in the

TABLE 4.2: Mercury in muscle and liver of seals and whales sampled in Greenland during the period 1972-78. Results of total mercury (total Hg) and methyl-mercury (CH_3Hg) calculated as Hg in mg/kg on wet weight basis, range and arithmetic mean (Johansen, 1981).

SPECIES	LOCALITY/YEAR	TISSUE	n	Total Hg range	Total Hg mean	CH_3Hg range	CH_3Hg mean	Percent of CH_3Hg of total Hg
Harp Seal (*Pagphilus groenlandicus*)	UMANAK/1972	muscle	12	0.11 - 0.26	0.20	0.07 - 0.15	0.11	57
		liver	7	0.21 - 3.6	1.2	0.11 - 0.26	0.19	30
	UPERNAVIK/1973	muscle	11	0.11 - 0.48	0.24	0.05 - 0.34	0.16	65
		liver	11	0.37 - 5.8	2.3	0.09 - 0.69	0.31	20
	UPERNAVIK/1976	muscle	4	0.16 - 0.26	0.20	-	-	-
		liver	4	0.54 - 1.3	0.86	-	-	-
Hooded Seal (*Cystophora cristata*)	UPERNAVIK/1974	muscle	4	0.16 - 0.24	0.20	0.10 - 0.17	0.14	68
		liver	4	1.9 - 11.2	6.5	0.061 - 0.45	0.27	4.8
	UPERNAVIK/1976	muscle	10	0.21 - 0.47	0.33	-	-	-
		liver	10	2.8 - 44.4	16.7	-	-	-
Ringed Seal (*Phoca hispida*)	UPERNAVIK/1973	muscle	10	0.05 - 0.51	0.23	0.02 - 0.34	0.15	64
		liver	10	0.32 - 4.9	2.4	0.03 - 0.55	0.30	15
	UPERNAVIK/1974	muscle	7	0.05 - 0.12	0.088	0.003 - 0.10	0.036	72
		liver	7	0.05 - 1.2	0.34	0.006 - 0.22	0.085	27
	DANEBORG/1974	muscle	7	0.25 - 0.68	0.42	0.23 - 0.56	0.36	86
		liver	7	1.4 - 8.1	2.9	0.31 - 0.96	0.58	20
	UPERNAVIK/1976	muscle	31	0.02 - 0.55	0.18	-	-	-
		liver	31	0.14 - 11.9	2.1	-	-	-
MINKE WHALE (*Balaenoptera acutorostrata*)	UMANAK/1972	muscle	9	0.06 - 0.21	0.11	0.03 - 0.09	0.06	56
		liver	4	0.10 - 0.21	0.17	0.05 - 0.09	0.08	47
	DISKO DAY/1978	muscle	6	0.09 - 0.25	0.15	0.08 - 0.16	0.11	60
		liver	6	0.07 - 0.41	0.18	0.03 - 0.13	0.06	43

TABLE 4.3: Cadmium, copper, lead, and zinc in ringed seal (<u>Phoca hispida</u>), range and arithmetic mean (ppm wet weight). n = number of samples (Johansen, 1981).

LOCALITY/YEAR	TISSUE	n	Cd range	Cd mean	Cu range	Cu mean	Pb range	Pb mean	Zn range	Zn mean
UMANAK/1979	blubber	29	0.02 - 0.03	0.02	0.08 - 0.18	0.12	0.05 - 2.38	0.12[a]	0.66 - 1.16	0.84
	muscle	29	0.02 - 0.42	0.07	1.03 - 1.55	1.27	0.02 - 0.10	0.04	14.2 - 39.5	22.2
	liver	29	2.71 - 14.9	7.32	4.48 - 22.3	11.6	0.01 - 0.03	0.01[b]	30.7 - 67.3	46.0
	kidney	29	9.01 - 146.2	37.4	4.95 - 21.8	10.6	0.004 - 0.48	0.05[c]	27.9 - 78.0	46.2
DANEBORG/1974	liver	7	1.8 - 18.2	6.6	1.3 - 14.6	8.1	0.03 - 0.04	0.03		
UPERNAVIK/1974	blubber	7	0.02 - 0.4	0.02	0.2 - 0.2	0.2	0.02 - 0.15	0.05[d]	0.1 - 2.3	1.4
+ 1976	muscle	7	0.09 - 0.24	0.15	2.0 - 4.7	3.2	0.05 - 0.35	0.16[3]	37 - 84	55
	liver	12	2.3 - 31.6	17.0	2.8 - 16.9	7.6	0.03 - 0.06	0.03	18 - 46	37

a) 26 out of 29 values were below the detection limit (0.05 ppm Pb). In computing the mean value values below the detection limit have been fixed to half this value, i.e. 0.025 ppm Pb. This procedure has been applied in similar cases mentioned below. In the actual case the mean value for lead in blubber probably is better expressed as less than 0.05 ppm Pb, see the text.

b) 15 values were below the detection limit (0.02 ppm Pb).

c) 12 values were below the detection limit (0.02 ppm Pb).

d) 4 values were below the detection limit (0.02 ppm Pb). The mean is probably better as less than 0.02 ppm Pb, see the text.

e) 1 value was below the detection limit (0.05 ppm Pb).

food. The most important sources of mercury and cadmium were livers and meat of seals and fish (Johansen, 1981). The calculations showed that the intake of mercury and cadmium were well above the 'provisional tolerable weekly intake' levels established by FAO/WHO. Factors of 2 to 45 times and 2 to 30 times above the tolerance concentrations were found for mercury and cadmium, respectively, depending on the level of fish and seal in the diet. Lead intake did not exceed the tolerance levels.

Hansen (1981) studied the mercury, lead, cadmium, selenium and copper content in hair of past and present-day Greenlanders. Of the elements, only mercury and, lead were found to be significantly higher in contemporary samples relative to those from the fifteenth century. Comparing these results to tests conducted with present-day individuals from Denmark show mercury levels to be significantly lower in the Danish hair samples. This was believed to be a reflection of the greater mercury load found in the diet of Greenlanders. Lead levels in hair of present-day residents of Greenland were similar to those of Danes. The reason for this finding is still not known. The absence of industry and the presence of only a few motor vehicles do not suggest lead to be an environmental problem in Greenland. It was postulated that increasing pollution of the environment by lead over time is occurring on a global scale. This is supported by the results showing lead levels in present-day samples to be five times higher than those from the fifteenth century.

Other studies dealing with Greenland and environmental contaminants have been identified. All of these investigations have generally been conducted from an ecological interest, rather than from a human health, perspective. The levels of chemical residues in Greenland marine mammals have been tabulated by Muir (1985) and are discussed in Section 7.0.

5.0 CHEMICAL RESIDUES IN CANADIAN GAME BIRDS

The available information on contaminants in tissues of game birds sampled in Canada has been reviewed (Wong, 1985). The report included seven summary tables of the published residue data on the following families of birds: Anatidae (ducks, geese, mergansers); Rallidae (coots, gallinules); Scolopacidae (woodcocks, snipes); Phasianidae (pheasants, partridges); Columbidae (doves, pigeons); and Alcidae (murres, guillemots, puffins). The report also included unpublished data on residue levels in game birds from the National Registry of Toxic Chemical Residue (NRTCR) database at the National Wildlife Research Centre (Hull, Quebec).

The summary tables show that although a large volume of residue information exists for game birds, the majority of the studies were conducted in southern latitudes and most surveys were performed in the late 1960s and early 1970s. The contaminants data generated in studies conducted with game birds from the Canadian Arctic are summarized in Table 5.1. No residue data were found for game birds collected in the Yukon Territory and there is only a limited database for birds from the Northwest Territories.

Wong (1985) reviewed the cases where the Canadian Wildlife Service had conducted surveys of toxic chemicals in game birds to support assessments of potential health hazards to consumers of these birds. These investigations involved mercury in upland game birds in Alberta, mercury in waterfowl from northwestern Ontario and Quebec, and DDT residues in Woodcocks from New Brunswick. No similar type of activity has been carried out with birds from the Arctic regions. In fact, the tabulation of mercury levels in wildlife used in the diets of native peoples (Desai-Greenaway and Price, 1976) shows residue information was available for only two ducks from the Northwest Territories.

Due to the fragmentary nature of the residue data (Table 5.1), it is not possible to define temporal or geographical trends. Few datasets were available where the collection sites and seasonal dates overlapped to the point where such trends are obvious. Furthermore, since many game bird species are migratory, the measured contaminant load in tissues do not necessarily represent the residue profile of birds from the area of collection. They may, in actuality, reflect the state of contamination in their wintering grounds, sites along the migration pathways or even the residue burden of the mother bird. The array and levels of residues found in eggs and tissues of such species as loons, geese and other waterfowl, and some seabirds (Table 5.1) indicate that they are being exposed to these contaminants during their movements.

Although the residue data for Arctic game birds are sparse, some species differences appear evident. DDE and PCB concentrations were highest in eggs and fatty tissues of birds, such as loons, Oldsquaw, and murres, which feed primarily on fish and invertebrates. The levels of DDE and PCBs found in fat of loons range from 19 to 25 ppm (dry weight) and 23 to 35 ppm, respectively. The highest residue concentration reported in Table 5.1 was in a Red-throated loon gonad sample which contained 60.5 ppm (dry weight) of DDE and 64.5 ppm of PCBs. An elevated level of PCBs (48 ppm, wet weight) was found in eggs of Oldsquaw.

The egg samples of Snow goose from Baffin and Bylot Island show this population to contain low levels of organochlorine and mercury residues. These specimens were collected in 1971 and recent information is not available to indicate if these levels have remained low. Residue surveys conducted in the United States have demonstrated that some populations of Snow goose are exposed to high levels of organochlorines in their wintering grounds (Wong, 1985).

Eiders (Somateria spp.) represent one of the most important bird species harvested by the Inuit (Section 2.0). They are the most abundant waterfowl species in some areas - comprising over 95% of all ducks during the summer. At present, residue information is available for one King eider egg from Seymour Island (Table 5.1).

No residue information is available for ptarmigans from the Canadian Arctic. Although one may expect this resident species to have low levels of contamination because of their herbivorous habit, high concentrations of DDE and PCBs were reported in ptarmigans from Greenland (Section 4.0). Furthermore, the harvest information indicates that these birds are harvested on a year-round basis (Section 2.0). Residue data is obviously required for ptarmigans from northern Canada in order to acquire some information on their level of contamination.

A major data gap which was identified was the paucity of information on organochlorine residues in migratory birds. It has been documented in the harvest studies (Section 2.0) that some northern communities regularly harvest Anatidae and Alcidae species (eggs and adults) for consumption. The migratory nature of these birds predisposes them to travel over wide areas and encounter a wide range of environmental contaminants. There is also some evidence showing these birds can accumulate organochlorine chemical residues in their wintering grounds or during their spring and fall migrations (Wong, 1985). Although one may hypothesize that these birds are only exposed to low levels of contaminants in their northern breeding habitat, one would also expect the type and magnitude of chemical exposure to differ in their southern ranges. At present, it is not possible to further evaluate the effects of accumulated chemical residues on the health of these birds or their consumers until more recent data are acquired.

A large volume of organochlorine residue data in birds from Alaska has been identified (Ohlendorf et al. 1982), but the information has not been summarized.

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (from Wong, 1985).

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Yellow-billed loon (*Gavia adamsii*)	(68°02'N,107°00'W)	May 1969	1	Egg	74.3	10.0	-	-	DDE	0.75*	-	Gilbertson and Reynolds, 1974.	dry weight basis *geometric means
									PCB	0.98*	-		
Arctic loon (*Gavia arctica*)	(68°02'N,107°00'W)	May 1969	5	Egg	-	-	-	-	DDE	4.80*	(2.09 - 11.0)x		dry weight basis * geometric means x95% confidence intervals
									PCB	6.49*	(2.65 - 15.9)x		
			9	Brain	-	-	-	-	DDE	1.99*	(0.79 - 5.02)x		
									PCB	1.44*	(0.45 - 4.64)		
			9	Fat	-	-	-	-	DDE	19.08*	(4.09 - 95.5)x		
									PCB	23.3*	(8.32 - 65.3)x		
			2	Gonad	-	-	-	-	DDE	8.85*	-		
									PCB	2.08*	-		
Red-throated loon (*Gavia stellata*)	(68°02'N,107°00'W)	August 1969	5	Egg	-	-	-	-	DDE	2.76*	(0.69 - 15.9)x		dry weight basis * geometric means x95% confidence intervals
									PCB	3.14*	(0.83 - 11.8)x		
			8	Brain	-	-	-	-	DDE	2.95*	(0.82 - 10.6)x		
									PCB	4.16*	(1.25 - 13.9)x		
			8	Fat	-	-	-	-	DDE	25.1*	(5.84 - 108.0)x		
									PCB	35.6*	(11.9 - 107.0)x		
			1	Gonad	-	-	-	-	DDE	60.5*	-		
									PCB	64.6*	-		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Snow goose (*Chen caerulescens*)	Baffin Island (72°57'N, 80°45'W)	1971	5+	Egg	-	12.3	-	-	Total DDT	0.041	-	Longcore *et al.* 1983	[+]1 pooled analysis [x] Aroclor 1254
									dieldrin	0.005	-		
									PCB[x]	0.13	-		
									BHC	0.025	-		
									Hg	0.05	-		
	Bylot Island (72°52'N, 79°55'W)	1971	5+	Egg	-	13.4	-	-	Total DDT	0.049	-		[+]1 pooled analysis
									dieldrin	0.005	-		
									PCB[x]	0.13	-		
									BHC	0.024	-		
									Hg	0.05	-		
			5+	Egg	-	13.4	-	-	Total DDT	0.047	-		[+]1 pooled analysis
									dieldrin	0.005	-		
									PCB[x]	0.13	-		
									BHC	0.026	-		
									Hg	0.05	-		
Mallard (*Anas platyrhynchos*)	Mills Lake (61°30'N 118°15'W)	1970	1	Breast muscle	-	-	-		Hg	0.01	-	Desai-Greenaway and Price, 1976	
	Yellowknife	1961-62	9	Carcass(?)	-	-	-		Total DDT	0.5	(0.1 - 0.8)	Sheldon *et al.* 1963	
Pintail (*Anas acuta*)	Mills Lake 61°30' 118°15'	1970	1	Breast muscle	-	-	-		Hg	0.03	-	Desai-Greenaway and Price, 1976	
	Yellowknife	1961-62	4	Carcass(?)	-	-	-		Total DDT	1.0	(1.0 - 1.0)	Sheldon *et al.* 1963	

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
American wigeon (*Anas americana*)	Yellowknife	1961-62	3	Carcass	-	-	-	-	Total DDT	0.2	(0.1 - 0.2)	Sheldon *et al.* 1963	
Lesser scaup (*Aythya affinus*)	Yellowknife	1961-62	1 4	Carcass Egg	- -	- -	- -	- -	Total DDT Total DDT	0.0 2.2	- (1.3 - 4.0)	Sheldon *et al.* 1963	* May be Greater scaup - not indicated
Oldsquaw (*Clangula hyemalis*)	NW Hudson Bay near Eskimo Point and Rankin Inlet	Jan. 7- Aug. 8 1971	33	Liver	-	-	AD	-	Hg	1.30 $\pm$ 0.15*	(0.31 - 4.39)	Peterson and Ellarson, 1976	* x $\pm$ SE
		July 25- Aug. 2 1971	12	Liver	-	-	im	-	Hg	0.29 $\pm$ 0.30*	(0.15 - 0.46		
		June 28- July 11 1971	11	Egg	-	-	-	-	Hg	0.20 $\pm$ 0.03*	(0.09 - 0.44)		
	Eskimo Point, Diana River and Rankin Inlet	June 7- 10, 1971	10	Carcass	-	-	AD	M	p,p'DDE PCB Endrin	6.4 25 0.1	(0.7 - 21.9) (3 - 81) (ND-0.1)	Peterson and Ellarson, 1978	ND = not detectable
		June 7- 10, 1971	10	Carcass	-	-	AD	F	p,p'DDE PCB Endrin	6.5 18 0.1	(0.6 - 19.8) (3 - 44) (Trace-0.2)		
		June 29- July 11 1971	11	Carcass	-	-	AD	F	p,p'DDE PCB Endrin	4.7 24 0.1	(0.1 - 16.0) (1 - 95) Trace-0.1)		females with cluthes
		June 29- July 11 1971	11	Egg	-	-	-	-	p,p'DDE PCB Endrin	7.6 48 0.1	(0.2 - 19.1) (1 - 172) (ND-0.2)		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Oldsquaw		July 25- Aug. 2 1971	3	Carcass	-	-	AD	F	p,p'DDE	2.8	(0.3 - 7.6)	Peterson and Ellarson, 1978	ND=not detectable females with broods
									PCB	14	(2 - 32)		
									Endrin	ND	-		
		July 25- Aug. 2 1971	3	Carcass	-	-	im	-	p,p'DDE	2.1	(0.2 - 3.1)		broods
									PCB	25	(1 - 63)		
									Endrin	0.1	(ND-0.1)		
		Aug 8 1971	5	Carcass	-	-	AD	F	p,p'DDE	2.6	(0.3 - 7.7)		moulting females with broods
									PCB	21	(1 - 57)		
									Endrin	(ND	-		
		July 10- Aug. 8 1971	4	Carcass	-	-	AD	M	p,p'DDE	2.9	(0.6 - 6.8)		subadult males
									PCB	15	(1 - 43)		
									Endrin	0.1	(ND-0.1)		
King eider (*Somateria* *spectabili*)	Seymour Island (76°48'N, 101°20'W)	July, 1976	1	Egg	79.8	8.9	-	-	DDE	0.020	-	NRTCR	
									DDT	0.007	-		
									DDD	0.0019	-		
									Dieldrin	0.005	-		
									Heptachlor epoxide	0.005	-		
									Oxychordane	0.009	-		
									-clordane	0.005	-		
									HCB	0.019	-		
									B-BHC	0.005	-		
									PCB 1260	0.050	-		
									PCB 1254:1260	0.060	-		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	$\%H_2O$	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Thick-billed murre (*Uria lomvia*)	Prince Leopold Island (74°02'N,90°00'W)	1975	12	Egg	71.4	12.6	-	-	DDE	0.297	0.229-0.383	NRTCR	
									DDT	ND	-		Geometric means
									DDD	ND	-		and 95%
									Deldrin	0.019	0.014-0.024		confidence
									HCB	0.097	0.078-0.119		intervals
									B-HCH	0.0035	0.001-0.009		
									Heptachlor	0.0025	0.001-0.005		
									epoxide				
									-chlordane	0.0013	0.001-0.003		
									Oxychlordane	0.0184	0.015-0.022		
									PCB 1260	0.529	0.436-0.644		
									PCB 1254:1260	0.708	0.582-0.859		
	Prince Leopold Island	1975	10	Liver	69.5	4.48	AD	-	DDE	0.059	0.044-0.080		
									DDT	ND	-		
									DDD	ND	-		
									Dieldrin	0.008	0.006-0.010		
									HCB	0.027	0.017-0.042		
									B-HCH	0.001	0.000-0.001		
									Heptachlor	0.001	0.000-0.002		
									epoxide				
									-chlordane	0.001	0.000-0.002		
									Oxychlordane	0.005	0.003-0.009		
									PCB 1260	0.157	0.119-0.208		
									PCB 1254:1260	0.203	0.151-0.273		
Thick-billed murre	Prince Leopold Island (74°02'N,90°00'W)	1976	12	Liver	70.9	6.43	im	-	DDE	0.144	0.083-0.249	NRTCR	
									DDT	ND	-		Geometric means
									DDD	0.009	0.001-0.002		and 95%
									Dieldrin	0.002	0.001-0.002		confidence
									HCB	0.060	0.037-0.096		intervals
									B-HCH	0.002	0.001-0.004		
									Heptachlor	0.001	0.001-0.003		
									epoxide-chlordane	0.001	0.000-0.001		
									Oxychlordane	0.009	0.005-0.017		
									PCB 1260	0.342	0.233-0.502		
									PCB 1254:1260	0.462	0.302-0.707		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	$\%H_2O$	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Thick-billed murre	Southeast of Maxwell Bay, West of Cape Warrender, Lancaster Sound	July-August 1976	2	Breast muscle	-	-	im	-	As	17.99 ± 6.01*	(13.74-22.24)	Renewable Resources Consulting Services, 1977	* $\bar{X}$ ± SD Hg - wet weight other metals - dry weight ND - non-detectable
									Cu	4.91 ± 0.86*	(4.30-5.52)		
									Zn	31.37 ± 2.62*	(29.51-33.22)		
									Cd	0.37 ± 0.28*	(0.17-0.56)		
									Cr	1.61 ± 1.36*	(0.65-2.57)		
									V	ND	-		
									Hg	0.042 ± 0.00*	(0.042-0.043)		
			2	Liver	-	-	im	-	As	6.79 ± 0.87*	(6.17-7.40)		
									Cu	12.35 ± 3.25*	(10.05-14.64)		
									Zn	65.50 ± 0.45*	(65.18-65.82)		
									Cd	1.24 ± 0.45*	(0.92-1.56)		
									Cr	0.23 ± 0.02*	(0.22-0.25)		
									V	ND	-		
									Hg	0.06 ± 0.04*	(0.034-0.089)		
			1	Bone	-	-	im	-	Pb	22.94 ± 4.14*	(20.01-25.87)		
	Southest of Maxwell Bay, West of Cape Warrender Lancester Sound	July-August 1976	8	Breast muscle	-	-	AD	-	As	13.70 ± 9.91*	(2.36-26.03)		
									Cu	12.55 ± 3.87*	(6.62-18.80)		
									Zn	31.82 ± 5.95*	(22.24-37.84)		
									Cd	2.21 ± 2.23*	(0.61-6.95)		
									Cr	1.72 ± 1.30*	(0.26-4.02)		
									V	ND	-		
									Hg	0.31 ± 0.12*	(0.125-1.539)		
			8	Liver	-	-	AD	-	As	35.64 ± 40.29*	(5.80-90.87)		
									Cu	17.24 ± 3.97*	(12.08-23.08)		
									Zn	106.74 ± 26.74*	(76.33-148.97)		
									Cd	23.15 ± 7.47*	(15.18-38.92)		
									Cr	1.89 ± 1.92*	(0.24-5.11)		
									V	ND	-		
									Hg	0.70 ± 0.48*	(0.392-1.845)		
			8	Bone	-	-	AD	-	Pb	9.58 ± 6.24*	(2.69-20.05)		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	$\%H_2O$	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Thick-billed murre	Southest of Maxwell Bay, West of Cape Warrender Lancaster Sound	July-August 1976	2	Fat	-	-	im	-	DDE	1.4 ± 0.01*	(1.35-1.39)	Renewable Resources Consulting Services, 1977	* $\bar{X}$ ± SD lipid weight basis ND = non-detectable Trace levels not included in calcualtion of mean
									p,p'-DDT	-	(Trace-0.57)		
									p,p'-DDO	-	(Trace-0.78)		
									o,p'-DDT	-	(Trace-1.68)		
									HCB	-	(ND-0.46)		
									PCB	-	(ND-0.20)		
									Total DDT	-	(1.35-4.42)		
			8	Fat	-	-	AD	-	DDE	4.5 ± 2.59*	(1.63-9.56)		
									p,p'-DDT	2.21 ± 1.35*	(Trace-3.75)		
									p,p'-DDD	1.83 ± 1.76*	(Trace-4.95)		
									o,p'-DDT	1.94 ± 1.69*	(Trace-4.84)		
									HCB	0.62 ± 0.83*	(ND-1.20)		
									PCB	1.25 ± 1.34*	(ND-2.20)		
									Total DDT	-	(1.63-22.57)		
Thick-billed murre	Prince Leopold Island (74°02'N,90°00'W)	1977	10	Egg	71.0	12.6	-	-	DDE	0.377	0.303-0.471	NRTCR	Geometric means and 95% confidence intervals
									DDT	ND	-		
									ODD	ND	-		
									Dieldrin	0.016	0.009-0.027		
									HCB	0.109	0.091-0.131		
									B-HCH	0.011	0.009-0.013		
									Heptachlor epoxide	0.004	0.002-0.008		
									-chlordane	0.001	0.000-0.002		
									Oxychlordane	0.024	0.020-0.029		
									PCB 1260	0.649	0.494-0.851		
									PCB 1254:1260	0.854	0.649-1.123		
		1977	19	Liver	71.1	3.47	AD	-	DDE	0.054	0.034-0.087		
									DDT	ND	-		
									DDO	0.001	0.000-0.001		
									Dieldrin	0.003	0.001-0.006		
									HCB	0.022	0.017-0.029		
									B-HCH	0.001	0.000-0.001		
									Heptachlor epoxide	0.001	0.000-0.002		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Thick-billed murre									-chlordane	0.001	0.001-0.002		
									Oxychlordane	0.006	0.004-0.009		
									PCB 1260	0.137	0.091-0.206		
									PCB 1254:1260	0.172	0.114-0.260		
Black guillemot (*Cepphus grylle*)	Leaf Inlet 58:48/69:40	July 1967	1	breast muscle	60.0	0.8	-	-	DDE	0.032	-	NRTCR	
			1	breast muscle	58.2	1.2	-	-	DDE	0.029	-		
									Dieldrin	0.005	-		
			1	breast muscle	80.0	0.3	-	-	DDE	0.013	-		
			1	breast muscle	63.4	1.2	-	-	DDE	0.031	-		
									Dieldrin	0.0005	-		
			1	breast	61.3	0.7	-	-	DDE	0.046	-		
Black guillemot	Dundas Harbour, Lancaster Sound	July-August 1976	5	breast muscle	-	-	im	-	As	12.66 ± 6.88**	(7.12-24.37)	Renewable Resources Consulting Services, 1977	** $\overline{X}$ ± SD Hg - wet weight other metals - dry weight ND = non-detectable
									Cu	15.72 ± 1.47**	(14.16-17.38)		
									Zn	40.32 ± 3.71**	(36.28-45.98)		
									Cd	0.59 ± 0.22**	(0.24-0.82)		
									Cr	0.87 ± 0.15**	(0.67-1.02)		
									V	ND	-		
									Hg	0.13 ± 0.05**	(0.073-0.216)		

Table 5.1: Chemical Residues in Tissues of Game Birds Collected in Northern Canada (continued)

SPECIES	LOCATION	DATE	N	TISSUE	%H_2O	% LIPID	AGE	SEX	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and REMARKS
Black guillemot	Dundas Harbour, Lancaster Sound	1976	5	Liver	-	-	im	-	As	20.38 ± 15.56**	(6.43-50.14)	
									Cu	16.05 ± 1.72**	(13.86+17.92)	
									Zn	84.86 ± 10.40**	(73.44-98.40)	
									Cd	0.83 ± 0.19**	(0.64-1.14)	
									Cr	0.80 ± 0.44**	(0.24-1.34)	
									V	ND		
									Hg	0.23 ± 0.09**	(0.134-0.368)	
	Dundas Harbour, Lancaster Sound	1976	5	Bone	-	-	im	-	Pb	17.25 ± 3.36**	(13.41-22.46)	
	Dundas Harbour, Lancaster Sound	1976	5	Fat	-	-	AD	-	DDE	3.97 ± 2.31**	(2.01-6.61)	Lipid weight basis
									p,p DDT	3.79 ± 2.14**	(0.99-6.88)	
									o,p DDT	2.60 ± 3.08**	(0.63-7.93)	** $\overline{X}$ ± SD
									p,p DDD	2.79 ± 2.01**	(1.42-6.29)	Trace levels not included in calculation of mean
									HCB	0.64 ± 0.78**	(ND-1.20)	
									PCB	0.90 ± 0.28**	(ND-1.10)	
	Dundas Harbour, Lancaster Sound	1976	5	Fat	-	-	im	-	DDE	0.40 ± 0.26**	(Trace-0.70)	
									p,p DDT	-	(ND-0.12)	
									o,p DDT	-	(ND-0.21)	
									p,p DDD	-	(ND-0.09)	
									HCB	ND	-	
									PCB	-	(ND-Trace)	

6.0 CONTAMINANTS IN TERRESTRIAL MAMMALS (OTHER THAN POLAR BEARS AND HUMANS)

There is little information on the contaminant load in terrestrial mammals from the Canadian Arctic (Table 6.1). The data were summarized from 3 published and 1 unpublished manuscripts. These were retrieved following extensive searches on the computerized bibliographic files (Toxic Chemicals in Wild Mammals) at the Canadian Wildlife Service (Hull, Quebec).

Muscle and liver of 3 Caribou from Holman were analyzed for total mercury residues (Smith and Armstrong, 1975). The mean mercury concentration in muscle tissue (0.017 ppm, wet weight) was lower than that found in liver (0.20 ppm). These levels were low compared to the concentrations reported in Ringed seal, Bearded seal, Arctic char, Arctic fox, sledge dog and wolf (Smith and Armstrong, 1975). It is interesting to note that sledge dog muscle contained the highest mercury level and the liver had the third highest mercury content (below the levels in Bearded seal and Ringed seal livers). This may be indicative of the level of mercury being accumulated by these dogs which are fed an almost exclusive diet of seals.

Shaw and Gunn (1981) reported the concentrations of 23 elements in the kidney and liver of Caribou collected from Prince of Wales Island in 1978. They also analyzed the elemental content in liver and kidney of Lemmings, *Synaptomys borealis*, and liver and feather of a Ptarmigan, *Lagopus mutus*, as well as a variety of lichens, grasses and shrubs. Although the sample sizes were small and the collection sites were limited, this study does provide baseline information on the distribution of a wide range of elements in a portion of the Arctic terrestrial ecosystem. However, it was not determined if the measured levels were of geochemical or anthropogenic origin.

The other two investigations on contaminants in Arctic mammals dealt with the levels of radionuclides found in these animals. Foreman _et al._ (1961) reported the concentrations of strontium-90 and total beta counts in Cervidae antlers collected in North America between 1943 and 1958. A Moose, _Alces alces_, and a Caribou from the Yukon were included in the results. Baker and co-workers (n.d.) reported the levels of cesium-137 and strontium-90 in milk of Mountain goat, _Oreamnos americanus_, Caribou, husky, Beluga whale and Polar bear from the Arctic. Milk of Caribou from Eskimo Point as found to contain the highest concentrations of the two radionuclides of all the wild mammals surveyed. Only the milk of human from Rankin Inlet and Baker Lake contained higher levels. Comparative information on the concentrations of cesium-137 and strontium-90 in human milk from the Northwest Territories and Montreal are discussed in Section 10.0.

To my knowledge, there is no published information on contaminant levels in Arctic hare, _Lepus arcticus_, and Muskox, _Ovibos moschatus_, although they are eaten by Arctic residents. Furthermore, organochlorine residue data in any terrestrial Arctic mammal are lacking. There are some Caribou and Muskox tissue samples held in frozen storage in the National Specimen Bank (Canadian Wildlife Service, Hull, Quebec). Some of these fat, liver, kidney and muscle samples may be useful for retrospective chemical residue analysis.

The limited amount of residue information on Arctic terrestrial mammals does not allow for any speculation on trends of specific contaminants or any discussion on potential risks of exposure to consumers of these animals. Obviously a larger body of residue data must be compiled prior to such an assessment. There are larger datasets (i.e. Alaska) which may be useful for comparison. Some of these reports have been identified but not summarized.

Table 6.1: Chemical Residues in Tissues of Terrestrial Mammals Collected in Northern Canada.

SPECIES	LOCATION	DATE	N	TISSUE	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and REMARKS
Caribou (*Rangifer tarandus*)	Victoria Island (Holman)	1973	3 3	liver muscle	Mercury	0.20 ± 0.036* 0.017 ± 0.006*		Smith and Armstrong, 1975. * $\overline{X} \pm$ SD
Caribou	Eskimo Point, NWT	1967	1	Milk	Cesium-137 Cesium-137 Strontium-90 Strontium-90	31.0 pCi/g ash 353 pCi/l 89.8 pCi/g ash 1023 pCi/l	- - - -	Baker *et al*. 19--
Caribou	Yulkon	1953	1	Antler	Strontium-90 Total Beta Counts Corrected Beta Counts	6.9 dpm/g ash 1.3 cpm/g ash 27.8 dpm/g ash		Foreman *et al*. 1961
Caribou	Prince of Whales Island (73:06/97:41) and (73:44/98:45)	1978	5	Liver	Ag	0.22	-	Shaw and Gunn, 1981 -wet weight -ND = non-detectable
					Al	13.7	-	
					Ba	0.09	-	
					Ca	49.8	-	
					Co	0.76	-	
					Cr	2.78	-	
					Cu	17.2	-	
					Fe	319	-	
					K	5122	-	
					Mg	173	-	
					Mn	3.75	-	
					Mo	4.00	-	
					Na	1956	-	
					Ni	N.D.	-	
					P	3082	-	
					Pb	3.00	-	
					Si	0.74	-	
					Sr	0.04	-	
					Th	0.78	-	
					Ti	1.49	-	
					V	0.14	-	
					Zn	28.8	-	
					Zr	0.15	-	

Table 6.1: Continued.

SPECIES	LOCATION	DATE	N	TISSUE	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and REMARKS
			5	Kidney	Ag	N.D.	-	
Caribou					Al	4.52	-	
					Ba	0.05	-	
					Ca	84.2	-	
					Co	N.D.	-	
					Cr	2.46	-	
					Cu	5.19	-	
					Fe	43.6	-	
					K	4238	-	
					Mg	157	-	
					Mn	1.64	-	
					Mo	N.D.	-	
					Na	3166	-	
					Ni	0.20	-	
					P	2138	-	
					Pb	2.80	-	
					Si	N.D.	-	
					Sr	0.05	-	
					Th	0.001	-	
					Ti	1.94	-	
					V	N.D.	-	
					Zn	28.8	-	
					Zr	N.D.	-	
Moose	Yukon	1953	1	Antler	Strontium-90	3.2 dpm/g ash	-	Foreman *et al*. 1961
					Total Beta Counts	3.9 cpm/g ash	-	
					Corrected Beta Counts	15.9 dpm/g ash	-	
Mountain goat (*Oreamnos americanus*)	Haines Junction, Yukon	1967	1	Milk	Cesium-137	0.9 pCi/g ash	-	Baker *et al*. 19--
					Cesium-137	11 pCi/l	-	
					Strontium-90	0.5 pCi/g ash	-	
					Strontium-90	6 pCi/l	-	
Arctic Fox (*Alopex lagopus*)	Victoria Island (Holman)	1973	16	Liver	Mercury	0.76 ± 1.12*	-	Smith and Armstrong, 1975 * $\bar{X} \pm$ SD
			16	Muscle		0.31 ± 0.54*	-	

SPECIES	LOCATION	DATE	N	TISSUE	RESIDUE	MEAN (PPM)	RANGE	REFERENCE and	REMARKS
Wolf (*Campus lupus*)	Victoria Island (Holman)	1973	7 7	Liver Muscle	Mercury	0.24 ± 0.15* 0.051 ± 0.027*	- -	Smith and Armstrong, 1975	* $\overline{X}$ ± SD
Husky dog	Baker Lake, NWT	1967	1	Milk	Cesium-137 Cesium-137 Strontium-90 Strontium-90	2.4 pCi/g ash 24 pCi/l 0.9 pCi/g ash 9 pCi/l	- - - -	Baker *et al*. 19--	

7.0 CHEMICAL RESIDUES IN MARINE MAMMALS AND FISH

7.1 Heavy Metals and Chlorinated Hydrocarbons in Marine Mammals

Muir (1985) summarized the data on heavy metal and chlorinated hydrocarbon residues in tissues of Arctic marine mammals. All available results from northern Canada and western Greenland have been included. Surveys conducted in Alaska, Scandinavia and other regions of the world are reported elsewhere (Wagemann and Muir, 1984) and are not included in this tabulation.

7.1.1 Heavy Metals

There is a large database on metal residues, particularly mercury, in whales and seals (Table 7.1). On a regional basis, mercury concentrations in livers of Beluga whales were higher in samples from the western Arctic (Mackenzie Delta) compared with levels in Hudson's Bay specimens. Smith and Armstrong (1978; cited in Muir, 1985) reported similar trends in mercury and selenium levels in livers of Ringed seals in their survey. The highest mercury and selenium concentrations were found in livers from Somerset and Holman Islands, and the lowest levels were from Arctic Bay. Furthermore, livers of Bearded seals from Victoria Island contained the highest mercury burden (143 ppm) of all marine mammals and were considerably greater than Bearded seals from Hudson Bay (26 ppm). With the exception of these seals, the mercury load in tissues of Arctic whales and seals are generally lower than those reported in species from Eastern Canada and U.S., and the Baltic Sea.

Narwhals from Pond Inlet and Admiralty Inlet, and Minke whales from western Greenland contain high cadmium concentrations in their liver and kidneys, ranging

Table 7.1: Heavy Metal Residues (ug/g wet weight, mean + standard deviation) in Arctic Marine Mammals (Muir, 1985).

Species	Location	Year	Tissue	N	Sex/Age	Hg	Pb	Cd	Se	Reference
Whales										
Beluga Whale	Hudson Bay	1971	Muscle	43	-	0.53	-(1)	-	-	Bligh and Armstrong (1971)
	Hudson 8ay	1969	Liver	1	-	8.87	-	-	-	
			Muscle	1	-	0.97	-	-	-	
			Kidney	1	-	2.44	-	-	-	
Beluga Whale	MacKenzie Delta (Kugmallit 8ay)	1972	Liver	7	M&F -	6.26 ± 3.71	-	-	-	Lutz and Armstrong (Unpublished)
			Muscle	7	M&F -	0.71 ± 0.14	-	-		
Beluga Whale	MacKenzie Delta (Kugmallit 8ay)	1977	Liver	8	M&F -	30.62 ± 20.53	-	-	-	Imperial Oil (1978)
			Muscle	11	M&F -	2.12 ± 1.15	-	-	-	
			Blubber	11	M&F -	0.08 ± 0.09	-	-	-	
Narwhal	Pond Inlet	1977	Liver	6	-	5.98 ± 3.13	0.17 ± 0.13	7.76 ± 6.63	5.54 ± 4.65	Fallis (Unpublished)
			Muscle	6	-	0.84 ± 0.32	0.11 ± 0.06	0.11 ± 0.11	0.37 ± 0.09	
			Kidney	6	-	1.18 ± 0.57	0.21 ± 0.27	30.51 ± 21.41	2.59 ± 0.49	
			Blubber	6	-	0.01	0.31 ± 0.34	0.02 ± 0.02	0.03 ± 0.04	
Narwhal	Pond Inlet	1979	Liver	37	M&F -	6.10 ± 3.13	0.03 ± 0.01	32.02 ± 33.20	4.06 ± 1.84	Wagemann *et al.* (1983)
			Muscle	58	M&F -	0.85 ± 0.04	0.01 ± 0.01	0.19 ± 0.22	0.44 ± 0.10	
			Kidney	54	M&F -	1.71 ± 0.14	0.02 ± 0.01	63.5 ± 41.0	3.15 ± 0.85	
			Blubber	44	M&F -	0.03 ± .01	0.02 ± 0.01	0.05 ± 0.05	0.07 ± 0.06	
Minke Whale	Umanak W. Greenland	1972	Liver	4	-	0.15 ± 0.08	-	-	-	Johansen *et al.* 1980
			Muscle	9	-	0.11 ± 0:05	-	-	-	
Minke Whale	Disko 8ay W. Greenland	1978	Liver	6	-	0.018 ± 0.13	-	-	-	Johansen *et al.* (1980)
			Muscle	6	-	0.015 ± 0.06	-	-	-	
Narwhal	Admirality Inlet	1975	Liver	26	-	-	0.11 ± 0.13	30.41 ± 25.67	-	Fallis (Unpublished)
			Muscle	27	-	-	0.05 ± 0.07	0.24 ± 0.24	-	
			8lubber	11	-	-	0.27 ± 0.78	0.04 ± 0.03	-	

[T]able 7.1: Continued

Species	Location	Year	Tissue	N	Sex/Age	Hg	Pb	Cd	Se	Reference
hales										
inke Whale	Disko Bay, W. Greenland	1978	Liver	1	M -	- -	-	11.30 ± 0.14	-	Stoneburner (1978)
			Kidney	1	M -	- -	-	27.80 ± 1.74	-	
			Blubber	1	M -	- -	-	0.34 ± 0.02	-	
eals										
inged Seal	N. Baffin Island	1975	Liver	5	-	3.27 ± 0.75	0.04	4.2 ± 3.3	-	Fallis (Unpublished)
			Muscle	6	-	-	0.04	0.03 ± 0.02	-	
inged Seal	Upernavik (W. Greenland)	1973	Liver	10	-	2.40 ± 1.49	-	-	-	Johansen *et al.* (1980)
			Muscle	10	-	0.23 ± 0.16	-	-	-	
inged Seal	Upernavik (W. Greenland)	1974	Liver	7	-	0.34 ± 0.38	0.03	-	-	Johansen *et al.* (1980)
			Muscle	7	-	0.09 ± 0.04	0.16	-	-	
		1976	Liver	31	-	2.10 ± 4.10	-	-	-	
			Muscle	31	-	0.18 ± 0.18	-	-	-	
inged Seal	Aston Bay, Somerset Island	1975	Liver	88	-	19.33 ± 18.44	-	-	16.35 ± 7.83	Smith and Armstrong (1979)
			Muscle	89	-	0.44 ± 0.16	-	-	-	
	Barrow Strait N. Baffin Island	1976	Liver	27	- 10.2	16.14 ± 13.84	-	-	9.44 ± 6.66	
			Muscle	27	- 10.2	0.91 ± 0.38	-	-	-	
	Arctic Bay,	1976	Liver	36	- 0.3	0.32 ± 0.08	-	-	4.13 ± 2.67	
			Muscle	37	- 0.3	0.08 ± 0.07	-	-	-	
	S.E. Beaufort Sea	1972	Liver	13	- 1.3	1.0 ± 1.16	-	-	-	
			muscle	13	- 1.3	0.23 ± 0.11	-	-	-	
	W. Victoria Island (Holman)	1972	Liver	83	- 12.8	27.5 ± 30.1	-	-	15.24 ± 7.75	
			Muscle	83	- 12.8	0.72 ± 0.33	-	-	-	
	Pond Inlet	1976	Liver	33	- 5.2	3.76 ± 3.42	-	-	-	
			Muscle	33	- 5.2	0.31 ± 0.17	-	-	-	
	W. Victoria Island	1976	Liver	112	- 8.1	25.54 ± 15.0	-	-	14.96 ± 6.42	

Table 7.1: Continued

Species	Location	Year	Tissue	N	Sex/Age	Hg	Pb	Cd	Se	Reference
Ringed Seal	N. Baffin Island	1977	Muscle	7	-	0.33 ± 0.06	-	-	-	Fallis (Unpublished)
			Kidney	1	-	2.32	-	-	-	
Ringed Seal	Umanak (W. Greenland)	1979	Liver	29	-	-	0.01	7.32 ± 3.0	-	Johansen *et al.* (1980)
			Muscle	29	-	-	0.04 ± 0.02	0.07 ± 0.10	-	
			Kidney	29	-	-	0.05	37.4 ± 33.7		
Ringed Seal	N. Baffin	1977	Liver	5	-	-	0.05	5.5 ± 0.8	-	Fallis (Unpublished)
			Muscle	7	-	-	-	0.05 ± 0.01	-	
			Kidney	1	-	-	0.04	27.9	-	
Hooded Seal	Upernavik (W. Greenland)	1974	Liver	4	-	6.5 ± 4.5	-	-	-	Johansen *et al.* (1980)
			Muscle	4	-	0.20 ± 0.04	-	-	-	
		1976	Liver	10	-	16.7 ± 13.5	-	-	-	
			Muscle	10	-	0.33 ± 0.08	-	-		
Harp Seal	Umanak (W. Greenland)	1972	Liver	7	-	1.2 ± 1.3	-	-	-	Johansen *et al.* (1980)
			Muscle	12	-	0.20 ± 0.05	-	-	-	
	Upernavik (W. Greenland)	1973	Liver	11	-	2.3 ± 1.7	-	-	-	
			Muscle	11	-	0.24 ± 0.12	-	-	-	
	Upernavik (W. Greenland)	1976	Liver	4	-	0.86 ± 0.37	-	-	-	
			Muscle	4	-	0.20 ± 0.05	-	-	-	
Harp Seal	Grise Fiord, Pangnirtung, N.W. Greenland	1976 -78	Liver	1	M /pups	3.22	0.04	1.44	1.50 ± 0.57	Ronald *et al.* (1984)
				2	F /pups	2.82 ± 1.55	0.02 ± 0.04	0.90 ± 0.15	1.48 ± 0.35	
				6	M /juv.	4.16 ± 3.35	0.14 ± 0.11	2.56 ± 1.13	2.85 ± 1.11	
				2	F /juv.	5.49 ± 3.42	0.06 ± 0.01	3.15 ± 1.63	3.85 ± 1.42	
				9	M /adl.	12.4 ± 9.03	0.08 ± 0.08	4.74 ± 2.41		
				6	F /adl.	12.6 ± 12.5	0.07 ± 0.02	7.98 ± 5.83	12.1	
			Muscle	2	M /pups	0.26 ± 0.01	0.05 ± 0.01	0.05 ± 0.06		
				4	F /pups	0.27 ± 0.03	0.05 ± 0.02	0.03 ± 0.04	0.05	
				11	M /juv.	0.32 ± 0.11	0.06 ± 0.05	0.07 ± 0.04	0.05	
				10	F /juv.	0.37 ± 0.11	0.12 ± 0.18	0.09 ± 0.06		
				9	M /adl.	0.27 ± 0.07	0.05 ± 0.03	0.15 ± 0.04	0.5	
				6	F /adl.	0.29 ± 0.15	0.03 ± 0.02	0.48 ± 0.70		
Bearded Seal	Victoria Island	1973	Liver	6	- 8.5	143 ± 17.0	-	-	34.42 ± 33.23	Smith and Armstrong (1978)
			Muscle	3	- 8.5	0.53 ± 0.35	-	-		
	Belcher Island (Hudson Bay)	1974	Liver	56	- 4.9	26.18 ± 26.13	-	-	20.83 ± 13.47	
			Muscle	55	- 4.9	0.09 ± 0.04	-	-		
Walrus	Thule (N.W. Greenland)	1975 -77	Liver	46	- 10.9	1.78 ± 1.54	-	-	-	Born *et al.* (1981)
			Muscle	58	- 10.9	0.08 ± 0.05	-	-	-	

Footnotes:

1 - Dash indicates not reported
2 - Reported on a dry weight basis.

from 7.79 to 63.5 ppm. Marine mammals from the North and Baltic Seas had cadmium levels which are about 10 fold lower (Wagemann and Muir, 1984).

Recent information on the levels of cadmium, copper, zinc, lead, arsenic, mercury and selenium in liver, kidney and muscle tissues of Ringed seals from the Strathcona Sound and Admiralty Inlet area was made available (Wagemann, unpublished). Although the mean concentrations of the elements were calculated for these samples (Table 7.1A), direct comparison of the data from the two areas can not be made because of the interdependence among metals and age of the animals. Some tissue samples of young seals from the Strathcona Sound area contained 'abnormally' high levels of mercury, cadmium and lead. Although this collection area is in the vicinity of a mining site (Nanisivik), it still does not appear possible to interpet the sample levels as normal background levels or elevated concentrations due to perturbation. A larger reference base of metal concentrations in tissues of marine mammals is required for such an assessment.

It should be pointed out that interpretation of metal contamination in biological samples (fish, birds, and marine mammals) on a regional basis is more complicated relative to synthetic chemicals (e.g. organochlorines). In most cases, it is impossible to differentiate the contributions of local geochemistry from anthropogenic sources. For example, large geographical variations in mercury and cadmium levels in the Arctic have generally been attributed to local geochemical differences (Muir, 1985). Furthermore, the age and size of the animal can greatly influence the levels of heavy metals found. In order to properly interpret the measured residue concentrations, detailed information on the age and sex of the specimens must be specified.

7.1.2 Chlorinated Hydrocarbons

The concentrations of DDT (total) and PCBs in blubber of cetaceans and Pinnipeds from the Canadian Arctic are generally below 5 ppm (Table 7.2). Similar species from the Baltic Sea, the North Sea, and the east coast of Canada/U.S.A. contain levels which are about 10 to 20 folds higher than those from Arctic waters (Wagemann and Muir, 1984). Two exceptions are Narwhals from Pond Inlet and Porpoises from western Greenland. Blubber from these specimens contained higher levels of PCBs (6 to 12 ppm, wet weight) compared to the other marine mammals. This may be a consequence of different feeding strategies of Narwhals and migration to southern latitudes by Porpoises (Muir, 1985).

Organochlorine residue concentrations in livers of whales and seals are about 1 to 10% of the levels found in the blubber, on a wet weight basis, which is roughly proportional to the extractable lipid content of the liver. The highest liver DDT (0.78 ppm, wet weight) and PCB (0.5 ppm) levels were recorded in Beluga whales from the MacKenzie River Delta.

Organochlorine levels in blubber of seals seem to be influenced by the age and sex of the animals. This is apparent in studies with reasonably large sample sizes. In male Ringed seals, correlations of DDT and PCB concentrations with age (Addison and Smith, 1974; cited in Muir, 1985) and chlordane levels with age (Muir et al., 1985a) have been established. Similar age and tissue residue correspondences were attempted for whales, but few correlations have been made because of the lack of age data. Tissue samples from male cetaceans and pinnipeds generally have higher DDT and PCB levels in the blubber compared to females. This sex difference is likely due to excretion of these compounds by female mammals during lactation (Wagemann and Muir, 1984).

Table 7.2: Chlorinated Hydrocarbon Residues (ug/g wet weight, mean ± standard deviation) in Arctic Marine Mammals (Muir, 1985).

Species	Location	Year	Tissue	N	Sex/Age	DDT (Total)	PCB[1] (as Aroclor)	Chlordane[2]	HCH (Total)	Dieldrin	Reference
Whales											
Beluga Whale (*Delphinapterus leucas*)	Shallow Bay, MacKenzie River Delta	1972	Liver	7	Adults	0.78 ± 0.23	0.5	nd[3]	nd	nd	Addison and Brodie (1973)
			Muscle	7	Adults	0.91 ± 0.26	0.5				
			Blubber	7	Adults	3.90 ± 0.89	0.5				
Beluga Whale	Kugmallit Bay MacKenzie River Delta	1972	Blubber	7	Adults	2.56 ± 1.46	0.5	nd	nd	nd	Addison and Brodie (1973)
Beluga Whale	Pangnirtung	1983	Blubber	11	-	0.98 ± 0.72	1.23 ± 1.13	0.30 ± 0.25	0.04 ± 0.04	0.39 ± 0.33	Muir (1985) (Unpublished)
			Liver	6	-	0.08 ± 0.09	0.09 ± 0.07	0.05 ± 0.03	0.008 ± 0.003	0.03 ± 0.02	
Beluga Whale	Repulse Bay	1983	Blubber	9	-	2.28 ± 1.98	2.57 ± 1.65	0.81 ± 0.57	0.073 ± 0.044	0.63 ± 0.41	Muir (1985) (Unpublished)
			Liver	6	-	0.10 ± 0.09	0.07 ± 0.05	0.04 ± 0.02	0.002 ± 0.002	0.02 ± 0.01	
Narwhal (*Monodon monoceros*)	Pond Inlet	1979	Blubber	9	F	1.98 ± 2.01	6.73 ± 2.22	nd	nd	nd	Wagemann and Muir (1984)
				11	M	4.84 ± 2.13	12.85 ± 6.88	nd	nd	nd	
Minke Whale (*Balaenoptera acutorostrata*)	Umanak, W. Greenland	1972	Blubber	6	-	1.40 ± 0.94	0.61 ± 0.38	nd	nd	nd	Johansen *et al.* (1980)
Fin Whale (*Balaenoptera physalus*)	S.E. Greenland	1975	Blubber	3	-	2.83	3.6	nd	nd	0.17	Holden (1975)
Porpoise (*Phocoena phocaena*)	W. Greenland	1975	Blubber	2	-	0.32 ± 0.39	6.7 ± 6.7	0.030 (as hept. epox.)	nd	nd	Clausen and Berg (1975)
Seals											
Ringed Seal (*Phoca hispida*)	Holman Island	1972	Blubber	13	F 10.9	0.61 ± 0.27	2.0 ± 9.0	nd	nd	nd	Addison and Smith (1974)
				15	M 14.5	1.31 ± 0.31	4.1 ± 1.4				
Ringed Seal	W. Greenland	1972	Blubber	5	-	0.15 ± 0.10	0.90 ± 0.27	nd	0.006 ± 0.011	nd	Clausen *et al.* (1974)

Table 7.2: Continued

Species	Location	Year	Tissue	N	Sex/Age	DDT (Total)	PCB1 (as Aroclor)	Chlordane2	HCH	Dieldrin	Reference
Ringed Seal	Arctic Canada	1970	Blubber	3	Adults	2.7 ± 1.5	3.0 ± 1.2	nd	nd	0.13 ± 0.05	Holden (1972)
Ringed Seal	Holman Island	1981	Blubber	15	F 9.60	0.33 ± 0.14	0.58 ± 0.25	nd	nd	nd	Addison (1985)
				16	M 8.88	0.78 ± 0.56	1.28 ± 0.75				
Ringed Seal	Barrow Strait at Resolute	1984 Apr.	Blubber	14	F/5.9	0.42 ± 0.26	0.54 ± 0.40	0.29 ± 0.17	0.28 ± 0.14	0.068 ± 0.037	Muir *et al.* (1985)
				14	M/6.7	0.59 ± 0.63	0.81 ± 0.86	0.37 ± 0.28	0.25 ± 0.14	0.078 ± 0.077	
			Liver	14	F/5.9	0.006 ± 0.005	0.009 ± 0.007	0.005 ± 0.003	0.004 ± 0.004	0.002 ± 0.001	
				14	M/6.7	0.009 ± 0.007	0.018 ± 0.014	0.007 ± 0.004	0.003 ± 0.003	0.002 ± 0.001	
	Admirality Inlet Strathcona Sound	1984	Blubber	11	F/5.3	0.46 ± 0.33	0.61 ± 0.33	0.27 ± 0.13	0.21 ± 0.095	0.080 ± 0.039	Muir *et al.* (1985)
				11	M/6.0	1.27 ± 1.44	1.53 ± 1.57	0.42 ± 0.28	0.22 ± 0.14	0.071 ± 0.049	
			Liver	16	F&M	0.004 ± 0.006	0.010 ± 0.013	0.003 ± 0.003	0.002 ± 0.002	0.002 ± 0.002	
Ringed Seal	Admiralty Inlet	1975	Blubber	6	F&M/3.1	0.654 ± 0.0160	0.826 ± 0.303	0.360 ± 0.186	0.253 ± 0.151	0.072 ± 0.012	Muir *et al.* (1985)
Hooded Seal (*Cystophora cristata*)	Upernavik and Disko Bay, W. Greenland	1974	Blubber	4	-	3.5 ± 1.5	3.9 ± 2.0	nd	nd	nd	Johansen *et al.* (1980)
Hooded Seal	W. Greenland	1972	Blubber	5	-	0.29 ± 0.10	2.74 ± 1.83	nd	0.003 ± 0.008	nd	Clausen *et al.* (1974)
Harp Seal (*Phoca groenlandica*)	Upernavik and Disko Bay,	1972	Blubber	8	-	4.9 ± 5.6	1.9 ± 1.1	nd	nd	nd	Johansen *et al.* (1980)
	W. Greenland	1974	Blubber	3	-	1.5 ± 0.6	1.7 ± 0.5				
		1976	Blubber	3	-	2.8 ± 1.4	1.6 ± 0.7				
Harp Seal	Grise Fiord Pangnirtung & N.W. Greenland	1976 -78	Blubber	4	F/pups	0.81 ± 1.03	1.09 ± 0.83	0.07 ± 0.03	nd	0.14 ± 0.19	Ronald *et al.* (1984)
				10	F/juv.	0.98 ± 0.48	1.44 ± 0.78	0.07 ± 0.03		0.17 ± 0.10	
				6	F/adl.	1.12 0.99	1.36 ± 0.79	0.17 ± 0.12		0.14 ± 0.11	
				2	M/pups	1.27 0.70	1.16 ± 0.49	0.21 ± 0.03		0.12 ± 0.03	
				11	M/juv.	1.64 ± 0.96	1.70 ± 1.29	0.32 ± 0.13		0.19 ± 0.10	
				9	M/adl.	2.19 2.13	3.76 ± 3.65	0.23 ± 0.10		0.18 ± 0.14	
Harp Seal	N.W. Greenland	1976	Liver	1	M&F	0.03	nd	nd	nd	nd	Ronald *et al.* (1984)
		1978	Muscle	2		0.13 ± 0.00					

Table 7.2: Continued

Species	Location	Year	Tissue	N	Sex/Age	DDT (Total)	PCB[1] (as Aroclor)	Chlordane[2]	HCH	Dieldrin	Reference
Ringed Seal	Sacks Harbour	1972	Liver	3	-	0.022 ± 0.013	0.04 ± 0.06	nd	nd	nd	Bowes and Jonkel (1975)
			Muscle	3	-	0.016 ± 0.009	0.01 ± 0.01				
			Blubber	5	-	1.538 ± 0.876	0.92 ± 0.77				
Ringed Seal	Grise Fiord	1972	Liver	3	F -	0.078 ± 0.089	0.04 ± 0.04	nd	nd	nd	Bowes and Jonkel (1975)
			Blubber	2	-	0.367 ± 0.266	0.50 ± 0.49				
Bearded Seal (*Erignathus barbatus*)	W. Greenland	1972	Blubber	5	-	0.47 ± 0.26	1.8 ± 0.99	0.048 (as (hept. epox.)	0.053 ± 0.053	nd	Clausen *et al.* (1974)
Walrus (*Odobenus rosmarus*)	Thule, Greenland	1975	Blubber	8	M	0.09 ± 0.13	0.36 ± 0.31	nd	nd	nd	Born *et al.* (1981)
		1976	Blubber	20	F	0.05 ± 0.05	0.18 ± 0.12				
Bearded, Hooded, Ringed Seals	W. Greenland	1978	Blubber	20	-	0.70 ± 0.50	5.1 ± 5.2	nd	nd	nd	Clausen and Berg (1975)

Footnotes:

[1]PCB calculated by comparison with Aroclor standards
[2]Chlordane includes cis- and trans-chlordane, cis- and trans-nonachlor, heptachlor epoxide, oxychlordane
[3]nd - not determined.

When residue variations attributable to the age and sex of the animals are taken into account, few regional differences in DDT and PCB concentrations are apparent in Arctic samples (Muir, 1985). This includes the extensive data for Ringed seals collected in in the early 1970s at Holman Island, Sach's Harbour and western Greenland, as well as recent samples from Resolute and Admiralty Inlet (Table 7.2).

On a temporal basis, DDT residues in Ringed seal blubber from Holman Island (collected in 1972 and 1981) appeared to have declined slightly. Significant decreases in total DDT and p,pDDE, but not p,pDDT, residues were evident in the blubber of female seals (Addison, DFO, pers. comm.). No statistically significant drop in DDT residues was reported in male seals. PCB concentrations showed significant declines in the blubber of both sexes. However, PCB levels in blubber of Ringed seals from Admiralty Inlet (collected in 1975 and 1984) appear to have remained about the same, although this has not been determined statistically (Muir, 1985).

Recent residue surveys, carried out with more sensitive analytical techniques, have reported the identification of chlorinated hydrocarbon residues other than DDT and PCBs. The occurrence of chlordane isomers, hexachlorocyclohexane (HCH) isomers and dieldrin in tissues of these animals demonstrates how fully some of these chemicals have contaminated the habitat or food resources. The highest concentrations of chlordane isomers (0.81 ppm, wet weight) and dieldrin (0.63 ppm) reported to date were in the blubber of Beluga whales from Repulse Bay. The highest level of HCH (total) residues was in Ringed seal blubber from Resolute and Admiralty Inlet (0.21 to 0.28 ppm).

In regard to consumption of contaminated tissues of marine mammals, Muir (1985) stated that the use of whale and seal blubber (e.g. muktuk) for food could be discouraged for animals found with high residue levels in this tissue. The concentrations of organochlorines in the liver are considerably lower and may not pose a health threat -unless large quantities are consumed. This may not be the case for mercury, since livers of seals from some areas contain higher mercury residues than other tissues. The muscle tissue of marine mammals generally contain low concentrations of both mercury and organochlorines. Muir (1985) also recommended that the consumption of tissues from older seals or longer whales could be discouraged since mercury and organochlorine residues are positively correlated to age and size of the animal.

7.2 Heavy Metal and Chlorinated Hydrocarbon Residues in Fish

7.2.1 Heavy Metals

A large amount of information is available from the Department of Fisheries and Oceans (DFO) on heavy metal levels in freshwater fish. The data for organochlorine levels are less extensive. These residue surveys are conducted during inspection of samples from commercial fisheries across Canada. The results from the Northwest Territories have been summarized. No data are available for the Yukon. For mercury, only the data collected in 1984 were tabulated. A voluminous dataset exists for this contaminant dating back to the early 1970s (McGregor, DFO, pers. comm.).

The heavy metal concentrations in fillet samples from the commercial fishery in the Northwest Territories (DFO, Fish Inspection) are summarized in Appendix C. The high mean values reported were: mercury (0.25 ppm in Northern pike from Hay River), cadmium (0.04 ppm in Whitefish from Liard River), arsenic (4.36 ppm in Lake trout from Ellice River), lead (0.73 ppm in Burbot from MacKenzie Delta), and copper (1.34 ppm in Burbot from Great Slave Lake).

Muir (1985) tabulated the published data on metals in Arctic marine fish, including a recent survey of the metal content of fish liver and muscle by Wagamann and Muir (1985) (Table 7.3). Some regional and species differences in metal levels were noted. The highest mercury concentration was found in muscle (0.18 ppm) and liver (0.19 ppm) of sculpins from Tuktoyaktuk. Similar levels were detected in muscle (0.21 ppm) of sculpins from Strathcona Sound. Muscle of sculpins also contained the highest lead residues (0.98 ppm). Livers of Whitefish and sculpins from Tuktoyaktuk contained cadmium concentrations

Table 7.3: Heavy Metal Residues (ug/g wet weight, mean ± standard deviation) in Arctic Fish (Muir, 1985).

Species	Location	Year	Tissue	N	Sex/Age	Hg	Pb	Cd	Se	Reference
Arctic Char	Holman Island	1972	Muscle	12	-	0.049 ± 0.017	-(1)	-	-	Smith and Armstrong (1975)
Pacific Herring	Tuktoyaktuk	1984	Liver	2	- 5	0.05 ± 0.03	-	30.6	3.26 ± 0.90	Wagemann (1985) (Unpublished)
			Muscle	2	-	0.02 ± 0.00	-	0.05	0.51 ± 0.06	
Whitefish			Liver	1	- 13	0.08	-	40.3	0.68	
			Muscle	1	-	0.01	-	0.05	0.52	
Sculpin			Liver	2	- 10	0.19 ± 0.06	-	40.09 ± 1.41	1.11 ± 0.17	
			Muscle	1	- 10	0.18 ± 0.03	-	0.05	0.37 ± 0.01	
Flounder			Liver	2	- 6	0.03 ± 0.0	-	37.02	1.61 ± 0.35	
			Muscle	-	- 6	0.03 ± 0.01	-	0.05	0.49 ± 0.04	
Arctic Cod	Arctic Bay	1984	Liver	8	- 5	-	-	-	0.85 ± 0.14	Wagemann (Unpublished) (1985)
			Muscle	8	- 5	0.02 ± 0.00	-	0.05	0.51 ± 0.19	
Arctic Cod	Kugmallit Bay	1984	Liver	6	- 3	-	-	-	0.48 ± 0.22	Wagemann (1985) (Unpublished)
			Muscle	6	- 3	0.02 ± 0.01	-	0.05	0.42 ± 0.06	
Greenland Cod	Cambridge Bay	1984	Liver	6	-	-	-	-	1.14 ± 0.21	Wagemann (1985) (Unpublished)
			Muscle	7	-	0.04 ± 0.01	-	0.05	0.33 ± 0.05	

Table 7.3: Continued

Species	Location	Year	Tissue	N	Sex/Age	Hg	Pb	Cd	Se	Reference
Fourhorn Sculpin	Resolute Bay	1984	Liver	1	-	-	-	-	0.15	Wagemann (1985)
			Muscle	1	-	0.05	-	-	0.25	(Unpublished)
Fish Doctor			Liver	2	- 12	-	-	-	0.59 ± 0.37	
			Muscle	2	- 12	0.08 ± 0.01	-	0.05	0.29 ± 0.08	
Arctic Cod			Liver	2	- 2	-	-	-	0.58 ± 0.40	
			Muscle	2	- 2	0.04 ± 0.02	-	0.05	0.43 ± 0.01	
Arctic Cod	Pangnirtung	1984	Liver	6	-	0.01 ± 0.01	-	0.83 ± 0.45	0.62 ± 0.20	Wagemann (1985)
			Muscle	6	-	0.03 ± 0.01	-	0.05	0.35 ± 0.10	(Unpublished)
Fourhorn Sculpin	Stratchona Sound	1979	Liver	10-14	-	0.20 ± 0.11	0.42 ± 0.32	3.15 ± 2.48	4.78 ± 1.97	Fallis (1982)
Arctic Sculpin	Stratchona Sound	1979	Liver	1	-	0.09	-	-	3.26	
			Muscle	1	-	0.21	0.98	2.61	3.55	
Arctic Sculpin	Strathcona Sound	1974	Liver	67	-	-	0.3 ± 0.2[2]	4.1 ± 3.1[2]	-	Bohn and
			Muscle	67	-	-	-	1.4 ± 0.3[2]	-	Fallis (1978)
Arctic Char	Kuhulu Lake, N. Baffin Island	1974	Liver	3	-	-	0.4 ± 0.2[2]	2.0 ± 0.3[2]	-	

Footnotes:

1 Dash indicates not reported

2 Reported on a dry weight basis

(40.3 ppm) which are about 10 to 1000 times higher than those reported in fish from other areas of the Northwest Territories. Selenium concentrations were highest in livers (3.26 ppm) of Pacific herring from Tuktoyaktuk and sculpins (4.78 ppm) from Strathcona Sound.

7.2.2 Chlorinated Hydrocarbons

All residue analyses carried out in the current DFO (Fish Inspection) monitoring program use muscle samples or the fillet. Residue levels, particularly organochlorines, in these headless, gutless, and skinless fish samples are low (Appendix C). The PCB levels (less than 0.001 ppm, wet weight) reported in the Fish Inspection data are much lower than those found in other surveys (Table 7.4) and are not consistent with the general trends reported (Muir, 1985).

The technique presently employed in routine monitoring does not separate DDT residues from PCB or chlordane isomers. Recent residue information shows chlordane isomers, hexachlorocyclohexane (HCH) and toxaphene to form a major proportion of the total organochlorine load in fish from the Eastern Arctic (Muir, 1985). These compounds are not being monitored in the Fish Inspection program.

The screening of samples in the Fish Inspection monitoring program underestimates the concentration of residues, at least for organochlorines, in whole fish. There is some evidence indicating whole fish specimens to contain higher concentrations of organic contaminants. The DDT and PCB residue levels found in whole Lake trout samples by Risebrough and Berger (1971) are the highest

Table 7.4: Chlorinated Hydrocarbon Residues (ug/g wet weight, mean ± standard deviation) in Arctic Fish (Muir, 1985).

Species	Location	Year	Tissue	N	Sex/Age	DDT (Total)	PCB[1] (as Aroclor)	Chlordane[2]	HCH	Dieldrin	Reference
Arctic Char	Baffin Island	1972	Liver	3	-	0.015 ± 0.016	nd	nd	nd	nd	Bowes and
(*Salvelinus*	Prince Patrick	1972	Liver	4	M&F	0.0043 ± 0.003	0.005 ± 0.004	nd	nd	nd	Jonkel
alpinus)	Island		Muscle	3	M&F	0.008 ± 0.005	0.008 ± 0.010	nd	nd	nd	(1975)
Arctic Char	Lake Minto,	1970	Liver	1	-	0.047	0.031	nd	nd	nd	Riseborough
Lake trout	N. Québec	1970	Whole	4	-	0.099 ± 0.048	0.067 ± 0.028	nd	nd	nd	and Berger
(*S. namaycush*)											(1971)
Arctic Cod (*B. saida*)	Resolute	1984	Muscle	1 pooled	-	0.002	0.007	0.003	0.018	0.001	Muir *et al.* (1985)
	Arctic Bay	1984	Muscle	2 pooled	-	0.002	0.002	0.003	0.002	0.001	
Arctic Char	Lake Paulatuk	1984	Muscle	6	-	nd	<0.001	nd	nd	nd	DFO (1985)
	Chesterfield Inlet	1984	Muscle	6	-	nd	<0.001	nd	nd	nd	DFO (1985)
Arctic Char	Ellice River	1984	Muscle	6	-	nd	0.006 ± 0.010	nd	nd	nd	DFO (1985)
	Byron Bay	1984	Muscle	3	-	nd	<0.001	nd	nd	nd	DFO (1985)
	Jayco Lake	1984	Muscle	6	-	nd	0.004 ± 0.007	nd	nd	nd	DFO (1985)
	Wellington 8ay	1984	Muscle	5	-	nd	<0.001	nd	nd	nd	DFO (1985)
	Surrey River	1984	Muscle	5	-	nd	<0.001	nd	nd	nd	DFO (1985)
	Rankin Inlet	1984	Muscle	5	-	nd	<0.001	nd	nd	nd	DFO (1985)
Greenland Cod (*Gadus ogac*)	Cambridge Bay	1984	Muscle	2	-/12+	nd	0.003	nd	nd	nd	EPS (1985)
Arctic Char	Cambridge Bay	1984	Muscle	4	F/12+	nd	0.035 ± 0.024	nd	nd	nd	EPS (1985)

Footnotes:
[1]PC8 calculated by comparison with Aroclor standards
[2]Chlordane includes cis- and trans-chlordane, cis- and trans-nonachlor, heptachlor epoxide, oxychlordane.
[3]nd - Not determined

concentrations found in Table 7.4. Furthermore, Muir et al., (1985b) reported much higher polynuclear aromatic hydrocarbon concentrations in a whole Arctic cod sample compared with muscle sample of the same species (Table 7.5). It appears that the current method of testing in the Fish Inspection program is inadequate for determining the exposure levels in native populations.

The limited data on organochlorine residues in Arctic fish species indicate that levels are generally low. Total DDT values range from 0.002 to 0.008 ppm, wet weight, and PCBs range from less than 0.001 to 0.008 ppm, wet weight in muscle samples (Table 7.4). One exception to this trend is the data reported for Arctic char and Greenland cod samples collected at Cambridge Bay in July, 1984 (Holtz and Sharpe, 1985) which contained 7.0 to 10.0 ppm of PCBs in fat. Subsequent samples collected in August, 1984 from the same area contained considerably lower levels of PCBs (0.6 to 2.0 ppm in fat and 0.003 to 0.06 ppm in muscles). The initial high values suggest the possibility of sample contamination. This is supported by the chromatograms of the fish extracts which resemble that of the PCB fluid in equipment from the Cambridge Bay DEW Line station. It is acknowledged that the PCBs usually found in fish extracts, while similar to Aroclor 1254 standards, have fewer gas chromatographic peaks than the pure fluid (Muir, pers. comm.).

Recently, Muir et al. (1985b) analyzed the levels of organochlorines and polynuclear aromatic hydrocarbons in muscle samples of Arctic marine fish. These are shown in Table 7.5 and 7.6, respectively. It shjould be emphasized that the results of the polynuclear aromatic hydrocarbon analyses are preliminary and await further confirmation. The organochlorine residue data showed levels in these fish were low (0.1 to 18.1 ng/g) in comparison to fish from the North

Table 7.5: Chlorinated Hydrocarbon (ng/g) Residues in Arctic Marine Fish (Muir et al. 1985).

Species	Location	Date	Number of Samples/Pools	Tissue	Residues (ng/g)					
					s-HCH[a]	HCB	s-DDT[b]	s-chlordane[c]	s-PCB[d]	Dieldrin
Arctic cod	Arctic Bay	1984	27/1	muscle	18.1	1.2	1.6	2.0	2.6	1.4
		1984	11/1	muscle	11.9	1.0	0.2	1.2	1.0	1.1
	Resolute Bay	1984	14/1	muscle	2.0	2.5	2.1	3.1	4.7	0.8
	Pangnirtung	1984	10/1	muscle	6.1	1.0	6.1	3.8	4.5	0.1
Whitefish	Tuktoyaktuk	1984	2/1	muscle	0.1	0.1	0.6	0.5	1.9	0.1
Herring		1984	2/1	muscle	12.5	0.6	4.7	5.6	4.1	0.6
Starry flounder		1984	5/1	muscle	0.2	0.1	1.6	0.5	4.6	0.1
Inconnu		1984	1/1	muscle	0.2	0.4	3.8	3.1	3.5	0.4
Greenland cod	Cambridge Bay	1984	10/1	muscle	1.2	0.3	1.5	1.2	3.7	0.1
		1984	1/1	muscle	0.2	0.3	1.2	1.8	3.0	0.2
	Frobisher	1984	1/1	muscle	0.3	0.9	3.2	0.8	2.3	0.1
		1984	1/1	muscle	0.5	0.7	2.1	1.7	4.1	0.1

Footnotes:

(a) Sum of Alpha and gamma-HCH

(b) Sum of p,p'-DDE, DDD and DDT.

(c) Sum of oxychlordane, cis-chlordane, trans-nonachlor, U3 (trans-nonachlor isomer), cis-nonachlor and heptachlor epoxide.

(d) Sum pf PC8 isomers #52, 49, 70, 95, 101, 99, 118, 110, 149, 153, 187, 183, 180, 170 except for Arctic 8ay and Resolute where isomers 31, 28, 44 63 and 66 are included.

Table 7.6: Polynuclear Aromatic Hydrocarbon (ng/g) Residues in Arctic Marine Fish (Muir et al. 1985).

Species	Location	Date	Number of Samples/Pools	Tissue	Residues (ng/g) Fluorene	Phenathrene	Anthracene	Fluoranthene	Pyrene	Chrysene/Benz(a)-anthracene
Arctic Cod	Arctic Bay	1984	27/1	muscle	14	16	9	37	40	48
		1984	11/1	muscle	10	23	3	42	9	18
		1984	1/1	whole fish	69	20	31	37	24	54
	Resolute Bay	1984	14/1	muscle	55	99	2	46	54	31
	Pangnirtung	1984	10/1	muscle	32	32	14	18	37	40
	Kugmallit Bay	1984	16/1	muscle	36	65	5	23	5	24
Whitefish	Tuktoyaktuk	1984	2/1	muscle	12	26	5	13	8	12
Sculpin			3/1	muscle	17	33	8	34	35	28
Herring			2/1	muscle	5	29	10	15	23	31
Starry Flounder			5/1	muscle	5	6	5	5	37	19
Greenland Cod	Cambridge Bay	1984	1/1	muscle	17	30	5	11	5	21
			2/1	muscle	5	18	5	10	42	29

Atlantic (Zitko, 1978; cited in Muir, 1985). Isomers of hexachlorocyclohexane (HCH) were the highest reported organochlorine residues, particularly in cod samples from Arctic Bay and herring samples from Tuktoyaktuk. Fish from the Eastern Arctic and the herring muscle from Tuktoyaktuk generally had the highest levels of the other organochlorines (HCB, total DDT isomers, chlordane isomers, PCBs and dieldrin). This was believed to be the first report of the presence of chlordane isomers in Arctic fish (Muir et al. 1985b). In addition, some samples were found to contain toxaphene residues but the levels were too low to quantify.

The polynuclear aromatic hydrocarbon levels in these fish were about 10 to 100 times higher than the organochlorines (Table 7.6). It is not known if these hydrocarbons are of natural or anthropogenic origin. Higher fluorene, anthracene and chrysene/benz(&)anthracene concentrations were reported in whole fish compared to muscle samples. This suggest that whole fish samples contain a larger load of polynuclear aromatic hydrocarbons than muscle samples and future analyses for these compounds should be conducted using whole fish.

The database for organochlorine compounds in freshwater and marine fish from the Arctic is inadequate for establishing present or past exposure levels. Although the levels reported in muscle (fillet) samples analyzed to date seem low (less than 0.01 ppm), some information should be collected with whole fish samples -since this is found to be the dietary preference of some native groups (Gunn, pers. comm.). It should, however, be possible to convert fish muscle data to whole fish if the percentage of fat in muscle and whole fish are known (Muir, pers. comm.).

8.0 CONTAMINANTS IN POLAR BEARS

An interim report by Norstrom and co-workers (1985) summarized the findings of their survey on the elemental and organochlorine residues in the Polar bear, *Ursus maritimus*. The results of their analysis of 26 elements in 63 livers of bears, harvested during the February-May, 1982 hunting season from the management zones depicted in Figure 8.1, are being published (Norstrom *et al*., in press). Organochlorine compounds in liver and fat samples, from the 1982 collection as well as samples from 1984, were analyzed and are presented in the interim report. In the 1982 survey, liver and fat tissues of harvested polar bears were obtained from hunters in the Tuktoyaktuk to Resolute (Beaufort Sea to Barrow Strait) area. The 1984 sampling sites covered the area from Pond Inlet, around Baffin Island, to Hudson's Bay. The systematic collection and chemical analysis of these bear samples provide the best dataset for defining geographical variations in metal and organochlorine residue contamination.

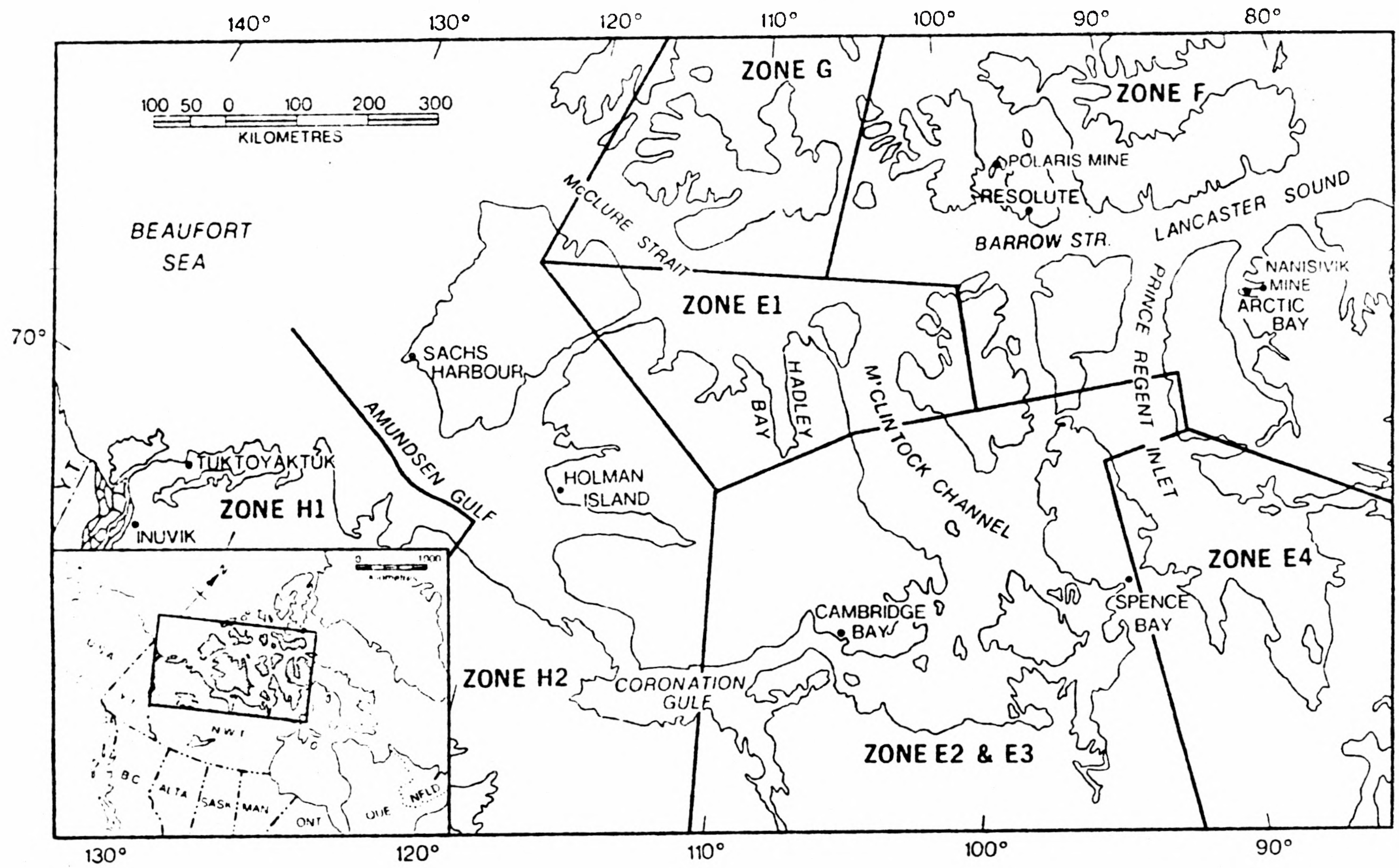


FIG. 8.1 Areas sampled in the Canadian arctic in 1982, divided into management (sub-population) zones. The actual areas from which the bears were taken in each zone are indicated by shading. In this report, the areas are designated by the name of the closest community, except E1 and G, which are called Hadley Bay and Viscount Melville Sound, respectively. Areas sampled in 1984 are identified by community name (Norstrom et al. 1985).

8.1 Metal Residues in Polar Bear Livers

Of the 26 elements analyzed in liver samples, the results for 15 elements were accepted following examination of the quality assurance data (Norstrom et al. 1985). Twelve of these 15 elements did not vary significantly with geographical location (Table 8.1). Only mercury (total), selenium and cadmium residues displayed geographical variations and were correlated with the age of the Polar bears (Figure 8.2). The mercury levels, which were highly correlated with the selenium levels (Figure 8.3), showed a slight decrease from the Beaufort Sea to Barrow Strait. The highest mean levels of mercury and selenium were found in bears from Zone G (Viscount Melville Sound Region). For cadmium, the concentrations found in bears from Zones F and E2/E3 were significantly higher than those from the other zones. Bears from areas southwest and north of Victoria Island contained cadmium levels which were three times lower than those from the Victoria Strait/Barrow Strait region.

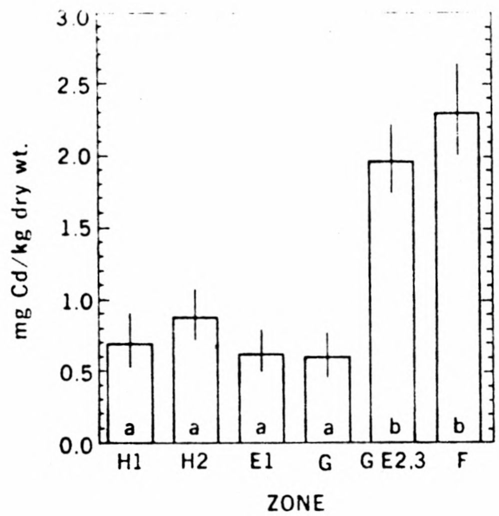
Methylmercury residues were not determined in these livers nor were muscle tissue analyzed. Yet, if a similar pattern of metabolism and distribution of mercury and methylmercury exists in polar bears as found in other mammals, then one would expect lower levels in muscles than in the liver (Norstrom et al. 1985). A residue distribution study using tissues and organs from a small number of bears would provide the needed information to formulate residue inter-tissue relationships.

Liver samples collected in 1984 from the eastern Arctic and Hudson's Bay region have been analyzed for mercury, selenium and cadmium residues. These data will become available by September, 1985 (Norstrom, pers. comm.).

Table 8.1 Levels of element in liver which did not vary significantly with geographical area. Averages and error range are calculated from the antilogarithm of the mean and standard error of the log transformed data, which has a more normal distribution than the untransformed data (Norstrom *et al*. 1985).

Element	Average[1], 10x (mg/kg dry wt.)	Error Range 10x-SE-10x (mg/kg dry wt.)
Ag	0.468	0.439 - 0.499
As	0.067	0.058 - 0.077
Ca	103	100 - 106
Cu	104	99 - 110
Fe	371	342 - 402
K	8,337	8,173 - 8,504
Mg	579	571 - 588
Mn	10.1	9.8 - 10.5
Na	2,228	2,042 - 2,432
P	9,333	9,190 - 9,478
Sr	0.037	0.033 - 0.041
Zn	178	171 - 185

[1] N=63. The mean water content was 64.6 ± 4.4%.



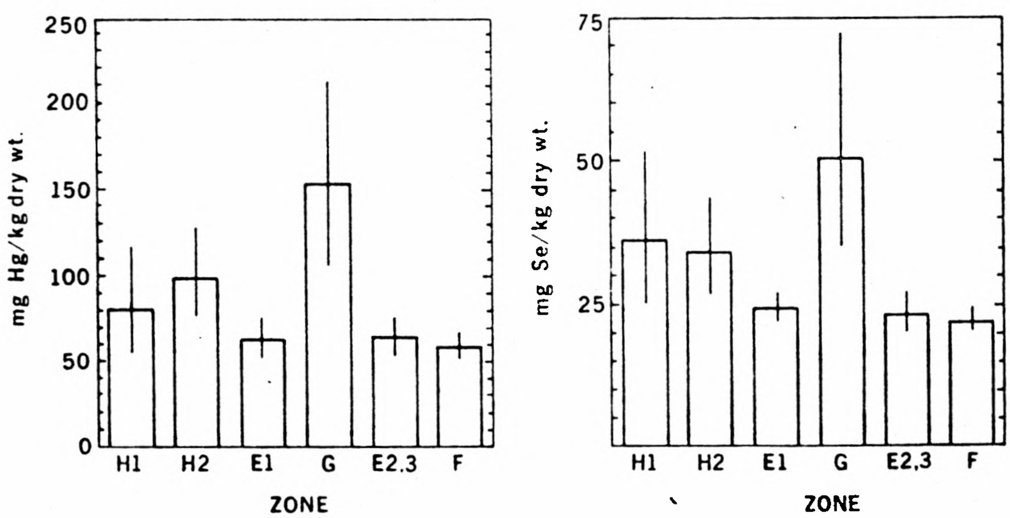


FIG. 8.2 Geographical distribution of Cd, Hg and Se levels in polar bear liver, 1982. Height of the bars is determined from the mean of the $\log_{10}$ transformed data, and the lines represent the SE range of this mean (from Norstrom *et al.* 1985). Zones are identified in Fig. 8.1

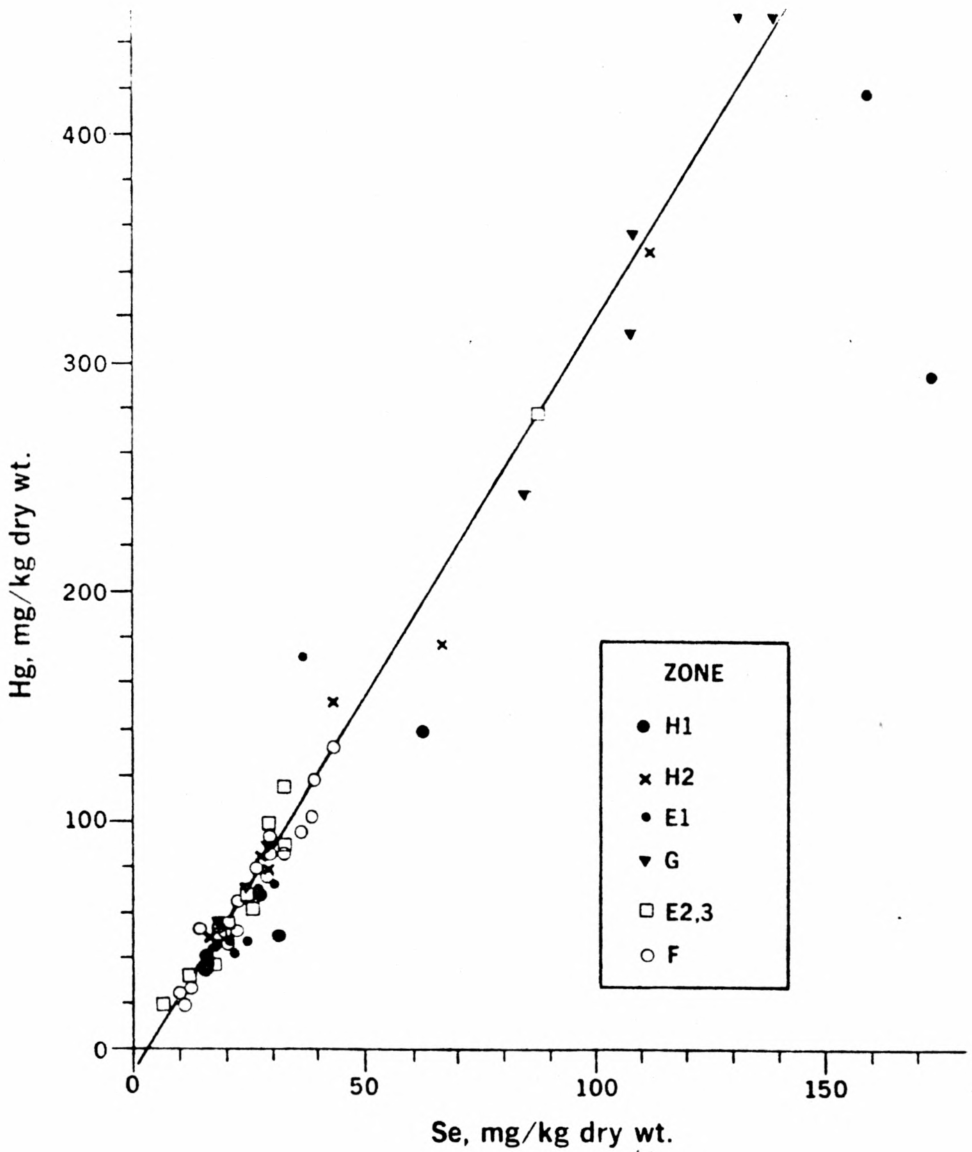


FIG. 8.3 Correlation between Hg and Se levels in polar bears liver, 1982. Individual determinations are plotted, and the Zone in Fig. 8.1 is indicated by the key. The line is determined by linear regression of all data points except those from Zone H1 (Tuktoyaktuk) which generally seemed to fall below the others (from Norstrom et al. 1985).

Eaton and Farant (1982) analyzed 122 polar bear hair samples collected in 1977 and 1980, as well as 18 museum specimens of hair collected between 1910-1927 for total mercury residues. The levels of mercury in all samples ranged from below 0.5 ppm to 44.3 ppm, with a low mean concentration of 2.54 ppm in hair of bears from the southern shore of Hudson Bay to a high of 18.54 ppm in samples from the Amundson Gulf in 1977 and 1980 collection. This range of concentrations and geographical distribution were also found in the museum specimens. Since no correlation was detected between the mercury levels and industrial sources of mercury, and there were no indication of increase over time (comparing the 1910-27 data with the 1977, 1980 data) these workers concluded that the high mercury levels are likely to be of geological, rather than anthropogenic, origin.

8.2 Organochlorine Compounds in Polar Bear Livers and Adipose Tissue

Many organochlorine residues were identified in Polar bear tissues. The two major groups of chlorinated hydrocarbons recovered were PCB isomers and chlordane isomers (Norstrom et al. 1985). In livers, only five major PCB isomers (one pentachloro-, two hexachloro- and two heptachlorobiphenyls) were found and all had chlorine substitutions at the 2 and 4 positions on both rings. Most of the other predominant isomers found in commercial mixtures of PCB, such as Aroclor 1254 and 1260, were not present or were at very low levels. Fat samples had small amounts of a few other PCB isomers. The pattern of PCB accumulation in Polar bears is unique and not similar to birds and other mammals studied to date, and is likely a reflection of selective metabolism by polar bears (Norstrom et al. 1985).

Of the chlordane related compounds, three isomers (oxychlordane, heptachlor epoxide and 2-chlorochlordane) were positively identified and four isomers (nonachlor, compound 'C', photo-heptachlor and oxychlordane isomer) were tentatively identified in Polar bear tissues (Norstrom et al. 1985). The main metabolite of the major active ingredients (cis- and trans-chlordane) is oxychlordane. This compound was found to be the most concentrated organochlorine residue -of all the organochlorine compounds identified. A previously unknown nonachlor isomer was the next most important chlordane related residue. Other individual chlordane compounds were found to be less than 10% of the total quantity of all recovered chlordane residues.

Other organochlorine residues found in polar bear tissues were dieldrin, p,pDDE, DDD, DDT, alpha-hexachlorocyclohexane (a-HCH), beta-hexachlorocyclohexane (B-HCH, in fat samples only), hexachlorobenzene (HCBz), pentachlorobenzene (PCBz) and 1,2,4,5- tetrachlorobenzene (TCBz, in fat samples only).

8.2.1 Organochlorine Levels in Polar Bear Livers

The concentrations of organochlorine compounds in Polar bear livers are shown in Table 8.2. No significant differences attributable to sex was found for any residue ($\log_{10}$ (concentrations) on a lipid weight basis). A negative correlation was observed with age for chlordane concentrations (total) in livers on a $\log_{10}$ (concentrations) lipid weight basis. PCBs displayed no significant trend with age.

PCB and chlordane residues showed few variations according to collection site (Figure 8.4). There was a gradual, but not significant, increase in the levels of these major residues from the Beaufort Sea to Lancaster Sound. Similar levels of chlordane (total) residues were found in areas around Baffin Bay, except for Clyde River. The concentrations in Hudson's Bay were 2 to 3 times higher than those in the Beaufort Sea region. DDT (total) and dieldrin residue concentrations exhibited similar geographical variations as PCBs and chlordane (total), but the differences were much greater. The levels in Hudson's Bay samples were 3 to 4 times higher than those from the Beaufort Sea region (Norstrom _et al_. 1985).

The highest a-HCH levels were found in livers of Polar bears from Victoria Strait/Franklin Strait (Cambridge Bay, Spence Bay) and the Hudson's Bay area (Coral Harbour, Rankin Inlet). Samples from Hadley Bay and Viscount Melville Sound had the lowest a-HCH levels. Intermediate concentrations were found in livers of bears from the Beaufort Sea area. HCB levels were similar in livers from all areas.

Table 8.2: LEVELS OF ORGANOCHLORINE COMPOUNDS IN LIVERS OF THE POLAR BEAR IN THE CANADIAN ARCTIC, 1982-1984 (Norstrom et al. 1985).

Area	Year	No. in Sample	Mean (Arithmetic) Residue Level (SD), ug/kg wet weight						
			alpha-HCH	HCB	dieldrin	Sum DDTc	Sum Chlordane[d]	Sum PCB isomers[e]	PCB (Arpclor 1260)
1. Tuktoyaktuk	1982	7	49 (26)	15 (10)	268 (96)	159 (94)	3236 (2307)	750 (561)	1497 (1145)
2. Holman Island	1982	8	33 (8)	8 (3)	193 (87)	209 (230)	1684 (1330)	667 (511)	1270 (1128)
3. Hadley Bay	1982	7	16 (15)	12 (6)	222 (160)	94 (74)	2853 (2007)	930 (495)	1918 (1037)
4. Viscount Melville Snd.	1982	8	14 (8)	12 (6)	270 (106)	215 (152)	2963 (1735)	1273 (883)	2778 (2619)
5. Cambridge/ Spence Bay	1982	17	61 (40)	9 (5)	252 (82)	167 (135)	2442 (1299)	460 (211)	915 (508)
6. Resolute	1982	20	31 (25)	8 (4)	214 (91)	201 (198)	1658 (866)	649 (439)	1419 (1870)
7. Pond Inlet	1984	10	25 (16)	24 (15)	380 (132)	228 (127)	3584 (1628)	886 (336)	1429 (503)
8. Broughton	1984	10	26 (14)	15 (12)	102 (185)	359 (227)	2959 (1245)	781 (255)	1258 (350)
9. Clyde River	1984	10	23 (5)	11 (9)	444 (162)	295 (217)	3890 (637)	560 (138)	964 (252)
10. Pangnirtung	1984	10	34 (14)	14 (10)	277 (177)	120 (60)	3410 (1465)	748 (359)	1410 (708)
11. Coral Harbour	1984	10	57 (20)	20 (14)	913 (559)	670 (647)	7208 (4724)	1373 (457)	2061 (539)
12. Rankin Inlet	1984	9	67 (29)	21 (10)	745 (511)	909 (1423)	5672 (3543)	1516 (1043)	2071 (1250)

a Alpha-hexachlorocyclchexane. A major component in technical BHC. Also formed in the environment by isomerization of gamma-HCH (Lindane).

b Hexachlorobenzene.

c Mostly oxychlordane, the principal metabolite of the main active ingredients of technical chlordane, cis- and trans-chlordane. Another major constituent was a previously unreported nonachlor isomer. Other compoinds included in the total were heptachlor epoxide, Compound "C", 2-chlorochlordene, a chlorochlordene isomer and an oxychlordane isomer.

e The PCBs present consisted of 5 major isomers: 2,4,2',4',5'-pentachloro-; 2,4,5,2',4',5'-hexachloro-; 2,3,4,2',4',5'-hexachloro-; 2,4,5,2',3',4',5'-heptachloro-; and 2,3,4,2',3',4',5'-heptachlorobiphenyl. Smaller amounts of 2,3,4,5,2',3',4',5'-octachlorobiphenyl were also present. The pentachloro- isomer could not be quantitated by electron-capture GC because of interference from the nonachlor isomer; it is probably less than 20% of the total PCB present. The two hexachloro- isomers are the main constitutents. In the 1982 samples, the octachloro- isomer was not included, but this constituent was very minor, and the data for the two time periods are comparable.

f For purposes of camparison with previously obtained data, the 2,4,5,2',3',4',5'-heptachlorobiphenyl isomer was used to calculate an equivalent level of Arochlor 1260. Note that this method of calculation overestimates the PCB level by approximately 50%.

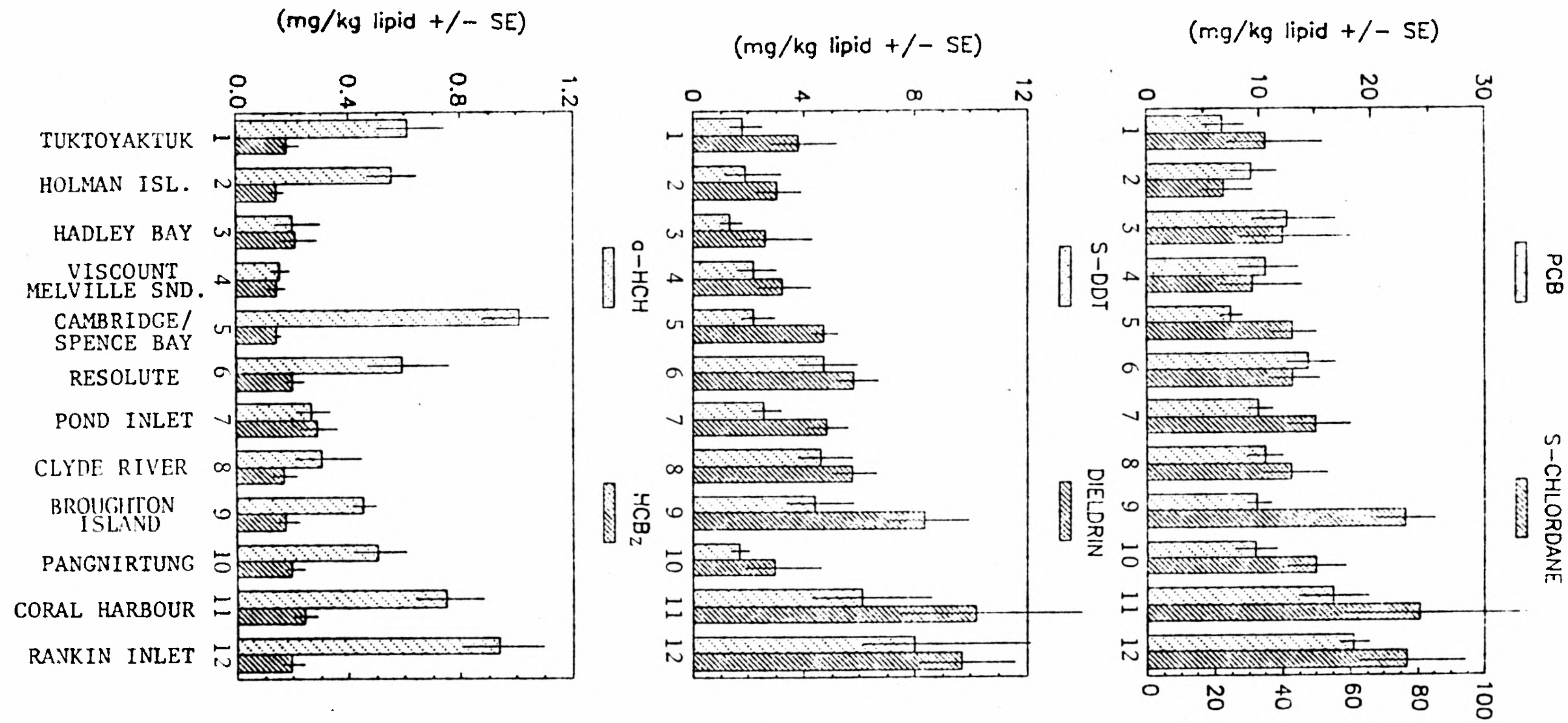


Fig. 8.4: Geographical distribution of organochlorine compounds in polar bear liver in Canada. Bar height is the re-transformed mean of the log-transformed levels, line is the re-transformed standard error range (Norstrom et al. 1985)

8.2.2 Organochlorine Levels in Polar Bear Adipose Tissue

The concentrations and geographical distribution of PCB and chlordane (total) residues in Polar bear adipose tissue are shown in Figure 8.5. The levels of chlordane (total), DDT (total) and dieldrin in fat were 7 to 10 fold lower than those in liver lipids, indicating preferential storage of these compounds in the liver. This is particularly true for oxychlordane residues. PCB levels were about 2 fold lower in fat than liver, although more PCB isomers were present in the former. HCH (total) levels were about the same, and CBz (total) levels were about 2 fold higher in adipose tissue lipids than liver lipids (Norstrom et al. 1985). Although b-HCH and p,pDDT were not present in the liver, these compounds along with a-HCH and p,p DDE were detected in adipose tissue.

The geographical trends of residue levels in adipose tissue were similar to those in the liver (Norstrom et al. 1985). The concentrations of CBz (total) were approximately the same in samples from all areas. Elevated levels of a-HCH were found in adipose tissue from the Victoria Strait, Barrow Strait and Hudson's Bay areas. The distribution of dieldrin was similar to a-HCH, except higher levels were reported in samples from Hudson's Bay. The concentrations of DDT (total) and dieldrin increased significantly from the west to east and south -with levels in Hudson's Bay about 5 fold higher than zones in the most westerly region. Chlordane concentrations were distributed almost uniformly, except for samples from Hudson's Bay which were 2 fold higher. The PCB levels followed a different pattern of geographical distribution, with samples from Amundsen Gulf, Barrow Strait and Baffin Island having lower levels while samples from Viscount Melville Sound and Hudson's Bay containing higher levels.

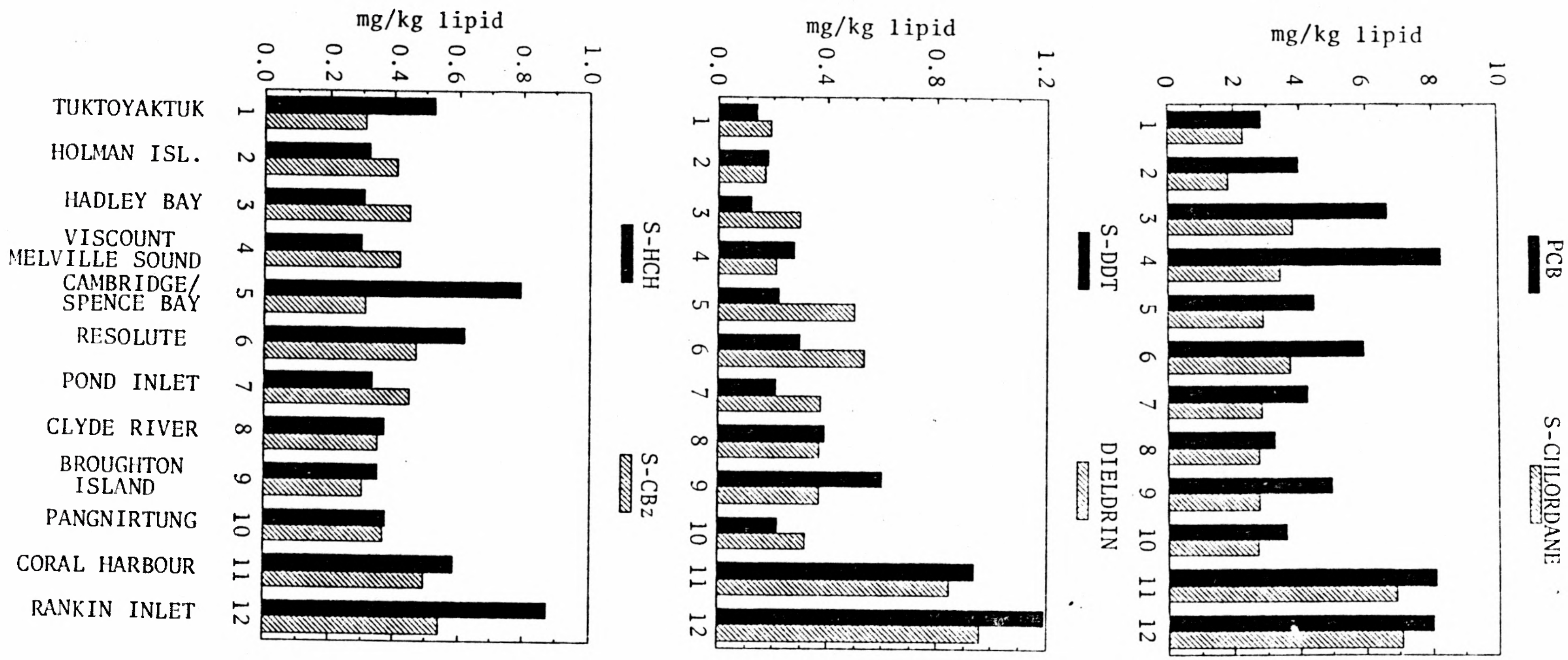


Fig. 8.5: Geographical distribution of organochlorine levels in polar bear adipose tissue lipid in Canada. Bar height represents level in pooled adipose tissue from each area (Norstrom et al. 1985)

Adipose tissue of bears collected in 1969 from Clyde River/Broughton Island, Coral Harour, and Eskimo Point, Rankin Inlet which were archived in the Canadian Wildlife Service Specimen Bank, were used for retrospective residue analysis. These results were compared to the 1984 data. The temporal trends defined demonstrated no differences in DDT (total) residue levels over the 13 year period (Norstrom et al. 1985). In addition, PCBs, dieldrin, HCH (total) and CBz (total) concentrations were two times higher in the recent samples. Furthermore, chlordane (total) levels were 4 to 5 times higher in the 1984 samples compared to those collected in 1969.

Norstrom et al.(1985) also calculated the apparent biomagnification factors for organochlorine compounds between lipids of Ringed seal and Polar bear collected from the Strathcona Sound/Pond Inlet regions. These biomagnification factors (bear/seal) showed that PCB (14.2), chlordane (6.7), dieldrin (6.1) and CBz (5.6) were being accumulated in fat of Polar bears. The factors for DDT (0.3) and HCH (0.7) were below 1.0, indicating levels of these residues were higher in seal blubber relative to bear fat. This signifies that Polar bears can metabolize and excrete these organochlorine compounds.

Other reports of contaminants in Polar bears from the published record have been identified (Baker et al. n.d.; Bowes and Jonkel, 1975; Lentfer, 1976; Eaton et al. 1978). These studies have not been reviewed.

9.0 POTENTIAL SOURCES OF POLLUTANTS IN THE ARCTIC

From the available information, it appears that the Arctic is receiving contaminants from localized as well as distant sources. Although it is difficult to identify, control, and estimate the quantity of the pollutant input of local origins (mining sites, industrial effluents, dumps and landfills), this is even more difficult for contaminants from long range transport (atmospheric and oceanic input). This section of the report documents the location of point sources of pollutants in the Arctic and briefly discusses the presence of contaminants originating from distant locales.

9.1 Local Sources of Pollutants

9.1.1 DEW Line Stations

Forty-two DEW (Distant Early Warning) stations are found in the Canadian Arctic (Table 9.1). These stations were strategically situated at 50 mile (80 km) intervals across the Arctic and were operating from 1957 to 1963. Twenty sites, every second one, were abandoned in 1963 and a twenty-first site was vacated two years later.

In July, 1984, EPS (Environmental Protection Service) personnel investigated five DEW Line stations in the Central Arctic in order to examine the environ- mental conditions and potential environmental problems at these sites (Holtz and Sharpe, 1985). It was reported that PCB-containing equipment was found at all five stations (Hat Island, Sturt Point, Cape Peel, Ross Point and Bernard Harbour). These included transformer filaments, filter chokes, power

Table 9.1: Location of Active and Abandoned DEW Line Stations in the Canadian Arctic (Holtz and Sharpe, 1985).

ACTIVE DEW LINE SITES				OLD "I" SITE LOCATIONS (Abandoned)			
STATION	LOCATION	LATITUDE (N)	LONGITUDE (W)	STATION	LOCATION	LATITUDE (N)	LONGITUDE (W)
BAR-1	Komakuk Beach, Yukon	69°35'	140°11'	BAR-B	Stokes Point, Yukon	69°20'	138°45'
BAR-2	Shingle Point, Yukon	68°55'	137°15'	BAR-C	Tununuk, NWT	69°01'	134°40'
BAR-3	Tuktoyatyk, NWT	69°26'	133°00'	BAR-D	Atkinson Point, NWT	59°56'	131°25'
BAR-4	Nicholson Peninsula, NWT	69°55'	128°58'	BAR-E	Horton River, NWT	70°01'	126°57'
PIN-M	Cape Parry, NWT	70°10'	124°43'	PIN-A	Pearce Point, NWT	69°48'	122°40'
PIN-1	Clinton Point, NWT	69°35'	120°47'	PIN-B	Clifton Point, NWT	69°14'	118°36'
PIN-2	Cape Young, NWT	68°56'	116°55'	PIN-C	Bernard Point, NWT	68°47'	114°50'
PIN-3	Lady Franklin Point, NWT	68°28'	113°13'	PIN-D	Ross Point, NWT	68°26'	111°08'
PIN-4	Bryon Bay, NWT	68°45'	109°04'	PIN-E	Cape Peel, NWT	69°03'	107°19'
CAM-M	Cambridge Bay, NWT	69°06'	105°43'	CAM-A	Sturt Point, NWT	68°48'	103°20'
CAM-1	Jenny Lind Island, NWT	68°40'	101°43'	CAM-B	Hat Island, NWT	68°19'	100°04'
CAM-2	Gladman Point, NWT	68°40'	97°48'	CAM-C	Matheson Point, NWT	68°49'	95°17'
CAM-3	Shepherd Bay, NWT	68°48'	93°26'	CAM-D	Simpson Lake, NWT	68°35'	91°57'
CAM-4	Pelly Bay, NWT	68°26'	89°45'	CAM-E	Keith Bay, NWT	69°35'	88°08'
CAM-5	Mockaw Inlet, NWT	68°18'	85°40'	CAM-F	Sarcpa Lake, NWT	68°33'	83°20'
FOX-M	Hall Beach, NWT	68°45'	81°11'	FOX-A	Bray Island, NWT	69°16'	77°21'
FOX-2	Longstaff Bluff, NWT	68°53'	75°09'	FOX-B	West Baffin Island, NWT	68°37'	73°15'
FOX-3	Dewar Lakes, NWT	68°40'	71°14'	FOX-C	Ekalugad Fiord, NWT	-	-
FOX-4	Cape Hooper, NWT	68°26'	66°44'	FOX-D	Kivitoo, NWT	67°56'	64°52'
FOX-5	Broughton Island, NWT	67°33'	63°49'	FOX-1	Rowley Island, NWT	69°03'	79°01'
DYE-M	Cape Dyer, NWT	66°40'	61°21'				

transformers, constant current regulators and various types of capacitors which contained from 2.0 to 108.9 litres of PCBs. It was estimated that approximately 6400 litres of PCB-containing fluid in 31,500 kg of equipment were abandoned at the 21 DEW Line stations. These figures were derived by extrapolation following an inventory of the five sites which had 305 litres of PCB fluid in 1500 kg of equipment (Holtz and Sharpe, 1985). Some leakage occurred at the five sites and soil analyses revealed PCB concentrations ranging from 1.5 to 21,000 ppm.

Other debris were found at the five DEW Line stations during the inspection. These included various types of scrap metals and fuel drums. Most of the drums were empty but some still contained diesel oil, lubricating oil and solvents. There was evidence of spillage from some of these containers in areas surrounding the buildings. A surveillance with detectors revealed no radioactivity.

These abandoned sites are accessible to both human and wildlife populations. There were indications at the inspected stations that humans visited these sites during fishing, hunting and trapping activities. Evidence of the presence of wildlife were also noted during the investigation. Some of the mammalian species found in the general area of the stations included caribou, muskox, fox and squirrel. The avifauna reported at these sites included sandhill cranes, hawks, geese, swans, and some small unidentified birds. Some Arctic char and Greenland cod samples were collected in the Cambridge Bay area for PCB residue analysis. These results are discussed in Section 7.0.

Six DEW Line stations in the Western Arctic were examined in September, 1984. The results of this survey will be reported at a later date (Sharpe, pers.

comm.). A clean-up operation of the abandoned stations was initiated in July, 1985. All visable equipment and spills were planned to be removed from the sites. This is expected to be completed by mid-September. Buried debris and equipment will also be taken away if time allowed. In addition, soil samples from these disposal sites will be collected for chemical analysis (Sharpe, pers. comm.).

9.1.2 Land Disposal Sites

The information on potential sources of pollutants in the Arctic (EPS, in preparation) was not available at the time of preparation of this review. An attempt was made to document at least some information, given the time restrictions, from the Underwood-McLellan reports (1982) which provides an inventory of the active and inactive land disposal sites in the Northwest Territories. Four hundred and thirty-two sites were identified, but only 197 had sufficient information to be categorized in these reports (Underwood-McLellan, 1982). The location of the disposal sites for which the types of contaminants have been identified are summarized in Table 9.2. Non-itemized "waste" or "sewage" has been omitted. In addition, a list of 20 sites which are considered to be Priority 1 or those of "great concern" is shown in Table 9.3.

Table 9.2: Disposal Sites in the Northwest Territories (Underwood-McLellan, 1982).

Contaminant	Name of Site	Lat/Long	Distance to Closest Settlement (kms)	Status	Type of Waste and Quantity
Arsenic	Con Mine Rycon Mine	62°25'N 114°22'W	0.8	Active	Arsenic Sludge 72,520 tonnes
	Giant Mines	68°32'N 114°20'W	2.4	Active	Underground Storage 165,000 tonnes (1951-1977)
Cyanide	Camlaren Mine	62°59'N 113°15'N	80	Inactive	Mine Tailings 135 tonnes/day (1980-81)
	Con Mine Rycon Mine	62°25'N 114°22'W	0.8	active	-
	Discovery Yk Mine	63°12'N 113°53'W	84	Inactive	-
	Negus Mine	62°25'N 114°22'W	3	Inactive	Mine Tailings
	Ptarmigan Mines	62°30'N 114°10'N	10	Inactive	Mine Tailings 31,200 tonnes
	Thompson- Landmark Mines	62°37'N 113°28'W	48	Inactive	-
	Lupin Mine	65°46'N 111°15'W	5	Active	Mine Tailings 900 tones/day
	Tundra Mine	64°02'12"N 111°11'36"W	241	Inactive	Mine Tailings 171,460 tonnes
	Cullation Lake	61°18'N 98°29'W	0.5	Active	Mine Tailings 55,600 tonnes/year
Lead	Polaris	75°23'N 96°56'W	2	Active	Mine Tailings 1,600 tonnes/day

Table 9.2: Continued

Contaminant	Name of Site	Lat/Long	Distance to Closest Settlement (kms)	Status	Type of Waste and Quantity
Mercury	Beaulieu Yk Mine	62°25'N 112°55'W	71	Inactive	Mine Tailings 526 tonnes (1947-48)
	Discovery Yk Mine	63°12'N 113°53'W	84	Inactive	-
	Hidden Lake Mine	62°33'N 113°31'W	45	Inactive	Mine Tailings
	Negus Mine	62°25'N 114°22'W	3	Inactive	Mine Tailings
	Pensive Yk Mine	62°44'N 113°21'W	61	Inactive	Mine Tailings
	Ptarmigan Mines	62°30'N 114°10'W	10	Inactive	Mine Tailings
	Ruth Mine	62°27'N 112°32'W	97	Inactive	Mine Tailings 1125 tonnes
	West Bay Yk Mines	62°55'N 113°15'W	77	Inactive	Mine Tailings 270 tonnes
	Liten Mines	62°44'N 113°32'W	53	Inactive	Mine Tailings 181 tonnes
Nickel	Rankin Inlet Mine	62°49'12"N 92°04'48"W	0.25	Inactive	Mine Tailings
PCB	Nanisivik Mine	84°38'N 72°59'W	1.2	Active	3605 Litres (contained)
	Con Mine Rycon Mine	62°25'N 114°22'W	0.8	Active	2805 Litres
	Discovery Yk Mine	63°12'N 113°53'W	84	Inactive	1300 Litres
	Canada Tungsten	61°57'N 128°15'W	1.2	Active	1000 Litres (1979)
	Giant Mine	68°32'N 114°20'W	2.4	Active	1294 Litres (1979)

[redacted]le [redacted] Co[redacted]ued[redacted]

Contaminant	Name of Site	Lat/Long	Distance to Closest Settlement (kms)	Status	Type of Waste and Quantity
PCB (cont'd)	Pine Point Mines	60°51'N 114°23'N	3	Active	Mine Tailings
	DND/DOE CFB and High Arctic Weather Station.	82°30'N 62°20'W	0.25	Active	Industrial Waste
Radioactive Waste	Echo Bay Mine	66°06'N 117°59'50"W	0.6	Active	Mine Tailings 83 tonnes/day
	Rayrock Mine	61°20'N 111°55'W	95	Inactive	-
	International Mine	66°00'N 117°47'W	15	Inactive	Mine Tailings 2054 tonnes
	Tundra Mines Ted and Beta Region	63°28'N 116°33'W	74	Inactive	Mine Tailings
	United Uranium Corp.	64°49'N 118°24'W	142	Inactive	-
	Terra Mine	65°36'15"N 118°06'55"W	54	Active	Mine Tailings 47,246 tonnes
Silver	Camsell River Mine	65°35'15"N 117°57'25"W	54	Inactive	Mine Tailings
	International Mine	66°00'N 117°47'W	15	Inactive	Mine Tailings
	Northrim Mine	65°36'N 117°58'W	54	Inactive	Mine Tailings 88 tonnes/day (1977)
Tantalum	Destaffany Tantalum-Beryllium Mines Ltd.	62°11'N 112°15'W	85	Inactive	Mine Tailings
	Peg Mine	62°40'N 113°15'W	71	Inactive	Mine Tailings
Zinc	Polaris	75°23'42"N 96°56'W	2	Active	Mine Tailings 1,600 tonnes/day

Table 9.3: Priority 1 Disposal Sites and their Contaminants (Underwood-McLellan, 1982).

LOCATION	TYPES OF CONTAMINANTS
Echo Bay Mine	- Radioactive Waste
D.E.W. - Fox Main	- PCBs
Tuktoyaktuk	- Petroleum by-products
Whale Cove	- Sewage
Fort Liard	- Unspecified Waste
Alert	- PCBs, Waste Oil, Sewage
D.E.W. - Fox 4	- PCBs
D.E.W. - Cam Main	- PCBs
D.E.W. - Cam 4	- PCBs
D.E.W. - Bar 3	- PCBs
D.E.W. - Bar "D"	- PCBs
Fort McPherson	- Sewage
Frob. Bay-Apex	- Unspecified Waste, Possibly PCBs
Ptarmigan Mines	- Cyanide, Mercury
D.E.W. - Cam 1	- PCBs
Crestaurum Mines	- Mine Tailing
Terra Mine	- Mine Tailings, Possibly Radioactive Waste
D.E.W. - Dye Main	- PCBSs
Nanisivik Mine	- Mine Tailings, PCBs
Tundra Mines-Rayrock	- Mine Tailings, Possibly Radioactive Waste

9.2 Distant Sources of Pollutants

Little is known regarding the long range transport of pollutants via the atmosphere or oceanic gyres. Given our present knowledge, it is not possible to state with certainty the origins of chemicals such as organochlorines. Yet, from the residue profiles documented in polar bears, it appears that the long range transport of certain organochlorine compounds and accumulation by local fauna is occurring in the Canadian Arctic.

Norstrom et al. (1985) stated that major vectors of organochlorine contamination in the Arctic and subarctic marine environment are long range atmospheric and oceanic transport. The fact that the same residues were found in Polar bear tissues in all areas sampled across the Arctic would support this statement (see Section 8.0). Chemical compounds such as PCBs, chlordane and its isomers, DDT and metabolites, HCB and HCH - which are well known contaminants in air masses - were all present in Polar bear tissues. These chemicals are initially dispersed in the vapour phase by air currents. Subsequent to scavenging by precipitation and deposition onto ocean surfaces, they may be transported to other latitudes including the Arctic regions, by ocean currents. A more detailed discussion of the possible pathways and vectors of contamination, in relation to organochlorines found in bear tissues from various regions of the Arctic, is found in Norstrom et al. (1985).

10.0 MEDICAL TESTING OF NORTHERN NATIVE POPULATIONS

The most comprehensive surveillance of environmental contaminants exposure in native groups in Canada was carried out by the Medical Services Branch of National Health and Welfare between 1971 and 1982. A program was developed to monitor mercury levels in blood and hair of Indian and northern Canadian residents in 350 communities across Canada. The first report reviewed the sources of environmental mercury, the levels of the contaminant in fish and marine mammals, and the effects of methylmercury in man. In addition, it documented the findings of clinical tests performed between 1975 and 1978 (Wheatley, 1979). The follow-up report summarized the test results performed between 1979 and 1982 (Anon., 1984). A tabulated summary of the cummulative results of the tests is shown in Table 10.1. A breakdown of the findings according to communities in the Northwest Territories and Yukon is indicated in Table 10.2 and Table 10.3, respectively.

TABLE 10.1: CUMULATIVE RESULTS OF THE NATIONAL HEALTH AND WELFARE MERCURY SURVEY IN NATIVE COMMUNITIES IN CANADA UP TO DECEMBER 31, 1982 - BY REGION AND LEVEL

Region	No. of Communities	Total Tests	20	20-99	100-199	200-299	300-399	400-499	500-599	600-699	ppb ug/L	Highest Result	Year
Atlantic	23	710	695 (97.9)*	15 (2.1)	-	-	-	-	-	-		99	1978
Quebec	52	21 360	12 487 (58.46)	8 184 (38.31)	609 (2.85)	57 (.027)	13 (0.06)	5 (0.02)	4 (0.02)	1 (0.01)		649	1975
Ontario	100	16 678	13 378 (80.21)	3 041 (18.23)	212 (1.27)	32 (0.19)	8 (0.05)	5 (0.03)	-	2 (0.01)		660	1971
Manitoba	65	7 492	6 025 (80.42)	1 443 (19.26)	23 (0.31)	1 (0.01)	-	-	-	-		251	1979
Saskatchewan	73	2 449	2 193 (89.55)	251 (10.25)	5 (0.20)	-	-	-	-	-		124	1978
Alberta	38	1 338	1 284 (95.96)	52 (3.89)	2 (0.15)	-	-	-	-	-		105	1977
British Columbia	87	4 375	4 071 (93.05)	301 (6.88)	3 (0.07)	-	-	-	-	-		146	1978
Northwest Territories	58	3 416	2 073 (60.68)	1 311 (38.38)	27 (0.79)	2 (0.06)	3 (0.09)	-	-	-		363	1971
Yukon	18	862	855 (99.2)	7 (0.8)	-	-	-	-	-	-		67	1977
Total	514	58 680	43 061 (73.38)	14 605 (24.89)	881 (1.50)	92 (0.15)	24 (0.04)	10 (0.02)	4 (0.01)	3 (0.01)			

*() Percentage of Total Tests

TABLE 10.2: MERCURY LEVELS IN RESIDENTS FROM VARIOUS COMMUNITIES IN THE NORTHWEST TERRITORIES

COMMUNITY	TOTAL TESTS	20	20-99	100-199	200-299	300-399	400-499	500-599	600-699	ppb ug/L
Aklavik	39	26	13	-	-	-	-	-	-	
Arctic Bay	406	200	204	2	-	-	-	-	-	
Arctic Red River	10	7	3	-	-	-	-	-	-	
Baker Lake	15	9	6	-	-	-	-	-	-	
Broughton Island	28	3	24	1	-	-	-	-	-	
Cambridge Bay	30	13	14	2	1	-	-	-	-	
Cape Dorset	26	2	24	-	-	-	-	-	-	
Chesterfield Inlet	28	16	12	-	-	-	-	-	-	
Clyde River	173	46	123	4	-	-	-	-	-	
Colville Lake	2	1	1	-	-	-	-	-	-	
Coppermine	40	27	13	-	-	-	-	-	-	
Coral Harbour	20	2	18	-	-	-	-	-	-	
Detah	17	12	5	-	-	-	-	-	-	
Eskimo Point	27	8	19	-	-	-	-	-	-	
Fort Franklin	189	143	45	1	-	-	-	-	-	
Fort Good Hope	361	343	17	1	-	-	-	-	-	
Fort Liard	35	32	3	-	-	-	-	-	-	
Fort McPherson	27	26	1	-	-	-	-	-	-	
Fort Norman	21	15	6	-	-	-	-	-	-	
Fort Providence	38	28	10	-	-	-	-	-	-	

TABLE 10.2: CONTINUED

COMMUNITY	TOTAL TESTS	20	20-99	100-199	200-299	300-399	400-499	500-599	600-699	ppb ug/L
Fort Resolution	20	19	1	-	-	-	-	-	-	
Fort Simpson	18	18	-	-	-	-	-	-	-	
Fort Smith	20	15	5	-	-	-	-	-	-	
Frobisher Bay	38	21	17	-	-	-	-	-	-	
Gjoa Haven	23	11	12	-	-	-	-	-	-	
Grise Fiord	20	6	14	-	-	-	-	-	-	
Hall Beach	22	8	14	-	-	-	-	-	-	
Hay River	14	12	2	-	-	-	-	-	-	
Holman Island	43	6	37	-	-	-	-	-	-	
Igloolik	307	78	216	9	1	3	-	-	-	
Inuvik	99	71	28	-	-	-	-	-	-	
Kakisa Lake	13	9	4	-	-	-	-	-	-	
Lac La Martre	10	5	5	-	-	-	-	-	-	
Lake Harbour	22	7	15	-	-	-	-	-	-	
Nahanni Butte	11	11	-	-	-	-	-	-	-	
Nanisivik	162	124	38	-	-	-	-	-	-	
Norman Wells	17	17	-	-	-	-	-	-	-	
Pangnirtung	25	4	21	-	-	-	-	-	-	
Paulatuk	19	12	7	-	-	-	-	-	-	
Pelly Bay	25	15	10	-	-	-	-	-	-	

TABLE 10.2: CONTINUED

COMMUNITY	TOTAL TESTS	20	20-99	100-199	200-299	300-399	400-499	500-599	600-699	ppb ug/L
Pine Point	6	5	1	-	-	-	-	-	-	
Pond Inlet	22	5	17	-	-	-	-	-	-	
Port Burwell	23	3	20	-	-	-	-	-	-	
Rae Edzo	60	43	17	-	-	-	-	-	-	
Rae Lakes	9	5	3	1	-	-	-	-	-	
Rankin Inlet	32	16	16	-	-	-	-	-	-	
Repulse Bay	24	16	8	-	-	-	-	-	-	
Resolute	22	2	19	1	-	-	-	-	-	
Sachs Harbour	34	28	6	-	-	-	-	-	-	
Sanikiluaq	43	6	35	2	-	-	-	-	-	
Snowdrift	46	32	14	-	-	-	-	-	-	
Spence Bay	20	8	12	-	-	-	-	-	-	
Trout Lake	2	-	2	-	-	-	-	-	-	
Tuktoyaktuk	360	249	108	3	-	-	-	-	-	
Umingmaktak	8	8	-	-	-	-	-	-	-	
Whale Cove	23	16	7	-	-	-	-	-	-	
Wrigley	40	28	12	-	-	-	-	-	-	
Yellowknife	182	175	7	-	-	-	-	-	-	
Total	3 416	2 073	1 311	27	2	3	-	-	-	

TABLE 10.3: MERCURY LEVELS IN RESIDENTS FROM VARIOUS COMMUNITIES IN THE YUKON

COMMUNITY	TOTAL TESTS	20	20-99	100-199	200-299	300-399	400-499	500-599	600-699	ppb ug/L
Burwash Landing	26	26	-	-	-	-	-	-	-	
Carcross	29	29	-	-	-	-	-	-	-	
Carmacks	62	59	3	-	-	-	-	-	-	
Champagne	10	10	-	-	-	-	-	-	-	
Dawson	67	67	-	-	-	-	-	-	-	
Oestruction Bay	15	15	-	-	-	-	-	-	-	
Elsa	43	42	1	-	-	-	-	-	-	
Faro	25	25	-	-	-	-	-	-	-	
Haines Junction	52	52	-	-	-	-	-	-	-	
Keno City	1	1	-	-	-	-	-	-	-	
Mayo	41	41	-	-	-	-	-	-	-	
Old Crow	78	78	-	-	-	-	-	-	-	
Pelly Crossing	26	26	-	-	-	-	-	-	-	
Ross River	31	31	-	-	-	-	-	-	-	
Tagish	1	1	-	-	-	-	-	-	-	
Teslin	31	30	1	-	-	-	-	-	-	
Watson Lake	77	77	-	-	-	-	-	-	-	
Whitehorse	247	245	2	-	-	-	-	-	-	
Total	862	855	7	-	-	-	-	-	-	

Mercury

The mercury content in hair samples of residents of Igloolik, Northwest Territories (69°10' N, 83°59' W) was studied by Hendzel et al. (1976) . Mercury was found in all 134 hair samples, with concentrations ranging from 1.94 to 109 ppm. The overall mean level in male subjects was 13.8 ppm, with the 10.5 to 20.5 year age group having the most elevated mean concentration (36.4 ppm). The overall mean level in female subjects was 16.9 ppm. Within this population, the 10.5 to 20.5 year age category also had the highest mean concentration of mercury (27.9 ppm). Four percent of the individuals tested had mercury burdens greater than 60 ppm. In general, the mercury levels found in hair of Igloolik residents were higher than those of southern populations, but no symptoms related to mercury poisoning was indicated. Selenium concentrations were also analyzed in 28 hair samples, but these levels could not be correlated with the corresponding mercury data. Information on the mercury content of foods consumed by Igloolik residents was not available at that time.

Eaton (1982) reviewed some specific incidences of high mercury intake in residents of the Northwest Territories, following the identification of two major dietary sources of mercury. Total mercury residues in Ringed seal liver averaged about 27 ppm of which less than 1 ppm is mercury in the methylated form. Seal meat contained considerably lower total mercury (2.0 ppm), but with a greater proportion in the organic form (less than 1.0 ppm). Mercury levels in fish from Victoria Island to Northern Quebec were generally reported to range from 1 to 3 ppm. However, at sites where mining activities have occurred, such as Gaique Lake in the MacKenzie District, individual fish mercury levels higher than 10 ppm have been found. Blood mercury concentrations in residents of Arctic Bay ranged from 5 to 65 ppb, with a mean of 20 ppb. This mercury load is believed to derived entirely from consuming seals. The level of mercury in hair of Inuit from Victoria Island, when extrapolated to blood equivalent, suggest values as high as 180 ppb. The primary source of mercury in this case was believed to be Lake trout.

A complete survey of all settlements in the Northwest Territories was initiated in 1976 (see Wheatley, 1979). Among Indian residents of the MacKenzie Valley, a few individuals had mercury hair levels above 30 ppm (Eaton, 1982). This was believed to be a reflection of their strong dependence on freshwater fish as a source of protein. A resident in Cambridge Bay also had elevated mercury levels. It was reported that this individual had worked as a guide at a fishing camp, and the family had large quantities of lake trout, some Arctic char and very little seal in their diet. Inuit residing in communities in the northeast coast of Baffin Island were reported to have derived their mercury levels from consumming seal tissues. Seals and other marine mammals are harvested throughout the year in this region of the Northwest Territories.

In Tuktoyaktuk and Inuvik, high mercury levels were founded only in Inuit, and not Indian or white residents (Eaton, 1982). The reason for this phenomenon was traced back to the diet. Whale meat and muktuk, particularly Beluga whales, are consummed only by the Inuit. From the data of mercury in Polar bear hair, one would expect to find high mercury levels in residents of Sach's Harbour. However, the concentrations found were uniformly low, which was related to the fact that seal tissues are not generally part of their staple diet. Similarly, residents of communities along the west coast of Hudson's Bay, where caribou is the major source of protein, also had low mercury levels. Few members of the Sanikiluaq settlement in Keewatin showed elevated levels of mercury. Although the source of mercury has not been pinpointed, it was postulated that it may be seals. Individuals from communities along the Hudson Strait showed an interesting geographical trend in mercury levels. Those residing on the North side had relatively low mercury loads compared to those on the Quebec side. Although still being investigated, it was suggested that the greater dependence of communities on the Quebec side on landlocked fish for food may account for this difference (Eaton, 1982).

Galster (1976) investigated the potential danger of mercury intake in diet of native groups -particularly mothers and infants- from the Yukon-Kuskokwim Delta of Alaska. Mercury levels were determined in cord blood, placenta, maternal blood, hair and milk of maternal-infant pairs. Although the measured levels were below those considered dangerous, residue trends with respect to geographical area and consumption pattern were indicated. Higher mercury concentrations were reported in red blood cells, milk and placenta of mothers and red blood cells of infants from coastal communities, when compared to those from the interior of urban centers (Anchorage). This was found to be related to the diet with coastal residents consuming greater quantities of seal oil, seal meat, fish and birds. Seal oil was implicated as the major source of the mercury residues.

The health significance of arsenic, lead and cadmium, to residents of the Northwest Territories was also reviewed by Eaton (1982). After examination of the individual cases, it was concluded that environmental contamination by arsenic, cadmium and lead were not a threat to public health at that time.

Arsenic

In 1966, Medical Services conducted an intensive survey of residents and local mine workers of Yellowknife to determine the effects of arsenic toxicity (deVillers and Baker, 1973; cited by Eaton, n.d.). The findings showed that the general population was not suffering from toxic effects of arsenic. Only a few mine workers, being exposed to high arsenic levels, had dermatoses of sweating areas (Eaton, n.d.). A re-examination of the situation which included hair analysis (Table 10.4) confirmed the earlier results. High arsenic levels in hair were detected only in employees of the mine exposed to high dust areas. Underground workers generally did not have elevated levels in hair.

Analysis of urine of individuals having hair levels above 10 ppm suggested that some of the high concentrations found in hair resulted from external contamination. Arsenic levels found in urine were low which indicated low ingestion or inhalation of the metal. Some employees (bay-house workers) showed elevated urine levels, although effects of arsenic toxicity were not evident. These results confirmed the earlier study showing arsenic to be an occupational, rather than an environmental hazard. A document by the Canadian Public Health Association (CPHA, 1977; cited in Eaton, n.d.)) reviewed the situation. Furthermore, an electromyographic survey of residents of Yellowknife conducted by the CPHA showed no evidence of neurotoxic effects as a result of environmental exposure.

Table 10.4: HAIR ARSENIC LEVELS IN 350 (NON-NATIVE) MALES BY AGE GROUP YELLOWKNIFE, FEBRUARY, 1975 (Eaton, 1982)

PPM Arsenic \ Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70+	Unknown	Total
0.0-0.9	1	1	3	12	14	11	5	4	1	2	1	55
1.0-4.9	2	13	24	18	35	24	34	19	11	2	4	186
5.0-9.9	-	3	4	2	8	9	11	6	1	1	2	47
10.0+	-	-	-	4	14	15	14	6	4	1	4	62
Total	3	17	31	36	71	59	64	35	17	6	11	350

HAIR ARSENIC LEVELS IN 292 (NON-NATIVE) FEMALES BY AGE GROUP YELLOWKNIFE, FEBRUARY, 1975

PPM Arsenic \ Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70+	Unknown	Total
0.0-0.9	-	1	19	10	37	46	39	29	6	3	6	196
1.0-4.9	2	17	21	7	9	8	13	5	5	1	3	91
5.0-9.9	-	1	1	-	1	1	-	-	-	-	-	4
10.0+	-	-	-	-	1	-	-	-	-	-	-	1
Total	2	19	41	17	48	55	52	34	11	4	9	292

Table 10.4: Continued

PPM Arsenic / Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70+	Total
0.0-0.9	-	-	-	-	1	1	-	-	-	2	4
1.0-4.9	-	-	1	1	4	2	-	1	2	1	12
5.0-9.9	-	-	1	1	2	1	-	-	-	1	6
10.0+	-	1	1	-	-	-	-	-	-	-	2
Total	-	1	3	2	7	4	-	1	2	4	24

HAIR ARSENIC LEVELS IN 37 NATIVE FEMALES BY AGE GROUP
YELLOWKNIFE, FEBRUARY, 1975

PPM Arsenic / Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70+	Total
0.0-0.9	-	-	1	3	9	2	-	-	-	-	15
1.0-4.9	-	1	1	2	3	1	3	1	3	-	15
5.0-9.9	-	1	2	2	-	-	1	1	-	-	7
10.0+	-	-	-	-	-	-	-	-	-	-	-
Total	-	2	4	7	12	3	4	2	3	-	37

Cadmium

Prior to the opening of a lead/zinc mine at Strathcona Sound, a report documented high levels of cadmium in tissues of some marine mammals (Hatfield and Williams, 1976; cited in Eaton, 1982). Concentrations as high as 40 ppm in a seal liver and 118 ppm in liver of Narwhal were found. As a consequence of this study, an investigation was initiated to record baseline cadmium levels in blood of residents from Arctic Bay, the closest community to the mine. The original assessment was unsuccessful because of contamination of the blood samples by cadmium from the rubber stoppers of the containers. The subsequent investigation revealed normal blood levels of cadmium in all cases.

Lead

The discovery of high lead levels in blood of some male residents of Arctic Bay in 1976, prior to the commencement of the lead/zinc mine, was somewhat surprising. The levels in these individuals were similar to those in residents in urban centers (Eaton, 1982). Further examination of the blood lead data (Table 10.5) showed that males falling into occupational categories which involved prolonged association with gas-driven vehicles (hunters and settlement employees trade operators) generally had blood lead concentrations greater than 25 ug/100 ml. These individuals were inhaling alkyl lead or ingesting particulate lead when work was performed on the engines; mainly in inadequately ventilated quarters.

Table 10.5: Blood Lead Levels (ug/100 ml) in Arctic Bay Residents (Eaton, 1982).

	0 - 25		26-40		40+		
	No.	%	No.	%	No.	%	N
Inuit 1976	97	97	3	3	-	-	100
Inuit 1976	76	73	23	23	1	1	100
Inuit 15-65 1976	56	71	22	28	1	1	79
Male Employees 1978	48	51	40	43	6	6	94
Inuit Employees 1980	14	54	7	27	5	19	26
White Employees 1980	40	83	4	8	4	8	48
All Male Employees 1980	54	73	11	15	9	12	74

Table 10.6: Distribution of 55 Male Heads of Households in Arctic Bay by Place of Employment and Blood Lead LEvels in 1976 (Eaton, 1982).

	Place of Work or Occupation					
Blood Lead	Strathcona Mine	Panarctic Oil	Hunter	Retired/ Welfare	Municipal Employee	Total
25 ug./100ml. or less	15	3	3	4	19	44
26 ug./100ml. or more	1	1	4	1	4	11
Total	16	4	7	5	23	55

Following the opening of the mine, regular surveillance of lead levels in blood (Table 10.6) and urine of employees showed only moderate increase in some workers. These levels were not considered hazardous. Furthermore, the contribution of lead in Arctic Bay residents from environmental sources were not believed to be a significant factor.

Radionuclides

In 1967 the levels of cesium-137 and strontium-90 were determined in milk of a group of women from Whale Cove, Coral Harbour, Rankin Inlet and a group from Baker Lake, Northwest Territories (Baker *et al.*, n.d.). Milk of Arctic mammals (Rocky Mountain bighorn sheep, Mountain goat, Caribou, Husky, Beluga Whale, and Polar bear) were also analyzed (see Section 6.0). In addition, human milk from the Royal Victoria Hospital Milk Bank in Montreal were tested for comparison with samples from Arctic women. The strontium-90 contents of human milk from Arctic communities (0.3 to 0.6 pCi/g ash) were similar to milk from Montreal (0.3 pCi/g ash). This was reasoned to be attributed to the fact that strontium enters into food-chains via contaminated plant material and plants in the diet are essentially the same in northern and southern communities (Baker *et al.* n.d.)

The cesium-137 concentrations in milk of humans from the Arctic is 50 to 100 times higher than milk collected in Montreal (Baker *et al.* n.d.). Additionally, milk of women from Baker Lake contain higher levels of cesium-137 (510 pCi/g ash) than those from other areas of the Northwest Territories (196 pCi/g ash). This was attributed to differences in dietary pattern among the communities, with residents of Baker Lake consuming more Caribou meat. Caribou milk was found to contain the highest cesium-137 levels among the Arctic animals.

Organic Contaminants

The Department of National Health and Welfare (Health Protection Branch) conducts regular monitoring surveys of PCB and other chlorinated hydrocarbon residues in adipose tissue (Mes et al. 1982) and milk (Mes and Davies, 1979) of Canadian residents in order to follow the trends in the levels of these chemical compounds. Although samples are collected nationwide, few samples have been obtained from natives of the Arctic region. Mes et al. (1982) have reported the chlorinated hydrocarbon residue levels in adipose tissue samples from across Canada, including two samples from the Yukon. These data, along with those from other regions of Canada, are shown in Table 10.7. The chlorinated hydrocarbon residues which are routinely analyzed in human milk and adipose tissue samples are summarized in Table 10.8.

Table 10.7: REGIONAL OISTRIBUTION OF CHLORINATED HYDROCARBON RESIOUES IN AOIPOSE TISSUE OF CANAOIANS (Mes et al. 1982).

	Average ug/g wet weight ± S.O.					
	Region					
Compound	Eastern[a]	Quebec	Ontario	Central[b]	Western[b]	Yukon
PCB, as Aroclor 1260	0.803 ± 1.094	0.890 ± 0.409	1.791 ± 1.468	0.779 ± 0.660	0.947 ± 1.233	1.398 ± 0.819
PCB, as Aroclor 1242	0.219 ± 0.304	0.293 ± 0.156	0.253 ± 0.073	0.416 ± 0.553	0.306 ± 0.181	0.367 ± 0.256
HCBD	0.002 ± 0.000	0.004 ± 0.000	0.004 ± 0.000	0.003 ± 0.000	0.003 ± 0.000	0.004 ± 0.000
PCBz	0.001 ± 0.000	0.002 ± 0.000	0.003 ± 0.000	0.002 ± 0.000	0.003 ± 0.000	0.001 ± 0.000
HCB	0.041 ± 0.020	0.072 ± 0.033	0.082 ± 0.048	0.149 ± 0.189	0.119 ± 0.121	0.126 ± 0.046
a HCH	0.002 ± 0.000	0.003 ± 0.000	0.004 ± 0.000	0.004 ± 0.000	0.006 ± 0.000	0.005 ± 0.000
b HCH	0.078 ± 0.087	0.074 ± 0.037	0.179 ± 0.318	0.126 ± 0.254	0.308 ± 0.848	0.089 ± 0.033
y HCH	0.002 ± 0.000	0.002 ± 0.000	0.001 ± 0.000	0.004 ± 0.000	0.003 ± 0.000	0.003 ± 0.000
Oxychlordane	0.043 ± 0.017	0.047 ± 0.014	0.054 ± 0.017	0.074 ± 0.046	0.059 ± 0.028	0.076 ± 0.022
t-Nonachlor	0.047 ± 0.022	0.051 ± 0.020	0.048 ± 0.022	0.071 ± 0.057	0.059 ± 0.030	0.081 ± 0.025
Heptachlor epoxide	0.014 ± 0.000	0.029 ± 0.010	0.052 ± 0.069	0.076 ± 0.097	0.030 ± 0.014	0.042 ± 0.026
Oieldrin	0.036 ± 0.017	0.053 ± 0.028	0.049 ± 0.026	0.056 ± 0.048	0.045 ± 0.022	0.036 ± 0.010
p,p'-ODE	0.965 ± 0.697	1.764 ± 1.248	1.531 ± 1.215	2.268 ± 1.704	1.663 ± 1.590	1.915 ± 1.167
o,p'-DDT	0.017 ± 0.010	0.028 ± 0.020	0.034 ± 0.041	0.031 ± 0.014	0.051 ± 0.113	0.032 ± 0.000
p,p'-DOT	0.118 ± 0.030	0.308 ± 0.328	0.225 ± 0.146	0.332 ± 0.323	0.404 ± 0.819	0.261 ± 0.064

[a] Prince Edward Island and Nova Scotia
[b] Manitoba and Saskatchewan
[c] Alberta and British Columbia.

Table 10.8: CONTAMINANTS ANALYZED IN HUMAN ADIPOSE TISSUE, BLOOD OR MILK SAMPLES BY THE DEPARTMENT OF NATIONAL HEALTH AND WELFARE.

Contaminant	Sample	Reference
PCB(Aroclor 1260)	Milk	Mes and Davies, 1978
DDT (Total)		
Dieldrin		
HCB		
bHCH		
Heptachlor epoxide		
Oxychlordane		
Trans-Nonachlor		
PCB (Aroclor 1260)	Milk	Mes and Davies, 1979
p,pDDE		
o,pDDT		
p,pDDT		
p,pDDD		
Dieldrin		
HCB		
bHCH		
yHCH		
Heptachlor epoxide		
Oxychlordane		
Trans-Nonachlor		
PCB (Aroclor 1260	Adipose tissue	Mes *et al*. 1982
PCB (Aroclor 1242)		
HCBD		
PCBz		
p,pDDE		
o,pDDT		
p,pDDT		
Dieldrin		
HCB		
aHCH		
bHCH		
yHCH		
Heptachlor epoxide		
Oxychlordane		
Trans-Nonachlor		
PCB (Aroclor 1260)	Blood	Mes *et al*. 1984
PCB (Aroclor 1242)		
p,pDDE		
p,pDDT		
Dieldrin		
HCB		
Oxychlordane		

Table 10.8: Continued

PCB (Aroclor 1260)	Milk	Mes *et al*. 1984
PCB (Aroclor 1242)		
p,pDDE		
p,pDDT		
Dieldrin		
HCB		
bHCH		
Heptachlor epoxide		
Oxychlordane		
Trans-Nonachlor		

To date, no comprehensive assessment of organochlorine residue exposure in northern natives has been conducted. Kinloch (1985) proposed such a project to investigate PCB intake in residents of the Northwest Territories. The suspected routes of exposure are believed to be primarily through the food chain and to a lesser extent through contact with PCB-containing equipment. Acute exposure to PCBs has not been shown to be toxic. However, in regards to long-term, low level contamination through ingestion, pregnant women, nursing infants and young children were identified as possible 'high risk' groups. Blood and breast milk samples will be obtained for PCB residue analysis. On the basis of the 1983 and 1984 Baffin Region Inuit Association (BRIA) harvest data, Arctic Bay, Broughton Island, Clyde River, Grise Fiord and Pangnirtung were tentatively identified as 'high risk' communities -in terms of total potential consumption of PCB contaminated country foods. Kinloch (1985 and pers. comm.) stated that the selection of communities using the harvest data, without quantitative diet information, may be misleading. Yet, the chosen sites appear to correspond to opinions regarding the relative consumption patterns and the use of harvest data constitute the best (or only) available method for selecting 'test' and 'control' communities. In order to determine the PCB intake of 'high risk' individuals in these communities with some precision, diet surveys will also be conducted. Qualitative as well as quantitative information for each individual or family will be generated using the direct interview technique. Since seasonal differences in the dietary pattern are likely to occur, the proposed surveys are to be conducted on a continuing monthly or quarterly basis. The third aim of this pilot study is to obtain samples of country foods for PCB analysis.

11.0 SUMMARY AND RECOMMENDATIONS

Northern natives depend on and consume more country foods (i.e. fish, game, marine mammals) than most other Canadian residents. Therefore, they may be more exposed to the hazards of some environmental contaminants compared to the general population. This report summarizes the available information concerning country food availability in northern communities; native diets; residue data of fish, game, marine mammals and Polar bears; potential sources of pollutants in the Arctic; and medical testing for environmental contaminants in northern native populations.

From the per-capita edible biomass figures derived from the harvest data, several communities were tentatively identified as 'at risk' because of the large amount of harvested country food. These were Arctic Bay, Broughton Island, Grise Fiord and Pangnirtung in the Baffin Region; Bay Chimo/Bathurst Inlet, Holman and Spence Bay in the Kitikmeot Region; and Coral Harbour and Repulse Bay in the Keewatin Region. There is very little harvest information for communities in other regions in northern Canada. This is particularly ture true for many of the Dene communities.

The identification of 'at risk' groups or communities, carried out in this review by using the available harvest data, requires further refinement. This exercise, along with attempts to determine the potential contaminant intake, was hampered by the dearth of specific information on the contemporary eating habits of northern natives. The acquisition of this supplementary diet information should bring in the participation of local native organizations. This is particularly relevent since various local factors, such as the intensity of acculturation and the ethnicity of the community, play major roles in determining eating habits. The inadequacy of our present knowledge of northern native food consumption patterns does not allow for an accurate assessment of the degree of contaminants exposure via the diet.

This review also reveals that there is insufficient monitoring information to provide a coherent picture of the present state of contamination in many species which are harvested. The fragmentary nature of the existing data is one of the major factors impeding the assessment of contamination in country food. Given the size and diversity of the Arctic region, this was not totally unexpected.

Some of the major data gaps recognized include:

a) the scarcity of metal or organic contaminant data for terrestrial mammals (Caribou, muskox, Arctic hare, moose, deer, Black bear, beaver, muskrat).

b) The lack of information on metal and organochlorine levels in eggs and tissues of game birds (Ptarmigan, waterfowl, seabirds).

c) The paucity of residue data for Arctic fish species in which analyses were conducted using whole fish samples.

There is a large database on mercury levels in whales and seals with some distinct geographical differences. Bearded seal from Victoria Island contain the highest mercury levels detected. The residue information for other metals is less extensive. The highest cadmium and lead concentrations were found in

Narwhal from Pond and Admiralty Inlets. Although many surveys have been conducted on organochlorine contamination in marine mammals, the geographical coverage is not complete. The highest DDT and PCB residues found to date were in specimens from Pond Inlet and Greenland. Residue information of whales and seals from unsurveyed regions in the Arctic should be procured.

The systematic surveillance of metal and organochlorine residues in liver and fat of Polar bears provide the best dataset for defining geographical and temporal trends. Large geographical differences in mercury and cadmium levels were reported. PCB and chlordane isomers were the major organochlorine compounds detected. The position of Polar bears in the Arctic food chain indicates that it is a good species for monitoring changes in Arctic contamination. Surveys of chemical residues in tissues of these animals should be conducted on a continuing basis (e.g. every 5 years) to document the changes in concentrations of existing chemicals and to determine the input of new chemicals. It is not known if Polar bear tissues are still widely used for food. A limited tissue distribution study which analyzes adipose tissue, muscles, liver and other organs should allow one to predict chemical content in edible portions.

Recent residue surveys of seals and Polar bears show PCB and Chlordane isomers as the major residues found in the tissue samples. More attention should be focused on these chemical residues in future programs. In particular, the level of oxychlordane, the highly toxic metabolite of commercial mixtures of chlordane, should be monitored. Another concern is the increase in chlordane levels over the last 13 years. The 1984 Polar bear samples contained chlordane levels which were 4 to 5 times higher than those collected in 1969.

The widespread distribution of contaminants, especially organochlorine compounds, in Arctic samples indicates that the sources are likely from long range transport of these chemicals, reflecting an extension of global contamination. However, local sources of contamination, particularly elemental residues levels reflecting the geochemical background of the area, can not be excluded.

Much of the medical testing of northern natives have involved metal contamination, generally in communities with mining developments. The results of these surveys did not point to widespread environmental contamination by these residues. The exception was mercury, and this situation was monitored by a program of surveillance between 1976 and 1982.

No assessment of the potential health hazards from organochlorine contamination has been conducted in northern communities. The limited information from Greenland showed adipose tissue samples of residents in that area to contain a variety of organochlorine residues. The PCB levels were reported to be higher than samples collected in industrialized areas. It is not known if a similar situation exists in the Canadian Arctic at the present time.

Short-term Research Needs

a) Determine the contemporary consumption pattern (species, portions, preparation methods) of country foods among northern native communities, especially those deemed at 'high risk'. Improvements in our understanding of this aspect of native life will enhance the identification of individuals 'at risk' and the determination of their potential level of exposure.

b) Fill in the information gaps of contaminant levels in harvested species. These data are required in order to identify which country food items may be important routes of entry of chemical residues into the human food chain. These monitoring surveys can be initiated in communities tentatively identified as 'at risk'.

c) Include the sampling of breast milk and adipose tissue of northern natives in the continuing nationwide monitoring program conducted by the Health Protection Branch of the Department of National Health and Welfare.

Long-term Research Needs

a) Develope a periodic monitoring program to analyze contaminants in the "typical northern food basket", using testing procedures based on northern consumption patterns. This would provide the necessary database for evaluating potential health risks to northern populations. Furthermore, such a program conducted on a continuing basis (e.g. every 4 to 5 years) would allow for the determination of temporal trends in the levels of existing contaminants, and the identification of new contaminants.

b) Determine the sources of contamination, particularly organochlorines, in Arctic fish, game and marine mammals.

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Appendix A: List of Individuals Contacted

NAME	AFFILIATION	TELEPHONE	CONTACTED
Addison, R.	Fisheries and Oceans (Halifax)	(902) 426-3279	X
Angmiuq, P.	Park Warden (Pangnirtung)	(819) 473-8962	no
Bennett, P.R.	Health and Welfare (Ottawa)	(613) 990-8987	X
Bisset, D.	Indian Affairs and Northern Development (Ottawa)	(819) 997-9333	no
Campbell, R.	Fisheries and Oceans (Ottawa)	(613) 990-0296	X
Cocksedge, W.	Health and Welfare (Ottawa)	(613) 990-7735	X
Cole, L.	University of Ottawa-Graduate student (Ottawa)	(613) 563-1242	no
Cole, R.	Canadian Wildlife Service (Yellowknife)		no
Conacher, H.B.S.	Health and Welfare (Ottawa)	(613) 993-4460	X
Davies, D.	Health and Welfare (Ottawa)	(613) 993-5541	X
Dimitroff, D.	Health and Welfare (Ottawa)	(613) 990-7734 (613) 990-8393	X
Eaton, R.D.P.	Health and Welfare (Halifax)	(902) 426-7392	X
Finley, K.J.	L.G.L. Consultants (Toronto)	(416) 833-1244	X
Foote, T.	Environmental Protection Service (Ottawa)	(819) 997-3376	X
Freeman, M.	University of Alberta (Edmonton)		no
Gamble, L.	Keewatin Wildlife Federation (keewatin)	(819) 645-2481	X
Graff, R.	Northwest Territories Renewable Resources(Yellowknife)	(403) 873-7778	X
Gunn, A.	Northwest Territories Renewable Resources(Cambridge Bay)	(403) 983-2139	X
Haller, A.A	Indian Affairs and Northern Development (Ottawa)	(819) 997-8319 (819) 997-9595	X
Hill, F.	Indian Affairs and Northern Development (Ottawa)	(819) 994-1909	X
Hoeff, M.	Yukon Government (Whitehorse)	(403) 667-5671	No

NAME	AFFILIATION	TELEPHONE	CONTACTED
Holtz, A.	Environmental Protection Service (Edmonton)	(403) 420-2005	X
Houston, J.J.P.	Fisheries and Oceans (Ottawa)	(613) 990-0296	X
Johansen, P.	Greenland Fisheries and Environment (Copenhagen)		no
Kapel, F.	Greenland Fisheries and Environment (Copenhagen)	01-45-1-834-4444	no
Kemp, W.	Makivik (Montreal)	(514) 483-2780	X
Kinloch, D.	Health and Welfare (Yellowknife)	(403) 920-8616	X
Kuhlein, H.	University of British Columbia (Vancouver)	(604) 228-6253	X
Kooneelinsie, D.	Park Warden (Broughton Island)	(819) 927-8834	no
Lee, J.	Northwest Territories Government (Yellowknife)	(403) 873-7782	no
McFarland, F.	Indian Affairs and Northern Development (Ottawa)	(613) 997-9621	X
McGregor, G.	Fisheries and Oceans (Winnipeg)	(204) 949-5069	X
Mackey, M.G.	MacDonald College (Montreal)	(514) 457-2000	no
Marshall, W.K.	Canadian Wildlife Service (Ottawa)	(819) 997-1412	X
Merchant, P.	Yukon Government (Whitehorse)	(403) 667-5285	no
Mes, J.	Health and Welfare (Ottawa)	(613) 993-5541	no
Moschenko, R.	Fisheries and Oceans (Winnipeg)	(204) 948-5160	X
Muir, D.	Fisheries and Oceans (Winnipeg)	(204) 949-5168	X
Musick, D.	The Bay (Nutritionist) (Winnipeg)	(204) 934-1447	X
Norstrom, R.J.	Canadian Wildlife Service (Ottawa)	(819) 997-1411	X
Ostrom, P.	Indian Affairs and Northern Development (Ottawa)	(819) 997-0550 (819) 994-6818	X
Pattimore, J.	B.R.I.A. (Frobisher Bay)	(819) 879-5219 (819) 879-5391	X

NAME	AFFILIATION	TELEPHONE	CONTACTED
Picard, L.	Health and Welfare (Yellowknife)	(403) 873-7058	no
Rousseau, P.	Parks Canada (Riding Mountain)	(204) 848-2811 (204) 848-2825	X
Schaefer, O.	Health and Welfare (Edmonton)	(403) 420-2744	X
Sharpe, M.A.	Environmental Protection Service (Edmonton)	(403) 420-2005	X
Slipchenko, W	Indian Affairs and Northern Development (Ottawa)	(819) 997-9595	X
Smith, T.	Fisheries and Oceans (St. Anne de Bellevue)	(514) 457-3660	X
Steckle, J.	Health and Welfare (Ottawa)	(613) 990-7596	X
Strong, T.	Fisheries and Oceans (Winnipeg)	(204) 949-3392	no
Sutherland, D.	Environmental Protection Service (Yellowknife)	(403) 430-2005	X
Tilden, D.	Environmental Protection Service (Yellowknife)	(403) 430-2005	no
Urenchuk, G.	Fisheries and Oceans (Winnipeg)	(204) 949-5156	X
Usher, P.J.	Consultant (Ottawa)	(613) 238-8556	X
Waddell, B.	Indian Affairs and Northern Development (Ottawa)	(819) 997-9334	X
Weick, E.	Indian Affairs and Northern Development (Ottawa)	(819) 997-0550	X
Wheatley, M.	Consultant (Ottawa)	(613) 828-1196	X
Wheatley, W.	Health and Welfare (Ottawa)	(613) 990-7600	X
Winesteine, M.	Consultant (Courtney)	(604) 338-5518	no
Wolfe, R.	Alaska State Government, Department of Fish and Game (Juneau)	(907) 465-4147	X

* Some individuals were not contacted because they were absent during the course of this review.

Appendix B: Harvest Data Collected in the Northwest Territories

Community	Species Harvested	Est. Harvest N - 1981 S - 1982	Est.§ Edible Weight (kg) 0-81 0-82	Period Of Harvest	Ref.	Est. Harvest N - 1982- S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest 0 - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Baker Lake	Caribou	3729	178987	N-S	1	4945	237341	N-S	1	6431	308569	0-S	2				
	Muskox	12	1320	M		12	1331	M		13	1430	M					
	Grizzly Bear	0				1				1	45	S					
	Arctic fox	172		N;F-A		602		N-F		757		N-A					
	Wolf	23		J;M-A		12		N;M;My		53		0-N;F-A					
	Ringed Seal	0		N		0	14	My		6	88	My-Jn;S					
	Canada Goose	0				0				296	710	My-Jn					
	Snow Goose	0				0				350	561	My-Jn					
	Ptarmigan	4	2	N		0				349	140	S					
	Goose Eggs	0				0				2722		Jn					
	Charr	128	10			0				203	508	Jn					
	Lake Trout	11678	28331	N-0 M-A		3236	7852	A-My;Jy Au		3745	8986	0-S					
	Whitefish	0				276	671	A-My		637	1782	D-My;Jy-S					
	Northern Pike	0				0				25	53	S					
	Grayling	0				0				25	23	S					
	Other freshwater fish	142		F		0				0							
Total			208649			0	247209			0	322895						

§ = value determined by calculating an average for those months that were not reported over the period specified.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	0 - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest O - 1981 S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1982 S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight ( )	Period Of Harvest	Ref.
Chesterfield	Caribou	151	7243	J;F;Au;S	1	613	29424	O-S	1	382	18,295	O-S	2				
	Polar Bear	3	476	J		10	1667	D-M		9	1451	N;J;M;					
	Arctic Fox	25		J;F		576		N-A		35		O-A;					
	Wolf	0				11		O;F;A-My		22		N-J;					
	Ringed Seal	46	661	J;F;Au;S		137	1966	O-S		43	622	O-D;M;My-S					
	Bearded Seal	2	226	S		0				4	394	O;S					
	Seal (spp.)	48				137				0							
	Walrus	0				11	2036	M-A; Jy		7	1322	M-A;Jn					
	Beluga	8	4301	Au;S		7	3370	Au		12	5923	Jy-S					
	Canada Goose	0				0				8	18	Jn					
	Snow Goose	20	32	Au;S		19	31			0							
	Eider	0				31	47	O;Jn		1	2	Jn					
	Canada Goose Eggs	0				0				2		Au					
	Duck Eggs	0				0				8		Jn					
	Other Fowl Eggs	0				0				6		J,A					
	Charr	76	555	J		152	838	Jn-Au		0		-					
	Sea-run Charr	0				0				480	1201	My;Jy-S					
	Lake Trout	220	535	Au		333	808	O-N		129	310	N;A-My					
	Sculpin	0				0				1		Jn					
Total			14030				40188				29538						

§ = value determined by calculating an average for those months that were not reported over the period specified.

Abbreviations for period of harvest:

J - January	Jy - July
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A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest O - 1981 S - 1982	Est.§ Edible Weight (kg) O - 1982 S - 1983	Period Of Harvest	Ref.	Est. Harvest O - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight ( )	Period Of Harvest	Ref.
Coral Harbour	Caribou	89	4277	Jn-O;F	1	637	30495	O-J;M-S	2								
	Polar Bear	15	2350	Jn;O-A		34	5399	O-J;									
	Arctic Fox	871		F;O-A		529		N-A									
	Wolf	0				1		My									
	Arctic Hare	26	61	N-O;M		1		A									
	Ringed Seal	821	11746	F;Jn-A		828	11839	O-S									
	Bearded Seal	35	3434	F;Jn-O;M-A		68	6719	O-A;Jn-S									
	Harp Seal	105	4525	Jy-S;		24	1063	J-F;Jy-S									
	Seal (spp.)	977		F;Jn-S		0											
	Other Seal	16		F		1		F									
	Walrus	73	13586	F;Jn-A		44	8248	O;J;M;My;Jy-S									
	Beluga	124	62472	Jy-S;O		116	55868	O-N;J-F;Jn-S									
	Canada Goose	656	1575	Jn-Au;D		137	328	My-Jn;Au									
	Snow Goose	4387	10530	Jn;S;O		5557	8890	J-F;A-Jn;Au-S									
	Ross's Goose	267	267	Jn-S;		0											
	Brant	0				5		My - Jn									
	Other Goose	5310		Jn-S		79		My - Jn									
	Eider	326	489	Jn;Au-S		53	80	O-N;A-MY;S									
	Guillemot	3		S		0											
	Oldsquaw	1	1	S		0											
	Ptarmigan	1051	420	F;Jn;Au-M		1269	508	O-A;S									
	Snowy Owl	1	2	F		0											
	Swan	2	12	Jn		6	39	My									
	Other Fowl	5		Jn		2		F									
	Brant eggs	3		Jy		0											
	Canada Goose Eggs	*				71		Jn									
	Snow Goose Eggs	*				10290		Jn									
	Other Goose Eggs	*				30		Jn									
	Sea-run Charr	*				3026	7565	O-S									
	Land-locked Charr	*				12		Jn									
	Charr	4180	10518	F;Jn-N		0		Jy									
	Other Freshwater Fish	0				19		Au									
	Lake Trout	419	1017	O,M		0											
	Cod	18		Jn		170		Jn-Au									
Total			127283				137041										

* Data either not compiled or collected

§ = Value determined by calculating an average for those months that were not reported over the period specified.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest O - 1981- S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1982- S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.
Eskimo Point	Caribou	3760	180461	O-S	1	2342	112474	O-S	1	2779	134,096	O-S	2				
	Moose	1	239	A		0				4	802	M;My					
	Polar Bear	14	2160	N;A		15	2414	N;M-A;		21	3,390	O-N;M;My					
	Arctic Fox	546		N-A		2365		O-My		621		N-My;					
	Red Fox	17		D;M-A		46		N-J;M-A		33		N;J-A					
	Wolf	32		D;M-A		21		N;A-My		57		O-O;F-My					
	Weasel	0				0				2		S					
	Arctic Hare	28	65	D-J;M-A		22	50	O;D-My		9	7	N;A;S					
	Rabbit	2		D		2		N;F		0							
	Martin	0				1		I		0							
	Muskrat	0				0		O		0							
	Ringed Seal	411	5877	O-S		244	3495	O-F;A-S		516	7,424	O-N;J-S					
	Bearded Seal	29	2893	O;M;My;Au		23	2303	O;My-Au		51	5,079	O-N;M-S					
	Harbour Seal	3	78	O;S		3	89	Jy-Au;		2	56	Jy					
	Harp Seal	5	198	Au-S		6	271	O;Jn-Jy;S		3	131	O;My;					
	Unknown Seal	0				1				0							
	Seal (spp.)	448				278				0							
	Beluga	85	40777	Jy-S		58	27971	Jy-S		50	24,407	Jy-Au.					
	Canada Goose	59	141	My-Jn; Au-S		545	1308	My-Jn;S		649	1,557	My-Jn;S					
	Snow Goose	715	1143	My-Jn;S		93	148	Jn;S		123	197	MY-Jn;S					
	Other Goose	773				638				12		My					
	Eider	2	3	O		3	5	Jn		12	18	My-Jn					
	Oldsquaw	0				8	4	Jn		8	4	Jn					
	Mallard	2	2	Jn		0				1	1	N					
	Duck (spp.)	4				11				0							
	Ptarmigan	286	107	O-My;Jy-S		117	47	N-F;A-S		367	147	O-J;M-My;Au;S					
	Snowy Owl	2	3	D		0				0							
	Swan	*				0				1	7	My					
	Canada Goose Eggs	*				0				384		My					
	Snow Goose Eggs	*				0				5		My					
	Other Goose Eggs	*				1112		Jn		61		Jn					
	Duck Eggs	*				14		Jn		0							
	Unk. Waterfowl Eggs	*				1		Jy		0							
	Fowl Eggs	*				6		Jn		0							
	Sea-run Charr	*				0				2,489	6,226	O-O;A-S					
	Land-locked Charr	*				0				10		O;My;					
	Charr	2480	6240	O-F;My-S		2048	5153	O-J;My-S		0							

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Abbreviations for period of harvest:

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Jn - June	D - December

A line beneath an abbreviaton includes a peak period.

Community	Species Harvested	Est. Harvest 0 - 1981- S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest 0 - 1982- S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest	Est. Harvest 0 - 1983 SRef1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.
Eskimo Point	Lake Trout	2473	6000	0-S	1	926	2248	0-N;J-Jn;Au-s	970	2332	0-0;M-S	2				
(Con't)	Whitefish	395	1111	N-J;		0			154	430	N-0;S					
	Northern Pike	10	22	N;J		86	183	Au-S	16	33	S					
	Grayling	305	290	N-D;A;N-S		12	12	A-My;Au-S	439	394	0-N;A;S					
	Longnose Sucker	0				2		S	0							
	Other Freshwater Fish	0				0			20		N;S					
	Cod	108		Jn-Jy		47		Jn	3		Jn					
	Sculpin	2				1			0		Jn					
	Marine Fish	0				14		Jy	-							
Total			247809				158175			186,738						

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A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest N - 1981- S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest 0 - 1982- S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest		Est. Harvest 0 - 1983 SRef1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.
Rankin Inlet	Caribou	2076	99638	N-S	1	1483	71189	0-S	1	1504	71980	0-S	2				
	Polar 8ear	9	1493	N-D;M-A		19	2985	N;F-M;My		9	1542	N-0;F-M;JN					
	Arctic Fox	51		0-A		793		N-M		128		N-A;					
	Wolf	14		J;M-A		31		J-My		10		N;F-My					
	Wolverine	0				9		My		1		My					
	Arctic Hare	9	21	J;S		7	17	J;M		7	11	Jn					
	Arctic Ground Squirrel	0				0				1		F					
	Ringed Seal	452	6465	F-S		449	6416	0-S		414	5907	0-N;J;M-S					
	Bearded Seal	13	1259	A;Jn-S		19	1870	0-N;A;Jn-Jy;S		18	1770	0-N;M-Au					
	Harbour Seal	0				0				1	30	S					
	Harp Seal	0				0				1	43	Au					
	Other Seal (+ Seal spp.)	465				469				4		My					
	Walrus	2	407	Jn		48	8718	0;F;My		1	197	A					
	Beluga	35	17849	Jy-S		29	14571	My		69	33081	Jn-S					
	Canada Goose	1177	2825	My-Jn		20	48	F-M		401	962	My-Jn;Au					
	Snow Goose	52	83	My-Jn;S		98	157	M		301	482	My-Jn;S					
	8rant	0				0				11		Jy					
	Goose (spp.)	1251		S		118				0							
	Eider	31	83	F-M;S		6	9	F		28	42	N;M;Jn-S					
	Ptarmigan	48	19	A-My;S		228	91	0-N;J;Au		291	117	F;A-Jn;Au-S					
	Sandhill Crane	9	39	My		0				3	12	My					
	Swan	0				0				9	59	My-Jn;Au					
	Other Fowl	0				0				1		Jy					
	Canada Goose Eggs	0				0				94		Jn					
	Other Fowl Eggs	0				0				22		Jy					
	Sea-run Charr	0				0				5087	12712	0-S					
	Land-locked Char	0				0				27		My	2				
	Charr	11068	27848	N;F;A-S		5508	13857	0-J;Jn-S		0							
	Lake Trout	185	449	D;J-A		354	859	N;F;My		458	1099	N;F;A-My;Jy-Au					
	Grayling	10	10	S		0				0							
	Whitefish	0		A-My		0				8	22	N;A					
	Other Freshwater Fish	147				104		A		0							
	Marine Fish	0				52		A		0							
Total			158452				120,831				130,068						

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A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest O - 1981- S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1982- S - 1983	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest O - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.
Repulse Bay	Caribou	1359	65242	O-S	1	849	40680	O-S	1	1279	61221	O-S	2				
	Polar Bear	16	2588	N-O		19	3033	N;F-A		14	2338	N-O;F-M;					
	Grizzly Bear	5	241	M		0				0							
	Black Bear	0				1	64	F		0							
	Arctic Fox	77		J-A		104		N-A;		280		N-A					
	Red Fox	1		M		0				3		N;F					
	Wolf	42		J-My		18		J;M-My		46		O-My					
	Wolverine	3		M		0				10		N;M-My					
	Arctic Hare	20	47	O;F;S		7	16	J-M		6	9	F;A					
	Ringed Seal	812	11609	O-O;M-S		345	4932	O-N;F-S		553	7890	O-N;J-S					
	Bearded Seal	21	2057	O;O;Au-S		15	1525	Jy-S		25	2382	O;Jy-S					
	Harp Seal	3	129	Au		0				6	245	Jy-Au					
	Seal (spp.)	836		O-A;M-S		360		O-N;F-S		0							
	Walrus	21	3850	O;S		13	2406	Jn-Jy;S		5	766	Au-S					
	Beluga	39	18365	O-Au,S		40	19269	Jy-S		25	11904	Jy-S					
	Narwhal	9	5416	Jy-Au		6	3452	Au		31	15401	Jy-S					
	Canada Goose	0				2	5	S		7	16	My-Jn					
	Snow Goose	27	44	My-Jn		0				4	7	My					
	Ross's Goose	9	9	My-Jn		4	9	Jy		0							
	Goose (spp.)	36				11				0							
	Eider	12	18	Jy-Au		22	33	Jn-Jy		5	8	Jn					
	Oldsquaw	0				0				6	3	Jn					
	Guillemot	9	2	Jy-Au		0				0							
	Ptarmigan	242	97	My-Jn;Au		13	5	O;My		82	33	F;M;Jn;Au-S					
	Sandhill Crane	0				0				1	6	My					
	Other Fowl	0				7		Jy		0							
	Land-Locked Charr	0				0				31		O					
	Sea-run Charr	0				0				2168	5419	O-O;My-S					
	Charr	1764	4437	O-D;M;My-S		1225	3082	O-N;M;Jn-S		0							
	Lake Trout	1395	3384	O-N;J;M-Jn;S		69	167	N;M-Jn		62	147	O;My;	2				
	Grayling	13	13	Jn		0				0							
	Other Freshwater Fish	0				0				216		O					
Total			117548				78678				107,795						

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Community	Species Harvested	Est. Harvest 0 - 1981 S - 1982	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Harvest 0 - 1982 S - 1983	Est.§ Edible Weight (kg)	Est. Period Of Harvest	Ref.	Est. Harvest 0 - 1983 S - 1984	Est.§ Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Whale Cove	Caribou	1097	52675	0-My;Jy-S	1	376	18038	0-M	1	545	26209	N-S	2				
	Polar Bear	7	1159	N-0;A		5	778	0-0		8	1296	N;M;My					
	Black Bear	1	50	S		0				0							
	Arctic Fox	5		F;A		243		N-M		36		N-D;					
	Red Fox	0				2		J		0							
	Wolf	5		M-A		0				9		N-0;F-A					
	Arctic Hare	14	32	0-N;J;		7	15	0		8	19	Au-S					
	Ringed Seal	124	1770	N;F-S		50	711	0-M		106	1528	N;J-S					
	Bearded Seal	7	718	F;A;Jy		2	197	0		10	964	A;Jn;Au					
	Harbour Seal	2	58	M		2	69	M		6	162	Jy-Au					
	Harp Seal	1	47	S		2	108	M		0							
	Seal (spp.)	134		N;F-S		57		0-M		0							
	Walrus	7	1388	0;F;A;Jn		0				0							
	Beluga	7	1733	Au-S		0				24	11660	Au-S					
	Narwhal	1	833	Au		0				0							
	Canada Goose	100	240	My-Jn		0				24	59	My-Jn					
	Snow Goose	149	239	My-Jn		0				540	865	My-Jy;S					
	Ross's Goose	2	2	Jn		0				0							
	Goose (spp.)	251		My-Jn		0				0							
	Eider	9	13	0;My		0				9	14	My					
	Goose Eggs	0				0				24		My					
	Ptarmigan	17	7	0;My		22	9	0;F		12	5	A-My					
	Sea-run Charr	0				0				961	2406	N-J;A-S					
	Land-Locked Charr	0				0				1		My					
	Charr	8183	20587	0-S		145	364	0-F		0							
	Lake Trout	561	1361	0-S		183	351	0-M		314	753	J-Jn					
	Northern Pike	2	4	A		0				0							
	Grayling	2	2	D		0				0							
	White Fish	11	31			0				0							
	Other Freshwater Fish	0		M-A		0				0							
	Marine Fish	6		My		0				0							
Total			82952				20639			0	45940						

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Community	Species Harvested	Est. Harvest J - 1983 0 - 1983	Est.[1] Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest A - 1984 0 - 1984	Est. Edible Weight (kg)	Period Of Harvest	Ref	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Apex	Caribou	246	11,808	J-D	6	149		A-Au									
	Muskox	0				0											
	Polar Bear	0				0											
	Wolf	0				0											
	White Fox	0				0											
	Blue Fox	0				0											
	Red Fox	2				0											
	Arctic Hare	13	26	J-F:My:Au-0:0		15		Au									
	Ringed Seal	263	5,260	J-0		117		A-Au									
	Bearded Seal	4	392	F:My:0		6		Jy-Au									
	Harp Seal	8	584	Au-S		3		Jy-Au									
	Hooded Seal	0				8		Au									
	Harbour Seal	0				2		Au									
	Walrus	0				2		Au									
	Narwhal	0				1		My									
	Beluga	0				0											
	Canada Goose	2	5	Au-S		0											
	Snow Goose	1	2	My		0											
	Brant	0				0											
	Eider	6	9	A:Ju-Jy		39		Ju-Au									
	Guillemot	0				0											
	Oldsquaw	0				0											
	Ptarmigan	372	234	A-My:Au-D		178		A-My									
	Murre	0				0											
	Canada Goose Eggs	*				R 0											
	Snow Goose Eggs	*				R 0											
	Oldsquaw Eggs	*				R 0											
	Eider Eggs	*				R 0											
	Murre Eggs	*				R 0											
	Gull Eggs	*				R 0											
	Tern Eggs	*				R 0											
	Sea-run Charr	206	412	Ju-Jy:0		491		My-Au									
	Land-locked Charr	0				5		My									
	Cod	0				0											
	Sculpin	0				0											

1. Edible weight estimates were not in the original report, but calculated based on the harvest estimates as described in the text on harvest.

Abbreviations for period of harvest:

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My - May	N - November
Jn - June	0 - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest J - 1981 D - 1981	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1982 D - 1982	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1983 D - 1983	Est.[2] Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest A - 1984 D - 1984	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Arctic Bay	Caribou	850 ± 38		J-A; N-O	310	990 ± 33		J-O:Au	4	891	42,768	J-O:Au	6	747		A-Jn:N-D	7
	Muskox	0		-		0				3	330	M		0			
	Polar Bear	25 ± 3		M-A;D		13 ± 1		F-M:Au:D		15	2,385	J-A:D		2		A:D	
	Wolf	4 ± 1		M:D		1 ± (.5)		Jn		5		N		2		My-Jn	
	White Fox	n.d.		n.d.		n.d.		J-A:D		206		M-A:N-O		346		A:S:N-O	
	Blue Fox	620 ± 101[1]		J-A;N-D[1]		136 ± 17[1]				0				2		D	
	Red Fox	1 ± 1		M		0				3		F:D		2		N	
	Arctic Hare	279 ± 20		J-Jn;Au-D		203 ± 11		J-Jn:Au-D		311	622	F:D		245		A-Jn:Au-D:S	
	Ringed Seal	1,560 ± 58		J-D;Jn-S		1820 ± 43		J-O:Jn-S		2446	48,920	J-D:Jn-S		2047		A-D:Jn	
	Bearded Seal	20 ± 3		Jy-O		48 ± 3		F:My:Jy-N		59	5,782	F-My:Jy-O:Au		24		Jn-O	
	Harp Seal	41 ± 6		Jy-O		86 ± 9		Jy-S		83	6,059	Jy-O		58		Au-S	
	Hooded Seal	0				0				0				0			
	Harbour Seal	0				0				0				0			
	Walrus	2 ± 1		My-Jn		5 ± 1		Jy:S		5	925	A-My:Jy-Au		2		My-Jn	
	Narwhal	111 ± 10		Jn-S		88 ± 6		Jy-S		77	38,192	Jn-S:Jy		47		My-S:Jn	
	Beluga	0				0				4	1,488	My:Jy-Au		12		My-Jn	
	Canada Goose	0				2 ± 1		Jn		0				0			
	Snow Goose	128 ± 12		My-S		360 ± 42		My-Au		359	574	My-Au		236		My-S	
	Brant Goose	0				0				0				2		Jn	
	Eider	55 ± 8		Jn-O		123 ± 13		Jn-O		119	179	My-O:S		120		My-O:S	
	Guillemot	0				1 ± (.1)		Jy		5	2	S:N		1		S	
	Oldsquaw	1 ± (.5)		Jn		6 ± 1		Jn:Au		0				2		Jn-S	
	Ptarmigan	770 ± 54		J-D;N		1070 ± 50		J-D:S-M:S-O		322	203	J-D:S-D		1014		A-Jn:Au-D	
	Murre	0				0				51	36	My-Jy:N:Jn		42		My-Jn	
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 340		Jn	
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 24		Jn	
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 24		Jn	
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	6700 ± 410		J-D;Au-N		6900 ± 580		M-D:A:Au		9782	19,564	F-D:N		12831		A-O:J:Au:N-D	
	Land-locked Charr	25 ± 9		Jn;Au		97 ± 23		My:Jy-Au		9	9	O		456		My-Jn:S-O	
	Cod	*				0				0				0			
	Sculpin	*				8 ± 2		Au		22	5	Jy		0			

n.d.: White and Blue Fox not differentiated.
*: Data either not collected or not compiled.
R: Data preceeded by an R is reported not estimated
( ): errors in parenthesis are not significant figures.
1. White Fox and Blue fox not differentiated: reported as: Arctic Fox.
2. Edible weight estimates were not in the original report, but calculated based on the harvest estimates as described in the text on harvest.

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Community	Species Harvested	Est. Harvest J - 1981 D - 1981	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1982 D - 1982	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1983 D - 1983	Est.[2] Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest A - 1984 D - 1984	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Broughton Island	Caribou	490 ± 56		F-S:M	3,10	410 ± 22		J:M-Jn:Au-O	4.5	586	28,128	J-My:Au-O:D	6	184		A-My:Au-S:N	7
	Muskox	0				0				0				0			
	Polar Bear	30 ± 11		J:A:S		29 ± 2		J:M-A:S		22	3,498	J-M		10		Au:O-D	
	Wolf	2 ± 2		Jn		D				17		J:M-My		0			
	White Fox	n.d.		n.d.		n.d.		J:M-My		22		J-M:N-D		86		A-My:N-D	
	Blue Fox	98 ± 24[1]		J-Jn:S-D[1]		140 ± 42[1]		M		3		D		3		O	
	Red Fox	5 ± 3		J:M		5 ± 1		J:M:N		1		O		1		D	
	Arctic Hare	148 ± 21		J-Jn-Au-S:N-D		129 ± 20		J:M-Jy:S-D		120	240	J-Jn:Au-D		83		AOD:	
	Ringed Seal	5700 ± 360		J-D:Jn-Au		4370 ± 119		J:M-D:Jn		3733	74,660	J-D:Jn		2985		A-D:Jn-Jy	
	Bearded Seal	110 ± 43		Jn-D:Jy		59 ± 8		A-Jn:Au-N		40	3,920	My:Jy-N		47		Jy-D:Au	
	Harp Seal	92 ± 18		Jy-N:S		97 ± 4		Jy-O		361	26,353	Jy-O		72		Jy-N	
	Hooded Seal	0				2 ± (.2)		S-O		4		Au-S		1		Au	
	Harbour Seal	0				0				1	28	O		0			
	Walrus	9 ± 7		S		33 ± 2		Jn:Au-O		6	1,110	Jn:Au-S		38		Jy-O:D:S	
	Narwhal	63 ± 13		Jy-S:Au		48 ± 2		My:Jy:S-O		17	8,432	Jy-Au:O		33		Jn:O-N	
	Beluga	0				0				6	2,232	Jn:Au-S		0			
	Canada Goose	26 ± 9		Jn:Au		33 ± 3		My-S:Jn		40	96	My-Jn		70		My-Au	
	Snow Goose	2 ± 2		Jn		7 ± 1		A:Jn		4	6	Jn		42		Jn-Au:	
	Brant	0				D				0				0			
	Eider	320 ± 73		M:My-N		356 ± 8		A-N		414	621	A-O		571		A:Jn-N:O-N	
	Guillemot	0				11 ± 2		Jy:S-O		7	3	Jn		4		Jn	
	Oldsquaw	2 ± 2		Jn		25 ± 6		Jy		13	7	O		7		Jn-Jy	
	Ptarmigan	250 ± 43		J-Jn:Au:N-D		450 ± 123		J:M-Jn:O-D		300	189	J-Jn:Au-S:N-O		100		A-Jn:N-D:	
	Murre	11 ± 7		Au-S		104 ± 9		Jy-O:Jy-Au		106	74	A-O		7		Jy-S	
	Canada Goose Eggs	*				*				*				R 74		Jn	
	Snow Goose Eggs	*				*				*				R 4		Jn	
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 112		Jy	
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 67		Jn	
	Tern Eggs	*				*				*				R 102		Jy	
	Sea-run Charr	4500 ± 1190		J:A-au:O:Jn-Au		15500 ± 560		J:A-O:A:Jn		15205	30,410	F:A-D		13738		A-S:N-D:Jn-Au	
	Land-locked Charr	1300 ± 630		J:A:D		600 ± 87		A-My:N-O		59	59	F		0			
	Cod	*				82 ± 28		J		392	392	J-F:M:		23		A	
	Sculpin	*				0				470	108	A:Jn-Au		14		Jy	

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Cape Dorset	Caribou	1670 ± 44		J-D:J-A	3,10	2260 ± 60		J-D	4	1836	88,128	J-D:	6	1062		A-D	7
	Muskox	0				0				0				0			
	Polar Bear	9 ± 2		J-F		15 ± 3		J-My		11	1,749	F-O		1		N	
	Wolf	25 ± 7		J:M:J,-Jn:Au-S		4 ± 2		M:My		0				4		A-My	
	White Fox	*		n.d.			n.d.	J-My:S-D:M-A		307		J-M:Au:D-D		224		N-D	
	Blue Fox	430 ± 36[1]		J-Jn:Au-S:A[1]		950 ± 66		F-A:S		1		D		12		S:N-D	
	Red Rox	3 ± 1		J		16 ± 3		J:My:N-D		8		J		0			
	Arctic Hare	441 ± 17		J-D:S		182 ± 14		J-D:S		68	136	J-N		76		A-D:	
	Ringed Seal	2190 ± 47		J-D:Jy-D		2220 ± 66		J-D:Jy-D		1727	34,540	J-D:Au-D		1418		A-D:S	
	Bearded Seal	234 ± 13		J-D:Jn-D		211 ± 11		J-D:Jn-Au		163	15,974	F-D:Jy		147		A-N	
	Harp Seal	6 ± 1		Jy:S-O		6 ± 1		Jy-S		20	1,460	Au-S		12		Jy-Au:D	
	Hooded Seal	0				0				0				0			
	Harbour Seal	3 ± (.5)		Au; O		2 ± 1		Au-S		2	56	Au		1		O	
	Walrus	89 ± 6		J-Au:N-D		54 ± 7		J-My:Jy-Au		66	12,210	J-A:Jy-Au:D		48		A-N	
	Narwhal	0				0				1	496	Au		0			
	Beluga	7 ± 2		Jn-Jy		4 ± 1		Jn:S-O		64	23,808	Au-D		16		Au-N	
	Canada Goose	231 ± 27		My-S:Jn-Jy		344 ± 28		My-S:Jn		280	672	My-D		227		A-S:A	
	Snow Goose	870 ± 96		My-S; Jn		1900 ± 350		My-S:My-Jn		1229	1,966	My-Jn:Jy-S		1700		A-S:Jn	
	Brant	25 ± 12		My-Jn		14 ± 4		My-S		0				1		Jn	
	Eider	2220 ± 130		J-F:A-D:Jn-Jy		347 ± 205		J-Jy:S-N		2382	3,573	J-N:My		2274		A-N:Jy	
	Guillemot	70 ± 11		J-F:My-Au:D		201 ± 29		F:My-Jy:D		213	85	J-D		29		Jn:S-D	
	Oldsquaw	17 ± 4		J-F:Jn-Au		39 ± 12		F:My-Jy:D		7	4	A:Jn-Jy:S		22		Jn-Jy:D	
	Ptarmigan	5500 ± 380		J-D:D:A-Jn		4200 ± 350		J-D:My-Jy		2173	1,369	F-D:My		2355		A-Jn:Au-D	
	Murre	970 ± 95		A-S:A-Jy		1330 ± 140		M-D:A-Jy		619	433	J:M-D		156		A-Au	
	Canada Goose Eggs	*				*				*				R-8		Jn	
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R-6		Jn	
	Eider Eggs	*				*				*				R 3299		Jn Jy	
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	14400 ± 680		J-D:Jn-Au		16400 ± 840		J-D:Jn-S		13340	26,680	J-D:D		9859		A-D:Jy-Au	
	Land-locked Charr	530 ± 57		J:Jn-Jy:S-N		1390 ± 250		J-Jy-S-O:D		900	900	J-M:Mu-Jn:Au:O		2481		A-Jy:S-N	
	Cod	*				0				0				0			
	Sculpin	*				180 ± 32		Jn-Au		148	34	Ju-Au		103		Jn-S	

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Clyde River	Caribou	609 ± 16		J-S:N-D	3,10	793 ± 11		J-S:N-D	4.5	765	36,72D	J-S:N-D	6	393		A:N-D	7
	Muskox	0				0				D				D			
	Polar 8ear	37 ± 3		J:-M-My:D		23 ± 1		J-F:A-My:0-D		51	8,1D9	J-A:D		13		A-My:D	
	Wolf	1 ± (.3)		A		5 ± (.4)		A-My		1		My		1		A	
	White Fox	* n.d.		n.d.		* n.d		J-A:N-D		15D		J-A:Jn:N-D:S		296		A:D-D	
	8lue Fox	121 ± 6[1]		J-Jy:D-D[1]		98 ± 3[1]		M-A		3		D:D		15		N-D	
	Red Fox	2 ± (.4)		J:N		1 ± (.2)		My		22		N:D		1		N	
	Arctic Hare	193 ± 10		J-0:D:My-Jn		285 ± 6		J-D		252	504	J-D:S		1D2		A-D:S	
	Ringed Seal	3730 ± 69		J-D:Jn		2565 ± 26		J-D:Jn		3257	65,14D	J-D:Jy		2189		A-D:Jn	
	Bearded Seal	60 ± 5		M:Jn-N:Jy		17 ± 1		My-N		32	3,136	J:A-My:Jy-D		25		A:Jn-N	
	Harp Seal	27 ± 2		Jn-D		8 ± (.5)		Au-N		16	1,168	Jy-Au:D		1		0	
	Hooded Seal	1 ± (.3)		0		D				D				0			
	Harbour Seal	0				0				D				D			
	Walrus	2 ± (.4)		Jy		D				6	1,11D	My:Jy-Au		D			
	Narwhal	31 ± 2		Jn-0		11 ± 1		Au-0		48	23,8D8	Jy-S		49		A:Jy-Au:0	
	8eluga	4 ± 1		Jy		0				1	372	Jn		1		S	
	Canada Goose	1 ± (.3)		Jy		1D ± 1		Jn-Au		1D	24	My-Au:		4		Ju:S	
	Snow Goose	19 ± 2		A:Jn-Au:		91 ± 4		My-Jy:S		85	136	Jn-S		85		J-Au:	
	8rant	1 ± (.3)		Jn		0				D				D			
	Eider	2D6 ± 10		Jn-M:Au-D		301 ± 6		My-N		506	759	A:Jn-0		401		Ju-N	
	Guillemot	5 ± 1		Au-S		2 ± (.2)		J:D		1D	4	S:D		12		S	
	Oldsquaw	1D ± 1		My-Jn:Au		2 ± (.2)		Ju:S		8	4	Ju-Jy		2		Jn	
	Ptarmigan	198 ± 1D		J:M-Au:0-D:My		5D0 ± 19		F-0:N		392	247	J-D		455		A-D:D-N	
	Murre	5 ± 1		Jy		1 ± (.2)		S		5	4	Jy:0		D			
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R-647		Jn, Jy	
	Oldsquaw Eggs	*				*				*				R D			
	Eider Eggs	*				*				*				R -32		Jn, Jy	
	Murre Eggs	*				*				*				R D			
	Gull Eggs	*				*				*				R -17		Jn	
	Tern Eggs	*				*				*				R -2D		Jy	
	Sea-run Charr	214D ± 138		M-D:Au		7080 ± 189		J-D:Jy:Au:S		9914	19,828	F-D:Au		5246		A-D:Au:D	
	Land-locked Charr	39 ± 1D		My-Jn:S-0		52 ± 6		J:Jy:0-D		54	54	S-N		158		Jn:D	
	Cod	*				106 ± 10		Jn-Jy		124	124	Ju-Jy:S		10[2]			
	Sculpin	*				1430 ± 49		My-Au:Jn-Jy		2301	529	Jn-S		1D22		Jn	

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Frobisher 8ay	Caribou	1620 ± 7S		J-0:F:N	3,10	2240 ± 59		J-D:S:N	4,5	2368	113,664	J-D		4635		A-0:Au-S:	7
	Muskox	0				0				0				0			
	Polar 8ear	10 ± 2		M:My		12 ± 3		F-A		11	1,749	J-A		0			
	Wolf	15 ± 7		J:N		2 ± 1		0		1		My		0			
	White Fox	n.d.		n.d.		n.d.				19		M-A:0-N		70		N-D	
	8lue Fox	53 ± 21[1]		M:0-0[2]		21 ± 4[1]				4		0-N		0			
	Red Fox	9 ± 4		S:N-0		16 ± 5		0		11		M:My:0-N		S		0	
	Arctic Hare	130 ± 18		J-My:Au-D		141 ± 11		J-Jn:Au-N		138	276	J-0:		480		A:Au-0	
	Ringed Seal	2170 ± 107		J-0:My-Au		2130 ± 75		J-0:My-S		1326	26,520	J-D:My-S		794S		A-0:Jy-S	
	8earded Seal	87 ± 9		J-0:Au		79 ± 12		J-F:My-0		34	3,332	F:A-0		332		Jn-N:Au	
	Harp Seal	168 ± 21		F:Jn-N		1S3 ± 14		Jy-0:Au-0		73	S,329	Jy-S		624		A:Jy-N	
	Hooded Seal	5 ± 2		Au		0				0				0			
	Harbour Seal	29 ± 8		Jy-S		1 ± (.S)		S		22	616	M-A:Jn:Au-S		38		Jy	
	Walrus	3S ± 6		Jy-S_0		44 ± 6		My-Jy-N		19	3,S1S	F:A:Jm:Au		138		Jy-0	
	Narwhal	0				0				2	992	A:Au		0			
	Beluga	63 ± 9		My-Au		29 ± 7		My-Jn		7	2,604	Jn-Au:0		10		Jy	
	Canada Goose	26 ± 6		My-Jn		S4 ± 6		My-Jy:S		46	110	My-Jn:S		11S		A:Ju:S	
	Snow Goose	0				17 ± 6		Jn		9	14	My-N-0		73		My:Au	
	8rant	0				0				1	1	Jn		0			
	Eider	400 ± 61		My-0:Jy:S		370 ± 31		My-0:S		183	27S	My-0		20S4		My-0	
	Guillemot	65 ± 17		Jn-Jy:S-0		170 ± 21		Jn:Au-0		8	3	Jn-Jy		236		Jy-0	
	Oldsquaw	S ± 2		S-0		4 ± 1[2]				62	31	N		0			
	Ptarmigan	1540 ± 176		J-0:		1660 ± 9S		F-Jn:Au-0:My		3631	2,288	J-Au:D-D:My		2324		A-0:	
	Murre	28 ± 9		My:Jy		10 ± 3		My:S:N		4	3			12S		Jy-Au:N	
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	1700 ± 400		M-0:My:Jy		SS00 ± 530		M-0		5369	10,738	J-0:S		1238S		Jn-0:Jy-A:0	
	Land-locked Charr	450 ± 172		J:Jn:0:0		0				128	128	N-0		4367		Jn	
	Cod	*				160 ± 48		My-Jy		101	101	A:Jn		208		Au	
	Sculpin	*				S8 ± 14		Jn-0		S	1	Jn		24S		Au	

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Grise Fiord	Caribou	52 ± 6		F-My:S-N	3,10	29 ± 3		F-A	4.5	31	1,488	J-M:Au	6	30		A:Au:0-N	7
	Muskox	14 ± 2		F-M		16 ± 2		F-A:Jn		5	550	J-F		3		0-N	
	Polar Bear	45 ± 4		J-My:S-N		36 ± 1		F-A:0-0		20	3,180	J-M:0-0		18		A-My:0	
	Wolf	0				5 ± 1		A		2		F-M		5		A-My:Au	
	White Fox	n.d.		n.d.		n.d.		J-A:N-0		230		J-M:N-0		132		N-0:	
	Blue Fox	243 ± 16[1]		J-A:N-0[1]		103 ± 8[1]		A		0				0			
	Red Fox	0 ±				0				0				0			
	Arctic Hare	244 ± 27		F-0:S		141 ± 7		F-0		124	248	F-0		109		A-N	
	Ringed Seal	771 ± 26		J-0:Jy-Au		766 ± 16		J-0:Jy-Au		727	14,540	J-0:S		573		A-0:Jn:Au	
	Bearded Seal	26 ± 2		Jy-S:		11 ± 1		Ju-Au		23	2,254	Jn-0		23		My-S:Au	
	Harp Seal	207 ± 12		Jy-0		115 ± 4		Jy-0:Au		160	11,680	Au-0		218		Au-S	
	Hooded Seal	0				0				0				1		S	
	Harbour Seal	0				0				0				0			
	Walrus	5 ± 1		Jy:0		15 ± 2		Jy-Au		19	3,515	Au		17		My-Au:0	
	Narwhal	0				31 ± 3		Au		3	1,488	Au-S		2		Jn	
	Beluga	54 ± 2		Au-0		5 ± (.5)		My:S		7	2,604	S		23		A:S	
	Canada Goose	0				1 ± (.2)		Jn		0				2		Jn:Au	
	Snow Goose	28 ± 10		My-Jn:S		53 ± 6		My-Au:		32	51	My-Am		13		Jn:Au	
	Brant	12 ± 3		Jn-Jy		25 ± 2		Jn-Au		6	8	My		3		Jn:Jy	
	Eider	187 ± 15		My-S		281 ± 7		My-S		303	455	Jn-0		305		Jn-S	
	Guillemot	14 ± 2		Jn:S		17 ± 2		Jn-Jy		0				0			
	Oldsquaw	0				9 ± 1		Jn		0				0			
	Ptarmigan	790 ± 42		F-Jn:Au-0		524 ± 9		F-A:Jn:S-N		160	101	M-A:Jn:Au-0:0		97		A:Jn:Au-N	
	Murre	4 ± 1		Au		55 ± 5		Jy-Au		16	11	Jn-0		3		Au	
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	1430 ± 137		A-Jy:S-0		1190 ± 80		A-Jn:Au:0		2850	5,700	A:Jn-Au		162		Jn:Au:0	
	Land-locked Charr	0				119 ± 19[2]				0				0			
	Cod	*								0				4		My:Au	
	Sculpin	*								0				55		Au	

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Hall Bench	Caribou	1210 ± 32		J-D:Au	3,10	1174 ± 21		J-D:Au	4,5	1113	53,424	J-D:Au	6	1677		A-D	7
	Muskox	0				0				0				0			
	Polar Bear	7 ± 1		O-N:		3 ± (.3)		Jy:O-N		7	1,113	A:D-N		2		O	
	Wolf	21 ± 5		F-M:My:N		6 ± 1		M:My		25		M:N		7		A:N	
	White Fox	n.d.		n.d.		n.d.		J-My:N-D		710		J-M:N-D		2260		A-Jn:N-D	
	Blue Fox	630 ± 50[1]		J-Jn:N-D:F-A[1]		108 ± 8[1]				1		D		13		O-M	
	Red Fox	0				0				0				1		N	
	Arctic Hare	6 ± 1		A-Jn:Au:N		6 ± 1		My		6	12	Jn:Au-S		8		A:Au	
	Ringed Seal	891 ± 28		J-N:Jn-O		361 ± 9		J:M-D:Jn-S		952	19,040	J-N:S		1076		A-D:Jn	
	Bearded Seal	83 ± 5		F-D:Jy-Au		76 ± 3		A:Jn-O		150	14,700	J-A:Jn-O		106		A-D	
	Harp Seal	1 ± (.4)		Au		0				11	803	Au-S		3		O	
	Hooded Seal	0				0				0				1		O	
	Harbour Seal	0				0				6	168	S-O		0			
	Walrus	98 ± 6		Jn-O:Jy:S		68 ± 3		A:Jn-O		50	9,250	A:Jn-D		131		A-D:D	
	Narwhal	20 ± 2		Jy:Au		1 ± (.2)		Jy		3	1,488	Au		0			
	Beluga	3 ± 1		S		0				9	3,348	Au-S		35		Au-S	
	Canada Goose	5 ± 1		Jn		16 ± 1		Jn-Jy		20	48	Jn-Au		79		Jn-Jy	
	Snow Goose	49 ± 4		My-Au		83 ± 6		Jn-Jy		47	75	My-Jn:Au		461		My-Au:	
	Brant	0				3 ± 1		Jn		6	8	Jn		0			
	Eider	280 ± 17		A-Jy:S-O-Jn		230 ± 11		My-S:Jn		126	189	My-S		383		My-O	
	Guillemot	0				2 ± 1		A		7	3	Jy		16		Jn-Jy	
	Oldsquaw	18 ± 3		Jn-Jy		2 ± (.3)		Jn:Au		2	1	Jn		20		Jn	
	Ptarmigan	238 ± 15		M-Jn:Au-N		127 ± 8		My-N:		131	83	My-N:		786		A-Au:O-D	
	Murre	0				1 ± (.2)[3]				1	1			0			
	Canada Goose Eggs	*				*				1				R 0			
	Snow Goose Eggs	*				*				*				R -44		Jn	
	Oldsquaw Eggs	*				*				*				R -6		Jn	
	Eider Eggs	*				*				*				R-192		Jn	
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R -25		Jy	
	Sea-run Charr	7220 ± 297		J-M-My-D:Jy		7870 ± 236		J-F:A-D:Jn-O		4984	9,968	F-D:Au		8612		A-O:Jy:O	
	Land-locked Charr	112 ±18		M:My-Jn:S-D		790 ± 104		J:M-O		657	657	J:A-Jn:Au:O-N		795		A-D:O	
	Cod	*				54 ± 6		N		0				38		My-Jn	
	Sculpin	*				1 ± (.2)		Jy		0				47		Jy	

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Iglookik	Caribou	2060 ± 80		J-O:Au	3,10	1930 ± 90		J-D:Au-S	4.5	1940	93,120	J-D:Au	6	913		A-O:Au	7
	Muskox	0				0				0				0			
	Polar Bear	7 ± 1		N		11 ± 2		J:A-My:O-N		18	2,862	M-My:N-D		8		N-OD	
	Wolf	11 ± 2		M-My:O:O		7 ± 1		F-M		20		A-My:D		7		A-M	
	White Fox	n.d.		n.d.		n.d.		J-My:N-O:M		505		J-A:Jn:N-D		456		A-M:N-O	
	Blue Fox	930 ± 68[1]		J-A:O-O:F-M[1]		311 ± 24[1]		M		0				0			
	Red Fox	2 ± 1		M		1 ± (.5)		M		0				1		O	
	Arctic Hare	52 ± 5		J-Jn:Au:O		64 ± 6		J-My:Jy-Au		38	76	M-Jn:Au-S		19		A:Au-D	
	Ringed Seal	1330 ± 46		J-D:My-S		1270 ± 58		J-D:Jn:Au-S		1530	30,600	J-D:Au		693		A-O	
	Bearded Seal	68 ± 7		J:M:My-O		71 ± 5		F-M:My:Jy-O		127	12,446	J-A:Jn-O		50		My-D	
	Harp Seal	1 ± (.4)		M		6 ± 1		A:Jy:S		14	1,022	Au-O		5		Jy-Au	
	Hooded Seal	0				0				1		Au		0			
	Harbour Seal	0				0				5	140	Au		0			
	Walrus	127 ± 9		J-F:Jn-O:D		83 ± 7		M:Jy-O		79	14,615	J:M-N:Jy-Au		47		A:Jn-D	
	Narwhal	38 ± 4		Jn-Jy:S-N		16 ± 3		Au-S		13	6,448	A:Au		1		O	
	Beluga	57 ± 7		Jy-N:S		43 ± 6		Au-S		71	26,412	Au-O		38		Au-O	
	Canada Goose	11 ± 3		Jn-Jy		14 ± 5		Jy		20	48	Jn-Au:		10		Jn-Jy	
	Snow Goose	54 ± 9		My-Au:Jn		94 ± 21		J-S		162	259	My-Au		29		Jn-Au	
	Brant	5 ± 3		Au		5 ± 2		S		0				0			
	Eider	123 ± 18		My-S:My-Jy		280 ± 57		Jn-S		106	159	My-S		48		Jn-O	
	Guillemot	3 ± 1		My-Jn		3 ± 1[2]				1	0.4	Jn		0			
	Oldsquaw	15 ± 5		Jn-Jy		48 ± 13		Au		15	8	Au		16		Jn-Jy	
	Ptarmigan	151 ± 14		F:My-O:My-Jn		284 ± 27		J-O		133	84	J-Jn:Au-O		95		A-Jn:A-S:N	
	Murre	0				0				0				0			
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 45		Jn	
	Oldsquaw Eggs	*				*				*				R 12		Jn	
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	12200 ± 850		J-O:F:Jn:O:D		18000 ± 3600		J-D:N-O		23772	47,544	J-M:My-D		4597		My-D:Au	
	Land-locked Charr	240 ± 51		J-My:Au:O		22 ± 10		Au:O		1851	1,851	F:Jy-Au:O-N		12		My-Jn:Au	
	Cod	*				0	0			12	12	My-Jn:Au		28		Jn	
	Sculpin	*				35 ± 19		Au		33	8	Jn-Au:O		13		Jy:O	

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Nanisivik	Caribou	250 ± 34		M-Jn:Au:N-D	3,10	260 ± 36		J-Jn:Au-S:N-0	4.5	127	6,096	J-F:A-M:A-S:N-0	6	51		A-Jn:Au-S:N	7
	Muskox	0								0				0			
	Polar Bear	1 ± 1		M						1	159	D		0			
	Wolf	0								9		A-My		0			
	White Fox	n.d.		n.d.		n.d.		J-F		46		F-M:N-0		41		A:N-0	
	Blue Fox	6 ± 3[1]		J:N[1]		12 ± 5[1]				2		N-0		0			
	Red Fox	0								0				5		N	
	Arctic Hare	19 ± 6		F:My:Au:0-N		44 ± 6		J-F:A-My:S-N		61	122	J-Jn:Au:0-N		22		A-Jn:Au-S	
	Ringed Seal	480 ± 101		J:M-N:Jn		440 ± 31		J-0		334	6,680	J-F:A-0:Jn		331		a-0:Jn-S	
	Bearded Seal	4 ± 3		Jy		8 ± 2		JY-0		3	294	Au		1		S	
	Harp Seal	0				26 ± 5		Au-S		8	584	Au-S		4		Jy:S	
	Hooded Seal	0								0				0			
	Harbour Seal	0								0				0			
	Walrus	0				4 ± 2		S		0				1		S	
	Narwhal	14 ± 5		Au		7 ± 2		Jy-Au		1	496	Au		16		Jn-Jy	
	Beluga	0								0				0			
	Canada Goose	0								0				1		Jn	
	Snow Goose	57 ± 20		My-Jy		11 ± 3		Jn-Au		175	280	My-Au:		9		Jn	
	Brant	0								0				0			
	Eider	2 ± 1		Au-Jy		71 ± 16		Au-S		10	15	Au-S		1		Au	
	Guillemot	0								0				0			
	Old squaw	0								0				0			
	Pturmigan	160 ± 40		F-My:0-N		360 ± 43		J-Jn:S-N		67	42	F:0-N		82		A:Jn:N	
	Murre	0								0				0			
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	3000 ± 650		Jn-S:D		750 ± 179		M-S:N		128	256	A:Jn:Au:N-0		180		A:Jn-S:N	
	Land-locked Charr	0								0				0			
	Cod	*								0				0			
	Sculpin	*				22 ± 9		Au		0				0			

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Pangnirtung	Caribou	960 ± 39[2]		J-My:Jy-D:D	3,10	1960 ± 64		J-O:D:Au	4	2413	115,824	J-D	6	1042		A-D:A:Au-O	7
	Muskox	0				0				0				0			
	Polar Bear	5 ± 1		J-F		14 ± 2		J:M-A		10	1,590	F-M		5		D	
	Wolf	23 ± 3		M-My:		5 ± 1		M-A		25		F-M		0			
	White fox	n.d.		n.d.		n.d.				27		J-M:N-D		185		N-D	
	Blue Fox	35 ± 4[1]		J-M:D[1]		100 ± 36[1]				1		D		5		D	
	Red Fox	15 ± 2		F-M:O		5 ± 1		J:M:N-D		17		N-D		78		M-D	
	Arctic Hare	189 ± 19		J-Jn:Au-S:N-D		225 ± 25		J:M-My:S-D		276	552	J-My:Jy-D		274		A:Jn:Au-D	
	Ringed Seal	5180 ± 130[2]		J-D:Jy		5320 ± 98		J-D:Jy-Au		5469	109,380	J-D:Jy-O		3072		A-D[1]	
	Bearded Seal	131 ± 4[2]		F-Au:Jy		54 ± 5		J:A:Jn:Au-O		136	13,328	J-F:A-My:Jy-N		81		My:Jy-N	
	Harp Seal	2700 ± 127[2]		Jn-N:Jy-S		4580 ± 112		F:My-N:Jy-O		2619	191,187	Jn-N:Au		1978		Jy-D:Au-O	
	Hooded Seal	1 ± (.5)		Au.		3 ± (.6)		Au.		9		Au-S		1		N	
	Harbour Seal	0				0				2	56	S		1		O	
	Walrus	36 ± 5[1]		Jy-D:S		11 ± 2		My-Au		31	5,735	My-S		19		My-Jn:Au-D	
	Narwhal	24 ± 3[1]		M-My:J-Au		55 ± 5		A-Jy:O		0				10		A-Jn	
	Beluga	30 ± 1		Jy-S		31 ± 3		Jy-Au		126	46,872	My-S:Au		6		Jy-D	
	Canada Goose	11 ± 4[2]		My-Jy		31 ± 7		A-My:S		73	175	My-Au		16		Jn:Au	
	Snow Goose	0				1 ± (.3)		My:Jy:S		0				2		Jn:	
	Brant	0				0				0				0			
	Eider	1000 ± 61[1]		A:Jn-N[1]		2300 ± 77		J:A-O		2140	3,210	J:My-D:O		1615		Jy-N:S-D	
	Guillemot	0				6 ± 1		Jy		0				6			
	Oldsquaw	0				0				76	38	Jn-Jy:O		86		O	
	Ptarmigan	400 ± 49		J-My:Au:O:D		640 ± 55		J-A:Au-O:N-D		1365	860	J-My:Jn:S-D		783		A:S-D	
	Murre	0				0				0				3		S	
	Canada Goose Eggs	*				*								R 0			
	Snow Goose Eggs	*				*								R 0			
	Oldsquaw Eggs	*				*								R 0			
	Eider Eggs	*				*								R 0			
	Murre Eggs	*				*								R 0			
	Gull Eggs	*				*								R 0			
	Tern Eggs	*				*								R 0			
	Sea-run Charr	9000 ± 920[2]		J-My:Jy Au:D-D:F		14500 ± 680				18484	36,968	J-D		8909		A-D:	
	Land-locked Charr	0				0				10	10	F:Jy		0			
	Cod	*				1 ± (.3)		D		0				368		Jn	
	Sculpin	*				43 ± 9		D		37	9			271		Jn:S-N	

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	Muskox	0				0				0				0			
	Polar Bear	5 ± 1		J-F		14 ± 2		J:M-A		10	1,590	F-M		5		D	
	Wolf	23 ± 3		M-My:		5 ± 1		M-A		25		F-M		0			
	White fox	n.d.		n.d.		n.d.				27		J-M:N-D		185		N-D	
	Blue Fox	35 ± 4[1]		J-M:D[1]		100 ± 36[1]				1		D		5		D	
	Red Fox	15 ± 2		F-M:0		5 ± 1		J:M:N-D		17		N-D		78		M-D	
	Arctic Hare	189 ± 19		J-Jn:Au-S:N-D		225 ± 25		J:M-My:S-D		276	552	J-My:Jy-D		274		A:Jn:Au-D	
	Ringed Seal	5180 ± 130[2]		J-0:Jy		5320 ± 98		J-D:Jy-Au		5469	109,380	J-D:Jy-0		3072		A-D[1]	
	Bearded Seal	131 ± 4[2]		F-Au:Jy		54 ± 5		J:A:Jn:Au-0		136	13,328	J-F:A-My:Jy-N		81		My:Jy-N	
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	Hooded Seal	1 ± (.5)		Au.		3 ± (.6)		Au.		9		Au-S		1		N	
	Harbour Seal	0				0				2	56	S		1		0	
	Walrus	36 ± 5[1]		Jy-0:S		11 ± 2		My-Au		31	5,735	My-S		19		My-Jn:Au-0	
	Narwhal	24 ± 3[1]		M-My:J-Au		55 ± 5		A-Jy:0		0				10		A-Jn	
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	Canada Goose	11 ± 4[2]		My-Jy		31 ± 7		A-My:S		73	175	My-Au		16		Jn:Au	
	Snow Goose	0				1 ± (.3)		My:Jy:S		0				2		Jn:	
	Brant	0				0				0				0			
	Eider	1000 ± 61[1]		A:Jn-N[1]		2300 ± 77		J:A-0		2140	3,210	J:My-D:0		1615		Jy-N:S-0	
	Guillemot	0				6 ± 1		Jy		0				6			
	Oldsquaw	0				0				76	38	Jn-Jy:0		86		0	
	Ptarmigan	400 ± 49		J-My:Au:0:0		640 ± 55		J-A:Au-0:N-0		1365	860	J-My:Jn:S-D		783		A:S-D	
	Murre	0				0				0				3		S	
	Canada Goose Eggs	*				*								R 0			
	Snow Goose Eggs	*				*								R 0			
	Oldsquaw Eggs	*				*								R 0			
	Eider Eggs	*				*								R 0			
	Murre Eggs	*				*								R 0			
	Gull Eggs	*				*								R 0			
	Tern Eggs	*				*								R 0			
	Sea-run Charr	9000 ± 920[2]		J-My:Jy Au:0-D:F		14500 ±680				18484	36,968	J-D		8909		A-D:	
	Land-locked Charr	0				0				10	10	F:Jy		0			
	Cod	*				1 ± (.3)		0		0				368		Jn	
	Sculpin	*				43 ± 9		D		37	9			271		Jn:S-N	

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Pond Inlet	Caribou	590 ± 30		J-0:Au	3	2360 ± 51		S-0:Au:S-N	4	1880	90,240	J-0:N	6	2062		A-0:	7
	Muskox	0				0				0				0			
	Polar Bear	15 ± 2		J-F:A-My:Jy		26 ± 3		J-M		7	1,113	J-F:A		3		A	
	Wolf	5 ± 1		M-My		1 ± (.5)		J		10		A-My:		2		S:0	
	White Fox	n.d.		n.d.		n.d.		J-A:Au:N		120		F-A:N-0		193		A:0-0:N	
	Blue Fox	274* ±	18[1]			J-Jn:0-0[1]		162	±	2		N-0		12		0-0	
22[1]										50		J-F:A:0-0		48		A:0-0	
	Red Fox	31 ± 4		J-A:Jm:0-D		16 ± 3		J:M-A:S		373	746	J-Jn:Au-D		483		A-0:	
	Arctic Hare	209 ± 15		J-Jn:Au-0		661 ± 25		J-0:A		2996	59,920	J-0:Jy		2826		A-0:	
	Ringed Seal	2010 ± 123		J-0:Jn-Au		4070 ± 59		J-0:Jn-Jy		35	3,430	F-A:Jy-Au:0-N		37		A:Jn-0	
	Bearded Seal	20 ± 3		J:Jy-S:N		26 ± 2		F:Jn-0		89	6,497	Jn:Au-0		64		Jn-0	
	Harp Seal	7 ± 2		Jy-Au:N		56 ± 3		J:Jy-0		3		Jy:0		6		S-0	
	Hooded Seal	4 ± 1		J:Jy-Au		5 ± 1		J:Jn-0		0				0			
	Harbour Seal	0				0				3	555	My:Jy		4		Jn-Jy:S	
	Walrus	3 ± 1		Jn:Au		14 ± 1		Jn-Au		80	39,680	Jn-Au		33		My:Jy-S	
	Narwhal	70 ± 8		My-S		139 ± 5		My-S		1	372	My		5		My-Jy	
	Beluga	2 ± 1		Jn		0				1	2	Au		10		Jn	
	Canada Goose	4 ± 2		0		2 ± (.4)		Jn:Au		1232	1,971	Myu-S:Jy-Au		658		My-Au	
	Snow Goose	280 ± 48		My-Au		1470 ± 45		My-S		0				0			
	Brant	0				0				32	48	My-Jn:S:N		51		My:Jn-0	
	Eider	15 ± 6		S-N		26 ± 3		M-S		0				10		0	
	Guillemot	9 ± 2		Au:0-N		0				13	7	Jn-Jy-S		2		0	
	Oldsquaw	0				35 ± 10		Jn-Jy		310	195	J-Jn:S-0		941		A-Jn:S-0	
	Ptarmigan	480 ± 43		J-Au:0-0		1320 ± 82		J-0:M		3	2	Au		51		My	
	Murre	17 ± 6		Jn-Au		45 ± 5		Jn-Au		*				R 0			
	Canada Goose Eggs	*				*				*				R-427		Jn	
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R-1367		Jn,Jy	
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				7489	14,978	F-0:Jy-0		12298		A-0:Jn-N	
	Sea-run Charr	9400 ± 1510		J:My-0:N-0		11400 ± 390		A-0		30	30	J:A:S-0		978		0	
	Land-locked Charr	1120 ± 280		Jy-0		55 ± 6		A:0-0		0				0			
	Cod	*				0				97	22	Jn:Au		122		Jy-Au	
	Sculpin	*				129 ± 13		Jn-S									

n.d.; White and Blue Fox not differentiated.
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1. White Fox and Blue fox not differentiated: reported as: Arctic Fox.
2. Edible weight estimates were not in the original report, but calculated based on the harvest estimates as described in the text on harvest.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	0 - October
My - May	N - November
Jn - June	0 - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest J - 1981 0 - 1981	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1982 0 - 1982	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est.[3] Harvest J - 1983 0 - 1983	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest A - 1984 S - 1984	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Resolute Bay	Caribou	201 ± 21		J-0	3,10	85 ± 10		F-0	4	155	7,440	F-Am:0	6	88		A-Jn:Au	7
	Muskox	5 ± 1		M		4 ± 1		F		2	220	0-N		2		My	
	Polar Bear	46 ± 3		J-My		25 ± 4		F-My		25	3,975	J:M-My		39		A-My	
	Wolf	6 ± 2		0-0		0				5		A-My:D		0			
	White Fox	n.d		n.d.		n.d.		J-A:N-0		88		J:M-A:N-0		2		A	
	Blue Fox	370 ± 35[1]		J-A:N-0[1]		143 ± 25[1]				0				0			
	Red Fox	0				0				0				0			
	Arctic Hare	25 ± 5		A-My:Au-S		5 ± 1		J:M-A:0-N		0				4		A	
	Ringed Seal	188 ± 22		J-0		233 ± 23		J-0:Au		252	5,040	J-0:		521		A-S:	
	Bearded Seal	7 ± 3		Au-0		4 ± 1		A:Au		16	1,56B	Jy-S:N-0		3		S	
	Harp Seal	0				2 ± 1		Au		0				0			
	Hooded Seal	0				0				0				0			
	Harbour Seal	0				0				0				0			
	Walrus	3 ± 1		M:Jy		5 ± 2		Jy-Au		0				0			
	Narwhal	15 ± 9		Au		6 ± 1		S		0				0			
	Beluga	29 ± 9		Au		29 ± 5		Jy-S		17	6,324	Au-S		0			
	Canada Goose	0				9 ± 3		Jy-Au		0				0			
	Snow Goose	50 ± 29		Au		0				17	27	Jn-Jy:S		6		Jn	
	Brant	0				4 ± 3		Jn		0				0			
	Eider	10 ± 3		Jn-Au		53 ± 16		Jy-Au		36	54	Jn-Jy:S		51		Jn:S	
	Guillemot	11 ± 8		Jn		0				21	B	Jn:au		0			
	Oldsquaw	0				4 ± 3		Jn		2	1	Jn		9		Au	
	Ptarmigan	610 ± 91		F:A-N:My:S		200 ± 33		J:M-Jn:S-N		299	188	A-Jn:Au-0:S-0		470		A-Jn:S	
	Murre	4 ± 3		Jn		6 ± 4		Jy		18	13			0			
	Canada Goose Eggs	*				*				*				R 0			
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 0			
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 2		Jn	
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	600 ± 202		Jn-Au:0		120 ± 36		Jn-S:		633	1,266	A-Au:Jn		2335		My-Jn:Au	
	Land-locked Charr	150 ± 44		My-S:Au-S		470 ± 74		Jn-0		25	25	Jn-Jy		2730		Jy-S	
	Cod	*				0				0				0			
	Sculpin	*				3 ± 1[2]				3	1	Jn-Jy		0			

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1. White Fox and Blue fox not differentiated: reported as: Arctic Fox.
2. No reported period of harvest for this estimate.
3. Edible weight estimates were not in the original report, but calculated based on the harvest estimates as described in the text on harvest.

Abbreviations for period of harvest:

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My - May
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Jy - July
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S - September
0 - October
N - November
0 - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest J - 1981 D - 1981	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1982 D - 1982	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest J - 1983 D - 1983	Est.[12] Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest A - 1984 D - 1984	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Sanikiluaq	Caribou	0			3,10	0			4.5	26	1,248	J:Jn	6	0			7
	Muskox	0				0				0				0			
	Polar Bear	30 ± 4[4]		J-A		34 ± 9		J-M		28	4,452	J-F		2		D	
	Wolf	0				0				0				0			
	White Fox	n.d.		n.d.		n.d.		J-Jn:O-D		126		J-A:Jy:S:N-D		178		A-My:O-D	
	Blue Fox	830 ± 33[1,5]		J-A:N-D[1,5]		129 ± 25[1]		J:O:D[1]		10		J-F:O-N		19		O-D	
	Red Fox	177 ± 4[6]		J-A:O-D		52 ± 9		F:O-D		112		J-F:A:O-D		131		S-D	
	Arctic Hare	29 ± 6[7]		F-M		36 ± 9		J-F:My:Jy-O:D		17	34	M:My-Jn:D		7		O-N	
	Ringed Seal	2890 ± 87[2]		J-D:		2110 ± 78		J-D:		2431	48,620	J-D:		3020		A-D	
	Bearded Seal	139 ± 10[2]		J-D		138 ± 12		F-A:Jn-D		58	5,684	J-F:My-D		136		A-O:D	
	Harp Seal	0				0				0				0			
	Hooded Seal	0				0				0				0			
	Harbour Seal	7 ± 1[3]		My-Jn;N		3 ± 1		O		2	56	A:Jn		5		Au-S	
	Walrus	0				12 ± 3		Jy-Au		6	1,110	Au.		15		JN	
	Narwhal	0				0		My-Au:O		0				2		S	
	Beluga	47 ± 7		My-O		57 ± 11				4	1,488	Jn:D		72		My-Au:Jn	
	Canada Goose	2300 ± 89		A-O:My-Jn		2870 ± 217		A-S:My		1903	4,567			4202		A-S:A-My	
	Snow Goose	900 ± 59		My-O;My;Jn		2600 ± 219		My-S		322	515			934		My-Jn:Au-S	
	Brant	39 ± 11		My-Jy:S		93 ± 20		Jn-Jy		1	1			0			
	Eider	4950 ± 117[8]		J-A;O-D;N-D		6000 ± 450		J-D:O-N		5183	7,775			7615		A-D:	
	Guillemot	60 ± 32		Jn-Au		280 ± 104		J:Jy:S		468	187			922		Jn-O:Au-S	
	Oldsquaw	186 ± 18[11]		Mu-Au:O-D		210 ± 46		My-Jy:S-D		217	109			280		My-Jy:O-N	
	Ptarmigan	640 ± 49[10]		J-My:Au:N-D		120 ± 27		F-Jn:O-D		127	80	J-Jn:Au:N:O		180		A-My:O-D	
	Murre	0				5 ± 3		Jn		38	27			51		Jy-S-O	
	Canada Goose Eggs	*				*				*				R 85		Jn	
	Snow Goose Eggs	*				*				*				R 0			
	Oldsquaw Eggs	*				*				*				R 0			
	Eider Eggs	*				*				*				R 20		Jn	
	Murre Eggs	*				*				*				R 0			
	Gull Eggs	*				*				*				R 0			
	Tern Eggs	*				*				*				R 0			
	Sea-run Charr	4850 ± 183[8]		J-D:My		5100 ± 620		J-Jn:Au-D		8785	17,570	J-D:N-D		17891		A-D	
	Land-locked Charr	290 ± 102[9]		Au:N		4900 ± 460		My-D:My		1506	1,506	J:Au:D		282		N-D	
	Cod	*				1900 ± 265		J-D:		1196	1,196	J-M:My-D:N		896		A-D	
	Sculpin	*				3500 ± 300		F:A-D		1245	286	My-O:Jy		1176		My-D:My-Jy	

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1. White Fox and Blue fox not differentiated: reported as: Arctic Fox.
2. Includes only the reported harvest for January, February, November and December. The total harvest couldbeotestimated for these months as the sample size was not known.
3. Based on the estimated total harvests in May and June and the reported harvest only for November.
4. Based on the reported harvests only for January and February and the estimated harvests for March and April.
5. Based on reported harvests for January, February, November, December, and estimated harvests for March and April.
6. Based on the estimated harvests in March April and October but only the reported harvest in January, FebrNovember and December.
7. Includes only the reported harvest for February as the sample size not known.
8. Includes only the reported harvest for Janurary, February, November and December, not the estimated harvest.
9. Includes only the reported harvest for November, not the estimated harvest.
10. Based on the estimated harvest from March to May but on the reported harest only for January, February, November and December.
11. Includes only the reported harvest for November and December not the estimated harvest.
12. Edible weight estimates were not in the original report, but calculated based on the harvest estimates asdescribed in the text on harvest.

Abbreviations for period of harvest: J - January Jy - July F - February Au - August M - March S - September
A - April O - October My - May N - November Jn - June D - December
A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Est. Harvest J - 1981 0 - 1981	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest J - 1982 0 - 1982	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest J - 1983 0 - 1983	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest J - 1984 D - 1984	Est. Edible Weight ( )	Period Of Harvest	Ref.
Outpost Camps	Caribou	1340 ±		J-0	3,10	1730 ± 111		n.s.	4	*				655		*	7
	Muskox	0				0		n.s.		*				8		*	
	Polar Bear	38 ±		J-M:0:0		39 ± 6		n.s.		*				7		*	
	Wolf	19 ±		J:A-My:Jy:0:D		32 ± 13		n.s.		*				5		*	
	White Fox	n.d.		n.d.		n.d.		n.s.		*				167		*	
	Blue Fox	590 ±		J-A:0-0		550 ± 72		n.s.		*				7		*	
	Red Fox	34 ±		M:S:N-0		31 ± 6		n.s.		*				12		*	
	Arctic Hare	311 ±		J-N:S-0		315 ± 27		n.s.		*				98		*	
	Ringed Seal	5000 ±		J-0:Jn-Jy		3240 ± 211		n.s.		*				1024		*	
	Bearded Seal	168 ±		My-N:		78 ± 10		n.s.		*				39		*	
	Harp Seal	1060 ±		Jn-Jy:S-D:Jy:0		730 ± 170		n.s.		*				13		*	
	Hooded Seal	0				2 ± 1		n.s.		*				8		*	
	Harbour Seal	53 ±		Jy-A		15 ± 9		n.s.		*				6		*	
	Walrus	41 ±		My-Jy:S-N		39 ± 9		n.s.		*				64		*	
	Narwhal	0				15 ± 6		n.s.		*				0		*	
	Beluga	12 ±		Jn:0		24 ± B		n.s.		*				0		*	
	Canada Goose	14 ±		My-Jy:0		170 ± 38		n.s.		*				30		*	
	Snow Goose	24 ±		Jn		84 ± 17		n.s.		*				71		*	
	Brant	0				5 ± 3		n.s.		*				1		*	
	Eider	920 ±		My-N:0		1030 ± 150		n.s.		*				352		*	
	Guillemot	14 ±		M:Jy:0		71 ± 19		n.s.		*				9		*	
	Oldsquaw	0				6 ± 3		n.s.		*				0		*	
	Ptarmigan	771 ±		F-Jn:S-0		880 ± 119		n.s.		*				345		*	
	Murre	12 ±		Jy		24 ± 9		n.s.		*				4		*	
	Canada Goose Eggs	*				*		n.s.		*				*		*	
	Snow Goose Eggs	*				*		n.s.		*				*		*	
	Oldsquaw Eggs	*				*		n.s.		*				*		*	
	Eider Eggs	*				*		n.s.		*				*		*	
	Murre Eggs	*				*		n.s.		*				*		*	
	Gull Eggs	*				*		n.s.		*				*		*	
	Tern Eggs	*				*		n.s.		*				*		*	
	Sea-run Charr	9700 ±		F-0:Jy:0-N		5700 ± 790		n.s.		*				2917		*	
	Land-locked Charr	206 ±		M:S-D		1200 ± 300		n.s.		*				168		*	
	Cod	*				13 ± 6		n.s.		*				0		*	
	Sculpin	*				560 ± 291		n.s.		*				91		*	

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1.; White Fox and Blue fox not differentiated: reported as: Arctic Fox.

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Abbreviations for period of harvest:

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Community	Species Harvested	Est. Harvest J - 1981 0 - 1981	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest J - 1982 0 - 1982	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest J - 1983 0 - 1983	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest J - 1984 0 - 1984	Est. Edible Weight ( )	Period Of Harvest	Ref.
Outpost Camps	Caribou	1340 ±		J-0	3,10	1730 ± 111		n.s.	4	*				655		*	7
	Muskox	0				0		n.s.		*				8		*	
	Polar Bear	38 ±		J-M:0:0		39 ± 6		n.s.		*				7		*	
	Wolf	19 ±		J:A-My:Jy:0:D		32 ± 13		n.s.		*				5		*	
	White Fox	n.d.		n.d.		n.d.		n.s.		*				167		*	
	Blue Fox	590 ±		J-A:0-0		550 ± 72		n.s.		*				7		*	
	Red Fox	34 ±		M:S:N-0		31 ± 6		n.s.		*				12		*	
	Arctic Hare	311 ±		J-N:S-0		315 ± 27		n.s.		*				98		*	
	Ringed Seal	5000 ±		J-0:Jn-Jy		3240 ± 211		n.s.		*				1024		*	
	Bearded Seal	168 ±		My-N:		78 ± 10		n.s.		*				39		*	
	Harp Seal	1060 ±		Jn-Jy:S-0:Jy:0		730 ± 170		n.s.		*				13		*	
	Hooded Seal	0				2 ± 1		n.s.		*				8		*	
	Harbour Seal	53 ±		Jy-A		15 ± 9		n.s.		*				6		*	
	Walrus	41 ±		My-Jy:S-N		39 ± 9		n.s.		*				64		*	
	Narwhal	0				15 ± 6		n.s.		*				0		*	
	Beluga	12 ±		Jn:0		24 ± 8		n.s.		*				0		*	
	Canada Goose	14 ±		My-Jy:0		170 ± 38		n.s.		*				30		*	
	Snow Goose	24 ±		Jn		84 ± 17		n.s.		*				71		*	
	Brant	0				5 ± 3		n.s.		*				1		*	
	Eider	920 ±		My-N:0		1030 ± 150		n.s.		*				352		*	
	Guillemot	14 ±		M:Jy:0		71 ± 19		n.s.		*				9		*	
	Oldsquaw	0				6 ± 3		n.s.		*				0		*	
	Ptarmigan	771 ±		F-Jn:S-0		880 ± 119		n.s.		*				345		*	
	Murre	12 ±		Jy		24 ± 9		n.s.		*				4		*	
	Canada Goose Eggs	*				*		n.s.		*				*		*	
	Snow Goose Eggs	*				*		n.s.		*				*		*	
	Oldsquaw Eggs	*				*		n.s.		*				*		*	
	Eider Eggs	*				*		n.s.		*				*		*	
	Murre Eggs	*				*		n.s.		*				*		*	
	Gull Eggs	*				*		n.s.		*				*		*	
	Tern Eggs	*				*		n.s.		*				*		*	
	Sea-run Charr	9700 ±		F-0:Jy:0-N		5700 ± 790		n.s.		*				2917		*	
	Land-locked Charr	206 ±		M:S-0		1200 ± 300		n.s.		*				168		*	
	Cod	*				13 ± 6		n.s.		*				0		*	
	Sculpin	*				560 ± 291		n.s.		*				91		*	

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Community	Species Harvested	Est. Harvest J - 1978 0 - 1978	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.
Pond Inlet	Caribou	1149		J-Jn;Au-D;M-My	8												
	Muskox																
	Polar Bear	16		F-A													
	Wolf	9		M;N													
	White Fox[1]	157		J-M;N-D;F													
	Blue Fox																
	Red Fox																
	Arctic Hare	132		J-A;Au-N;S													
	Ringed Seal	2487		J-0;A-My;Jy													
	Bearded Seal	38		M;Jn-0													
	Harp Seal	21		Au-0													
	Hooded Seal	3		Au													
	Harbour Seal																
	Walrus	14		My-Jn													
	Narwhal	139		My-S													
	Beluga	9		My													
	Canada Goose																
	Snow Goose	642		My-Jy-S													
	Brant Goose	6		Au													
	Eider	33		My;Au-0													
	Guillemot	9		S-0													
	Old Squaw	8		Au													
	Ptarmigan	527		J-M;My;S-N;D-N													
	Murre	43		Jy-Au													
	Canada Goose Eggs																
	Snow Geese Eggs																
	Oldsquaw Eggs																
	Eider Eggs																
	Murre Eggs																
	Gull Eggs																
	Tern Eggs																
	Sea-run Charr[1]	4689		J-M;My-D;Jy-Au													
	Land-locked Charr																
	Cod																
	Sculpin																

1 Reported as "charr", not differentiated as to land-locked or sea run.
2 Reported as "Fox", not differentiated as to type.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	0 - October
My - May	N - November
Jn - June	0 - December

Community	Species Harvested	Est. Harvest J - 1978 O - 1978	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.
Pond Inlet	Caribou	1149		J-Jn;Au-D;M-My	B												
	Muskox																
	Polar Bear	16		F-A													
	Wolf	9		M;N													
	White Fox[1]	157		J-M;N-O;F													
	Blue Fox																
	Red Fox																
	Arctic Hare	132		J-A;Au-N;S													
	Ringed Seal	2487		J-O;A-My;Jy													
	Bearded Seal	38		M;Jn-O													
	Harp Seal	21		Au-O													
	Hooded Seal	3		Au													
	Harbour Seal																
	Walrus	14		My-Jn													
	Narwhal	139		My-S													
	Beluga	9		My													
	Canada Goose																
	Snow Goose	642		My-Jy-S													
	Brant Goose	6		Au													
	Eider	33		My;Au-O													
	Guillemot	9		S-O													
	Old Squaw	8		Au													
	Ptarmigan	527		J-M;My;S-N;O-N													
	Murre	43		Jy-Au													
	Canada Goose Eggs																
	Snow Geese Eggs																
	Oldsquaw Eggs																
	Eider Eggs																
	Murre Eggs																
	Gull Eggs																
	Tern Eggs																
	Sea-run Charr[1]	4689		J-M;My-D;Jy-Au													
	Land-locked Charr																
	Cod																
	Sculpin																

1 Reported as "charr", not differentiated as to land-locked or sea run.
2 Reported as "Fox", not differentiated as to type.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

Community	Species Harvested	Est. Harvest J - 1978 O - 1978	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.
Grise Fiord	Caribou	74		M-My;O-N	8												
	Muskox	11		F-M													
	Polar Bear	24		FOMy;O-O;O													
	Wolf	4		M													
	White Fox [2]	263		J-My;N;O													
	Blue Fox																
	Red Fox																
	Arctic Hare	117		F-S;N-D;M;My													
	Ringed Seal	686		J-N;Jn-S													
	Bearded Seal	25		Jy-O;Au													
	Harp Seal	166		Au-O;S													
	Hooded Seal																
	Harbour Seal																
	Walrus	9		Jy-Au													
	Narwhal	15		Au-S													
	Beluga	14		S-O													
	Canada Goose																
	Snow Goose	20		Jn-Jy													
	Brant Goose																
	Eider	284		A-O;My;S													
	Guillemot	6		My-Jn;Au-S													
	Oldsquaw	10		Jn-Jy													
	Ptarmigan	485		J;M-D;S													
	Murre	5		My-Jn;Au													
	Canada Goose Eggs																
	Snow Geese Eggs																
	Oldsquaw Eggs																
	Eider Eggs																
	Murre Eggs																
	Gull Eggs																
	Tern Eggs																
	Sea-run Charr [1]	841		My-Jy;Jn													
	Land-locked Charr																
	Cod																
	Sculpin																

1. Reported as "charr", not differentiated as to land-locked or sea-run.
2. Reported as "Fox", not differentiated as to type.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

Community	Species Harvested	Est. Harvest J - 1979 0 - 1979	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight ( )	Period Of Harvest	Ref.
Clyde River	Caribou	992		J-0;J;A;N	8												
	Muskox																
	Polar Bear	21 [1]		J;M;S;0;0													
	Wolf	15		F;M;S													
	White Fox[3]	289		J-A;0-0													
	Blue Fox																
	Red Fox																
	Arctic Hare	169		J-0;M;Au													
	Ringed Seal	4,733		J-0,Jn;Jy													
	Bearded Seal	5		Jn,S													
	Harp Seal	4		Au;0													
	Hooded Seal																
	Harbour Seal																
	Walrus																
	Narwhal	5		Jn;S													
	Beluga																
	Canada Goose																
	Snow Geese	18		Jn;Au-S													
	Brant Beese	5		Jn													
	Eider	150		Au-0;0													
	Guillemot	5		S-0													
	Oldsquaw	11		Jn-Jy;0													
	Ptarmigan	530		J-Jn;Au;0-0;N													
	Murre																
	Canada Goose Eggs																
	Snow Geese Eggs																
	Oldsquaw Eggs																
	Eider Eggs																
	Murre Eggs																
	Gull Eggs																
	Tern Eggs																
	Sea-run Charr[2]	2867		J-0;Jn-S													
	Land-locked Charr																
	Cod																
	Sculpin																

1. In 1979 the hunters from Clyde River delayed the hunting season for polar bears until late in the year and filled their 1979 quota of 40 in March 1980. The bears takin in January and March were included on the 1978 quota and those taken in September and October were killed in outpost where they considered threats to life and property.
2. Reported as "char", not differentiated as to land-locked or sea-run.
3. Type of fox not identified.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	0 - October
My - May	N - November
Jn - June	0 - December

Community	Species Harvested	Reported[1] Harvest J - 1983 D - 1983	Est.[3] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Bay Chimo/	Caribou	398	19,104	J-D;My-Jn	9												
Bathurst Inlet	Caribou	422 ±9[2]	20,256	J-D													
	Muskox	1	110	J													
	Wolverine	25		J-A;N													
	Wolf	15		F-M;My-Jn													
	Arctic Hare	103	237	J-D;J-M;N													
	Moose	2	398	M													
	Seal (spp.)	26		A;Jn-O;S-O													
	Whale (spp.)	0															
	Goose (spp.)	3		Jy;S													
	Duck (spp.)	83		Jn-O													
	Ptarmigan	99	40	J-F;A-My;S-O													
	Charr	1207	3,018	Jn-D													
	White Fish	195	546	J;Jn-D;N													
	Trout	329	790	J;A-D;Jn													

1. No information was collected during the month of August
2. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period
3. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported Harvest O - 1982 N - 1983	Est.[2] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Cambridge Bay	Caribou	2,234	107,232	J-O;N;M	g												
	Caribou	2,161 ±56	103,728	O-(82)-N(83)													
	Muskox	15	1,650	O(82);J;Au-S(83)													
	Wolverine	1		M													
	Wolf	2		J-F													
	Arctic Hare	26	60	J;M-A;O-N													
	Moose	0															
	Seal (spp.)	0															
	Whale (spp.)	0															
	Goose (spp.)	271		My-S													
	Duck (spp.)	771		Jn-S													
	Ptarmigan	830	332	M-Jn;Au-O;S-O													
	Charr	6,657	16,643	O(82);A-N(83);Au													
	White fish	720	2,016	S-N;O													
	Trout	2,825	6,780	O(82);J;M-N(83)													

1. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period
2. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported[1] Harvest F - 1983 D - 1983	Est.[3] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Coppermine	Caribou	1,271	61,008	F-D;F;A;N[2]													
	Caribou	2,256 ±115[2]	108,288	J-D													
	Muskox	15	1,650	F;O-D													
	Wolverine	64		F-A;N-D													
	Wolf	49		F-A;N-D													
	Arctic Hare	89	205	F-S;N-O;F;N													
	Moose	7	1,393	F;Jy;O-D													
	Seal (spp.)	549		F-N;Jy-Au													
	Whale (spp.)	0															
	Goose (spp.)	191		My-S													
	Duck (spp.)	562		My-O													
	Ptarmigan	477	191	F-N													
	Charr	8,531	21,328	Jn-O													
	White fish	5,188	14,526	M;Jn-D													
	Trout	1,756	4,214	F-D;N													

1. No data collected for January.
2. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period.
3. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported[1] Harvest S - 1982 N - 1983	Est.[3] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Gjoa Haven	Caribou	1,567	75,216	J-O;S;M	9												
	Caribou	1,567 ±165[2]	75,216	O(82)-N													
	Muskox	23	2,530	S(82);F-A;O-N													
	Wolverine	0															
	Wolf	29		S;N-O(82);F-Jn;O-N													
	Arctic Hare	37	85	M-Jn;Au-O													
	Moose	0															
	Seal (spp.)	371		S-N(82);J-O													
	Whale (spp.)	7		Au-S													
	Goose (spp.)	214		S(82);M-Au													
	Duck (spp.)	412		S(82);My-O													
	Ptarmigan	63	25	M-Jy;S-N													
	Charr	13,049	32,623	S-A(82);J-F;A-N													
	White fish	1,355	3,794	Jy-N;Jy-Au													
	Trout	956	2,294	J-M;Jr-N													

1. No data collected for October 1982.
2. Caribour is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ form the reported period.
3. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	O - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported Harvest 0 - 1982 N - 1983	Est.[2] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Holman	Caribou	1,105	53,040	J-My;Jy-S;N-J	9												
	Caribou	1,207 ±62[1]	57,936	0(82)-N(83)													
	Muskox	16	1,760	F;A;Jy-Au;0													
	Wolverine	0															
	Wolf	1		J													
	Arctic HAre	100	230	J-A;S-N													
	Moose	0															
	Seal (spp.)	1,665		0(82);M-N;Jy													
	Whale (spp.)	0															
	Goose (spp.)	142		My-Jn;Au-S													
	Ouck (spp.)	1,940		Jn;S													
	Ptarmigan	37	15	A-My;11													
	Charr	9,150	22,875	0(82);Jy-0													
	White fish	4	11	Au													
	Trout	2,200	5,280	M-0;My													

1. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period.
2. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	0 - October
My - May	N - November
Jn - June	0 - Oecember

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported[1] Harvest O - 1982 N - 1983	Est.[3] Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Pelly Bay	Caribou	887	42,576	J-D;O;Jn;Au	9												
	Caribou	750 ±24[2]	36,000	D(82)-N													
	Muskox	0															
	Wolverine	0															
	Wolf	20		O(82);M-A;N													
	Arctic Hare	4	9	M-A;Jn													
	Moose	0															
	Seal (spp.)	339		O(82);M-S;N;Jn													
	Whale (spp.)	0															
	Goose (spp.)	67		O(82);Jn													
	Duck (spp.)	98		O(82);Jn-Jy													
	Ptarmigan	6	2	Jn													
	Charr	17,479	43,698	O-D(82);A-O													
	White fish	156	437	A;Au;O-N													
	Trout	645	1,548	A;Jn;Au;O-N													

1. No data for May 1983.
2. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period.
3. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

Community	Species Harvested	Reported Harvest S - 1982 N - 1983	Est. Edible Weight (kg)	Period of Harvest in 1983 unless specified	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Est. Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.	Reported Harvest	Est. Edible Weight (kg)	Period Of Harvest	Ref.
Spence Bay	Caribou	1,636	78,S28	J-D;J-M;S-N	9												
	Caribou	1,388 ±34[2]	66,624	D-(82)-N													
	Muskox	0															
	Wolverine	0															
	Wolf	8			N(82);N												
	Arctic Hare	99	228		J-Jy;S-N;M												
	Moose	0															
	Seal (spp.)	1,044			S;N(82);J-N;Au												
	Whale (spp.)	1S			S(82);Au-S												
	Goose (spp.)	342			S(82);Jn-S												
	Duck (spp.)	1,102			S(82);Jn-O												
	Ptarmigan	34S	138		J-Jy;S-N												
	Charr	24,142	60,3SS		S;M(82);M;Jn-N;S												
	White fish	997	2,792		My;Jy-N												
	Trout	12,699	30,478		J-N;Jn-Jy												

1. No data for October (82), February (83) and April (85).
2. Caribou is the only species for which an estimated value was calculated; period of harvest for the estimated value may differ from the reported period.
3. These estimates are not from the original report but are based on the reported data: see text on harvest for further explanation.

Abbreviations for period of harvest:

J - January	Jy - July
F - February	Au - August
M - March	S - September
A - April	O - October
My - May	N - November
Jn - June	D - December

A line beneath an abbreviation includes a peak period.

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Appendix C: Residue Data from Commercial Fishery Samples from the Northwest Territories

Table 7.3: Heavy Metal (PPM) and Chlorinated Hydrocarbon (PPB) Levels in Freshwater Fish Sampled in the Northwest Territories (DFO Fish Inspection).

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Whitefish	Hay River	6051	11544	84	Hg	15	0.03	0.01	0.04	392	880
(*Coregonus*	Great Slave All	6130	11400	75	Pb	85	0.10	0.05	1.26	404	865
sp.)	Liard River	6151	12118	77		8	0.05	0.05	0.05	364	600
	Ellice River	6803	10400	77		24	0.14	0.05	1.29	468	1485
	McCrae	6333	11235	77		1	0.05	0.05	0.05	560	2900
	MaGuire	6312	11352	77		2	0.05	0.05	0.05	550	2450
	Wagenitz	6303	11352	77		15	0.05	0.05	0.07	445	1270
	Mackenzie Delta	6915	13408	77		25	0.05	0.05	0.11	457	1361
	Great Slave All	6130	11400	77		64	0.12	0.05	2.49	403	940
	Thistlethwaite	6310	11337	77		10	0.07	0.05	0.12	447	1230
	Giauque	6311	11351	77		1	0.05	0.05	0.05	480	1600
	Tree River	6743	11155	77		4	0.17	0.08	0.42	416	1175
	Manuel	6700	12856	78		5	0.05	0.05	0.05	523	2048
	Rorey	6655	12825	78		1	0.08	0.08	0.08	370	730
	Loche	6519	12540	78		5	0.05	0.05	0.05	444	1220
	Hidden	6600	11751	78		2	0.05	0.05	0.05	515	1825
	Yeltea	6655	12923	78		3	0.05	0.05	0.05	467	1543
	Carcajou	6715	12840	78		5	0.05	0.05	0.05	480	1588
	Thompson	6237	11330	78		19	0.12	0.05	1.36	376	811
	Great Slave All	6130	11400	78		19	0.05	0.05	0.05	420	1173
	Mackenzie Delta	6915	12408	81		6	0.02	0.01	0.04	446	1362
	Hay River	6051	11544	84		9	0.04	0.04	0.04	389	886
Whitefish	Great Slave All	6130	11400	75	Cu	85	0.20	0.01	0.43	404	865
	Great Slave All	6130	11400	76		29	0.23	0.13	0.60	397	940
	Liard River	6151	12118	77		8	0.38	0.25	0.64	364	600
	Ellice River	6803	10400	77		24	0.31	0.16	1.10	468	1485
	McCrae	6333	11235	77		1	1.00	1.00	1.00	560	2900
	MaGuire	6312	11352	77		2	0.21	0.20	0.22	550	2450
	Wagenitz	6303	11362	77		15	0.29	0.18	0.53	445	1270
	MacKenzie Delta	6915	13408	77		25	0.39	0.16	1.24	457	1361
	Great Slave All	6130	11400	77		64	0.29	0.15	0.93	403	940
	Thistlethwaite	6310	11337	77		10	0.30	0.22	0.45	447	1230
	Giauque	6311	11351	77		1	0.23	0.23	0.23	480	1600
	Tree River	6743	11155	77		4	0.31	0.23	0.40	416	1175
	Manuel	6700	12856	78		5	0.20	0.20	0.20	523	2048
	Rorey	6655	12825	78		1	0.20	0.13	0.20	370	730
	Loche	6519	12540	78		5	0.23	0.14	0.30	444	1220
	Hidden	6600	11751	78		2	0.33	0.27	0.39	515	1825
	Yeltea	6655	12923	78		3	0.17	0.14	0.19	467	1543
	Carcajou	6715	12840	78		5	0.19	0.14	0.22	480	1588
	Thompson	6237	11330	78		19	0.26	0.16	0.47	376	811
	Great Slave All	6130	11400	78		19	0.42	0.30	0.58	420	1173
	MacKenzie Delta	6915	13408	81		6	0.62	0.48	0.78	446	1362
	Hay River	6051	11544	84		9	0.20	0.11	0.40	389	886

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Whitefish	MacKenzie Delta	6915	13408	77	Cd	25	0.01	0.01	0.10	457	1361
	Great Slave All	6130	11400	77		64	0.01	0.01	0.05	403	940
	Thistlethwaite	6310	11337	77		10	0.01	0.01	0.01	447	1230
	Giauque	6311	11351	77		1	0.01	0.01	0.01	480	1600
	Tree River	6743	11155	77		4	0.01	0.01	0.01	416	1175
	Manuel	6700	12856	78		5	0.01	0.01	0.01	523	2048
	Rorey	6655	12825	78		1	0.01	0.01	0.01	370	730
	Loche	6519	12540	78		5	0.01	0.01	0.01	444	1220
	Hidden	6600	11751	78		2	0.01	0.01	0.01	515	1825
	Yeltea	6655	12923	78		3	0.01	0.01	0.01	467	1543
	Carcajou	6715	12840	78		5	0.01	0.01	0.01	480	1588
	Thompson	6237	11330	78		19	0.01	0.01	0.02	376	811
	Great Slave All	6130	11400	78		19	0.01	0.01	0.02	420	1173
	MacKenzie Delta	6915	13408	81		6	0.01	0.01	0.02	446	1362
	Hay River	6051	11544	84		9	0.02	0.02	0.04	389	886
Whitefish	Great Slave All	6130	11400	75	As	85	0.21	0.04	0.77	404	865
	Great Slave All	6130	11400	76		29	0.19	0.02	0.64	397	940
	Liard River	6151	12118	77		8	0.03	0.02	0.05	364	600
	Ellice River	6803	10400	77		24	0.64	0.05	2.91	468	1485
	McCrae	6333	11235	77		1	0.12	0.12	0.12	560	2900
	MaGuire	6312	11352	77		2	0.32	0.29	0.36	550	2450
	Wagenitz	6303	11352	77		11	0.09	0.01	0.27	460	1395
	MacKenzie Delta	6915	13408	77		24	0.01	0.01	0.02	457	1361
	Great Slave All	6130	11400	77		64	0.13	0.02	0.77	403	940
	Thistlethwaite	6310	11337	77		10	0.46	0.05	1.01	447	1230
	Giauque	6311	11351	77		1	0.03	0.03	0.03	480	1600
	Tree River	6743	11155	77		4	0.39	0.18	0.62	416	1175
	Manuel	6700	12856	78		5	0.07	0.03	0.09	523	2048
	Rorey	6655	12825	78		1	0.03	0.03	0.03	370	730
	Loche	6519	12540	78		5	0.04	0.01	0.08	444	1220
	Hidden	6600	11751	78		2	0.56	0.36	0.76	515	1825
	Yeltea	6655	12923	78		3	0.04	0.03	0.06	467	1543
	Carcajou	6715	12840	78		5	0.06	0.03	0.09	480	1588
	Thompson	6237	11330	78		30	0.14	0.06	0.26	377	793
	Great Slave All	6130	11400	78		19	0.29	0.03	0.59	420	1173
	MacKenzie Delta	6915	13408	81		6	0.05	0.03	0.09	446	1362

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Whitefish	Hay River	6051	11544	84	DDT	15	7	3	30	392	880
	Hay River	6051	11544	84	PCB	15	2	1	3	392	880
	Hay River	6051	11544	84	Dieldrin	15	1	1	1	392	880
	Hay River	6051	11544	84	Aldrin	15	1	1	1	392	880
	Hay River	6051	11544	84	Mirex	15	1	1	1	392	880

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Lake Trout	Ellice River	6803	10400	77	Cd	4	0.01	0.01	0.01	525	1988
(Salvelinus	Oease Strait	6840	10800	77		7	0.01	0.01	0.01	511	1836
namaycush)	McCrae	6333	11235	77		17	0.01	0.01	0.05	482	1494
	MaGuire	6312	11352	77		34	0.01	0.00	0.01	479	1162
	Wagenitz	6303	11352	77		15	0.01	0.01	0.05	547	1713
	Thistlethwaite	6310	11337	77		16	0.01	0.00	0.02	567	2478
	Giauque	6311	11351	77		31	0.01	0.01	0.03	571	2255
	Tree River	6743	11155	77		3	0.01	0.01	0.01	607	3700
	Trout	6035	12110	77		25	0.01	0.01	0.05	604	3040
	Hall	6841	08217	78		25	0.01	0.01	0.02	670	1
	Rorey	6655	12825	78		3	0.01	0.01	0.01	522	1602
	Hidden	6600	11751	78		6	0.01	0.01	0.02	462	1467
	Tunago	6620	12550	78		1	0.01	0.01	0.01	400	790
	Carcajou	6715	12840	78		2	0.01	0.01	0.01	528	1935
	Great Slave ALl	6130	11400	78		24	0.01	0.01	0.01	573	2043
	Great Bear	6600	12000	78		29	0.01	0.01	0.02	613	3255
Lake Trout	Ellice River	6803	10400	77	As	4	4.36	1.89	8.82	525	1988
	Dease Strait	6840	10800	77		7	0.03	0.01	0.07	511	1836
	McCrae	6333	11235	77		17	0.17	0.02	0.48	482	1494
	Maguire	6312	11352	77		33	0.34	0.06	1.50	480	1162
	Wagenitz	6303	11352	77		12	0.09	0.03	0.24	555	1771
	Thistlethwaite	6310	11337	77		16	0.26	0.04	0.90	567	2478
	Giauque	6311	11351	77		30	0.30	0.01	1.39	573	2291
	Tree River	6743	11155	77		3	4.22	0.33	9.93	607	3700
	Trout	6035	12110	77		25	0.03	0.01	0.12	604	3040
	Hall	6841	08217	78		25	0.06	0.01	0.22	670	1
	Rorey	6655	12825	78		3	0.04	0.03	0.05	522	1602
	Hidden	6600	11751	78		6	0.53	0.12	1.24	462	1467
	Tunago	6620	12550	78		1	0.02	0.02	0.02	400	790
	Carcajou	6715	12840	78		2	0.12	0.05	0.19	528	1935
	Great Slave All	6130	11400	78		24	0.19	0.05	0.73	573	2043
	Great Bear	6600	12000	78		30	0.14	0.03	1.10	609	3197
Lake Trout	Ellice River	6803	10400	77	Pb	4	0.08	0.07	0.10	525	1988
	Oease Strait	6840	10800	77		7	0.08	0.05	0.13	511	1836
	McCrae	6333	11235	77		17	0.05	0.05	0.05	482	1494
	MaGuire	6312	11352	77		34	0.05	0.05	0.05	479	1162
	Wagenitz	6303	11352	77		15	0.05	0.05	0.05	547	1713
	Thistlethwaite	6310	11337	77		16	0.07	0.01	0.10	567	2478
	Giauque	6311	11351	77		30	0.05	0.05	0.07	569	2232
	Tree River	6743	11155	77		3	0.11	0.08	0.15	607	3700
	Trout	6035	12110	77		25	0.09	0.05	0.33	604	3040
	Hall	6841	08217	78		25	0.09	0.05	0.70	670	1
	Rorey	6655	12825	78		3	0.05	0.05	0.05	522	1602
	Hidden	6600	11751	78		6	0.07	0.05	0.16	462	1467
	Tunago	6620	12550	78		1	0.05	0.05	0.05	400	790
	Carcajou	6715	12840	78		2	0.05	0.05	0.05	528	1935
	Great Slave All	6130	11400	78		24	0.06	0.05	0.39	573	2043
	Great Bear	6600	12000	78		29	0.08	0.05	0.90	613	3255

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Lake Trout	Ellice River	6803	10400	77	Cu	4	0.45	0.29	0.87	525	1988
	Dease Strait	6840	10800	77		7	0.31	0.27	0.33	511	1836
	McCrae	6333	11235	77		17	0.51	0.28	1.21	482	1494
	MaGuire	6312	11352	77		34	0.37	0.24	0.90	479	1162
	Wagenitz	6303	11352	77		15	0.37	0.15	0.86	547	1713
	Thistlethwaite	6310	11337	77		16	0.45	0.27	1.30	567	2478
	Giauque	6311	11351	77		31	0.46	0.21	1.65	571	2255
	Tree River	6743	11155	77		3	0.29	0.28	0.32	607	3700
	Trout	6035	12110	77		25	0.37	0.24	0.52	604	3040
	Hall	6841	08217	78		25	0.53	0.25	0.84	670	1
	Rorey	6655	12825	78		3	0.32	0.23	0.40	522	1602
	Hidden	6600	11751	78		6	0.37	0.20	0.57	462	1467
	Tunago	6620	12550	78		1	0.32	0.32	0.32	400	790
	Carcajou	6715	12840	78		2	0.29	0.26	0.33	528	1935
	Great Slave All	6130	11400	78		24	0.34	0.23	0.50	573	2043
	Great bear	6600	12000	78		29	0.30	0.16	0.44	613	3255
Northern Pike (<u>Esox lucius</u>)	Hay River	6051	11544	84	Hg	15	0.25	0.11	0.45	590	1474
Northern Pike	Grainger River	6108	12305	77	Cd	25	0.01	0.01	0.01	616	2016
	MacKenzie River	6020	12320	77		13	0.01	0.01	0.01	503	954
	McCrae	6333	11235	77		8	0.01	0.01	0.01	600	1513
	MaGuire	6312	11352	77		4	0.01	0.01	0.01	593	1650
	Wagenitz	6303	11352	77		10	0.01	0.01	0.02	669	2235
	MacKenzie Delta	6915	13408	77		25	0.01	0.01	0.01	1118	5902
	Great Slave All	6130	11400	77		48	0.01	0.01	0.09	591	1791
	Kakisa	6055	11740	77		16	0.01	0.01	0.01	572	1377
	Thistlethwaite	6310	11337	77		8	0.01	0.01	0.02	586	1663
	Giauque	6311	11351	77		27	0.01	0.01	0.02	584	1870
	Trout	6035	12110	77		3	0.01	0.01	0.02	813	4833
	Manuel	6700	12856	78		4	0.01	0.01	0.01	574	1494
	Loche	6519	12540	78		5	0.01	0.01	0.01	688	2310
	Tunago	6620	12550	78		2	0.01	0.01	0.01	568	1533
	Carcajou	6715	12840	78		1	0.01	0.01	0.01	660	2190
	Thompson	6237	11330	78		13	0.01	0.01	0.01	535	1035
	Great Slave All	6130	11400	78		12	0.01	0.01	0.01	656	2183
	Kakisa	6055	11740	78		9	0.01	0.01	0.01	592	1427
	Great Bear	6600	12000	78		25	0.01	0.01	0.01	728	3032
	Marian River	6304	11621	79		23	0.01	0.01	0.01	644	1672
	Hay River	6051	11544	84		21	0.03	0.02	0.04	535	1302

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIOUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Northern Pike	Great Slave All	6130	11400	76	Cd	5	0.24	0.09	0.47	610	1869
	Grainger River	6108	12305	77		25	0.02	0.01	0.09	616	2016
	MacKenzie River	6020	12320	77		13	0.03	0.01	0.07	503	954
	McCrae	6333	11235	77		8	0.17	0.07	0.44	600	1513
	Wagenitz	6303	11352	77		10	0.10	0.03	0.28	669	2235
	MacKenzie Oelta	6915	13408	77		25	1.09	0.06	3.41	1118	5902
	Great Slave All	6130	11400	77		48	0.23	0.05	1.02	591	1791
	Kakisa	6055	11740	77		16	0.02	0.01	0.04	572	1377
	Thistlethwaite	6310	11337	77		8	0.21	0.10	0.35	586	1663
	Giauque	6311	11351	77		25	0.17	0.03	0.90	587	1872
	Trout	6035	12110	77		3	0.03	0.02	0.03	813	4833
	Manuel	6700	12856	78		4	0.03	0.03	0.04	574	1494
	Loche	6519	12540	78		5	0.08	0.07	0.11	688	2310
	Tunago	6620	12550	78		2	0.03	0.03	0.04	568	1533
	Carcajou	6715	12840	78		1	0.03	0.03	0.03	660	2190
	Thompson	6237	11330	78		16	0.34	0.12	1.46	524	1000
	Great Slave All	6130	11400	78		12	0.09	0.07	0.13	656	2183
	Kakisa	6055	11740	78		9	0.04	0.03	0.05	592	1427
	Great Bear	6600	12000	78		25	0.07	0.04	0.12	728	3032
	Hay River	6051	11544	84		21	0.03	0.02	0.04	535	1302
Northern Pike	Grainger River	6108	12305	77	Pb	25	0.07	0.05	0.43	616	2016
	MacKenzie River	6020	12320	77		13	0.05	0.05	0.07	503	954
	McCrae	6333	11235	77		8	0.05	0.05	0.05	600	1513
	MaGuire	6312	11352	77		4	0.05	0.05	0.05	593	1650
	Wagenitz	6303	11352	77		10	0.05	0.05	0.05	669	2235
	MacKenzie Delta	6915	13408	77		25	0.05	0.05	0.08	1118	5902
	Great Slave All	6130	11400	77		48	0.09	0.05	0.87	591	1791
	Kakisa	6055	11740	77		16	0.06	0.05	0.09	572	1377
	Thistlethwaite	6310	11337	77		8	0.06	0.05	0.10	586	1663
	Giauque	6311	11351	77		25	0.05	0.05	0.08	581	1882
	Trout	6035	12110	77		3	0.06	0.05	0.08	813	4833
	Manuel	6700	12856	78		4	0.05	0.05	0.05	574	1494
	Loche	6519	12540	78		5	0.05	0.05	0.05	688	2310
	Tunago	6620	12550	78		2	0.05	0.05	0.05	568	1533
	Carcajou	6715	12840	78		1	0.05	0.05	0.05	660	2190
	Thompson	6237	11330	78		13	0.05	0.05	0.05	535	1035
	Great Slave All	6130	11400	78		12	0.05	0.05	0.05	656	2183
	Kakisa	6055	11740	78		9	0.05	0.05	0.05	592	1427
	Great Bear	6600	12000	78		25	0.50	0.05	2.60	728	3032
	Marian River	6304	11621	79		23	0.05	0.05	0.13	644	1672
	Hay River	6051	11544	84		21	0.04	0.04	0.04	535	1302

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIOUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Northern Pike	Great Slave All	6130	11400	76	Cu	5	0.26	0.21	0.32	610	1869
	Grainger River	6108	12305	77		25	0.26	0.16	0.43	616	2016
	MacKenzie River	6020	12320	77		13	0.24	0.16	0.32	503	954
	McCrae	6333	11235	77		8	0.41	0.23	0.62	600	1513
	MaGuire	6312	11352	77		4	0.52	0.25	0.86	593	1650
	Wagenitz	6303	11352	77		10	0.23	0.20	0.35	669	2235
	MacKenzie Delta	6915	13408	77		25	0.17	0.09	0.43	1118	5902
	Great Slave All	6130	11400	77		48	0.29	0.15	1.10	591	1791
	Kakisa	6055	11740	77		16	0.23	0.17	0.74	572	1377
	Thistlethwaite	6310	11337	77		8	0.36	0.19	0.79	586	1663
	Giauque	6311	11351	77		26	0.39	0.19	1.07	581	1865
	Trout	6035	12110	77		3	0.29	0.26	0.34	813	4833
	Manuel	6700	12856	78		4	0.32	0.18	0.65	574	1494
	Loche	6519	12540	78		5	0.17	0.14	0.19	688	2310
	Tunago	6620	12550	78		2	0.19	0.18	0.20	568	1533
	Carcajou	6715	12840	78		1	0.16	0.16	0.16	660	2190
	Thompson	6237	11330	78		13	0.19	0.12	0.25	535	1035
	Great Slave All	6130	11400	78		12	0.14	0.03	0.20	656	2183
	Kakisa	6055	11740	78		9	0.16	0.12	0.21	592	1427
	Great Bear	6600	12000	78		25	0.22	0.15	0.33	728	3032
	Marian River	6304	11621	79		23	0.25	0.18	0.39	644	1672
	Hay River	6051	11544	84		21	0.21	0.14	0.39	535	1302
Northern Pike	Hay River	6051	11544	84	OOT	15	3	3	3	590	1474
	Hay River	6051	11544	84	PCB	15	0	0	1	590	1474
	Hay River	6051	11544	84	Dieldrin	15	1	1	1	590	1474
Northern Pike	Hay River	6051	11544	84	Aldrin	15	1	1	1	590	1474
	Hay River	6051	11544	84	Mirex	15	1	1	1	590	1474

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Pickerel (Stizozstedion vitreum)	Hay River	6051	11544	84	Hg	13	0.23	0.12	0.51	406	832
Pickerel	Grainger River	6108	12305	77	Cd	15	0.01	0.01	0.04	468	1287
	Muskeg River	6020	12320	77		25	0.01	0.01	0.02	435	1044
	Great Slave All	6130	11400	77		37	0.01	0.01	0.02	427	954
	Kakisa	6055	11740	77		25	0.01	0.01	0.01	438	934
	Trout	6035	12110	77		7	0.01	0.01	0.01	591	2343
	Hay River	6051	11544	84		13	0.03	0.02	0.05	406	832
Pickerel	Grainger River	6108	12305	77	As	15	0.02	0.01	0.03	468	1287
	Muskeg River	6020	12320	77		25	0.01	0.01	0.04	435	1044
	Great Slave All	6130	11400	77		37	0.09	0.03	0.58	427	954
	Kakisa	6055	11740	77		25	0.04	0.01	0.07	438	934
Pickerel	Grainger River	6108	12305	77	Pb	15	0.07	0.05	0.32	468	1287
	Muskeg River	6020	12320	77		25	0.07	0.05	0.28	435	1044
	Great Slave All	6130	11400	77		37	0.09	0.05	0.77	427	954
	Kakisa	6055	11740	77		25	0.06	0.05	0.09	438	934
	Trout	6035	12110	77		7	0.05	0.05	0.05	591	2343
	Hay River	6051	11544	84		13	0.04	0.03	0.05	406	832

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Pickerel	Grainger River	6108	12305	77	Cu	15	0.21	0.14	0.30	468	1287
	Muskeg River	6020	12320	77		25	0.23	0.14	0.45	435	1044
	Great Slave All	6130	11400	77		37	0.22	0.16	0.43	427	954
	Kakisa	6055	11740	77		25	0.20	0.15	0.36	438	934
	Trout	6035	12110	77		7	0.32	0.25	0.42	591	2343
	Hay River	6051	11544	84		13	0.16	0.07	0.37	406	832
Pickerel	Hay River	6051	11544	84	DDT	13	5	3	21	406	832
	Hay River	6051	11544	84	PCB	13	3	1	3	406	832
	Hay River	6051	11544	84	Dieldrin	13	1	1	1	406	832
	Hay River	6051	11544	84	Aldrin	13	1	1	1	406	832
	Hay River	6051	11544	84	Mirex	13	1	1	1	406	832

SPECIES	LAKE NAME	LAT	LONG	YEAR	RESIDUE	NUMBER SAMPLES	MEAN CONC	MIN	MAX	MEAN (MM) LENGTH	MEAN (G) WEIGHT
Burbot (Lota lota)	Great Slave All	6130	11400	75	Cd	1	0.02	0.02	0.02	610	1410
	MacKenzie Delta	6915	13408	77		10	0.01	0.01	0.01	711	2268
	Great Slave All	6130	11400	77		1	0.01	0.01	0.01	660	1955
	Hidden	6600	11751	78		1	0.01	0.01	0.01	430	700
	Yeltea	6655	12923	78		1	0.01	0.01	0.01	670	2490
Burbot	Great Slave All	6130	11400	75	Pb	1	0.05	0.05	0.05	610	1410
	MacKenzie Delta	6915	13408	77		10	0.73	0.14	1.58	711	2268
	Great Slave All	6130	11400	77		1	0.05	0.05	0.05	660	1955
	Hidden	6600	11751	78		1	0.05	0.05	0.05	430	700
	Yeltea	6655	12923	78		1	0.05	0.05	0.05	670	2490
Burbot	Great Slave All	6130	11400	75	Cu	1	0.60	0.60	0.60	610	1410
	MacKenzie Delta	6915	13408	77		10	0.25	0.17	0.37	711	2268
	Great Slave All	6130	11400	77		1	1.34	1.34	1.34	660	1955
	Hidden	6600	11751	78		1	0.21	0.21	0.21	430	700
	Yeltea	6655	12923	78		1	0.22	0.22	0.22	670	2490