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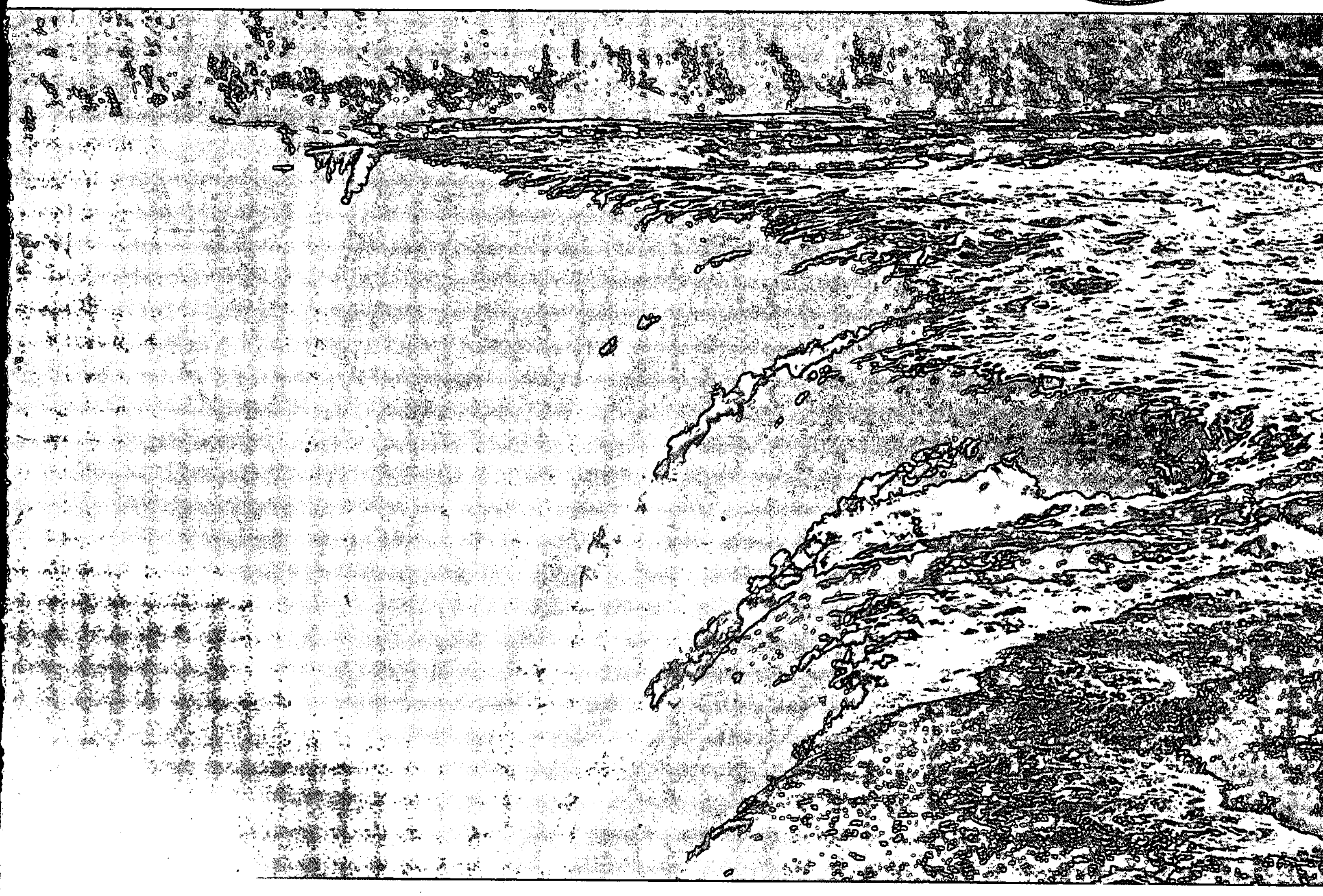

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INLAND WATERS DIRECTORATE
ONTARIO REGION
WATER QUALITY BRANCH
BURLINGTON, ONTARIO, 1984

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Abstract

A comprehensive water quality study was conducted June 4-11, 1981, near the mouths of the five major rivers of the Hudson Bay Lowland. A wide range of trace organic and trace metal contaminants were measured in water, fish, suspended and bottom sediments. Although levels of organochlorine pesticides were generally low in the water samples, a wide range of compounds were detected. Total PCB's (polychlorinated biphenyls), α-BHC and p,p'-DDE were most often detected in fish and the concentrations of all of the compounds present were very low. Polychlorinated biphenyls were the only compounds detected in suspended sediment samples and all trace organic contaminants were below the detection limit in bottom sediment. The results of the survey conducted to determine benthic structure indicate that a large number of benthic species were present in each river, but that no one species predominated. The Chironomidae and Tubificidae families were the two major taxonomic groups in terms of numbers of individuals in each river.

Résumé

Une étude exhaustive de la qualité des eaux a été réalisée du 4 au 11 juin 1981 à proximité de l'embouchure des cinq principales rivières des basses terres de la Baie d'Hudson. On a dosé de nombreux polluants organiques et métalliques à l'état de trace dans des échantillons d'eau, de poissons, de sédiments en suspension et de sédiments de fond. Même si les concentrations de pesticides organochlorés étaient généralement faibles dans les échantillons d'eau, on a décelé de nombreux produits. Les BPC totaux (biphényle polychloré), le α-BHC et le p,p'-DDE ont été le plus souvent décelés chez le poisson, et les concentrations de tous les composés présents étaient très faibles. Les BPC ont été les seuls composés décelés dans les sédiments en suspension, et la concentration de tous les polluants organiques à l'état de trace était inférieure à la limite de détection dans les sédiments de fond. D'après les résultats de l'étude visant à déterminer la structure benthique, un grand nombre d'espèces benthiques sont présentes dans chaque rivière mais il n'y a pas dominance d'une espèce particulière. Les chironomidés et les tubificidés constituaient, numériquement, les deux principaux groupes taxonomiques dans chaque rivière.

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INTRODUCTION

The northern watershed of Ontario, with a combined drainage area of 552 000 km^2, is composed of two major physiographic regions, the Precambrian Shield in the south and the Hudson Bay Lowland in the north (Hustich, 1957). The Ontario portion of the Lowland comprises an area of 260 000 km^2, providing the Province with its full coastal access and representing a major nesting and feeding area for many migratory birds and waterfowl. The region represents a unique wetland environment which is sparsely populated and supports very few industrial and resource-based activities.

The Hudson Bay Lowland, composed of marine, fluvial and glacial till deposits, is overlain by organic (peat) deposits which can reach a combined depth of 200 m (Pala, 1981; Sanford *et al*., 1968; Sims *et al*., 1979). Poor drainage of the extremely flat Lowland results in a water-logged terrain with extensive bogs and fens to the south and peat plateaus to the north (Pala and Boissoneau, 1981). It has been described as the largest continuous peatland expanse in the world (Sims *et al*., 1979). The area encompasses five large rivers—Moose, Albany, Attawapiskat, Winisk and Severn—whose banks commonly rise 5 to 15 m to form forested levees (Fig. 1). These rivers are generally shallow, slow moving and display a highly seasonal flow pattern (Fig. 2).

Certain areas of scientific concern in the Hudson Bay Lowland have not been studied. Even though very little human activity has occurred in the Lowland, it may well provide a site for the deposition of toxic substances originating in the more industrialized southern portion of the Province.

Due to the lack of information concerning water quality in the major rivers of the Lowland, a comprehensive study focussing on the most significant components of these northern aquatic systems was undertaken by the Water Quality Branch, Ontario Region (WQB-OR) of Environment Canada. To assess the potential for bioaccumulation and/or impact, fish representing two trophic levels as well as water, suspended sediment and bottom sediment were studied. Due to recent concern about toxic substances in the environment, analyses of naturally occurring toxic chemicals such as mercury and anthropogenic toxic substances (organochlorine pesticides and PCB's) were carried out. In addition, benthic macroinvertebrate communities were sampled to assess ambient environmental conditions. The data collected complement an ongoing Northern Baseline Network (carried out by the WQB-OR) and provide a basis for evaluating subsequent changes in the water quality should they occur as a result of large-scale land or river use.

MATERIALS AND METHODS

Sampling Strategy and Operational Methods

The approach adopted was to sample the five major rivers of the Hudson Bay Lowland just upstream from their mouths (Fig. 1). All sampling was carried out near the end of spring runoff (June 4–11, 1981), upstream from the farthest expected salt-water intrusion points for the year. Surveys were also carried out from the most southerly river to the most northerly river, minimizing seasonal variation. A field crew of five was flown to the sampling sites in a single-engine Otter. Samples for trace organics in water and suspended sediment (designated station O in Figures A-1 to A-5, Appendix A) were collected from the airplane at one location per river. Samples of water, bottom sediment and benthos were collected from freighter-canoes at five stations in each river. Additional samples were collected in the Moose River, since it has a highly channelized flow regime (McCrea and Merriman, 1981) and because there is a greater likelihood of environmental impacts occurring in its basin. Only four sites were sampled on the Albany River due to adverse weather conditions.

Physical parameters (depth, velocity, clarity, temperature and dissolved oxygen) were measured *in situ*. Aliquots for water chemistry analyses and bottom sediment grab samples for trace metal, trace organic and benthic analyses were collected. The field party was flown out each evening to a base camp (either in Moosonee or Winisk) where initial sorting and preservation of the benthic material took place. Details regarding the sample collection can be found in Tables A-1 to A-4 in Appendix A. All chemical analyses, as well as the identification and enumeration of the macroinvertebrates, were carried out at WQB-OR laboratories in Burlington, Ontario. The exception to this was the identification and enumeration of the benthic group Chironomidae, which were carried out through an outside contract.

Physical Parameters

Water temperature was measured *in situ* at a depth of 0.5 m with a Doric T-meter digitized thermometer model 430-A. Dissolved oxygen determinations (to the nearest milligram per litre) were made with a Hach kit in triplicate from samples collected 0.5 m off the river bottom. Water transparency was assessed using a 20-cm all-white Secchi disk. The average depth at which the Secchi disk disappeared and then reappeared was measured to the nearest 0.1 m. Water depth was determined to the

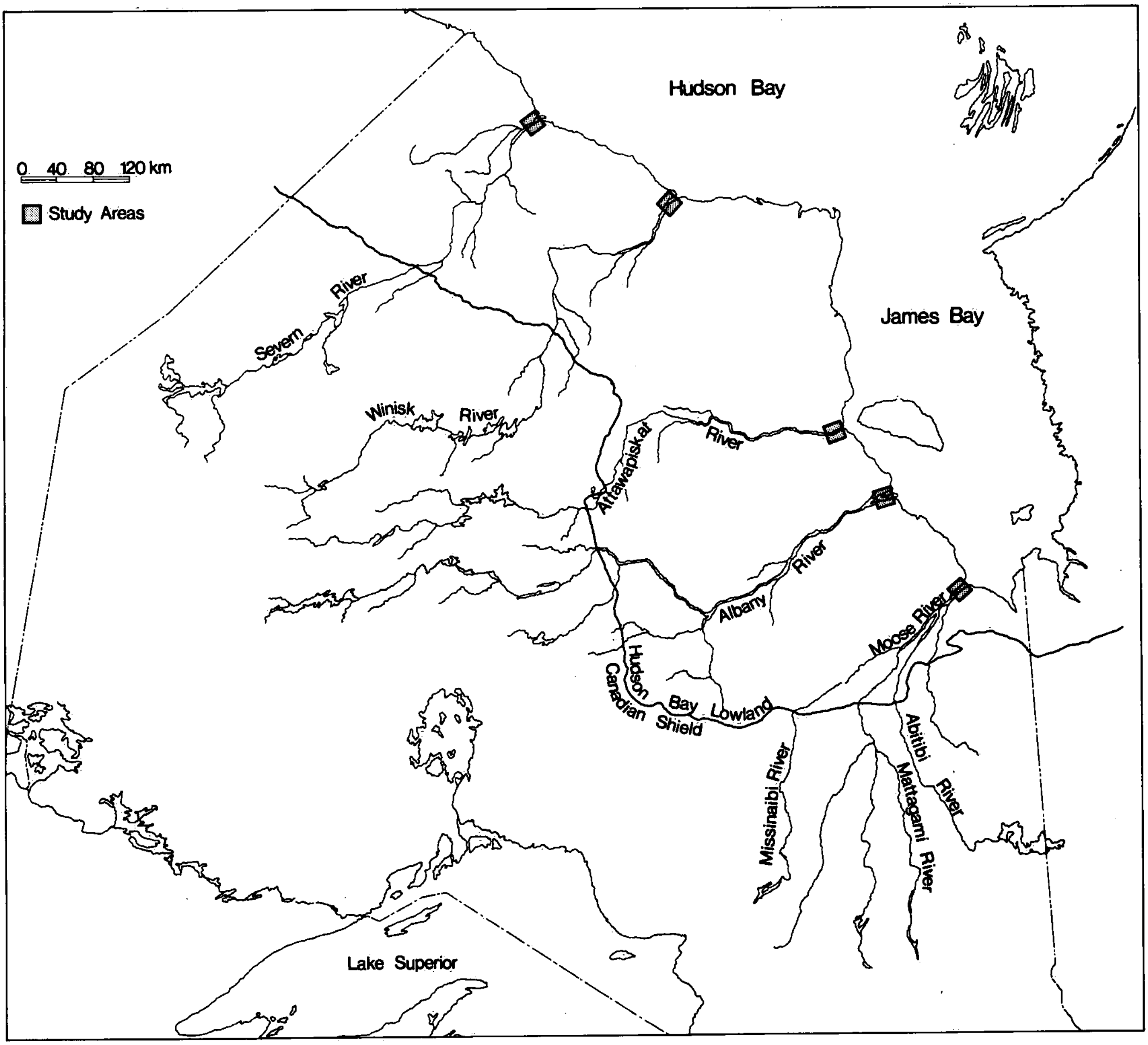

Figure 1. Location of sampling areas in the Hudson Bay Lowland drainage basin

nearest 0.1 m by sounding line. Relative stream velocity was determined with a Price 622 AA water vane held 1 m below the water surface. The number of revolutions counted per second was converted to velocity using the equation

$$v = B + 0.676\ N$$

where v is the velocity in metres per second, N is the number of revolutions per second counted and B is the Y-intercept (0.000).

Water Chemistry

Water chemistry samples were collected at a depth of 0.5 m with 500-mL polyethylene sampling bottles. Aliquots were decanted into bottles containing preservatives and analyzed at WQB-OR laboratories using methods outlined in the *Analytical Methods Manual* (Environment Canada, 1979) for major ions (calcium, chloride, magnesium, potassium, silica, sodium and sulphate), nutrients (total Kjeldahl nitrogen, nitrate plus nitrite, ammonia and total phosphorus) and trace metals (extractable aluminum, and total arsenic, cadmium, copper, iron, lead, manganese, nickel, selenium and zinc). Samples were also analyzed for alkalinity, colour, conductivity and pH. Details concerning the type of containers used, sample preservation and reporting limits are given in Appendix A.

Benthos

Since quantitative study of each river system was beyond the scope of the benthic survey, a qualitative approach was adopted. The traditional stream transect was attempted on all rivers but abandoned because in the main channels of the rivers, the river bottom consisted of large stones which prevented the mini-Ponar from closing. Repeated attempts in the main channels of each of the five rivers yielded no sediment whatsoever, and the large stones caught in the jaws of the mini-Ponar had no attached macroinvertebrates. It was thus decided to use the sample site selection method of systematic sampling. Four to nine sampling sites were chosen on each river in areas where active sedimentation was likely to occur, such as low flow areas between or downstream from islands. Since the Moose River basin is more heavily populated than the other river

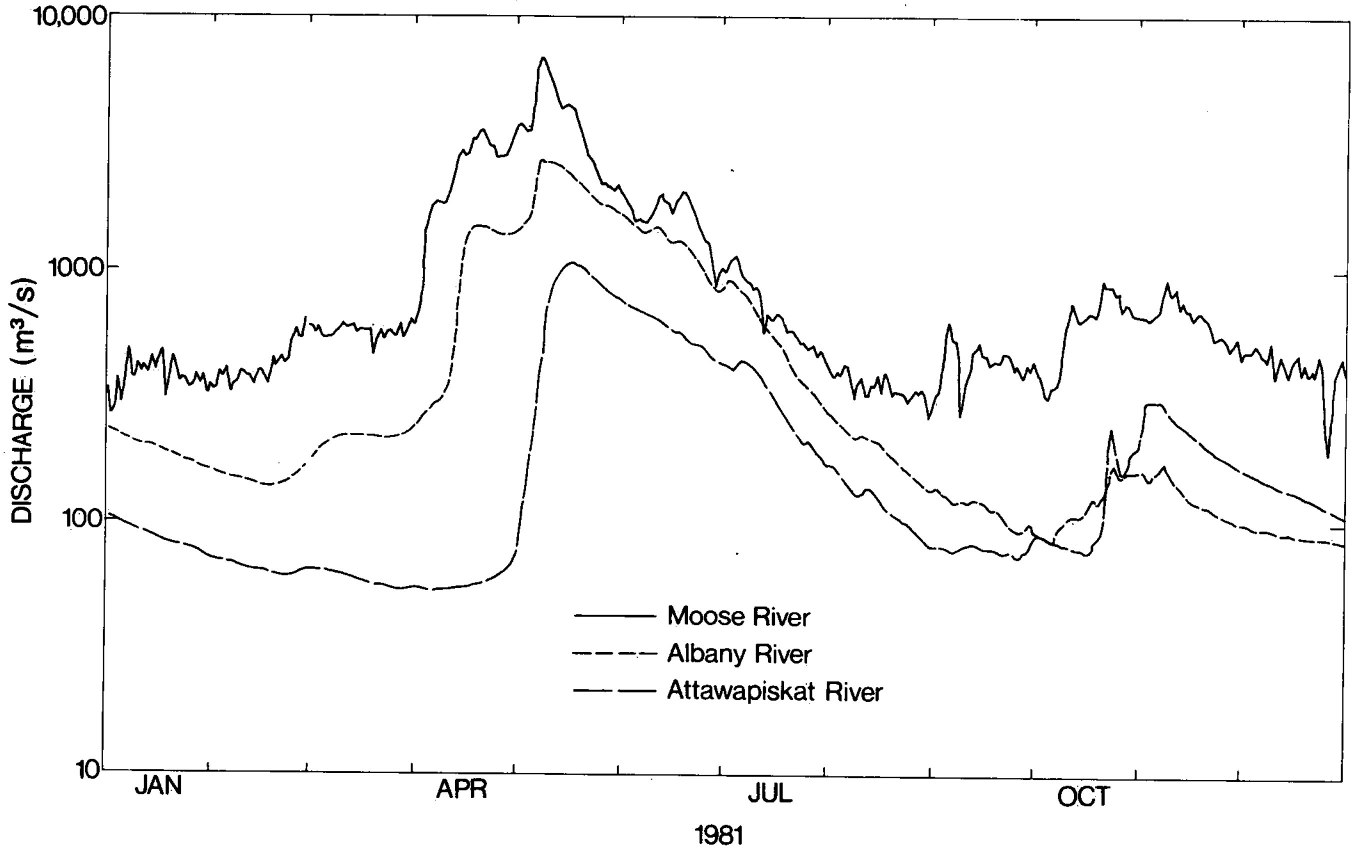

Figure 2. Record of discharge for the Moose, Albany and Attawapiskat rivers in 1981. (Data courtesy of Water Survey of Canada).

systems studied, the potential for ecological damage is greater. In addition, water quality parameters, particularly suspended sediment levels, vary markedly in the east and west channels (McCrea and Merriman, 1981); thus the Moose River was sampled at a greater intensity than the other rivers. Wilhm (1967) and Pielou (1966), using Patten's (1962) species diversity index (D)[1] on invertebrate communities, showed that for all sets of data, D approached an asymptotic level at, or prior to, the fifth sample. Thus five replicates were taken at each sampling site.

Benthic grab samples were collected with a 10-kg, 15- by 15-cm mini-Ponar. The contents of each grab sample were placed in a plastic bucket equipped with a U.S. No. 30 (0.59-mm mesh) sieve. A visual estimate of the bottom substrate type (based on the entire grab sample) was made as a percentage of five categories (pebble, sand, silt, clay and organic debris). The sieve bucket was placed over the side of the canoe, partially submerged in the river and then agitated until all fine materials had passed through. The remaining debris in the sieve bucket was backwashed with river water into wide-mouthed 2-L bottles. At the base camp each evening, all benthic samples were emptied into white enamel trays, visually sorted and placed in 175-mL plastic bottles containing 70% ethanol. Each benthos sample was returned to the laboratory where the organisms were enumerated and identified to the lowest taxonomic level possible with the aid of stereoscopic microscopes (magnification: × 1-50). Organisms containing inner tissues, as seen with a stereoscopic microscope, were considered to be alive at the time of collection and are recorded in Tables B-1 to B-5 in Appendix B. Those organisms without inner tissues, yet still in good condition with prominent markings, were identified as dead. Although these organisms were dead at the time of collection, it was decided that they could yield valuable historical information about the water quality. Therefore the numbers per species obtained at each station were recorded (Table B-6, Appendix B). The taxonomic groups Chironomidae and Tubificidae were permanently mounted on glass slides for examination on an inverted or compound microscope (× 10 to × 100 objectives). The taxonomic keys used in this study were Brinkhurst (1976), Brinkhurst and Jamieson (1971), Burks (1953), Clark (1973), Klemm (1972), Mackie (unpublished), Needham and Westfall (1955), Oliver *et al.* (1978), Pennak (1953), Ross (1944) and Usinger (1963). A reference collection of type specimens obtained was compiled.

[1]Species diversity index:

$$\left(D = \sum_{i=1}^{s} \frac{N_i}{N} \log_2 \frac{N_i}{N}\right)$$

where N is the total number of individuals, N_i is the number of individuals per species, and s is the number of species present.

Trace Organic and Trace Metal Contaminants

At one site per river, approximately 200 L of water was filtered and extracted inside the plane for trace organics. To minimize the risk of contamination, water was drawn by a submersible magnetically driven pump (March, 5C-MD), which was anchored upstream from the aircraft and suspended 1 m below the water surface with a marker buoy. The river water was pumped into a 20-L pressure vessel and filtered through a 293-mm pre-combusted Gellman glass-fibre filter with nitrogen at a gauge pressure of 140 kPa. The filtrate was then extracted for 2 h with 8 L of dichloromethane (Caledon, DIG) using a newly developed aqueous phase liquid-liquid extractor (APLE) (McCrea, 1982). The solvent extract was stored in 4-L amber solvent bottles at 4°C, and filters were stored at the same temperature in pre-extracted tin-plated cans containing 150 mL of 1:1 acetone-hexane solution. The aqueous phase and suspended sediment samples were analyzed for a wide range of organochlorines (HCB, α-BHC, γ-BHC, heptachlor, aldrin, heptachlor epoxide, α-chlordane, γ-chlordane, α-endosulfan, p,p′-DDE, dieldrin, endrin, o,p′-DDT, p,p′-TDE, p,p′-DDT, β-endosulfan, mirex and p,p′-methoxychlor) and total PCB's at WQB-OR laboratories using standard methods (Environment Canada, 1979).

Bottom sediment grab samples for trace metal and trace organic analyses were collected at various sites across each river with a mini-Ponar. The top 1 cm of bottom sediment was carefully removed and placed in polyethylene bags for trace metal analyses and in solvent-cleaned (acetone-hexane) tin-plated containers for organic analyses. These samples were subsequently stored at -20°C. At the WQB-OR laboratories a portion of wet sediment from the trace metals samples was submitted for extractable mercury analysis. The remaining sediment was freeze-dried and analyzed for particle size and both non-residual and total metals. Sieve analysis yielding gravel, sand and silt/clay percentages was carried out on the coarse bottom sediment samples. On the finer bottom sediment sieve, short pipette and settling tube analysis was performed to separate the silt/clay fraction. Particle size analyses were determined courtesy of the Hydraulics Division of the National Water Research Institute in Burlington, Ontario (Duncan and LaHaie, 1979). The trace metal samples were tested for aluminum, cadmium, copper, iron, lead, manganese, nickel and zinc (Environment Canada, 1979). A composite sample for trace organic analysis was prepared from each river. In addition, individual sample analyses on Moose River bottom sediment were carried out for organochlorine pesticides, total PCB's, polyaromatic hydrocarbons, chlorobenzenes and phthalates (see Table A-3 of Appendix A for a complete parameter listing).

Five northern pike (*Esox americanus*) were captured from each river using gill nets. The same method was used to capture five common white sucker (*Catostomus commersoni*). The exceptions were the Attawapiskat and Winisk rivers where only three individuals of this species were collected. These species were of particular interest because they represent two different trophic levels. The northern pike is a top carnivore, whereas the common white sucker is a bottom scavenger. Immediately after collection each fish was wrapped in acetone-hexane-rinsed aluminum foil, placed in polyethylene bags and stored at -20°C. Individual fish were measured (total and fork length), weighed, sexed and aged. Ageing of northern pike was determined by counting cleithral annuli and verified by scale readings. Common white suckers were aged by enumerating opercular annuli and some specimens were checked using fin-ray sections. The whole fish tissue was passed (a minimum of five times) through a Hobart stainless-steel meat grinder. A portion of the fish paste was further homogenized for 5 min in a stainless-steel blender. Fifty-gram aliquots of the homogenate were stored at -20°C in acetone-hexane-rinsed and acid-washed glass containers for trace organic and trace metal analyses, respectively. The analyses were carried out by WQB-OR laboratories using standard methods (Environment Canada, 1979).

RESULTS AND DISCUSSION

Water temperatures in the five major rivers of the Hudson Bay Lowland ranged from 10.2°C to 16.7°C. It is interesting to note that the water temperatures increased markedly immediately following spring runoff even though surrounding inland lakes were frozen, air temperatures were still quite low, and blocks of ice up to 5 m high could be found on the riverbanks. This reflects the southern origin of the headwaters. Dissolved oxygen measurements indicated that the waters were at or near saturation at all stations. Even though the rivers drain the acidic peatlands of the Hudson Bay Lowland, pH readings were found to be neutral (6.8–7.6). The water was in general moderately soft and of the alkaline earth bicarbonate type where calcium, magnesium and bicarbonate account for most of the ions (Moose, 84%; Albany, 92%; Attawapiskat, 90%; Winisk, 91%; and Severn, 92%). The inorganic water chemistry of the major rivers of the Hudson Bay Lowland varies greatly on a seasonal basis (McCrea and Merriman, 1981). Values obtained in June of 1981 (Tables A-5 to A-9, Appendix A) were typical of spring runoff conditions and represent the lowest ionic concentrations found during the year. Acid stress to these aquatic systems during runoff is unlikely, since the buffering capacity of these rivers appears to be quite high.

Secchi disk readings showed that water clarity in all five rivers was extremely low (0.3 to 0.8 m). It was apparent that the Severn River and the east channel of the Moose River carried high levels of fine suspended sediment (clay) and as a result appeared to be highly coloured. Once the suspended sediments were removed, however, results indicated that the Moose River had the highest true colour, whereas the Severn River had the lowest. The natural yellow-brown colour of these waters reflects high levels of humic acids.

Typical for these northern waters (McCrea and Merriman, 1981), the concentrations of total iron and extractable aluminum were generally high and approached levels of parts per million. Arsenic, lead, nickel and selenium were present at levels well below water quality objectives for the protection of freshwater aquatic life (Ontario Ministry of the Environment, 1978). Cadmium was not detected in any of the water samples. Although concentrations of aluminum, copper and iron exceeded water quality objectives (Ontario Ministry of the Environment, 1978), it is likely that these metals are bound to particulates and the dissolved organic carbon component of these waters, and may not be readily bio-available.

Biological sampling indicated that a large number of benthic species were present in each river, but that no one species predominated. The classes Insecta (dominated by the family Chironomidae) and Oligochaeta (dominated by the family Tubificidae) were the two major taxonomic groups in terms of numbers of individuals in all five river systems (Table 1). A large number of dead pelecypods and gastropods were found in all rivers.

Most of the benthic samples were collected in water less than or equal to 1.0 m in depth, with velocities less than or equal to 0.5 m/s. These stations had high species richness ($\leq$39) and many organisms ($\leq$344). Stations with greater depths and velocities had fewer species ($\leq$7) and fewer organisms ($\leq$20). Little benthic life was found at stations having a high percentage of clay. For a more detailed analysis of this benthic community data and interrelationships between the physical and biological regime refer to Campbell *et al.* (1984).

Particle size analysis revealed that sand was the major component in the bottom sediment, as 15 of the 17 samples contained at least 50% sand (Table C-16, Appendix C). Cadmium was not detected in any of the total metal bottom sediment samples (Table C-17, Appendix C) and was found once in the non-residual fraction at the Moose A station (Table C-18, Appendix C). Other metals, such as mercury, copper, lead, nickel and zinc were below the Ontario Ministry of the Environment guideline for dredge spoils (1976).

Table 1. The Percentage of Individual Organisms in Listed Taxa, Total Number of Organisms and Total Number of Species Collected in the Five Major Rivers of the Hudson Bay Lowland, June 4–11, 1981

River	Oligochaeta*	Insecta*			Mollusca*		Total No. of organisms	Total No. of species
	Tubificidae	Chironomidae	Trichoptera	Ephemeroptera	Gastropoda	Pelecypoda		
Moose (9 stations)	26.2	53.3	1.0	0.5	4.3	10.8	585	63
Albany (4 stations)	13.8	72.4	0.2	10.6	1.1	1.1	471	47
Attawapiskat (5 stations)	9.4	73.8	1.4	3.8	0.7	0.7	424	51
Winisk (5 stations)	54.2	36.6	0	0.7	0.5	4.0	618	48
Severn (5 stations)	5.7	67.1	1.9	1.9	2.5	6.0	316	62

*Percentage of individuals in listed taxa.

Analyses of composite bottom sediment samples prepared for each river showed that organochlorine pesticides, phthalates, polyaromatic hydrocarbons and chlorobenzenes were below the detection limit. Polychlorinated biphenyls were the only compounds detected (0.23–1.57 ng/L) in the suspended sediment samples (Tables C-11 to C-15, Appendix C). As it was not possible to determine accurately the small quantity of suspended sediment collected, the concentration of PCB's was calculated with respect to the volume of water filtered and expressed in nanograms per litre.

Total PCB's, α-BHC and p,p′-DDE were most often detected in the two species of fish collected and the concentrations of all compounds present were very low (Tables C-1 to C-10, Appendix C).

Although the levels of organochlorine pesticides and PCB's in the water (unfiltered) and aqueous phase samples were low, a wide range of compounds was detected. A total of 11 different compounds were found with α-BHC, PCB's and heptachlor epoxide having the highest concentrations.

Water samples for trace organic analysis have been routinely collected and analyzed since September of 1980 from the five major rivers of the Hudson Bay Lowland as part of the WQB-OR Northern Baseline Network. The results indicate that the concentrations of many of these compounds are extremely variable and that high levels can be found in these northern waters. A future paper based on information obtained during this study and data generated by the Northern Baseline Network will provide a detailed analysis, focussing on the distribution and bioaccumulation of trace organics in the five major rivers of the Hudson Bay Lowland.

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The authors wish to thank the staff of the Water Quality Branch Laboratories, Ontario Region, for conducting the chemical analyses. We would also like to acknowledge the help of C. Burke, J.M. Hunter, R. Turner, T. Edwards and the staff of the Ministry of Natural Resources at Moosonee for the collection of fish. We are grateful to Greg Munger for ageing the fish and to D.M. Whittle and V.W. Cairns of the Great Lakes Fisheries Research Laboratories for their advice and assistance in the collection and preparation of the fish. Special thanks are extended to B. Rooke of the University of Guelph, L. Kalas of the National Water Research Institute and R. Dermott (GLFRL) for the help they provided in identifying the benthic organisms. We would also like to thank G. Duncan and K. Salisbury of the National Water Research Institute for determining the particle size distribution of the bottom sediments. In addition, the authors would like to thank J. Fischer, M. Neilson, R. Stevens and D. Warry for reviewing this report.

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Appendix A

Listing of Sampling Locations, Field Observations, Parameters Measured and Water Chemistry Data

Listing of Sampling Locations, Field Observations, Parameters Measured and Water Chemistry Data

Figures A-1 to A-5 show the locations of the sampling sites for the Moose, Albany, Attawapiskat, Winisk and Severn rivers, respectively. Tables A-1 to A-9 contain field observations, parameters measured and water chemistry data.

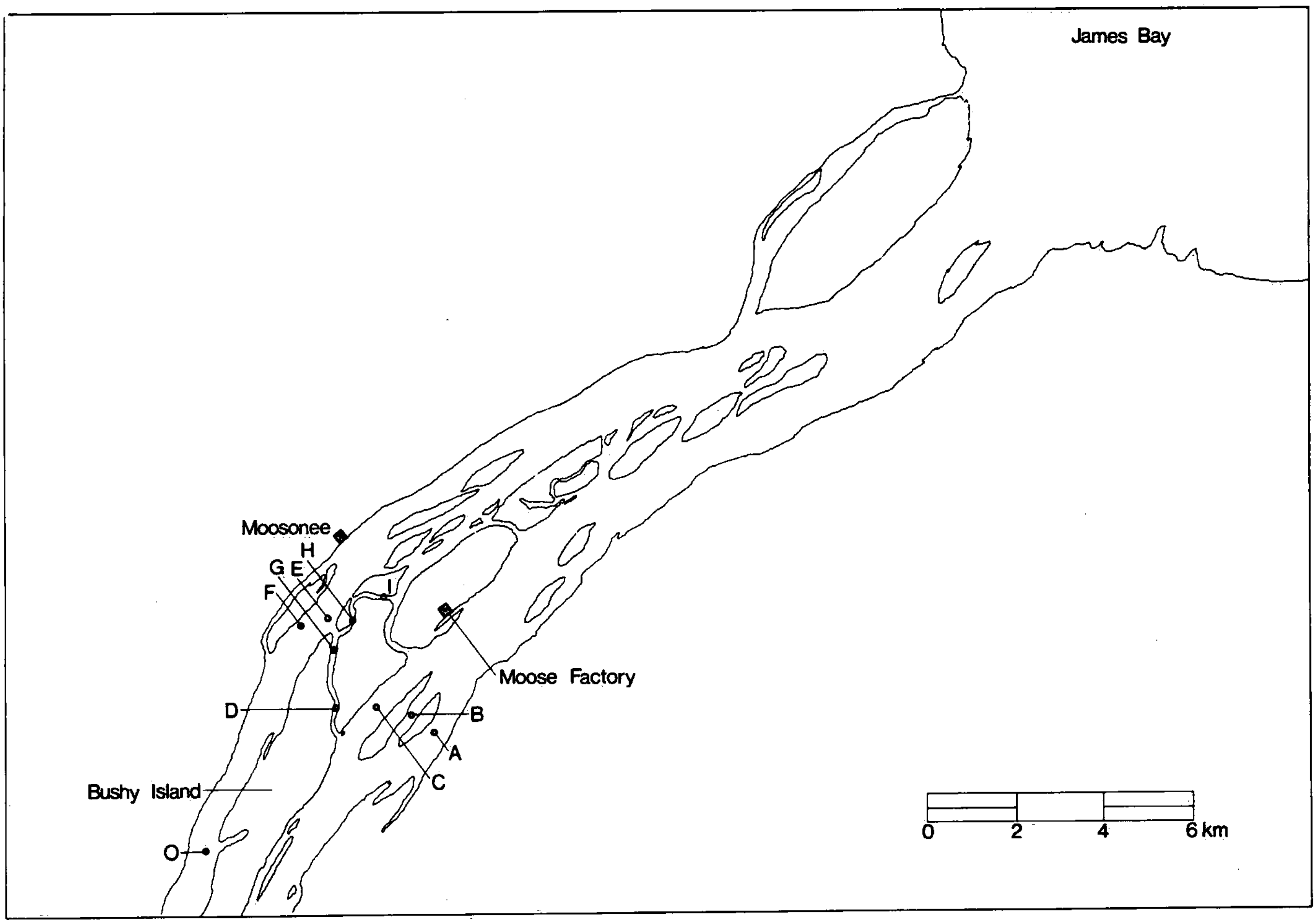

Figure A-1. Location of sampling sites on the Moose River, June 1981.

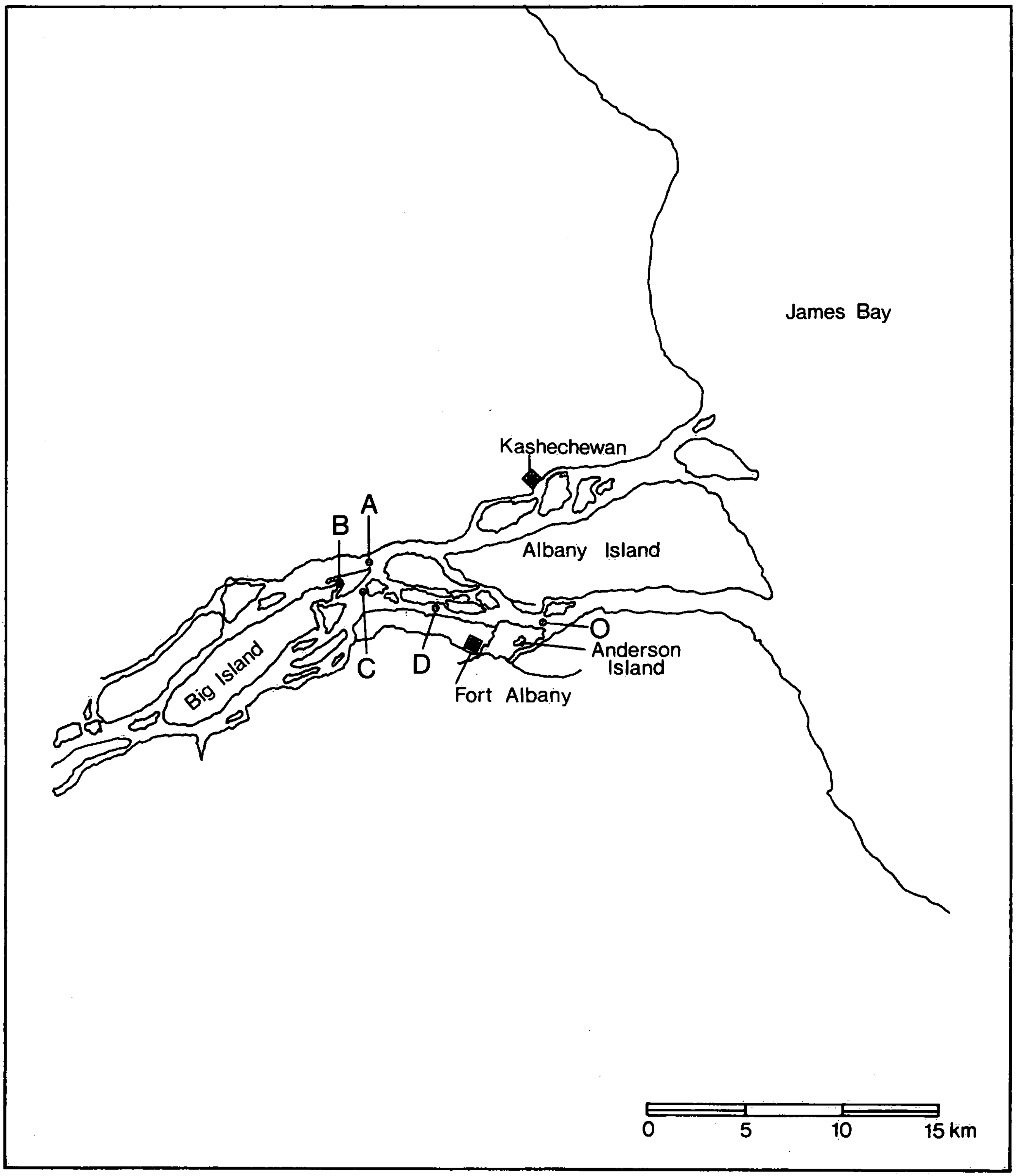

Figure A-2. Location of sampling sites on the Albany River, June 1981.

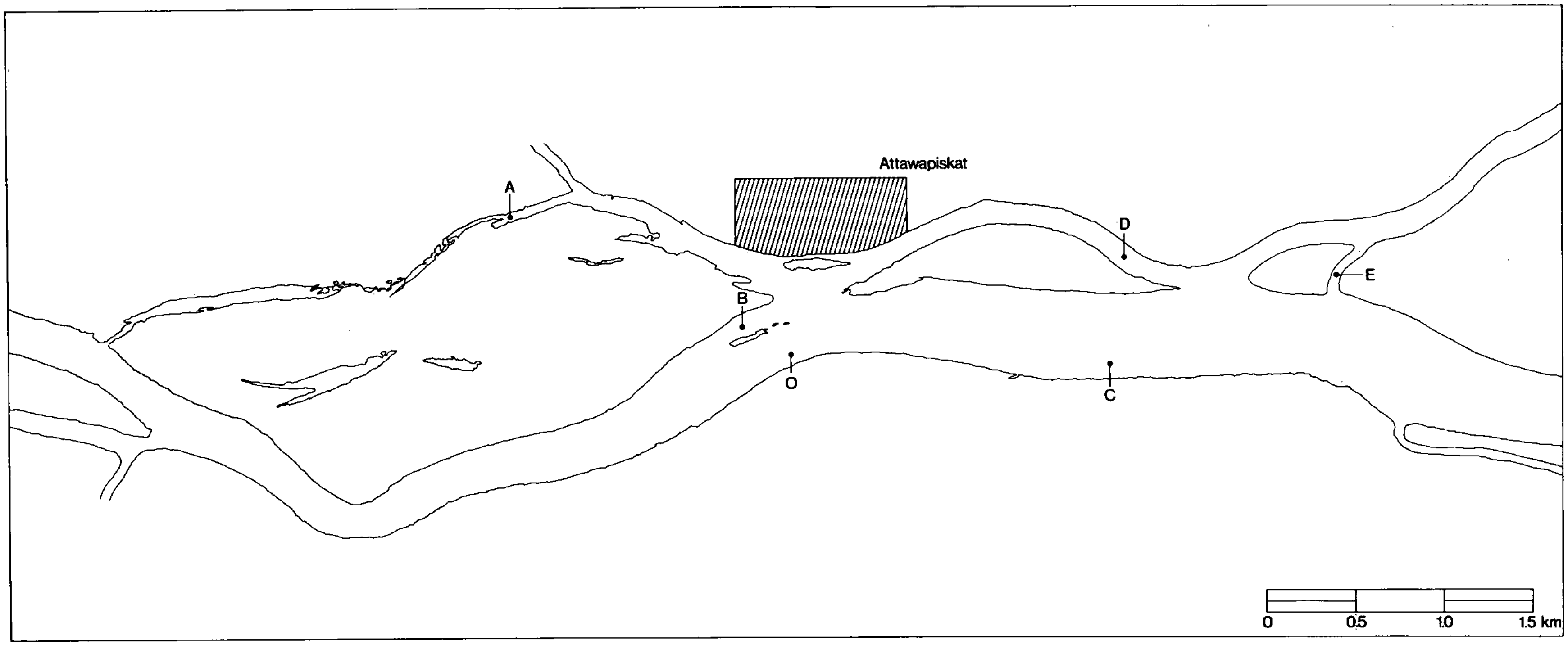

Figure A-3. Location of sampling sites on the Attawapiskat River, June 1981.

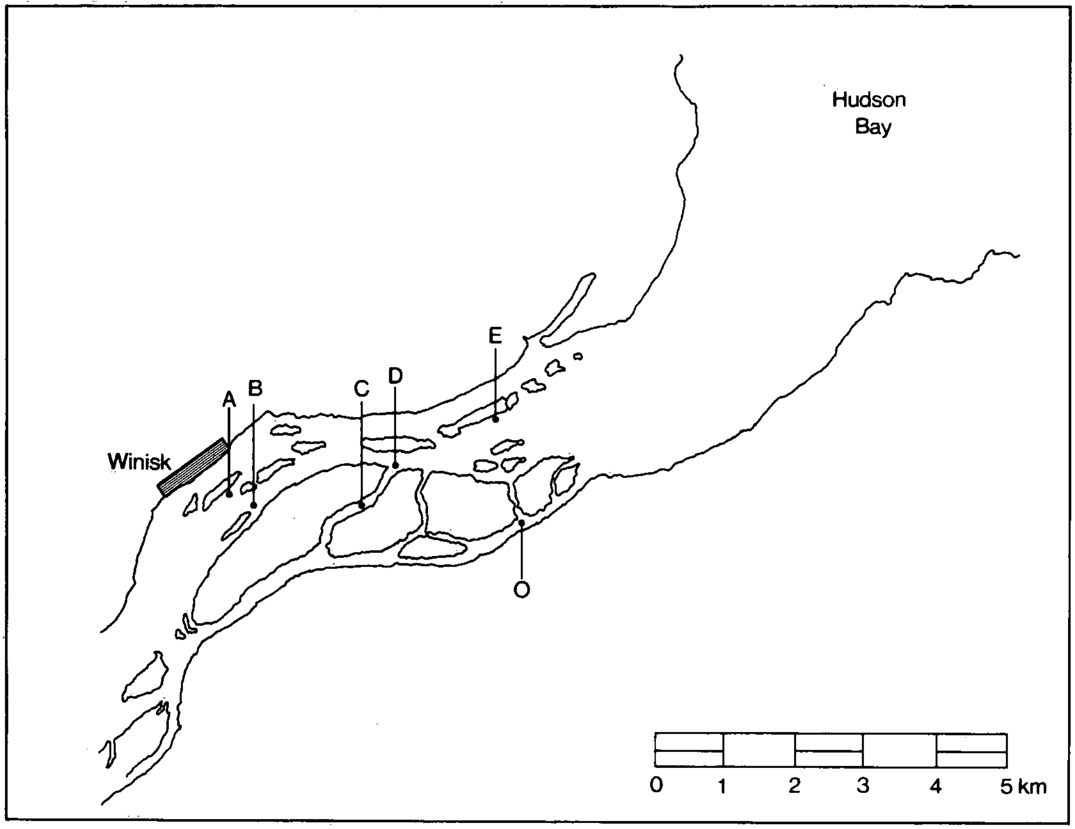

Figure A-4. Location of sampling sites on the Winisk River, June 1981.

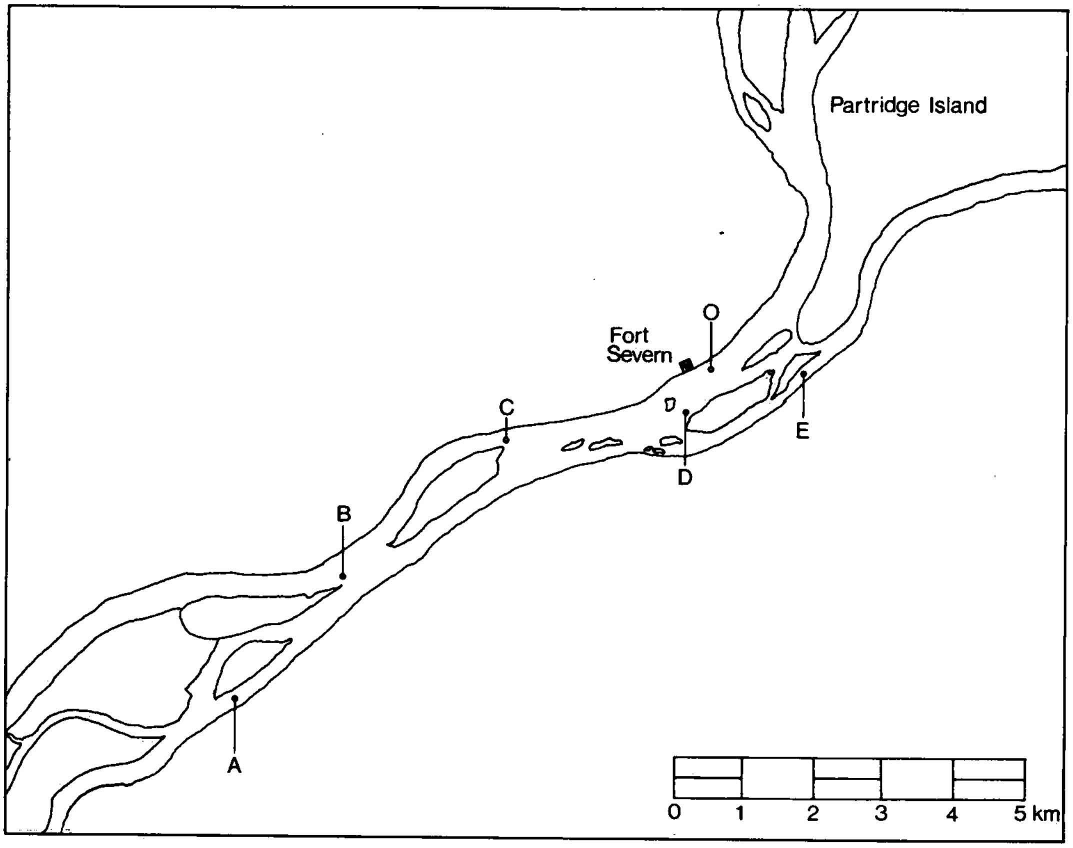

Figure A-5. Location of sampling sites on the Severn River, June 1981.

Table A-1. A Listing of Samples Collected from the Five Rivers Studied in the Hudson Bay Lowland, June 4-11, 1981

River	Station	Bottom sediment trace organic	Bottom sediment trace metal	Water chemistry samples	Benthos grab samples	Physical parameters
Moose	A	X/C	X	N.S.	X	X
	B	N.S.	N.S.	X	X	X
	C	X/C	X	X	X	X
	D	N.S.	N.S.	N.S.	X	X
	E	X/C	X	X	X	X
	F	X/C	X	X	X	X
	G	N.S.	N.S.	N.S.	X	X
	H	N.S.	N.S.	N.S.	X	X
	I	N.S.	N.S.	N.S.	X	X
Albany	A	N.S.	X	X	X	X
	B	C	X	X	X	X
	C	C	X	X	X	X
	D	N.S.	N.S.	N.S.	X	X
Attawapiskat	A	C	X	X	X	X
	B	C	N.S.	X	X	X
	C	C	X	X	X	X
	D	C	X	X	X	X
	E	C	N.S.	N.S.	X	X
Winisk	A	X	X	X	X	
	B	X	X	X	X	
	C	C	X	X	X	X
	D	N.S.	N.S.	N.S.	X	X
	E	C	X	X	X	X
Severn	A	C	N.S.	X	X	X
	B	C	X	X	X	X
	C	C	X	X	X	X
	D	C	X	X	X	X
	E	C	X	X	X	X

X – Denotes sample or measurement taken.
C – Denotes from which stations a single composite sample per river was prepared.
N.S. – No sample or measurement taken.

Table A-2. A Listing of Inorganic Parameter Reporting Limits, Preservatives and Containers Used for Water Samples Collected from the Five Rivers Studied, June 4-11, 1981

Parameter	Reporting limit (mg/L)	Preservative	Sample container (material/size)
Alkalinity	1.0	None	Polyethylene, 0.5 L
Calcium	0.2	None	Polyethylene, 0.5 L
Chloride	0.1	None	Polyethylene, 0.5 L
Magnesium	0.1	None	Polyethylene, 0.5 L
Potassium	0.05	None	Polyethylene, 0.5 L
Sodium	0.1	None	Polyethylene, 0.5 L
Sulphate	0.4	None	Polyethylene, 0.5 L
Nitrate + nitrite	0.001	Kept at 4°C	Glass, 125 mL
Nitrogen, total Kjeldahl	0.01	Kept at 4°C	Glass, 125 mL
Phosphorus, total	0.0005	H_2SO_4 (30%), 1 mL	Glass, 125 mL, 0.5 L
Silica, soluble reactive	0.01	Kept at 4°C	Polyethylene, 0.5 L
Aluminum, extractable	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Mercury, extractable	0.00005	H_2SO_4 (conc.), 1 mL +$K_2Cr_2O_7$ (5%), 1 mL	Polypropylene, 125 mL
Arsenic, total	0.0001	None	Polyethylene, 0.5 L
Cadmium, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Copper, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Iron, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Lead, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Manganese, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Nickel, total	0.001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L
Selenium, total	0.0001	None	Polyethylene, 0.5 L
Zinc, total	0.0001	HNO_3 (50%), 2 mL	Polyethylene, 0.5 L

Table A-3. Listing of Organic Contaminants Measured in the Five Rivers Studied, June 4–11, 1981

Organochlorine pesticides	Phthalates	Polyaromatic hydrocarbons (PAH's)	Chlorobenzenes
HCB	Dimethylphthalate	1-Methylnaphthalene	1,3-Di-chlorobenzene
α-BHC	Diethylphthalate	2-Methylnaphthalene	1,4-Di-chlorobenzene
γ-BHC	Bi-*n*-butylphthalate	Acenaphthylene	1,2-Di-chlorobenzene
Heptachlor	Butylbenzylphthalate	Fluorene	1,3,5-Tri-chlorobenzene
Aldrin	Bis-(2-ethylhexyl)phthalate	Phenanthrene	1,2,4-Tri-chlorobenzene
Heptachlor epoxide	Dioctylphthalate	Fluoranthene	1,2,3-Tri-chlorobenzene
γ-Chlordane		Pyrene	1,2,4,5-Tetra-chlorobenzene
α-Chlordane		Indene	1,2,3,5-Tetra-chlorobenzene
α-Endosulfan		1,2,3,4-Tetrahydronaphthalene	1,2,3,4-Tetra-chlorobenzene
p,p'-DDE		Acenaphthene	
Dieldrin		Quinoline	
Endrin			
o,p'-DDT			
p,p'-TDE			
p,p'-DDT			
β-Endosulfan			
Mirex			
p,p'-Methoxychlor			

Detection limits:
Organochlorine pesticides – Water, 0.0001 μg/L; fish and sediment, 0.001 μg/g.
Total PCB's – Water, 0.001 μg/L; fish and sediment, 0.01 μg/g.
Phthalates and PAH's – Sediment, 0.5 μg/g.
Chlorobenzenes – Sediment, 0.001 μg/g.

Table A-4. Physical Data for the Five Rivers Studied, June 4–11, 1981

River	Station	Date	Depth (m)	Velocity (m/s)	Temperature (°C)	Secchi (m)	Dissolved oxygen (mg/L)*	Bottom type (%)†				
								Pebble	Sand	Clay	Silt	Organic
Moose	A	4	1.0	0.55	14.3	0.6	10.	60	35	0	0	5
	B	4	4.0	0.65	14.2	0.5	10.	75	25	0	0	0
	C	4	1.8	0.71	14.2	0.6	11.	0	95	0	5	0
	D	4	2.1	0.85	16.5	0.6	10.	10	90	0	0	0
	E	4	3.7	0.61	16.7	0.6	9.	0	100	0	0	0
	F	4	3.0	0.13	16.0	0.6	10.	5	95	0	0	0
	G	11	1.4	0.13	14.5	0.6	9.	0	90	0	0	10
	H	11	1.4	0.05	14.7	0.6	10.	0	0	0	80	20
	I	11	0.6	0.13	14.6	0.4	10.	0	0	0	80	20
Albany	A	5	0.8	0.61	13.4	0.8	10.	90	10	0	0	0
	B	5	1.0	0.05	14.6	0.6	10.	0	50	0	0	50
	C	5	1.2	0.05	14.3	0.6	10.	0	30	0	0	70
	D	10	1.0	0.36	11.9	0.3	10.	0	0	20	40	40
Attawapiskat	A	7	0.5	0.05	9.3	0.5	11.	0	0	0	50	50
	B	7	0.6	0.30	11.2	0.6	9.	75	0	0	25	0
	C	7	3.7	0.52	11.2	0.5	9.	0	0	100	0	0
	D	7	1.8	0.40	11.9	0.5	10.	0	0	0	80	20
	E	7	1.0	0.18	11.6	0.8	10.	0	0	0	100	0
Winisk	A	8	0.6	0.05	10.9	0.6	9.	0	0	0	80	20
	B	8	0.7	0.23	10.2	0.7	10.	0	0	0	90	10
	C	8	0.4	0.05	11.1	0.4	10.	0	0	0	80	20
	D	8	0.5	0.05	10.3	0.5	10.	0	0	0	80	20
	E	8	0.5	0.39	10.2	0.5	10.	80	0	0	20	0
Severn	A	9	0.4	0.33	10.4	0.4	10.	0	0	100	0	0
	B	9	0.5	0.42	10.3	0.5	10.	0	0	0	20	80
	C	9	0.5	0.09	11.6	0.5	11.	0	80	0	0	20
	D	9	0.5	0.5	11.4	0.5	11.	35	50	0	0	15
	E	9	0.6	0.33	10.8	0.6	10.	0	0	0	100	0

*Average of three measurements.
†The percentages given are strictly a visual estimate by the collector.

Table A-5. Water Chemistry Data (mg/L) for the Moose River, June 4, 1981

Parameter	Station B	Station C	Station E	Station F
pH*	7.3	7.2	7.3	7.3
Specific conductance*	128.	126.	134.	126.
Colour*	80	80	80	100
Alkalinity	50.	50.	51.	50.
Calcium	19.6	19.3	20.3	21.0
Chloride	2.0	1.8	2.2	3.7
Magnesium	3.7	3.8	3.9	3.6
Potassium	0.61	0.54	0.51	0.46
Silica	3.36	2.94	2.56	2.03
Sodium	1.6	1.2	1.4	2.2
Sulphate	7.2	5.7	5.0	4.7
Ammonia	0.014	0.022	0.010	0.010
Nitrogen, total Kjeldahl	0.311	0.379	0.391	0.563
Nitrate + nitrite	0.126	0.167	0.188	0.046
Phosphorus, total	0.0238	0.0181	0.0189	0.0146
Aluminum, extractable	0.84	0.36	0.33	0.26
Arsenic, total	0.0008	0.0005	0.0003	0.0004
Cadmium, total	N.D.	N.D.	N.D.	N.D.
Copper, total	0.014	0.014	0.012	0.021
Iron, total	0.90	0.51	0.42	0.39
Lead, total	0.004	0.004	0.010	0.001
Manganese, total	N.D.	N.D.	N.D.	N.D.
Nickel, total	0.001	0.003	0.001	N.D.
Selenium, total	0.0001	0.0001	N.D.	0.0001
Zinc, total	0.10	0.002	0.002	N.D.

Table A-6. Water Chemistry Data (mg/L) for the Albany River, June 5, 1981

Parameter	Station A	Station B	Station C
pH*	7.3	7.4	6.8
Specific conductance*	115.	123.	125.
Colour*	70	70	70
Alkalinity	55.	54.	59.
Calcium	18.5	18.9	19.5
Chloride	1.5	1.7	1.8
Magnesium	3.4	3.7	3.9
Potassium	0.35	0.34	0.34
Silica	1.98	2.10	1.98
Sodium	0.9	1.0	1.1
Sulphate	1.7	1.9	2.0
Ammonia	0.011	0.016	0.028
Nitrogen, total Kjeldahl	0.445	0.434	0.467
Nitrate + nitrite	0.059	0.032	0.060
Phosphorus, total	0.0185	0.0134	0.0142
Aluminum, extractable	0.28	0.28	0.16
Arsenic, total	0.0003	0.0004	0.0003
Cadmium, total	N.D.	N.D.	N.D.
Copper, total	0.008	0.007	0.012
Iron, total	0.44	0.25	0.28
Lead, total	N.D.	N.D.	N.D.
Manganese, total	N.D.	N.D.	N.D.
Nickel, total	N.D.	N.D.	N.D.
Selenium, total	N.D.	0.0001	0.0001
Zinc, total	N.D.	0.002	N.D.

Table A-7. Water Chemistry Data (mg/L) for the Attawapiskat River, June 7, 1981

Parameter	Station A	Station B	Station C	Station D
pH*	7.0	7.3	6.9	7.3
Specific conductance*	206.	113.	121.	141.
Colour*	40	50	50	70
Alkalinity	85.	48.	54.	45.
Calcium	26.6	17.8	18.9	18.5
Chloride	15.5	2.5	2.3	10.6
Magnesium	4.1	2.9	3.0	3.1
Potassium	1.07	0.41	0.42	0.40
Silica	2.56	2.32	2.28	1.13
Sodium	10.1	1.6	1.5	6.5
Sulphate	0.9	1.1	1.1	1.7
Ammonia	0.011	0.013	0.012	0.025
Nitrogen, total Kjeldahl	0.355	0.311	0.328	0.446
Nitrate + nitrite	0.068	0.067	0.009	0.010
Phosphorus, total	0.0172	0.0204	0.0209	0.0241
Aluminum, extractable	0.29	0.26	0.46	0.55
Arsenic, total	0.0004	0.0006	0.0005	0.0004
Cadmium, total	N.D.	N.D.	N.D.	N.D.
Copper, total	0.006	0.013	0.015	0.007
Iron, total	0.64	0.47	0.59	0.71
Lead, total	N.D.	N.D.	N.D.	0.001
Manganese, total	0.041	N.D.	0.022	0.020
Nickel, total	N.D.	N.D.	N.D.	N.D.
Selenium, total	N.D.	0.0001	N.D.	0.0001
Zinc, total	N.D.	N.D.	0.003	0.002

NOTES:

*Units are: pH = $-\log [H^+]$

Specific conductance: microsiemens per centimetre ($\mu S/cm$)

Colour measured in units of 10 on platinum-cobalt scale.

N.D. – Not detected.

Table A-8. Water Chemistry Data (mg/L) for the Winisk River, June 8, 1981

Parameter	Station A	B	C	E
pH*	7.1	7.2	7.3	7.6
Specific conductance*	104.	110.	108.	106.
Colour*	40	40	40	40
Alkalinity	47.	48.	49.	46.
Calcium	17.2	18.1	18.1	18.2
Chloride	1.6	2.1	1.6	2.2
Magnesium	2.4	2.1	2.4	2.2
Potassium	0.28	0.26	0.30	0.27
Silica	1.56	1.49	1.66	1.55
Sodium	1.0	1.3	1.0	1.4
Sulphate	0.7	0.7	0.8	0.7
Ammonia	0.033	0.010	0.014	0.009
Nitrogen, total Kjeldahl	0.380	0.354	0.327	0.294
Nitrate + nitrite	0.057	0.069	0.054	0.076
Phosphorus, total	0.0163	0.0178	0.0220	0.0169
Aluminum, extractable	0.14	0.22	0.29	0.20
Arsenic, total	0.0002	0.0004	0.0004	0.0003
Cadmium, total	N.D.	N.D.	N.D.	N.D.
Copper, total	0.013	0.011	0.017	0.014
Iron, total	0.33	0.60	0.57	0.46
Lead, total	N.D.	0.001	0.001	0.001
Manganese, total	N.D.	0.047	0.031	N.D.
Nickel, total	N.D.	N.D.	N.D.	N.D.
Selenium, total	N.D.	N.D.	N.D.	N.D.
Zinc, total	0.076	0.007	0.005	0.001

Table A-9. Water Chemistry Data (mg/L) for the Severn River, June 9, 1981

Parameter	Station A	B	C	D	E
pH*	7.4	7.5	7.5	6.9	7.4
Specific conductance*	125.	126.	130.	119.	115.
Colour*	20	20	20	20	20
Alkalinity	54.	56.	58.	56.	52.
Calcium	19.7	19.9	20.8	19.0	18.4
Chloride	2.1	2.6	2.1	1.7	1.7
Magnesium	2.9	2.9	3.0	3.0	2.8
Potassium	0.38	0.39	0.38	0.35	0.35
Silica	1.74	1.76	1.89	1.63	1.69
Sodium	1.7	2.1	1.6	1.4	1.4
Sulphate	0.9	0.5	0.5	0.5	0.4
Ammonia	0.012	0.022	0.049	0.009	0.013
Nitrogen, total Kjeldahl	0.324	0.339	0.401	0.335	0.318
Nitrate + nitrite	0.037	0.051	0.014	0.136	0.012
Phosphorus, total	0.0278	0.0187	0.0212	0.0300	0.0214
Aluminum, extractable	0.63	0.72	0.51	0.54	0.35
Arsenic, total	0.0005	0.0004	0.0005	0.0003	0.0003
Cadmium, total	N.D.	N.D.	N.D.	N.D.	N.D.
Copper, total	0.006	0.006	0.008	0.007	0.013
Iron, total	0.67	0.47	0.72	0.44	0.51
Lead, total	N.D.	N.D.	N.D.	N.D.	0.003
Manganese, total	N.D.	N.D.	0.023	N.D.	N.D.
Nickel, total	0.001	N.D.	N.D.	N.D.	N.D.
Selenium, total	0.0001	N.D.	0.0001	N.D.	N.D.
Zinc, total	0.003	N.D.	0.004	N.D.	0.002

Appendix B
Occurrence and Abundance of Benthic Organisms

Occurrence and Abundance of Benthic Organisms

Table B-1a. Benthic Species Found in the Moose River, June 1981

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gastropoda																									
Hydrobiidae																									
Probythinella lacustris (Baker)							2									5	2	4							
Valvatidae																									
Valvata tricarinata (Say)																2	2	3	1						
Insecta																									
Coleoptera																									
Chrysmelidae																									
Donacia sp.																									
Elmidae																									
Limnius sp.	1																								
Incomplete specimens								1																	
Diptera																									
Ceratopogonidae																									
Probezzia sp.											1							1							
Chironomidae																									
Chironomus sp.																									
Cladotanytarsus sp.																									
Cryptochironomus sp.			1										1												
Cryptotendipes sp.																									
Dicrotendipes sp.																									
Endochironomus sp.																									
Eukiefferiella sp.																									
Eurorthocladius sp.																									
Larsia sp.																									
Micropsecta sp.																									
Orthocladius sp.	2																								
Paracladopelma sp.																							1		
Paratendipes sp.																									
Phaenopsectra sp.																									
Polypedilum sp.	1			2																					
Procladius sp.																									
Psectrocladius sp.																									
Pseudochironomus sp.			2	5	1																				
Pseudochironomus fulviventris (Johannsen)					1																				
Rheotanytarsus sp.																									
Robackia sp.			2		1			3			1			1											
Stempellina sp.					12																				
Stictochironomus sp.																									
Tanytarsus sp.																									
Unidentified																									
Culicidae																									
Chaoborus sp.																									
Unidentified																									
Empididae																									
Clinocera sp.					1																				
Hemerodromia sp.			1	1																					
Unidentified				3																					

*Numbers 1 to 5 represent replicates.

Table B-1a. Continued

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ephemeroptera																									
Ephemeridae																									
Hexagenia atrocaudata McDonnough																									
Hexagenia limbata (Serville)																									
Hexagenia rigida McDonnough																									
Heptageniidae																									
Stenonema bipunctatum (McDonnough)	1																								
Odonata																									
Gomphidae																									
Ophiogomphus sp.	1																								
Plecoptera																									
Perlodidae																									
Isogenus sp.	1																								
Trichoptera																									
Hydropsychidae																									
Potamyia flava (Hagen)	1																								
Leptoceridae																									
Oecetis sp.		1																							
Oecetis cinerascens (Hagen)																									
Limnephilidae																									
Neophylax sp.	1																								
Philopotamidae																									
Chimarra socia Hagen			1																						
Psychomyiidae																									
Psychomyia flavida Hagen				1																					
Oligochaeta																									
Tubificidae																									
Limnodrilus claparedianus (Ratzel)																									
Limnodrilus hoffmeisteri Claparede												1													
Limnodrilus profundicola Verrill																									
Potamothrix vejdovsky Hrabe																									
Tubifex tubifex Muller																									
Incomplete specimens																									
Immature with (-) setae												1													
Unidentified mature (+) setae																									
Unidentified mature (-) setae																									
Pelecypoda																									
Sphaeriidae																									
Musculium lacustre (Muller)										1															
Pisidium compressum Prime																									
Pisidium lilljeborgi Sterki			1																						
Pisidium nitidum Jenyns					1		1		4																
Pisidium subtruncatum Malm																									
Sphaerium striatinum (Lamarck)																									
Unionidae																									
Lasmigona compressa (Lea)									1																

Table B-1b. Benthic Species Found in the Moose River, June 1981

Organisms	Station F					Station G					Station H					Station I				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gastropoda																				
Hydrobiidae																				
Probythinella lacustris (Baker)																			1	
Valvatidae																				
Valvata tricarinata (Say)											1						1			1
Insecta																				
Coleoptera																				
Chrysmelidae																				
Donacia sp.																		1		
Elmidae																				
Limnius sp.																				
Incomplete specimens																				
Diptera																				
Ceratopogonidae																				
Probezzia sp.						1		4	1		6	2	1	8	4		13	3	19	4
Chironomidae																				
Chironomus sp.																			2	
Cladotanytarsus sp. 1											5					2	16	1		32
Cladotanytarsus sp. 2												2		1		4				
Cryptochironomus sp.			1	2															1	
Cryptotendipes sp.												1	2							
Dicrotendipes sp.														2						
Endochironomus sp.					1															
Eukiefferiella sp.								1												
Eurorthocladius sp.																				
Larsia sp.																		1		
Micropsecta sp.																1			3	1
Orthocladius sp.																				
Paracladopelma sp.									1	1										
Paratendipes sp.									1											
Phaenopsectra sp.					1						11	5	3	1		2		3	4	
Polypedilum sp.				1												1	4	3	8	1
Procladius sp.																				
Psectrocladius sp.															2					
Pseudochironomus sp.																				
Pseudochironomus fulviventris (Johannsen)																				
Rheotanytarsus sp.						3					10	15								
Robackia sp.				1	2															
Stempellina sp.																				
Stictochironomus sp.												2								
Tanytarsus sp.											2	12			5		2			
Unidentified																				
Culicidae																				
Chaoborus sp.											1									
Unidentified											8	2								
Empididae																				
Clinocera sp.																				
Hemerodromia sp.																				
Unidentified																				
Ephemeroptera																				
Ephemeridae																				
Hexagenia atrocaudata McDonnough																		1		
Hexagenia limbata (Serville)																		1		
Hexagenia rigida McDonnough																1				
Heptageniidae																				
Stenonema bipunctatum (McDonnough)																				

*Numbers 1 to 5 represent replicates.

Table B-1b. Continued

Organisms	Station F					Station G					Station H					Station I				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Odonata																				
Gomphidae																				
Ophiogomphus sp.																				
Plecoptera																				
Perlodidae																				
Isogenus sp.																				
Trichoptera																				
Hydropsychidae																				
Potamyia flava (Hagen)																				
Leptoceridae																				
Oecetis sp.																				
Oecetis cinerascens (Hagen)																		1		
Limnephilidae																				
Neophylax sp.																				
Philopotamidae																				
Chimarra socia Hagen																				
Psychomyiidae																				
Psychomyia flavida Hagen																				
Oligochaeta																				
Tubificidae																				
Limnodrilus claparedianus (Ratzel)														2						
Limnodrilus hoffmeisteri Claparede																2	1	8	2	5
Limnodrilus profundicola Verrill											3	1	3	2	2	35	5	7	3	12
Potamothrix vejdovsky Hrabe																			1	1
Tubifex tubifex Muller																			1	
Incomplete specimens											1			2		8	1	12	1	7
Immature with (-) setae											1	1	3	1		17	2	7	3	6
Unidentified mature (+) setae																1	1	1		
Unidentified mature (-) setae																9		1	1	
Pelecypoda																				
Sphaeriidae																				
Musculium lacustre (Muller)																				
Pisidium compressum Prime														3				4		1
Pisidium lilljeborgi Sterki																		2		2
Pisidium nitidum Jenyns				2							1			1		10		4		
Pisidium subtruncatum Malm																20			1	
Sphaerium striatinum (Lamarck)				2	1															
Unionidae																				
Lasmigona compressa (Lea)																				

Table B-2. Benthic Species Found in the Albany River, June 1981

Organisms	Station A					Station B					Station C					Station D				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gastropoda																				
Hydrobiidae																				
Probythinella lacustris (Baker)																	1			
Lymnaeidae																				
Stagnicola arctica Lea																	1			
Valvatidae																				
Valvata tricarinata (Say)							1		1								1			
Insecta																				
Coleoptera																				
Elmidae																				
Dubiraphia sp.											1									
Diptera																				
Ceratopogonidae																				
Probezzia sp.			1		1				2	1	1	1	2			9	11	5	6	11
Chironomidae																				
Ablabesmyia sp.					1															
Chironomus anthracinus																	1			
Cladotanytarsus sp. 1																			1	2
Cryptochironomus sp.	8		2	5	3					3	1	2	2							
Cryptotendipes sp.																2	1			
Larsia sp.					1															
Micropsecta sp.	2																			
Microtendipes sp.			1																	
Paracladopelma sp.																		1		
Paramerina fragilis																		1		
Paratendipes sp.	3	1		3	6					1	4	2	3			4	5	1	4	7
Phaenopsectra sp.	5				1															1
Polypedilum sp.	1				1					2	2	3					2			1
Polypedilum laetum		1									2									
Polypedilum ophoides			3																	
Procladius sp.	1				2					1	1		1				8	2	2	3
Psectrocladius sp.	2																			
Rheotanytarsus sp.																5	13			
Stempellina sp.	3		1	4	4															
Stictochironomus sp.										1							3			
Tanytarsus sp.	58	31	7	6	18												2	1		
Thienemannemyia sp.											1									
Ephemeroptera																				
Caenidae																				
Caenis sp.							1													
Ephemerellidae																				
Ephemerella bicolor Clemens		1																		
Ephemeridae																				
Ephemera guttulata Pictet		1			1															1
Ephemera simulans Walker						1														
Hexagenia atrocaudata McDonnough									1											
Hexagenia limbata (Serville)							1	3	1							6	10	4		7
Hexagenia rigida McDonnough								1								1	7	1		
Immature nymphs																		1		
Unidentified								1												
Trichoptera																				
Leptoceridae																				
Oecetis eddlestoni Ross												1								

*Numbers 1 to 5 represent replicates.

Table B-2. Continued

Organisms	Station A					Station B					Station C					Station D				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Oligochaeta																				
Enchytraeidae																				
Unidentified													1							
Tubificidae																				
Ilyodrilus templetoni Southern								1												
Limnodrilus augustipenis Brinkhurst and Cook								2												
Limnodrilus claparedianus Ratzel							1	9												
Limnodrilus hoffmeisteri Claparede								5									3			
Limnodrilus profundicola Verrill							1	1		2						1				
Incomplete specimens						2	2	14		3										
Immature with (-) setae							1	22								1	4	1		
Unidentified mature (+) setae							1	2			1					2	1			2
Ostracoda																				
Cutheridae																				
Entocythere sp.												1	1							
Pelecypoda																				
Sphaeriidae																				
Pisidium compressum Prime																1	1			
Pisidium nitidum Jenyns												1				1	1			

Table B-3. Benthic Species Found in the Attawapiskat River, June 1981

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gastropoda																									
Physidae																									
Physa gyrina (Say)					1																				
Planorbidae																									
Gyraulus parvus (Say)					1																				
Valvatidae																									
Valvata tricarinata (Say)					1																				
Insecta																									
Coleoptera																									
Elmidae																									
Dubiraphia sp.					1																1				1
Haliplidae																									
Haliplus sp.	1																								
Diptera																									
Ceratopogonidae																									
Probezzia sp.			2							1						3	8	1		5				2	1
Chironomidae																									
Chironomus anthracinus		2	1																		1			1	
Cladopelma sp.																					1				
Cricotopus sp.	1	5	1						2	8							1								
Cryptochironomus sp.			1	5			2		2	6						2	2	10	1	3		1		5	3
Dicrotendipes sp.	6		2	3	3																				
Eukiefferiella sp.																						1			
Glypototendipes sp.		1																							
Micropsecta sp.																	12								
Paracladopelma sp.													1			4				1		3		3	13
Paratendipes sp.	1	1	1		17			1								2		10	1	2	1	1			4
Polypedilum sp.		1		2	7					3						1	7	1	1		1			4	1
Polypedilum ophoides	9																								
Procladius sp.					1												3	3	1	1				5	4
Pseudochironomus sp.										1	1														
Rheotanytarsus sp.	2	25	1	20	8					1											1				
Stempellina sp.										2															
Stempellinella sp.																					1				
Stictochironomus sp.	1		4	4	2																				
Tanytarsus sp.	6		3	1	5											1	2				1				1
Thienemannemyia sp.						1																			
Tipulidae																									
Penthoptera sp.																1									
Unidentified Diptera pupae			1		1												1								
Ephemeroptera																									
Caenidae																									
Caenis sp.																	2	1							
Ephemeridae																									
Ephemera sp.																	1	1			1				
Ephemera guttulata Pictet																	4								
Ephemera simulans Walker																	1								
Hexagenia sp.																							1		
Hexagenia limbata (Serville)																				1		1			
Hexagenia rigida McDonnough			1																						
Heptageniidae																									
Stenonema sp.																	1								

*Numbers 1 to 5 represent replicates.

Table B-3. Continued

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Trichoptera																									
Hydroptilidae																									
Agraylea multipunctata Curtis																						1			
Leptoceridae																									
Oecetis sp.	1															1									
Oecetis eddlestoni Ross					1																				
Unidentified			2																						
Psychomyiidae																									
Psychomyiid Genus A																	1								
Phylocentropus placidus (Banks)																							1		
Incomplete specimens																							1		
Nematoda																									
Unidentified										1															
Oligochaeta																									
Lumbriculidae																									
Immature	1																								
Tubificidae																									
Limnodrilus hoffmeisteri Claparede																3									3
Potamothrix vejdovsky Hrabe					1																				
Incomplete specimens					2																				
Immature with (-) setae			1	6	17					1						1							1	2	
Unidentified mature with (+) setae																								2	
Unidentified mature with (-) setae		1																							
Pelecypoda																									
Sphaeriidae																									
Pisidium casertanum (Poli)			2																						
Sphaerium sp.														1											

Table B-4. Benthic Species Found in the Winisk River, June 1981

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Crustacea																									
Amphipoda																									
Talitridae																									
Hyalella azteca Saussure																				1					
Gastropoda																									
Hydrobiidae																									
Amnicola limosa (Say)																				1					
Lymnaeidae																									
Nasonia bulimoides Lea																		1							
Planorbidae																									
Gyraulus deflectus (Say)						1																			
Hirudinea																									
Erpobdellidae																									
Erpobdella sp.														1											
Glossiphoniidae																									
Helobdella stagnalis Linnaeus																1									
Insecta																									
Coleoptera																									
Elmidae																									
Dubiraphia sp.										1		1													
Diptera																									
Ceratopogonidae																									
Forcipomyia sp.					1																				
Probezzia sp.																1									
Chironomidae																									
Chironomus anthracinus												1	1	1						1			1		
Cricotopus sp.													1	1									1		
Cryptochironomus sp.			1		4	5	6	4	2							4	1		2	3			2		
Demicrypotochironomus sp.																	1								
Microtendipes sp.			1																						
Paracladopelma sp.	1	1		1	2						4	5	3		5										
Paratendipes sp.	1		1	1		1	1		1		2	1	5		3	5	6			2			1		
Phaenopsectra sp.			1																						
Polypedilum sp.	4		8	1	11	5	2				1	2	2		3	10	7	7	10	11			8		
Polypedilum ophoides	1	1																							
Potthastia longimanus												1							2						
Procladius sp.		1										2			1			1	1	1					
Stempellina sp.	6	2								1															
Stempellinella sp.	1						3																		
Stictochironomus sp.												1	1						1						
Synorthocladius sp.																				1					
Tanytarsus sp.								1	1	1		1	2		1										
Thienemannemyia sp.											1														
Dixidae																									
Unidentified															1										
Muscidae																									
Lispe sp.	1																								
Tabanidae																									
Chrysops sp.											1					1									
Tipulidae																									
Penthoptera sp.																							1		

*Numbers 1 to 5 represent replicates.

Table B-4. Continued

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ephemeroptera																									
Ephemeridae																									
Ephemera sp.															1										
Ephemera simulans Walker			2																						
Hexagenia limbata (Serville)				1																					
Plecoptera																									
Perlodidae																									
Isoperla sp.																				1					
Trichoptera																									
Hydropsychidae																									
Cheumatopsyche sp.																1									
Incomplete specimens																	1								
Nematoda																									
Unidentified																				1					
Oligochaeta																									
Lumbriculidae																									
Immature																							1		
Tubificidae																									
Limnodrilus augustipenis Brinkhurst and Cook												1	2	2	2										
Limnodrilus hoffmeisteri Claparede											3	3	2	7	2	1			1				2		
Limnodrilus profundicola Verrill											1	1	3	3	2	1			1				5		
Tubifex tubifex Muller												1													
Incomplete specimens					3	2	1				16	4	5		6	2	1	1	3				23		
Immature with (-) setae					3						20	40	66	23	48	10	4	4	9	10			17		
Unidentified mature with (+) setae											5	2	6	3	6	3	2	4							
Unidentified mature with (-) setae						1	1													1			2		
Pelecypoda																									
Sphaeriidae																									
Musculium lacustre Muller												1													
Pisidium sp.				1																					
Pisidium lilljeborgi Sterki					2																				
Pisidium nitidum Jenyns	10		1			8																			

Table B-5. Benthic Species Found in the Severn River, June 1981

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gastropoda																									
Physidae																									
Physa gyrina Say													4												
Pupillacea																									
Columella simplex Gould													1												
Valvatidae																									
Valvata tricarinata (Say)												1													2
Hemiptera																									
Unidentified									1																
Hirunidea																									
Glossiphoniidae																									
Glossiphonia sp.					1																				
Glossiphonia complanata (Linnaeus)													2												
Helobdella stagnalis (Linnaeus)								2					1												
Insecta																									
Coleoptera																									
Elmidae																									
Dubiraphia sp.						1							1								1	1			
Optioservus sp.								2	1																
Gyrinidae																									
Gyrinus sp.							1																		
Diptera																									
Ceratopogonidae																									
Probezzia sp.						1																			
Chironomidae																									
Ablabesmyia sp.							1																		
Chironomus anthracinus								2																	1
Cricotopus sp.																							1		
Cryptochironomus sp.						2				3		3			2				1	1	3	7	2	4	2
Micropsectra sp.												1	1							2					
Paracladopelma sp.						2		1		1															
Paratendipes sp.						2	1	7	9			1			1						5	2			
Phaenopsectra sp.								7	1				2												
Polypedilum sp.	1					8	6	4	5	1	3	2	20		1			1	1	1	2	13			2
Potthastia longimanus									1																
Procladius sp.						2	1	3	1	1															
Pseudochironomus sp.							1		1																
Rheocricotopus sp.							3						5												
Stempellina sp.														2											
Stictochironomus sp.								3	13	1	1					1				1					
Synorthocladius sp.																								1	
Tanytarsus sp.										1		1	8												
Thienemannemyia sp.							4	1	2				1												1
Empididae																									
Clinocera sp.							1																		
Ephydridae																									
Brachydeutera sp.								1																	
Muscidae																									
Unidentified						1																			
Tipulidae																									
Hexatoma sp.							1																		
Penthoptera sp.							1		1			1	3						1	1					
Tipula sp.							1																		

*Numbers 1 to 5 represent replicates.

Table B-5. Continued

Organisms	Station A					Station B					Station C					Station D					Station E				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ephemeroptera																									
Baetiscidae																									
Baetisca bajkovi Neave								1																	
Ephemerellidae																									
Ephemerella aestiva McDonnough																									1
Ephemerella bicolor Clemens													1												
Ephemeridae																									
Hexagenia limbata (Serville)								1																	
Hexagenia rigida McDonnough								2																	
Odonata																									
Cordulegasteridae																									
Cordulegaster sp.								1																	
Gomphidae																									
Ophiogomphus sp.								1																	
Plecoptera																									
Perlodidae																									
Isogenus sp.							1																		
Isoperla sp.							9		2				2												
Trichoptera																									
Hydropsychidae																									
Hydropsyche simulans Ross								1																	
Lepidostomatidae																									
Lepidostoma sp.							1																		
Lepidostoma liba Ross													2												
Limnephilidae																									
Pycnopsyche sp.								1																	
Phyacophilidae																									
Agapelus sp.							1																		
Nematoda																									
Unidentified																							1		
Oligochaeta																									
Lumbriculidae																									
Kincaidiana hexatheca									1																
Tubificidae																									
Limnodrilus profundicola																						1			
Tubifex tubifex Muller												1												1	1
Immature with (-) setae						1					1	1									4	4		1	1
Pelecypoda																									
Sphaeriidae																									
Pisidium sp.																									1
Pisidium casertanum (Poli)																						1			
Pisidium compressum Prime																					1	1			
Pisidium lilljeborgi Sterki															1				1						
Pisidium nitidum Jenyns											1	3	2								1	2			
Sphaerium sp.																1		1							
Sphaerium rhomboideum (Say)															1										
Sphaerium striatinum (Lamarck)														1											

Table B-6. Dead* Gastropods and Pelecypods Found in the Hudson Bay/James Bay Lowland, June 1981

Organisms	Moose									Albany				Attawapiskat					Winisk					Severn				
	A	B	C	D	E	F	G	H	I†	A	B	C	D	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Gastropoda																												
Arionidae																												
Nesouitrea electrina (Gould) (T)												2																
Endonontidae																												
Discus cronkhitei Newcomb (T)												4		1														
Hydrobiidae																												
Amnicola limosa (Say)											1		1	8										2			3	
Cincinnatia cincinnatiensis (Anthony)									1					5														
Probythinella lacustris (Baker)	2	3	6	37	1	1		4	12			1		5	2		2	2	1					2				
Lymnaeidae																												
Fossaria parva Lea								10	4																			
Lymnaea arctica Lea				1								2	2	1														
Lymnaea bulimoides																					1							
Nasonia bulimoides Lea												4		2			1			1		4				2	1	
Stagnicola arctica Lea								4	1					18	1				4	1		3	5			1		
Stagnicola reflexa (Say)														4														
Physidae																												
Physa gyrina (Say)		8						1		1	1								3	2	1	2	4			3		
Physa integra Haldeman											1																	
Physa skinneri Taylor								1																				
Planorbidae																												
Armiger crista (Linné)																												1
Gyraulus deflectus (Say)								3						2														
Gyraulus parvus (Say)	1				1									12	3				8			16						
Promenetus exacuous exacuous (Say)														3									7					
Succineioae																												
Succinea ovalis Say															3				4				2					
Succinea wilsoni Lea											2																	
Valvatidae																												
Valvata sincera helicoidea Dall											1								1									
Valvata tricarinata (Say)				3				7	13			3	1	23	2					3		7	7					3
Zonitidae																												
Zonitoides nitidus Muller												2																
Pelecypoda																												
Sphaeriidae																												
Musculium lacustre (Muller)																						1			5			
Pisidium sp. Pfeiffer		1	1																1	1		1						
Pisidium casertanum (Poli)	2			4																								
Pisidium lilljeborgi Sterki																									1			1
Pisidium lilljeborgi cristatum Sterki									2																			
Pisidium nitidum Jenyns				4															11			4				1	2	
Pisidium ventricosum Prime																						1						
Sphaerium sp.				1																								
Sphaerium striatinum (Lamarck)	3	14		3	1							1							4							1	2	

*Organisms without inner tissues when viewed under a stereoscopic microscope were classified as dead.
†Letters A to I represent river stations.

Appendix C

Trace Metal and Trace Organic Contaminants in Fish, Water, Suspended Sediment and Bottom Sediment

Trace Metal and Trace Organic Contaminants in Fish, Water, Suspended Sediment and Bottom Sediment

Table C-1. Physical and Chemical Data (mg/kg) on Five Northern Pike (*Esox americanus*) from the Moose River

Parameter	1	2	3	4	5
Weight (g)	1319.	2361.	1432.	1413.	2160.
Tail length (cm)	58.5	71.0	59.0	61.0	65.0
Fork length (cm)	55.5	67.8	56.0	58.0	61.6
Sex	M	F	F	F	M
Age (yr)	10	16	13	14	12
Arsenic	0.33	0.14	0.12	0.31	0.15
Cadmium	N.D.	N.D.	0.02	0.02	0.02
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	0.45	1.3	0.52	1.6	0.81
Lead	N.D.	N.D.	0.22	0.26	0.32
Mercury	0.19	0.40	0.21	0.26	0.32
Nickel	0.05	0.09	N.D.	0.09	N.D.
Selenium	0.18	0.14	0.21	0.28	0.18
Zinc	32.	24.	27.	33.	33.
HCB	0.001	N.D.	N.D.	N.D.	N.D.
α-BHC	0.001	N.D.	N.D.	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	0.003	N.D.	0.004	0.002	0.005
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.03	0.02	0.04	0.05	0.04

N.D. – Not detected.

Table C-2. Physical and Chemical Data (mg/kg) on Five Common White Sucker (*Catostomus commersoni*) from the Moose River

Parameter	1	2	3	4	5
Weight (g)	1134.	987.	1175.	848.	1396.
Tail length (cm)	45.5	43.0	45.5	39.5	48.0
Fork length (cm)	43.0	41.0	42.5	38.0	45.0
Sex	M	M	F	F	F
Age (yr)	12	10	12	6	14
Arsenic	0.05	0.05	0.07	0.08	0.05
Cadmium	0.03	0.03	0.03	0.02	0.03
Chromium	0.27	N.D.	0.20	0.28	0.27
Copper	3.8	4.6	6.8	3.9	3.0
Lead	0.12	0.17	0.20	0.13	N.D.
Mercury	0.45	0.38	0.32	0.17	0.26
Nickel	0.09	0.09	0.08	0.13	0.13
Selenium	0.22	0.23	0.20	0.22	0.22
Zinc	8.9	9.5	11.	9.4	9.7
HCB	N.D.	N.D.	N.D.	N.D.	N.D.
α-BHC	0.002	N.D.	0.001	0.002	0.004
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	0.001
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	0.004	0.002	0.001	0.004
Dieldrin	N.D.	N.D.	N.D.	N.D.	0.002
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.02	0.21	0.08	0.08	0.06

N.D. – Not detected.

Table C-3. Physical and Chemical Data (mg/kg) on Five Northern Pike from the Albany River

Parameter	1	2	3	4	5
Weight (g)	1275.	1631.	859.	1111.	1591.
Tail length (cm)	57.2	61.8	51.5	57.0	62.1
Fork length (cm)	54.0	58.5	48.5	54.0	58.7
Sex	M	F	M	F	F
Age (yr)	8	9	10	11	14
Arsenic	2.2	1.1	0.99	0.96	1.7
Cadmium	N.D.	0.05	N.D.	N.D.	N.D.
Chromium	N.D.	N.D.	N.D.	0.21	N.D.
Copper	0.44	0.60	0.43	0.60	0.93
Lead	N.D.	N.D.	N.D.	N.D.	N.D.
Mercury	0.20	0.22	0.19	0.27	0.18
Nickel	0.13	0.07	0.13	0.08	0.09
Selenium	0.23	0.23	0.24	0.24	0.21
Zinc	35.	34.	37.	39.	30.
HCB	N.D.	N.D.	N.D.	0.001	0.002
α-BHC	0.002	0.001	0.004	0.004	0.002
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	0.001
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.02	0.08	0.07	0.09	0.02

N.D. – Not detected.

Table C-4. Physical and Chemical Data (mg/kg) on Five Common White Sucker from the Albany River

Parameter	1	2	3	4	5
Weight (g)	587.	724.	572.	919.	570.
Tail length (cm)	36.5	38.5	35.5	45.0	36.0
Fork length (cm)	34.5	35.7	33.3	42.0	33.7
Sex	M	F	F	F	F
Age (yr)	5	7	7	9	5
Arsenic	0.07	0.09	0.06	0.05	0.06
Cadmium	N.D.	0.04	0.02	0.02	N.D.
Chromium	0.27	N.D.	N.D.	N.D.	N.D.
Copper	1.4	5.7	2.0	2.9	0.76
Lead	N.D.	0.25	0.11	0.10	N.D.
Mercury	0.13	0.12	0.11	0.22	0.21
Nickel	0.11	0.10	N.D.	N.D.	N.D.
Selenium	0.19	0.17	0.14	0.21	0.19
Zinc	10.	9.8	9.1	11.	9.3
HCB	N.D.	N.D.	N.D.	0.001	0.002
α-BHC	0.002	0.001	0.004	0.004	0.002
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	0.001
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.02	0.08	0.07	0.09	0.02

N.D. – Not detected.

Table C-5. Physical and Chemical Data (mg/kg) on Five Northern Pike from the Attawapiskat River

Parameter	1	2	3	4	5
Weight (g)	759.	452.	1261.	748.	918.
Tail length (cm)	52.5	41.2	55.5	48.5	51.0
Fork length (cm)	50.5	39.0	52.0	46.0	48.3
Sex	F	F	F	M	F
Age (yr)	11	6	12	5	8
Arsenic	0.10	0.17	0.71	0.91	0.32
Cadmium	0.02	N.D.	N.D.	N.D.	N.D.
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	0.81	0.64	0.90	1.0	1.1
Lead	N.D.	N.D.	N.D.	N.D.	N.D.
Mercury	0.25	0.12	0.11	0.13	0.10
Nickel	N.D.	N.D.	N.D.	0.05	0.06
Selenium	0.23	0.16	0.25	0.25	0.20
Zinc	34.	36.	25.	25.	26.
HCB	N.D.	N.D.	N.D.	N.D.	N.D.
α-BHC	N.D.	0.002	N.D.	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	N.D.	0.02	0.01	0.01	N.D.

N.D. = Not detected.

Table C-6. **Physical and Chemical Data (mg/kg) on Three Common White Sucker from the Attawapiskat River**

Parameter	1	2	3
Weight (g)	1222.	980.	364.
Tail length (cm)	49.0	45.5	32.0
Fork length (cm)	45.5	42.3	30.0
Sex	F	F	P.N.D.
Age (yr)	14	11	7
Arsenic	N.D.	N.D.	0.07
Cadmium	0.02	0.07	N.D.
Chromium	N.D.	N.D.	N.D.
Copper	1.0	1.8	1.4
Lead	N.D.	N.D.	N.D.
Mercury	0.29	0.16	0.11
Nickel	0.05	0.26	0.06
Selenium	0.17	0.21	0.17
Zinc	11.	12.	8.4
HCB	0.001	N.D.	N.D.
α-BHC	0.003	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.
Heptachlor epoxide	0.001	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.
p,p'-DDE	0.002	0.001	N.D.
Dieldrin	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.
Total PCB's	0.03	N.D.	N.D.

N.D. – Not detected.
P.N.D. – Parameter not determined.

Table C-7. Physical and Chemical Data (mg/kg) on Five Northern Pike from the Winisk River

Parameter	1	2	3	4	5
Weight (g)	1725.	1981.	2839.	1816.	2419.
Tail length (cm)	62.5	70.0	73.0	66.2	68.7
Fork length (cm)	59.2	65.7	69.2	63.9	65.2
Sex	F	F	F	M	F
Age (yr)	13	9	15	13	15
Arsenic	0.78	0.68	0.44	13.	0.29
Cadmium	N.D.	0.02	N.D.	N.D.	N.D.
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	0.99	0.87	0.60	0.78	1.1
Lead	N.D.	N.D.	N.D.	N.D.	N.D.
Mercury	0.15	0.22	0.18	0.22	0.11
Nickel	0.06	N.D.	N.D.	N.D.	N.D.
Selenium	0.30	0.17	0.26	0.23	0.27
Zinc	31.	32.	37.	48.	26.
HCB	0.001	0.001	N.D.	0.001	N.D.
α-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	0.003	0.003	0.004	0.007	0.003
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.01	0.00	0.01	0.03	0.01

N.D. – Not detected.

Table C-8. Physical and Chemical Data (mg/kg) on Three Common White Sucker from the Winisk River

Parameter	1	2	3
Weight (g)	931.	846.	681.
Tail length (cm)	42.3	P.N.D.	39.2
Fork length (cm)	39.2	41.6	37.1
Sex	F	F	P.N.D.
Age (yr)	8	13	9
Arsenic	0.06	N.D.	N.D.
Cadmium	N.D.	N.D.	N.D.
Chromium	N.D.	N.D.	0.47
Copper	1.4	3.1	1.6
Lead	N.D.	0.11	N.D.
Mercury	0.12	0.33	0.27
Nickel	N.D.	0.06	0.19
Selenium	0.17	0.15	0.08
Zinc	11.	13.	12.
HCB	0.001	0.001	N.D.
α-BHC	0.005	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.
Heptachlor	N.D.	0.001	N.D.
Aldrin	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.
p,p'-DDE	0.001	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.
Total PCB's	0.01	N.D.	N.D.

N.D. – Not detected.
P.N.D. – Parameter not determined.

Table C-9. Physical and Chemical Data (mg/kg) on Five Northern Pike from the Severn River

Parameter	1	2	3	4	5
Weight (g)	1729.	2514.	4220.	1310.	1348.
Tail length (cm)	65.6	69.5	82.6	64.5	59.1
Fork length (cm)	62.5	66.3	78.4	60.8	56.2
Sex	M	M	F	F	M
Age (yr)	13	12	17	14	12
Arsenic	0.46	0.40	1.3	0.42	0.09
Cadmium	N.D.	0.03	0.03	N.D.	N.D.
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	0.49	0.48	0.60	0.60	0.56
Lead	N.D.	N.D.	N.D.	N.D.	N.D.
Mercury	0.19	0.21	0.30	0.18	0.10
Nickel	0.09	0.09	0.09	0.05	N.D.
Selenium	0.25	0.25	0.27	0.26	0.19
Zinc	36.	33.	35.	34.	47.
HCB	0.001	N.D.	0.002	N.D.	N.D.
α-BHC	0.001	0.001	0.004	0.001	0.001
γ-BHC	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	0.002	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	0.001	0.002	0.010	0.002	0.002
Dieldrin	N.D.	N.D.	0.001	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	0.01	N.D.	0.02	N.D.	N.D.

N.D. – Not detected.

Table C-10. Physical and Chemical Data (mg/kg) on Five Common White Sucker from the Severn River

Parameter	1	2	3	4	5
Weight (g)	1265.	1214.	981.	1068.	919.
Tail length (cm)	47.5	46.7	43.8	44.5	42.9
Fork length (cm)	44.4	44.4	40.9	42.9	40.7
Sex	F	M	F	F	F
Age (yr)	11	14	12	12	9
Arsenic	N.D.	0.06	N.D.	N.D.	N.D.
Cadmium	0.02	0.02	0.02	0.02	N.D.
Chromium	N.D.	N.D.	N.D.	0.28	N.D.
Copper	0.67	1.4	0.77	2.8	0.57
Lead	N.D.	N.D.	N.D.	0.11	N.D.
Mercury	0.15	0.24	0.20	0.22	0.07
Nickel	0.08	N.D.	N.D.	0.12	N.D.
Selenium	0.16	0.22	0.12	0.13	N.D.
Zinc	12.	12.	14.	13.	12.
HCB	0.001	N.D.	N.D.	N.D.	N.D.
α-BHC	0.001	0.002	N.D.	N.D.	N.D.
γ-BHC	N.D.	N.D.	N.D.	N.D.	0.001
Heptachlor	N.D.	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	N.D.	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	0.001	0.001	0.001	0.001	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.	N.D.
Total PCB's	N.D.	N.D.	N.D.	N.D.	N.D.

N.D. – Not detected.

Table C-11. The Concentration of Organochlorine Pesticides and Polychlorinated Biphenyls in the Moose River, June 4, 1981

Parameter	Water* (ng/L)	Aqueous phase† (ng/L)	Suspended sediment (ng/L)	Bottom sediment (mg/kg)
HCB	N.D.	0.0072	N.D.	N.D.
α-BHC	0.6	1.15	N.D.	N.D.
γ-BHC	0.3	0.11	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	0.2	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	0.025	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.
Total PCB's	1.0	0.25	1.29	0.01

*Water represents analysis of 2 L of unfiltered river water.
†Aqueous phase represents analysis of 200-L extracts of filtered river water.
N.D. – Not detected.

Table C-12. The Concentration of Organochlorine Pesticides and Polychlorinated Biphenyls in the Albany River, June 5, 1981

Parameter	Water* (ng/L)	Aqueous phase† (ng/L)	Suspended sediment (ng/L)	Bottom sediment (mg/kg)
HCB	N.D.	0.014	N.D.	N.D.
α-BHC	1.3	2.2	N.D.	N.D.
γ-BHC	0.3	0.12	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	1.0	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	0.029	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.
Total PCB's	N.D.	0.21	0.90	N.D.

*Water represents analysis of 2 L of unfiltered river water.
†Aqueous phase represents analysis of 200-L extracts of filtered river water.
N.D. – Not detected.

Table C-13. The Concentration of Organochlorine Pesticides and Polychlorinated Biphenyls in the Attawapiskat River, June 7, 1981

Parameter	Water* (ng/L)	Aqueous phase† (ng/L)	Suspended sediment (ng/L)	Bottom sediment (mg/kg)
HCB	N.D.	0.0037	N.D.	N.D.
α-BHC	1.9	0.262	N.D.	N.D.
γ-BHC	N.D.	0.12	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	0.0059	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.
p,p′-DDE	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.
o,p′-DDT	N.D.	N.D.	N.D.	N.D.
p,p′-TDE	N.D.	N.D.	N.D.	N.D.
p,p′-DDT	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.
p,p′-Methoxychlor	N.D.	N.D.	N.D.	N.D.
Total PCB's	N.D.	0.24	0.23	N.D.

*Water represents analysis of 2 L of unfiltered river water.
†Aqueous phase represents analysis of 200-L extracts of filtered river water.
N.D. – Not detected.

Table C-14. The Concentration of Organochlorine Pesticides and Polychlorinated Biphenyls in the Winisk River, June 8, 1981

Parameter	Water* (ng/L)	Aqueous phase† (ng/L)	Suspended sediment (ng/L)	Bottom sediment (mg/kg)
HCB	N.D.	0.0088	N.D.	N.D.
α-BHC	1.1	1.63	N.D.	N.D.
γ-BHC	N.D.	0.057	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	N.D.	0.012	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Endosulfan	N.D.	0.0047	N.D.	N.D.
p,p′-DDE	N.D.	0.0050	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.
o,p′-DDT	N.D.	N.D.	N.D.	N.D.
p,p′-TDE	N.D.	N.D.	N.D.	N.D.
p,p′-DDT	N.D.	0.008	N.D.	N.D.
β-Endosulfan	N.D.	N.D.	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.
p,p′-Methoxychlor	N.D.	N.D.	N.D.	N.D.
Total PCB's	N.D.	0.43	1.17	N.D.

*Water represents analysis of 2 L of unfiltered river water.
†Aqueous phase represents analysis of 200-L extracts of filtered river water.
N.D. – Not detected.

Table C-15. The Concentration of Organochlorine Pesticides and Polychlorinated Biphenyls in the Severn River, June 9, 1981

Parameter	Water* (ng/L)	Aqueous phase† (ng/L)	Suspended sediment (ng/L)	Bottom sediment (mg/kg)
HCB	N.D.	0.003	N.D.	N.D.
α-BHC	1.5	0.054	N.D.	N.D.
γ-BHC	0.2	0.056	N.D.	N.D.
Heptachlor	N.D.	N.D.	N.D.	N.D.
Aldrin	N.D.	N.D.	N.D.	N.D.
Heptachlor epoxide	0.2	N.D.	N.D.	N.D.
γ-Chlordane	N.D.	N.D.	N.D.	N.D.
α-Chlordane	N.D.	0.0059	N.D.	N.D.
α-Endosulfan	N.D.	N.D.	N.D.	N.D.
p,p'-DDE	N.D.	N.D.	N.D.	N.D.
Dieldrin	N.D.	N.D.	N.D.	N.D.
Endrin	N.D.	N.D.	N.D.	N.D.
o,p'-DDT	N.D.	N.D.	N.D.	N.D.
p,p'-TDE	N.D.	N.D.	N.D.	N.D.
p,p'-DDT	N.D.	N.D.	N.D.	N.D.
β-Endosulfan	N.D.	0.001	N.D.	N.D.
Mirex	N.D.	N.D.	N.D.	N.D.
p,p'-Methoxychlor	N.D.	N.D.	N.D.	N.D.
Total PCB's	2.0	0.24	1.57	0.01

*Water represents analysis of 2 L of unfiltered river water.
†Aqueous phase represents analysis of 200-L extracts of filtered river water.
N.D. – Not detected.

Table C-16. Particle Size Distribution (%) of the Top 1 cm of Bottom Sediment Collected from the Five Rivers Studied, June 4-11, 1981

River	Station	Gravel	Sand	Silt	Clay	Organic
Moose	A	42.1	57.9	0.0*		N.D.
	C	0.1	99.9	0.0*		N.D.
	E	2.1	97.9	0.0*		N.D.
	F	2.2	97.7	0.1*		N.D.
Albany	A	50.1	45.9	4.0*		N.D.
	B	0.0	90.0	5.7	4.3	N.D.
	C	0.0	48.9	45.2	5.9	N.D.
Attawapiskat	A	1.5	83.3	15.2*		N.D.
	B	0.0	84.4	2.2	13.4	P
Winisk	A	7.5	90.6	1.9*		N.D.
	B	0.0	62.0	31.2	6.8	N.D.
	C	0.0	59.0	40.8	0.2	P
	E	0.0	80.0	13.7	6.3	N.D.
Severn	B	0.0	73.3	21.1	5.6	P
	C	0.0	86.8	8.8	4.4	N.D.
	D	0.0	75.8	18.5	5.7	P
	E	0.0	99.3	0.7*		N.D.

*Represents percent concentration of silt and clay.
N.D. – Not detected.
P – Organic detritus was present.

Table C-17. Total Metals (mg/kg) in Bottom Sediment Collected from the Five Rivers Studied, June 4-11, 1981

River	Station	Mercury	Aluminum	Cadmium	Copper	Iron	Lead	Manganese	Nickel	Zinc
Moose	A	0.01	41 000.	N.D.	19.	32 200.	14.	620.	23.	83.
	C	0.01	33 200.	N.D.	6.9	18 000.	7.9	360.	13.	31.
	E	0.01	35 900.	N.D.	6.0	12 700.	10.	220.	16.	25.
	F	0.01	35 600.	N.D.	5.0	9 560.	12.	230.	12.	30.
Albany	A	0.01	45 100.	N.D.	7.0	14 200.	11.	330.	15.	31.
	B	0.02	16 400.	N.D.	5.9	12 200.	14.	360.	N.D.	31.
	C	0.02	39 900.	N.D.	6.0	13 900.	17.	470.	22.	39.
Attawapiskat	A	0.01	30 300.	N.D.	6.9	13 600.	15.	290.	24.	38.
	C	0.01	9 230.	N.D.	8.9	20 200.	14.	380.	24.	52.
	D	0.01	37 900.	N.D.	6.0	12 400.	11.	320.	11.	32.
Winisk	A	N.D.	22 900.	N.D.	3.0	12 100.	9.0	260.	5.0	24.
	B	0.01	14 400.	N.D.	3.9	7 690.	9.9	270.	12.	28.
	C	0.02	35 300.	N.D.	6.9	13 600.	15.	570.	22.	40.
	E	0.02	35 000.	N.D.	5.0	11 600.	7.0	310.	16.	30.
Severn	B	0.01	31 000.	N.D.	4.0	10 100.	8.9	360.	17.	27.
	C	0.01	9 570.	N.D.	3.0	5 600.	11.	280.	N.D.	23.
	D	0.01	19 500.	N.D.	4.0	9 970.	8.0	340.	11.	25.
	E	N.D.	31 900.	N.D.	4.0	8 110.	9.9	250.	17.	24.

N.D. – Not detected.

Table C-18. Non-residual Metals (mg/kg) in Bottom Sediment Collected from the Five Rivers Studied, June 4-11, 1981

River	Station	Aluminum	Cadmium	Copper	Iron	Lead	Manganese	Nickel	Zinc
Moose	A	353.	0.19	1.4	1348.	4.2	111.	0.93	10.
	C	240.	N.D.	0.38	1250.	1.7	106.	0.96	6.2
	E	309.	N.D.	N.D.	1179.	N.D.	95.	0.97	6.0
	F	292.	N.D.	N.D.	1169.	1.4	92.	0.97	5.8
Albany	A	547.	N.D.	2.9	1770.	1.8	199.	1.2	9.4
	B	429.	N.D.	1.9	974.	1.5	185.	1.2	6.8
	C	660.	N.D.	2.0	1889.	2.8	320.	1.5	10.
Attawapiskat	A	239.	N.D.	0.41	1293.	1.4	139.	0.50	5.0
	C	340.	N.D.	0.92	1011.	2.4	129.	1.4	4.0
	D	478.	N.D.	0.90	1691.	1.8	169.	1.5	7.7
Winisk	A	242.	N.D.	0.39	918.	2.5	76.	0.48	4.6
	B	217.	N.D.	0.61	817.	0.59	118.	0.79	3.9
	C	407.	N.D.	2.4	1595.	1.4	369.	1.0	7.0
	E	386.	N.D.	0.61	1387.	1.2	149.	1.2	5.0
Severn	B	359.	N.D.	0.88	1197.	1.6	210.	1.0	4.9
	C	359.	N.D.	0.61	1297.	1.6	210.	1.0	5.3
	D	327.	N.D.	0.60	1190.	1.6	139.	1.0	5.0
	E	196.	N.D.	N.D.	701.	0.93	81.	0.93	2.9

N.D. – Not detected.