Canada Alberta Northwest Territories

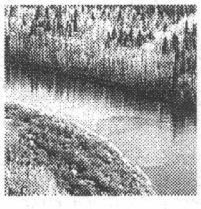
Northern River Basins Study

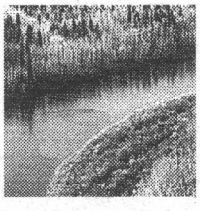












Prepared for the
Northern River Basins Study
under Project 3118-B2

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NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 20

COLLECTION OF FISH FROM THE TRADITIONAL WINTER FISHERY ON THE PEACE-ATHABASCA DELTA, FEBRUARY, 1993

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PREFACE:

The Northern River Basins Study was initiated through the "Canada-Alberta-Northwest Territories Agreement Respecting the Peace-Athabasca-Slave River Basin Study, Phase II - Technical Studies" which was signed September 27, 1991. The purpose of the Study is to understand and characterize the cumulative effects of development on the water and aquatic environment of the Study Area by coordinating with existing programs and undertaking appropriate new technical studies.

This publication reports the method and findings of particular work conducted as part of the Northern River Basins Study. As such, the work was governed by a specific terms of reference and is expected to contribute information about the Study Area within the context of the overall study as described by the Study Final Report. This report has been reviewed by the Study Science Advisory Committee in regards to scientific content and has been approved by the Study Board of Directors for public release.

It is explicit in the objectives of the Study to report the results of technical work regularly to the public. This objective is served by distributing project reports to an extensive network of libraries, agencies, organizations and interested individuals and by granting universal permission to reproduce the material.

NORTHERN RIVER BASINS STUDY
PROJECT REPORT RELEASE FORM

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Whereas the above publication is the result of a project conducted under the Northern River Basins Study and the terms of reference for that project are deemed to be fulfilled,
IT IS THEREFORE REQUESTED BY THE STUDY OFFICE THAT;
this publication be subjected to proper and responsible review and be considered for release to the public.

(Dr. F. J. Wrona, Ph.D., Science Director) — (Date) 26 August 1993

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board",
IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;
this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.
SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [ ] Yes [✓] No

(Dr. P. A. Larkin, Ph.D., Chair) — (Date) Sept. 8/93

Whereas it is the duty of the Operations Committee to attend to the day-to-day management of the Study on behalf of the Study Board,
IT IS THEREFORE RECOMMENDED BY THE OPERATIONS COMMITTEE THAT;
this publication be released to the public and it is reported that
THIS PUBLICATION HAS BEEN REVIEWED BY THE HEALTH ASSESSMENT COMMITTEE AND SUBSEQUENTLY FORWARDED TO APPROPRIATE HEALTH AUTHORITIES: [ ] Yes [✓] No

Whereas the Study Board is satisfied that this publication has been reviewed for scientific content and for immediate health implications,
IT IS HERE APPROVED BY THE BOARD OF DIRECTORS THAT;
this publication be released to the public, and that this publication be designated for: **[✓] STANDARD AVAILABILITY [ ] EXPANDED AVAILABILITY**

(Bev Burns, Co-chair) — (Date) 93/09/20

NRBS.005

COLLECTION OF FISH FROM THE TRADITIONAL WINTER FISHERY ON THE PEACE-ATHABASCA DELTA, FEBRUARY, 1993

STUDY PERSPECTIVE

Lake Athabasca and the Peace-Athabasca Delta are important traditional fish harvest areas in the northern river basins. Previous fish collections have been made in the summer for the purpose of determining contaminant levels in fish at traditional harvest areas. This collection was undertaken at the request of local community leaders to determine whether upstream developments were causing contamination in fish caught at traditional winter harvest sites used for human consumption and/or as a source of food for dogs. The collections were also to be used to assess whether uranium mining around Lake Athabasca is leading to elevated radionuclide levels in fish at these same sites.

Related Study Questions

1a) How has the aquatic ecosystem, including fish and/or other aquatic organisms, been affected by exposure to organochlorines or other toxic compounds?

3) Who are the stakeholders and what are their consumptive and non-consumptive uses of water resources in the river basins?

8) Recognizing that people drink water and eat fish from these river systems, what is the current concentration of contaminants in water and edible fish tissue and how are these levels changing through time and by location?

12) What native traditional knowledge exists to enhance the physical science studies in all areas of enquiry?

Local native representatives were consulted by the NRBS Traditional Knowledge Group Leader to identify appropriate sites for sampling. A total of five sites were identified - four in the Delta and one on Lake Athabasca. The NRBS selected an additional site, Hook Point, on Lake Athabasca for sampling because elevated uranium levels were recorded from water samples in this area in the past.

Under this sampling program five fish species commonly used by local area residents (Whitefish, Burbot, Pike, Walleye and Goldeye) were targeted for collection. Collections were made by local native technicians under the supervision of professional biologists. In addition, suckers were taken from the two sites on Lake Athabasca for radionuclide analysis. In total, 248 fish were obtained from the six sites. However, because of the timing of the collections and other field constraints, not all of the species were available at all of the sites. In addition, the sampling program indicated that future collections should be earlier or later in the winter to maximize the capture success of all species.

Based on the analytical results of other NRBS fish collections and fish collections made by other agencies, and where adequate sample sizes exist (minimum of six fish of one species from one site), fish collected under this project will be submitted to laboratories for contaminant and/or radionuclide analyses. The results of these analyses could be used to complement other related studies examining the distribution, fate and effect of contaminants in the aquatic ecosystem of the northern rivers. This data could also be used to determine whether the fish harvested from these sites are safe to eat.

EXECUTIVE SUMMARY

The Peace-Athabasca delta is situated downstream of a number of developments which may contribute to changes in water quality. These include oil sands projects, pulp and paper mills, mining projects, forestry harvesting, urban expansion, urban storm water runoff, municipal effluents and agricultural developments. The impacts of these developments on water quality and aquatic biota within the Peace and Athabasca river basins are of concern to the residents of the Peace-Athabasca delta, federal, provincial and municipal governments, the private sector, and the public.

As part of the three-year research program of the NRBS, potential contaminant fate and effects processes and existing environmental quality are being assessed throughout the Peace and Athabasca river basins. At the present time, few data exist on environmental quality in the Peace-Athabasca delta, particularly in relation to the presence and potential bioaccumulation of contaminants in fish species which are commonly used by local residents. In order to assess fish quality in the subsistence winter fishery on the Peace-Athabasca delta, the Northern River Basins Study (NRBS) undertook a study to collect whole fish samples from the traditional winter fishery in the vicinity of Fort Chipewyan, Alberta.

Six aboriginal technicians from the Fort Chipewyan community and two biologists from The Delta Group were retained by the NRBS to collect fish specimens from traditional winter fishing sites in the Peace-Athabasca delta and Lake Athabasca. A total of 396 fish were caught at six traditional winter fishing sites between 10-16 February 1993; 248 of these fish were collected for organic compound and radionuclide analysis, while the remaining surplus fish (N=148) were used for traditional needs by the aboriginal technicians and other residents (e.g., elders) in Fort Chipewyan.

Northern Pike, Lake Whitefish and Goldeye were caught at all sites, whereas Walleye were caught at five of the six sites, and Burbot were caught at three sites. Where these species were present, 1 to 20 specimens were considered to be suitable for subsistence use and were collected for analysis by NRBS. White Suckers were caught at five sites, but were only collected at the two sites on Lake Athabasca (as specified by the NRBS). With the exception of Northern Pike and Lake Whitefish, it was generally not possible to provide the recommended minimum number of specimens of each sample site within the specified sampling period.

Lake Whitefish were the most common fish in all net returns, except at the Big Point Channel site where Walleye were most abundant. Northern Pike were the second most abundant fish caught, except at the Big Point Channel site, where Burbot were common. Goldeye were caught at three of the six sites, while White Suckers were

caught at five of the six fishing sites. White Suckers were caught in low numbers at all sample sites except the Embarras River site.

A marginal tail deformity was observed in one Lake Whitefish taken from the Hook Point sample site. No external abnormalities were observed on the other fish specimens.

Fish collected for analysis were bagged and labelled according to established protocol, but field conditions led to some minor changes in the recommended NRBS protocol for packaging and transport of samples. Specifically, under the cold, ambient, daytime temperatures, large fish frequently fractured the bottom seal of the contaminant-free bags, even when care was used in placing the specimens in the bag. As a result, multiple bagging was often required. Fish which broke through the bags should be analyzed with caution. Some Northern Pike and Burbot were too large to be shipped in the Coleman type coolers. None of the fish were packed in dry ice due to shipping difficulties, however, potential freeze-thaw effects were likely minimized or avoided by the combination of cold ambient temperatures and wind chill during shipping.

If future collections are conducted during preferred fishing seasons at specific fishery locations, the number of fish specimens could increase by as much as 2.5 times. This increase in sample size would complicate shipping logistics. Specifically, more and larger coolers would be required. Guaranteed air transport (i.e., charter aircraft) for dry ice into Fort Chipewyan, as well as transport of fish samples from Fort Chipewyan to Fort McMurray or Edmonton would also be required.

The aboriginal technicians indicated that winter fishing for human consumption typically occurs when the ice is first thick enough for travel (early to mid-December). Although nets are set throughout the winter, most fish caught in late winter are traditionally used for feeding sled dogs. However, some of these fish may be used for human consumption depending on need, and personal preference. Local residents typically prefer to use other protein sources such as moose and caribou meat during late winter. Northern Pike, Walleye and Lake Whitefish are the preferred eating species during the winter months, although Goldeye, Burbot and White Suckers will be eaten depending on need, availability, size of fish and individual preference.

Before conducting future collections, preferred dates for traditional fish harvests should be confirmed with the community. Different fishing techniques (e.g., jigging vs. net fishing) may also be employed. Confirmation of preferred fishing seasons and techniques is important if specific fish species are targeted for collection.

RECOGNITION OF TECHNICAL ASSISTANCE BY FORT CHIPEWYAN RESIDENTS

The Delta Group Ltd. would like to acknowledge and express its appreciation for the significant contribution to the Winter Fishery Study by the six aboriginal technicians from the Fort Chipewyan community. The six aboriginal technicians, in alphabetical order, were:

- Ronald Campbell,
- Michael Cardinal,
- Eugene Coutereille,
- Raymond Ladouceur,
- Daniel Marcel, and
- Charlie Voyageur.

These individuals provided essential information on the preferred locations for traditional winter fishing sites, typical dates for the winter fishery, and preferences for fish species for eating and other uses. They also provided invaluable expertise in winter travel and fishing techniques. Their cooperation and assistance with the sampling and handling procedures was essential to the success of the fish collection program, and is greatly appreciated.

ACKNOWLEDGEMENTS

We would like to acknowledge Mr. Sonny (Lloyd) Flett, Traditional Knowledge Group Leader of the Treaty 8 Community and President of the Fort Chipewyan Metis Association; Chief Anthony (Tony) Mercredi of the Athabasca Chipewyan Band, Chief Archie Waquan of the Mikisew Cree First Nation, Mr. Raymond MacKenzie, Band Manager for the Mikisew Cree First Nation, and Mr. Emil Trip de Roche, Special Projects Coordinator for the Athabasca Chipewyan Band for their assistance in selecting the six aboriginal technicians and coordinating local logistical support. We also would like to thank Chief Waquan for accommodations in his home during our stay in Fort Chipewyan, and Mr. John Marcel for his assistance in transporting the fish samples from Fort Chipewyan to Edmonton.

We also would like to acknowledge the assistance and cooperation of Mr. Greg Wagner, Project Liaison Officer of the Northern River Basins Study during the project initiation, in resolving several logistical problems during the project, and for providing comments on the draft report. We also thank Mr. Larry Bergeron of the Alberta Fish and Wildlife Division in Fort Chipewyan for the use of the Department's walk-in freezer.

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1.0 INTRODUCTION

1.1 BACKGROUND

The Peace-Athabasca delta is situated downstream of a number of developments which may contribute to changes in water quality. These include oil sands projects, pulp and paper mills, mining projects, forestry harvesting, urban expansion, urban storm water runoff, municipal effluents, and agricultural developments. The impacts of these developments on water quality and aquatic biota within the Peace and Athabasca river basins are of concern to the residents of the Peace-Athabasca delta, federal, provincial and municipal governments, the private sector, and the public.

As part of the three-year research program of the NRBS, potential contaminant fate and effects processes and existing environmental quality are being assessed throughout the Peace and Athabasca river basins. At the present time, few data exist on environmental quality in the Peace-Athabasca delta, particularly in relation to the presence and potential bioaccumulation of contaminants in fish species which are commonly used by local residents. In order to assess fish quality in the subsistence winter fishery on the Peace-Athabasca delta, the Northern River Basins Study (NRBS) undertook a study to collect whole fish samples from the traditional winter fishery in the vicinity of Fort Chipewyan, Alberta.

In February 1993, the NRBS retained the Delta Environmental Management Group Ltd. (The Delta Group) to coordinate a fish collection program from the traditional winter fishery in Lake Athabasca, the Athabasca River delta, and the Peace River delta in the vicinity of Quatre Fourches. The Delta Group was responsible for the overall coordination of the winter fish collection program. Biologists with the Delta Group worked cooperatively with representatives of the Athabasca Chipewyan Band, the Fort Chipewyan Metis Association and the Mikisew Cree First Nation in collecting fish samples and preparing them for shipment to the NRBS in Edmonton. The aboriginal technicians also provided information on preferred fishing locations, preferred fish species, seasonal changes in fish abundance in the fishery, uses of fish products, and criteria for selection of fish for these various uses (e.g., size, visual appearance).

1.2 PROGRAM OBJECTIVES AND REQUIREMENTS

Based on the Terms of Reference for the winter subsistence fishery program (see Appendix 1), the objectives of the program were to:

1. "Collect fish species commonly caught and used for human consumption at the winter harvest sites in the Peace-Athabasca delta"; and

2. Complete "chemical contaminant and radionuclide analyses on these fish to determine any potential threats to human health"(NRBS 1993).

The Delta Group and members of the Fort Chipewyan community were responsible for collection of the fish samples (Objective 1). The NRBS was responsible for analysis of the samples (Objective 2).

The specific requirements of the The Delta Group, as described in the Terms of Reference (Appendix 1), were to:

1. Identify up to six traditional winter harvest sites for collection of fish through liaison with Mr. Lloyd Flett, Traditional Knowledge Group Leader. In cooperation with Mr. Flett, the community leaders were to be kept informed of the winter subsistence fishery program, aboriginal involvement in the study design and specimen collection, and the results of the project.

2. In consultation with Mr. Flett, select aboriginal technicians from the local community to assist with the collection of fish.

3. Meet with the aboriginal technicians prior to the field program to review the program objectives, the fish collection protocol, and the types of analyses which would be conducted on the fish samples.

4. In consultation with Mr. Flett, arrange all logistical requirements for the winter fish collections.

5. Obtain all necessary provincial and federal permits.

6. Coordinate and supervise the collection of commonly-consumed fish species by the aboriginal technicians. If readily available, Northern Pike (*Esox lucius*), Walleye (*Stizostedion vitreum*), Goldeye (*Hiodon alosoides*), Burbot (*Lota lota*) and Lake Whitefish (*Corogonus clupeaformis*) were to be collected at each site. In addition, White Suckers (*Castostomus commersoni)* were to be obtained from sample sites on Lake Athabasca. A minimum of 6 fish specimens of each species were to be collected at each sample site for chemical contaminant analyses. A minimum of 10 additional fish specimens of

each species were to be collected at each sample site for radionuclide analyses.

7. Ensure that all fish samples were appropriately handled, labelled, packaged and preserved in the field in accordance to the NRBS sampling protocol (see Schedule A in Appendix 1).

8. Arrange for storage of fish samples in government agency freezers in Fort Chipewyan.

9. On completion of fish collections at all sites, arrange and coordinate the shipping of samples from Fort Chipewyan to the NRBS in Edmonton.

10. Inform Mr. Greg. Wagner, Project Liaison Officer for NRBS of all major activities throughout the winter fish collection program.

11. Prepare a comprehensive data report on the fish collection program.

2.0 STUDY AREA

2.1 BIOPHYSICAL DESCRIPTION OF THE PEACE-ATHABASCA STUDY AREA

The Peace-Athabasca delta is one of the largest freshwater deltas in the world, and encompasses approximately 6,239 km^2 of water, wetlands, and boreal forest (PADPG 1972). It is located at the west end of Lake Athabasca, and is comprised largely of the deltas of the Peace and Athabasca rivers and, to a much lesser extent, the Birch River.

The Peace-Athabasca delta is a complex and dynamic mosaic of river channels, lakes, perched and open basin wetlands, raised levees, shrublands, grass - shrub meadows and wet and dry grassland meadows (PADPG 1972). Prior to the construction of the Bennett dam, plant succession was frequently disrupted by annual spring flooding, low water periods and sedimentation (Dirschl 1972). The delta ecosystem which was created by these natural forces was estimated to support at least 250 species of plants, 215 species of birds, 45 species of mammals, and 20 species of fish (Environment Canada N.D.).

The Peace-Athabasca delta and Lake Athabasca lie within the Dry Mixedwood Subdivision of the Boreal Mixedwood ecoregion in northeastern Alberta (Strong and Leggat 1981). Relief is generally subdued although localized occurrences of greater relief occur.

The Dry Mixedwood Subdivision has a mean summer precipitation from 200 to 300 mm. The mean summer temperature for the subregion is 12.0°C, while winter temperatures can drop to -40°C. Snow cover lasts for an average of 150 days with an average accumulation of 160 cm.

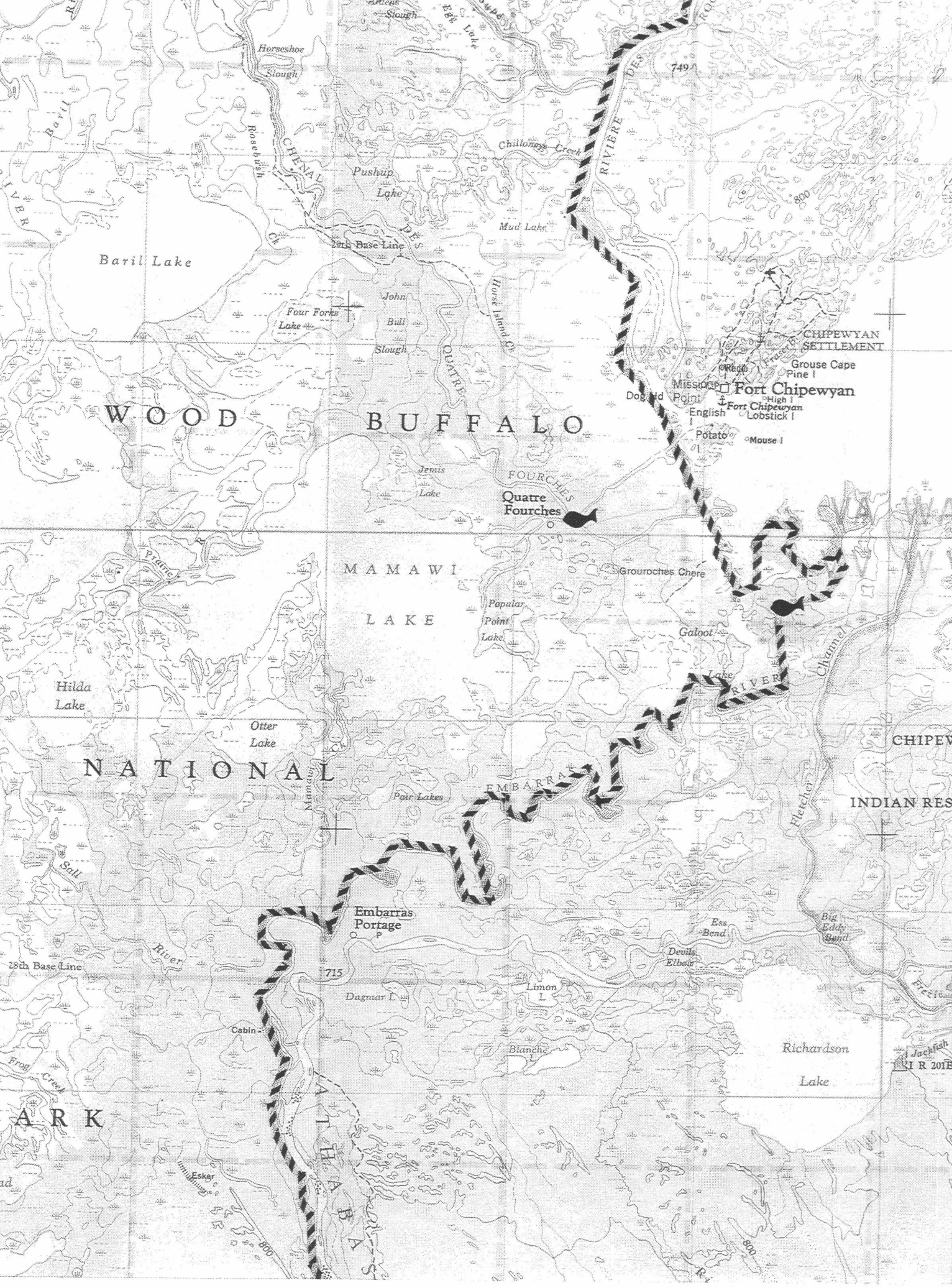
2.2 SELECTION AND LOCATION OF SAMPLE SITES

During February 1993, Mr. Lloyd Flett consulted with the community leaders, elders and fishermen in Fort Chipewyan to identify important winter fishing locations in the Peace and Athabasca river deltas. Six winter fishing locations were selected (Figure 1):

- the west side of Bustard Island in Lake Athabasca,
- Old Fort Bay (Hook Point) in Lake Athabasca,
- Big Point Channel on the Athabasca River delta,

- Jackfish Creek, a distributary from Richardson Lake into the Athabasca River,
- Embarras River near the north end of the Athabasca River delta, and
- Quarte Fourches.

Details on the sampling dates, legal land description and UTM location for each site are provided in Table 1. During the field program, unusually thick ice (approx. 1.25 m) precluded the use the preferred net location on the west side of Bustard Island. Instead, a net was set off the southeast shore of the island. Similarly, ice thickness in Old Fort Bay resulted in the use of an alternate site at Hook Point.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Popular Point Lake
Galoot Lake
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Jackfish
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Frog Creek
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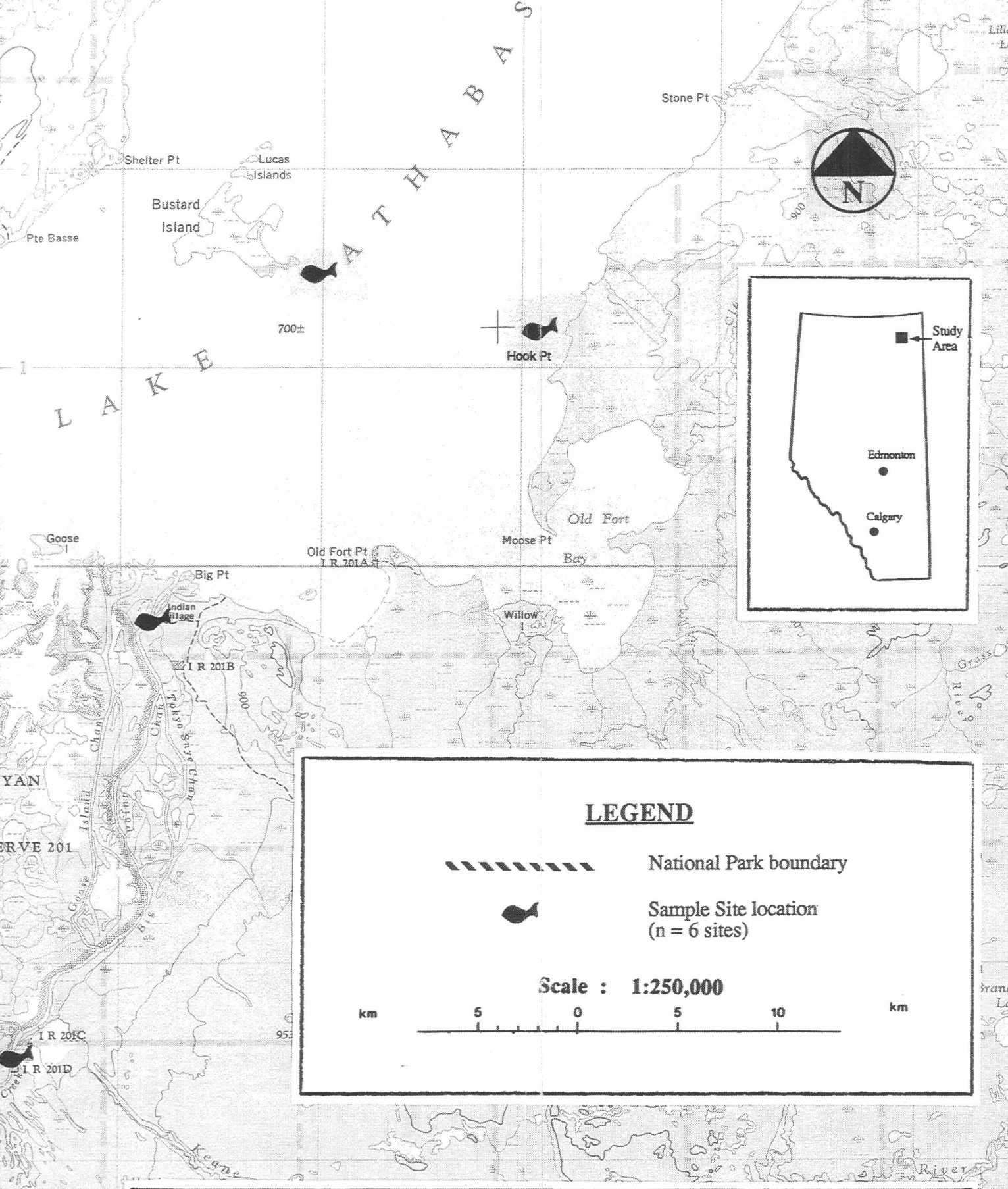

Figure 1. Location of traditional native fishing sites selected for sampling for the Northern Rivers Basin Study, 10-16 February 1993.

Table 1. Description of the six fish collection sample sites for the Winter Subsistence Fishery Program on the Peace-Athabasca delta,10 - 16 February 1993.

Sample Site	Sampling Dates (February 1993)	Location (Legal Land)	Gill net No.	Net Length (yds.)	Location (UTM)
Bustard Island	12, 14 & 16	NE-112-5-W4th	Net #1	100	74 I/15 (191 152)
Hook Point	12, 14 & 16	SW-112-3-W4th	Net #1	100	74 L/9 (321 115)
Big Point Channel	11 & 15	NW-110-5-W4th	Net #1	50	74 I/10 (117 972)
			Net #2	50	74 I/10 (116 969)
Jackfish Creek	11 & 15	NW-108-6-W4th	Net #1	50	74 I/7 (047 751)
Quatre Forches	10 & 13	SW-112-8-W4th	Net #1	50	74 L/11 (829 009)
			Net #2	50	74 L/11 (826 008)
Embarras River	10 & 13	NW-110-7-W4th	Net #1	50	74 L/11 (944 963)
			Net #2	50	74 L/11 (944 964)
			Net #3	50	74 L/11 (945 968)

3.0 METHODOLOGY

3.1 COMMUNITY LIAISON AND IDENTIFICATION OF SAMPLE SITES

Prior to the start of the fish collection program on 11 February 1993, Delta staff worked cooperatively with Mr. Lloyd Flett to:

1. Identify locations of important traditional winter fishing locations in the vicinity of Fort Chipewyan and, with input from the community leaders, select six of these sites for fish collection.

2. Finalize selection of the six aboriginal technicians, and brief the technicians on the schedule and logistics for the fish collection program.

3. Meet with the community leaders and the six aboriginal technicians, to discuss the objectives of the fish collection program, the fish collection protocol (including precautions to prevent accidental contamination of samples), and the types of analyses which would be completed on the fish samples. A meeting of representatives from the Athabasca Chipewyan Band, the Fort Chipewyan Metis Association and the Mikisew Cree First nations, the six aboriginal technicians, Mr. Flett and Mr. J. Green of The Delta Group was held on the afternoon of 9 February 1993.

   Arrangements were made at this meeting for the aboriginal technicians to set nets at each of the sampling locations on either the 9 or 10 February 1993 (see Section 3.2.2 below).

3.2 COLLECTION OF FISH SAMPLES

Fish samples were collected from each of the sample sites during 11 to 16 February 1993. Details on the sampling dates, number and length of nets, and the locations of each sample site are provided in Table 1.

3.2.1 Selection of Fish for Collection

As described in the Terms of Reference, fish samples were to be taken which reflected typical subsistence winter fishing activities. As noted earlier, sample locations were selected from traditional fishing sites which are used regularly by subsistence fishermen in Fort Chipewyan. In addition, only fish which subsistence fishermen would

have normally selected from a day's catch were collected for analysis by the NRBS. The aboriginal technicians were therefore asked to select only those fish from the total catch which, on the basis of size and visual appearance, would normally have been kept for eating, feeding sled dogs, or other uses (e.g., bait).

Although net fishing and jigging are used by local residents in the winter subsistence fishery, only nets were employed at all six sample locations. The nets, floats, ice jigs and other fishing equipment used at each sample site were provided by the aboriginal technician for that respective site.

3.2.2 Fish Collection and Handling Methods

Procedures for the collection, handling, labelling, packaging, preservation and transport of the fish samples are described in Schedule A of the Terms of Reference (see Appendix 1). These procedures were followed as best as possible. However, climatic extremes and several logistical problems necessitated minor changes to some of these procedures (see below and Section 4.3).

To minimize potential for accidental contamination of fish samples from locally-provided equipment, each of the aboriginal technicians was asked (1) to rinse their nets and other equipment with freshwater prior to the first set of their nets at the sample site, and (2) to take precautions to prevent the nets and other fishing equipment from contacting oil and gas products during their initial transport to the sample site. As trucks and/or snowmobiles ("skidoos") with sleds are commonly used to transport fishing equipment from Fort Chipewyan to the fishing location, and gas and oil are commonly carried at the same time, this precaution minimized potential for accidental hydrocarbon contamination of the fishing equipment and, ultimately, the fish samples. The technicians were also asked to not smoke during the setting of nets or the collection of fish samples.

Gill net location, length, mesh size and the number of sets per site were left to the discretion of the aboriginal technician and assumed to be typical for that site (e.g., type and number of fish desired). Tradition, river bed condition, ice thickness and previous fishing success ultimately determined net set location. One hundred yard nets were utilized on Lake Athabasca sites while fifty yard nets were used on the river sites (Photo 1). Four (4) inch mesh was used at all sites except the Embarras River site where 4.5 inch mesh was selected in an attempt to catch large Northern Pike.

Photo 1. Gill net set at Quatre Fourches , showing the marking flags at each end of the net, as required by the Provincial Fish Collection License.

Photo 2. Raymond Ladouceur removing a Walleye from one of the gill nets at the Big Point Channel site. Note use of rubber gloves, as well as the Burbot removed earlier from the same net.

All sites were sampled at least twice in an effort to obtain the minimum desired sample size for each fish species. The lake sites were sampled three times in an attempt to increase the sample size of Northern Pike.

During the first and subsequent collection of fish samples at each site, a number of precautions were employed to prevent possible contamination of the samples:

- Aboriginal technicians and biologists were provided with new rubberized gloves for handling fish or nets, and were only used while at the collection sites (Photo 2);

- Equipment and samples were transported in new cardboard boxes and/or clean tarps to minimize potential contact with oil and gas residues in the truck boxes and the sleds.

- When fuel and oil had to be carried in the trucks or sleds, the fuel and oil containers were kept separated from all collection equipment and samples;

- All approaches to the sample sites by snowmobiles or trucks were from downwind of the sample site. All vehicles were parked away from the haulout area for the nets;

- No refueling of snowmobiles or trucks was permitted within the immediate vicinity of the sampling areas; and

- Smoking was not permitted in the sample site area during collection of fish samples.

The following procedures were employed during the collection of fish samples for chemical contaminant and radionuclide analyses (Photos 3 and 4).

- As fish were removed from the nets, they were assigned a sample number. For each fish, the following data was recorded on pre-formatted data forms:

  - Sample date,
  - Sample location,
  - Fish species,
  - Sample number, and
  - Fork length.

Photo 3. Charlie Voyageur hauling out a gill net at the Bustard Island sample site.

Photo 4. Processing fish, recording data and labelling sample bags at Hook Point

Fork length was measured from the leading edge of the longest mandible (e.g., lower in Northern Pike and upper in Lake Whitefish) to the fork of the tail fin.

- Each whole fish was then placed in contaminant-free plastic bags which had been provided by NRBS. The bags meet specifications by the Department of Fisheries and Oceans for such sampling. Bags were knotted or closed using plastic-coated twist ties. As noted below, large fish would not fit into a single bag. Two bags were used to cover large fish (one bag was inserted over the head of the fish, while the other was inserted over the tail).

- Bags were labelled by sample site, sample number and species. To promote rapid freezing of the samples, samples were placed individually on the ice surface until the sample collection was completed. The combination of daytime temperatures of -12° to 15°C and high wind chill factors aided in the rapid cooling of specimens during the collection period and during the transport of samples back to Fort Chipewyan.

- Small fish samples (in the contaminant-free plastic bags) were then placed into coolers or cardboard boxes for transport back to Fort Chipewyan. Large fish samples (in double plastic bags) were wrapped in clean tarps.

At the end of each sampling day, all fish samples were transferred into the walk-in freezer at the Alberta Fish and Wildlife Division office. Samples were spread out to promote rapid freezing.

3.2.3 Shipping of Samples to NRBS in Edmonton

As a result of several logistical problems, the shipping protocol for samples (Schedule A of the Terms of Reference; Appendix 1), was not followed completely. Samples were shipped from Fort Chipewyan to Edmonton by truck on 17 February 1993, but could not be delivered to the NRBS facilities until the morning of 18 February 1993 (see below).

Most fish samples were packed in fourteen 40 litre and one 98 litre Coleman® coolers. However, a number of the Northern Pike and Burbot specimens were too long to fit into the coolers. To protect these specimens and the sample bags during transport, large fish were instead placed in cardboard crates lined with the contaminant free plastic bags.

The sample shipping protocol specified that (i) during shipping of samples, dry ice must be placed underneath and on top of the samples to ensure that no freeze-thaw cycles occur; and (ii) that samples must be kept at -20°C until (and presumably during) shipping. Dry ice was ordered from Edmonton, with guaranteed air-freight delivery to Fort McMurray. Delivery to Fort Chipewyan was not possible due to the large size of the dry ice shipment and the small size of the scheduled aircraft which service Fort Chipewyan. Following discussion with Greg Wagner of the NRBS, it was decided to transport all samples from Fort Chipewyan to Fort McMurray by truck, and to then pack the fish samples with dry ice in Fort McMurray. As the daytime ambient temperatures were -12° to -18°C and the windchill factor was substantial, samples were expected to be maintained at or below -20°C during transport.

Due to a shipping error, the dry ice did not arrive in Fort McMurray as scheduled. To expedite the delivery of the samples to Edmonton, it was decided to continue transporting the samples by truck to Edmonton. As outside temperatures were declining from the daytime high, samples were likely at or below -20°C. The samples arrived in the early evening in Edmonton and were stored overnight in the coolers and cardboard cartons at ambient outside temperatures. Overnight temperatures were -20° to -25°C. Samples were accepted by NRBS during the early morning on 18 February 1993.

4.0 RESULTS AND DISCUSSION

4.1 WINTER FISHERY COLLECTION

A combined total of 396 fish were caught at the six sample sites; 248 of these were collected for chemical contaminant and radionuclide analyses by the NRBS (Table 2). Fish caught in excess of the required sample size, and not collected for the NRBS (N=148), were used for traditional needs by the aboriginal technicians in accordance with Treaty and traditional use rights.

Lake Whitefish were the most common fish in all net returns, except at the Big Point Channel site where Walleye were most abundant. Northern Pike were the second most abundant fish caught, except at the Big Point Channel site, where Burbot were common. Goldeye were caught at three of the six sites, while White Suckers were caught at five of the six fishing sites. White Suckers were caught in low numbers at all sample sites except the Embarras River site.

The NRBS requested that a minimum of 16 and a maximum of 20 specimens of Northern Pike, Walleye, Goldeye, Lake Whitefish, and Burbot be collected at each sample site. Six specimens of each species were required for chemical contaminant analyses, while ten specimens of each species were required for radionuclide analyses. In addition, the NRBS requested that a minimum of ten White Sucker specimens be obtained at the two sample sites in Lake Athabasca for radionuclide analyses.

Difficulties were encountered in obtaining adequate numbers of Northern Pike, Walleye and Goldeye at most sample sites, as well as obtaining the minimum number of White Suckers at the two lake sites. If all fish captured in the nets had been collected (as opposed to only those fish which are normally taken in the subsistence fishery), sample sizes at some sites would have been greater. Early in the study, one Northern Pike at the Big Point Channel site, three Northern Pike at the Hook Point site, four Northern Pike at the Quatre Fourches site, and one Walleye at the Bustard Island site were considered to be too small for human use and were not collected as samples. After several sites had been sampled twice it was apparent that minimum sample sizes were only being obtained for one species per site (usually whitefish).

Staff of The Delta Group consulted with Mr. Greg Wagner, NRBS, and it was mutually agreed that by increasing the number of sampling days for lake sites and relaxing size criteria for selection of fish specimens, minimum sample sizes could be obtained for an additional fish species. As a result of the relaxed size criteria, three Northern Pike were included in each of the samples for Quatre Fourches and Hook Point sampling sites, even though the aboriginal technicians would not normally use these fish for human consumption.

Table 2. Total numbers of fish collected, by species and sample site, for the Northern Rivers Basin Study, 10-16 February 1993. Numbers in parentheses refers to the total number of fish caught at each site, by species. Surplus fish were kept by the aboriginal technicians for use by themselves or elders in Fort Chipewyan.

Species	Bustard Island (n=3)	Hook Point (n=3)	Big Point Channel (n=2)	Jackfish Creek (n=2)	Quatre Forches (n=2)	Embarras River (n=2)	**TOTAL**
Whitefish	20 (84)	20 (39)	9 (9)	20 (28)	16 (16)	20 (39)	**105 (215)**
Pike	19 (19)	17 (20)	1 (2)	3 (3)	12 (16)	4 (4)	**56 (64)**
Burbot	3 (3)	0 (0)	27 (27)	0 (0)	8 (8)	0 (0)	**38 (38)**
Walleye	1 (2)	0 (0)	21 (29)	2 (2)	2 (2)	1 (1)	**27 (36)**
Goldeye	0 (0)	0 (0)	1 (1)	0 (0)	6 (6)	3 (3)	**10 (10)**
Sucker	6 (6)	6 (6)	N/R* (10)	N/R* (2)	N/R* (9)	N/R* (0)	**12 (33)**
TOTAL	**49 (114)**	**43 (65)**	**59 (78)**	**25 (35)**	**44 (57)**	**28 (47)**	**248 (396)**

N/R*: Not Required; samples of suckers were only required by the NRBS for the two sample sites on Lake Athabasca.

In contrast, additional Burbot were caught and collected from the Big Point Channel site (total collection = 27) at the request of the NRBS. Burbot is considered to be a good contaminant indicator because it is a bottom feeding fish.

The aboriginal technicians indicated that the net catches were smaller than typical winter fishery catches in early to mid-December. Poor net returns were attributed by the aboriginal technicians to the time of year (February vs. December), as well as the unusually cold temperatures and thick ice conditions during the 1992/93 winter. For example, low Walleye numbers were attributed to the low flow levels in the rivers as well as low oxygenation levels near the ice, possibly because of the unusually thick ice conditions. Therefore, the Walleye may have been lethargic, and have remained in the deeper portions of the water channels.

The Terms of Reference requested that any deformities or external ulcerations on fish be reported. The aboriginal technician at Hook Point noticed a marginal deformity of the tail of one Lake Whitefish caught on 12 February 1993 (label # PO-06-WF). No other deformities were noticed.

4.2 TRADITIONAL WINTER FISHERY USE

Information on traditional uses of fish from the winter fishery was obtained through discussions with the six aboriginal technicians. With some exceptions, all fish species are generally used for human consumption, while some species are used only for feeding sled dogs (Table 3). The following trends represent information for the aboriginal technicians and their immediate families. It is not known if these trends are representative of the Fort Chipewyan community.

The mid-February time frame for fish collection in this study are not typical of the winter fishery for most subsistence use. In the Fort Chipewyan region, there appear to be three major seasons for subsistence fishing:

- early to mid-December when ice is firm for travel,
- in May to June immediately following ice breakup (dependent on weather and site), and
- in late September to October, immediately prior to freeze up.

Table 3. Traditional use of fish species, by sample site, as identified by the aboriginal technicians during the fish collection program. (HC denotes species used primarily for human consumption; DF refers to fish species which are used primarily as dog food.)

Sample Site	Whitefish*	Pike*	Walleye*	Burbot	Goldeye	Sucker
Quatre Forches	HC	HC	HC	HC	HC	HC
Embarras River	HC	HC	HC	HC	HC	HC
Big Point Channel	HC	HC	HC	DF	HC	HC
Jackfish Creek	HC	HC	HC	HC	HC	HC
Bustard Island	HC	HC	HC	HC	HC	HC
Hook Point	HC	HC	HC	DF	HC	DF

*: Fish species which are preferred for human use during winter.

However, nets may be set throughout the year to provide dog food and to provide fish on a opportunistic basis. Most of the fish caught during the late winter period are used for feeding sled dogs, instead of for human consumption. During this period, most people in Fort Chipewyan prefer to eat caribou and moose meat if it is available.

Traditional fishermen may also not use the same fishing site each year, depending on other seasonal pursuits (e.g., commercial fishing, hunting, trapping). For example, Raymond Ladouceur (Big Point Channel) will commercial fish for Walleye on the lake during the summer.

Lake Whitefish, Walleye and Northern Pike were the preferred eating fish caught at most sites. Goldeye, Burbot and White Suckers are less preferred, but are eaten from most sites when available. The order of fish taken for eating is dependent on daily availability, size of fish (e.g., a medium sized Walleye may be preferred over a small Northern Pike), individual preference and need. The aboriginal technicians at Big Point Channel (Raymond Ladouceur) and the Embarras River (Ronald Campbell) prefer Walleye caught from the lake over those caught from their river sites.

Most of the aboriginal technicians eat Burbot. Charlie Voyageur (Bustard Island), Eugene Coutereille (Quatre Fourches) and Ronald Campbell (Embarras River) indicated they will eat the flesh and the livers of large Burbot, while Daniel Marcel (Jackfish Creek) usually chooses to eat only the livers. Raymond Ladouceur indicated although his father previously ate Burbot, he did not eat Burbot himself since the cooking technique had been lost. White Suckers may be used at most sites to make fish head soup. Michael Cardinal (Hook Point) does not eat Burbot or White Suckers, choosing to feed these fish species to his dogs.

During the fish collection program, the elders of the community requested Lake Whitefish from the aboriginal technicians; they were provided with fish from Bustard Island site at least once.

4.3 DEVIATION FROM THE RECOMMENDED FISH SAMPLING PROTOCOL

Immediately following removal of fish from the gill nets, the fish started to freeze because of the cold ambient daytime temperatures (~ -15°C plus wind chill). While these temperatures assisted freezing requirements, they also made placing the fish in the contaminant free bags difficult. The bags frequently broke because of the cold. This problem was especially evident, but not confined to, handling Northern Pike which were greater than 85 cm long and greater than 5 kg in weight. Even with careful handling, the bottom seals of the large sample bags fractured easily. The sample bags also broke

during transportation and handling. It is recommended that the fish in broken bags be analyzed with caution, and the analytical results evaluated accordingly.

As noted earlier, the contaminant-free plastic bags provided for the fish collection program were not large enough to accommodate large Northern Pike. Specimens longer than 85 cm protruded from the end of the largest sample bags, and were double bagged to minimize contamination during subsequent handling and transport. In addition, the 40 l and 98 l coolers were not large enough to contain large Northern Pike, Walleye or Burbot.

As also discussed above, dry ice was not used during the transport of fish samples from Fort Chipewyan to Edmonton. However, due to the combination of cold ambient daytime and night time temperatures (-12° to -15°C and -20° to -25°C, respectively) and wind chill during transport, we believe that all samples were maintained at temperatures of approximately -20°C or colder during transport to the NRBS facility in Edmonton.

4.4 RECOMMENDATIONS FOR FUTURE COLLECTIONS

Based on logistical problems encountered during the winter subsistence fishery program, we recommend that future fish collection programs consider:

- Electronic testing of contaminant-free bags prior to use in extreme conditions. Placing a double seal on the bag may improve puncture resistance.

- Use of sample bags which are large enough to accommodate Northern Pike of at least 100 cm in length and a girth of approximately 50 cm.

- Construction of plywood and Styrofoam coolers, if commercial coolers cannot be obtained for shipping large Northern Pike and Burbot. Construction of custom coolers by aboriginal technicians in Fort Chipewyan may ensure that minimum size requirements are met (e.g., inside minimum dimensions of 120 cm long x 75 cm wide x 75 cm deep).

The aboriginal technicians suggested that if fishing occurred at optimum times (see Section 4.2), the maximum number of samples required for each species could easily have been obtained at each site (i.e., 640 fish; 2.6 times that collected in this study). The fish in this study were packaged in fourteen (14) 40 litre coolers and one (1) 98 litre cooler, while an additional 26 large Northern Pike and 2 Burbot were packaged in cardboard crates. It is estimated that an additional seven (7) 104 litre coolers and several

custom coolers would have been required if the maximum number of fish samples had been obtained (i.e., 640 specimens).

If specific fish species are targeted for future study, it would be best to confirm preferred fishing dates for those species at each site, since some sites may not experience maximum catches for all species during the above-noted dates. In addition, net-fishing techniques may not be the most effective for collecting certain fish species at all times. For example, Daniel Marcel believed that more Walleye could have been caught at Jackfish Creek using a jigging technique rather than gill nets.

5.0 SUMMARY AND CONCLUSIONS

Six aboriginal technicians from the Fort Chipewyan community and two biologists from The Delta Group were retained by the Northern River Study Board to collect fish specimens from traditional winter fishing sites in the Peace-Athabasca delta and Lake Athabasca. A total of 396 fish were caught at six traditional winter fishing sites between 10-16 February 1993; 248 of these fish were collected for organic compound and radionuclide analysis, while the remaining fish (N=148) were used for traditional needs by the aboriginal technicians and other residents (e.g., elders) in Fort Chipewyan.

Northern Pike, Lake Whitefish and Goldeye were caught at all sites, whereas Walleye were caught at five of the six sites, and Burbot were caught at three sites. Where these species were present, 1 to 20 specimens were considered to be suitable for subsistence use and were collected for analysis by NRBS. White Suckers were caught at five sites, but were only collected at the two sites on Lake Athabasca (as specified by the NRBS). With the exception of Northern Pike and Lake Whitefish, it was generally not possible to provide the recommended minimum number of specimens of each sample site within the specified sampling period.

Lake Whitefish were the most common fish in all net returns, except at the Big Point Channel site where Walleye were most abundant. Northern Pike were the second most abundant fish caught, except at the Big Point Channel site, where Burbot were common. Goldeye were caught at three of the six sites, while White Suckers were caught at five of the six fishing sites. White Suckers were caught in low numbers at all sample sites except the Embarras River site.

A marginal tail deformity was observed in one Lake Whitefish taken from the Hook Point sample site. No external abnormalities were observed on the other fish specimens.

Fish collected for analysis were bagged and labelled according to established protocol, but field conditions led to some minor changes in the recommended NRBS protocol for packaging and transport of samples. Specifically, under the cold, ambient, daytime temperatures, large fish frequently fractured the bottom seal of the contaminant-free bags, even when care was used in placing the specimens in the bag. As a result, multiple bagging was often required. Fish which broke through the bags should be analyzed with caution. Some Northern Pike were too large to be shipped in the Coleman type coolers. None of the fish were packed in dry ice due to shipping difficulties, however, potential freeze-thaw effects were likely minimized or avoided by the combination of cold ambient temperatures and wind chill during shipping.

If future collections are conducted during preferred fishing seasons at specific fishery locations, the number of fish specimens could increase by as much as 2.5 times. This increase in sample size would complicate shipping logistics. Specifically, more and larger coolers would be required. Guaranteed air transport (i.e., charter aircraft) for dry ice into Fort Chipewyan, as well as transport of fish samples from Fort Chipewyan to Fort McMurray or Edmonton would also be required.

The aboriginal technicians indicated that winter fishing for human consumption does not usually take place during the late winter but instead occurs when the ice is first thick enough for travel (early to mid-December). Nets are set throughout the winter but fish caught late in the winter are traditionally used for feeding sled dogs. Local residents typically prefer to use other protein sources such as moose and caribou meat during late winter. Pike, Walleye and Lake Whitefish are the preferred eating species during the winter months, although Goldeye, Burbot and White Suckers will be eaten depending on need, availability, size of fish and individual preference.

Before conducting future collections, preferred dates for traditional fish harvests should be confirmed with the community. Different fishing techniques (e.g., jigging vs. net fishing) may also be employed. Confirmation of preferred fishing seasons and techniques is important if specific fish species are targeted for collection.

6.0 LITERATURE CITED

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7.0 APPENDICES

7.1 TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

TERMS OF REFERENCE

Project 3118-B2: Winter Subsistence Fishery - Peace-Athabasca Delta

I. Objective

The purpose of this project is to collect fish species commonly caught and used for human consumption at traditional winter harvest sites in the Peace-Athabasca Delta. Chemical contaminant and radionuclide analyses will subsequently be carried out on these fish to determine any potential threats to human health.

II. Requirements

The Consultant will perform the following tasks:

1. Liaise with Mr. Lloyd (Sonny) Flett, Traditional Knowledge Group Leader, Northern River Basins Study, to identify up to six traditional winter harvest sites for the collection of fish. Mr. Flett will be identifying these sites through consultation with local community representatives. Based on direction from Mr. Flett, the Consultant will help to inform community leaders about the winter subsistence fishery program, native involvement in the study design and specimen collection and the results of the project. The Consultant will also keep Mr. Flett informed of all major activities throughout the winter fish collection project.

2. In consultation with Mr. Flett, the consultant will select individuals (aboriginal technicians) from the local community to assist with the collection of fish. The Consultant will be responsible for hiring aboriginal technicians and for paying their wages and field costs.

3. Meet with aboriginal technicians prior to the start of the field program to review:

   - the objectives of the winter fisheries study;
   - the location of collection sites;
   - the schedule of fish collections at each site;
   - the specific Northern River Basins Study protocols for handling, labelling, packaging and preservation of fish specimens;
   - the shipping of fish samples for analyses; and
   - the type of analyses that will be conducted on fish specimens.

4. In consultation with Mr. Flett, arrange all logistical requirements for the completion of the winter fish collections.

5. Obtain all necessary provincial and federal (Wood Buffalo National Park) permits for the collection of fish at each identified harvest site.

6. Coordinate and supervise the collection of commonly consumed fish species by aboriginal technicians from winter harvest sites in the Peace-Athabasca Delta. The following sites have tentatively been identified for fish collections:

   1) The four rivers junction of Quatre Forche (near the old weir);
   2) Embarras River directly south of Goulet Lake;
   3) Jackfish Lake/Richardson Lake;
   4) Mouth of the Athabasca River;
   5) Lake Athabasca between Bustard Island and Shelter Point; and
   6) Old Fort Bay.

   If readily available, pike, walleye, whitefish, goldeye and burbot are to be collected at each site. If available, suckers are also to be collected at the two sites on Lake Athabasca for possible radionuclide analyses. No special effort should, however, be extended to collect suckers at these sites.

   At each site, a minimum of six fish of each species are to be collected for chemical contaminant analyses. At each site, a minimum of ten fish of each species are to be collected for radionuclide analyses.

7. Ensure that all fish are appropriately handled, labelled, packaged and preserved in preserved in the field in accordance with the Northern River Basins Study sampling protocol outlined in Schedule A. The Consultant is also responsible for recording fork lengths on all fish collected and for noting any gross deformities present on fish.

8. Arrange for the storage of fish in a freezer in Fort Chipewyan. The freezers of the Fish and Wildlife Division, Alberta Environmental Protection or Parks Canada may be available for such purposes.

9. On completion of fish collections from all sites, arrange and coordinate the shipping of samples from Fort Chipewyan to the Northern River Basins Study in Edmonton. All fish will be shipped in accordance with the protocol outlined in Schedule A.

10. Inform the Project Liaison Officer (Greg Wagner, Office of the Science Director, Northern River Basins Study, phone: (403) 427-1742, fax: (403) 422-3055) of all major activities throughout the winter fish collection program. In

particular, the Project Liaison Officer and Mr. Flett are to be advised of any significant problems that arise.

III. Reporting Requirements

1. The Consultant is to prepare a comprehensive data report that includes the following information: sampling methodology, sampling locations, date of collections at each site, sample number and label, fork length, observed fish deformities and the principal fish species used for human consumption at each site. The report is to contain tables and/or figures specifying the collections made. If photographs are to be included with the report, they should be black and white, and of high contrast.

2. Ten copies of the draft report are to be submitted to the Project Liaison Officer by March 22nd, 1993.

3. Three weeks after the receipt of review comments the consultant is to submit ten cerlox bound copies and two unbound, camera-ready originals of the final report to the Project Liaison Officer. An electronic copy of the report, in Word Perfect 5.1 format, is to be submitted to the Project Liaison Officer at the same time as the final report. Relevant data presented in tables, figures, appendices, etc. in the final report are also to be compiled in an electronic database (dBase IV format preferred) and submitted to the Project Liaison Officer. The final report is to contain a table of contents, list of figures (if appropriate), list of tables (if appropriate), acknowledgements, executive summary and an appendix containing the Terms of Reference for this project. All sampling locations presented in the report and electronic database are to be geo-referenced (lat./long. preferred).

SCHEDULE A

FISH SAMPLING PROTOCOL - CONTAMINANT AND RADIONUCLIDE ANALYSES

1. Fish may be collected using a variety of techniques including:

   - electrofishing
   - gill nets
   - seines
   - drift nets
   - set lines
   - angling

2. All samples must be submitted as whole intact fish.

3. All fish samples are to be frozen as soon as possible after collection.

4. Details of species, length, date, location and the collector's name must be recorded with the sample number for each sample.

5. All fish must be immediately processed (length recorded) and directly placed into Department of Fisheries and Oceans recommended contaminant free plastic bags and the bags specifically labelled. Under no circumstances are fish to be placed in ordinary plastic bags.

6. The use of dry ice for initial freezing and shipping is the approved method. Alternatives are ice packs and then ice, and may be used only as a secondary means on occasion where there may exist a shortfall in available dry ice.

7. The use of sturdy styrofoam coolers is most practical and is recommended. Styrofoam coolers of weak construction may not assure constant freezing and may break down during shipping. Coleman type coolers may also be used.

8. Place dry ice both on top and bottom of the coolers to assure that no freeze-thaw cycles will occur.

   N.B.

   Any freeze-thaw, however moderate, will cause contaminant migration within a sample and this may affect contaminant concentration levels in tissues.

9. Ship samples as soon as possible or, if not possible, samples must be kept frozen at -20° C until shipping. Samples should be shipped to:

Alberta Environment
c/o Dr. Sub Ramamoorthy or Earle Baddaloo
Standards Development Office
Oxbridge Place
9820 - 106th Street
Edmonton, Alberta
T5K 2J6
(403) 427-6102

10. Any deviation from the above established protocol/procedure should be justified and accounted for in writing and a detailed description of what was done is to be submitted with the fish sample; this is to assure credibility and validity of results

7.2 LISTS OF SPECIES COLLECTED AT EACH SAMPLE SITE

Appendix Table 7.2.1. Fish species caught at the Bustard Island sampling site on the 12, 14 and 16 February 1993, including fork lengths.

Date	Location	Species	Sample No.	Length (cm)
12-Feb-93	Bustard Island	Pike	SH-01-PI	67.4
		Whitefish	SH-02-WH	38.7
		Whitefish	SH-03-WH	32.7
		Whitefish	SH-04-WH	38.0
		Whitefish	SH-05-WH	42.9
		Whitefish	SH-O6-WH	40.4
		Whitefish	SH-07-WH	39.1
		Whitefish	SH-08-WH	40.3
		Whitefish	SH-09-WH	40.7
		Whitefish	SH-10-WH	44.5
		Whitefish	SH-11-WH	40.8
		Whitefish	SH-12-WH	42.2
		Whitefish	SH-13-WH	38.8
		Whitefish	SH-14-WH	41.6
		Whitefish	SH-15-WH	40.9
		Whitefish	SH-16-WH	42.5
		Whitefish	SH-17-WH	40.6
		Whitefish	SH-18-WH	40.1
		Whitefish	SH-19-WH	42.2
		Whitefish	SH-20-WH	42.1
		Whitefish	SH-21-WH	39.9
		Pike	SH-22-PI	70.7
		Pike	SH-23-PI	78.1
		Pike	SH-24-PI	88.4
		Pike	SH-25-PI	91.5
		Pike	SH-26-PI	67.4
		Burbot	SH-27-BU	68.3
		Sucker	SH-28-SU	41.6
		Sucker	SH-29-SU	36.1
		Sucker	SH-30-SU	40.3
		Pike	SH-31-PI	94.6
14-Feb-93		Walleye	SH-32-WA	41.1
		Burbot	SH-33-BU	59.8
		Pike	SH-34-PI	91.3
		Pike	SH-35-PI	81.4
		Pike	SH-36-PI	67.1
		Pike	SH-37-PI	59.9
		Pike	SH-38-PI	72.6

Appendix Table 7.2.1 Continued ...

Appendix Table 7.2.1. Concluded.

Date	Location	Species	Sample No.	Length (cm)
16-Feb-93	Bustard Island	Sucker	SH-39-SU	35.8
		Pike	SH-40-PI	59.6
		Pike	SH-41-PI	78.5
		Sucker	SH-42-SU	47.4
		Pike	SH-43-PI	78.0
		Pike	SH-44-PI	63.0
		Bubot	SH-45-BU	77.6
		Pike	SH-46-PI	78.2
		Pike	SH-47-PI	92.6
		Sucker	SH-48-SU	44.2
		Pike	SH-49-PI	89.7

Appendix Table 7.2.2 Fish species caught at the Hook Point sampling site on the 12, 14 and 16 February 1993, including fork length.

Date	Location	Species	Sample No.	Length (cm)
12-Feb-93	Hook Point	Whitefish	PO-01-WH	43.2
		Whitefish	PO-02-WH	44.8
		Whitefish	PO-03-WH	37.8
		Whitefish	PO-04-WH	42.4
		Sucker	PO-05-SU	48.0
		Whitefish	PO-O6-WH	36.0
		Whitefish	PO-07-WH	44.8
		Pike	PO-08-PI	80.4
		Sucker	PO-09-SU	41.5
		Whitefish	PO-10-WH	48.7
		Whitefish	PO-11-WH	44.0
		Pike	PO-12-PI	83.9
14-Feb-93		Whitefish	PO-13-WH	41.0
		Whitefish	PO-14-WH	40.9
		Pike	PO-15-PI	65.5
		Sucker	PO-16-SU	42.4
		Whitefish	PO-17-WH	42.7
		Pike	PO-18-PI	71.9
		Pike	PO-19-PI	79.0
		Pike	PO-20-PI	86.4
		Pike	PO-21-PI	83.2
		Sucker	PO-22-SU	44.0
		Pike	PO-23-PI	96.4
		Whitefish	PO-24-WH	40.0
		Whitefish	PO-25-WH	38.5
		Whitefish	PO-26-WH	43.8
		Whitefish	PO-27-WH	43.6
		Sucker	PO-28-SU	41.4
		Pike	PO-29-PI	57.0
		Pike	PO-30-PI	70.0
		Pike	PO-31-PI	53.1
16-Feb-93		Whitefish	PO-32-WH	49.7
		Whitefish	PO-33-WH	42.5
		Whitefish	PO-34-WH	46.1
		Whitefish	PO-35-WH	42.3
		Whitefish	PO-36-WH	44.9
		Pike	PO-37-PI	80.2

Appendix Table 7.2.2 Continued ...

Appendix Table 7.2.2. Concluded.

Date	Location	Species	Sample No.	Length (cm)
16-Feb-93	Hook Point	Pike	PO-38-PI	87.6
		Pike	PO-39-PI	71.2
		Pike	PO-40-PI	59.6
		Pike	PO-41-PI	67.7
		Pike	PO-42-PI	51.4
		Sucker	PO-43-SU	34.4

Appendix Table 7.2.3 Fish species caught at the Big Point Channel sampling site on the 11 and 15 February 1993, including fork lengths.

Date	Location	Species	Sample No.	Length (cm)
11-Feb-93	Big Point Channel	Walleye	BP-01-WA	39.2
		Walleye	BP-02-WA	46.8
		Burbot	BP-03-BU	58.4
		Walleye	BP-04-WA	46.7
		Burbot	BP-05-BU	62.2
		Walleye	BP-O6-WA	46.2
		Walleye	BP-07-WA	47.6
		Burbot	BP-08-BU	56.3
		Walleye	BP-09-WA	48.1
		Whitefish	BP-10-WH	45.1
		Walleye	BP-11-WA	41.5
		Walleye	BP-12-WA	47.6
		Whitefish	BP-13-WH	46.1
		Burbot	BP-14-BU	65.1
		Walleye	BP-15-WA	45.0
		Burbot	BP-16-BU	57.8
		Burbot	BP-17-BU	65.6
		Burbot	BP-18-BU	64.9
		Walleye	BP-19-WA	45.2
		Burbot	BP-20-BU	60.4
		Burbot	BP-21-BU	59.3
		Burbot	BP-22-BU	61.4
		Whitefish	BP-23-WH	41.6
		Walleye	BP-24-WA	45.9
		Burbot	BP-25-BU	54.1
		Walleye	BP-26-WA	45.2
		Whitefish	BP-27-WH	45.2
		Whitefish	BP-28-WH	47.2
		Burbot	BP-29-BU	57.1
		Burbot	BP-30-BU	59.6
		Walleye	BP-31-WA	50.1
		Burbot	BP-32-BU	55.3
		Burbot	BP-33-BU	55.8
		Burbot	BP-34-BU	54.4
		Burbot	BP-35-BU	51.9
		Whitefish	BP-36-WH	48.6
		Walleye	BP-37-WA	40.1
		Whitefish	BP-38-WH	39.6
		Burbot	BP-39-BU	46.9

Appendix Table 7.2.3 Continued ...

Appendix Table 7.2.3. Concluded.

Date	Location	Species	Sample No.	Length (cm)
11-Feb-93	Big Point Channel	Burbot	BP-40-BU	55.1
		Walleye	BP-41-WA	46.5
		Goldeye	BP-42-GO	33.6
15-Feb-93		Burbot	BP-43-BU	59.5
		Burbot	BP-44-BU	59.4
		Burbot	BP-45-BU	55.4
		Burbot	BP-46-BU	56.9
		Burbot	BP-47-BU	55.0
		Burbot	BP-48-BU	57.0
		Walleye	BP-49-WA	51.2
		Walleye	BP-50-WA	41.2
		Walleye	BP-51-WA	45.5
		Burbot	BP-52-BU	64.7
		Whitefish	BP-53-WH	53.2
		Walleye	BP-54-WA	43.8
		Whitefish	BP-55-WH	40.0
		Walleye	BP-56-WA	44.6
		Pike	BP-57-PI	62.7
		Burbot	BP-58-BU	58.5
		Walleye	BP-59-WA	46.0
		Burbot	BP-60-BU	52.0

Appendix Table 7.2.4 Fish species caught at the Jackfish Creek sampling site on the 11 and 15 February 1993, including fork lengths.

Date	Location	Species	Sample No.	Length (cm)
11-Feb-93	Jackfish Creek	Whitefish	JK-01-WH	43.0
		Whitefish	JK-02-WH	43.0
		Whitefish	JK-03-WH	40.0
		Whitefish	JK-04-WH	45.0
		Whitefish	JK-05-WH	49.0
		Pike	JK-O6-PI	61.0
		Pike	JK-07-PI	79.0
15-Feb-93		Whitefish	JK-08-WH	42.4
		Whitefish	JK-09-WH	42.1
		Whitefish	JK-10-WH	44.1
		Walleye	JK-11-WA	46.9
		Whitefish	JK-12-WH	53.6
		Pike	JK-13-PI	63.4
		Whitefish	JK-14-WH	48.4
		Whitefish	JK-15-WH	44.9
		Whitefish	JK-16-WH	44.5
		Whitefish	JK-17-WH	42.0
		Whitefish	JK-18-WH	46.3
		Whitefish	JK-19-WH	40.1
		Whitefish	JK-20-WH	41.8
		Whitefish	JK-21-WH	43.9
		Whitefish	JK-22-WH	45.6
		Whitefish	JK-23-WH	44.5
		Whitefish	JK-24-WH	44.4
		Walleye	JK-25-WA	48.1

Appendix Table 7.2.5 Fish species caught at the Quatre Fourches sampling site on the 10 and 13 February 1993, including fork lengths.

Date	Location	Species	Sample No.	Length (cm)
10-Feb-93	Quatre Forches	Whitefish	QF-01-C	39.1
		Pike	QF-02-C	48.9
		Pike	QF-03-R	54.4
		Pike	QF-04-C	53.2
		Whitefish	QF-05-R	37.7
		Pike	QF-O6-R	49.7
		Whitefish	QF-07-C	40.4
		Whitefish	QF-08-R	41.6
		Whitefish	QF-09-C	34.2
		Whitefish	QF-10-R	41.1
13-Feb-93		Whitefish	QF-11-WH	39.8
		Whitefish	QF-12-WH	42.4
		Goldeye	QF-13-GO	37.5
		Walleye	QF-14-WA	55.4
		Burbot	QF-15-BU	76.0
		Goldeye	QF-16-GO	38.6
		Whitefish	QF-17-WH	42.8
		Burbot	QF-18-BU	82.2
		Whitefish	QF-19-WH	48.4
		Whitefish	QF-20-WH	43.9
		Whitefish	QF-21-WH	41.5
		Pike	QF-22-PI	50.0
		Goldeye	QF-23-GO	39.0
		Pike	QF-24-PI	82.5
		Goldeye	QF-25-GO	40.0
		Burbot	QF-26-BU	77.5
		Whitefish	QF-27-WH	44.3
		Burbot	QF-28-BU	61.0
		Goldeye	QF-29-GO	39.6
		Burbot	QF-30-BU	85.0
		Whitefish	QF-31-WH	38.1
		Whitefish	QF-32-WH	39.0
		Burbot	QF-33-BU	58.0
		Goldeye	QF-34-GO	40.0
		Walleye	QF-35-WA	56.0
		Whitefish	QF-36-WH	47.6
		Pike	QF-37-PI	87.7
		Pike	QF-38-PI	73.6

Appendix Table 7.2.5 Continued ...

Appendix Table 7.2.5. Concluded.

Date	Location	Species	Sample No.	Length (cm)
13-Feb-93	Quatre Forches	Pike	QF-39-PI	58.6
		Burbot	QF-40-BU	51.2
		Burbot	QF-41-BU	79.0
		Pike	QF-42-PI	53.0
		Pike	QF-43-PI	51.2
		Pike	QF-44-PI	48.5

Appendix Table 7.2.6 Fish species caught at the Embarras River sampling site on the 9 and 13 February 1993, including fork lengths.

Date	Location	Species	Sample No.	Length (cm)
9-Feb-93	Embarras River	Whitefish	EM-01-WH	43.0
		Goldeye	EM-02-GO	37.0
		Pike	EM-03-PI	72.0
		Pike	EM-04-PI	86.0
		Goldeye	EM-05-GO	45.0
		Whitefish	EM-O6-WH	43.0
		Whitefish	EM-07-WH	39.0
		Whitefish	EM-08-WH	43.0
		Whitefish	EM-09-WH	42.0
		Goldeye	EM-10-GO	35.0
		Whitefish	EM-11-WH	42.0
		Whitefish	EM-12-WH	38.0
		Whitefish	EM-13-WH	38.0
		Whitefish	EM-14-WH	42.5
		Whitefish	EM-15-WH	33.0
13-Feb-93		Pike	EM-16-PI	66.1
		Whitefish	EM-17-WH	45.1
		Whitefish	EM-18-WH	45.7
		Whitefish	EM-19-WH	43.1
		Whitefish	EM-20-WH	45.2
		Pike	EM-21-PI	71.9
		Whitefish	EM-22-WH	43.1
		Whitefish	EM-23-WH	42.7
		Whitefish	EM-24-WH	45.1
		Whitefish	EM-25-WH	43.1
		Whitefish	EM-26-WH	40.3
		Whitefish	EM-27-WH	46.4
		Walleye	EM-28-WA	45.8