Literature Review

Local and Traditional Knowledge In the Lower Mackenzie Watershed

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trackingchange

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SUMMARY POINTS

This document is produced for the *Tracking Change…* project, which is a collaborative research initiative led by the University of Alberta involving many Aboriginal organizations, governments and co-management boards, universities, as well as the Government of the Northwest Territories and the Mackenzie River Basin Board. Funding for the project has been provided by the Social Sciences and Humanities Research Council, the University of Alberta, the Government of the Northwest Territories, Mackenzie River Basin Board and in-kind contributions from numerous other sources.

The Lower Mackenzie sits within the jurisdiction of the Government of the Northwest Territories. The watershed is recognized internationally as an important area of ecological biodiversity. It is one of the largest deltas in North America and has been a focus of exploration and development for several decades.

The Mackenzie Delta is home to Inuvialuit and Gwich'in peoples who value the region and its resources according to a rich and diverse number of socio-economic, cultural and ecological values.

The fishing livelihoods of communities in the Mackenzie Delta are well-documented. As a result of the work of the Gwich'in Social and Cultural Institute (GSCI) and Gwich'in Renewable Resources Board (GRRB), much local and traditional knowledge about the aquatic ecosystems of the delta has been documented from research with Gwich'in elders. In addition, an important study led by Milton Freeman in the 1990s provides detailed observations about key aspects of fish harvesting and fish ecology in the delta from an Inuvialuit perspective. The data from these studies require updating, as they are more than 20 years old in some cases.

Observations related to water quality, flow, water levels, and ice conditions and their implications for fish habitat, fish ecology and fishing livelihoods are relatively limited and may be an urgent issue of local and traditional knowledge given the pace and scale of climate change impacts in northern regions.

Governance and stewardship arrangements that respect traditional knowledge are well-developed as a result of the institutions created under the Inuvialuit and Gwich'in land claim agreements. Although scientific classification systems are in common use today (taxonomies), fish are classified by Gwich'in differently: by their location, size, and the colour and firmness of their flesh. Differences in these kinds of taxonomies may account for differences in the ways that scientists and traditional knowledge holders make decisions about management.

INTRODUCTION

The Lower Mackenzie sits within the jurisdiction of the Government of the Northwest Territories. The watershed is recognized internationally as an important area of ecological biodiversity. It is one of the largest deltas in North America and has been a focus of exploration and development for many decades.

The Mackenzie Delta is home to many Inuvialuit and Gwich'in peoples who value the region and its resources according to a rich and diverse number of socio-economic, cultural, and ecological values. In addition to being an important area of subsistence, the channels of the lower Mackenzie Delta have always been important travel corridors for Indigenous peoples as well as explorers, whalers, trappers, missionaries, and those seeking to discover and extract natural gas resources. The Department of Fisheries and Oceans and later the Gwich'in Renewable Resources

Board, Inuvialuit Fisheries Joint Management Committee, Gwich'in Social and Cultural Institute as well as anthropologists, such as Milton Freeman, have documented many details about the aquatic ecosystem and its value to Inuvialuit and Gwich'in peoples. There is a greater number of documented and available sources of traditional knowledge associated with Gwich'in communities in comparison to those detailing Inuvialuit knowledge.

Table 1: Summary of Knowledge by Indicator Theme

Indicator	LTK	Notable Sources, Programs, Projects
Traditional Land Use—Indigenous		Arctic Borderlands Ecological Knowledge Coop Department of Fisheries and Oceans Gwich'in Social and Cultural Institute Gwich'in Renewable Resources Board Inuvialuit Fisheries Joint Management Committee
Contemporary Use—Indigenous		
Subsistence Values/Historical—Fisheries		
Commercial Values/Historical—Fisheries		
Subsistence Values/Contemporary —Fisheries		
Commercial Values/Contemporary—Fisheries		
Fish Diversity		
Fish Health		
Fish Movements and Migration		
Water Quality		
Water Flow, Levels		
Climate Change Effects		
Effects of Disturbance		
Traditional Stewardship Practices		

METHODS

This report was developed for the *Tracking Change*… project with the aim of synthesizing and documenting existing local and traditional knowledge about social and ecological change in the Lower Mackenzie Watershed.

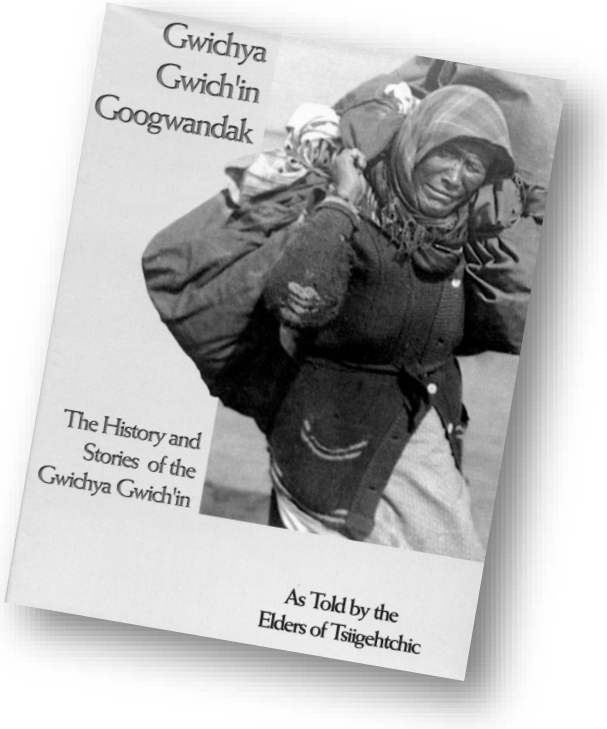
The identification, synthesis and reporting on Traditional Knowledge for this region is complex, owning to the fact that much of the rich oral history for the region has been little documented. When compared to western science, there is typically very little in the way of resources for communities to document and share their own knowledge, thus many gaps exist. Owing to its relative remoteness to early explorers and present-day southern Canada, there is limited ethnographic material from missionaries, anthropologists, and settler institutions. Capacity has also been limited for communities to carry out their own knowledge research given the many other pressures on time and resources. This has changed since the 1990s owing to the settlement of land claims in the region and the creation of institutions like the Gwich'in Social and Cultural Institute established through the *Gwich'in and Metis Comprehensive Land Claim Agreement*. Notable is the work of the Gwich'in Social and Cultural Institute (GSCI) on the designation of the Mackenzie River as a Heritage River.

Resource development in the region, including the expansion of infrastructure and activities associated with natural gas exploration and development, have led to other kinds of research about the socio-economic and cultural values of the delta and its resources. Notable are the large project reports led by the Gwich'in Social and Cultural Institute about the impacts of the proposed Mackenzie Gas Project.

Traditional Knowledge is generated differently from 'western science' and is tied to a unique set of values, perspectives, and historical/contemporary experiences; it is important that the following is acknowledged:

- Traditional Knowledge has many meanings; it is generally broader and more holistic of other ecological and socio-cultural variables than conventional scientific definitions of 'aquatic ecosystem';
- Documented and public sources of Traditional Knowledge only recognize a small percentage of existing Traditional Knowledge;
- The collection of Traditional Knowledge should increase the capacity of First Nations and Métis communities to participate in the planning, monitoring and management of the Lower Mackenzie Watershed.

Searching for Secondary Sources of Publicly Available Traditional Knowledge



A search of publicly available sources of Traditional Knowledge was conducted between January and June 2016. This report accounts for six different kinds of secondary sources of Traditional Knowledge and related community studies gathered through the Lower Mackenzie Watershed. The majority of information was found through searches of public databases including the following:

- Academic Search Elite Database (University of Alberta)
- Google/Google Scholar;
- Gwich'in Social and Cultural Institute Website
- Gwich'in Renewable Resources Board Website
- Department of Fisheries and Oceans

Through this research, the following kinds of documents were found:

Early Ethnographic Data

Early ethnographers and anthropologists have documented the cultural practices of peoples in the lower Mackenzie and provided valuable insights about the resources available for subsistence, including fish stocks, navigable waters (water levels/access) as well as related information about the significance of fish stocks.

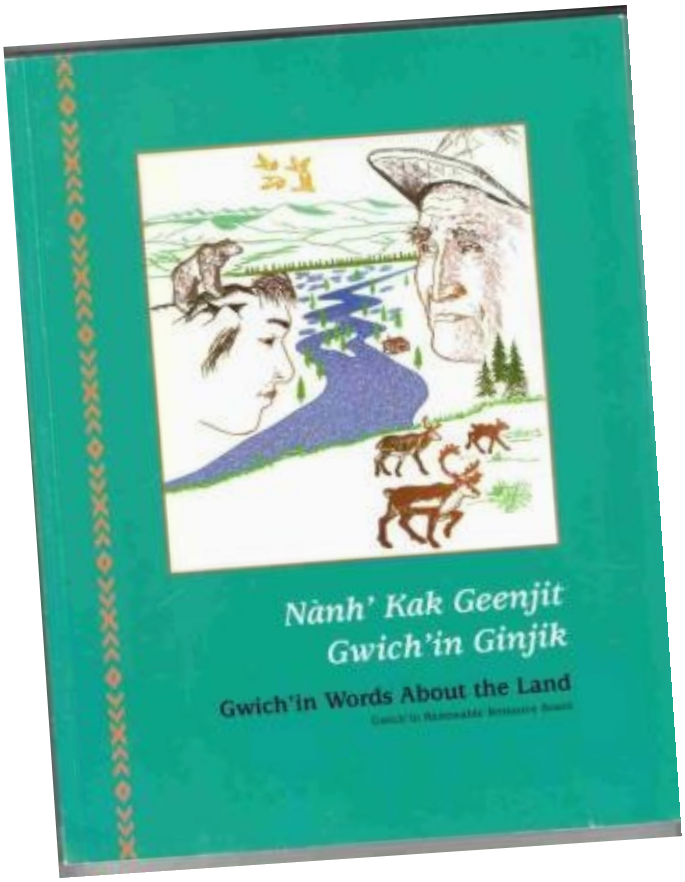
Oral Histories

A significant body of work has been documented by the Gwich'in Social and Cultural Institute about the history of the Gwich'in peoples—notably the Gwichya Gwich'in in the Lower Mackenzie. Among the most comprehensive sources about socio-cultural practices and use values

for the lower Mackenzie is the publication, *Gwichya Gwich'in Googwandak: The History and Stories of the Gwichya Gwich'in As Told By The Elders of Tsiigehtshik* (Heine *et al.* 2007).

Traditional Land Use Studies

Land and resource use studies are fundamental to our understanding of Traditional Knowledge in the area. For many communities and scholars, traditional land use practices like hunting, fishing, trapping, and plant harvesting are the means by which Aboriginal people have come to know about ecosystems and ecosystem change. The majority of traditional land use research for this region was undertaken in the years leading up to negotiation of the *Inuvialuit Final Agreement (1984)* and the *Gwich'in and Metis Comprehensive Land Claim Agreement (1992)*.



Ecological Knowledge Studies

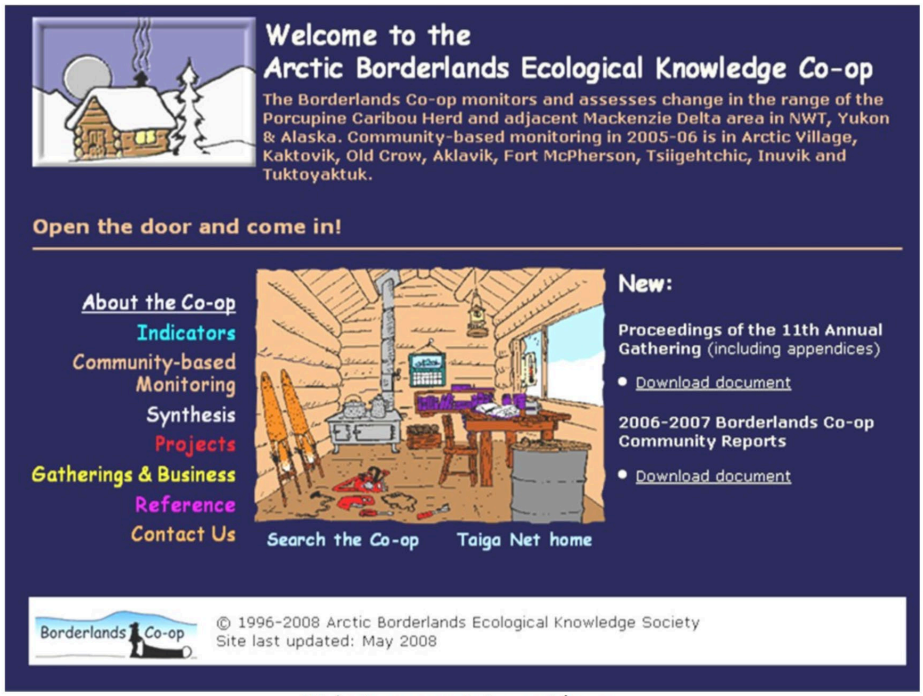
Traditional Knowledge is of increasing interest to policy-makers and environmental managers, in large part because of the potential expertise and insight that can be gained about environments and environmental change. In that context, communities, in collaboration with biologists, anthropologists and others, have focused attention on documenting many aspects of ecosystems and ecosystem change. Relevant to this research is knowledge related to sustainable management including ways of respecting the land, water and wildlife (rules, practices and tools). Among the most important research detailing the ecology of fish and other aquatic resources in the region were undertaken by the Gwich'in Renewable Resources Board (GRRB); notably *Nanh' Kak Geenjit Gwich'in Ginjik* and *Gwìndòo Nanh' Kak Geenjit Gwich'in Ginjik*. Other traditional knowledge studies led by GRRB staff such as, *Traditional Knowledge of Fish Migration and Spawning Patterns in Tsiigehnjik (Arctic Red River) and Nagwichoonjik (Mackenzie River), Northwest Territories"* are uniquely valuable (Thompson and Millar 2007).

Assessment/Impact Specific Studies

A number of traditional knowledge studies were funded by or initiated as a result of resource development projects. Among these are studies associated with the proposed Mackenzie Gas Project. Others include studies on the impacts of ferry landings on fish, and fishing practices on the Mackenzie River.

Monitoring Data

The Arctic Borderlands Ecological Knowledge Coop (ABEKC) is a program that involves ongoing documentation of traditional knowledge about changes in the ecosystem, including those associated with climate warming, etc. Each year, community researchers report on data collected with community members, including quantitative data about harvests, as well as qualitative data such as observations about permafrost slumping. The ABEKC is among the longest-running traditional ecological knowledge studies of its kind that has evolved into a monitoring program. www.taiga.net



Website: www.taiga.net/coop

Other

This report has also made room for other kinds of knowledge and information that would be considered outside the definition of 'Traditional Knowledge.' These include results of studies that addressed some common concerns:

- Did the study involve documenting sources of Traditional Knowledge (i.e., documentation of the values, knowledge, practices, and institutions of a particular Aboriginal group?)
- Was the study focus defined by Traditional Knowledge? (i.e., selection of issues or valued ecosystem components being studied)?
- Was the study led or guided by an Aboriginal community?
- Did the study have some other relevance to Aboriginal communities?

Those studies that were either defined or guided by Aboriginal organizations or communities were recognized as important to our understanding of community perspectives on the state of the aquatic ecosystem. The inclusion of other kinds of knowledge and information sources is important to many communities who see themselves as informed by many sources of knowledge and information.

A complete listing of the sources can be found in the reference section to this report.

LOWER MACKENZIE RIVER SYSTEM

The Mackenzie River is one of the longest and most complex rivers in North America. Its delta is rivalled in size and complexity only by the Mississippi River Delta. Imposed on this is the great variability of the arctic climate. Imposed on this is the great variability of the arctic climate" (Tallman and Reist 1997: 53).

The Aboriginal peoples who live within the Mackenzie Delta system include the Inuvialuit and Gwich'in communities, defined by the *Inuvialuit Final Agreement (1984)* and the *Gwich'in and Metis Comprehensive Land Claim Agreement (1992)*. The delta has also been an important use and trading area for other Indigenous groups from present day Yukon as well as the Slavey of the Sahtu region. The communities most directly located and reliant on the delta include the communities of Tsiigehtchic, Aklavik, Inuvik, and Tuktoyaktuk.

Tsiigehtchic is a community of fewer than 200 persons located at the confluence of the Mackenzie River and the Arctic Red River. Formerly called Arctic Red River, the community officially changed its name to Tsiigehtchic (Mouth of Iron River) in 1994 to honour its traditional name. This location has a very long history as a summer fish camp for the Gwichya Gwich'in ('people of the flat lands') and was the site of many gatherings and trade (both friendly and not so friendly) between the Gwichya Gwich'in, Slavey, and Inuvialuit.
http://www.gwichin.ca/gwichin-settlement-region/aklavik

Aklavik is a community of some 700 Gwich'in and Inuvialuit, located on the Peel Channel of the Mackenzie Delta, many of whom still harvest fish and muskrats. Traditionally, Gwich'in and Inuvialuit gathered here to trade for goods from as far away as the Pacific and Arctic coasts. The Hudson's Bay Company set up a post across the channel in 1912 to trade for furs. By 1918, Aklavik was a permanent settlement and the centre of a thriving trapping economy based on local muskrat and white fox from the Arctic.
http://www.gwichin.ca/gwichin-settlement-region/aklavik

Inuvik is the largest Canadian community north of the Arctic Circle and the regional government center for the Mackenzie Delta area, as was planned by the federal government. The site was selected to replace Aklavik, and a hospital, school and airport were built over a period of six years, from 1955 to 1961. Both Gwich'in and Inuvialuit families moved to the new community, located on a navigable channel of the Mackenzie Delta.
http://www.gwichin.ca/gwichin-settlement-region/aklavik

Tuktoyaktuk was once the harvesting site for Tuktu, the caribou. In the past, thousands of Inuvialuit were scattered along the coast from Herschel Island to Cape Bathurst. During the winter—from December to March—they gathered at Kittigazuit, 16 miles from Tuk, at the mouth of the East Channel of the Mackenzie River Delta. When there was the need for a suitable harbour for community resupplies for Inuvialuit communities of the area and communities to the east, Tuk was chosen as a sight because of the natural shelter from winds and waves. A [Hudson's] Bay trading post was established in 1937. The new community was situated on one of the nicest harbours in the western Arctic.
https://www.yukoninfo.com/tuktoyaktuk/

FISHING LIVELIHOODS

The fishing livelihoods of communities in the Mackenzie Delta are well documented. As a result of the work of the Gwich'in Social and Cultural Institute and Gwich'in Renewable Resources Board, much documented and available local and traditional knowledge about the aquatic ecosystems of the delta comes from research with Gwich'in elders. However, a key study led by Milton Freeman in the 1990s provides detailed observations about many key aspects of fish harvesting and fish ecology from an Inuvialuit perspective.

> Long ago, Gwich'in made fishing hooks from moose antlers or bone, and they would bait the hook with fish tails or guts. Spears were made from animal horns, and used to spear fish. Fishing with rods, hook, or spear is done in clear water to make it easier for people to find the fish and so the fish can find the hook. Gwich'in also use nets to catch lake trout. Nets are usually about 20 feet long and 6 feet deep and are set right after freeze up (GRRB 2001:109).

Fish camps were an important aspect of Inuvialuit and Gwich'in culture, and many camps in the delta have notable historic significance.

> For just as long, it has been the summer home of the Nagwichoonjik Gwich'in who lived at the many fish camps along both banks of the river, making dry fish and preparing for the coming winter. When the families began to use dog teams during the early fur trade, the summer fishery along the river became even more important because now the families had to make enough dry fish, not only for themselves, but for their dogs as well (GSCI 2001:171).

In addition to the value of fish as food, many people also used fish liver and other materials as medicine.

> Lake trout grease is believed to have many of the same properties as cod liver oil and is used to soothe rashes and sores. Long ago Gwich'in used lake trout liver to help whiten [caribou] skins in the process of tanning them (GRRB 2001:110).

> Jackfish is fat fish… They use the grease for burns. Its really strong grease that jackfish. They claim its good for when you get burned. Any kind of little burn you get on your skin or on your hand or something, like that they rub it on and its just as good as cold cream (Cecil Andre in GRRB 2001:113).

TRAVEL IN THE MACKENZIE DELTA

Since *ts'ii deji* days, the river has been an important link in the trail system used by Gwichya Gwich'in families (GSCI 2001:171).

> The river was not only important for the summer fishery of the Nagwichoojiik Gwich'in, it was also a major travel route for many Gwichya Gwich'in families at

different times of the year. Families who left the Flats to move into one of the regions at the end of the summer, traveled on the river to reach one of the major trail heads… . Families heading towards the Flats in early summer would travel on the river by raft or birch bark canoe (GSCI 2001:168).

Long ago a great number of people have been using that river. It wasn't only the Gwich'in people who came to the fish camps. Our elders used it for transporation—even dog teams, boats or just tracking along the shore upstream. It has not been that long ago that bigger boats came, the steam boats, they used that river too. And today it's tourists who are using it—even the polar bear used it. I don't know much from where he started, but he swam all the way downriver. That's how much we used that river (Noel Andre in GSCI 2001:170).

Each trading post had its own York boats. They were stored at the post over winter and began the long and difficult trip to Fort Smith as soon as the ice was out on the Mackenzie River. The men making this journey would not return to their families before the end of September. On one occasion, one boat did not make it back to Fort McPherson before freeze up. It became ice bound at a point about halfway between Srehtadhadlaii and the mouth of the Peel. The boat was left there for the winter and the supplies were moved to Fort McPherson by dog team. This spot is known as Tr'ih choo iintyin, 'where the big boat sat.' The men rowed and tracked these heavy boats up river for most of the way. One could almost say that they walked much of the way to Great Slave Lake…. (GSCI 2001:181).

In 1887 the Bay began to use steamships instead of york boats to move supplies downriver and furs upriver. Some time later, trading companies such as Lansom & Hubbard, and Hislop & Nagle also began to use steam boats (GSCI 2001:182).

Working on the steamer was quite an experience. I remember we spent one week unloading at Tununik. We came back to Aklavik, finished what we had to do late in the evening. The boat left, we all went to sleep (GSCI 2001:183).

All of these fisheries failed for a number of reasons that included technical problems and a lack of markets (Davies *et al.* 1987).

Commercial fisheries have made up a very small portion of the total harvest. Length and age of broad whitefish harvested in the fishery have remained stable between 1984 and 1989, suggesting that there is little change in population due to increased harvest (Treble and Reist1997:5).

I went partners with a fellow in 1948, and we went up the river here and we caught 23,000 [whitefish] from July, August, September, October—four months... and we sold the whole works. The fresh fish that we caught in the fall went mostly to the hospitals; they had an epidemic, a measles epidemic that year... we had the two hospitals, and they were full for a couple of months. [81A] (Tallman and Reist 1997:24).

In general, resource users were positive regarding the fishery and its current co-management regime. Inuvialuit, Gwich'in and Sahtu resource users agreed that a broad whitefish management plan should be developed (Treble and Reist 1997:5).

Broad whitefish are known to move up the Mackenzie River in search of gravel reefs and shoals on which to lay their eggs, after having spent the summer feeding along the coast and in the delta channels and lakes (*see* Chang-Kue and Jessop 1997, in this publication). This migration takes them past the communities of Tuktoyaktuk, Inuvik, Aklavik, Ft. McPherson, Tsiigehtchic and Ft. Good Hope… Low water levels in the fall at the Ramparts Rapids likely stop them from moving further up the river at this time (Treble and Reist 1997:6).

Many people from these communities fish for broad whitefish to feed their family and friends. Some surplus may be used for dog food, although they prefer to feed lake whitefish to their dogs and save the broad whitefish for themselves. Fishing for broad whitefish is also a cultural activity, a way of life that is highly valued (Treble and Reist 1997:6).

There have been several attempts to develop an export commercial fishery and a five-year exploratory fishery project based in Inuvik was completed in 1993 (Anderson 1995; Treble and Tallman 1997). The immense size of the Mackenzie Delta and lower Mackenzie River region, coupled with the fact that the same population(s) of broad whitefish could be harvested by both the commercial and subsistence fisheries of several communities during their fall spawning migration, results in a very complex and difficult management situation (Treble and Reist 1997:6).

When asked about establishing a sport fishery for broad whitefish, most people responded that a sport fishery should not be established. The most common reason given was that a sport fishery would be inappropriate because whitefish have small rounded mouths and they do not normally bite hooks. Another reason given was that whitefish are too important to the people. However, there may be opportunities to develop tours that incorporate traditional use of fish (Greenland and Walker-Larson 2001:8).

[Gwich'in] elders say they would like to see people take good care of the fish and to stay away from commercial fishing (GRRB 2001:98).

FISH HARVESTING[1]

Species Harvested

The significance of fish to the diets and economies of the Gwich'in and Inuvialuit can be gleaned from the *Inuvialuit Harvest Study* and *Gwich'in Harvest Study.* The amount of fish harvested and consumed is thought to have remained the same or declined marginally in the last several decades due to the disappearance of dog teams as well as changes in dietary preferences, access, as well as concerns about the health of the fish.

Broad whitefish are among the most common and valued fish harvested from the delta.

> Broad whitefish have been harvested as long as there have been people living in and near the Mackenzie River. The amount of fish caught has varied over time for a number of different reasons (Treble and Reist 1997:6).

> Quantitative information on the subsistence harvest suggests that there has been little change in the total catch since the 1960s. The best estimate for the Inuvialuit area is 295,693 kg in 1988 (Treble and Reist 1997:5).

> Everyone agreed that more people were catching more fish in the 1950s and 1960s than they are today. There has been no noticeable change in the size of broad whitefish caught. However, some people have noticed changes in the numbers they have caught in their nets (Treble and Reist 1997:6).

Historically, fish was the mainstay of subsistence for delta communities. Oral histories tell of hundreds of fish camps up and down the Mackenzie River in both the Inuvialuit and Gwich'in regions.

> There were over 200 camps in the delta at one time...they had thousands of dogs... when you go to visit people they fed you and your dog team... a long time ago fish were taken anywhere and it never changed... . I would get a few hundred fish for my dogs before the ice was thick, every fall I would do that... a hundred feet of fish net... it used to be that we could hardly pull it out [3] (Freeman 1997:23).

> The Nagwichoonjik Gwich'in mainly spent the summer at ts'ii dejj fish camps. Most fish camps were located at the mouths of creeks flowing into the Mackenzie. The eddies created at these points are especially good for fishing and nets would be set just downstream from the eddies. The families living at these camps spent the summer making dry fish to prepare for the coming winter; they repaired their equipment, and made new clothing (GSCI 2001:163).

> The story of the Mackenzie River is the story of families who spent the summer at the fish camps along the river from about Teetshik goghaa to Vihtrii tshik, year after year… . *They used to set tends any place in the summer, I guess, there were no*

[1] In this section, the codes in square brackets reference the survey/interview respondent.

> *cabins—Across from Tree River, there's Diighe tr'aajil, that's another number one fish camp. And from there you went on the west side of the Mackenzie and you hit Tree River is a good size river, a good fish camp… . From Chaa lee's cabin, you go up a couple of miles, there's a big flat, they call it Travaillant Creek Flat. There's just a little delta there, that's a good place for rats in the spring but its not a fishing spot. From there you go across the Mackenzie… .* (Noel Andre 2001:167).

People had recollections of the fish being extremely plentiful—as described here in a report citing Inuvialuit oral histories.

> We used to catch so much fish that when we had visitors we would feed their dogs. When we would visit their camp they would feed our dogs. That's the way it worked long ago [38] (Freeman 1997:23).

The harvest of delta fish were critical to subsistence at all times of the year. They were particularly important during years when there was limited big game such as caribou or poor marine harvests of whale in the Inuvialuit regions. As described by one Inuvialuit elder, "we never ran out of fish."

> Indeed, people remarked that fish and caribou were staple items in the diet, and when caribou were scarce, fish, and especially the broad whitefish, was a vital and dependable resource: "...fish camps were located about six miles apart all over the delta, and people never ran out of fish." [81A] (Freeman 1997:23).

In Gwich'in communities, Broad Whitefish and Lake Whitefish, Lake Trout are the species most commonly consumed, with whitefish being more common and lake trout being rarer and a delicacy.

> Lake Whitefish are preferred by most people [compared to other whitefish] because they have more fat, firmer meat and generally taste better than river whitefish. Lake whitefish are also hunted by black bear, grizzly bear, wolf, fox, grey owl, eagle, loche and jackfish (GRRB 2001:99).

> Lake trout is considered a delicacy for the Gwich'in. The meat varies in colour and texture from white to creamy to orange and fish. It is best to eat while it is fresh as it spoils quickly (GRRB 2001:109).

Broad whitefish of the lower Mackenzie River Basin are one of the most important food fishes for residents of the lower Mackenzie River Basin (Treble and Reist 1997).

> People have their fish nets set here at the river all up towards Husky river. The people usually fish for whitefish, coney, and loche during the summer and winter. During August and September people would fish for arctic char and herring at Shingle Point. Most fish that were caught reported in excellent condition. It was a good fishing year (Sherry Arey, Aklavik in ABKC 2013:40).

> Many elders say that long ago the people used lake whitefish as medicine, but they did not know exactly what it was used for. Some say it was used as a rubbing medicine like ointment (GRRB 2001:101).

Fishing Practices and Technologies

There are a variety of fishing practices and technologies, which made harvesting more successful. The timing of the harvest during critical periods of fish runs was important. As described byInuvialuit elders, the best time to fish is in early July, right after the ice disappears and the water is still high.

> The best fishing is about the first part of July, right after the open water and the ice is still on the water and the water is high. After that the water goes down and there are no more fish. They start running again the first part of August [79A] (Freeman 1997:24).

A variety of changes in technologies have affected the success of fish harvesting, including the adoption of the nylon gill net.

> Nylon nets were being used by the mid 1950s. They were stronger and more durable than cotton and therefore more efficient at catching fish. Finally, the skidoo had replaced dog teams by the mid 1970s so most hunters only needed fish for their family and for a few dogs they kept as pets. There are only a few people in each community that still keep teams of dogs (Tallman and Reist 1997:6).

> Most fishers surveyed for this report stated that fish are easier to catch now because of the introduction of gillnets but that broad whitefish harvest levels have decreased because of a fewer number of people fishing now than in the past… . Almost all fishermen report that about 75% to 95% of their whitefish harvest will go to making dry fish. The remaining 25% or so is the fish cooked just for eating. Rarely, whitefish is used for dog feed. Usually the broad whitefish fed to dogs are fish that drowned in the nets and are unsuitable for human consumption (Greenland and Walker-Larson 2001:3).

> Inuvialuit domestic fishery in the early 1950s. It is assumed that the fish taken ranged between 2 and 3 kg round weight each. Thus, the estimated minimal annual harvest of broad whitefish taken by Inuvialuit in the Mackenzie Delta ranged between 224,000 and 945,000 kg with a mid-range estimate of 534,000 kg (Freeman 1997:32).

Although much harvesting of fish continues in the delta, there is no evidence according to scientists of ‘overharvesting.’

Age and length data for broad whitefish captured in September from the middle channel appeared to have remained stable, with relatively high mean and modal ages, for the years 1984-1989. This suggests that no overharvesting had occurred during this time (Treble and Reist 1997:8).

Scientific name	Common name	Mackenzie Basin		
		Lower	Upper	Total
Acipenser fulvescens	Lake sturgeon	–	–	–
Salmo gairdneri	Rainbow trout	+	+	+
Salvelinus alpinus	Arctic char	+	–	+
Salvelinus fontinalis	Brook trout	–	–	–
Salvelinus namaycush	Lake trout	+	+	+
Coregonus clupeaformis	Lake whitefish	+	+	+
Coregonus nasus	Broad whitefish	+	–	+
Coregonus autumnalis	Arctic cisco	+	–	+
Stenodus leucichthys	Inconnu	+	+	+
Thymallus arcticus	Arctic grayling	+	+	+
Hiodon alosoides	Goldeye	+	+	+
Esox lucius	Northern pike	+	+	+
Lota lota	Burbot	+	+	+
Stizostedion vitreum	Walleye	+	+	+

Figure 1: *Presence/absence of subsistence and commercially valued fish in the Mackenzie.*

OBSERVATION OF FISH ECOLOGY

Fish Distribution

Lake Whitefish (Dalts'an) are best caught in August and September when they are big and fat before the winter. The Mackenzie, Peel, Aklavik and Arctic Red rivers are all known to be good areas for catching whitefish as well as the Travaillant, Sandy, Bathing, Deepwater, Narrow and Trout lakes (GRRB 2001:99).

Jackfish live in rivers, lakes, and creeks all over the Gwich'in Settlement Area. There are many living in the lakes and creeks, but at freeze-up time they all come out into the big rivers. To escape danger, jackfish will go to the deepest part of the lake or river and stay there until the danger has passed. Some people say that early in the morning when the sun is rising, jackfish can be seen sleeping in the grass at the bottom of the lakes or along the river's edge (GRRB 2001:112).

Jackfish stay around eddies so they can eat smaller fish and water bugs coming out of the creeks, and will eat anything that they can swallow; larger jackfish have been known to go after young muskrats, beavers, goslings and frogs. They are sometimes seen laying still, waiting for their prey in the grassy lakes and creeks (GRRB 2001:112).

The broad whitefish (*Coregonus nasus)*, and its fisheries in the lower Mackenzie River present considerable challenges to fisheries management; [it] possesses a complex life cycle undergoing extensive migrations between over-wintering areas in the outer delta and spawning areas to the south at Point Separation, the Peel River, Arctic Red River and at the Ramparts Rapids (Tallman and Reist 1997:53).

> There is a fish 'run' in September when people obtain good catches. However, there may also be periods of a week or ten days during September when few whitefish are taken and the catch consists mostly of northern pike (hiulik, jackfish) that are leaving the creeks and entering the main river at that time. During these periods, nets may be lifted until the pike have disappeared (Freeman 1997:24).
>
> The best places for setting nets in the river include the eddies and stretches of clear water and near where creeks flow into the river channels. Following northerly or westerly winds, the water becomes cloudy or water levels may rise, and fewer fish are caught at that time. After an east wind, the water becomes clearer again and fish become more plentiful. In hot summers, fewer fish are caught, for it is believed that the fish move around less in warmer water (Freeman 1997:24).

Fish Species Diversity

Although scientific classification systems are in common use today (taxonomies), different cultures classify different species according to different values and attributes. According to Freeman (1997), fish are classified by Inuvialuit according to their location, size, and the colour and firmness of their flesh. Differences in these kinds of taxonomies may account for differences in the ways that scientists and traditional knowledge holders make decisions about management. In the Inuvialuit region, the colour and texture of whitefish flesh is a major consideration affecting taste:

> There are two kinds of whitefish. The whitefish from the lakes are a darker colour and they are firmer. Whitefish from the rivers are more white or silvery in colour and the flesh, when you cook it, is more soggy with water in the meat. [200] (Freeman 1997:25).
>
> The broad whitefish (*anaakliq*) is everywhere in the Western Arctic, distinguished from the lake whitefish (*pikuutuuq*, crooked back). People recognize that there are two kinds of broad whitefish of similar size, and also a decidedly larger form, the 'jumbo' broad whitefish that people occasionally take in their large-mesh nets. The two similar-sized forms of broad whitefish are not distinguished by name in either Inuvialuktun or English, but are nevertheless readily distinguished: those that live in lakes are a darker colour and are firmer and tastier, and those from the rivers are lighter or silvery in colour, with a more watery flesh: "The whitefish would come from the lakes: we would call them the 'lassie whitefish.' The fish we got from the Mackenzie River was a different kind of whitefish, they were big in the fall time. The 'lake whitefish' are small whitefish but they are fat... they come out from the lake and they have spawned already. [The] 'lake whitefish' and 'river whitefish' are different. [3] (Freeman 1997:25).
>
> Fish around Kendall Island, for example, are so big you can catch them by their head:
>
> Kendall Island has a creek I have fished around October; the fish [there] are different. They just go to that same lake because I don't see big whitefish around

> here in the delta. There's big ones about 2 1/2 feet and they are fat in October. They got fat so that even at -40° they don't freeze... they are so big you can catch them by the head (in a 5 1/2" mesh net). There are some fish that stay around Campbell Creek every spring when the water starts shooting out [11] (Freeman 1997:25).

The diversity of species in the delta region has been defined by local and traditional knowledge holders as well:

> Species taken in lakes include trout, both species of whitefish, loche, and northern pike. During the fall fishery on the Mackenzie, broad and hump-backed whitefish, coney, herring, loche and northern pike are caught. The whitefish species and coney are the most abundant species. (Johnson 2010:126)

> At the moment I believe the crooked backs outnumber the broad whitefish. If we are only going to be catching broad whitefish...and let the other fish go, we do have concerns. If [broad whitefish] get so outnumbered will this harm the broad whitefish and the system they and the crooked backs have? Is there any possibility this might harm the whitefish in some way?" [81A] (Freeman 1997:27-29).

> As mentioned earlier, lake whitefish and broad whitefish are nearly always taken together in nets and the concern was expressed that the live release of lake whitefish (now no longer needed for dogfood) may in some way damage the broad whitefish (perhaps by over-populating the region). It was suggested that consideration might have to be given to removing the lake whitefish [crooked backs] from the system in an acceptable (i.e., 'non-wasteful') manner: "we might have to establish a pet food cannery for crooked backs [in order] to use them." [81A] (Freeman 1997:27-32).

> At the present time it is still the same: we have the same value this time as it was at that time. The broad whitefish is used all year round as a basic food, not like any other fish. Loche is mostly taken in the fall time, same with coney. You use it [broad whitefish] all through the early spring and summer. Whitefish is used all the time." [93] (Freeman 1997:27-32).

Fish Abundance

There are some observations dating back to the 1990s from the Inuvialuit region that fish numbers are decreasing in the delta; but on the whole, observations from this period suggested no major concerns with fish abundance.

> Some residents observe that fish are now less abundant in the Mackenzie Delta; they state that many places where formerly nets were set are now too shallow; this is especially the case in some of the lakes and streams. There are other changes noted that are believed to affect the fish, some related to development activities taking place in the delta a few years ago (Freeman 1997:24).

APPENDIX 1

Broad Whitefish Traditional Knowledge Study List of Questions

The purpose of the study is to gather local Inuvialuit residents' knowledge about:

a) the past and present fishery
b) the life history of the broad whitefish
c) the environmental conditions that variously affect whitefish behaviour, and
d) observations on past or present management practices.

The Fishery:

1) How is the broad whitefish fishery carried out today? What places, times of year, and fishing equipment are important in this fishery? [Mark and number fishing locations on maps].
2) When you go fishing at different times, who goes with you (family members, partners or others)? How do you share the catch (in the camp and later in the community)? How have these arrangements changed over the years?
3) Have there been any environmental changes in recent times that have influenced the whitefish harvest? If so, what are these (e.g., changes in break-up or freeze-up, river flow or water quality changes [temperature, clearness/cloudiness, etc.], ice thickness)?
4) How important is this fishery to people's diet and economic well-being today? Does the fish have other value to the community (e.g., uses of fish oil, as medicine, on special occasions maybe)?
5) How important is the present-day broad whitefish fishery compared to earlier times (in your parent's day, or five years ago say)? In earlier times, what (estimated) quantities of fish were harvested, seasonally and by what different techniques? How were fish stored and used in those days?
6) We would like to get some measure of the fishery in the past and today. Could you indicate how many fish you caught each day, or each season (or some other way of reckoning?) in the past [say when you had dogs] or in the past couple or three years say?
7) What makes a successful fisherman/ fisherwoman in Inuvialuit society? How can a person become a better fisherman/woman? Are there proper ways to treat or think about fish (or the other fish and animals people need and use)?

Naming:

8) Are there Inuvialuit or local names for different types of broad whitefish?
9) Are there other kinds of whitefish in the area, and how do you distinguish them from broad whitefish?
10) Do people distinguish (by names or other means?) between broad whitefish of different ages (young or sexually immature from adult fish maybe?) or at certain times/seasons of the year?

Life History:

11) What can people say about the breeding habits: e.g., where do the fish lay their eggs, how do they behave at that time, do they breed every year, are they feeding at that time, etc.?
12) Are there special conditions (of light, water temperature or other characteristics) that the fish need before they will lay their eggs?
13) What are the best environmental conditions to ensure the eggs hatch and the young fish do well (and in contrast, what conditions do not favour the survival of eggs and young fish)?
14) With regard to whitefish populations numbers or abundance, do you know of any times when whitefish were very numerous, or alternatively, very scarce? Do these changes in population numbers occur regularly or irregularly, say every few years? If there are "cycles", about how many years are there between high and low population numbers?
15) What about migration (i.e., what time of their lives are the fish in lakes, rivers, salt water)? Are these migrations regular, say every year, or do the fish spend several years in some parts of the territory they move over during their lifetime?
16) Do the fish move in the groups having similar characteristics (say, certain age groups moving together from the sea to river, or out of lakes)?
17) What can people say about the habitat choices the fish make or seem to prefer while they are in lakes, rivers, or the sea (that is, do they avoid certain types of water if it is maybe too cloudy, shallow, fast moving) or avoid certain bottom characteristics (e.g., muddy, vegetated, rocky, etc.)?
18) If the fish do seem to make these choices [of different locations] do they do so at particular seasons of the year, or when the fish reach certain sizes or ages perhaps?
19) Do broad whitefish suffer from diseases or parasites that you think cause problems (to the fish, to other animals or to people that eat them)?
20) If they have these parasites, then what problems are caused (e.g., do they affect the fish's ability to breed or to survive, cause dogs to lose stamina, etc.)?
21) Are fish living in some places more heavily diseased (or have more parasites) than in some other places?
22) Apart from diseases or parasites you can see, are there differences in fish quality that you can taste, smell or feel, or differences in texture or colour that have occurred at any time in the past or recently?
23) If there are differences in quality, do you have any thoughts on what might cause them, or any other information related to these changes?

Management Issues:

24) If it is necessary to limit the size of the catch for any reason, how is this best done (e.g., by only allowing certain fishing gear to be used, or to close certain areas to fishing, or not allowing fishing at certain times of year, or by some other means perhaps)?
25) Do you think quotas are a good way of regulating a fishery?
26) Some fisheries are regulated by fishing until it's no longer worth continuing and then moving away from that fishing place to another area in order to let the fish stock in the first area recover. What do you think of this as a management strategy? Could this be a method that was used in earlier times or could be used in future?
27) What are your views on fishery management carried out today? Do you have problems with the way it's done at present, and if so, how could management be improved?
28) Are there any traditional management methods that Inuvialuit used but that are now no longer used or have become weaker or less often used? Could these methods be brought back into use now? What sorts of changes might have to be made to make these traditional management methods work today?
29) Though I/we have taken a lot of your time, are there any other bits of information that you think could help us in this study that we haven't asked you about?

Figure 2: *Appendix 1 – Traditional Knowledge Questions from Freeman 1997.*

> Ever since we have been fishing down the coast for the last 10 years... there haven't been any major fluctuations in those years... we usually take about 100 to 200 some years... . We get coneys (hiiraq, inconnu]... and pike, but basically it's the whitefish we are catching [11] (Freeman 1997:24).

One Inuvialuit elder at a workshop theorized that there must be more fish now because the number of people fishing and the amount of fish being taken is much less than in the past.

> I think there's more fish now because people in the delta were about 300 and they had camps all over the delta and about 70 people were fishing. They used to get lots of fish for dogfood, maybe 1000-2000 [each]. Now nobody hardly goes fishing... . I know around this side of Tuk[toyaktuk] they are plentiful. You could get in one fish net in the morning maybe about 50. Even in the night you could get about 80 when you have a long net. They are not really scarce now because people don't fish for them anymore. [11] (Freeman 1997:24).

In some key areas however, people have observed declines and recovery of fish, such as at the whaling camp known as Whitefish Station.

> Along the Mackenzie River, whitefish always seem to be numerous. Down at our whaling camp [Whitefish Station] we used to... set our net in the daytime or in the morning and we would have to take the net out before night because it was catching too many fish. But [since 1983] there has been no whitefish at our whaling camp. We probably get somewhere from 60 to 100 fish during our stay there, which is a month and a half. Last summer the fish were starting to come back a little bit and we were catching more." [81A] (Freeman 1997:24).

> The crooked backs are similar to the whitefish but they are different. The 'lake whitefish' and the 'river whitefish' are two different types. They are the same kind of fish, but the 'lake whitefish' is a lot clearer and a lot tastier [38] (Freeman 1997:25).

Fish Condition

There are a variety of indicators of fish health that are used by both the Inuvialuit and Gwich'in to make decisions about whether to eat the fish.

> Gwich'in determine the health of their fish and animals by looking at their liver and pipe (intestines) condition. A healthy liver has a clear dark colour to it and is free of spots or marks. A liver that has blisters or has other unusual spots on it indicates that the fish is sick (GRRB 2001:101).

> I lived on the Mackenzie River in 1959 and we caught fish in lakes and small channels. I could not eat the fish because they were really soft and watery. Since then the quality of the fish in the Mackenzie seems to be improving, but I still could not compare them with those caught in salt water [81A] (Freeman 1997:27).

There seems to be a common (but by no means universal) view that there has been a change in the quality of fish over the years. People remark that in recent years there appear to be more 'injuries' (scars and deformities) in the fish, and that sometimes the livers are discoloured or blotchy… (Freeman 1997:27).

Maybe there was a spill of some kind of chemical into the water and that could have affected the health, and maybe that's why they were soggy that year. The coney, the whitefish, and the crooked back were soggy just for that one year. Even though they had been freshly caught, they were soggy [38] (Freeman 1997:27).

Not only now, but in the past it's been well known that the fish in the river are soft and there are better quality fish in the lakes. But we've been hearing of deformities in different species of fish, that wasn't common in the olden days. There is something out there that's really creating some kind of problem for our fish [46] (Freeman 1997:27).

It is generally agreed that, when the summer water temperature is higher, the quality of the fish is lower: "If you got a hot summer there would be no fish; the bottom gets warm and the fish don't move. If you take a fish out of the net your finger would go right through the fish...when it's warm in the summer there's not much fish [82A] (Freeman 1997:27).

If you go to certain lakes you get these fish and they have tapeworms inside; nice big whitefish and they have tapeworms. I never heard of any Inuvialuit saying they got sick from eating certain kinds of fish. I think when they are clean they could tell by the liver or the inside of the fish [2] (Freeman 1997:27-28).

You can tell when the fish is not healthy. You feel that it's soggy and when you open the inside you can see the colour of its gills and liver and then you know the fish is not healthy [38] (Freeman 1997:27-28).

The diseased fish get watery and the meat is no good. If you boil it and it's watery, it's a sick fish. You can cook it for the dogs, but you don't eat it [4 & 6] (Freeman 1997:27-28).
We never eat fish when they get red skin. You could feel them on the back, when they are skinny; you never eat them. [44C] (Freeman 1997:27-28).

In the spring when [the whitefish] come out of the lakes, the fish scales are very dark. The fish taste very good, they are very fat...[but] when the fish are really skinny we don't eat them, also the fish skin or scales are very hard and we cannot scale them so we feed them to the dogs [74 & 75] (Freeman 1997:27-28).

In the past, when the jackfish [northern pike] bit it and lose it that's the only time they get sick and sometimes they get skinny. Jackfish have some kind of sickness you know. [82](Freeman 1997:27-28).

> Sometimes the fish have sores in the summer time. In the fall time they have lumps under the skin: when they get a cut it bruises then it forms a lump where the sore used to be. Maybe other fish try to eat them, especially the jackfish. [90A] (Freeman 1997:27-28).

> One time I got some fish from someone and there was worms in it right under the scale. We don't know what that was from, but some people say it's from the boats: they get hit by the propellers...or maybe they got scars from the boats when they go back and forth. [2] (Freeman 1997:27-28).

> The general health of the whitefish is reported to be very good. Whitefish are reported to be fat and healthy almost all the time. There were a couple of reports of abnormal whitefish. Such fish were turned over to Fisheries to undergo testing. The fishermen say it is very rare that they catch abnormal whitefish. The most common abnormality found on whitefish is scars and other marks. It is believed that most of these scars and marks are from jack fish bites and motor props in the water (Greenland and Larson 2001:6).

> Parasites were not reported by any of the participants in the questionnaire for [broad whitefish] fish caught in rivers; however, one respondent reported catching whitefish with worms from lakes in the spring (Greenland and Larson 2001:7).

In addition to indicators of condition, Inuvialuit and Gwich'in elders have described the reproductive and life cycle of fish as the basis for decisions about whether the population of fish is healthy or not healthy. When fish lay their eggs, for example, this is a critical time of the lifecycle during which habitat must be protected.

> Whitefish lay their eggs in the lakes in the fall before the creeks freeze up. [81] (Freeman 1997:27-28).

> In the lakes in the fall time they start coming up from the ocean and they start breeding in the lakes. They stay there until they lay their eggs and they start going back out in the spring to the ocean. Then they start coming back in the fall time to lay their eggs in lakes or creeks. In the fall, in the small creeks, the young fish come out, little broad whitefish and crooked back, even little jackfish [northern pike]. [82] (Freeman 1997:27-28).

> They lay their eggs right in the lakes and they stay with their eggs until they hatch. They lay eggs in the shallow lakes: we could see the eggs. After they lay their eggs they get really skinny and are no good to eat. [79A] (Freeman 1997:27-28).

> They prefer cool water, not too deep and not too rough. They would lay their eggs in calm water. [46] (Freeman 1997:27-28).

Another critical period of the lifecycle is during spawning.

> Around the first part of September you catch a lot of whitefish that recently spawned. These fish are really white in colour and are really soft and not good quality... . When the water comes out of the lakes and creeks early in November there are [large numbers] of little fish there. That is why the people go to those places to jiggle for loche: their stomachs are full of little fish. You can identify the little loche and little jackfish among these little fish; the others are coney, broad whitefish and crooked backs which can't be told apart, but certainly they must include broad whitefish among them. [81A] (Freeman 1997:27-29).

> In fall they lay their eggs; I don't know where. May be at Great Slave Lake, because they travel up the Mackenzie River." [RP13] "You get whitefish all the way to past [Fort] Good Hope. I don't know where they go from there, maybe Great Slave Lake or up Great Bear" (Freeman 1997:27-29).

Elders are very aware that many aspects of the lifecycle of fish harvested occur upstream in the Mackenzie River Basin.

> They mostly breed around Great Slave Lake or up around Yellowknife or coming down; they are always coming down going to Tuk[toyaktuk] all along the delta... . I know they spawn right along the Mackenzie when they are coming up[stream]... in December they have no more eggs. In the spring time they have small little eggs, just like a bead. Some of them, their eggs are half-size down around Whitefish Station. I know they spawn right along the Mackenzie when they are coming up. Sometimes you see female fish that spawned already, that's in October or November they are just about spawning. In December they have no more eggs. [11] (Freeman 1997:27-29).

> Once I caught an unusual fish that looked like a whitefish. They told me the name in Inuvialuktun but I forgot it. It looked like a coney and whitefish. We caught it on a big hook, a bone hook." [89] (Freeman 1997:27-29).

> One of my boys was all excited this fall because he caught what he thought was a coney when he was taking it out of the net. But the coney head had the body of a whitefish... . I've seen a few of them in my time. [81A] (Freeman 1997:29)

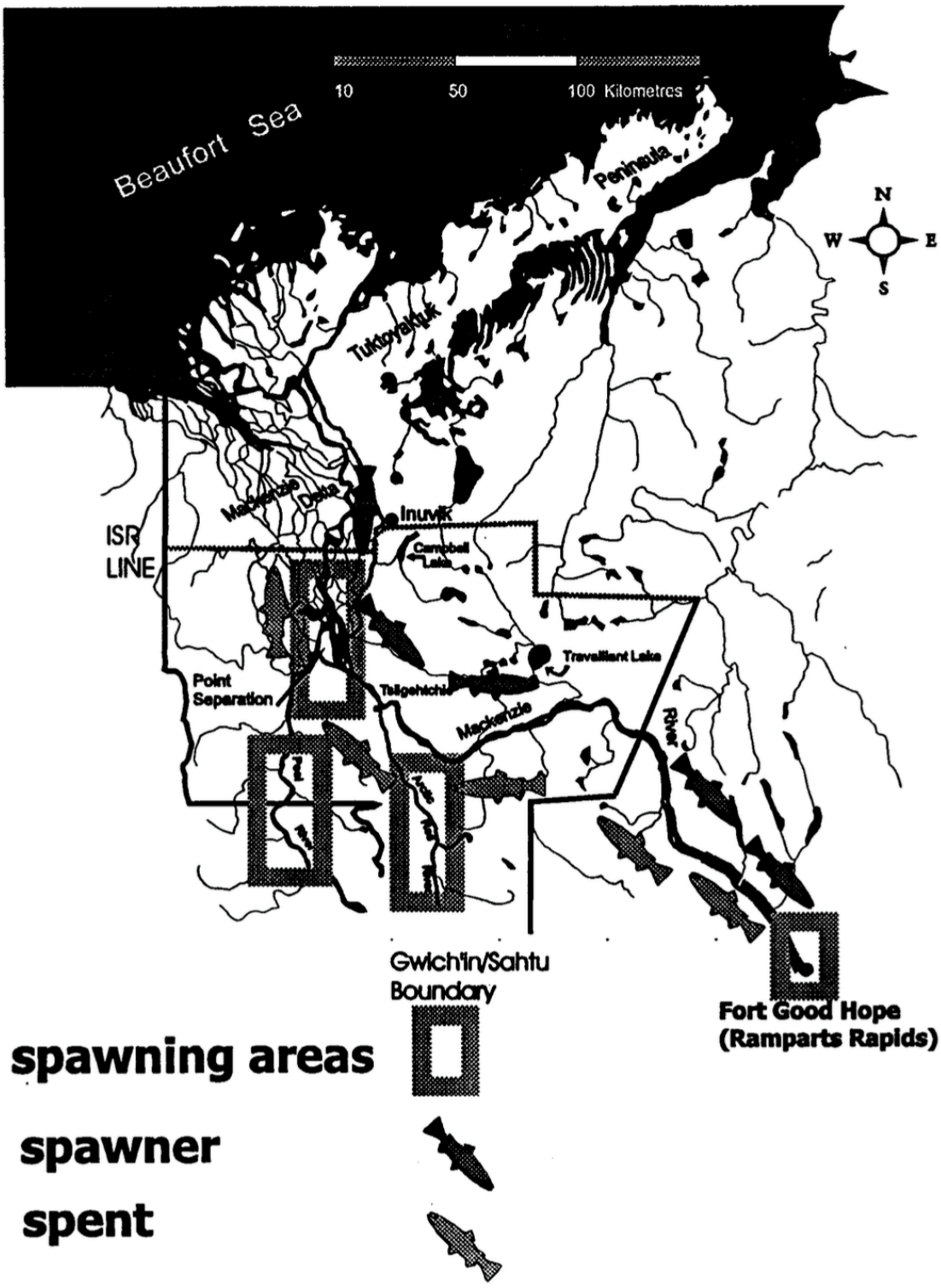


Figure 3: *Spawning Areas and Movements of Broad Whitefish in the Mackenzie Delta* (Tallman and Reist 1997:61).

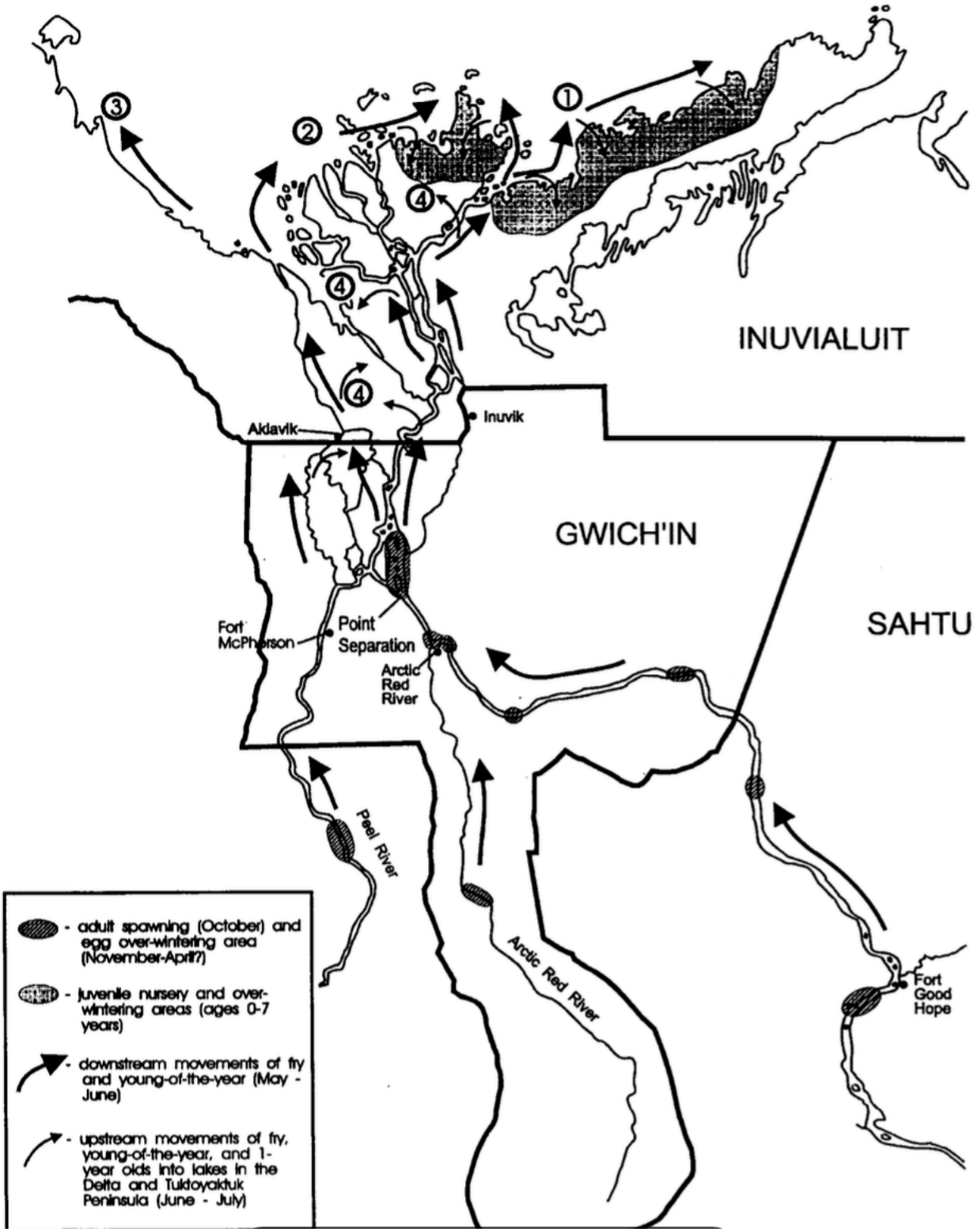


Figure 4: *Habitats and movement patters of Broad Whitefish in the Mackenzie Delta*.

WATER LEVELS AND WATER QUALITY

Water quality is a major issue affecting fish health in the delta. A commonly cited indicator of water quality is muddy water or 'too much dirt in the water.'

> There are times of the year when there's so much dirt in the water [and] you're usually not catching fish that you would be catching... what we do in situations like that is we take the net out and hang it up to dry and clean all the silt out of it, and then put it back in; of course, there are some places that are a lot worse than others. [81A] (Freeman 1997:24).

Although the Mackenzie Delta is naturally characterized by much suspended sediment, elders differentiate the water being 'too muddy' at different times of year or under conditions of river bank erosion (e.g., permafrost melt) or due to a disturbance:

> Our Gwich'in harvesters observed there is a lot of erosion due to the ice break-up. Now it is harder to travel around because there are now shallow rivers and lots of sand bars. It also makes it harder to get to the animals they hunt (Sherra Arey, Aklavik in ABKC 2013:40).

> I wanted to bring up a point I brought up to the Department of Public Works last spring about the amount of shale that they're putting into the Peel River at the ferry landing and also at the Arctic Red ferry landing. I work on the ferry there and tons and tons of that—might as well call it mud. It comes up when it rains. The river rises and all that stuff goes back down and washes away down the river. That causes a lot of concern for fishermen because all the eddies are getting filled with all this mud they're putting in (John Nitzi in Treble and Reist 1997:204).

> The other one, again, is about the sewage lagoon in McPherson running into the Peel River. A lot of our people, even younger people now, are starting to die from cancer and we figure from that sewage lagoon running to the river and people are living down below the creek there and drinking the water, eating the fish and we're very concerned about it (John Nitzi in Treble and Reist 1997:204).

> Flooding is another dimension of water quality:

> When traveling, people are seeing lots of low water along the delta and making different channels every year, lakes turning into creeks. When traveling lots of overflow was seen this winter (Rose Mary Arey, Aklavik in ABKC 2013:42).

CLIMATE CHANGE

Ice Conditions—Freeze-Up/Break-Up

Changing ice conditions are another area of observation that has been increasingly well-documented by organizations such as those involved in the *Arctic Borderlands Knowledge Coop.* Although it's getting warmer according to some, the timing of the breakup varies:

> In October ice begins to form on the lakes, and once it is safe, the most intense fishing period commences, ending in December when sufficient fish for the winter have been taken and before the ice becomes too thick and the coldest weather arrives. Large catches are made from nets set beneath the ice in certain lakes and in the river where the depth is suitable for setting nets (Freeman 1997:24).

> Breakup was so late last spring and it was not like it used to be when the river was high and everything was colder. Every year it's up, it used to be [every] 10 years; now it's every second year." [4 & 6] (Freeman 1997:24).

> During spring our ice takes longer to break up and clear the rivers. Long ago it would warm up and as soon as it warmed up the ice was gone quickly. Now today it takes longer for the ice to break up and it affects trapping and hunting muskrats (Sherra Arey, Aklavik in ABKC 2013:40).

> This last year (2012), summer weather is getting hotter and more thunderstorms are occurring. It can also stay dry for a long period of time. Fall is also getting warmer and it takes longer to freeze up. Winter: some said there was more wind and less snow than last winter and not as [many] blizzards as there used to be. Spring is warming up earlier than usual. A thunderstorm was also recorded in May (Sheery Arey, Aklavik in ABKC 2013:40).

> Most interviewees said the same: the weather is changing, and it is not as cold as it used to be. These days, we get a nice warm day in the winter and then a few days of cold weather and sprints of snow and when it does snow we get lots. But still we do not get the blizzard conditions we use to get in the 60s, 70s and even in the 80s. Last year there was a lot of thunder and lightning in early June, usual thunder and lightning weather. The thunder was so low it would shake the houses (Mavis Clark, Inuvik in ABKC 2013:47).

> Most everyone said the land is shifting, the land is slumping. That the creeks and lakes are drying out. The Channels are changing. The land is changing. Valleys are different from the slumping and drying out. The trees and willows are falling into the creeks and smaller rivers, you can't travel thru them anymore, and you used to be able to drive thru them with a boat or ski-doo now you can't. The river banks are falling in more and even the hills are falling in (Mavis Clark, Inuvik in ABKC 2013: 47).

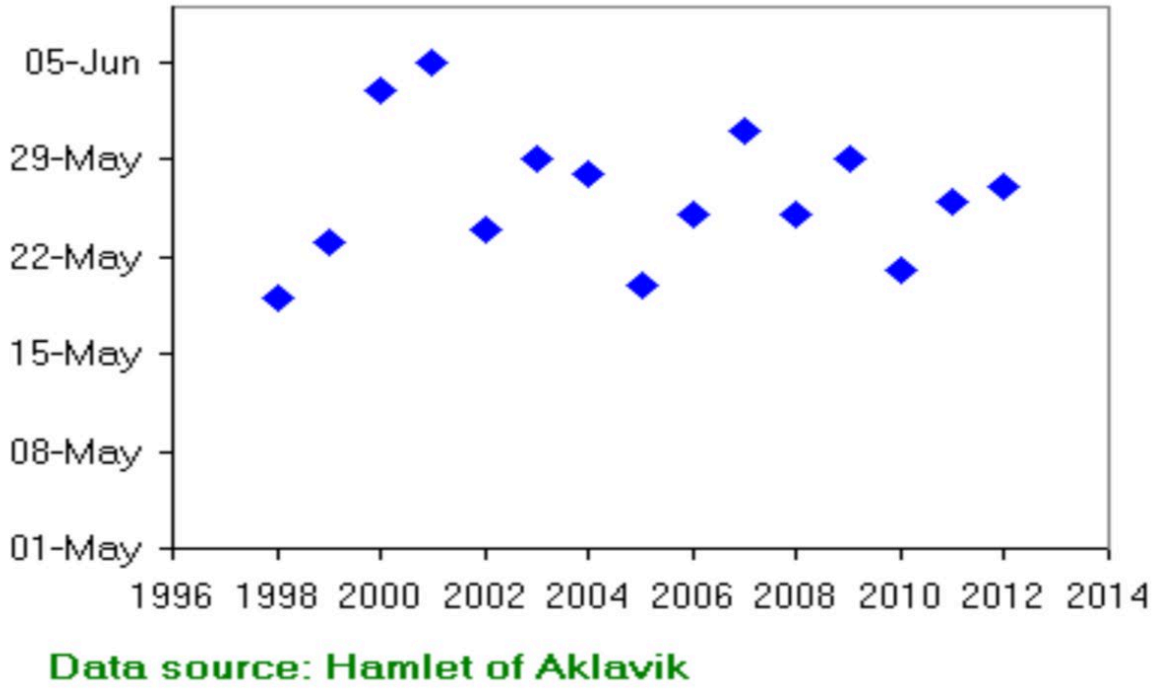


Figure 5: *Arctic Borderlands Knowledge Coop Data on Peel River Breakup (from ABKC 2013).*

> People interviewed for this study have observed a number of changes in the environment. They report that temperatures have become warmer. This has resulted in changes to freeze-up and break-up conditions. Late freeze-up affects the fish harvest because the main run has passed before the ice is thick enough to set net under. The ground has also changed, becoming softer and less signs of permafrost (Greenland and Walker-Larson 2001:5).

RESOURCE DEVELOPMENT AND DISTURBANCE

Commercial Harvesting

At various points over the last 60 years, there have been discussions about commercial harvesting of fish from the region. Even before this period, the mass harvest of fish to feed traders and missionaries was occurring. Fishing increased as these communities grew and the fur trade expanded throughout the delta (Treble and Reist 1997:6).

There were efforts at creating a commercial fishing operation beginning in the 1950s near Fort McPherson. However, none of these operations proved successful for a variety of socio-economic reasons.

Table 2: Commercial Fish Operations (from Tallman R.F. and J.D. Reist 1997).

Commercial Fishing Operations in the Lower Mackenzie		
Fort McPherson Trader	1950s	Lakes surrounding Fort McPherson (Bissett 1967)
Department of Northern Affairs and National Resources	1960-61	Aklavik, Kittigazuit, Mouth of the Peel (Davies *et al.* 1987)
Department of Northern Affairs and National Resources	1963-64	Fish and Inconnu Fishery at Holmes Creek
Menzies Fish Co.	1965-66	Inuvik
Government of the Northwest Territories	1972-73	Holmes Creek
Government of the Northwest Territories Freshwater Fish Marketing Corporation	1975	Inuvik
Ummarmiut Development Corporation	1989-93	Inuvik, FFMC

Petroleum Development and Cumulative Effects

Other changes in the Mackenzie Delta region as they relate to transportation, forestry, petroleum extraction, and related activities have been a major area of concern and a focus of local and traditional knowledge research. Among the species most vulnerable are whitefish.

> Like many other fish, lake whitefish are vulnerable to changes in their environment. Forest fires, pollution and commercial fishing all affect the health of the fish in the Gwich'in Settlement Area (GRRB 1999:98).

> Some people expressed concern that a large commercial fishery might deplete the broad whitefish, like the Atlantic cod on the east coast of Canada, and suggested that any development should start slowly and be monitored, so the subsistence fishery would be assured and protected (Treble and Reist 1997:8).

The use of dynamite by those explorers is perceived to be highly dangerous and detrimental to fish and fish habitat:

> When I was fishing, I found out the oil companies were dynamiting all over the rivers and lakes... we had a hard time catching fish because they were killing all the fish at that time... lots of fish died... . I set out a couple of fish nets and only got a few fish. That's the time everyone was short of fish... . We used to have [lots of fish]... after the dynamiting... I went and set fish nets in the summertime; there were no fish for me [39] (Freeman 1997:24).

The ferry landing operations on the Mackenzie crossing at Tsiigethchic have also been a focus of study:

> Barge traffic and seismic work does interfere with whitefish. I've seen it happen years ago when they were doing seismic blasts in the delta. There were lots of dead fish in lakes in the springtime, after the blasts were done in winter [RP15] (Freeman 1997:24).

The Mackenzie Gas Project proposal was among the greatest triggers of concern for communities in the delta in recent years.

> Several potential threats to broad whitefish were identified by the survey. There were some concerns about the construction of a dam in the Mackenzie River around Tulita. Respondents believe this development will lower water levels in this region and that lakes and creeks will dry out. A number of respondents believe that oil and gas pipeline construction and operation may impact the fish, as well as damming of creeks through seismic activities (Greenland and Walker-Larson 2001:7).

> According to the responses, the second biggest environmental concern [associated with the proposed Mackenzie Gas project] that the participants had was water and wildlife. The majority of the participants (74%) were very concerned about water. Participants talked about their concerns about run-offs, stream crossings, changes in water flow rates and fish migration… . "Run-off from sumps can cause contaminants to seep into the water table perhaps killing fish or even destroying whole ecosystems. More comprehensive studies have yet to be conducted regarding flow rates and fish migration. Presently they are only studying 100m on either side of major stream crossings. They should study 1500m on either side of EVERY stream crossing." (/p158/ - male, age 35, Tsiigehtchic) "They should go under all creek crossings, the only reason they don't do that is because of money, and they should go further from Caribou Lake." (/p150/ - male, age 58, Tsiigehtchic) (Salokangas 2005:56).

The cumulative effects of many activities in the region present a compounded problem of disturbance for the delta and delta communities:

> Many people stated concerns about contaminated sites, specifically Caribou River. There are fears that present and future development may result in similar destruction. Community residents would like the Gwich'in Renewable Resource Board, Gwich'in Land and Water Board, Department of Fisheries and Oceans, and other management groups to be very careful about what occurs on Gwich'in Settlement Land and waters. One example given was past seismic work in the One Man's Camp area and how it had blocked off important creeks, resulting in impacts on the fish run in One Man's Camp area. Another elder was concerned about the calcium salts on the highways because when it rains, it is washed off the roads and it may affect the berries, trees and water, leading to the fish (Greenland and Walker-Larson 2001:10).

GOVERNANCE AND STEWARDSHIP

Land claim settlements in the Inuvialuit and Gwich'in regions have created significant architecture for co-management of the Mackenzie Delta. There have been major efforts made to document and incorporate traditional knowledge in this region.

As a starting point, Inuvialuit and Gwich'in peoples consider themselves to be the original conservationists for the region, with strong principles for how to take care of the land, including the Mackenzie Delta, for current and future generations .

> I've always sort of bragged about the Inuvialuit probably being the best conservationists in the world. I stick to my word because they took what they needed and nothing was wasted. [81A] (Freeman 1997:24).

Some elders are critical of younger harvesters from their own communities who do not respect the principles of stewardship, including the rule, don't overfish or 'take only what you need.'

> Several people interviewed had concerns about poor fishing practices. They noted that it is very important for a fisherman to check his net regularly to avoid spoiled fish, and reported seeing nets that were full of spoiled fish because the owner wasn't caring for the net properly. Elders say this is very disrespectful to the fish and is not the traditional way of the Gwich'in (Greenland and Walker-Larson 2001:8).

> I'm pretty sure that my granddad never overfished in one area; he would never fish in one spot all of the time. [79A] (Freeman 1997:30).

> I don't think they should fish too much whitefish. That's why we don't fish in the Mackenzie too much because we don't fish when the fish are running. We never bother that big eddy, only that one year when we thought there was too much fish in the lakes...I think some places should be cut off: that big eddy should be cut off because there's a lot of fish there and they should let the fish go by. [82A] (Freeman 1997:29).

> There's never really been concerns about the fish except when you have broad whitefish in lakes where there's no creeks coming out. People set a net in the lake and they take a certain amount each year. Once they get that amount, they take their nets out and then that lake is left alone until next year. I've known people who have a good fish lake where there was nice big fat broad whitefish and they would go in there every year catch 75 and once they caught 75 they took their nets out. [81A]

> We used to pull our nets at certain times so we didn't hurt the spawning fish. [93] (Freeman 1997:30).

People also expressed concern about the effect of the fall net fishery on another seasonally important fishery, namely that for loche (*tiktaliq*, burbot). Loche are fished in the fall for their highly valued livers, a local delicacy. It is understood that

> setting nets in locations where the loche can be taken on hooks (by jiggling) will disrupt this fall loche fishery, so in view of that, several individuals observed: "You can't jiggle and set a fish net in the same place." (Freeman 1997:30).
>
> ...if you just catch too much fish you just waste the fish, just throw it away because you have no dogs. I never wasted fish, I would give it away for dogfood. [87A] (Freeman 1997:31).
>
> Long ago the old people never threw fish away, they never wasted it. They just caught what they needed. I was brought up by my grandparents and was told not to take more than I needed. That's how we manage our wildlife. If you have too much you give it away. [CS] (Freeman 1997:31).
>
> The people who care, they don't catch too much, they don't throw fish away. They catch them the right way, set the net in the right place in order to catch fish. [82] (Freeman 1997:31).
>
> A good fisherman knows where to fish, how to fish, and what kind of fish. The proper way to fish is to check the nets 2-3 times a day to make sure the fish don't spoil. [96A] (Freeman 1997:32).
>
> If a fisherman is going to be a good fisherman, he would visit his nets every 5-6 hours or overnight and look at them early in the morning. In the summer the fish dies right away, they drown. I know that is a proper way to catch or net some good fish for eating. You have to be ready to get the fish when they want to be caught. [38] (Freeman 1997:32).

The protection of habitat in the delta and further upstream has been a major area of consideration in the land-use planning process and in the designation of key fish camp sites as National Historic Sites.

> People identified areas throughout the Gwich'in Settlement Area that were important to the broad whitefish. Although specific areas were mentioned, all people stated that the entire water system is connected, so if just one area were to be polluted or damaged in any way, the other areas would eventually be affected as well. Fish migrate, so all rivers and lakes should be protected and kept healthy. The priority areas that should be protected include the Peel River, Mackenzie River, Arctic Red River, Aklavik River, Mouth of Caribou River, Mouth of Bear Creek, and Travaillant Lake Area. These areas are said to be the main habitat for broad whitefish and other fish species. There is a big eddy in the mouth of Bear Creek and it's always full of whitefish (Greenland and Walker-Larson 2001: 4).

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