Results of the 2000 Lower Mackenzie River Index Netting Program

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Executive Summary

During the development of the Integrated Fisheries Management Plan for inconnu (*Stenodus leucichthys*) in 1998, a need was identified for a program that would document average biological parameters (*e.g.*, weight, length and distribution) of inconnu and other fish species in the Mackenzie Delta and nearby areas. Documenting "average" parameters was viewed as necessary to be able to detect changes in fish stocks due to possible future natural or man-made changes to the environment. As a result, an index netting study was proposed as a means to begin collecting this information for all locally important fish species. The study began in 1999 and 2000 marked the second year.

Hunter and Trappers Committees and Renewable Resource Councils selected members to carry out index netting near the communities of Aklavik, Inuvik, Fort Good Hope, Fort McPherson, Tsiigehtchic and Tuktoyaktuk during early July, 2000. A total of 1,136 fish were captured during a six-day sampling period. The majority of fish (77.9%) captured were coregonids (inconnu, whitefish and ciscos). Excluding the two new locations, two new species were captured that were not seen during 1999 netting.

The second year of study provides additional information that will be used to focus the methodology of the study towards those species of greatest management need and interest. Several recommendations are made to help ensure proper data collection in the field and increase the overall value of the program.

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Introduction

The 1999 index netting program was proposed as a means to help answer some of the questions regarding the status of transboundary and non-migratory fish stocks in the Lower Mackenzie River (including the outer Delta and the Arctic Red and Peel rivers). For example, while several point in time databases are available on the distribution or average length and weight of fish species in the Lower Mackenzie River, some are now dated (*e.g.*, Stein *et al.* 1973) or do not present information on all species of interest (*e.g.*, Treble and Tallman 1997). Thus, most historic or recent studies are not immediately useful for providing information about distribution or average biological characteristics of a number of fish species. Due to the great costs involved with repeating similar studies, an alternative was to begin using a method that was less costly, but would still provide useful information.

The program evolved during discussions of the Integrated Fisheries Management Plan (IFMP) for inconnu (coney) (*Stenodus leucichthys*) with area residents during 1999 community visits and during the 1998 "Coney Workshop" (Stephenson 1998). While most area residents thought that the distribution and average size of inconnu was unchanged over the past 20 years, there was no data to support this. Index netting was suggested as one means to begin creating a database that would result in point in time information on average length, weight and relative abundance of inconnu and other important fish species. The 2000 index netting program was a continuation of the 1999 study.

Index netting refers to a fishing method in which several sizes of mesh comprise a single gill net. Multiple meshes capture fish of a variety of sizes at the same time, sampling all available size classes and reducing the effects of single mesh size selectivity. Information collected by annual index netting of several locations and habitats during the same time period could be used in future IFMPs and to monitor changes in the biological characteristics of various fish stocks over time. Being able to detect significant changes in fish population parameters as they occurred might identify areas of concern prior to their becoming major management issues.

Because 1999 was the first year of a (planned) long-term program, there were several questions that were answered about the methodology of the program at the end of the year. Thus, the first year of the program was, in part, exploratory in nature and the results of the first year were used to make appropriate changes to the methodology used in 2000. For example, the timing of the study was changed from two three-day periods to a single sampling period and the study was focussed on the capture of coregonids (*i.e.*, inconnu, whitefish and cisco); species known to be the most important in the aboriginal subsistence harvest (Fabijan 1998; McDonald 1998).

Methods

Each Hunter and Trapper Committee (HTC) or Renewable Resource Council (RRC) from the communities of Aklavik, Inuvik, Fort Good Hope, Fort McPherson, Tsiigehtchic

and Tuktoyaktuk selected netting crews. Communities participating in the 1999 index netting used the netting sites selected in 1999. Each netting crew was provided with instructions as to how the netting and sampling should be carried out. A collection of line drawings of fish species likely to be encountered was included with each sampling kit to aid with identification. All equipment necessary for measuring and weighing fish and removing and storing ageing tissues were provided. Hand held thermometers were provided so that water temperature at the time of net setting could be determined.

Multifilament index nets were comprised of eight 20-foot long sections ranging in stretched mesh size from 50.0 mm (2.0") to 140.0 mm (5.5") seamed together and hung on lead and float lines. Mesh sizes were arranged as 127.0, 50.0, 102.0, 63.0, 114.0, 76.0, 140.0 and 89.0 mm (5.0, 2.0, 4.0, 2.5, 4.5, 3.0, 5.5 and 3.5"). Sampling crews were provided with buoys and sideline and, in some cases, anchors.

Index nets were set from the 2-8 of July. However, weather during the week made net setting and retrieval dangerous for some crews and they were unable to set nets on one or two days. One of the crews also began the study late. As a result of weather problems, netting was mainly performed from July 2-8 by the majority of the crews and from July 8-13 by the Fort McPherson crew.

Crews were instructed to set their nets on the evening of the first day of netting and to remove them from the water on the following morning for a total of six nights of fishing. Nets were set for a minimum of 12 hours. Crews were asked to record the time of net set and lift, weather conditions at the time of the set, water temperature at the time of setting and the approximate maximum and minimum water depths of the net. As the nets were lifted, all fish were recorded as to the mesh size of capture. Appendix 1 presents a copy of the field data sheets used to record this information.

Timing for the second year of the study was determined through: **1/** examination of the number of fish captured during each of the two periods utilised in 1999 (Stephenson 2000), and **2/** by questioning participants at a 1999 "Transboundary Fish Workshop" as to when would be the most suitable time to capture large numbers of fish. Catches were higher in the July period than in September of 1999 (Stephenson 2000) and therefore the July period was deemed the best sampling time. Similarly, participants at the 1999 Transboundary Fish Workshop almost all agreed that early July was the best time to fish.

Fish were sampled for fork length (FL) to the nearest mm, round weight to the nearest 50.0 g, sex and gross stomach contents (when possible). Ageing tissues were removed from the first 50 of each species captured at each location. Otoliths were removed from Dolly Varden char (*Salvelinus malma*), broad whitefish (*Coregonus nasus*), lake whitefish (*C. clupeaformis*), Arctic cisco (*C. autumnalis*), least cisco (*C. sardinella*), burbot (*Lota lota*) and inconnu. Scale samples were taken from northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*) and suckers (*Catostomus* sp.). Written instructions identified the specific ageing tissues required from fish not listed here (*e.g.*, salmon and other cisco species).

Netting crews were asked to preserve any fish that were rare in occurrence (*e.g.*, rainbow smelt (*Osmerus mordax*) in upstream areas, goldeye (*Hiodon alosoides*)) (as indicated on line drawing sheet) or unknown to them. These fish were to be preserved whole for return to the Fisheries and Oceans Canada (DFO) Area Office for positive identification.

Once the sample envelopes had been returned to DFO, all data was entered onto a spreadsheet program. Lengths and weights of all fish were plotted by species to determine if the data "looked" accurate. Those fish that appeared to be "outliers" (*i.e.*, individual fish that were far outside the "average" weight or length for the species) were identified and the spreadsheet and sample envelopes were checked to determine if errors were due to data entry or recording in the field. If the errors were found to have taken place in the field (*i.e.*, incorrect information recorded on sample envelopes), those samples were dropped from the working total.

Results

1/ The Fish

A total of 1,136 fish were captured during the project of which 744 (65.4%) were, or appeared to have been, properly identified, weighed and measured. The greatest number of fish were captured at the Tuktoyaktuk site (n= 568) while only 26 were captured at the Aklavik RRC site. The average number of fish captured per site was 141. A summary of all fish species captured at each location is presented in Table 1. Catch results (with average fish lengths) from each community are presented in Tables 2-9. Where possible, comparisons are made with the July, 1999 catch.

Coregonids comprised the majority (77.9%) of the catch. Northern pike comprised 5.2% of the total catch. Other primarily freshwater fish, such as walleye, char, sucker and burbot made up 2.3% of the catch. Primarily marine fish, such as rainbow smelt, flounder sp. (Pleuronectidae), Pacific herring (*Clupea pallasi*) and sculpin sp. (Cottidae), made up 14.5% of the catch and were captured only at the Tuktoyaktuk site. Rare fish (*i.e.*, goldeye) were not captured during the index netting although the Tsiigehtchic crew kept three fish for positive identification. These fish were later identified as flathead chub (*Platygobio gracilis*); a species not uncommon to the Tsiigehtchic area, but seldom captured due to their small size and the standard use of large mesh gill nets in the subsistence and commercial fishery.

Excluding those fish identified by the Tsiigehtchic RRC as "herring", the Fort Good Hope RRC and the Tuktoyaktuk HTC sites possessed the highest species diversity (9) while the Aklavik RRC location possessed the lowest (4 species). Overall, however, diversity was largely similar at all locations (mean=7; mode=7).

When considering all areas, the majority of fish (23.5%) were caught in the 63.0 mm mesh while the 140.0 mm mesh captured the fewest (2.2%). The percent of fish captured by other meshes were: 127.0 (6.42%), 114.0 (5.63%), 102.0 (7.22%), 89.0 (16.11%), 76.0 (16.64%) and 50.0 (22.37%).

Broad Whitefish
Broad whitefish were captured at all locations except the Aklavik RRC site. Overall, broad whitefish comprised 7.2% of the total catch (n=82). Broad whitefish ranged in FL from 221-675 mm. The average FL and weight for all areas was 400 mm and 1.26 kg (n=82). Broad whitefish captured at Tuktoyaktuk possessed the shortest mean FL (313 mm) (n=34) of all locations. Almost twice as many males were captured as females (1.8:1.0). The greatest number of broad whitefish were captured at the Tuktoyaktuk and Inuvik RRC (n=26) sites.

Lake Whitefish (Crooked back)
Lake whitefish were captured at all but the Aklavik RRC and Fort Good Hope locations. Lake whitefish represented 9.2% of all fish captured (n=104). The average lake whitefish was 312 mm long in FL and weighed 0.60 kg. Lake Whitefish ranged in FL from 185-585 mm. Lake whitefish captured at Tuktoyaktuk possessed the shortest average FL (247 mm) and exhibited the shortest maximum length (424 mm) (n=56). Within the entire sampling area over five times as many males as females were captured (5.5:1.0). The Tuktoyaktuk netting crew captured the greatest number of lake whitefish (n=56) and also reported the highest male to female ratio (27.0:1.0) (Table 10).

Inconnu (Coney)
Inconnu were captured at all locations with the greatest numbers captured at the Tuktoyaktuk HTC (n=92) and the Inuvik RRC (n=74) sites. Inconnu comprised 21.4% of the total catch (n=243). Inconnu possessed an average FL of 634 mm (range 295-1000 mm). Average weight was 3.11 kg (range 0.20-11.48 kg). The heaviest inconnu was an 11.5 kg female captured at Fort McPherson. Males outnumbered females (2.6:1.0) although the greatest difference was noted in Tuktoyaktuk where the male to female ratio was 22.0:1.0. Tuktoyaktuk coney possessed the shortest average FL (528 mm).

Northern Pike
Northern pike were captured at all locations except the Tsiigehtchic and Tuktoyaktuk sites. The Inuvik HTC crew captured the greatest number of northern pike (n=16). Overall, northern pike represented 5.2% of all fish captured (n=59). Northern pike ranged from 280-772 mm in FL and possessed an average FL of 552 mm (n=58). Average weight for all northern pike was 1.31 kg (range 0.10-3.0 kg). Males slightly outnumbered females (1.6:1.0) when all locations are considered. Only at the Aklavik sites did males greatly outnumber females (Table 10).

Burbot
Burbot were captured only at Tuktoyaktuk and Fort Good Hope and represented 0.17% of the total catch (the second lowest of all species). Average total length of both burbot was 705 mm and 1.6 kg in weight.

Longnose Sucker
Longnose sucker were captured at three locations and represented 0.35% of the catch (n=4). Average FL and weight of all longnose suckers was 391 mm and 0.75 kg. Longnose sucker were captured at a 3.0:1.0 male to female ratio.

White Sucker
White sucker were captured at Fort McPherson and at the Aklavik HTC site. White sucker made up 0.7% of the catch (n=8). The average FL of white sucker was 432 mm (range 337-550 mm). Average weight was 0.90 kg (range 0.5-1.3 kg). White sucker were captured at a 0.75:1.0 male to female ratio.

Round Whitefish
All round whitefish (*Prosopium cylindraceum*) were captured at Fort Good Hope. They represented 0.52% of the total catch (n=6). This species was not captured during 1999 index netting. Round whitefish had an average FL of 392 mm (range 350-444 mm) and an average weight of 0.63 kg (range 0.50-0.80 kg). Females outnumbered males 5.0:1.0.

Dolly Varden Char
Only one char was captured by the Aklavik HTC crew. Overall, char represented 0.08% of the total catch. This fish was identified as male, measured 338 mm in FL and 0.35 kg in weight.

Walleye
Walleye were captured at Fort Good Hope, Tsiigehtchic and at the Inuvik RRC site. Walleye represented 0.7% of the total catch (n=8). Walleye were captured at a 0.25:1.0 male to female ratio. Average FL of walleye was 405 mm (range 335–480 mm) and average weight was 0.67 kg.

Flathead Chub
Flathead chub were captured at Fort Good Hope and Tsiigehtchic and represented 0.35% of the catch (n=4). Average FL of flathead chub was 258 mm (range 225-283 mm). Average weight was 0.22 kg. The three fish captured at Tsiigehtchic were sexed as female while the single flathead chub taken at Fort Good Hope could not be sexed. This species was not captured during the 1999 sampling.

"Herring"
Ciscos, or "herring", as many people throughout the area refer to both Arctic and least cisco, were reported only at Tsiigehtchic (n=119). Overall, ciscos represented a total of 39.3% of the catch (n=447). However, because it is impossible to tell which species was actually captured by the Tsiigehtchic crew, summary weights and lengths are not presented here.

Arctic Cisco
All netting sites except for Fort Good Hope captured arctic cisco. Average FL was 350 mm (range 238-432 mm) and average weight was 0.52 kg (range 0.1-0.98 kg) (n=61) (Table 11). Arctic cisco were reported at a 0.93:1.0 male to female ratio. Arctic cisco represented 11.6% of all fish captured (n=132).

Least Cisco
Least cisco were reported captured at the Aklavik and Inuvik RRC sites as well as Tuktoyaktuk. Some of the "herring" reported from Tsiigehtchic may have also been least

cisco. Least cisco averaged 251 mm in FL (range 195-315 mm) and 0.21 kg in weight (range 0.10-0.40 kg) (n=41). Males were slightly outnumbered by females (0.70:1.0) (n=46). Least cisco comprised 17.2% of the total catch (n=196).

Lake Herring

Lake herring (*Coregonus artedi*), or lake cisco, were captured only by the Fort Good Hope netting crew (n=3). Lake herring averaged 346 mm in FL (range 300-380 mm) and 0.50 kg in weight (range 0.3-0.6 kg). One lake herring was sexed as male while the other two could not be sexed. This species was not captured in 1999.

Marine Species

Primarily marine fish species were only captured at the Tuktoyaktuk site. Because no information was recorded for these species (other than number captured and mesh size of capture), little can be said except that they were present in the area. A total of 62 rainbow smelt, 66 flounder, 22 sculpin and 15 Pacific herring were captured.

2/ Physical Parameters

Weather during the sampling period was typically overcast with occasional rain although there were several clear and partly cloudy days recorded by the netting crews. Water was high at many locations for at least some portion of the study and several of the crews noted the large amount of debris in the water and extremely high turbidity. High winds in most areas on the evening of July 5 prevented some crews from setting nets.

Most of the study sites varied considerably with regards to physical conditions (*e.g.*, depth, water velocity, salinity, channel with) and these undoubtedly played some role in the species present and, subsequently, the numbers captured.

Aklavik HTC

The Aklavik HTC netting location was at an eddy on the west shore of the west channel of the Mackenzie River approximately 5.0 km downstream from the town of Aklavik. Water depths ranged from 1.2 to 13.5 m. Water temperature ranged from 15-18°C. Bottom substrate was comprised primarily of muds and sand. Netting was carried out from July 3-9.

Aklavik RRC

The Aklavik RRC site was on the west shore of the Husky Channel approximately 1.0 km upstream of Aklavik. There were no obvious eddies or other structures present in this area. Water depths ranged from 1.2 to 6.2 m. Water temperature was recorded as 15 °C every day of the netting. Bottom substrate was comprised primarily of muds. Netting was carried out from July 3-8.

Inuvik HTC

The Inuvik HTC site was on the east shore of the east channel of the Mackenzie River approximately 4.0 km upstream of Inuvik and approximately 100.0 m downstream of a creek mouth. Water depth was recorded as 1.2 to 6.2 m deep. Water temperature ranged

from 15-18°C. Bottom substrate was comprised primarily of muds with some aquatic weeds. Netting was carried out from July 3-8.

Inuvik RRC
The fishing site for the Inuvik RRC was situated in the Mackenzie Delta approximately 20.0 km upstream of the town of Inuvik. Water depths at the site were the deepest of all locations and ranged from 1.2 to 21.5 m. Water temperature ranged from 16-18°C. Bottom substrate was comprised primarily of sand and muds. Netting was carried out from July 3-8.

Fort McPherson
The Fort McPherson site was on the east shore of the Peel River approximately 5.0 km downstream of the town of Fort McPherson. Water depths at the site ranged from 2.5 to 3.7 m. Water temperature was recorded as 12°C during the entire sampling period. Bottom substrate was comprised of weeds, sand, mud and rocks. Netting was carried out from July 8-13.

Tsiigehtchic
The Tsiigehtchic netting site was on the west shore of the Mackenzie River at the confluence of the Arctic Red River and the Mackenzie River. This site is slightly different from the one used in 1999 (Stephenson 2000). The area is greatly influenced by water from the Arctic Red River. Nets were set in water ranging from 2.2 to 6.2 m deep. Water temperature ranged from 14-16°C. Bottom substrate, similar to most other areas, was comprised primarily of silts and clays. Netting was carried out from July 4-10.

Fort Good Hope
The Fort Good Hope netting site had to be moved to the west side of the Mackenzie River after two days of fishing as it was thought to be interfering with a local fishermen. Nets were set approximately three miles upriver of the community. Bottom substrates were comprised of mud and rocks. Nets were set in water ranging from 1.2 to 9.0 m deep. Water temperatures ranged from 15-19 °C. Netting was carried out from July 3-8.

Tuktoyaktuk
Nets for the Tuktoyaktuk crew were set in the east channel of Tuk Harbour. Water temperatures ranged from 10-20 °C. Nets were set in water ranging from 1.2 to 2.5 m deep. Bottom substrates were comprised of rocks and aquatic weeds. Netting was carried out from July 3-8.

Discussion

Almost twice as many fish were captured in the second year of index netting as compared to 1999 (1,136 vs. 631 for all of 1999) although the main reason for this is the inclusion of two new netting locations. However, a large number of the fish (500+) captured in 2000 were not weighed or measured (Table 11), not identified to species (*i.e.*, "herring") or were otherwise not useful due to missing or inaccurate information on the sample envelopes (*e.g.*, incorrect weights or lengths). A greater average number of fish per site

was captured in 2000 compared to 1999 (141 vs. 53) although the number of "useable" samples per site (and overall) remained approximately the same due to the above mentioned problems. A higher percentage of the catch was comprised of coregonids as compared to 1999 (77.9% vs. 62.1%) and this is one of the encouraging results from the 2000 netting. Better identification of ciscos was also achieved in 2000 (73.4% identified to species as compared to 14.8% in July of 1999 (Stephenson 2000)). Fish lengths were, on average, very similar to those reported in 1999 (Tables 2-7) although a more complete analysis of all results will take place in 2001.

Excluding species captured by crews in the new sampling areas of Fort Good Hope and Tuktoyaktuk, two new species, flathead chub and white sucker, were added to the list of species captured in the Delta. These captures are important because they add to our understanding of general fish distribution. New species taken at Fort Good Hope and Tuktoyaktuk are similarly important because they enable the monitoring of a greater number of species and perhaps reveal the "normal" limit of distribution of some species.

At least one crew suggested that the timing of the program was too early and that late August or September would be a better time. However, given that weather conditions can vary greatly from year to year and that this time was picked based on 1999 results and consultation with local fishermen, it is unlikely that a time agreeable to everyone can be chosen. The problems associated with co-ordinating eight different crews means that it would be difficult to suddenly change the sampling time by even a few days should heavy rains or some other event occur. Additionally, problems encountered in one area (*e.g.*, high winds) were not always evident in all areas. Thus, the chosen sampling period reflects a number of compromises and will remain for at least the next few years.

One crew made the suggestion that the field sheets (Appendix 1) should be revised. They suggested that the order of gill net mesh size on the field sheets be set up the same way as the gill nets. This may make the recording of species captured easier, so this suggestion will be followed and changes will be made to the form prior to 2001 sampling.

1/ The Fish

Broad Whitefish

Broad whitefish were captured at all locations except Fort Good Hope. Those captured at Tuktoyaktuk (n=34) had the shortest mean length (313 mm). Those captured by the Aklavik HTC (n=14) possessed the greatest mean FL (492 mm) and the second greatest maximum length (558 mm). Those captured by the Inuvik RRC (n=24) exhibited the greatest maximum length (625 mm). These results may suggest an early movement of larger fish towards fall spawning areas with subsequent capture in Delta and other upstream communities in July. It will be worth observing to see if this result is repeated in 2001.

Lake Whitefish (Crooked back)

Similar to broad whitefish, lake whitefish captured at Tuktoyaktuk possessed the shortest average length. Lake whitefish exhibited the greatest difference in the male to female

ratio at almost all locations (Table 10) and is similar to what was observed in 1999 (Stephenson 2000). However, in 1999, the skewed ratio of males to females was not as apparent in September sampling (1.5:1.0) as it was in July (1.7:1.0). Therefore, although this finding could be due to chance, inexperience of samplers (*i.e.*, identifying females as males, especially when the fish are immature) or simple seasonal segregation of the sexes, there may be some other reason for the skewed sex ratios and it will bear watching in the future. It is interesting to note that Stein *et al.* (1973) captured lake whitefish at an almost even 1.0:1.0 ratio in Aklavik and Tsiigehtchic during 1972 sampling.

Inconnu (Coney)

Inconnu captured at Tuktoyaktuk (n=92) exhibited the shortest average length (528 mm) and the fourth shortest maximum length (880 mm). Thus, there may be some evidence that three species of coregonid fish (inconnu, broad and lake whitefish) in the non-spawning phase remain in coastal areas such as Tuktoyaktuk while maturing, pre-spawning fish are already moving towards upstream spawning areas. Similar to 1999, inconnu captured at Aklavik and Inuvik were smaller than those captured in Tsiigehtchic and Fort McPherson (Stephenson 2000). This may also suggest that current year spawners have already begun their upstream migrations by mid July. It will be interesting to see if these findings are repeated in 2001. The high male to female ratio in Tuk Harbour (Table 10) may also suggest that males began the upstream migration prior to females.

Northern Pike

There are no known concerns from HTCs or RRCs regarding the health or status of northern pike populations although several people have recently commented that pike may be more abundant and larger than in the past. Average lengths of pike caught were similar to the average lengths recorded in July of 1999 (Tables 2-7). This program may help document if northern pike really are becoming much larger and more abundant. The number of pike captured was much lower than in 1999 when pike comprised 18.5% of the July sample (Stephenson 2000) (compared to only 5.2% in 2000).

Burbot

There was a decrease in the number of burbot captured in 2000 as compared to 1999 (2 vs. 7) perhaps in part because of the earlier netting. However, because burbot are not considered a priority species for study in any community, the low number captured is not cause for concern.

Longnose Sucker

A lesser number of longnose sucker were captured in 2000 compared to 1999 (4 vs. 8) and they were not captured in as many locations (3 vs. 5). As suggested in 1999, longnose sucker appear to be sporadically distributed throughout the area. However, as there are no outstanding concerns regarding the status of longnose sucker within the area, it currently does not seem necessary to monitor them and, therefore, large samples are not required.

White Sucker
Based on their capture near Aklavik and Fort McPherson, white sucker appear to be sporadically distributed throughout the Delta area. Similar to longnose sucker, there are no issues concerning the distribution or status of white sucker.

Dolly Varden Char
The capture of only one char is not a concern as there is a specific program that collects information on the Aklavik and Fort McPherson char harvest. This fish perhaps represents very early movement by Rat River char.

Walleye
The small number of walleye captured does not provide much in the way of interpretable information. Walleye were captured at Tsiigehtchic, Fort McPherson and the Inuvik RRC sites in 1999 (Stephenson 2000) so their appearance at two of these same sites is not unexpected. As walleye are more common in the south, their capture at Fort Good Hope is also not unexpected.

Round whitefish
Round whitefish are known to be randomly distributed throughout the Delta and Mackenzie River (Stein *et al.* 1973). Little can be interpreted from the small number of fish captured.

"Herring"
In 1999, especially during the initial July sampling period, a large number of the ciscos captured were identified simply as "herring" (Stephenson 2000). A greater effort to help crews identify these to correct species has apparently resulted in the majority of crews being able to successfully identify these. Some continued effort (*e.g.*, more photographs and line drawings) will be required to ensure that crews continue (or begin) to properly identify these species.

Arctic Cisco
Arctic cisco were generally distributed throughout the entire area as they were in 1999. However, the earlier sampling period than in 1999 revealed that Arctic cisco were largely confined to the lower Delta area. Relatively large numbers in Tuktoyaktuk suggests that spawning migrations to upstream areas may have not yet begun. The lack of measurements from the Tuktoyaktuk area means it is impossible to determine if there was size segregation as seen in other coregonids.

Least Cisco
The largest numbers of least cisco were taken at Tuktoyaktuk and lower Delta areas (excluding possible high captures at Tsiigehtchic). This may be evidence of late movement into the upper Mackenzie area prior to spawning. Results from future years and more detail on spawning condition may prove or disprove this.

Lake Herring

The capture of three lake herring at the Fort Good Hope site confirms earlier surveys that found them sporadically distributed in upper areas of the Mackenzie River (Stein *et al.* 1973). Not enough specimens were collected in 2000 to be able to make definitive statements about the species other than they are present in the area.

2/ Physical Parameters

Similar to 1999, results from the 2000 netting confirm that the most productive fishing waters in the Delta are back eddies and near creek or river mouths. Nets set in other locations (*i.e.*, along the shore without any definite structure) did not catch as many fish. These areas are not well suited for capturing the large number of fish required for this program and nets set in these areas should be repositioned for future netting.

With the limited and rather coarse habitat data available from only two years of netting, it is still difficult to determine if there are any strong correlations between habitat and fish species distribution or whether any will ever be found.

Future Considerations

As in 1999, perhaps the most important question that arises from the second year of the program is; was the program successful in getting the required information to be able to detect changes in distribution, length frequency or sex distribution of various fish species? Generally, the answer appears to be yes. However, more detail, especially on the sex and state of the sexual maturity of fish, will provide additional and necessary insights for helping to identify the timing of spawning migrations and the location of possible spawning areas.

The utility of two sampling locations near Aklavik and Inuvik should be reconsidered. Considering that the Aklavik RRC site and the Inuvik HTC site have, in both years, taken a considerably lesser number of fish than their respective counterparts, it is probably economically wise to drop the Aklavik RRC and the Inuvik HTC netting locations for at least the next few years. It may be possible to reconsider these sites for inclusion in the program in 2004 or 2005.

Some species are almost certainly underrepresented in the sample due to the method of setting nets although none of these underrepresented species (*e.g.*, suckers, burbot) are considered important management species at this time. The number of fish captured by each crew (except where noted) seems to be relatively high and the coregonid harvest has increased since last year. Net location appears to be much more important than the actual method of setting nets in securing large samples.

In 1999 there was some concern that the different methods of setting nets in each community might affect the results. However, in 2000, no instructions were given as to how nets should be set, rather each crew was allowed to set nets in their own manner. All of these nets were set as floating nets, although there may have been some slight variation

between communities. Overall, this should not have a negative affect on the program because most crews throughout the area are setting nets in a very comparable manner. Additionally, in the future, most results will likely be compared within rather than between communities due to the large variation in the biological characteristics of fish captured at each location. Therefore, variation in net setting methodology between communities does not appear to be an issue.

As mentioned above, the possibility that very skewed sex ratios for several species of coregonids in a few areas are a result of sampler inexperience should be addressed. An increase in written or visual definitions should be an important part of 2001 sampling to see if the results seen in 1999 and 2000 are repeated.

Concluding Comments and Recommendations

Major benefits of the second year of index netting include:
1. Continued validation of known/suspected movements of some fish species,
2. additional, seasonal information on species distribution,
3. an increase in the coregonid harvest (with subsequent increase in data collection), and
4. additional information on average weight/length of many species, including several new ones, in some areas.

The final recommendations arising from the 2000 index netting program are:

- Elimination of the Inuvik HTC and Aklavik RRC sites in 2001 for at least the next 3-4 years.

- Future sampling of fish should concentrate effort on determining the state of maturity. Additional information provided to crews (via photographs or written definitions) would help them determine not only sex, but also the potential for these fish spawning in the current year.

- Additional documentation of the physical conditions at each sampling site should be carried out (either during or just after the netting) to more completely document the physical conditions.

- To ensure that identification of all species is correct (*e.g.*, cisco species) additional photos should be included with the field sheets.

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Table 1: Summary of fish species captured at all locations during the 2000 index netting. The dash (-) indicates the absence of that species at those locations.

Species	Aklavik RRC	Aklavik HTC	Inuvik RRC	Inuvik HTC	Fort McPherson RRC	Tsiigehtchic RRC	Fort Good Hope RRC	Tuktoyaktuk HTC
Dolly Varden	-	1	-	-	-	-	-	-
Inconnu (coney)	9	17	74	6	16	26	3	92
Broad whitefish	-	9	26	1	5	5	2	34
Lake whitefish	-	14	24	3	4	3	-	56
Lake herring	-	-	-	-	-	-	3	-
Round whitefish	-	-	-	-	-	-	6	-
Arctic cisco	1	10	20	1	26	3	-	71
Least cisco	2	-	45	-	-	-	-	149
"Herring"	-	-	-	-	-	119	-	-
Northern pike	14	6	10	16	2	-	11	-
Longnose sucker	-	1	-	-	2	-	1	-
White sucker	-	6	-	-	2	-	-	-
Flathead chub	-	-	-	-	-	3	1	-
Burbot	-	-	-	-	-	-	1	1
Walleye	-	-	3	-	-	1	4	-
Sculpin sp.	-	-	-	-	-	-	-	22
Rainbow smelt	-	-	-	-	-	-	-	62
Pacific herring	-	-	-	-	-	-	-	15
Flounder Sp.	-	-	-	-	-	-	-	66
Total fish captured	**26**	**64**	**202**	**27**	**57**	**160**	**32**	**568**

Table 2: Number, average FL (in mm) and range of FL for fish species captured by the Aklavik HTC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Average FL	Number	Average FL	FL Range
Dolly Varden	7	471	1	336	N/A
Inconnu (coney)	1	765	17	657	448-900
Broad whitefish	20	419	9	492	331-558
Lake whitefish	2	310	14	420	335-553
Arctic cisco	0	-	10	337	335-339
Least cisco	0	-	0	-	-
"Herring"	12	361	0	-	-
Northern pike	6	610	6	617	502-772
Longnose sucker	1	410	1	447	N/A
White sucker	0	-	6	436	337-550
Burbot	0	-	0	-	-
Walleye	0	-	0	-	-
Total fish caught	49	N/A	64	N/A	N/A

Table 3: Number, average FL (in mm) and range of FL for fish species captured by the Aklavik RRC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Mean Fork Length	Number	Mean Fork Length	FL Range
Dolly Varden	1	510	0	-	-
Inconnu (coney)	5	545	9	557	415-725
Broad whitefish	0	-	0	-	-
Lake whitefish	1	428	0	-	-
Arctic cisco	6	363	1	400	N/A
Least cisco	1	269	2	240	N/A*
"Herring"	1	379	0	-	-
Northern pike	2	630	14	482	280-680
Longnose sucker	1	422	0	-	-
White sucker	0	-	0	-	-
Burbot	1	628	0	-	-
Walleye	0	-	0	-	-
Total fish caught	19	N/A	26	N/A	N/A

* No weight for one fish.

Table 4: Number, average FL (in mm) and range of FL for fish species captured by the Inuvik HTC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Mean Fork Length	Number	Mean Fork Length	FL Range
Dolly Varden	0	-	0	-	-
Inconnu (coney)	2	820	6	556	392-752
Broad whitefish	0	-	1	418	N/A
Lake whitefish	4	440	3	392	328-434
Arctic cisco	1	361	1	238	N/A
Least cisco	1	232	0	-	-
"Herring"	0	-	0	-	-
Northern pike	13	561	16	558	374-661
Longnose sucker	0	-	0	-	-
Burbot	0	-	0	-	-
Walleye	0	-	0	-	-
Total fish caught	21	N/A	27	N/A	N/A

Table 5: Number, average FL (in mm) and range of FL for fish species captured by the Inuvik RRC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Mean Fork Length	Number	Mean Fork Length	FL Range
Dolly Varden	0	-	0	-	-
Inconnu (coney)	33	667	74	699	295-960
Broad whitefish	11	500	26	434	315-675
Lake whitefish	0	-	24	365	185-585
Arctic cisco	12	261	20	345	240-405
Least cisco	0	-	45	251	195-315
"Herring"	-	-	0	-	-
Northern pike	12	616	10	596	430-730
Longnose sucker	0	-	0	-	-
Burbot	0	-	0	-	-
Walleye	2	420	3	376	335-410
Total fish caught	70	N/A	202	N/A	N/A

Table 6: Number, average FL (in mm) and range of FL for fish species captured by the Fort McPherson RRC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Mean Fork Length	Number	Mean Fork Length	FL Range
Dolly Varden	0	-	0	-	-
Inconnu (coney)	10	784	16	777	538-1000
Broad whitefish	5	493	5	514	505-523
Lake whitefish	10	412	4	414	387-443
Arctic cisco	0	-	26	362	273-432
Least cisco	0	-	0	-	-
"Herring"	37	363	0	-	-
Northern pike	26	534	2	572	540-605
Longnose sucker	0	-	2	390	372-408
White sucker	0	-	2	420	398-443
Flathead chub	0	-	0	-	-
Burbot	0	-	0	-	-
Walleye	2	340	0	-	-
Total fish caught	90	N/A	57	N/A	N/A

Table 7: Number, average FL (in mm) and range of FL for fish species captured by the Tsiigehtchic RRC during index netting in July 1999 and 2000.

	1999		2000		
Fish Species	Number	Mean Fork Length	Number	Mean Fork Length	FL Range
Inconnu (coney)	8	831	25	783	350-975
Broad whitefish	0	-	5	467	415-540
Lake whitefish	4	406	3	370	310-450
Arctic cisco	0	-	3	356	350-370
Least cisco	0	-	0	-	-
"Herring"	70	-	119	369	325-450*
Northern pike	4	525	0	-	-
Longnose sucker	1	440	0	-	-
Flathead chub	0	-	3	269	247-283
Burbot	0	-	0	-	-
Walleye	4	411	1	470	N/A
Total fish caught	91	N/A	160	N/A	N/A

* A mix of arctic cisco and least cisco.

Table 8: Number, average FL (in mm) and range of FL for fish species captured by the Fort Good Hope RRC during index netting in July 2000.

	2000		
Fish Species	Number	Fork Length	FL Range
Inconnu (coney)	3	589	448-670
Broad whitefish	2	589	558-620
Lake whitefish	0	-	-
Lake herring	3	346	300-380
Round whitefish	6	392	350-444
Arctic cisco	0	-	-
Least cisco	0	-	-
Northern pike	11	551	380-690
Longnose sucker	1	340	N/A
Flathead chub	1	225	N/A
Burbot	1	891	N/A
Walleye	4	411	365-480
Total fish caught	32	N/A	N/A

Table 9: Number, average FL (in mm) and range of FL for fish species captured by the Tuktoyaktuk HTC during index netting in July 2000.

	2000		
Fish Species	Number	Fork Length	FL Range
Dolly Varden	0	-	-
Inconnu (coney)	92	528	332-880
Broad whitefish	34	313	221-662
Lake whitefish	56	247	221-424
Arctic cisco	71	?	-
Least cisco	149	?	-
Northern pike	0	-	-
Longnose sucker	0	-	-
Flathead chub	0	-	-
Burbot	1	520	N/A
Walleye	0	-	-
Marine species	165	?	-
Total fish caught	568	N/A	N/A

The question mark (?) means that these fish were not weighed or measured.

Table 10: Summary of sex ratios (male:female) for fish species captured at all locations during the 2000 index netting. Ratios are based on sexed fish and may be inaccurate due to errors made in the field or fish that could not be sexed. The dash (-) indicates the absence of that species at those locations.

Species	Aklavik RRC	Aklavik HTC	Inuvik RRC	Inuvik HTC	Fort McPherson RRC	Tsiigehtchic RRC	Fort Good Hope RRC	Tuktoyaktuk HTC
Dolly Varden	-	1 male	-	-	-	-	-	-
Inconnu (coney)	3.0 : 1.0 + 1 ?	4.7 : 1.0	1.4 : 1.0	0.5 : 1.0	1.3 : 1.0	0.8 : 1.0	1 male + 2 ?	22.0 : 1.0
Broad whitefish	-	1.25 : 1.0	1.2 : 1.0	1 male	5 female	0.67 : 1.0	2 male	5.8 : 1.0
Lake whitefish	-	3.6 : 1.0	2.4 : 1.0	2.0 : 1.0	3.0 : 1.0	0.5 : 1.0	-	27.0 : 1.0
Lake herring	-	-	-	-	-	-	1 male + 2 ?	-
Round whitefish	-	-	-	-	-	-	0.2 : 1.0	-
Arctic cisco	1 male	0.67 : 1.0	1.2 : 1.0	1 female	0.7 : 1.0	2 male + 1 ?	-	N/A
Least cisco	1 female	-	0.73 : 1.0	-	-	-	-	N/A
"Herring"	-	-	-	-	-	0.67 : 1.0	-	-
Northern pike	12 male + 2 ?	6 male	0.25 : 1.0	0.78 : 1.0	1.0 : 1.0	-	2.0 : 1.0 + 4 ?	-
Longnose sucker	-	1 male	-	-	1.0 : 1.0	-	1 male	-
White sucker	-	0.67 : 1.0 + 1 ?	-	-	1.0 : 1.0	-	-	-
Flathead chub	-	-	-	-	-	3 female	1 ?	-
Burbot	-	-	-	-	-	-	1 ?	1 female
Walleye	-	-	0.5 : 1.0	-	-	1 female	1 female +3 ?	-
Sculpin sp.	-	-	-	-	-	-	-	N/A
Rainbow smelt	-	-	-	-	-	-	-	N/A
Pacific herring	-	-	-	-	-	-	-	N/A
Flounder sp.	-	-	-	-	-	-	-	N/A

N/A = fish not sexed

Table 11: Summary of mean weight and fork length, weight and fork length range, standard deviation (SD) and number sampled, for fish species captured during 2000 index netting.

Species	Mean weight (kg)	SD weight	Weight range	Mean FL (mm)	SD FL	FL Range	Number *
Dolly Varden char *Salvelinus malma*	0.35	-	-	336	-	-	1
Inconnu (coney) *Stenodus leucichthys*	3.11	2.42	0.2-11.5	634	163.6	295-1000	243
Broad whitefish *Coregonus nasus*	1.26	1.07	0.1-4.9	400	128.6	221-675	82
Lake whitefish *C. clupeaformis*	0.60	0.56	0.1-2.9	312	98.4	185-585	104
Lake herring *C. artedi*	0.50	0.17	0.3-0.6	346	41.6	300-380	3
Round whitefish *Prosopium cylindraceum*	0.63	0.12	0.5-0.8	392	31.8	350-444	6
Arctic cisco *Coregonus autumnalis*	0.52	0.14	0.1-0.98	350	33.9	238-432	61
Least cisco *C. sardinella*	0.21	0.07	0.1-0.4	251	26.03	195-315	41
"Herring" *Coregonus* sp.	0.54	0.10	0.3-0.8	369	23.7	325-450	118
Northern pike *Esox lucius*	1.31	0.67	0.1-3.0	552	103.7	280-772	58
Longnose sucker *Catostomus catostomus*	0.75	0.32	0.4-1.15	391	46.1	340-447	4
White sucker *C. commersoni*	0.90	0.30	0.5-1.3	432	60.64	337-550	8
Flathead chub *Platygobio gracilis*	0.22	0.08	0.1-0.3	258	27.5	225-283	4
Burbot *Lota lota*	1.6	0.98	0.9-2.3	705	262.3	520-891	2
Walleye *Stizostedion vitreum*	0.67	0.39	0.1-1.5	405	49.0	335-480	8

* Number refers only to those weighed and measured.

Appendix 1: Field data sheet used during index netting, 2000.

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INDEX NETTING FISHERY DATA SHEET

Location: _____ Set #: _____

Date net set: _____ Time: _____ am pm

Date net lifted: _____ Time: _____ am pm

Net depth: Minimum: _____ Maximum: _____ feet metres

Temp. (water): _____ °C Secchi: _____ Metres

Bottom Type(s): Weeds☐ Sand☐ Clay ☐ Mud ☐ Rocks ☐ (check all that apply).

Weather: Clear ☐ Rain ☐ Partly cloudy ☐ Overcast ☐ (at time of setting net).

CAPTURE DATA: Record the number of each species captured in each mesh size.

5.0, 2.0, 4.0, 2.5, 4.5, 3.0, 5.5, 3.5

MESH SIZE

Fish Species	2.0"	2.5"	3.0"	3.5"	4.0"	4.5"	5.0"	5.5"
Northern pike (jackfish)								
Broad whitefish								
Coney								
Crooked back or humpback whitefish								
Loche (mariah or burbot)								
Charr								
Longnose sucker								
White sucker								
Least cisco								
Arctic cisco								
Other								
Other								

July/August 1999