Proceedings of a Workshop to Examine the Status, Conservation and Fishing Practices, including Mesh Size, Relative to the Primary Fishery Resources of the Inuvialuit and Gwich'in, February 15-17, 1995, Inuvik, N.W.T.

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PROCEEDINGS OF A WORKSHOP TO EXAMINE THE STATUS, CONSERVATION AND FISHING PRACTICES, INCLUDING MESH SIZE, RELATIVE TO THE PRIMARY FISHERY RESOURCES OF THE INUVIALUIT AND GWICH'IN, FEBRUARY 15-17, 1995, INUVIK, N.W.T.

by

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Representatives from local communities, Fisheries Joint Management Committee and Gwich'in Renewable Resources Board, and Department of Fisheries and Oceans attended a workshop to examine the status, conservation and fishing practices (including mesh size) for whitefish and charr resources of the Mackenzie River and Beaufort Sea regions. The main recommendations were: (1) for Kuujjua River charr, to continue using 4.5" (11.43 cm) mesh nets for the subsistence fishery; (2) for Hornaday River charr, to continue present mesh size (5.0" or 12.7 cm and 5.5" or 13.97 cm) and fishing practices; (3) for Rat River charr, to restrict use of small mesh nets, to discontinue the practice of sinking nets, to increase monitoring of the fishery, and to explore a possible Fort McPherson/Aklavik management plan; and (4) for Mackenzie broad whitefish, to give priority to the subsistence fishery should a commercial licence be granted, and to continue using a range of mesh sizes in the subsistence fishery. Many participants stressed that regulating mesh size is not sufficient to return a depleted stock to a healthy state; number of fish taken is likely the most critical factor.

Key words: Arctic charr; broad whitefish; Dolly Varden charr; Mackenzie River; mesh size; western Arctic; conferences.

RÉSUMÉ

NORTON, P. 1997. Proceedings of a workshop to examine the status, conservation and fishing practices, including mesh size, relative to the primary fishery resources of the Inuvialuit and Gwich'in, February 15-17, 1995 Inuvik, NT. Can. Manuscr. Rep. Fish. Aquat. Sci. 2394: vi + 30 p.

Des représentants des communautés locales, du Comité mixte de gestion des peches, du Conseil des ressources renouvelables gwich'in et du ministere des Peches et des Océans ont, dans le cadre d'un atelier, examiné l'état des stocks, la conservation et les méthodes de peche (notamment le maillage) concernant le corégone et l'omble chevalier des régions du Mackenzie et de la mer de Beaufort. Voici leurs principales recommandations: 1) en ce qui concerne l'omble chevalier de la riviere Kuujjua, continuer a utiliser des filets a mailles de 4,5 po (11,43 cm) dans la peche de subsistance; 2) pour ce qui est de l'omble chevalier dans la riviere Hornaday, maintenir le maillage (5 po ou 12, 7 cm et 5,5 po ou 13,97 cm) et les méthodes de peche actuels; 3) en ce qui concerne l'omble chevalier de la riviere Rat, restreindre l'utilisation de filets a petit maillage, mettre fin a l'utilisation de filets immergés, accroitre la surveillance de la peche et envisager un plan de gestion pour Fort McPherson Aklavik; 4) dans le cas du corégone tschir du Mackenzie, donner la priorité a la peche de subsistance, advenant l'octroi de permis de peche commerciale, et continuer a utiliser une variété de maillages dans la peche de subsistance. De nombreux participants ont indiqué que réglementer le maillage ne suffit pas a rétablir un stock épuisé; le nombre de poissons capturé est vraisemblablement l'élément le plus crucial.

Mots-clés: omble chevalier; corégone tschir; Dolly Varden; riviere Mackenzie; maillage; ouest de l'Arctique; conférences.

EXECUTIVE SUMMARY

by Dr. Lionel Johnson

Charr and broad whitefish have been and continue to be important subsistence resources of the Gwich'in and Inuvialuit people of the Mackenzie Delta and Beaufort regions. During this workshop, traditional and scientific knowledge on the life history, population characteristics and behaviour of these species were pooled to provide the best information base available for developing conservation goals and attaining sustainable fisheries. Fishing methods and techniques were also surveyed, with special emphasis on the regulation of mesh size as a method of managing the stocks.

In the Mackenzie River there are a number of broad whitefish stocks and it is a very complex system. There is much we do not understand, but the basic life cycle is known. A broad whitefish caught in the Delta begins its life on spawning grounds in the lower reaches of the Mackenzie River in the vicinity of the Ramparts Rapids, in the Peel River or in the Arctic Red River. Spawning occurs during the fall, and the eggs hatch in spring. The young then migrate through the Delta, to streams and lakes of the Tuktoyaktuk Peninsula. They remain in freshwater areas for several years, before beginning a cycle of migrating each summer to freshwater lakes to feed and returning each fall to deep coastal bays. When the fish are between six and ten years old, their movement pattern changes and they migrate through the Delta to the spawning grounds further upstream.

Charr are also complex because of the extent and degree of variability between stocks. Two basic forms of charr exist in the region: Dolly Varden charr are found to the west of the Delta, in rivers of the North Slope, and "true" Arctic charr occur to the east of the Delta. Dolly Varden charr are generally smaller in size and have a shorter life span than Arctic charr, but both show considerable variability in their characteristics and life history patterns. The Arctic charr stock at Nauyuk Lake on the Kent Peninsula was examined in considerable detail to serve as a reference system against which other stocks (for which such detail is not yet available) may be compared.

Arctic charr spend much of their life cycle in one river system, which they leave to go to the sea in the summer to feed and return to in the fall. Different stocks frequently mix in the salt-water feeding areas. Tagging studies have shown that considerable interchange between stocks takes place in the selection of overwintering sites. Both Arctic charr and Dolly Varden forms may undergo cyclical changes in size and abundance.

The workshop participants agreed that mesh size is an important factor in determining the size of charr caught. The general consensus was that 3.5" (8.89 cm) and smaller mesh catch mostly small fish and some larger ones, 4.5" (11.43 cm) mesh catches mostly medium-sized fish as well as some small and some large fish, and 5.5" (13.97 cm) mesh catches mainly large fish. In some circumstances, 4.5" (11.43 cm) is the most suitable mesh to use as it targets the most abundant, mid-range size classes of fish. However, the absence of large fish in 4.5" (11.43 cm) mesh may result from a lack of availability rather than be an indication that the large fish are escaping capture. In addition to mesh size, it was stressed that the number of nets employed, and the material the nets are made of are also important in determining total catch.

The broad whitefish fishery in the Delta appears to have been at a sustainable level for many years. The pressure on the stocks is assumed to be less now than previously, because the amount of fish needed for dog food has declined. The participants discussed factors affecting the setting of quotas should a commercial broad whitefish license be granted. Everyone agreed that the subsistence fishery should have priority over any commercial fishery, but no other specific recommendations were made. It was felt that changing mesh size would have little effect on the size of broad whitefish caught in the Delta because few small whitefish are available when and where the fishery occurs.

The Hornaday River Arctic charr stock was considered to be relatively stable by the Paulatuk elders and no changes in mesh size or fishing pressure were recommended at the workshop. The local by-laws and restrictions currently in place were considered satisfactory. Monofilament nets are generally used, as these are considered to be the most efficient. Cotton and nylon twist-thread nets have the advantage of quickly losing their effectiveness at catching fish if they are torn from their anchors and lost.

The Holman Island charr fishery has experienced problems recently owing to too intensive a fishery at the main spawning and overwintering grounds in Tatik Lake on the Kuujjua River. The same stock is also being fished along the Holman Coast and in Safety Channel. The HTC's self-imposed cessation of fishing in Tatik Lake from 1993 to 1995 is a good step toward allowing Kuujjua charr to recover. This workshop decided that continuing the use of 4.5" (11.43 cm) mesh (rather than changing to 5.5" or 13.97 cm mesh) was a necessary management measure. The pressure on the Kuujjua River stock could be reduced by encouraging people to fish at other locations, such as the central areas of northern Prince Albert Sound.

The Sachs Harbour charr fishery was considered to be too small to require management recommendations at the present time.

The Shingle Point coastal fishery, carried out mainly during the beluga whale harvesting period, is affected by factors seldom experienced in other regions. These include the presence of whales frightening charr either away from or toward nets positioned along the shore, and inshore winds pushing sea ice into nets and damaging them.

The Rat River stock, which sustains the major charr fishery in the Delta, is utilized by both the people of Aklavik, as the run passes the vicinity of that community, and the people of Fort McPherson, in Husky Channel and when the run enters the Rat River itself. A wide variety of mesh sizes and fishing methods are used.

Potential and current problems facing fisheries along the North Slope and in the Mackenzie Delta that were discussed at the workshop are: i) coastal uplift, ii) climatic change, iii) low water levels (a 20-year cycle has been suggested), iv) dredging of shipping channels, v) roads for seismic surveys, vi) the possibility of a new Mackenzie highway, vii) pollution, viii) ferry crossings and erosion of ramps, and ix) commercial fishing in spawning areas.

Workshop participants agreed that effective management involves regulating and monitoring all aspects of a fishery, including: mesh size and length of nets, number of fishermen, frequency and place of

fishing, and total catch. A cautious approach to increasing harvests was recommended. The detailed information necessary for satisfactory management can be obtained only through application of a management plan designed to uniformly distribute the intensity of fishing and to ensure the fisheries are adequately monitored. Management is an ongoing activity that requires continual updating and changing to meet circumstances as they unfold.

A great deal of ground was covered at the workshop, and all parties agreed that the exchange of information had been most profitable and interesting, and had served to greatly strengthen the mutual confidence between fishermen, management and researchers.

INTRODUCTION

The summer coastal fishery off the Holman, N.W.T. coast impacts significantly on the Kuujjua River Arctic charr stock, which is known to be in a depleted state and currently the subject of the "Plan for Recovery of the Kuujjua River Charr Stock" (Holman Hunters and Trappers et al. 1994). During a meeting in Holman in May 1993, the community suggested using net mesh size as a management tool to conserve the stock. The Fisheries Joint Management Committee (FJMC), which is responsible for assisting the Inuvialuit and the Department of Fisheries and Oceans (DFO) in the management of fishery resources in the Inuvialuit Settlement Area, recommended a workshop be held to examine if changes to mesh size would really help the situation. As the "mesh size" question was relevant to other local fisheries, DFO, the FJMC and the Gwich'in Renewable Resource Board (GRRB) decided to sponsor a workshop involving both Gwich'in and Inuvialuit representatives, and to address all of the primary fishery resources in both land claim areas.

The workshop plan involved three species, Arctic charr (Salvelinus alpinus), Dolly Varden charr (Salvelinus malma) and broad whitefish (Coregonus nasus). There are significant subsistence harvests for all three species and, in addition for broad whitefish, there is some interest and possible potential for a commercial harvest. An experimental fishery was conducted in the Mackenzie Delta from 1989 through 1993 to determine the feasibility of a commercial operation, and the Uummarmiut Development Corporation (UDC) may apply for a commercial broad whitefish quota in the near future. Inuvialuit and Gwich'in representatives had met previously at a whitefish workshop in Inuvik in March 1994, but they had not considered the mesh size question.

The "mesh size" workshop was held in Inuvik, N.W.T. on February 15-17, 1995, and was attended by 40 participants, including representatives of the local Hunters and Trappers Committees (HTCs) and Renewable Resource Councils (RRCs) as well as technical advisers from the FJMC, the GRRB, DFO and private agencies (Appendix A). Communities represented included Aklavik, Inuvik, Fort McPherson, Tsiigehtchic (formerly Arctic Red River), Tuktoyaktuk, Sachs Harbour, Holman and Paulatuk (Fig. 1).

POSTER SESSION

A poster session prepared by DFO Inuvik was available for arriving participants starting mid-day February 15, 1995. The displays compared length frequency data for charr and broad whitefish caught using non-selective methods (weir count, random sample and experimental gillnet) and selective methods (various sizes of gillnets). Information on the following stocks/species was presented for the years indicated:

1. Hornaday River Charr: Weir Count (1986) and Subsistence Harvest using 4.5"(11.43 cm), 5.0" (12.7 cm) and 5.5" (13.97 cm) mesh size (1990-1994)

2. Rat River Charr: Random Sample (1973) and Subsistence Harvest using 3.5" (8.89 cm) mesh size (1989-1994)

3. Kagloryuak River Charr: Weir Count (1990) and Subsistence Harvest using 4.0" (10.16 cm), 4.5" (11.43 cm) and 5.0" (12.7 cm) mesh size (1994, 1994 and 1993-1994, respectively)

4. Kuujjua River Charr: Weir Count (1992), Subsistence Harvest using 4.5" (11.43 cm) and 5.0" (12.7 cm) mesh size (1992) and Fish Lake Experimental Harvest using 4.5" (11.43 cm) and 5.0" (12.7 cm) mesh size (1994)

5. Holman Coast Charr: Subsistence Harvest using 4.5" (11.43 cm) mesh size (1993-1994)

6. Mackenzie Delta broad whitefish: Experimental Gillnet (1990-1993), Commercial Harvest using 5.5" (13.97 cm) mesh size (1990-1993) and Subsistence Harvest using 4.5" (11.43 cm) and 5.0" (12.7 cm) mesh size (1990-1993 and 1992, respectively)

Appendix B includes the graphed data presented during the poster session.

OVERVIEW OF WORKSHOP STRUCTURE

The workshop started at 14:00 February 15 with Opening Prayers by Jimmy Memogana (Holman HTC elder). Lois Harwood (DFO - Inuvik) introduced the workshop facilitator, Dr. Lionel Johnson (DFO - retired), who then described the process, scope and goals of the workshop. This was followed by introductory comments by individuals representing each group present at the workshop. Basic biological information on Arctic charr (Lionel Johnson) and broad whitefish (Ken Chang-Kue, DFO - Winnipeg) was presented the first afternoon, and a hypothetical case study on the effects of changing mesh size (Al Kristofferson, DFO - Winnipeg) was given the following morning to provide all participants with additional background.

Participants then divided into three subgroups, according to fish species of interest, to discuss specific questions posed for each workshop goal (Appendix C). Subgroup discussions continued throughout the second day (February 16), with a break after lunch for a slide show/discussion of conventional and new techniques used to count and study fish.

During the final morning of the workshop, February 17, the reports by each of the subgroups were presented. There followed a round table discussion of the various subgroup reports, focusing on the identification of data gaps and suggestions for fishery management priorities. Closing prayers were provided by Jimmy Memogana and Alfred Francis (Fort McPherson RRC elder).

WORKSHOP GOALS

The following goals had been identified during the workshop planning process:

- To review the current state of scientific and local traditional knowledge on the status of the primary fishery resources (e.g. Mackenzie River whitefish, North Slope charr and Rat River charr, Hornaday charr, Kuujjua charr, Prince Albert Sound charr),

- To obtain, share and merge scientific and local knowledge about the effect that the specific fisheries and the fishing gear used has on these primary resources,

- To identify existing or potential conservation problems with the primary fishery resources,

- To become familiar with existing, ongoing and new ways for conserving these resources and getting the maximum benefit from the fisheries, and

- To reach consensus and make recommendations on stock-specific ways to conserve the primary fishery resources.

INTRODUCTORY COMMENTS

During the opening plenary session representatives of each sponsoring agency presented their perspective on the workshop and what would be necessary to achieve the workshop goals. While these introductory remarks were brief, the comments helped provide a framework for the discussions which followed and established the open format which would encourage exchanges between all participants.

Lionel Johnson, in his role as workshop facilitator, noted that the diversity of backgrounds of the workshop participants provided a complex source of information upon which to draw. He stressed that the process of sharing scientific and local knowledge would be basic to all of the workshop discussions. He urged participants to expect surprises during the process, as the pool of information we don't know is always greater than the pool of information we do know. Speaking as a scientist, he commented on the importance of the elders in the fish community structure. The role of the larger fish in initiating local movements and migrations make them particularly vulnerable to overfishing. A conservative approach to the management of the fishery resources was suggested, given the constraint that "Dead fish don't reproduce."

Bob Bell, Chairman of the FJMC, suggested fishing gear and fishing techniques have been a long-standing issue not specifically addressed at previous workshops. While FJMC's particular concern for the Kuujjua River charr stock provided the impetus for their interest in the workshop, Bob noted that the decisions reached would have implications far beyond the specific situations examined during the course of the meeting.

Billy Day, representing the Inuvialuit Game Council and the FJMC, identified the importance of balancing the fish resource's need for reproductive individuals with the subsistence harvester's need for food. He also emphasized that the concern regarding the status of several of the charr stocks did not extend to the Mackenzie Delta broad whitefish. In his experience, net mesh size used in the Delta was consistent through the 1930's, 1940's and the 1950's (4.5" or 11.43 cm mesh), but recently had increased (to 5.5" or 13.97 cm mesh).

Peter Clarkson, representing the GRRB, outlined the Board's responsibilities for resources, including fish, and noted that there was currently concern about the Rat River charr stock. Although the invited participants would recognize the boundaries of the established land claim areas, fish have no regard for such divisions. Joe Benoit, also of the GRRB, reiterated that while each agency observes the activities and the subsistence harvest levels of the stocks within their own geographical bounds, exchange of information is needed to understand the significance of the observed activities and the total impact of the fisheries on the resources. The scientific community needs to present their findings such that local people can understand their conclusions.

Al Kristofferson, DFO - Winnipeg, concluded the introductory comments by reviewing key factors which must be considered in order to effectively manage a fishery. As Al pointed out, a fishery resource is comprised of different species, and within each species, different stocks. Each stock must be managed as a separate unit. Some stocks do not migrate and are widely separated from one another, and thus are easy to manage. Other stocks are migratory and this can result in mixing of stocks at certain times of the year, which makes management difficult.

There are several available fishing methods, but gillnets are currently the most common method used in the Mackenzie River/Beaufort Sea region. These nets catch many species, including charr and broad whitefish. The importance of gillnet mesh size on different species depends upon the size of the stock, which is affected by many species-specific characteristics, such as first size/age of spawning and fish fecundity (e.g. an Arctic charr female will produce 2,000-7,000 eggs; for a broad whitefish, this figure is 30,000-60,000 eggs). The fisheries for Arctic charr and broad whitefish are complex because: (1) there can be several stocks mixed within a fishing area, (2) both have migratory and lake-dwelling forms, and (3) they move between the land claim areas (Gwich'in, Inuvialuit and Sahtu) during critical periods of their life cycles, so people who catch fish in each of these areas must work together to ensure that these migratory stocks are not overharvested.

BACKGROUND BIOLOGICAL INFORMATION

Basic life history information about Arctic charr and broad whitefish was presented, as follows.

ARCTIC CHARR

Nauyuk Lake is located on the Kent Peninsula (Fig. 2), and charr in this system were studied by Lionel Johnson over a 15-year period, starting prior to exploitation and continuing long after a fishery was implemented at the mouth of the Nauyuk River. Charr activity and movement patterns presented were consistent throughout the study, but length-at-first-spawning and sex ratios changed with exploitation. Lionel's suggestion to the charr subgroup participants was to use the Nauyuk Lake fish as an example to compare to other stocks, keeping in mind that charr stocks are known for showing remarkable variability in their life histories. Each charr stock is consistent within its own framework.

The Nauyuk Lake system includes Willow Lake which is connected to the larger Nauyuk Lake by a stream that floods in the spring but becomes impassable to larger charr in August (Fig. 2). The Nauyuk River joins Nauyuk Lake to Parry Bay. In the fall, the migratory fish return from the Bay to overwinter in Nauyuk Lake, where they remain without feeding for 9-10 months. In mid-June the non-spawners (pre-exploitation ratio of three females to one male) migrate down the river to the sea, with the largest fish leaving first, usually as soon as the river is passable. The migration starts before the sea ice leaves and the fish make long journeys under the ice along the coast to other bays. Once the ice clears, they remain out in the ocean feeding. On average, they spend 35-40 days feeding. There is little stock segregation during this time. In the fall, the non-spawning fish may return to Nauyuk Lake or they may migrate to a different watershed to overwinter. One Nauyuk Lake fish travelled at least 650 km between its tagging and overwintering sites. Figure 3 summarizes these movements.

When the charr reach some minimum size (pre-exploitation, the length was 65 cm for females and 70 cm for males; although age and size are not well related, generally these fish were at least 9-10 years old) and have sufficient fat reserves, they return to Nauyuk Lake to await spawning. In June and July, as the non-spawners again return to the sea, the spawners move into Willow Lake (pre-exploitation spawning ratio was 10 females to one male), where they spend the summer continuing to mature. In fall, at freeze-up, usually in late September or early October, the females begin digging nests or redds and laying their eggs in gravel under 20-30 feet of water. Each female produces 2,000-7,000 eggs. Spawning males then fertilize the eggs. The post-spawning fish remain in the smaller lake overwinter, returning to Nauyuk Lake as the ice-blocked stream clears the following spring. The stream often floods in the spring pushing the fish, already weakened by spawning, out into the willows where they frequently die. The fish that complete the trip then go out to sea with the non-spawning fish, having spent 22 months in freshwater without feeding. They may make two or three migrations to sea before acquiring enough energy to spawn again. Under good conditions, spawning will occur every other year. There are records of a fish returning up to four times to the same location to spawn during it's lifetime.

The fertilized eggs remain in their gravel nest throughout the winter until May or June the following year. As the ice goes out, the eggs hatch and the juveniles live in the gravel for three or four weeks, surviving on food reserves in their yolk sac. They emerge from the gravel around mid-July and move into the shallows where there are many small crustaceans on which to feed. Some juveniles will move down Willow Creek and into the shallows of Nauyuk Lake but lake trout take most of these young. The juveniles remain in Willow Lake for seven or eight years, usually attaining at least 20 cm in length, before making their first migration to the sea. Gulls and loons probably eat many of the smaller fish before they become large enough to go to sea. The small, immature fish are particularly vulnerable during their migrations.

Some Arctic charr remain in Willow Lake, without ever going to the sea to feed. These non-migratory fish seem to interbreed with the migratory sea-run form.

After 10 years of fishing, the Nauyuk Lake stock decreased from 12,000 to 2,500 fish. The mininum size at first spawning also declined (from 65 cm to 50-60 cm for females) and several small female charr were observed laying immature eggs that had no chance of hatching.

Discussion

Following Lionel Johnson's presentation, a discussion developed regarding key features of the Nauyuk Lake stock, namely spawning areas and intervals and characteristics of declining stocks. The suggestion was made to exclude spawning areas from any fishing pressure. The well-fed non-spawners returning from the ocean in fall could be, and apparently are, utilized if fat fish are desired. The taking of these fish will still affect the stock because the big, older fish, which usually lead the migrations back up the rivers, will include most of the spawners for the following year. A question regarding the extent of spawning area limiting stock growth was discussed. Nursery habitat was identified as being a more critical factor.

Several speakers commented on spawning intervals for local stocks. Suggested times between spawning ranged from one year (in 1975, which was a good year with early ice breakup) to three or four years (under poor conditions). A comment was made that there is new evidence that Big Fish charr may spawn every year.

Characteristics of charr stock declines were also examined. With the Nauyuk Lake stock, the number of spawners changed very little even when the stock declined by more than 9,000 individuals. Females playing at spawning occurred when the population was very low. In one year many fish left the Nauyuk Lake system; there is evidence they moved somewhere else.

BROAD WHITEFISH

Ken Chang-Kue, DFO - Winnipeg, has studied aspects of the Mackenzie Delta broad whitefish life cycle during the last 20 years. Studying the broad whitefish is particularly difficult because several stocks use the same water bodies, the stocks are so large and mixed that tagging is not an effective way of determining stock size (not enough fish can be tagged, relative to the total, to give meaningful results), and many communities fish the same stock. There is good information on use of many different areas by broad whitefish, but no good estimates of the size of the stocks.

Broad whitefish are known to spawn in the upper regions of the Peel and Arctic Red rivers, and in upstream areas of the Mackenzie River from Point Separation to Rampart Rapids (Fig. 4). The major wave of fish from the coast reach these areas by early November and spawning occurs soon thereafter. The post-spawners quickly move downstream in the Peel River, to the East Channel of the Mackenzie River and Kugmallit Bay, and to the western Delta channels and Shallow Bay to overwinter (Fig. 4). Overwintering sites are usually reached by late November.

The eggs hatch in May and June. Young-of-the-year are flushed, by water from the spring melt, down through the Mackenzie Delta and out along the Tuktoyaktuk Peninsula coast. They then swim up small tundra creeks and into their associated lake systems. Some young-of-the-year broad whitefish spend their first year in lakes within the Delta before moving into the Tuktoyaktuk Peninsula nearshore drainages. In 1979, about one million broad whitefish young-of-the-year and one-year-old fish were estimated to be migrating up just one of many streams along the Tuktoyaktuk Peninsula coast. The young fish spend three to four years within these nearshore drainages. When broad whitefish reach four to eight years of age, they migrate from the Tuktoyaktuk Peninsula to deep coastal bays to feed. They then begin to overwinter in the outer Delta waters.

Other places in the Delta are also used as nursery grounds by broad whitefish but the Tuktoyaktuk Peninsula lakes are particularly important because they have fewer fish, such as burbot and pike, that prey on the whitefish juveniles. In one Delta lake it was estimated that pike take more than 70 per cent of the small fish that come into that lake during the summer.

Broad whitefish begin spawning at seven or eight years of age and some fish live to be 30 years old. The fish in spawning condition leave the Tuktoyaktuk Peninsula areas in July, swimming close to the shore in Kugmallit Bay, and migrate slowly upstream to reach prespawning locations in Middle Channel by September or October. A concerted run to reach the spawning grounds begins in late October.

Small local lake-spawning broad whitefish populations have also been found. These fish spend their entire lives in fresh water and do not migrate to sea. One such population occupies Campbell Lake near Inuvik. The number and relative importance of these lake-spawning fish is not known.

The discussion following this presentation centered on unknown aspects of the whitefish life history, including where the post-spawning fish go the next summer, the range of the spawning interval (2-3 years was suggested), and the number of stocks resident in the area. There are known to be at least two Mackenzie Delta migratory stocks, and there are likely many more. The two known stocks mix at Horseshoe Bend and may also mix at many other locations.

HYPOTHETICAL STOCK

To illustrate how stock characteristics interact with mesh size to alter stock size, Al Kristofferson (DFO - Winnipeg) presented a hypothetical fish stock. First he reviewed the concepts of birth, growth and death rates. Each of these rates plays an important role in determining the size of the stock and thus how many fish can be taken from the stock. High birth rates and fast growth rates produce a large stock that can sustain a large harvest. Low birth rates and slow growth rates produce a small stock that can only sustain a small harvest. Birth rate is affected by a number of factors. Man can exert some control over two of these, the number of spawners (by allowing some to escape to lay eggs) and pollution, but not usually the others, temperature and water level. Growth rate is determined primarily by one factor, the amount of food, and man has no control over this. Death rate is determined by the level of predators, disease, and the amount of fishing. Predators and disease are largely outside man's influence. The amount of fishing is the one factor that can be directly controlled by man. Most efforts to regulate a fishery involve setting a maximum level of fishing.

A simple graph was used to illustrate how the birth and death rates interact to produce the stock's size/age structure (number of fish in each size/age category in the stock). Applying an average weight to each age of fish converts number of fish to biomass (total weight) of fish. For the hypothetical stock Al presented, the biomass curve peaked at 4 kg or 5 years (Fig. 5). To maximize the return from fishing, this size/age category is the one that should be targeted.

In order to target a particular size/age category of fish, some type of selective fishing method must be used and net mesh size is the usual method used to do this. The use of an experimental gillnet (a long net comprised of panels of net of different mesh sizes sewn together; mesh sizes usually range from 1.5" [3.81 cm] to 5.5" [13.97 cm], in one inch intervals) in two lakes on Baffin Island illustrates the mesh size/fish size correlation for Arctic charr. In one lake, the small mesh size (e.g., 1.5" or 3.81 cm) caught a few large fish but mainly small ones and the large mesh size (e.g., 5.5" or 13.97 cm) caught a few small fish but mostly large ones. Intermediate mesh sizes caught primarily medium-sized fish with a few small and a few large fish. In the second lake, little difference was found between the size of fish caught using the 4.5" (11.43 cm) mesh and the 5.5" (13.97 cm) mesh. Further study showed that in the second lake there were no large fish to be caught.

Pat Ekpakohak (FJMC & Holman HTC) did an experiment at the Kagloryuak River in 1994, where he used three sizes of nets. Pat positioned each net in the same spot and left each one in overnight. With the 3.5" (8.89 cm) net he caught 120 small fish; with the 4.5" (11.43 cm) net he caught 90 middle-sized fish; and with the 5.5" (13.97 cm) net he caught 30 big fish. This is another example that shows that different mesh sizes catch different sizes of fish when the full range of fish is available to be caught. In the Hornaday River, it seems there are no differences in mesh size catches between 4.5" (11.43 cm), 5.0" (12.7 cm) and 5.5" (13.97 cm) nets, probably because there are few big fish available to be caught.

While determining the size of fish to be caught is important, the number of fish taken is also critical. Catching fish of a small size is hard on the stock because too many must be caught to have a reasonable harvest. Catching too many large fish is also hard on the stock because enough spawning fish must be allowed to escape to sustain the stock. Al used the fish graph to illustrate this principle. Size and number of fish must be considered together when assessing the impact of fishing on a fish stock.

During the discussion following Al's presentation it was mentioned that fish size and age are not necessarily closely related in charr and whitefish. Given two fish the same age, one may weigh 7 pounds (3.175 km) and the other, 12 pounds (5.443 km), because of variable growth rates. In terms of harvesting and spawning, size is usually more important than age.

The question was raised regarding the effect on the stock of some harvesters' preference for whitefish eggs. The consensus was that the number of spawning females taken was important. Removing some spawners will not cause serious problems for the stock, but removing too many spawners will have a noticeable effect.

A side discussion developed on which Arctic charr reproduce. In several areas full-sized eggs have been found in charr which have no noticeable reddening, a sign that the fish is preparing to spawn. So the suggestion was made that some silvers may reproduce.

Several community representatives suggested that 30-40 years ago the level of the Mackenzie Delta whitefish fishery was much higher than it is now. Some people thought that there may be more problems catching fish now than there used to be. However, people were using 3.5" (8.89 cm) and 4.5" (11.43 cm) mesh nets 30 or 40 years ago. Now they use 5.5" (13.97 cm) mesh nets.

Prior to breaking into subgroups, the participants noted they should consider many fishing practices, not just mesh size, when discussing means of maximizing resource use. For example, position of net in the water column and angle of net relative to the shore can affect the catch. Net type may also affect fishing success. It was suggested that the new synthetic (nylon) nets may be more efficient than the old cotton nets, but that little fish can more easily get tangled in cotton than in monofilament nets.

CHARR SUBGROUP DISCUSSIONS

Two charr subgroups were set up. One subgroup discussed Arctic charr stocks fished by the residents of Paulatuk (Hornaday River), Holman (Kuujjua River and Prince Albert Sound) and Sachs Harbour (Mary Sachs River) communities. The other group discussed Dolly Varden charr stocks of the North Slope area that are fished by residents of Aklavik and Fort McPherson (Big Fish and Rat rivers).

HORNADAY RIVER CHARR STOCK

The residents of Paulatuk fish the Hornaday River charr in spring around the coast of Darnley Bay, at the mouth of the Hornaday during the upstream run in August, and at several upstream holes during fall. A few charr have been found in Fish Lake, across the Bay from Paulatuk. There was a commercial fishery for this stock from 1968 to 1986, and it is believed the stock is still recovering. One community representative suggested that the Hornaday may support more than one stock, as every few years, the fish in the run appear larger than the previous year or the following year. Grayling and whitefish are other species taken in conjunction with the charr fishery.

Paulatuk has a set of community by-laws regulating charr fishing which are adhered to by the community and seem to be working. These by-laws include restrictions on fishing gear and locations. During the main upstream run in August, most people use 5.0" (12.7 cm) and 5.5" (13.97 cm) nets in the river. A few people use 4.5" (11.43 cm) nets to catch fish for making dry fish. Nets with mesh smaller than 4.5" (11.43 cm) or longer than 50 yards (45.72 m) are prohibited. Monofilament nets are what most harvesters in Paulatuk use now. The Paulatuk representatives commented that the old cotton nets take more small fish than the monofilament nets.

The Paulatuk HTC has developed fishing zones and regulates fishing activity according to the zones. Fishing is allowed only at the sandbar at the mouth of the river and not in the river itself. Checking the nets daily is also required under the by-laws; no one can set a net and leave it unattended. Fall ice fishing is encouraged as a replacement for the summer fishery. The current harvest levels appear sustainable and remarkably constant year-to-year. There is still interest in resuming a commercial fishery at the Hornaday, but one HTC member said a full count of the stock(s) would be necessary prior to this.

Nothing is known about the location of the spawning grounds for the Hornaday charr. Very few spawners are caught in the summer fishery but slinks (presumed to be post-spawners) are caught in the spring fishery and in the fall (1994) near Coalmine. A suggestion was made that spawning may occur in the small creeks near the mouth of the river (see Fig. 6); no studies to find spawning locations have yet been undertaken.

Community representatives from Paulatuk and Holman, at this and previous meetings, have said that they think that the charr overwinter in the ocean. A general discussion followed, with biologists explaining that charr could not overwinter in truly marine waters as temperatures fall below 0° C, to as low as -4° C. At these temperatures, a fish would freeze. The only possibility for charr overwintering in the ocean would be if the charr could locate and stay within freshwater surface layers (such as probably occur at the mouth and estuary of large rivers such as the Hornaday, Kuujjua, and Mackenzie). Conditions may occur that would be suitable to sustain overwintering charr.

Evidence of seal predation on charr has been observed by representatives from both Paulatuk and Holman. Scar patterns consistent with seal claws have been found on the underside of charr in those areas.

The following recommendations were decided by the group regarding the Hornaday stock:

1. There is no recommended change in mesh size (mostly 5.5" or 13.97 cm nets) or fishing patterns as they presently exist for the Hornaday River subsistence fishery.

2. The monitoring program currently in place should be continued.

3. More information is needed on the location of the spawning areas so these places can be protected from any disturbance or future fishery. This recommendation will be presented to the Paulatuk HTC by the community representative and to the FJMC by the FJMC representative at the table.

MINTO INLET/PRINCE ALBERT SOUND CHARR STOCKS

Charr is a particularly important subsistence resource to the residents of Holman; they have a harvest level of about 7000-8000 charr per year (FJMC 1993). Up until 1992, the community harvest came primarily from the spawning/overwintering site, Fish (Tatik) Lake on the Kuujjua River system, during fall and from the Holman coast area during summer (Fig. 7). In the last five years or so, some residents of Holman have been travelling farther to fish, primarily to four charr rivers in the Prince Albert Sound area (Kagloryuak, Kuuk, Kagluk and Naloagyok, Fig. 7).

A weir count (n = 10,500) at the Kuujjua in 1992 showed the stock was in a seriously depleted state, and the HTC consequently closed Tatik Lake to all fishing for a three year period (1993-1995), in order to let the Kuujjua River stock recover. The Kuujjua stock has become depleted since the early 1970's when one 4.5" (11.43 cm) 50-yard (45.72 m) net in Tatik Lake would easily catch 60-70 fish. Recently the yield from the same location has been more like 5-6 fish. The size of the original stock is not known but one representative from Holman said there was a local antecdotal report of 15,000-20,000 charr at the mouth of Minto Inlet and that the stock used to support a sport lodge on the Kuujjua River. There used to be three locations for spawning fish in Tatik Lake, but subsistence harvesters have noticed few spawners there recently.

The Tatik Lake closing seems to have resulted in increased fishing pressure along the Holman coast during the summer. Charr are harvested in July, during the out migration, and in August, when the fish are returning. More fish are caught in August than in July. The general impression of the community representatives was that the Kuujjua River stock has had little chance to recover because this summer fishery heavily targets the Kuujjua stock. Tag returns support the community view that Kuujjua fish are caught off Holman in summer.

There are indications that 1993 and 1994 were good growth years for charr in the Holman area. No large fish were taken during the summer fishery several years ago, but in 1993 and 1994, lots of large, healthy fish were caught along the coast. It is not known if this increased growth will translate into an increase in stock size.

There are suggestions that there are charr stocks other than the Kuujjua using Minto Inlet. A representative of the Holman community talked of spearing fish in two or three locations in Boot Inlet, on the north side of Minto Inlet, 40 or 50 years ago. He commented on seeing lots of charr there. This spring there will be an exploratory fishery in Boot Inlet.

Prince Albert Sound charr stocks are considered to be healthy. The Kagloryuak River stock has fish of all sizes available and, until recently, was not fished to any great extent. In 1993 a small commercial fishery was set up on that river, using the mandatory 5.5" (13.97 cm) mesh nets. In 1990, the weir on the Naloagyok River enumerated 22,386 charr but a question has been raised as to where these fish were going. In 1994, a Holman harvester set nets in the first two lakes along the Naloagyok River system, the only accessible lakes on the river, and found no charr. This lack of fishing success could not be explained by low water levels.

Many marine areas are used by more than one stock. Areas at the mouth of Prince Albert Sound (e.g., Safety Channel) appear to be a mix of the Kuujjua and Prince Albert Sound stocks, particularly from Kuuk River. At the mouth of the Naloagyok River, both Naloagyok and Kagloryuak tagged fish were caught during the 1990 weir study. Utilizing areas for the fishery where there is a mixture of stocks diffuses pressure on any one particular stock.

Much of the discussion of this subgroup revolved around mesh size. Community representatives related that many years ago 5.0" (12.7 cm) and 5.5" (13.97 cm) mesh nets were not available. Most participants agreed that 4.5" (11.43 cm) nets are more efficient (i.e. take more fish) than 5.0" (12.7 cm) or 5.5" (13.97 cm) nets, but some people still felt that the 4.5" (11.43 cm) nets were the ones to recommend because these nets take a few small fish, many medium-sized fish and a few large fish. Thus, many but not all participants felt these nets would leave most of the large spawning fish to escape to the spawning grounds. Other participants felt that the 4.5" (11.43 cm) nets would take the larger fish, including spawners, and thus no consensus was reached. There is no available scientific data to support either view.

In unexploited fish stocks, the graph of biomass versus size/age is a smooth curve with biomass increasing up to a peak value and then decreasing gradually. This is the desired situation. When a fish stock is fished too heavily, this smooth curve can become jagged or unbalanced. The same thing can happen if the same mesh size is used over and over, and always targets fish from the same size/age class. If a wider range of mesh sizes is used, then the fishing pressure is "spread out" over a range of size classes and this tends to maintain the smooth curve.

Wellington Bay, near Cambridge Bay, was cited as an example of a fishery using 5.5" (13.97 cm) mesh. The average fish taken in that fishery is 60 cm long. The relatively large size of the stock, combined with a conservative quota and spawners remaining in freshwater, and therefore not available to the fishery, explains why this stock withstands the repeated removal of many of the large fish.

There was some discussion of aspects of fishing methods other than mesh size. Net type was discussed because lost or discarded monofilament nets continue to catch fish as long as they are in the water. It was this characteristic which has resulted in monofilament nets being banned in some provinces. Algal growth on the old cotton nets eliminated this concern by making those nets noticeable to fish relatively soon after being immersed in water. There are advantages to monofilament nets as these don't rip, like the old cotton nets do, if they catch big fish. It was suggested that net colour can be an important net characteristic, but there was no agreement as to which colour was best.

The community representatives made and endorsed the following recommendations:

1. That fishing should be conducted with 4.5" (11.43 cm) nets; some also felt that 4.0" (10.16 cm) nets should be used. This recommendation was based on the feeling that taking a range of fish, but targetting medium-sized individuals, would conserve the large spawning fish, allowing them to spawn and thus replenish the stock.

2. That work be undertaken to further examine the composition of the catches with various mesh sizes in the Tatik Lake, Holman coast and Prince Albert Sound fisheries.

3. That the fishing pressure on the Kuujjua stock be lessened, with the idea that the following recommendations be further discussed with the HTC and community in the coming months:

   (1) to encourage/facilitate fishing during the summer to take place about half way down Prince Albert Sound on the north side; it was noted that financial support would be needed to achieve this, to cache fuel there during the spring;

   (2) to limit fishing activity during August (when the Kuujjua run is migrating back to Tatik Lake/Kuujjua River) along the coast to elders only;

   (3) to encourage people fishing along the coast in August to pull their nets during a certain period to increase escapement.

4. That DFO attend further community meetings in Holman to discuss the Kuujjua situation with the community.

5. That further work be done to educate the people of Holman about the status of the Kuujjua River stock and the effect of the summer fishery on that stock.

6. That the 1995 monitoring program at Tatik Lake be done and most agreed that the fishing closure should be continued.

7. That if and when fishing resumes at Tatik Lake, that no fishing be allowed to take place on the spawning grounds (there are sites that could be fished that would not overlap with the known spawning sites). No fishing is recommended on spawning grounds of the Prince Albert Sound stocks.

8. That it was not practical or feasible to recommend changes in net type (e.g., multi-strand or monofilament) at this time.

9. That there be ongoing monitoring of all charr stocks.

Different strategies can be used for different stocks but the important things are to monitor the catch closely, by mesh size, and to determine the total number of fish taken. The number of fish removed is ultimately the most important factor.

SACHS RIVER CHARR STOCK

Only two or three families from Sachs Harbour fish for charr and their efforts are expended in the area of the Mary Sachs River down the coast about 100 km (Fig. 1). It is primarily the Mary Sachs River stock that is being fished. Their average catch is two fish per day and maybe six charr per week. There has never been heavy fishing pressure and presently the pressure is light. Occasionally, in the odd year, salmon are taken. Both 3.5" (8.89 cm) and 4.5" (11.43 cm) mesh nets are used. The size of charr caught is smaller than reported for other areas, probably because smaller mesh nets are used.

No recommendations regarding this fishery were suggested at this time. There are unlikely to be further recommendations unless a commercial fishery is implemented.

NORTH SLOPE CHARR STOCKS

The North Slope area includes four rivers with Dolly Varden charr stocks: Firth, Babbage, Big Fish and Rat (Fig. 8). The migration pattern for all four stocks is the same; they migrate downriver to the coastal areas during spring, feed in the ocean during the summer and move upriver during the fall to reach spawning and overwintering sites. Most of this subgroup's discussion centered on the Rat River (primarily) and Big Fish River stocks, as these are most heavily fished due to their proximity to Fort McPherson and Aklavik.

Three fishing areas were outlined by community representatives. Comments on the fishery are by area as indicated below:

1. Coastal area: Many people from Aklavik fish for charr along the North Slope coast, from Nunaluk Spit west of Herschel Island east to Shingle Point, during the period they are in the whaling camps. This fishery usually occurs from the end of July through the end of August and into September, depending on the location. All four North Slope, and possibly to a limited extent some Alaskan, stocks are targeted by this fishing effort. Most of the fishing pressure on the Big Fish River stock occurs in these coastal areas. The nets used are 4.0" (10.16 cm) to 5.0" (12.7 cm) mesh, from 20 to 75 feet (6.1 to 22.86 m) long, depending on which nets are used and how the net is to be set. Net placement is usually perpendicular to shore, in wind-created eddies, or in nearshore currents (at King Point).

2. Aklavik area: Aklavik residents fish an area extending from approximately 20 km north of town on West Channel to about 60 km south of town on Husky Channel. The charr fishery usually occurs from the beginning of August through early September, when the charr are on their return migration. Most (approximately 90%) of the fish taken are from the Rat River stock; some are from the Big Fish River. Net size varies from 2.5" (6.35 cm) to 5.5" (13.97 cm) mesh, with a depth of 24 to 48 mesh and 25 to 100 yards (22.86 to 91.44 m) long, depending on where and how the net is set. Some of the techniques used for net placement are similar to those used in the coastal fishery; however, in the river channels, both a semi-drift or a corral method may be used. In the semi-drift method, only one end of the net is stationary; the other end is left to drift in the current. The corral method is used around an eddy. The usual procedure is to have one end and the middle of the net stationary above the eddy with the other end loose to drift in the eddy. In some cases both ends and the middle are stationary above the eddy. Occasionally the nets are set in the standard method with two stationary ends but the nets are sunk below the surface to harvest charr moving along the bottom of the river. This practice is not as common as it once was.

3. Rat River area: Fort McPherson residents utilize a fishing area which includes the south end of Husky Channel, and the mouth and areas upstream on the Rat River. Most of the fishery occurs between mid August and mid September, depending on the timing and length of the run. Local residents feel that, on average, the run starts earlier now than it did many years ago. It is primarily the Rat River charr stock, as it migrates to spawning and overwintering areas farther upstream, that is affected by this fishery. The nets used have a mesh size of 3.5" (8.89 cm) to 4.5" (11.43 cm), with a depth of 30 to 40 mesh and a length of 25 yards (22.86 m). Usually the nets are set close to eddies rather than in the strong river currents. Sometimes the nets are sunk below the surface to catch charr moving along the river bottom as in the Aklavik area.

There are a number of factors other than the number of charr present which influence the success of the fishery. In the coastal areas the main influences are presence of whales, strong winds and pack ice movement. Movements of whales affect the movements of the charr, which can help or hinder the harvest, depending on whether the whales frighten the charr into moving toward or away from the nets. Strong winds cause small charr to delay their migration, holding up in areas away from the rough water, but do not affect the movements of the larger fish. Strong onshore (NW) winds push the pack ice and the charr migration closer into the nets lining the shore. Ice can rip the nets out if it comes too close.

With the channel/river fisheries the primary factor affecting fishing success, other than number of fish present, is water levels. High levels make it difficult to set and maintain a net. Rising water levels will pick up debris from the shorelines, which then becomes entangled in the nets, reducing their efficiency and damaging the mesh. The charr run continues during periods of high water, when fishing effort is reduced, ensuring part of the run gets through to the spawning and overwintering areas. Human factors, such as number of fishermen and level of boating activity, also affect fishing success. As the number of fishermen increases, the average number of fish caught per net decreases. Increased boating activity increases the chances nets will be run over and damaged.

Overall, community representatives felt that gillnets of any mesh size select more male than female charr, because the large protruding lower jaw of the males catches the mesh. At King Point 5.0" (12.7 cm) mesh caught more silver (nonspawning) males than females. At Shingle Point, however, no distinction was noticed between the number of males and the number of females caught. It was noticed that 4.5" (11.43 cm) mesh catches larger fish than 4.0" (10.16 cm) mesh.

In 1989 DFO estimated the Rat River charr stock at 11,500 individuals. Approximately 80% of the stock was spawners, which had a ratio of more than 4 females to each male. The Big Fish River stock has a similar ratio of spawners to silvers, and of females to males for the spawning segment. DFO has suggested the high levels of spawners in the Big Fish River may have resulted from heavy fishing pressure in the past. The Babbage River stock, which has been subjected to little fishing pressure, has about an equal number of spawning versus nonspawning fish.

It was suggested that a number of factors other than the amount of fishing have had an impact upon the charr stock sizes. Water levels can affect charr stocks in a number of ways. Low water levels may decrease the amount of spawning area available and thus decrease the annual recruitment. Both communities felt that recent water levels were lower than in the past. Several years ago, some Aklavik residents reported that a winter kill of charr at the Big Fish River and Babbage River overwintering grounds was caused by a rapid increase followed by a rapid decrease in water level. The rapid water drain left many charr stranded on high ground. Rapid water level fluctuations have been noticed on more than this one reported occasion. Otter activity along the Big Fish and Rat rivers, and on the spawning grounds, has increased. Both black and grizzly bear predation have also been observed on the spawning grounds. An Aklavik representative expressed concern about the possible effects of the discharge from the Aklavik lagoon on the charr stocks.

Many of the community conservation measures are self-imposed. Harvesters are reported to release the larger (or smaller) charr in their nets that are alive when the nets are pulled. On the Rat River, fishing on the spawning grounds was a common practice, but this is not done any more. Sometimes more drastic measures are required. In 1987, the Community of Aklavik requested and got the closure of the Big Fish River to charr fishing in an effort to increase that depleted stock. The river was reopened in 1992, but the harvest has been limited. In 1993, the first time the spawning grounds were fished since the closure, all large spawners caught in the nets were released.

The subgroup agreed on several measures that should be taken to ensure safe harvest levels and long-term health of the stocks. They decided the use of small mesh nets and the method of sinking nets to harvest charr moving along the channel/river bottom should be avoided. There should be increased monitoring of all the charr harvests by all communities and increased accuracy in the monitoring procedure. Increased monitoring would provide greater public awareness of the health of the charr stocks.

The representative from the Joint Secretariat expressed concern about the amount of spawning habitat on the Big Fish River. A proposal to assess that habitat has been submitted. The suggestion was made to place incubation boxes at the fish holes to help the spawning charr.

Some measures were suggested that relate directly to the Rat River stock. It was felt the overall number of nets used along the migration corridor should be reduced and a standard set as to the type of net that could be used (mesh size, depth, length and type). A limit should be placed on the number of charr harvested per fisherman and this limit should be in place for a few years to determine if it results in a safe harvest level. There was agreement on increased monitoring relative to the Rat River stock and on the monitors from Aklavik and Fort McPherson working together. Both the HTC and RRC members agreed the communities need to formulate a harvest plan. This plan should include a survey of the harvesters, to determine who requires the fish, and then an equitable division of the resource among all users. The subgroup agreed that the most important concern was the long-term survival of the Rat River charr stock.

BROAD WHITEFISH STOCKS

Representatives from Tuktoyaktuk, Inuvik, Aklavik, Tsiigehtchic, and Fort McPherson participated in this subgroup discussion. Because the discreteness of broad whitefish stocks in the Mackenzie is not completely known, the discussion was directed toward two main groups of whitefish: migratory stocks (which use the Delta channels) and the smaller, nonmigratory stocks (which occupy some lakes and drainages). Discussions on each are summarized together, except where there were differences, which are highlighted.

Most of the broad whitefish fishery occurs at traditional sites along the fish's major migration routes, such as the coastal areas of Whitefish Bay and Tuktoyaktuk Harbour and most of the major channels of the Delta and tributary rivers (Arctic Red and Peel; Fig. 4). Some fishing also occurs in lakes and small watersheds just off the Delta channels and rivers; these areas are targeted before the ice and debris clears out of the major channels. Some of the lakes and small drainages, such as Campbell Lake, and the Travaillant River System, are believed to have their own whitefish stocks distinct from the Mackenzie River stocks. A Fort McPherson RRC representative mentioned that fish in different lakes in the same general area seem to have their own length frequency curves, indicating these probably are separate stocks. In some of the smaller Delta lakes the whitefish taken are smaller and younger than the fish from the main channel. These smaller lakes freeze during the winter and so these areas may be just summer feeding spots rather than homes to resident populations. It is believed that the whitefish get flushed into these smaller lakes during high water periods.

A number of spawning locations were identified. These include upstream areas on the Peel River, as far as the Snake River, Point Separation, Arctic Red River and Ramparts Rapids (Fig. 4). Less is known about overwintering sites. Some suggestions included upstream locations on the Peel River, but many of the whitefish are known to go downstream as far as Aklavik and Shallow Bay after spawning.

The preferred fishing gear for all communities is the gillnet. Both monofilament and multifilament (nylon or cotton, nylon blend or twines) gillnets are presently used. Nets are usually floated before freeze-up, but for ice fishing, the net must be sunk. Fort McPherson representatives reported the use of fish wheels in the past in the Peel River area.

Preferred mesh size varies by community. At Tuktoyaktuk, 3.5" (8.89 cm) to 5.0" (12.7 cm) mesh is used. Inuvik and Aklavik harvesters use 4.5" (11.43 cm) to 5.5" (13.97 cm) mesh nets. In these communities smaller mesh sizes are used when other fish species are targeted and whitefish are taken coincidentally. Tsiigehtchic residents use 5.0" (12.7 cm) or 5.5" (13.97 cm) mesh. Fort McPherson residents use the same mesh sizes as Tsiigehtchic when fishing in the upper Peel area (Trail River and Caribou River), but change to 4.0" (10.16 cm) to 4.5" (11.43 cm) mesh when fishing in the vicinity of the town. The latter area is fished later in the season when the run consists of smaller fish.

The timing of the fishery is dependent on the timing of ice breakup and the whitefish migrations. Most communities do some fishing from July, or as soon as there is open water, through November. In Tuktoyaktuk fishing for whitefish usually ends in October because the run is finished at that time. In Tsiigehtchic fishing in late July and August targets the early upstream migrants. Residents of Fort McPherson may fish the lakes and their outlet streams in May and June. Segregation in the fish run was suggested. At Fort McPherson the "eggfish" (gravid females) come first, followed by the spawning males and then the smaller fish. At Tuktoyaktuk Harbour, the smaller fish come first, in early August, and the larger fish come later in the month.

Community representatives reported no specific targeting of one sex or the other by most harvesters. A few individuals may prefer large females ("eggfish"), because the eggs are desired if caught during a specific stage of maturity, but there is no effort made to specifically catch these fish.

The subsistence harvest comprises the majority of the fishery. Presently, in Inuvik and Tsiigehtchic, there is a small amount of commercial use, which is primarily sales to tourists. A total of 22 commercial licences have been issued in the area. There has been limited, sporadic commercial fishing for broad whitefish in the Delta during the past 40 years.

There was general consensus among the subgroup participants that the broad whitefish stocks in the Mackenzie Delta are healthy, even though occasionally the catches are poor. The community representatives expressed the belief that natural factors, such as water levels, winds and ice, affect the whitefish catch. For example, following a big storm in July 1985, broad whitefish stopped their migration through Tuktoyaktuk Harbour. As soon as the sun came back, so did the fish. Low harvests are not perceived to be indicative of depleted stocks. If fishing is poor at the usual locations, people travel to alternative sites to fish. For example, Tuktoyaktuk residents moved to different coastal locations or to inland lakes when fishing in Tuktoyaktuk Harbour was poor.

One participant expressed concern about scarring on the broad whitefish. DFO has analyzed the incidence of scarring in the Mackenzie Delta and a scientific paper by Reist et. al. (1987) is available which identifies many causes of scarring. Several community representatives suggested the marks were evidence of predation by other fish such as the jackfish.

A broad range of topics was mentioned in regard to future conservation of broad whitefish stocks. It is the smaller lake-dwelling stocks, which serve as alternative sources and are specific to each community, about which many participants expressed possible concern. There was very limited discussion on any one topic. Most problems were confined to one, or at most two, of the communities and so the topics listed below are in point form. Additional remarks are noted where applicable. Concern was expressed regarding the following:

1. Coastal uplift at the Beaufort Sea coast

2. Long-term climatic changes (A DFO paper by Reist {1994} is available.)

3. Low water levels. Representatives from both Aklavik and Fort McPherson observed that current water levels are lower than in the past, especially in the Peel River. A biologist suggested 20-30 years of low water are followed by 20-30 years of high water and we may currently be in a low water cycle. The availability of the long-term records by Water Survey was mentioned.

4. Dredging of river or navigation channels in the Mackenzie River and Tuktoyaktuk Harbour. A Tuktoyaktuk representative related that two years of poor fishing success followed the 1985 dredging in Tuktoyaktuk Harbour. There was concern that the migration patterns had changed, however, many channel changes are natural processes and the stocks must have been exposed to these before.

5. Building roads for seismic activity

6. Construction of a possible Mackenzie Highway. Representatives from Tsiigehtchic were concerned that the alignment and construction of a highway east of the Mackenzie River would affect the smaller nonmigratory stocks in the area that serve as their alternate fishing sources or as a reserve in case the migratory stocks suffer from high levels of pollution.

7. Pollution from upper Mackenzie River watersheds from pulp mills, pesticides, etc. in Alberta and the proposed Westmin Mine at the head of the Peel and Bonnetplume rivers.

8. Commercial fishing on spawning areas, especially at Point Separation and on the Arctic Red River

9. Ferry crossings. Both Tsiigehtchic and Fort McPherson representatives expressed concern about the effects of ferry crossings. One aspect of their concern was that the gravel ramps will erode and fill in the back eddies downstream that are good fishing habitat, affecting the fish migration. Evidence that this process has already started is available along a eight km downstream stretch from Tsiigehtchic. A secondary concern was that the noise from the twenty-four hour ferry operation would deter some of the fish migration. Such an effect is already evident in the Arctic Red River. When the Tsiigehtchic ferry first started operation, the noise did not affect the spawning population because most of the spawners would arrive after the ferry operation had ceased for the winter. At Fort McPherson the residents have requested a bridge be put in to replace the ferry.

The current method of gillnet fishing has been practiced for generations and is the accepted, reliable technique. The community representatives suggested overfishing is not and would not become a problem because self-regulatory mechanisms are already in place. For example, harvesters remove their nets when they have taken enough fish. One community representative explained that individuals who harvest fewer fish one year may take more fish the next year, but in the long run, these variations tend to balance each other out. Tsiigehtchic residents mentioned limiting their take to 20-30 fish from the small resident populations, preferring to fish several different lakes rather than targeting just one.

The question of mesh size as related to the Delta fishery was discussed and felt to be a relatively minor issue for the following reasons. DFO data from 1972-1973, 1980-1981 and 1990-1993 suggest that the majority of the whitefish in the Mackenzie Delta channels are adult fish of spawning age and size (7-30 years old and longer than 40 cm fork length). Age frequency, length frequency and first age of maturity have been consistent over the 21-year time span, indicating that the complex of broad whitefish migratory stocks is generally stable and does not show signs of stress. Gillnets with 4.5" (11.43 cm) to 5.5" (13.97 cm) mesh size essentially catch the same size ranges of fish because those are the sizes of fish available to be taken. The smaller, immature fish do not migrate through the Delta channels and thus are not exposed to the Delta fishery. The smaller mesh size (e.g. 3.5" or 8.89 cm in the Aklavik area) probably has a greater impact on the harvest of other important fish species, such as charr.

Using smaller mesh nets in the lake fisheries may be an important issue, because the lake-dwelling fish have a broad range of sizes available for capture. If harvesters target the smaller fish, using the smaller mesh, more fish will have to be removed to get the desired biomass and this could harm the population.

The only DFO regulation in place that applies specifically to broad whitefish is that commercial nets must have 5.5" (13.97 cm) mesh. Regulations that apply to all subsistence fisheries, including broad whitefish, are 1) a net can not block a stream, and 2) nets must be checked at regular intervals, depending on the season. During the summer 36 hours is the maximum length of time a net can be in the water without being checked. During the winter, this time is 72 hours.

For most of the subgroup participants, basic to the review of the long-term health of the broad whitefish stocks was the commercial fishing licence under consideration by the UDC. The discussion on how to set quotas to ensure the stocks remain stable was hampered by the lack of any firm estimates of stock size. Available information on the broad whitefish suggests there are many large stocks sharing the same migration corridors; it is this mixing that makes the assessment of stock estimates so difficult. In fact one biologist suggested that the Mackenzie broad whitefish fishery is the most complex freshwater fishery in North America. (This mixing, however, may have served as a protective mechanism to keep any individual stock from being overharvested.) The argument for additional harvesting (i.e. more commercial fishing) was supported by the general acknowledgement by the community representatives that harvesting levels are lower now than in the past. Not knowing the size of previous harvest levels makes setting a commercial quota difficult. The test fishery conducted from 1990 to 1993 and the monitoring of subsistence harvest levels in the ISR provides good information on current takes. The Gwich'in and Sahtu harvest programs are still being developed, so a complete picture, even of the current harvest, is not yet available.

Mechanisms are already in place in the ISR to address fishery development and habitat concerns and similar mechanisms are being started for the Gwich'in and Sahtu areas. The Environmental Impact Screening Committee (EISC) is available to community members to hear any resource concerns. If the EISC decides an issue requires public review, it is then referred to the Environmental Impact Review Board, who can hold public meetings on the issue and decide whether or not the activity can proceed. A west coast firm wanting to start a herring fishery in the Beaufort Sea is an example of how this process works. The plan was opposed by the Tuktoyaktuk HTC and the project was declined. In the GSA, the GRRB reviews any fish or fish habitat concerns and passes its recommendations along to the Land and Water Board for further screening. The Sahtu board has not been established.

WRAP-UP COMMENTS

During the final plenary session participants reviewed the three subgroup reports. This was followed by a wrap-up discussion, starting with a statement from Lionel Johnson that it is easier to protect a stock that is healthy, than it is to restore an over-harvested stock to health. Recovery is a long process that usually requires drastic measures. Once a stock is depleted, even a small amount of fishing will keep the stock down.

Al Kristofferson offered the example of the Cambridge Bay charr population. During the 1960's, there had been a commercial fishery on Freshwater Creek. After one year the commercial operation was relocated to streams farther away, to target other charr stocks, but a subsistence gillnet harvest and angling continued on Freshwater Creek. At the time, there was limited concern by the community on the effects of the short-lived commercial harvest because there were still a lot of big fish available. By 1982, a DFO study estimated that only 10,000 charr were in the Freshwater Creek system and no big fish were caught. Shortly after the study, the local people, concerned about getting the big fish back, banned gillnetting. People limited themselves to using a rod and reel to fish for charr and the number of charr landed was carefully recorded. This change in fishing gear resulted in a reduction in the size of the total harvest. By the late 1980's the stock was estimated to be 36,000 fish and there were lots of small fish available. By 1991, the stock had increased to 39,000 fish and the average size was increasing. The trend towards larger fish is continuing.

The Cambridge Bay example illustrates that total numbers landed can be more important than how the fish are caught. Mesh size can be used to select for particular fish sizes in the catch and needs to be adjusted depending on the species targetted. The Holman HTC member stressed that reducing mesh size from 5.5" (13.97 cm) to 4.5" (11.43 cm) was important for charr stocks in his region to ensure a sufficient number of spawners are allowed to reach the spawning grounds.

During the discussion several data gaps were identified. 1) An important piece of missing information is the location of the Hornaday River charr spawning grounds. Several of the biologists stressed the need to protect, or at least, limit and monitor any activity in spawning areas, but this is impossible until those areas have been determined. 2) A few community representatives questioned how information from scientific studies done in the area is presented to the communities. Lois Harwood explained the usual procedure of sending a report to the FJMC and giving oral summaries at settlement meetings. Local monitors also report their findings at these meetings. 3) The importance of net characteristics other than mesh size was questioned. Twine size, length, colour, and material may alter the effectiveness of a net, but little information is available on the extent of influence these factors have. 4) The possibility of a fishery cycle was suggested. A representative from Fort McPherson related that old timers talk about years with big catches alternating with years with no fish. It was suggested that 1989 was the last year with a big catch for the Rat River. Since then there have been fewer fish and the fish tasted different. But the fish are coming back. In 1994 there were some good, healthy charr, and the possibility of a five-year cycle was inferred. 5) Weekend hunters were identified as a possible source of error in the local monitoring programs because they can go out and come back without anyone knowing how many fish they have taken. Setting limits on the number of fish each person can take may help overcome this difficulty.

There was general agreement that the fishery resource should be utilized for and by the local people first, and second for commercial purposes, only if there are enough fish. Many community representatives stressed the importance of protecting the fishery for the next generation. Having a commercial fishery does not mean that the full quota will be used. As one of the Holman representatives pointed out, sometimes it is too hard or too costly to get the fish out to the large market that wants the product.

Co-operation between communities was the key to this workshop. Without co-operation it will be impossible to arrive at the useable and accurate monitoring plan necessary to manage the fishery resources, especially those that travel across land claim boundaries. Co-operation is particularly important when a stock is in trouble. There was consensus that this workshop had made very real progress toward increasing co-operation.

ACKNOWLEDGMENTS

Thanks are extended to all workshop attendees listed in Appendix A for their co-operation and participation. Special thanks are extended to Brad Parker for organizing the workshop, to Brenda Webster for assisting with financial aspects, to Lionel Johnson for his insight and leadership, and to Brad Parker, Lois Harwood, Paul Sparling, Earl Jessop and Margaret Treble for collating the data and preparing the posters presented. The idea for the workshop was developed by Ron Allen and Pat Ekpakohak. Mike Papst was unable to attend due to illness, and was greatly missed.

Funding for the workshop and preparation of this report was provided by the DFO Area office, the FJMC, the GRRB and the Science Institute of the Northwest Territories. Peter Clarkson, Eric Gyselman, Lois Harwood, Earl Jessop, Lionel Johnson, Al Kristofferson, Brad Parker and Margaret Treble provided insightful comments on this manuscript.

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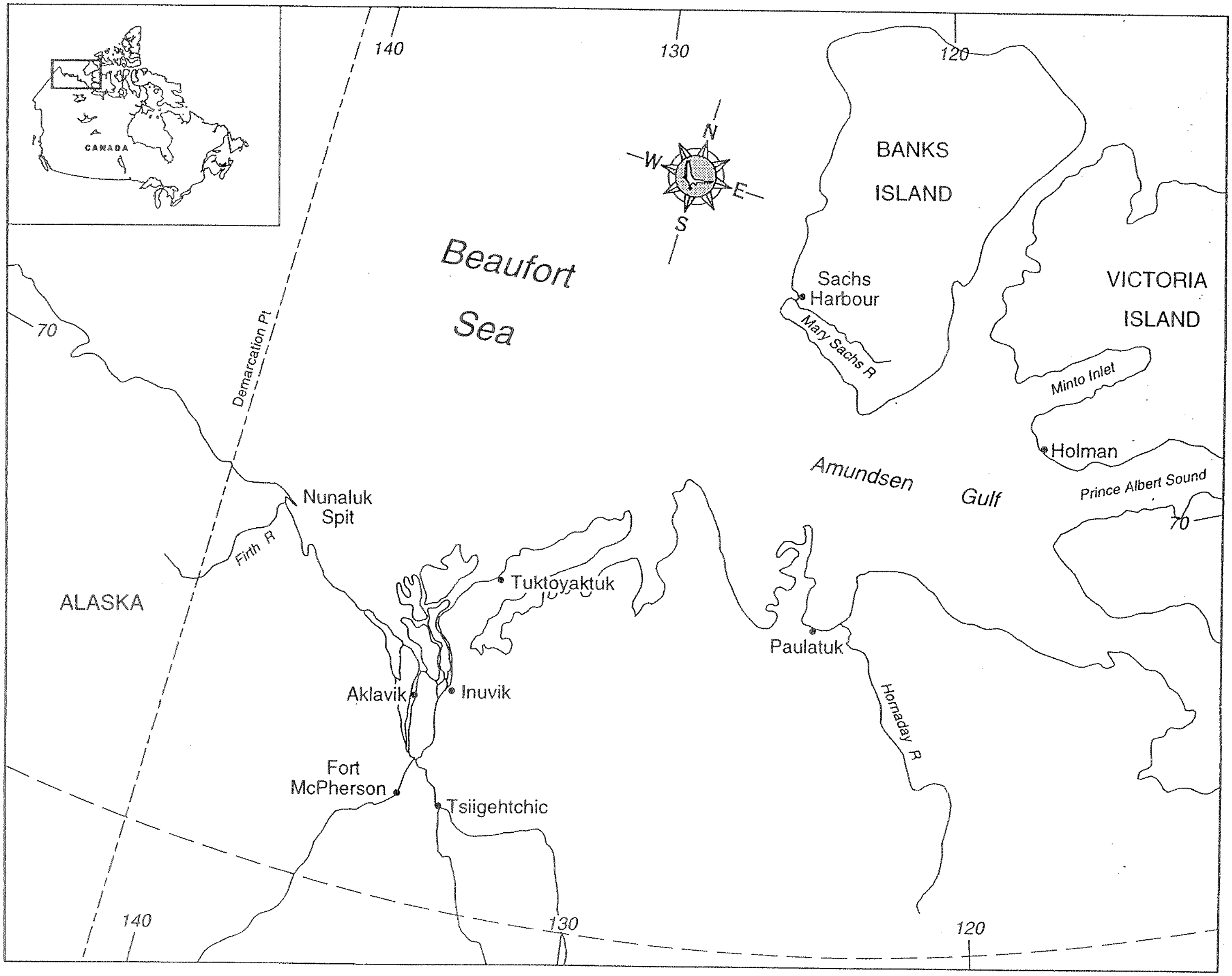

Fig. 1. Communities represented at the Mesh Size Workshop in Inuvik, NT, February 15-17, 1995.

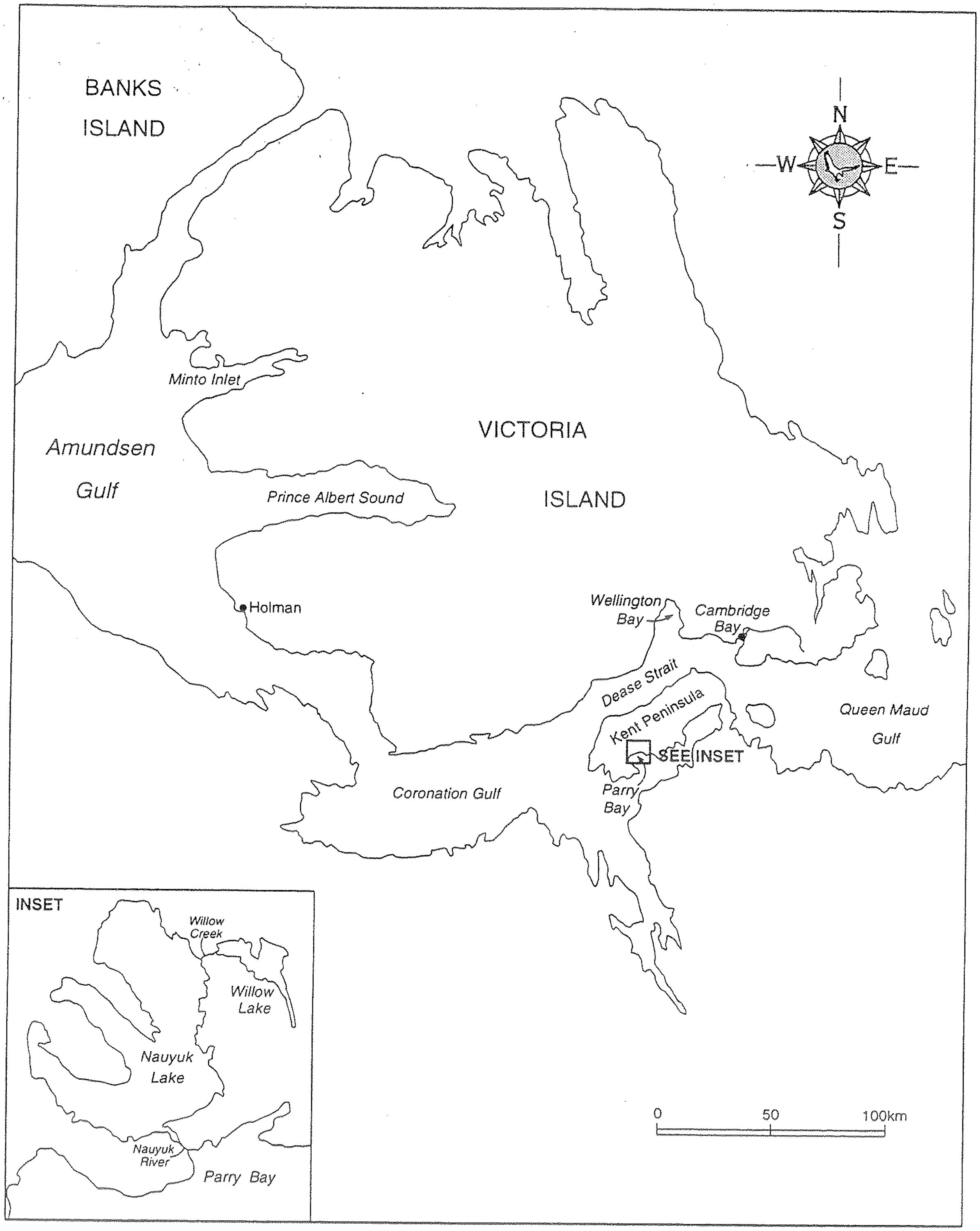

Fig. 2. Locations of waterbodies near Victoria Island and adjoining mainland utilized by arctic charr stocks.

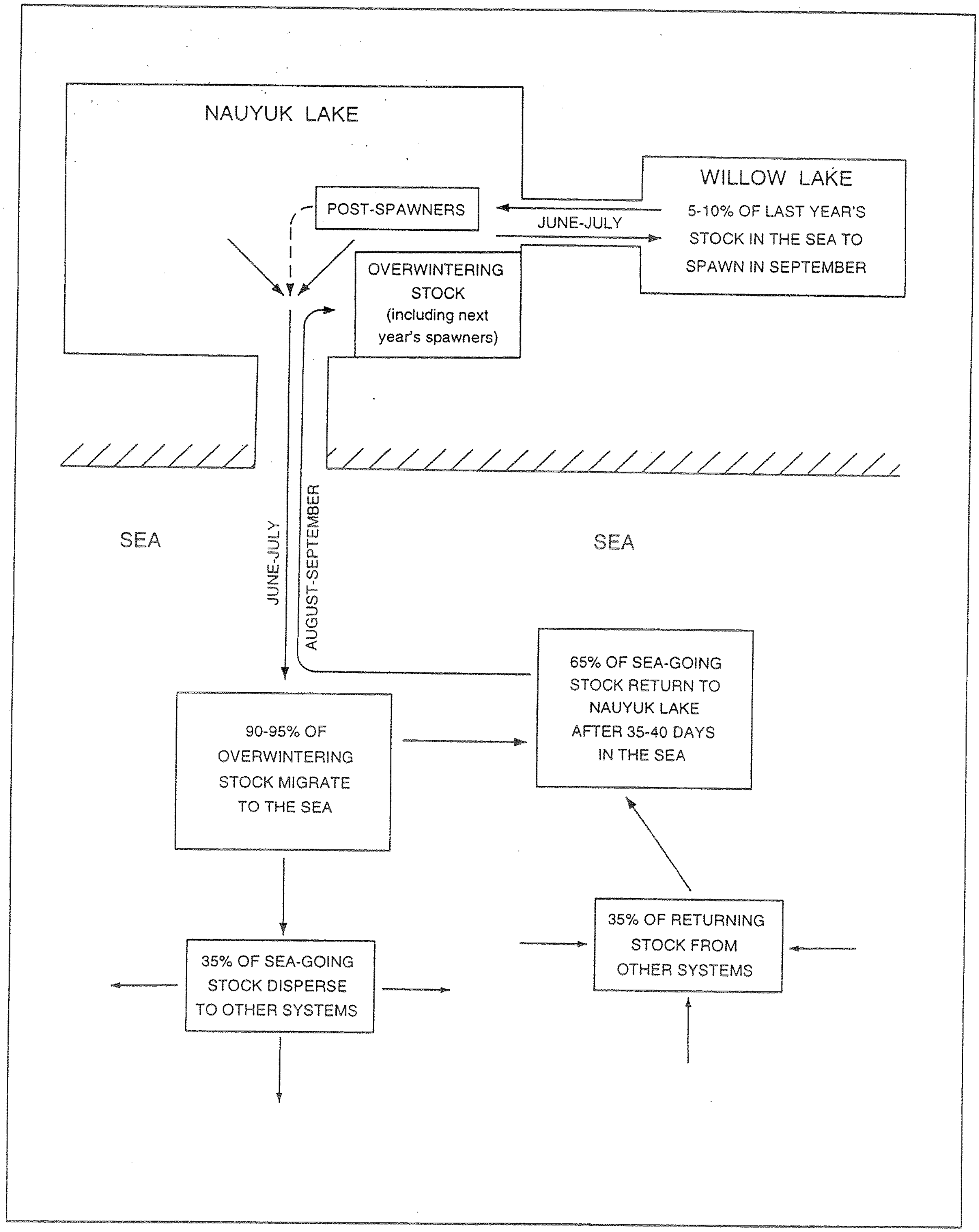

Fig. 3. Movement patterns of Nauyuk Lake arctic charr stock.

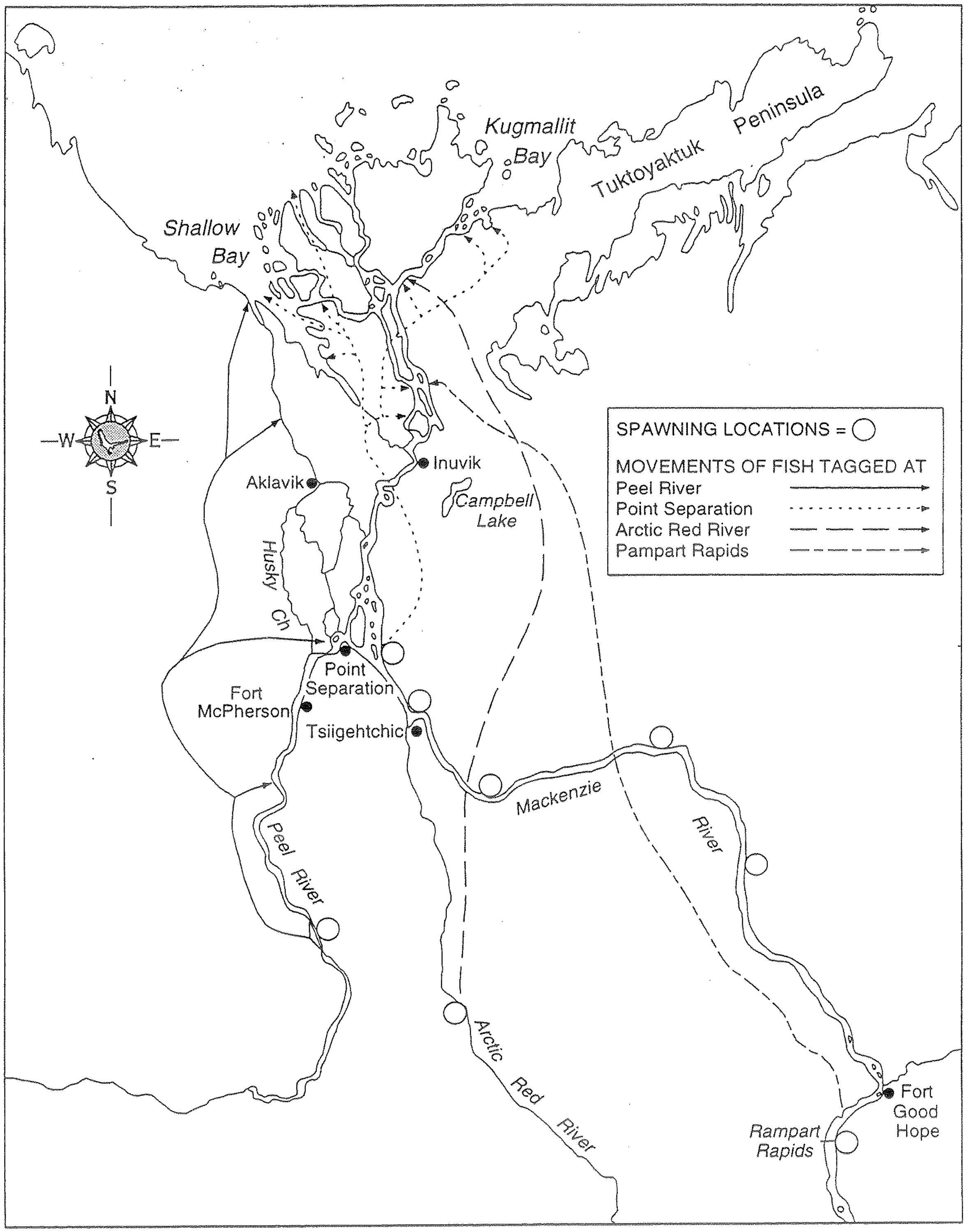

Fig. 4. Movement of post-spawning broad whitefish from spawning sites to overwintering sites as identified by radio tagging, 1982-1993.

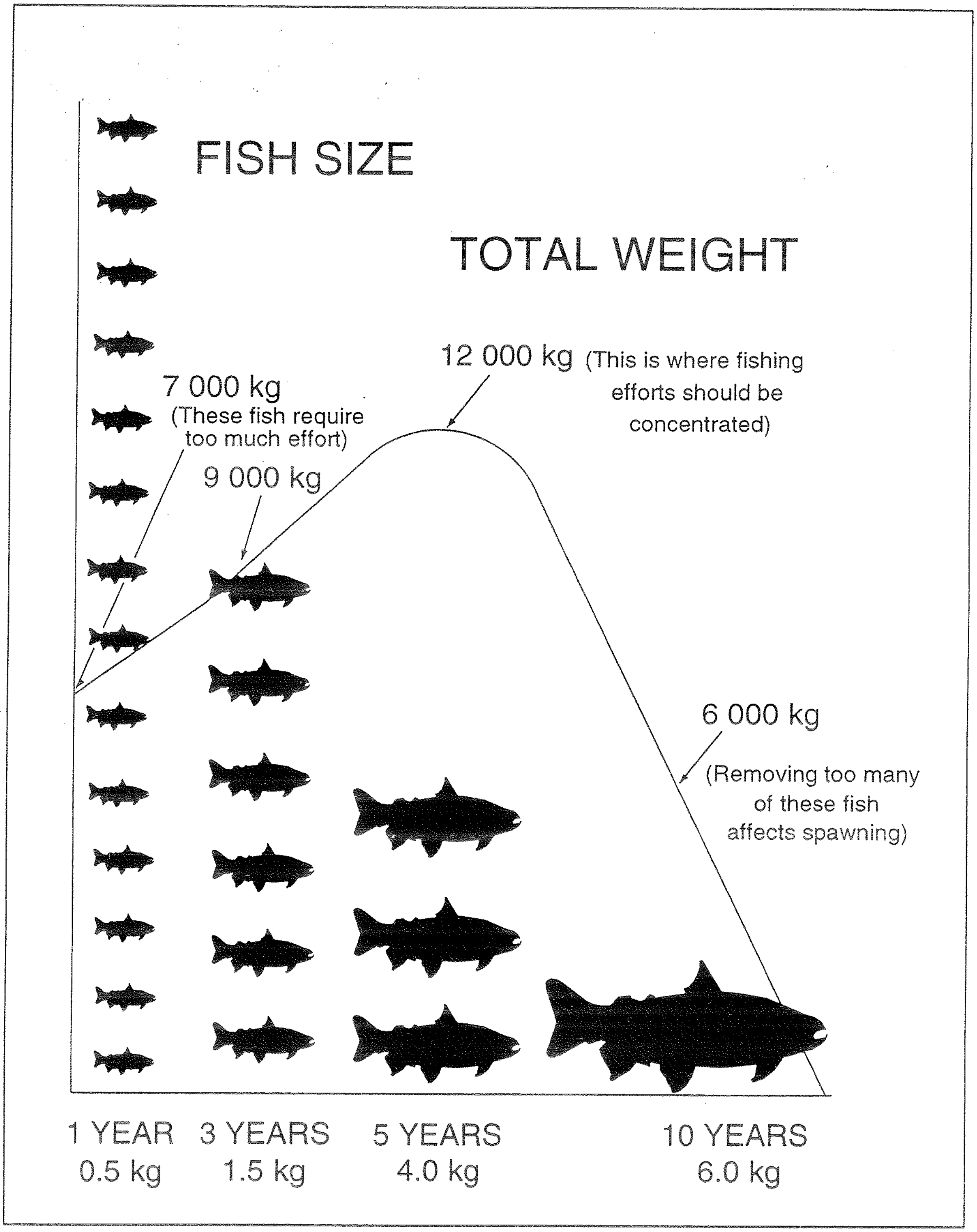

Fig. 5. Size/Age structure and biomass of a hypothetical stock.

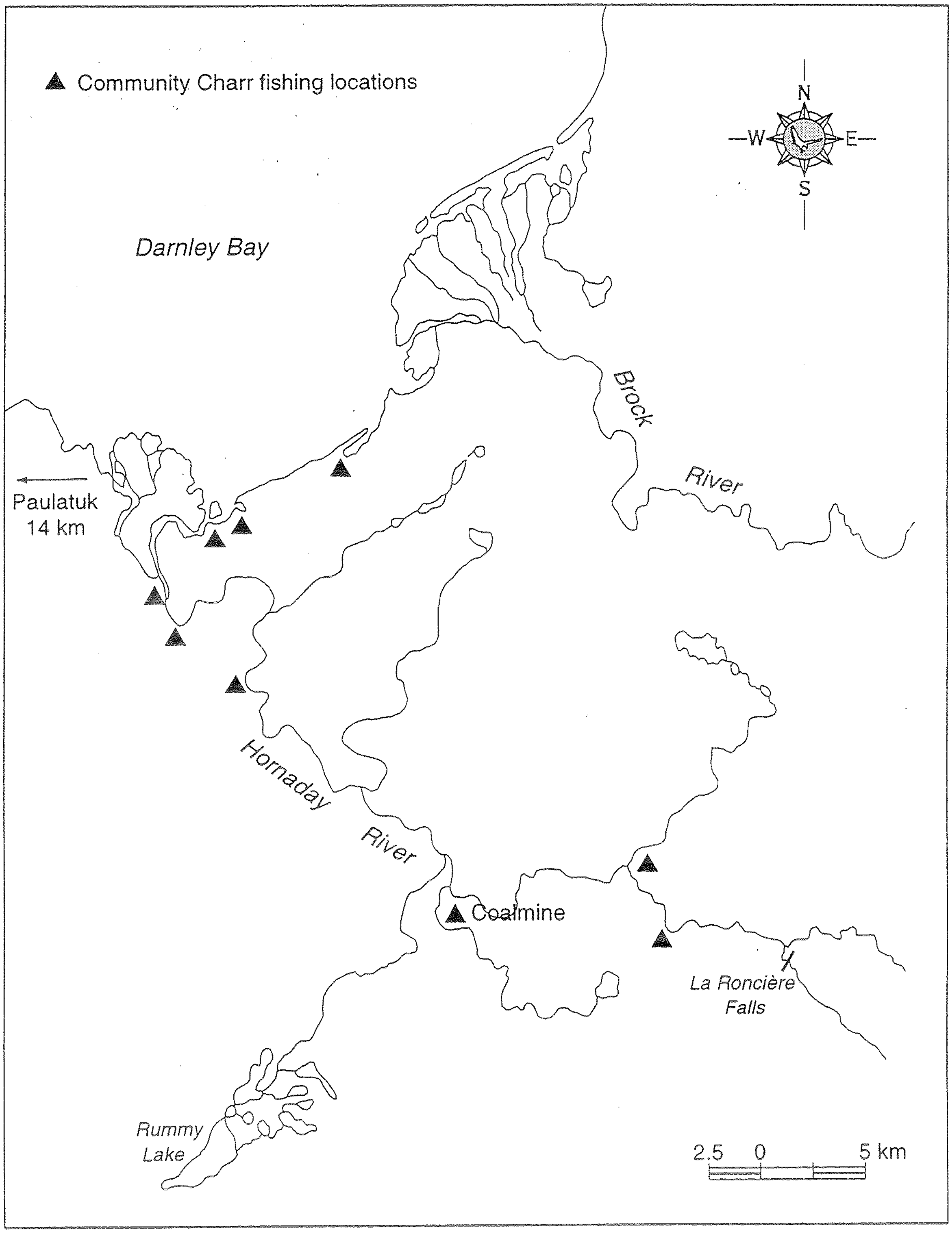

Fig. 6. Location of Arctic charr rivers in the Paulatuk area.

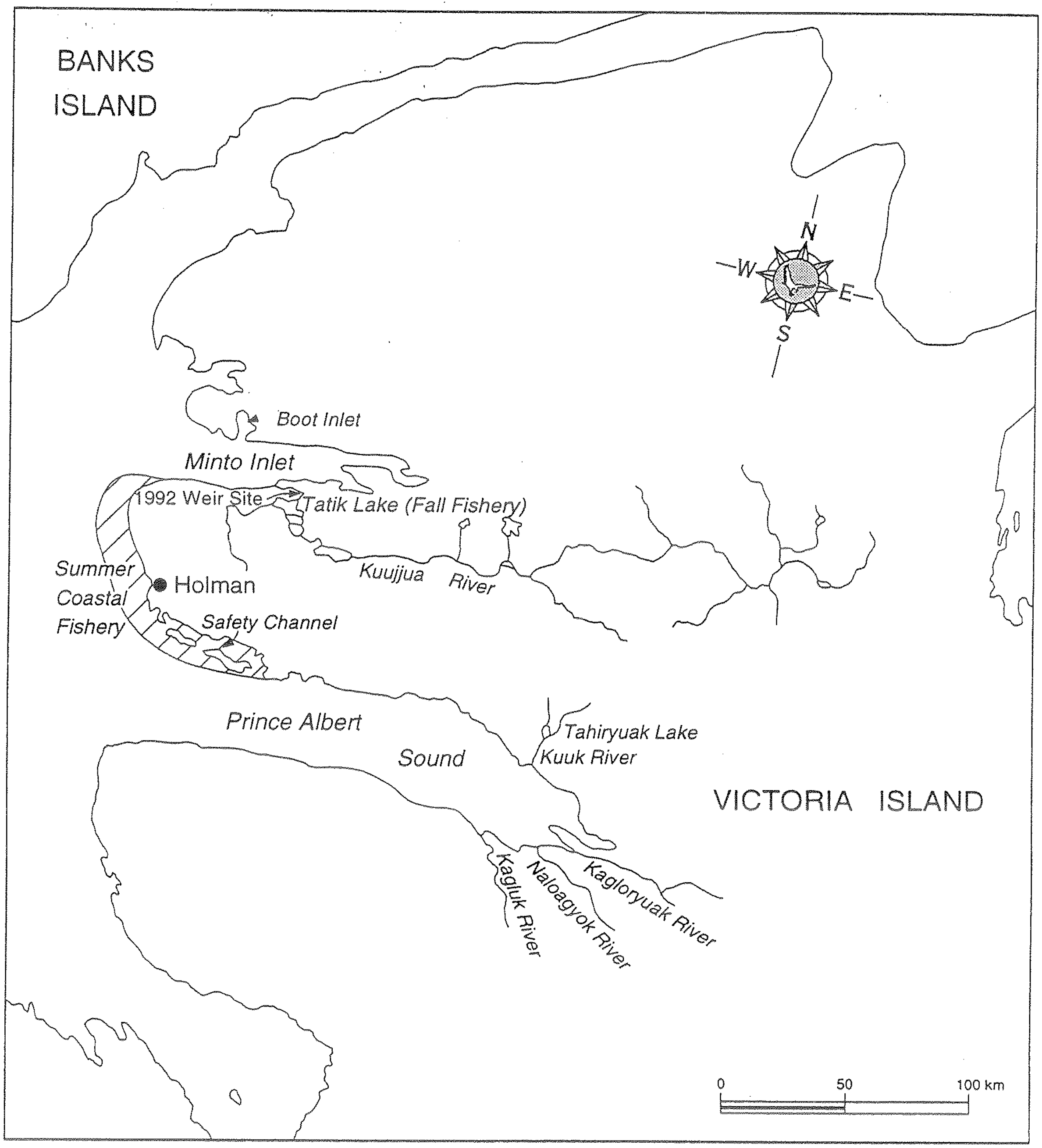

Fig. 7. Location of Arctic charr rivers in the Holman area.

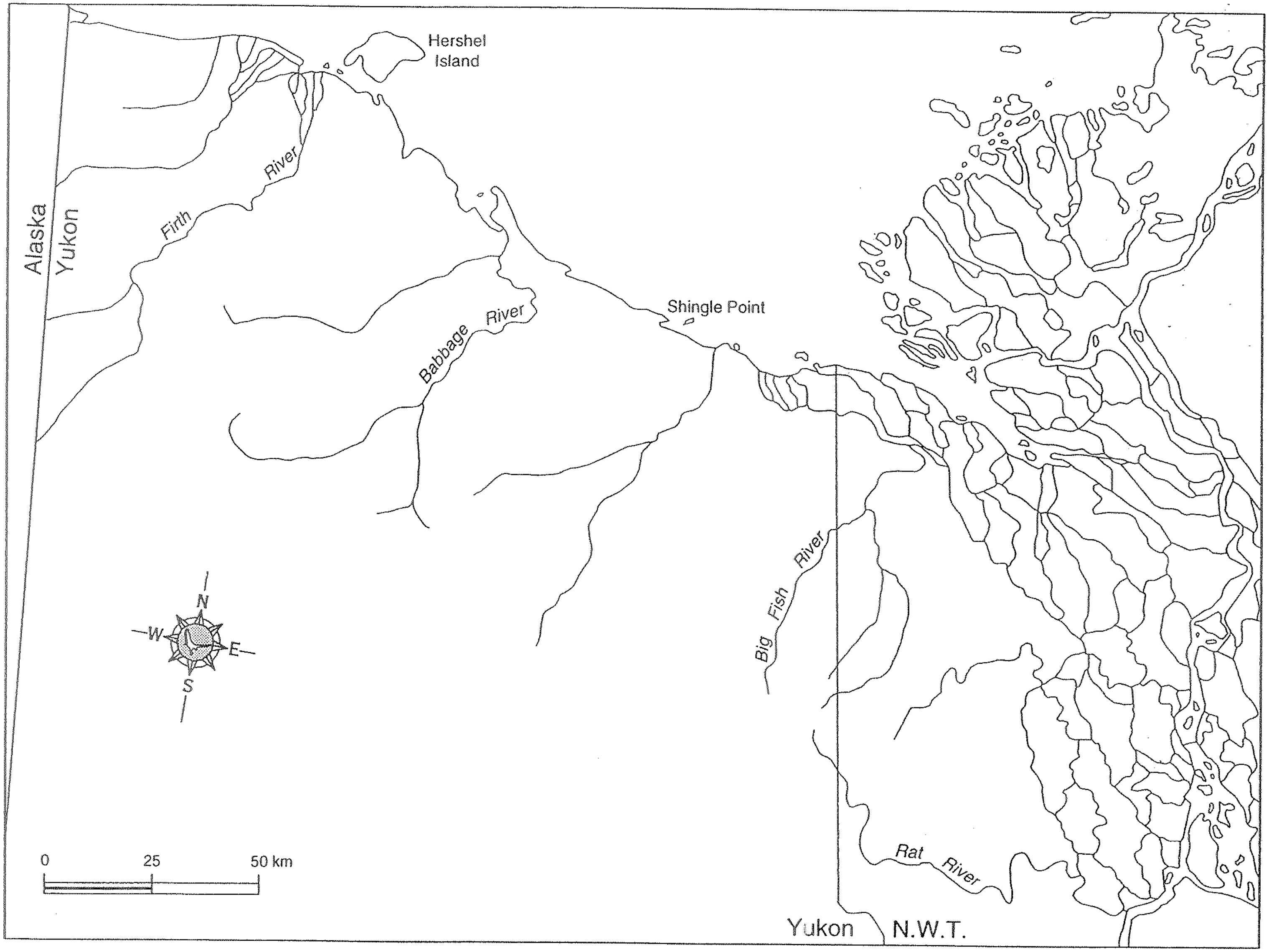

Fig. 8. Location of Dolly Varden charr rivers in the North Slope area.

APPENDIX A

List of workshop participants

Robert Alexie Sr.
GRRB
Fort McPherson, NT

John Alikamik
Holman HTC
Holman, NT

Titus Allen
Aklavik HTC
Aklavik, NT

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Aklavik HTC
Aklavik, NT

Bob Bell
FJMC
Air Ronge, SK

Joe Benoit
GRRB
Inuvik, NT

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Tsiigehtchic RRC
Tsiigehtchic, NT

Wayne Cardinal
Tsiigehtchic RRC
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Billy Day
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William Day
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FJMC
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Pat Ekpakohak
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Alan Fehr
Science Institute of NWT
Inuvik, NT

Hebert Felix
Tuktoyaktuk HTC
Tuktoyaktuk, NT

Alfred Francis
Fort McPherson RRC
Fort McPherson, NT

William Francis
Inuvik RRC
Inuvik, NT

Neil Greenland
Aklavik RRC
Aklavik, NT

Eric Gyselman
DFO
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Lois Harwood
DFO
Inuvik, NT

David Husky
Aklavik RRC
Aklavik, NT

Joseph Illasiak Jr.
Paulatuk HTC
Paulatuk, NT

Earl Jessop
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Sidney, BC

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Inuvik HTC
Inuvik, NT

John Keevik
Sachs Harbour HTC
Sachs Harbour, NT

Dan Klengenberg
Holman HTC
Holman, NT

Al Kristofferson
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Jimmy Memogana
Holman HTC
Holman, NT

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Neil Robinson
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William Teya
Fort McPherson RRC
Fort McPherson, NT

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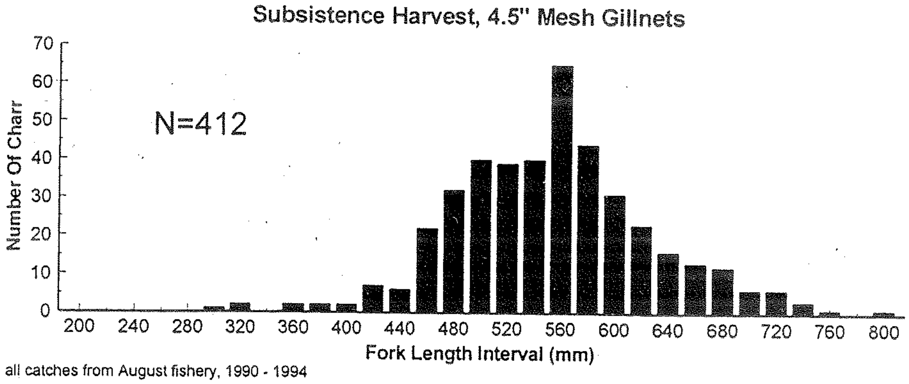
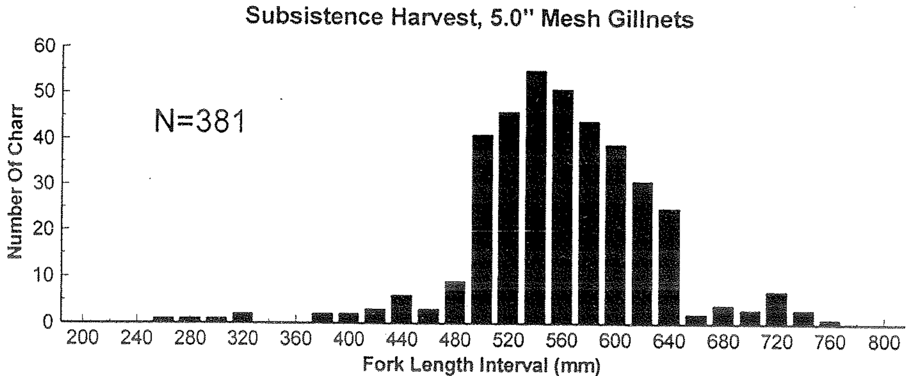
APPENDIX B

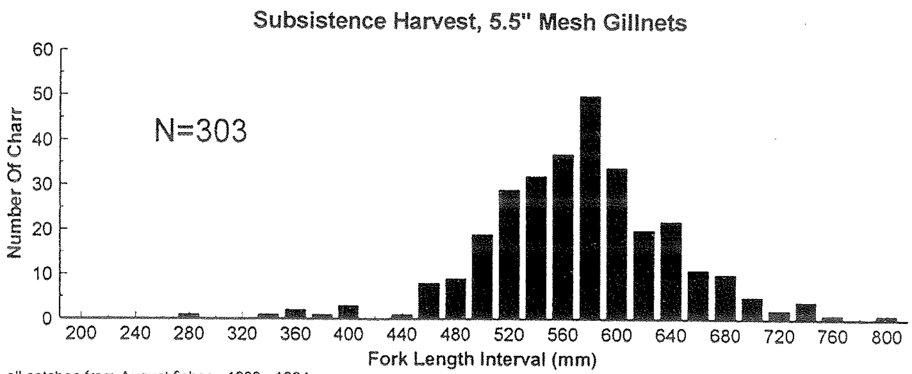
Poster Session graphs



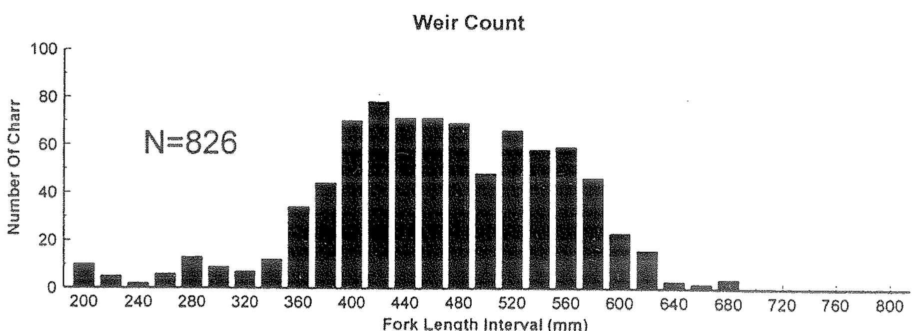
all catches from August fishery, 1990 - 1994



all catches from August fishery, 1990 - 1994

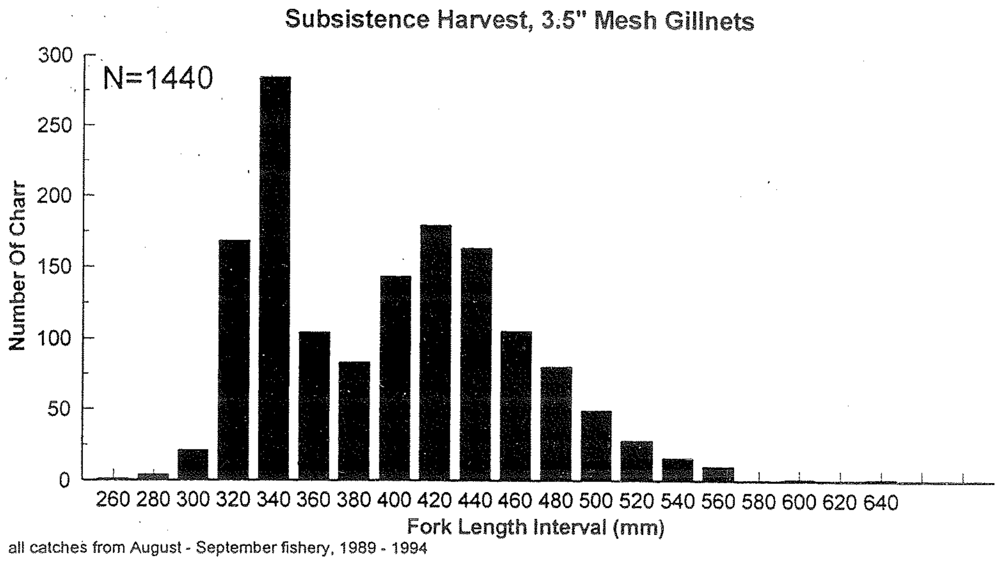


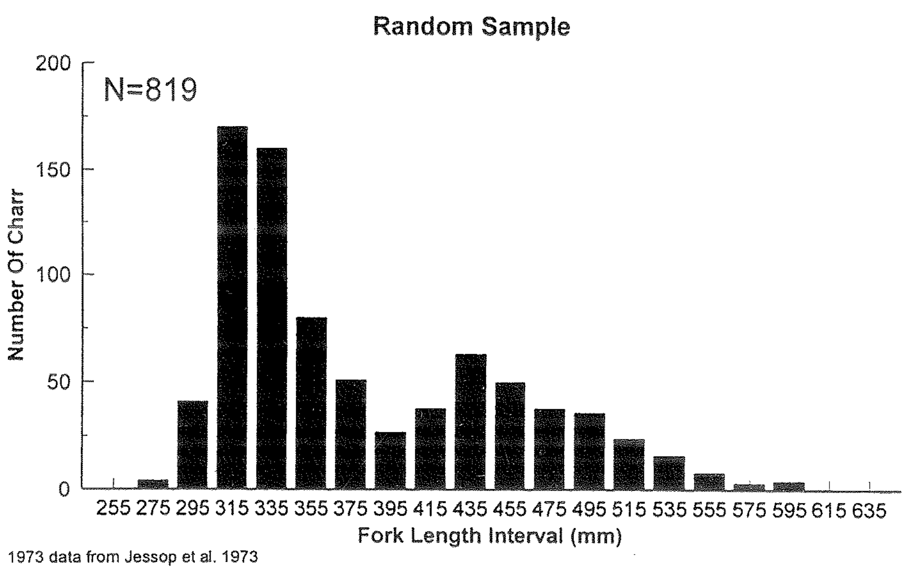
all catches from August fishery, 1990 - 1994



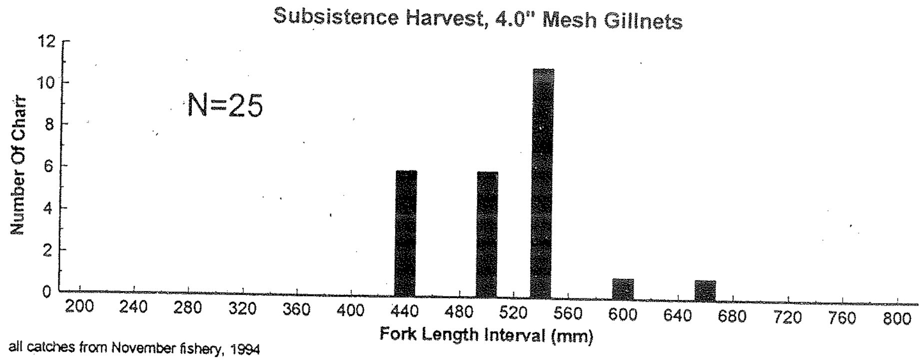
August 9 - 28, 1986 data incomplete as weir washed out

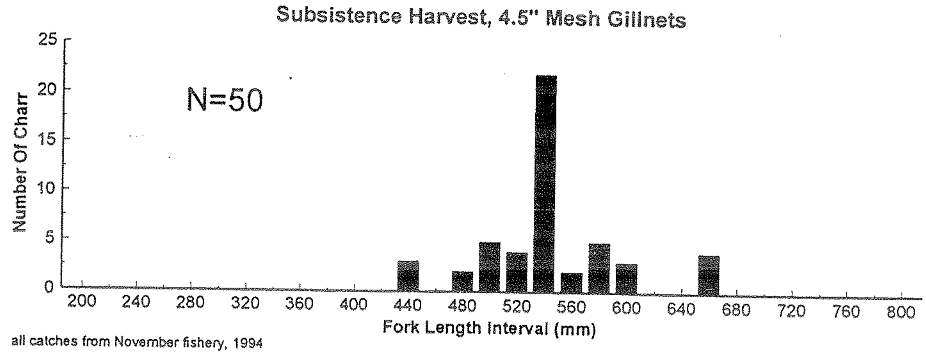
Length frequency distribution of Hornaday River charr caught in the subsistence harvest and at the 1986 weir.

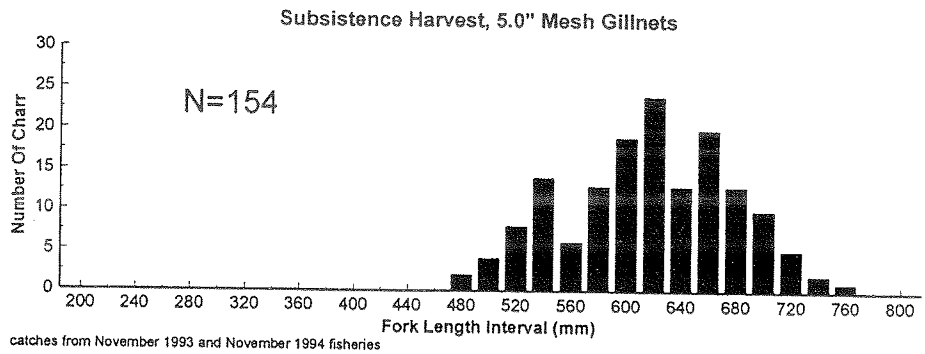


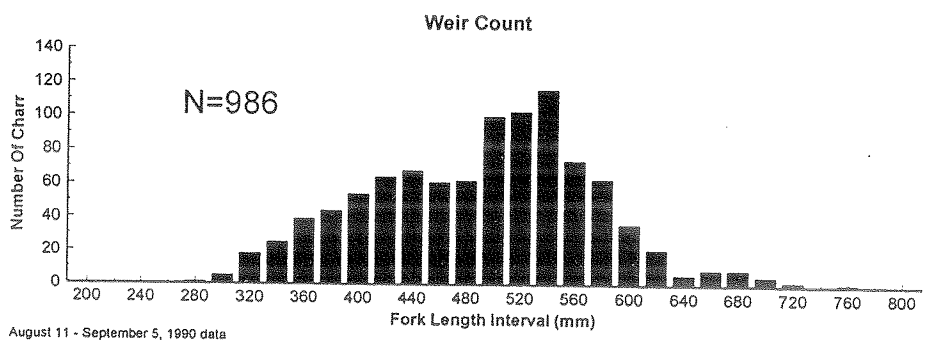


Length frequency distribution of Rat River charr caught in the subsistence harvest and by random sample.

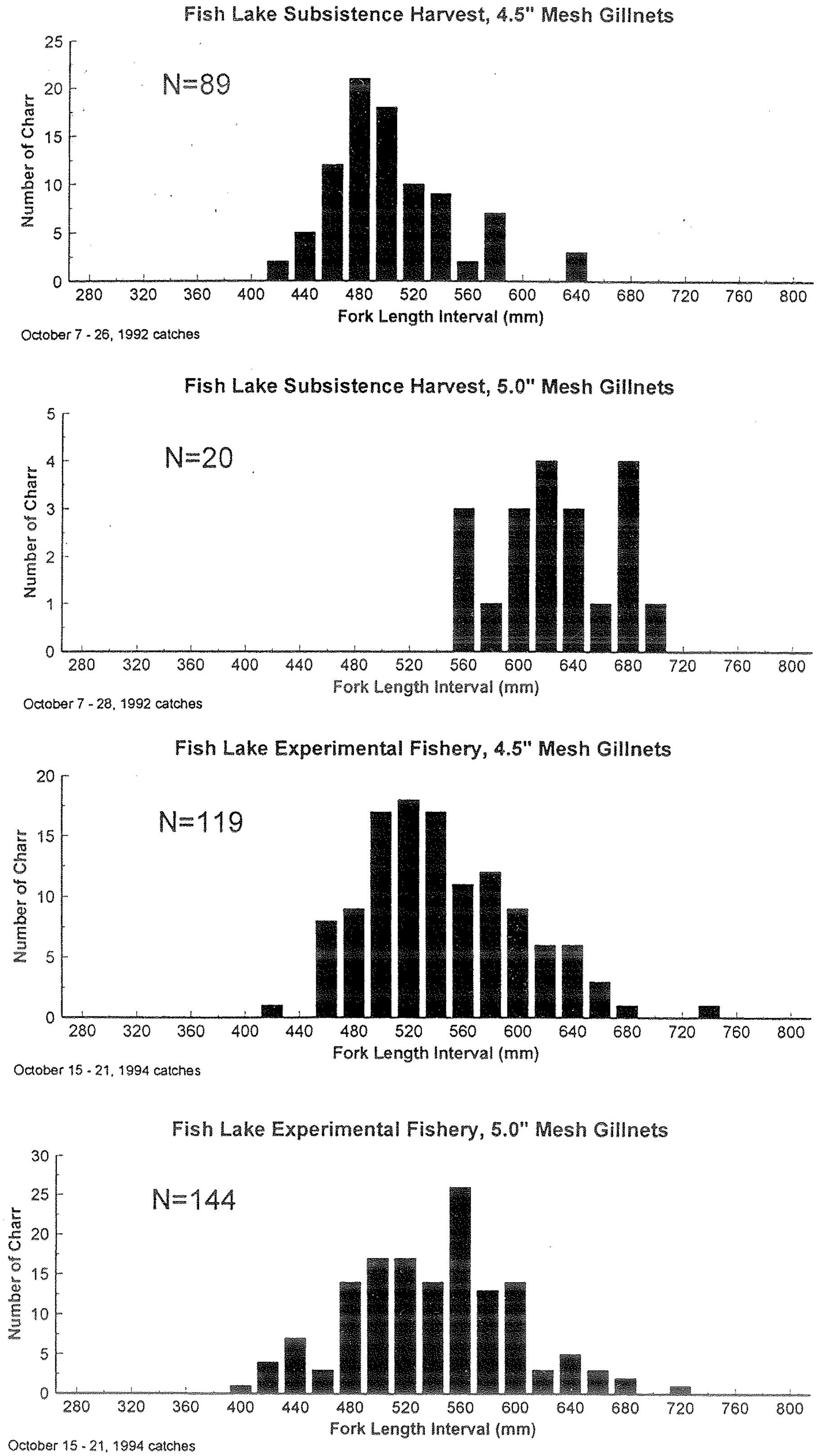




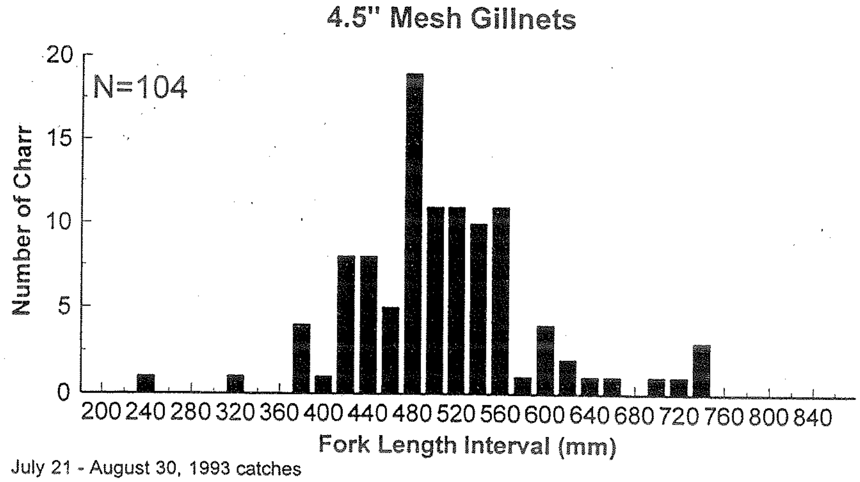




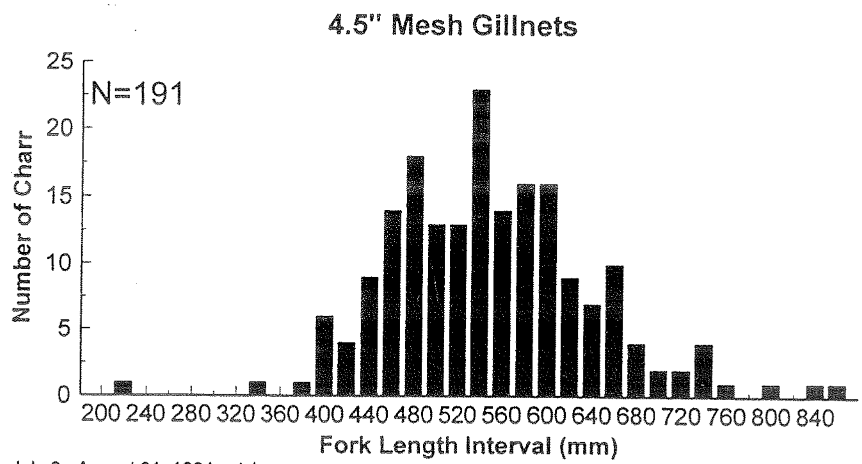
Length frequency distribution of Kagloryuak River charr caught in the subsistence harvest and at the 1990 weir.



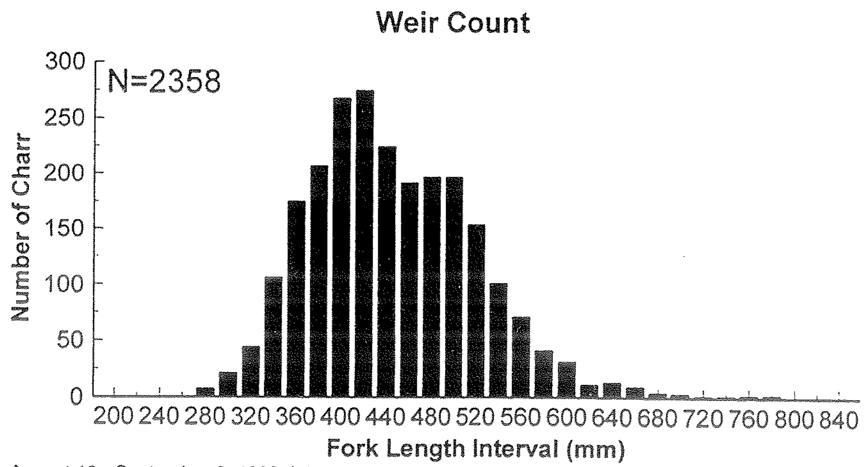
Length frequency distribution of Kuujjua River charr caught in the subsistence harvest and experimental fishery at Fish Lake.



July 21 - August 30, 1993 catches

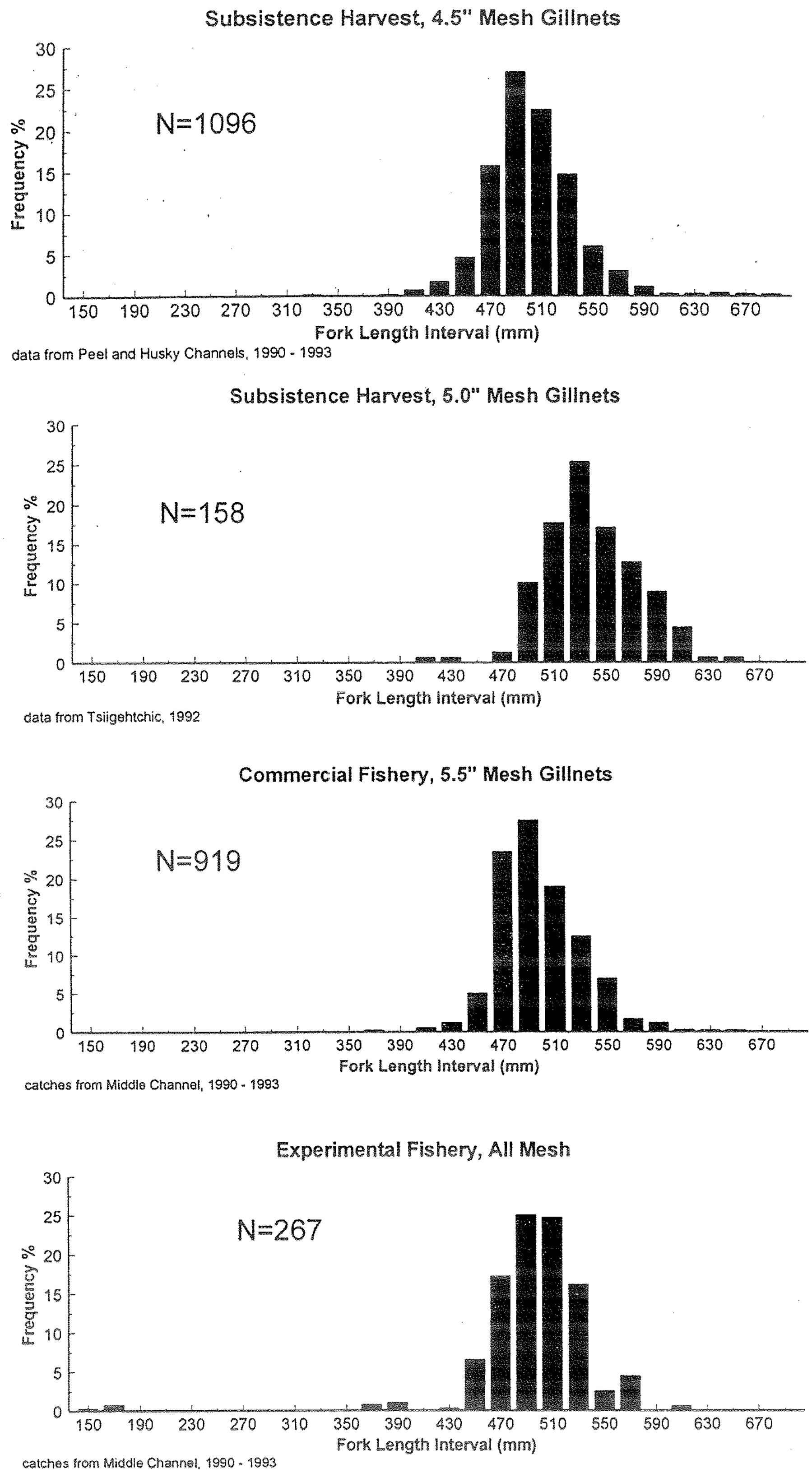


July 6 - August 31, 1994 catches



August 12 - September 8, 1992 data

Length frequency distribution of charr caught in the Holman coast subsistence harvest and at the Kuujjua River weir.



Length frequency distribution of broad whitefish caught in Mackenzie Delta subsistence harvest, commercial fishery and experimental fishery.

APPENDIX C QUESTIONS ADDRESSED DURING SUBGROUP DISCUSSIONS

Question 1 What areas are fished by communities represented in the group? (GOAL 1)

Question 2 What type of gear is used and how is it used? (GOAL 1)

Question 3 What is the timing of the fishery, and what are the constraints (e.g. open water or ice-fishery, spawning, associated with hunting activity)? (GOAL 1)

Question 4 Could the gear used be selecting more females than males, and what would be the effect of this? (GOAL 2)

Question 5 Are there other constraints due to how the harvest is used (e.g. commercial, local consumption or winter storage)? (GOAL 2)

Question 6 What is the status of the stock(s) and what are the present conservation concerns for these stocks? (GOAL 3)

Question 7 Are there factors other than fishing affecting the stock? (GOAL 3)

Question 8 Are there conservation or other concerns or impacts which may come up in the future for this stock? (GOAL 3)

Question 9 What are some of the measures that can be taken (or are already in place) to conserve the stock(s) (e.g. net mesh size, timing of fishery, location of fishery, net material)? (GOAL 4)

Question 10 What does the community already do to ensure long-term health of the stock? (GOAL 4)

Question 11 What does DFO do to ensure the long-term health of the stock (e.g. restrictions and regulations in place for the stock)? (GOAL 4)

Question 12 What do you think the effect of each of these measures (Questions 1,2 and 3) on the stock and fishery would be? (GOAL 4)

Question 13 Which of these measures do you recommend for this stock? (GOAL 5)