MONITORING OF THE 1987-1988 EXPERIMENTAL COMMERCIAL AND EXPLORATORY ARCTIC CHARR *(Salvelinus alpinus)* FISHERIES IN KANGIQSUALUJJUAQ, QUEBEC

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Ministère de l'Agriculture, Pêcheries et Alimentation
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ABSTRACT

The David Annanack and Son's experimental commercial Arctic charr fishery and the concurrent biological monitoring program commenced on 27 November, 1987, and was completed by 15 April, 1988. In total, 2020 Arctic charr were harvested in the experimental commercial fishery, representing 30% of the proponent's allocated quota. Five Arctic charr systems (Koroc River, Lake Tasikallak, L. Qarliik, L. Akilasaaluk and Ijjurittuq R.) were commercially fished; one other system (L. Sanirarsiq) was the site of an experimental research fishery. The Kuujjuaq Research Centre staff accompanied the proponent to all locations fished (a total of 160 research man-days), and sampled all fish captured. The proponent eagerly cooperated with the researchers, and to the best of our knowledge, there were no violations of the regulations stipulated in the fishing permit. Commercial fishing effort was highest at L. Tasikallak where an average of 63 kg of charr were captured per net per day. Low C.P.U.E. was experienced during January and February due to extremely low ambient temperatures; poor catches throughout the experimental fishery at Sanirarsiq may be at least partly attributed to catch selectivity of the experimental gang-mesh nets. The fishing methods employed in the commercial venture, processing of the commercial catch, the subsistence harvest study, and problems and recommendations for both the experimental commercial fishery and biological monitoring program are discussed.

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PERSONNEL

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INTRODUCTION

Recent amendments to Québec Fishery Regulations permitted commercial harvesting of anadromous Arctic charr *(Salvelinus alpinus)*. To this end, there has currently been much interest shown by several Inuit parties to initiate commercial inshore and offshore fisheries in the Ungava Bay region. Specifically, David Annanack, resident of Kangiqsualujjuaq, Québec (58°42'N, 65°57'W), submitted a request to Ministère de l'Agriculture, Pêcheries et Alimentation (M.A.P.A.Q.) in 1986 to undertake a commercial winter fishery for Arctic charr in 17 inshore water systems proximate to Kangiqsualujjuaq. In the fall of 1987 the request was accepted, and Mr. Annanack received a permit to conduct an experimental fishery in 12 of these systems (Figure 1).

This field report provides an outline of the research conducted to monitor the 'David Annanack and Son's' experimental commercial fishery at Kangiqsualujjuaq during the winter of 1987-1988. Problems encountered during the pilot season of the fishery, as well as recommendations for future commercial fisheries are also discussed. Note that all English spelling of Inuttitut place names are taken from L. Muller-Wille and Avataq Cultural Institute (1987).

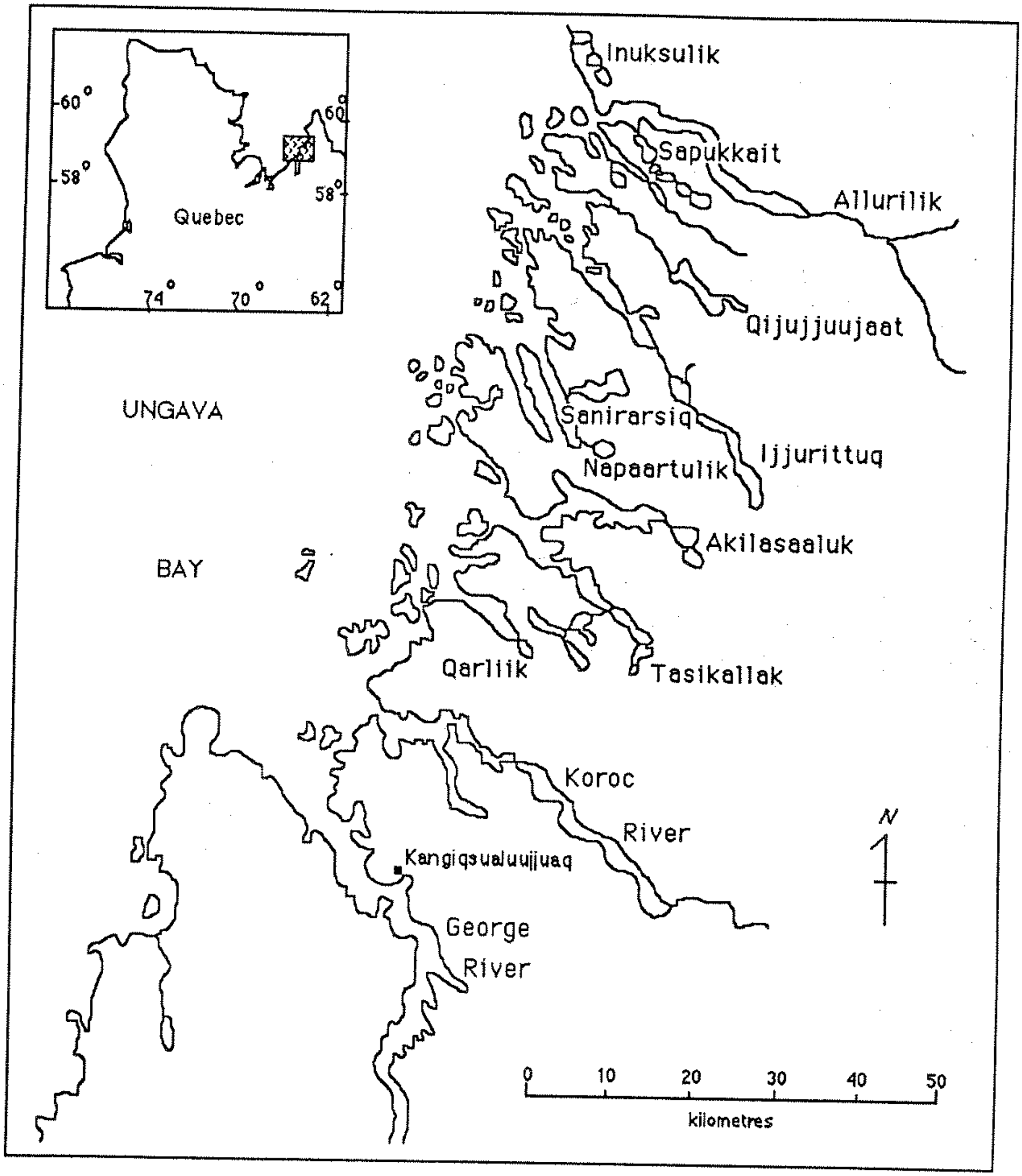

Figure 1: Arctic charr systems near Kangiqsualujjuaq which were selected for experimental commercial exploitation during the winter of 1987-88.

FIELD WORK, TOTAL HARVEST AND FISHING EFFORT

The proponent received confirmation for an experimental commercial fishing licence on 26 November, 1987; on 27 November 1987, the fishery and research program was initiated. As agreed by the proponent, no two commercial sites were fished concurrently. Quotas were fulfilled at each site before moving to a new fishing location (the exception being Akilasaaluk). Sites were fished in serial order according to distance from the community, starting with those most proximate. All fishing locations were reached by snowmobile with field equipment, supplies and fishing gear being transported on site using sleds (qaamutiks). In total 5 of the 12 Arctic charr systems were fished commercially during the winter of 1987-88; the entire quota was obtained from 3 of these systems (Table 1).

Table 1. Allocated quotas (numbers of charr), commercial harvest and mesh sizes employed at each system .

Fishery Site	Quotas (#)	Harvest **	Rejects	Surplus	Total	Mesh(cm)
Koroc	150	150	14	6	170	11.4
Tasikallak	200	201	26	14	241	11.4
Qarliik	100	101	16	1	118	11.4
Akilasaaluk	545	499	54	0	553	11.4
Ijjurittuq	1250	944	85	0	1029	14.0
Sanirarsiq *	900	24	0	0	305	gang-mesh
George River	300	not fished				
Napaartulik	425	not fished				
Qijujjuujàat	770	not fished				
Allurilik	520	not fished				
Sapukkait	770	not fished				
Inuksulik	770	not fished				
TOTAL	6700	1919	195	21	2416	

* experimental scientific fishery alone
** commercially-tagged Arctic charr

A total of 158 man-days of research were conducted by the Kuujjuaq Research Centre staff (Table 2). At least 2 researchers were present with the proponent during each fishing trip; usually 4-6 Inuit fishermen would undertake commercial fishing at any given location.

Table 2. Summary of field time (November, 1987-April, 1988), research man-days, and field personnel

Location	Research Period	Research Man-Days	Research * Personnel	Fishery Personnel
Koroc	27-30 Nov	12	S. Olpinski (4) T. Boivin (4) S. Baron (4)	D. Annanack J.S. Annanack E.S. Annanack J. Annanack
Tasikallak	5 -6 Dec	4	T. Boivin (2) S. Baron (2)	D. Annanack J.S. Annanack E.S. Annanack K. Assivak
Qarliik	9 -10 Dec	4	T. Boivin (2) S. Baron (2)	J.S. Annanack E.S. Annanack J. Annanack K. Assivak
Akilasaaluk	16-20 Dec 9 -12 Jan	18	S. Olpinski (4) P. May (5) S. Baron (9)	D. Annanack J.S. Annanack E.S. Annanack J. Annanack
Ijjurittuq	18-23 Jan 2-8 Feb 19-24 Feb 2-6 Mar	54	S. Olpinski (6) T. Boivin (13) P. May (6) S. Baron (18) T.G. Etok (6) A. Annanack (5)	D. Annanack J.S. Annanack E.S. Annanack J. Annanack M.S.Annanack B. Morgan T. E. Annanack J.W. Etok
Sanirarsiq	10-15 Mar 25-30 Mar 9 -14 Apr	66	S. Olpinski (12) T. Boivin (6) P. May (6) S. Baron (12) E.S. Annanack (18) T.E. Annanack (6) T.G. Etok (6)	
TOTAL		158		

Note: Number of research man-days does <u>not</u> include days spent travelling to fishing sites, nor time required for net placement, unforseen equipment failures, etc.

* Bracketed numbers represent research man-days per researcher.

Table 3. Travel days and days lost due to weather and equipment failure

Location	# Trips	Days Travel	* Wasted Days Weather	** Wasted Days Equipment Failure
Koroc	1	2	0	0
Tasikallak	1	2	0	0
Qarliik	1	2	0	0
Akilasaaluk	2	4	2	2
Ijjurittuq	4	8	3	2
Sanirarsiq	3	6	3	2
Total	12	24	8	6

* fishing days lost remaining in community or in the field
** skidoo repair, breakage of sleds, ice augers etc.

Travel time (h) to fishing locations (Table 4), varied and depended upon two main factors: trail conditions (a function of snow quantity, consistency and texture; roughness of sea ice), and weather (ambient temperatures ranging from -45° to 0° C, extreme wind, and blizzard conditions). Furthermore, travel was often delayed due to equipment failure or damage caused by extreme conditions.

Table 4. Distances and average travel time to fishing locations

Location	Distance (km)	Travel Time (h)
Koroc	30	1.0
Tasikallak	75	3.0
Qarliik	60	2.5
Akilasaaluk	80	4.0
Ijjurittuq	100	5.0
Sanirarsiq	100	5.0

Considerable differences were found in fishing success between different charr systems (Table 5). At Tasikallaq, the entire quota (200 fish) was captured in 7 gillnet-days, while it took over 106 gillnet-days to obtain 944 fish from Ijjurittuq. The discrepancy in catch per unit of effort (C.P.U.E.) between systems and during different times of the winter makes it difficult to predict the number of field trips required to obtain the total quota.

Table 5. Experimental commercial fishing effort at each system

Location	*Gill Net Days	# Charr	**Total Wt (kg)	# Charr/Net per day	Wt(kg)/Net per day	Avg Total Net Lgth(m)/day
Koroc	21	164	340.3	7.8	16.2	202
Tasikallak	7	241	441.0	34.4	63.0	326
Qarliik	9	118	210.2	13.1	23.4	167
Akilasaaluk	43	553	1102.3	12.9	25.6	186
Ijjurittuq	106	944	2881.9	8.9	27.2	238
TOTAL	186	2020	4975.7	10.9	26.8	1119

* gillnet day: 24 hr period; standard net length = 45 m
** round weight

FISHING METHODS

Once on site, tents were erected and wood was cut for heating. Following establishment of a campsite, nets with pre-selected mesh size (see Table 1) were set according to a standardized procedure: 1) holes were drilled through the ice using a gasoline-powered ice auger; 2) a leader line, of a length equivalent to the net, was deployed under the ice using an "ice jigger" (dorsal surface of this jigger was painted a fluorescent orange to enhance visibility). The jigger was located using a combination of emitted sound and ultimately from the aforementioned colouring; 3) a second hole was drilled at the predicted recovery site, and the jigger retrieved; 4) the leader line was attached to the net ; 5) the net was pulled under the ice. Nets were typically set in intermediate depths (a minimum of 4 m; a maximum of 15 m) with the net resting on the substrate (as opposed to other communities whose fishermen typically set nets adjacent to the undersurface of the ice (P. Oqituk, pers. comm.)); 6) net leaders were tied to the bottom of pieces of wood suspended in the water and secured by wooden cross pieces straddling the hole.

Alternatively, when the ice auger was malfunctioning and/or the ice jigger was unavailable, nets were set in the traditional manner. A hole was chopped through the ice using an ice chisel and the leader line was fed under the ice attached to a long piece of wood propelled, and directed, by a second bifurcated piece of wood. This technique required numerous holes to be chopped, or drilled through the ice (equidistant to the length of wood placed under the ice), hence by its nature was time-consuming and very labour-intensive. As in the aforementioned technique, the leader line was retrieved and the net pulled under the ice. In all cases, choice of net placement and its orientation was apparently a function of experience and individual preference of each fisherman.

A record of time of initial net set, location, ownership, and all subsequent net checks was maintained in field booklets for each net (see Appendix for an example of field data sheet). Nets were typically left undisturbed for a twelve-hour period, after which they were checked in serial order to ensure eqivalent intervals between placement and check. Net-placement holes were cleared using an ice chisel and the nets were withdrawn with an attached line (for resetting nets). Fish were removed from nets as soon as they were pulled on the ice to minimize entaglement compounded by freezing of the net.

BIOLOGICAL SAMPLING

All fish sampled in the commercial and experimental fisheries (n=2421) were immediately examined for overall condition. Fish were sexed according to external characteristics including shape and size of head, and degree of kype formation. External coloration ('red' or 'silver') was used as a general index of fish maturity; 'red' charr are designated as having spawned the previous fall, while 'silver' charr did not contribute to the spawning run (Boivin, 1987). All fish were weighed to the nearest 50 g using a 10 kg Pesola spring scale and were measured for fork length to the nearest 0.5 cm. A minimum of 150 samples (or the entire quota if less than 150) were selected for aging using a systematic sampling procedure. In this years monitoring program, morphometric parameters (fork-length and round weight) for <u>all</u> fish harvested in the experimental commercial fishery (including rejects) were collected.

$$P = \frac{N}{n}$$ Where: N = size of statistical population
n = size of the sample

All fish, except those in the population kept for aging, were tagged through the opercular opening. Tags for sampled fish were placed through the flesh encircling the vertebral column, immediately anterior to the caudal fin. Heads from this sample population were removed on return to the community and placed together with identifying tag numbers, in individual 1 L Whirlpack bags. Due to extremely low temperatures, it was impossible to remove the otoliths in the field; hence, they were extracted at the Research Centre. The quality of the frozen heads did not deteriorate over time, and the otoliths proved to be in condition comparable to those removed from freshly-sacrificed fish. At the Kuujjuaq Research Centre, otoliths were read with a dissecting microscope and reflected light according to the method of Nordeng (1961).

Any fish that were scarred, excessively skinny or were too small to be of market value (it was decided that a fish <30 cm was unmarketable) were classified as "rejects" and were not tagged for commercial sale. These fish were brought back to Kangiqsualujjuaq for local subsistence consumption or dog food. Morphometric measurements were collected from these rejects. In the event the particular reject came up as a systematic sample, heads were removed for otolith extraction.

PROCESSING OF THE COMMERCIAL CATCH

Following morphometric sampling, all fish designated suitable for commercial sale were eviscerated by the fishermen. Gonads were examined for confirmation of sex and gill arches were removed. Kidneys were removed using a spoon and fish were tagged either through the opercular opening or immediately anterior to the caudal fin according to the sequence of systematic sampling. All fish were thoroughly washed to remove blood, kidney residue and excess slime. A string was looped either through the opercular opening or around the tail, and all fish were individually suspended from a rack erected on the ice at each net site (racks consisted of a ridgepole supported on both ends by tripods of roped wood). Low ambient temperatures throughout most of the fishery period provided excellent conditions for freezing the fish (fish froze in an average of 10 minutes in January and February; however see 'Problems and

Recommendations'). Frozen fish were re-glazed by dipping them in water on subsequent net checks.

Before returning to Kangiqsualujjuaq, all debris (including wooden racks and fish viscera) were removed from the ice and placed on the land. Each fisherman transported his individual catch back to the community by sled. At locations where quotas were not achieved in one fishing period, tents and some gear were left on site; otherwise all equipment was brought back to Kangiqsualujjuaq. In the community, researchers removed heads from fish systematically-sampled for aging (i.e. those tagged through the tail) following which the proponent weighed total catches of individual fishermen. Towards the end of the season the proponent received equipment permitting him to package fish in individually-sealed plastic bags (which functioned in protecting fish while in transit to southern markets).

EXPERIMENTAL FISHERY AT LAKE SANIRARSIQ

The objective of the scientific fishery was to collect detailed information regarding structure and dynamics of the overall population in a charr system. The choice of system depended on it having received minimal exploitation in recent years, the population theoretically being comprised of the least-disturbed age cohorts (hence a "natural population"). Comparison of data from this system, with that from systems receiving commercial exploitation, will prove invaluable for the future development of sustainable yields . The system which best fit these criteria, yet was also within reasonable travel distance from the community, was Sanirarsiq (see Figure 1).

The scientific fishery began at Sanirarsiq on 10 March 1988. It was intended that a minimum 350 fish be sampled by the research team before any experimental commercial fishery was conducted. However, due to advancement in the season, it was agreed that any fish of marketable size caught during the scientific fishery would be tagged, thereby reducing the proponent's commercial quota for Sanirarsiq by an equivalent amount . As a result of poor C.P.U.E, only 305 fish were captured. Furthermore, unseasonable daytime temperatures (+5° C ambient temperature) for the duration of the scientific fishery prevented complete freezing of the fish; unfortunately, all 24 tagged fish spoiled. The tags were subsequently removed and discarded.

To fulfill the objective of sampling a cross-section of the total fish population in Sanirarsiq, four geometric-progression gang-mesh nets were utilized in the fishery. Each net was comprised of seven 6-m panels with the following combination of stretched mesh sizes (cm): 15.2, 11.4, 7.6, 6.4, 5.1, 3.8, and 2.5. Nets were set following the same technique described for the experimental commercial fishery, and were checked according to a similar schedule. In order to minimize any bias in net placement, sites were randomly selected. A map of Lake Sanirarsiq was blocked into eight quadrants arbitrarily labeled from 1-8. Random numbers were drawn (from a book of random numbers) to select the sequence of net placement for the four nets. A total of 12 random numbers were drawn, permitting 8 moves within or between quadrants. Specific location of net placement within a given grid was achieved in the field by throwing a stick and drilling at the site it landed. In practice, two of the sites randomly-chosen proved innapropriate due to extreme depth (> 40 m) and alternate sites had to be used. Unlike some of the other sytems which have been exploited for many years, Sanirarsiq has only received moderate use. Therefore, the bias afforded by accumulated netting experience was lacking and selection of net sites was, in effect, random . In the end, a total of 6 sampling sites were used in the experimental fishery (Figure 2).

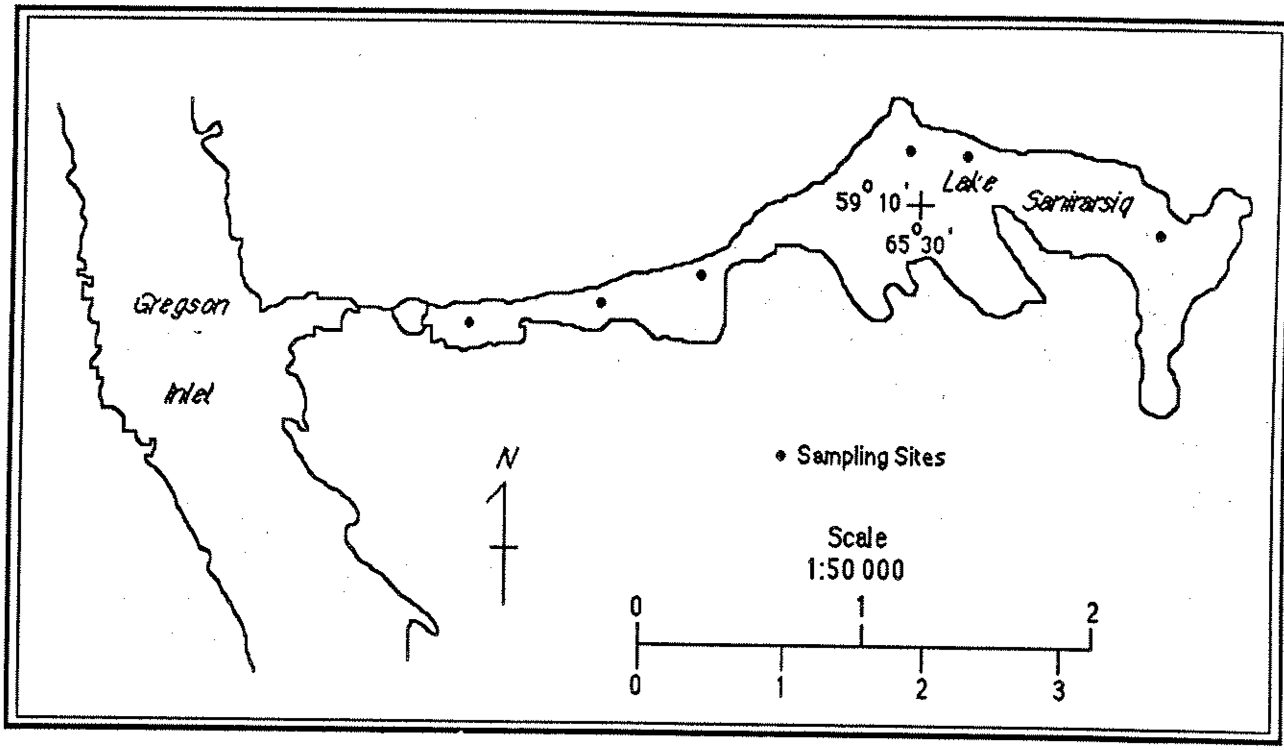

Figure 2. Sampling sites at Lake Sanirarsiq

In addition to the same aforementioned data collected at experimental commercial fishery sites, both pectoral fins were removed (using scissors) from every fish and placed in individual Whirlpack bags.The fin rays have not yet been sectioned nor examined under a dissecting microscope to evaluate their use in age interpretation (if viable, this would eliminate the need of removing heads for otolith extraction in subsequent years, increasing the market value of those fish). It is expected that examination and analysis of fin rays will be undertaken during the fall of 1988, before the start of the next winter fishery.

All Arctic charr were sexed according to external characteristics, and the method was confirmed by examination of the gonads (91.4 % accuracy; n=267). Of the 23 fish sexed incorrectly, 11 designated as males by external characteristics were, in fact, females. Thus, when using this method for determination of sex, there does not appear to be a difference or selective bias between sexes. Lake Trout *(Salvelinus namaycush)* were sexed according to gonadal examination, and any fish of either species under 20 cm in length was retained whole and examined under dissecting microscope at the Research

Centre. Maturity level was determined by external coloration, and verified by examination of gonads (94.4% accuracy; n=267). Most (80%; n=15) 'incorrect' determinations of maturity were 'silver' female charr which appeared to have spawned the previous fall. However, despite these exceptions, the methods for determining sex and maturity by visual inspection appear to be very accurate.

A record of catch by mesh size was maintained (Tables 6 & 7) whereby fish captured by the teeth, or tangled in the net, were designated caught 'non-selectively'. A 'selective' catch was one which had been captured by the gills or body (a discussion of catch selectivity will be included in the scientific report). A total of 1 Lake trout and 5 Arctic charr were caught by jigging and these fish were included in the data pool for statistical analyses. All fish caught at Sanirarsiq (excluding those initially tagged but subsequently rejected due to spoilage) were distributed to members of the community for subsistence consumption.

Table 6. Geometric gang-mesh catch for Sanirarsiq Arctic charr scientific fishery

Mesh Size	Min Length (cm)	Max Length (cm)	Length Range (cm)	% Non-selective catch
2.5	12.5	76.0	63.5 (n=14)	71
3.8	53.5	71.0	17.5 (n=28)	93
5.1	21.5	77.0	55.5 (n=55)	83
6.4	31.0	74.5	43.5 (n=50)	82
7.6	35.0	76.5	41.5 (n=48)	69
11.4	52.0	75.0	23.0 (n=57)	33
15.2	54.0	75.5	21.5 (n=21)	24

It appears that the gang-mesh nets utilized by the research team were highly non-selective. The 2.5 cm mesh captured the widest length-range of fish, and the 3.8 cm mesh had the highest percentage of non-selective catch. As a result, it is difficult to determine if a suitable cross-section of the population was sampled.

Table 7. Geometric gang-mesh catch for Sanirarsiq lake trout scientific fishery

Mesh Size	Min Length (cm)	Max Length (cm)	Length Range (cm)	% Non-selective catch
2.5	12.0	49.5	37.5 (n=2)	50
3.8	18.0	84.0	66.0 (n=9)	22
5.1	22.5	71.0	48.5 (n=5)	40
6.4	31.0	44.0	13.0 (n=4)	0
7.6	41.0	42.0	1.0 (n=2)	0
11.4	42.0	95.0	53.0 (n=4)	100
15.2	no lake trout captured by gillnet			

The geometric gang-mesh nets appear to be less size-selective for the lake trout captured in the experimental scientific fishery. Compared to the Arctic charr catch, the percentage of non-selective catches of lake trout was lower for all mesh sizes (except the 11.4 cm mesh).

SUBSISTENCE HARVEST STUDY

To obtain an estimate of the subsistence fish catch, harvest booklets were distributed to all households in the community (n =78) on 30 November, 1987. Fishermen were visited twice over the course of the fishery period (10 February and 19 April, 1988) to determine whether harvest records were being maintained. If booklets were not completed or up-to-date, fishermen were requested to answer a questionnaire concerning catch and harvest effort (see Appendix for examples of booklets and questionnaire). All households in Kangiqsualujjuaq cooperated fully with the harvest study, and fishing effort data was collected from all potential fishermen. The following data regarding total harvest and C.P.U.E. were recorded in harvest booklets by both commercial and subsistence fishermen:

- fisherman (men) involved
- date of capture
- specific location
- mesh size used
- length of net
- time of net set
- time of subsequent net checks
- number of charr (or other spp.) caught

PROBLEMS AND RECOMMENDATIONS

To our knowledge a commercial winter fishery of this nature conducted by Inuit proponents was the first of it's kind in northern Québec. Because of its unique nature, plus the fact that this was a pilot season, problems were inevitable and were encountered in both the experimental commercial fishery and the research monitoring program.

Key factors affecting the success of the experimental commercial fishery are presented in Table 8. Although a number of the factors are interrelated both within and between the fishery and the monitoring program, they will be treated separately.

Table 8. Factors affecting success of the experimental commercial fishery.

1) Compliance to the conditions of the permit
2) Weather (extreme cold - unseasonable and mild temperatures)
3) Equipment (availability; failure/breakage)
4) Reduced market value of red (spent) Arctic charr
5) Low C.P.U.E.
6) Logistical organization
7) Lack of participation by M.L.C.P. conservation officers
8) Unsuitable format of "Fiche de Pêche"
9) Improvement of harvesting techniques (use of fish weirs for commercial harvests in the future)

The commercial fishing operation, biological monitoring program and subsequent management of the Arctic charr stocks of eastern Ungava Bay is dependent upon the proponent's strict adherence to the conditions of the fishing permit. David Annanack and his assistant fishermen made every effort to cooperate with the research staff, and followed all fishing regulations stipulated by M.A.P.A.Q. To the best of our knowledge, there were no violations of the conditions of the fishing permit during the entire fishing period.

As previously discussed, weather played a significant role in affecting access to fishing locations. Furthermore, extremely low temperatures (although permitting rapid freezing of fish) and blizzard conditions resulted in equipment failure, frosbite, and at least one instance where the fishermen were unable to eviscerate and clean 40 fish. These fish were taken by fishermen for subsistence consumption. Conversely, mild temperatures in March resulted in spoilage of fish. Net placement, using the jigger, was also sometimes complicated by thick ice and/or wind which muffled the emmitted noise and made locating the jigger difficult. Obviously, since this is a winter fishery in the arctic, one must contend with cold temperatures. However, to reduce some of the discomfort, perhaps a portable shelter with a heat source could be located near the net sites. Equipment failure due to extreme cold can only be minimized by using quality equipment and by practicing preventative maintenance. To ensure a quality product during periods of mild temperatures, the fish must be kept under ice while in the field and be immediately frozen in a commercial-type freezer on return to the community.

In any commercial enterprise, it is critical that the necessary equipment is available. Under rugged conditions it is important the equipment is of top quality and in working order. In this particular fishery, it was unfortunate that this was sometimes not the case. On several instances, major delays were encountered due to major breakage of snowmobiles. The same was true of the ice auger which was in poor working order. The proponent did not possess an ice jigger, and the one supplied by the research team was used throughout the fishery. Perhaps of greater importance was the lack of appropriate freezer facilities to handle large quantities of fish, especially later in the season when daytime temperatures were milder. It is paramount that the proponent and his fishermen purchase the types of gear necessary to conduct a more viable commercial fishery.

An unpredicted complication arose when the proponent was informed about the low market value of red (spent) Arctic charr. Apparently, southern markets were not willing to pay as much for these fish because their clients (incorrectly) associated them with spent (dead) Pacific salmon *(Onchorhynchus* spp.*)*. Boivin (1987) examined the proximate composition of spent and immature Arctic charr from the Kangiqsualujjuaq area, and found that despite the poorer general condition of spent charr, they were still suitable for commercial sale. Although some spent charr sampled during the 1987-88 experimental commercial fishery were also in poor condition (from scarring and reduced weight) these were rejected and only those spent charr in good condition were tagged for commercial sale. To deal with this misunderstanding, it is important that either a promotional campaign is addressed at southern consumers clarifying any misconceptions, or alternatively the proponent must find a different market for spent Arctic charr (ie. a smoked product).

Low C.P.U.E. was experienced during January and February. Inuit fishermen suggest the reason for this was extreme temperatures; during this period, charr remain close to the lake bottom, reduce their activity and conserve energy reserves. Consequently, this lower rate of activity lessens their chance of encountering nets. According to the fishermen, the fish once again become active later in the fishing season. It is important the fishery begins as soon as trail conditions permit travel to fishery sites (early November) and continues until such time trail conditions no longer permit travel (late April), so that fish may be captured during their 'most active' periods.

In any commercial venture, efficiency and organization must be inherent to maximize success. This was often lacking in the pilot season of the fishery; coordination amongst fishermen, and scheduling of work and travel was sometimes disorganized. Following discussions with the proponent, and acting on the aforementioned recommendations, it should be expected that efficiency and organization will improve in subsequent years.

The lack of participation by M.L.C.P. conservation officers was disappointing. Not only did it place the onus of "policing" on the researchers (something which had been specified in the protocol the researchers were <u>not</u> willing to do), but it also prevented a rapport being established between "the government" and the Inuit fishery. Hopefully this will be rectified in subsequent field seasons.

Although appropriate for southern commercial fisheries, the 'Fiche de Pêche' forms provided by M.A.P.A.Q. were unsuitable for this northern fishery. Firstly, a species number for Arctic charr was absent and, secondly, the exclusive French format complicated record-keeping for Inuit who predominantly use English as a second language. In the future, it is hoped that the proponent will record his own fishing effort and catches, but at present this is impossible given the present format of the 'Fiche de Peche'. A new form adapted for local northern use prepared in Inuttitut, English (and French) would be of great value.

During the summers of 1988 and 1989, a portable fish weir will be installed on two Arctic charr systems in eastern Ungava Bay. Both systems (Sapukait and Sanirarsiq) are presently listed as commercial fishing sites. The use of these weirs for the commercial harvest of sea-run Arctic charr has been used in the past (Kristofferson et al., 1986), and should be considered as a possible method for this fishery in the future.

As stated above, a number of factors affecting the experimental commercial fishery would also affect the biological monitoring program. Included amongst these are all the effects of weather (temperature, wind) on travel, location of jigger, equipment failure etc . Those factors which affect the success of the research program are listed in Table 9.

Table 9. Factors affecting the success of the biological research program.

1) Selectivity of gang-mesh net
2) Tag breakage
3) Clubbing of fish heads
4) Fading of tag/sample numbers on labels
5) Poor C.P.U.E.
6) Water depth at Sanirarsiq

In theory, properly-designed gang-mesh nets are the sampling gear used to eliminate the problem of catch selectivity (Hamley, 1975). The gang-mesh nets used during the exploratory fishery at Sanirarsiq proved to be a highly non-selective fishing gear (eg. the length-range of charr caught in the 2.5 cm mesh was 63.5 cm (see Table 6)). As a result, it is questionable whether a true cross-section of the fish population in Sanirarsiq was sampled. Some fish were caught by jigging at Sanirarsiq. Since this method appears moderately selective, it should be considered an additional capture technique during subsequent scientific winter fisheries.

During transport back to the community, 52 tags were broken. Sixteen of these tags which had been placed through the opercular opening were lost and complicated identification of the fish (these were replaced by surplus "replacement" tags provided by M.L.C.P.). The remaining 36 tags (although broken) were frozen in place anterior to the caudal fin and could not be removed. Apparently, extreme cold induced brittleness in the tags which then broke due to rough trail conditions. This however was enhanced by a design feature in the tags (a hole adjacent to the locking closure) intended to reduce the possibility of tampering. The solution is to use a different, more durable design of tag.

To facilitate the removal of thrashing fish from gill nets, they were clubbed on the head to kill them. Unfortunately, this sometimes resulted in massive haemorrhaging which later made the location and extraction of otoliths difficult. When fish were clubbed on the anterior portion of the head, haemorrhaging was reduced . Therefore, care should be taken when striking the fish.

To identify either individual fish heads or fin rays, labels with tag or sample number (written in pencil) were placed into Whirlpack bags. In some cases blood or fat leached from fish, faded the written numbers and subsequently complicated (or in some cases prevented) identification of the number. In the future this problem will be eliminated by using indelible Nalgene felt markers to write on waterproof labels.

Poor C.P.U.E. was experienced in the experimental commercial fishery during January and February, as previously described. Moreover, this also had a significant effect on the expenditures of the monitoring program . Although catches were reduced, payment for fieldwork (including skidoo rental, food purchase, salaries etc.) was still required. C.P.U.E. during the scientific fishery at Sanirarsiq was also low, resulting in more than the predicted number of trips and an inability to attain the desired sample size in a reasonable period of time. The cause of this reduced C.P.U.E. cannot be attributed to low temperatures; it is highly probable the gang-mesh nets were partially responsible. Although the small mesh sizes were found to catch a wide range in fish sizes as a result of entanglement by teeth, it can also be safely assumed that a high percentage of large fish encountering the smaller mesh escaped. As a result, the gang-mesh nets were inefficient as a fishing gear. Thought should be given concerning alternate fishing techniques, including jigging.

At some locations at Sanirarsiq, water depth was extreme (> 40 m) and inapropriate for net placement. This reduced the number of available sites to choose from using the previously-described random process. Being a physical feature of the lake, no recourse is apparent .

SUMMARY

Although the proponent was unable to harvest his assigned quota at 2 systems, and conducted his fishery at only 5 of 12 systems for which he had a commercial permit, he and his fishermen considered the1987-1988 pilot fishery season a success. The proponent cooperated fully with the research team and adhered to all restrictions and conditions identified in his licence; there were no violations of the commercial fishing permit. The unique nature of the fishery and its arctic location was responsible for numerous logistical complications both for the experimental commercial fishery and the biological monitoring program. Key factors have been identified and critical recommendations made with the benefit of hindsight. Certainly the data obtained from this fishery will be invaluable not only from a scientific perspective, but will also provide critical information concerning management of commercial fisheries in freshwater arctic systems.

LITERATURE CITED

Boivin, T.G. 1987. The winter fishery of Kangiqsualujjuaq, Quebec and winter physiology of Arctic charr. MSc thesis, University of Waterloo, Waterloo, Ontario. 174 p.

Hamley, J.M. 1975. Review of gillnet selectivity. Journal of the Fisheries Research Board of Canada 32: 1943-1969.

Kristofferson, A.H., D.K. McGowan and W.J. Ward. 1986. Fish weirs for the commercial harvest of searun Arctic charr in the Northwest Territories. Cnadian Industry Report of Fisheries and Aquatic Sciences # 174. 31 p.

Muller-Wille, L. and Avataq Cultural Institute. 1987. Gazetteer of Inuit Place names in Nunavik (Quebec, Canada). Avataq Cultutral Institute, Inukjuaq, Quebec 368 p.

Nordeng, H. 1961. On the biology of charr (*Salvelinus alpinus* L.) in Salangen, north Norway. 1: Age and spawning frequency determined from scales and otoliths. NYTT Magasin for Zoologi. 10: 67-123. Oslo University Press.

APPENDICES

i) Example of field data sheets

Date: ____________
ᐅᓪᓗᖓ:

Location: ____________
ᓇᓂᓐᓂᖓ:

Time Net Set: ____________
ᖃᑦᓯᐅᕕᑎᓗᒍ ᓄᓗᐃᓂᕐᒪᖔᑦ:

Time Of Check: ____________
ᖃᑦᓯᐅᕕᑎᓗᒍ ᓄᓗᐃᐊᓂᕐᒪᖔᑦ:

Number Caught: ______
ᖃᑦᓯᑦᓯᓂᒪᖔᑕ:

Mesh: ______
ᓯᓪᓗᖓᑕ ᐊᖏᓂᖓ

Length of Net: ______
ᓄᓗᐊᑦ ᑕᑭᓂᖏᑦ:

Depth Set: ______
ᐃᑎᓂᖓ ᓄᓗᐃᐱᐅᖅ:

#	Tag # ᓇᓗᓇᐃᖅᑕᖓᑕ ᑭᓯᐅᑎᖓ	Mesh (mm) ᓯᓗᖓ	Length (cm) ᑕᑭᓂᖓ	Weight (g) ᐅᖁᒪᐃᓐᓂᖓ	Sex M	F	Colour S	R	Mat.	Ol.	Sel.	Comments ᐅᖃᐅᓯᕐᓯᖅᑲᐃᑦ ᐊᓯᖏᓐᓂᑦ

SEL.: X = invalid catch (i.e. caught by teeth or tangled) / otherwise leave BLANK

ii) Example of harvest booklet data sheet.

Date:
ᐅᓪᓗᖓ: ______________

ᓇᓂ ᐃᖃᓗᓯᐅᖅᐱᑦ ᐅᓪᓗᒥ?
Where did you fish today? ______________

ᖃᑦᓯᓂᒃ ᓄᓗᐊᓂᒃ ᐊᑐᖅᐱᑦ ᐅᓪᓗᒥ?
How many nets did you use today? ☐

ᐃᖃᓗᐃᑦ Fish Species	ᓄᓗᐊᓄᑦ Net Catch		Jigging ᐊᐅᓚᓯᖅ	Kakivak or Gaff ᓂᒡᓯᖃᑦᑕᓗᑦ ᑲᑭᕙᒃᑯᓗᓂ
	Good ᓱᒃᑯᓯᒪᙱᑦᑐᑦ	Spoiled ᓱᒃᑯᓯᒪᔪᑦ		
ᐃᖃᓗᒃᐱᑦ Arctic Char				
ᓄᑎᓪᓛᑦ Land Locked Char				
ᐃᓯᐅᕿᓕᒃᑕᖅ Lake Trout				
ᐊᓇᐃᑦ Brook Trout				
ᑲᐱᓯᓕᒃ Whitefish				
ᓴᒪᐃᑦ Atlantic Salmon				
ᖃᓂᒃᑯᖅ/ᑲᓇᔪᐃᑦ Sculpins				
ᐅᒐᐃᑦ Cod Fish				

Have you filled in all the information (date, location, catch)?
ᐊᓪᓚᒋᐊᓕᓕᒪᑦ ᐊᓪᓚᓯᒪᔭᑎᑦ (ᐅᓪᓗᖓ, ᓇᓂᓐᓂᖓ ᐊᒻᒪᓗ ᖃᑦᓯᖁᒪᖓᑦᐱᑦ)?

iii) Example of harvest study questionnaire

Subsistence Questionnaire
ᓇᖕᒥᓂ ᓂᕆᔭᖅᓱᓚᖓᔪᓄᑦ ᐊᐱᖅᓲᑎ

Time Period: ____________
ᖃᖓᐅᓂᖓ:

Hunter: ____________
ᐃᖃᓗᓐᓂᐊᖅᑐᖅ:

Fishing Location: ____________
ᓇᑭᑦ ᐱᔭᐅᒪᖓᑕ:

Fishing Companion(s): ____________
ᐃᖃᓗᓐᓂᐊᖃᑎᖏᑦ:

Nets Used: ____________
ᖃᑦᓯᐅᓂᖏᑦ ᓄᓗᐊᑦ ᐊᑐᖅᑕᐱᓃᑦ:

Days Fishing By Net: ____________
ᖃᑦᓯᓂ ᐅᓪᓗᓂ ᓄᓗᐊᖅᓂᐊᓚᖓᑦ:

Species ᓱᓇᐅᓂᖓ	* Of Fish Caught With Net ᖃᑦᓯᐅᓂᖏᑦ ᓄᓗᐊᓄᑦ ᐱᔭᐱᓃᑦ								
	0	1-10	11-20	21-30	31-40	41-50	51-75	76-100	>100
Arctic Char ᐃᖃᓗᒃᐲᑦ									
Land-Locked Char ᓄᑎᑦᓛᑦ									
Lake Trout ᐃᓯᐅᕿᓕᖅᑖᑦ									
Whitefish ᑳᐱᓯᓖᑦ									
Brook Trout ᐋᓇᐃᑦ									
Salmon ᓴᒪᐃᑦ									

Fish Caught By Jigging: ____________
ᖃᑦᓯᐅᓂᖏᑦ ᐊᐅᓚᓴᐅᑎᒧᑦ ᐱᔭᐱᓃᑦ:

Caught With Kakivak: ____________
ᖃᑦᓯᐅᓂᖏᑦ ᑳᑭᕙᒃᒧᒃ ᐱᔭᐱᓃᑦ: