Operations report of the research on Arctic charr from Lake Sapukkait, eastern Ungava Bay, northern Québec, 1990

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by

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ABSTRACT

A total of 4146 arctic charr were counted at the Lake Sapukkait counting fence in 1990. This number is similar to the counts made at this site in both 1988 and 1989. 4126 charr were measured for fork length, and were examined for the presence of Carlin tags and fin clips. 72% of the 1990 charr run was <50 cm fork length; this was the largest proportion of small fish recorded in the 3 years of operation of the counting fence. The modal ~~size~~ class of migrating charr was 25-30 cm, and the average length of all fish was 38.8 cm. A total of 242 arctic charr <50 cm were randomly selected for biological analyses throughout the course of the study. From recaptures of tagged fish and examination of the state of maturity of migrating charr, it may be concluded that the life cycle of Sapukkait arctic charr is complex; charr appear to make bi-annual or intermittent sea migrations, depending upon spawning frequency. No commercial fishing was attempted at either Lake Sapukkait or Lake Sannirarsiq in 1990. As a result, only 67 charr of commercial size (>50 cm fork length) were sampled in 1990. The failure of the commercial fisherman to organize a harvest in the fall of 1990 had serious implications, not only for the future operation of the fishery, but also for the fulfillment of all aspects of the sampling protocol.

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INTRODUCTION

The arctic charr (*Salvelinus alpinus*) research program in the Kangiqsualujjuaq area has been undertaken since November, 1987, and has provided 3 years of data from both experimental-commercial fisheries in winter and summer fisheries using counting fences. The information collected from these studies has proven to be extremely valuable for increasing our knowledge of this important fish species, and will be useful for developing management strategies for eastern Ungava charr.

The goal of the arctic charr research program in the eastern Ungava region is to determine the optimal allocation of the community's resources between the subsistence, commercial and sport sectors, and to best manage the resources accordingly. The objectives of the Lake Sapukkait research project are:

i) to obtain in-depth biological data regarding population numbers and structure, mortality, life cycle, and migration patterns of a lightly-exploited arctic charr stock in eastern Ungava;
ii) to determine the impacts of controlled commercial fishing on the stock both in the short- and long-term;
iii) to examine the potential of using counting fences for commercial harvest of arctic charr;
iv) to determine the abundance of reproductive stock and juvenile production in the system; and,
v) to use the data collected from the experimental system (Sapukkait) as a model for sustainable management of the charr resources in the eastern Ungava region.

The use of counting fences in eastern Ungava for studying aspects of arctic charr ecology and biology has been very successful; the data collected is valuable not only for improving our understanding of the life history of this species, but also allows for developing accurate harvesting quotas (Boivin and Vandal 1989; Boivin et al. 1990). As a result, this research program has led to the development of weirs as a commercial fishing method; weirs were successfully employed for harvesting arctic charr during the 1989 field season.

This report will discuss the data collected and results obtained at the Lake Sapukkait counting fence in 1990. A detailed discussion of the biology and life history of arctic charr sampled at the counting fence from the 3 years of data collected will be presented in a separate report (Boivin and Roy (in prep.)).

DESCRIPTION OF THE STUDY SITE

Lake Sapukkait (59°28'N, 65°18'W) is situated in north-eastern Ungava Bay, near the mouth of Abloviak (Allurilik) Fjord (Figure 1). The study site is approximately 65 km by plane (100 km by canoe) from the village of Kangiqsualujjuaq. The system consists of a series of 9 overwintering lakes, each connected by a small river; it appears that each lake is accessible to charr for overwintering. The lakes contain a lightly-exploited population of anadromous and land-locked arctic charr, anadromous and resident brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*) and three-spine sticklebacks (*Gasterosteous aculeatus*).

Before 1960, this location was used for subsistence fishing using stone weirs (saputit), but in recent years has received little fishing effort. Since 1988, commercial, subsistence and sport fishing for arctic charr, as well as biological sampling, has been undertaken at this site. Hence, the system is now in a changing state, from virtually unexploited to moderately-exploited.

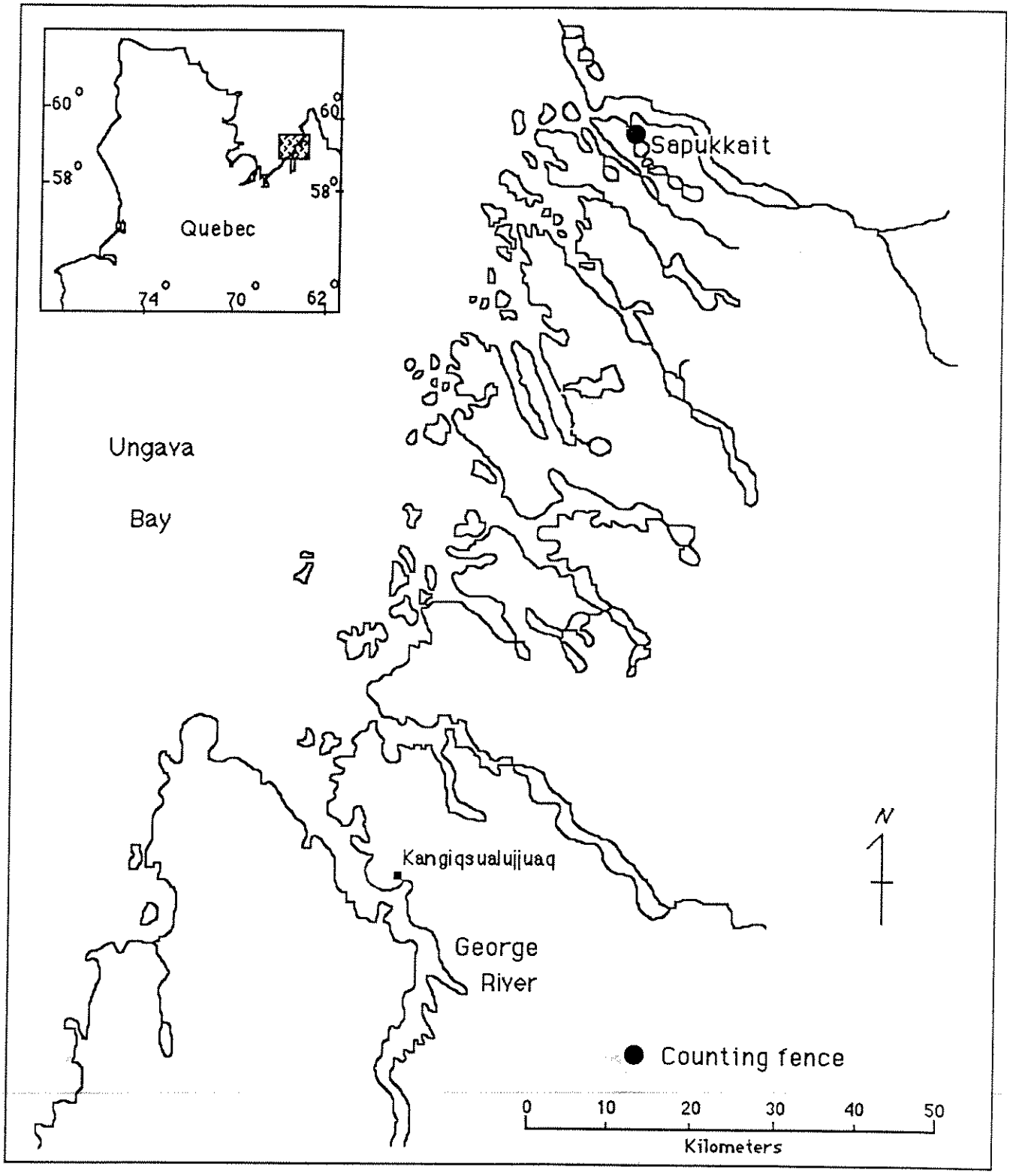

Figure 1. Location of Lake Sapukkait in eastern Ungava Bay, northern Québec.

MATERIALS AND METHODS

A counting fence similar to that employed by Anderson and McDonald (1978) and Caron and Mercier (1987) was installed near the river mouth of the Sapukkait system. A description of the materials used in construction and the method of operation of the counting fences is discussed by Boivin and Vandal (1989).

During the 1990 field season, the upstream movements of arctic charr were monitored between July 24 and September 20, thereby encompassing most of the charr run. The holding cages were checked daily at 0830 and 1500; however, checking times varied slightly during the peak of the migration, depending upon the numbers of charr captured. Captured fish were removed from the holding cage with a dipnet, and then transferred to the holding tank/tagging box for observation of Carlin tags (Carlin 1955) and measurement of length. All fish captured in the trap were counted, fork length was measured ($\pm$ 0.1 cm) and adipose fins of all unmarked fish were clipped. Tags and clips from the 1988 and/or 1989 research were noted, and sex was determined from examination of external characteristics (eg. degree of kype formation and size and shape of head) for all fish. Coloration of charr (red or silver) was noted as a relative index of maturation. The total handling time for each fish was approximately 1 minute.

A random sample of the run <50 cm fork length were selected from the trap throughout the duration of the field season. It was anticipated that charr $\geq$50 cm would be selected in the commercial fishery; however, since no fishery took place in 1990, a directed sample of 77 fish were selected from the trap. All fish kept for biological analyses were sampled for length, whole and eviscerated weight (g), sex, state of maturity (Kesteven (1960), and gonad weight; samples of each gonad was preserved in both Gilsen's liquid and Bouin's solution for later examination to determine fecundity and degree of maturation. Otoliths were extracted for age determination and were later read according to the method of Nordeng (1961).The spellings of all Inuit place names cited in this report are taken from Müller-Wille and Avataq Cultural Institute (1987).

RESULTS

Operation of the counting fence and total numbers of fish sampled

A total of 4,146 arctic charr were counted as they migrated upriver to Lake Sapukkait in 1990. Of the total, 4126 were measured for fork length (Table 1) and were examined for the presence of tags and/or fin clips. As was seen in both 1988 and 1989, less than 5% of the charr run was observed before August 20, 1990, and larger fish dominated the catch until this date. The peak of the run was on September 7th, when 300 charr were counted (Figure 2). The main charr run was characterized by a mix of large and smaller fish, and fish <50 cm predominated during the month of September.

Table 1. Total number of arctic charr counted, measured, and numbers of charr < and ≥50 cm during the 1990 field season at Lake Sapukkait .

Location	N	# measured	# ≥50 cm	# <50 cm
Sapukkait	4146	4126	2992	1134

Biological characteristics of sampled fish

Sapukkait arctic charr which migrated upriver in 1990 averaged 38.8 cm fork length (Table 2). 72.5% of the fish were less than 50 cm fork length; the 1990 run was characterized by an abundance of small fish, with few in the larger size classes. The modal length of charr sampled in 1990 was between 20-25 cm (Figure 3). In both 1988 and 1989, a much larger proportion of fish >50 cm were captured in the trap.

Table 2. Mean fork lengths (cm), including range and Standard error of the mean (SEM), of arctic charr < and ≥50 cm sampled at the Lake Sapukkait counting fence in 1990.

Sample	N	Mean Fork Length	Range	SEM
Fish <50cm	2992	30.7	13.5-49.9	0.19
Fish ≥50 cm	1134	60.0	50.0-77.8	0.19
All Fish	**4126**	**38.8**	**13.5-77.8**	**0.25**

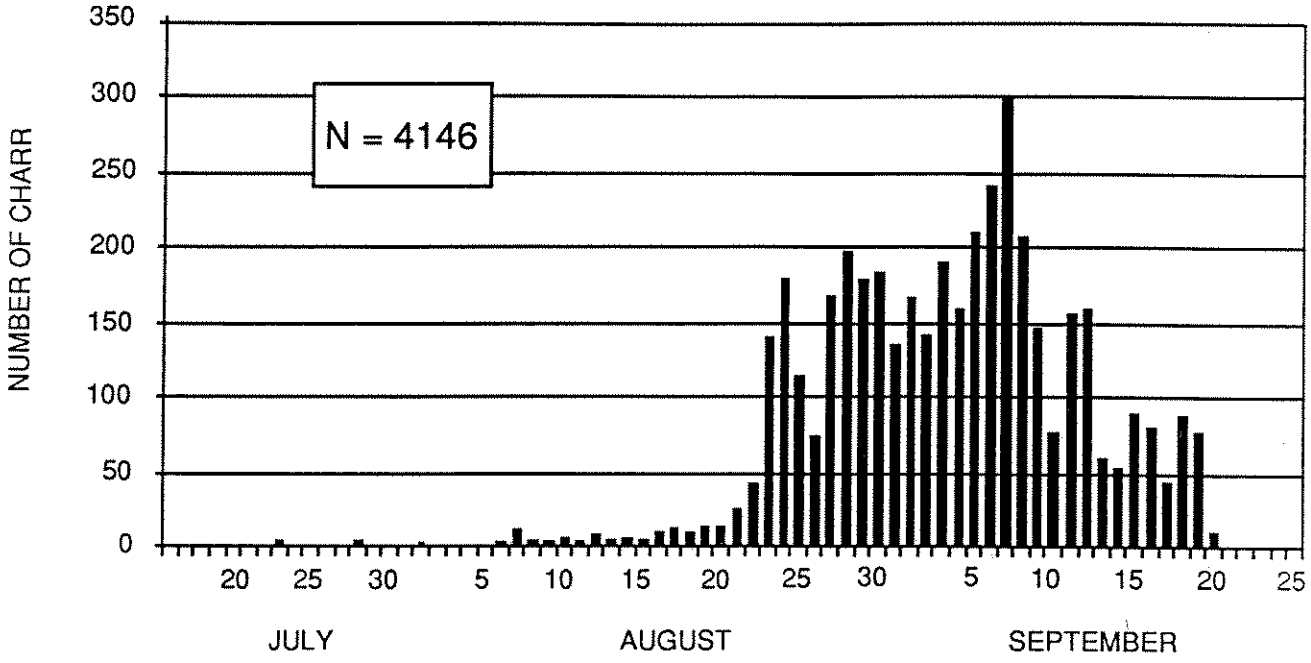

Figure 2. Daily counts of arctic charr at the Sapukkait counting fence, summer 1990

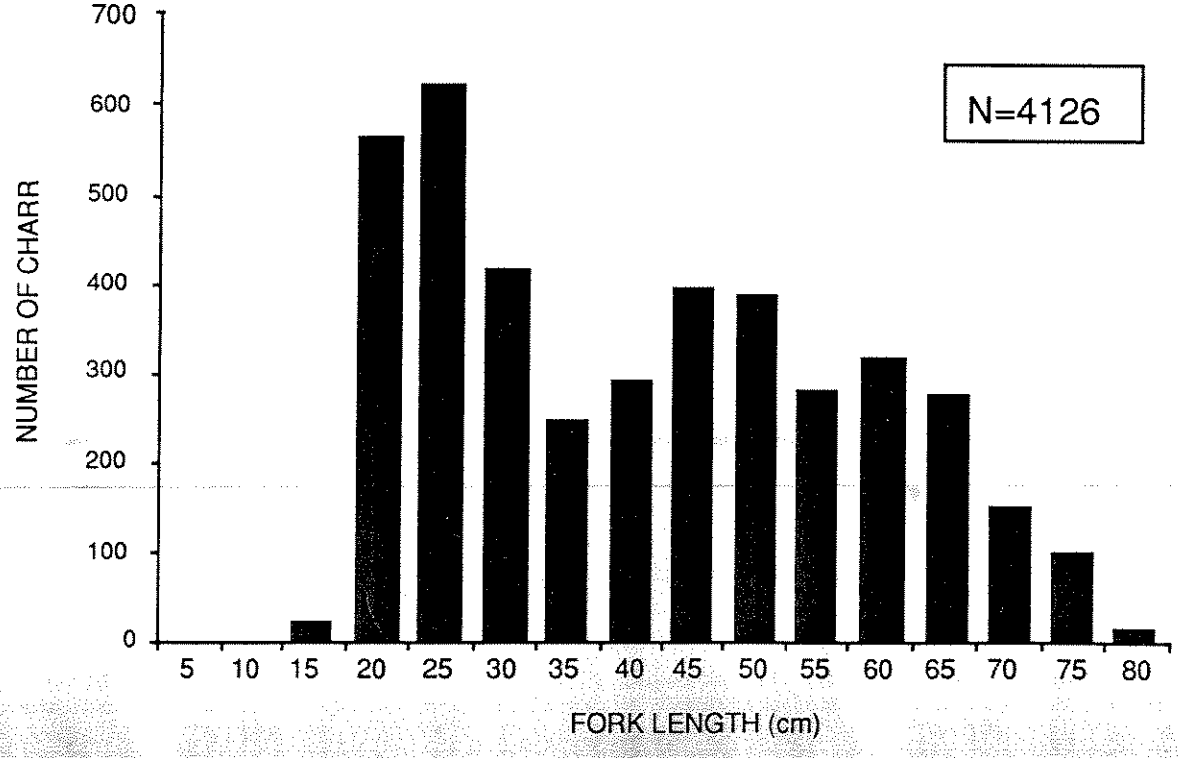

Figure 3. Length-frequency distribution of arctic charr migrating upriver at Sapukkait, 1990

The summary statistics of charr <50cm fork length which were randomly selected throughout the course of the summer study are presented in Table 3. Females were more numerous than males in the sample, and also had a larger average fork length and round weight. The average of all samples combined was 31.9 cm and 507.1 g.

Table 3. Mean fork lengths (cm) and mean round weights (g) of arctic charr randomly selected during the monitoring of the Lake Sapukkait counting fence in 1990. M=Males; F=Females.

			Mean Fork			Mean Round	
Sample	Sex	n	Length	Range	n	Weight	Range
Random	M	104	30.3	14.5-50.5	104	439.9	27-1650
	F	137	33.0	15.5-54.0	136	558.6	34-2050
TOTAL		242	31.9	14.5-54.0	240	507.1	27-2050

Females were also more numerous than males in the directed sample of charr >50 cm fork length (Table 4). However, the average size of males (61.4 cm; 3030 g) was greater than that of the females (59.2 cm; 2572.5 g). The average of all samples combined was 59.3 cm and 2705.5 g.

Table 4. Mean fork lengths (cm) and mean round weights (g) of arctic charr (directed samples) collected during the monitoring of the Lake Sapukkait counting fence in 1990. M=Males; F=Females.

			Mean Fork			Mean Round	
Sample	Sex	n	Length	Range	n	Weight	Range
Directed	M	26	61.4	50.1-75.8	25	3030.0	1450-5300
	F	41	59.2	51.7-66.5	40	2572.5	1500-3350
TOTAL		77	59.3	16.9-75.8	75	2705.5	54-5300

Distribution by sex and maturity

Of the 239 charr <50 cm which were randomly sampled at the counting fence in 1990, only 2 were potential spawners (Kesteven (1960) classification 4 or greater) (Table 5). Of all directed samples (Table 6) only 2/67 (3%) of larger fish (≥50 cm) sampled at Sapukkait were in spawning condition in the fall of 1990.

Table 5. Maturity of arctic charr randomly selected at the Lake Sapukkait counting fence in 1990. Maturity determined according to Kesteven (1960).

	# Arctic charr in each Maturity Class (Kesteven 1960)							
Sample	1	2	3	4	5	6	7	Total
Random								
Males	72	31	0	0	0	0	0	103
Females	62	31	41	1	0	1	0	136
TOTAL	134	62	41	1	0	1	0	239

Table 6. Maturity of arctic charr (directed samples) selected at the Lake Sapukkait counting fence in 1990. Maturity determined according to Kesteven (1960).

	# Arctic charr in each Maturity Class (Kesteven 1960)							
Sample	1	2	3	4	5	6	7	Total
Directed								
Males	0	14	11	1	0	0	0	26
Females	0	0	40	0	1	0	0	41
TOTAL	0	14	51	1	1	0	0	67

Discussion and Recommendations

i) Biological information

The upstream migration of charr in eastern Ungava occurs between mid-July and late September, similar to the dates reported in the Cambridge Bay area, N.W.T. (Johnson 1980) and in northern Labrador (Dempson and Green 1985). As was seen in both previous years, the peak of the charr run occurred in late August in 1990. Before August 20th, less than 5% of the total charr run enters the river; after this date, the numbers migrating increase rapidly to a peak in early September. The minumum length of smolts returning from their first sea migration is 15 cm fork length, and few fish in the population appear to be greater than 80 cm.

The length-frequency distribution of the 1990 charr run at Sapukkait was quite different from what was observed in 1988 and 1989. In 1988, the run appeared to have a bi-modal length distribution, with modes at both 30 and 60 cm fork length (Boivin and Vandal 1989); this type of distribution is similar to that observed in other studies of lightly-exploited or unexploited stocks in the North-West Territories (Johnson 1980). In 1989, the length distribution of the Sapukkait run was unimodal, but a mode at 60 cm was still apparent (Boivin and Roy, unpub. data). The 1990 data indicate a strong recruitment of first- and second-year smolts into the population, with the mode of the entire run at 25 cm; larger fish were much fewer in number in 1990 than in previous years.

Possible explanations for such changes in the length distribution include the presence of the commercial fishery in 1989 (which removed 601 charr from the larger size classes), changes in recruitment of the younger size classes between years, and natural fluctuations in the charr life cycle (bi-annual spawning migrations, and movement of charr between systems). From tag recaptures at the fence in 1989 and 1990, it appears that Sapukkait charr exhibit a complex life-history pattern whereby sea migrations are made on a bi-annual or intermittent basis. Furthermore, Sapukkait charr also appear to overwinter at different systems in some years; thus far, 2 tagged fish have been recaptured in other systems (1 while attempting to migrate to Lake Napaartulik in September 1989, and another during the winter fishery at Koroc River in December, 1990).

Few of the fish migrating upriver at Lake Sapukkait in the summer and fall were potential spawners in 1990. Samples of charr collected in the overwintering lakes in July, 1989, at Lake Sapukkait indicated that most (73%) were ready to spawn in the fall (Boivin and Roy unpub. data). Therefore, the collection of data on spawning fish (including fecundity and degree of development of the ovaries) must be undertaken on the lake system itself; the low numbers of fish in spawning condition sampled at the weir is insufficient to determine the spawning potential for this stock. It is recommended that a separate study of spawning charr be conducted on the overwintering lakes during the fall of 1991 to collect this information.

ii) Commercial fishery

No commercial fishing was attempted at either Lake Sapukkait or Lake Sannirarsiq in 1990; this was due to the failure of the commercial proponent to organize and operate the weir fishery. According to the promotor, the main reasons no fishery was undertaken was due to the lack of available freezer facilities in Kangiqsualujjuaq and the high cost of renting the community boat for transporting the catch from the harvest site.

The installation and operation of the Sannirarsiq counting fence was the exclusive responsibility of the proponent; since no fishery was undertaken, no data was collected from this site in 1990. Furthermore, the absence of the fishery at Sapukkait also affected our research team's ability to collect biological information on fish $\geq$50 cm fork length (the minimum commercial size). As a result, we were only able to collect a small sample (N=77) of charr from this size range, and therefore did not obtain the necessary information as was outlined in the research protocol.

It is essential that the proponent better coordinate his commercial fishing operation in the future, and that he make the necessary arrangements to ensure that freezing facilities and transportation are better organized for the 1991 fishing season.

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