THE KOKSOAK RIVER FISHERY

FINAL REPORT

1998

Report presented to:
Kuujjuamiut Incorporated
and the
Community of Kuujjuaq

D.W. Doidge and A.H. Gordon
Makivik Corporation
Renewable Resources Development Department
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Société Makivik

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PREFACE

This report summaries the results of the Koksoak River Fish Study in 1998. These include basic biological data from the harvested species (length and weight), estimates of the number of fishermen, and the size and composition of the subsistence catch. Problems associated with these estimations are discussed. A review of the salmon fishery, between 1982 and 1995, has been completed and is presented in a separate report (Robitaille et al., 1998). A similar synthesis of the time-series of data for the other fish species is planned for the Summer/Fall of 1999.

RESEARCH PERSONNEL

Field work:	Alix H. Gordon Sandy Suppa Peter May Chesley Mesher Alec Gordon Bill Doidge Michael Kwan Barrie Ford William Saunders Paul Mesher
Laboratory and Data Analysis:	Bill Doidge Alix H. Gordon Deirdre Greene Peter May Chesley Mesher Sandy Suppa Michael Kwan Barrie Ford Daniel Leclair Taqralik Partridge

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1.0 INTRODUCTION

The Koksoak River is a source of country food for the Inuit of Kuujjuaq. The subsistence harvest of fish is substantial (J.B.N.Q.N.H.R.C. 1982), and constitutes a major component of the local subsistence economy during summer. The James Bay and Northern Quebec Agreement (J.B.N.Q.A. 1975) guarantees that fisheries on the Koksoak River will not be detrimentally affected by hydro-electric development of the Caniapiscau River diversion. In keeping with this guarantee, the Caniapiscau-Koksoak Joint Study Group initiated a monitoring study in 1977 (five years preceding completion of the diversion) to obtain a data base on the fishery prior to changes in river flow. Under the Kuujjuaq Agreement of 1988, responsibility for the Koksoak River fisheries research project was transferred to Kuujjuamiut Incorporated. Since that time Kuujjuamiut has contracted the Nunavik Research Centre of Makivik Corporation to undertake basic monitoring of the biology and harvest of the fish species harvested from the Koksoak.

Each year, data have been collected to document post-diversion harvest levels in the Koksoak fishery. Currently in its eighteenth post-diversion year (1998), the study addresses two aspects of the fishery:

i) Harvest: number of fish caught (by species) and catch per unit of fishing effort (C.P.U.E.);

ii) Biology: biological characteristics of the harvested species.

The objective of collecting harvest data before and after diversion is to evaluate the impacts (if any) on the quantity of fish harvested by Kuujjuaq Inuit for subsistence and commercial purposes. Collection of fishing effort data allows comparisons of average fishing success over successive years.

The objective of collecting biological data is to determine whether population dynamics and species composition have been affected by changes in the flow of the Caniapiscau River. Based on poor returns of sea-run salmon in 1997, the commercial fishery for salmon was closed.

In the event that declines in harvest levels, fishing success or changes in population dynamics were evident (and were related to the Caniapiscau Diversion), the existing data base may be used as documented information to compensate fishermen as per the Kuujjuaq Agreement (1988).

1.1 FISH SPECIES HARVESTED

The fish species captured by the Inuit of Kuujjuaq, in decreasing order of importance are: Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*) and whitefish (*Coregonus clupeaformis* and *Prosopium cylindraceum*), lake trout (*Salvelinus namaycush*) and sculpins (*Myoxocephalus scorpius* , *M. quadricornis* and *Gymnocanthus tricuspis*). Arctic char (*Salvelinus alpinus*), northern pike (*Esox lucius*) and suckers (*Catostomus catostomus* and *C. commersoni*) are also harvested (Dumas et al., 1985).

In the Koksoak River system, Atlantic salmon are caught for subsistence and sport in the lower part of the river. An outfitting camp for salmon fishing operates on the Delay River, near the spawning grounds. A commercial fishery had been directed at sea-run salmon, but also included big estuarine salmon and a small number of kelts. However, due to low returns of sea-run fish the commercial fishery has been closed.

The sea-run salmon fishery takes place along two main sections of the Koksoak: the river area near the community of Kuujjuaq (subsistence fishermen) and the stretch of river between Nuvukallak and the river mouth (formerly used by commercial fishermen). With the advent of increased license fees for fishing permits on Category I land for non-beneficiary fishermen, most sport fishing is now directed upriver near the confluence of the Caniapiscau and Larch rivers and at Manitou Gorge.

Large numbers of brook trout are harvested annually from the Koksoak River; gillnet and fishing rod are the main methods by which this species is captured. Brook trout fishing is most intensive during June and July. Substantial numbers of whitefish are harvested concurrently with brook trout; however, whitefish are caught by gillnet only. Of the two species of whitefish harvested for subsistence use, lake whitefish are the most numerous.

Few of the arctic charr harvested by the community are from the Koksoak River. Most are taken from other stocks, including Dry Bay, and from systems near both Tasiujaq and Kangiqsualujjuaq. Although a series of lakes drain into Dry Bay, none appear to be accessible to charr for over-wintering. This suggests that these charr migrate to Dry Bay for summer feeding, and then return to other systems to over-winter; however, some Inuit fishermen have reported that charr are present in this area immediately after spring break-up of ice and remain until the fall (Dumas, 1990).

Small numbers of lake trout are caught in the Koksoak River. They are harvested mainly up-river, and occasionally in the estuary. Most of the community harvest of this species originates from inland lakes near the community, a fishery which is not monitored by the Koksoak Fish study.

Sculpins are caught by net, but most are usually taken by rod or by jigging at specific locations in the Koksoak estuary. They are caught during high tide, close to the shore at deep escarpments. Sculpins are abundant in the middle of the summer but are most often caught in the fall (late August and early September)

when females are fat and full of eggs. Of the three species of sculpin harvested, the shorthorn sculpin dominates the catch.

Other species, which are a by-catch of the salmon, brook trout and whitefish fisheries, are suckers, northern pike and burbot.

2.0 METHODS

Since 1982 a system of booklets and/or questionnaires has been used to estimate the harvest level and the fishing effort of the Koksoak subsistence fishery. In June, 1998, booklets were distributed to 126 fishermen in Kuujjuaq. Using these booklets, each person was asked to keep a daily record of their gillnet and rod catch by species, the number of nets or fishing rods used and fishing location. To increase participation a prize was offered through a raffle for fishermen who filled in booklets.

The catches reported in the booklets are divided by fish species and by fishing method (gillnet or rod). The method used by Kaminski and Gordon (1994) in the 1993 report are thought to overestimate the catch; they assumed that all fishermen who did not return booklets fished. However, since some fishermen who returned booklets did not fish, it is reasonable to expect that some fishermen who did not return booklets also did not fish. The harvest success of the fishermen who completed booklets was used to estimate the harvest of the other fishermen. We consider this method less biased than the others used previously (Dumas et al. 1984, Doidge et al. 1992, Kaminski and Gordon 1993, 1994). However, this method may over-estimate the number of fishermen if the proportion of people not fishing is not the same in the general population as in our sample.

No attempt is made to differentiate between the harvests of the two species of whitefish. The harvests of these two species have been pooled. The same applies to the three species of sculpin harvested in the Koksoak estuary.

The methods used to collect biological data follows Dumas et al. (1984). Most samples were collected in the estuary, between the first rapids upriver from Kuujjuaq and the river mouth. In 1998, field sampling started in June and concluded in November.

Biological data collected from fish species of the Koksoak River in 1998 included:

i) fork length (0.5 cm);
ii) whole weight (0.1 kg);
iii) gender
iv) age (from scales or otoliths);

Ages of Atlantic salmon were determined from scales according to the methods outlined in Power (1969) and Dumas et al. (1984). Coregonid scale circuli

patterns were read as described by Hogman (1968), and brook trout otoliths according to the methodology described by Dutil and Power (1977).

3.0 RESULTS AND DISCUSSION

3.1.0 Characteristics of the species sampled

3.1.1 Size

The size (fork length) of the brook trout and whitefish sampled in the last 5 years varies little year to year (Table 1). Brook trout and whitefish weights vary year to year. Whitefish weights are heavier in the past 3 years (1996 -1998) compared to the previous two (1994, 1995). Salmon length has been more or less stable over the last 3 years (Table 1), however weight is more variable (Table 2)

Table 1. Average length (cm) of fish sampled between 1994 -1998.

	Year				
Species	1998	1997	1996	1995	1994
Brook trout	39.9 ± 6.6 (276)	40.0 ± 7.2 (295)	40.1 ± 6.9 (210)	37.4 ± 6.4 (207)	37.9 ± 5.7 (183)
Salmon	61.9 ± 10.7 (67)	61.8 ± 16.1 (133)	64.4 ± 37.7 (241)	52.5 ± 21.1 (240)	64.1± 16.4 (250)
Whitefish	38.4 ± 5.4 (72)	38.7 ± 7.5 (273)	38.6 ± 5.4 (227)	36.6 ± 5.2 (92)	36.6 ± 6.7 (168)

Table 2. Average weight (kg) of fish sampled between 1994 -1998.

	Year				
Species	1998	1997	1996	1995	1994
Brook trout	0.74 ± 0.34 (274)	0.66 ± 0.35 (295)	0.79 ± 0.40 (209)	0.62 ± 0.35 (206)	0.67 ± 0.31 (183)
Salmon	2.90 ± 1.49 (68)	3.26 ± 0.17 (148)	2.86 ± 1.40 (240)	2.32 ± 2.10 (239)	3.22± 2.22 (248)
Whitefish	0.80 ± 0.51 (73)	0.76 ± 0.49 (272)	0.84 ± 0.43 (226)	0.70 ± 0.38 (92)	0.70 ± 0.43 (167)

The length frequencies of the primary species are shown in Figure 1. Brook trout 45 cm long and whitefish of 40 cm long are the most numerous in the catch. Several years ago, the length frequency of salmon was multi-modal representing a mixture of sea-run, mixed growth and estuarine fish. However, since 1996 only one mode is present which reflects the absence of large, i.e. sea-run, fish in the sample.

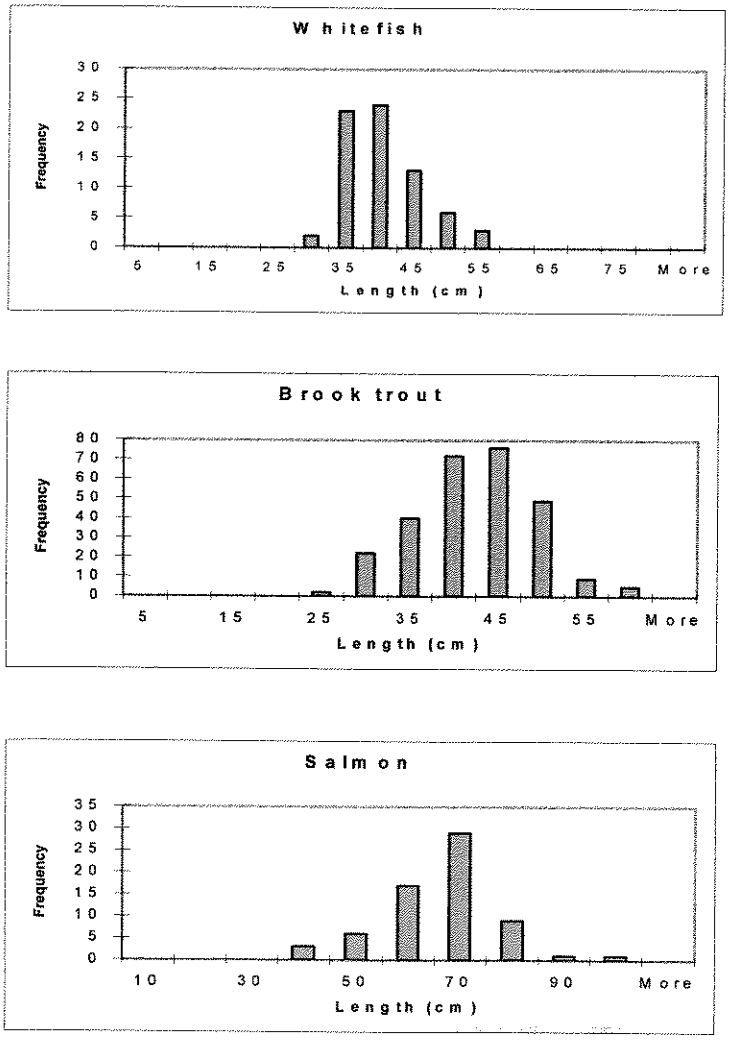

Figure 1. Length frequencies of the primary species caught in the Koksoak River, 1998

Weight frequencies are show in Figure 2. Several growth-types of salmon are represented in the salmon weight frequency graph. Estuarine fish and kelts are represented in the first peak at 2000 grams; the next peak represents one-year-at-sea fish; there are few two-year-at-sea fish in the sample (eg 5000 grams plus).

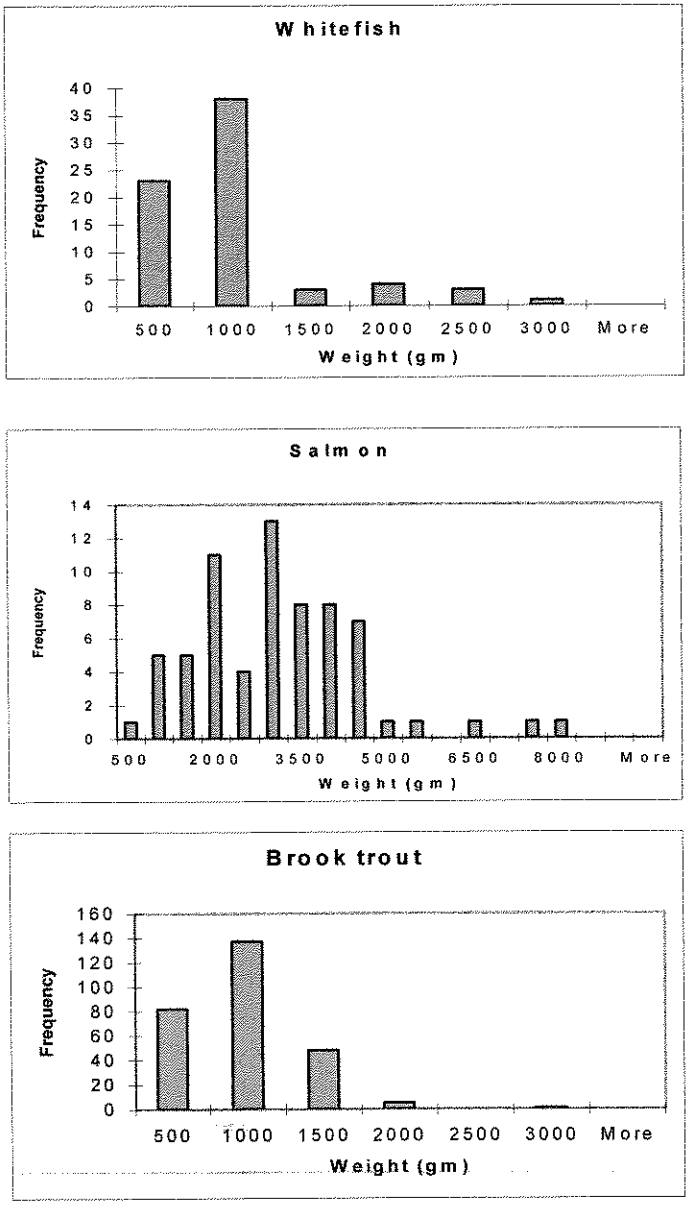

Figure 2. Weight frequencies of the primary species caught in the Koksoak River, 1998

3.1.2 Age

Whitefish, 5 years and older, and Brook Trout 4 years and older are the main basis of the catch. Because spawning-marks in the scales of Atlantic salmon obscure their true age, salmon age data is not presented. However, the scales are used to determine the type of salmon caught (See Section 3.1.3)

Figure 3. Age frequencies of whitefish and brook trout caught in the Koksoak River, 1998.

3.1.3 Composition of the salmon catch

Based on the 1,308 salmon recorded by booklet fishermen 37% of the salmon catch were classified as sea-run (12% large sea-run *Samatuinnak*, 25% smaller sea-run *Samakudluk*), 27% as estuarine fish *Samaaruk*, 27% as kelts *Samakotak* and 9% as smolts *Samaruaapik* (Fig. 4). This is similar to the 1997 classification (Doidge and Gordon 1998). Note that booklet fishermen tend to not always differentiate 1 year-at-sea fish and estuarine fish because of their similar size (Robitaille et al 1998).

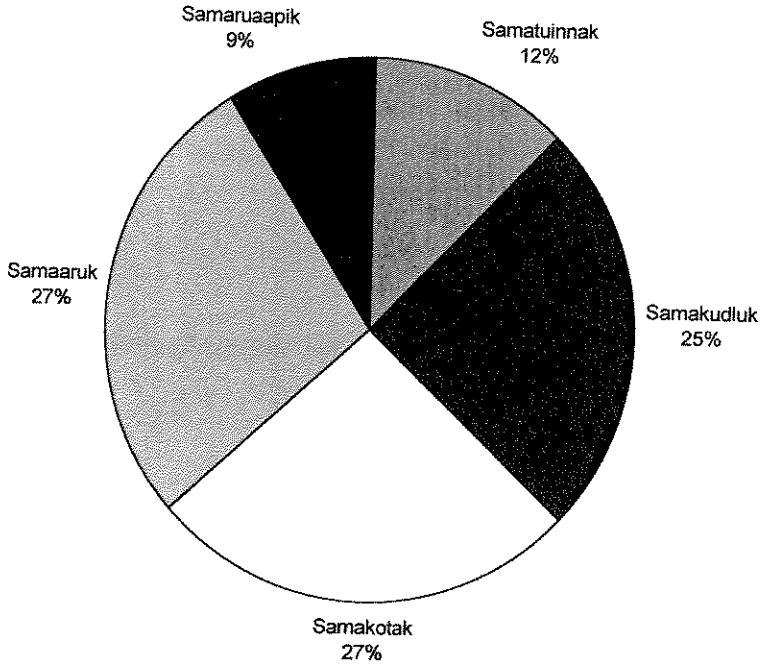

Figure 4. Catch composition of salmon catch as classified by `Booklet` fishermen

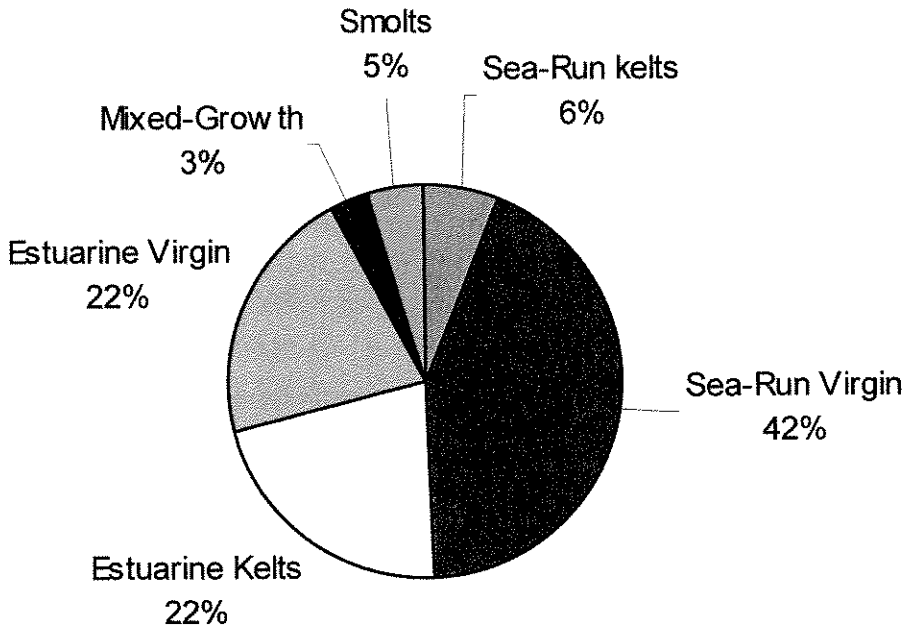

Figure 5. Classification of salmon growth-type based on interpretation of scales.

Examination of 65 salmon scales under the microscope showed the following composition: 42% (28) were virgin sea-run, 6% (4) were sea-run kelts, 3% (2) showed mixed-growth (both estuarine and sea habitat), 22% (14) were estuarine virgin, 22% (14) were estuarine kelts and 5% (3) were smolts (Fig. 5). Of the sea-run fish, only 7% (2/28) were 2-year sea-fish. These 2-year sea-fish are mostly large females responsible for recruitment (Robitaille et al 1998).

3.2.0 Harvest Study

3.2.1 Number of active fishermen

In 1998, 126 booklets were distributed to potential fishermen in Kuujjuaq. Forty-nine (49) of these booklets were returned; 77 were not. Of those returned, 43 booklets reported fishing activity; 6 persons reported that they did not fish. Assuming that the same proportion of persons that fished versus did not fish exists in the group of 77 people who did not return booklets, 68 would be expected to have fished and 9 not to have fished. The estimated number of active fishermen in 1998 is 111 (43 + 68).

There are two assumptions which influence this estimate:

1. the proportion of persons that fished versus did not fish is the same for people who returned booklets and those that didn't.
2. all people who fish receive booklets.

3.2.2 The catch

Table 3 summaries the subsistence catch from the Koksoak River in 1998 (See Section 3.2.4 for the method used). The estimated catch of Atlantic salmon was 3,363 fish, representing a total biomass of 9,754 ± 5,011 kg. The biomass of salmon cannot be estimated precisely because the weights of salmon were very variable in 1998. Brook trout is the next important by weight; 6,863 fish were landed weighing a total of 5,079 kg. Almost 4 metric tons (3,838 kg) of whitefish were caught.

The estimates for total catch and biomass are greater than in for 1997: 11,684 vs 15,024 fish caught; 14,152kg vs 18,671kg landed. It is not possible to estimate the error in these estimates precisely. The precision of the total catch depends in part on how many fishermen participate in the study; the greater the participation, the better the estimate. Similarly, the estimate for biomass is improved as the number of fished weighed is increased. In 1998, the number of salmon examined by field workers and NRC staff was less than half the usual number (See Table 2 for comparison of years).This is in part due to the apparently poor run of 2 year-at-sea fish. Methods of improving the estimates for catch and biomass will be investigated by NRC staff this summer.

The species contribution to the total biomass of fish caught is similar to 1997: half of the biomass is Atlantic salmon (52%), followed in importance by brook trout (27%) and whitefish (21%).

Nets were used to catch all of the whitefish, and most of the salmon (92%). In 1998, a greater proportion of brook trout were caught by rod compared to in 1997 (62% vs 46%).

Table 3. Numbers, percentage by gear type, and biomass of fish caught in the subsistence harvest, Koksoak River, 1998

Species	Estimated Catch	By Rod %	By Net %	Biomass (kg)
Brook trout	6,863	62	38	5,079
Salmon	3,363	8	92	9,754
Whitefish	4,798	0	100	3,838
TOTAL	15,024	-	-	18,671

3.2.3 Catch per unit effort

All 43 fishermen who completed booklets reported the type of gear they used. A total of 468 net days and 467 rod days of fishing-effort was recorded. In 1998, fishing-effort with nets peaked in July (Fig. 4), which is the pattern seen in 1995 and 1996. In 1997, net-effort showed an earlier peak (in July) probably due to the fishermen's response to a poor run of sea-salmon (Doidge and Gordon 1998). Rod-days are constant in June and July then gradually declined throughout the summer and fall (Fig. 4).

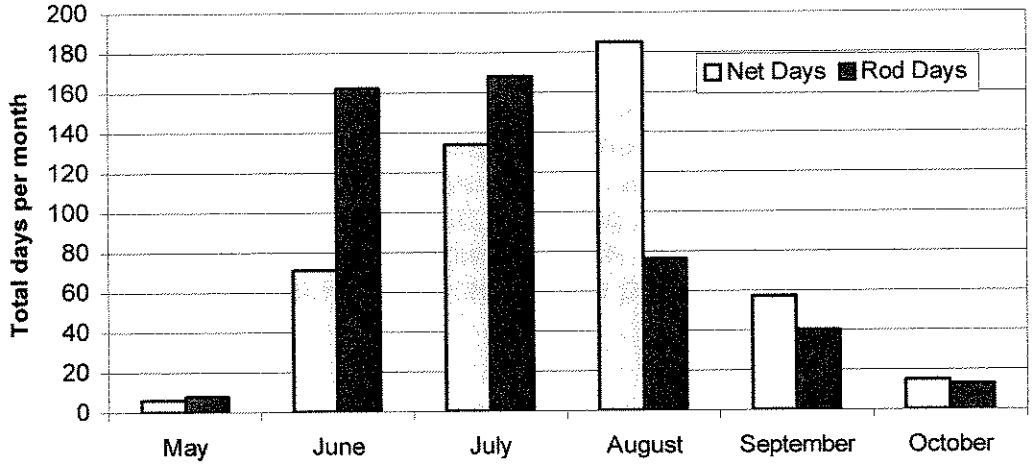

Figure 4. Monthly total days fishing by net and rod, Koksoak River 1998

The CPUE of whitefish continues to increase and has surpassed the previous high logged in 1994; it is now 3+ fish-per-net/day. The catch-per-unit-effort of brook trout has changed little since 1995 at 2 fish per-net/day; the CPUE of salmon continues to fluctuate; it is up from 1997, being intermediate between 1995 and 1996 levels (Table 4).

Table 4. Catch-per-unit-effort (CPUE) for fish species harvested, 1993 - 1998.

		Reported Catch by Net			Fish per net day (CPUE)		
Year	Net days	Salmon	Brook trout	White fish	Salmon	Brook trout	White fish
1993	432	568	692	629	1.31	1.60	1.46
1994	280	649	669	867	2.32	2.39	3.10
1995	630	1,532	1,354	1,108	2.43	2.14	1.76
1996	499	1,430	1,067	1,306	2.87	2.14	2.62
1997	536	1,085	1,584	1,939	2.02	1.99	3.62
1998	468	1,198	1,008	1,866	2.56	2.07	3.84

3.2.4 Trends in the reported salmon catch

The estimated harvest for salmon in the Koksoak subsistence fishery for 1998 is 3,363 fish. The calculations used to estimate the Atlantic salmon catch for the period 1991 to 1998 are presented in Table 5. The subsistence harvest of salmon is similar to that of 1996, following a low in 1997 (Table 5, Column J). The estimated number of people who fish shows a general increase over the years (Column H) which is expected as the population of Kuujjuaq grows.

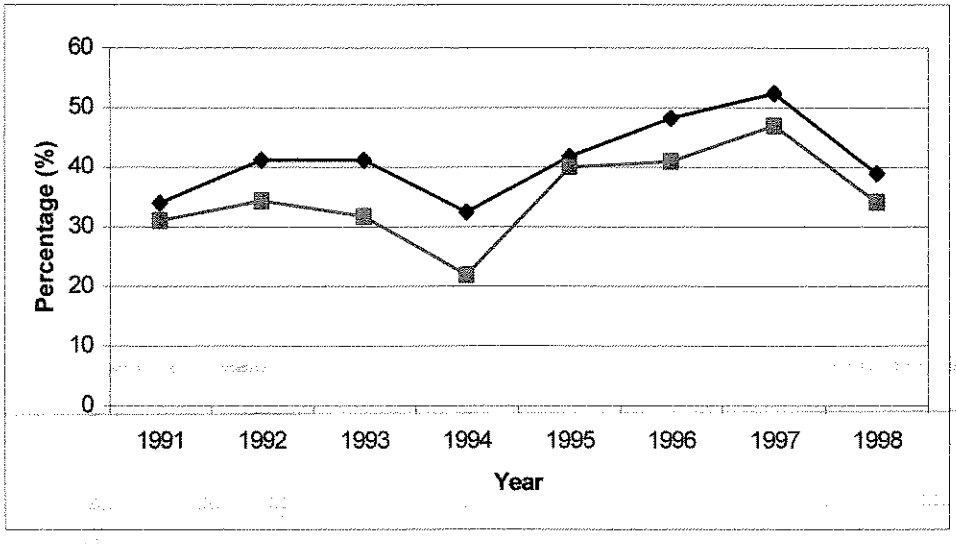

Figure 5. Fate of booklets 1991-1998: % returned (diamonds) vs % reporting fishing activity (squares).

The number and proportion of fishermen who return booklets declined in 1998, following an increasing trend since 1994 (Fig. 5, Table 5), when a raffle was initiated for participating fishermen. This may be due to a drop of interest in the study due to the apparent lack of large (2 year) sea-run salmon. Efforts are being made in 1999 to increase awareness of, and participation in the Koksoak Fish Study.

Table 5. Estimation of harvest of salmon, caught for subsistence purposes, on the Koksoak River 1991-1998

A	B	C	D	E
Year	Booklets distributed	Booklet fishermen who didn't fish	Booklets not returned	Salmon catch of booklet fishermen
1998	126	6	77	1308
1997	130	7	62	1220
1996	110	8	57	1,525
1995	110	2	64	1,703
1994	114	12	77	774
1993	107	10	63	696
1992	102	7	60	912
1991	103	3	68	819

	F=B-C-D	G=(D)(C/(F+C))	H=F+D-G	I=E/F	J=(H)(I)
Year	Booklet fishermen who fished	Fishermen who didn't fish & didn't return booklet	Total number fishermen who fished	Salmon per booklet fishermen	Estimated salmon harvest
1998	43	9	111	30.4	3,363
1997	61	6	117	20.0	2,332
1996	45	9	93	33.89	3,165
1995	44	3	105	38.70	4,072
1994	25	25	77	30.96	2,385
1993	34	14	83	20.47	1,693
1992	35	10	85	26.08	2,215
1991	32	6	94	25.59	2,410

The average catch of salmon per booklet fisherman recovered to 30.4 fish (similar to 1996 values) following the sharp drop to 20.0 fish which occurred in 1997 (Table 5, Column I). The average catch of salmon per net day has also increased from 1997 to be intermediate between 1996 and 1995 values (Table 4).

3.2.5 Commercial Harvest of Salmon

The commercial quota for Atlantic salmon for the Koksoak in 1998 was closed in 1998 following the poor salmon catch in the Koksoak River in 1997. This decline is widespread; there has been a general decline in sea-run fish in rivers on the eastern side of the North Atlantic (Robitaille et al. 1998)

3.3 Review of mercury levels in fish 1988-1997

Mercury content in the flesh from fish caught on the Koksoak has been monitored since 1988. A review of the existing data for fish on the Koksoak River is now complete. Mercury levels in the flesh of Atlantic salmon, Brook trout and Whitefish are well below the Health Canada guidelines of 0.2ug/g set for fish from a subsistence fishery. The level of mercury is above the guides for sculpin and burbot, however, since these species are consumed on an occassional (seasonal) basis, it is not a health concern. The level of mercury increases in Lake Trout with age, therefore some restriction in the amount of lake trout (especially large fish) may be called for. A more detailed analysis and discussion of mercury levels in Koksoak fish is contained in Kwan (1999).

4.0 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

Another successful program of data collection was completed in 1998 by participating fishermen and field-workers in the fishing camps. The number of fishermen filling in booklets has decreased after an increasing trend of the previous 5 years. Therefore, more effort is needed to increase community participation – this is the goal for the 1999 study.

A full-time fisheries biologist will be joining the NRC staff this summer. He will be working with other staff and personnel from MEF to complete a review of the existing data (1982 to present) for brook trout and whitefish. Part of the review will entail assessing the procedures used in the Koksoak Fish Study. The report will be similar to the one completed on salmon by Robitaille et al (1998).

While the catch rate of whitefish has increased and that of brook trout remains stable, the CPUE of salmon continues to fluctuate. The estimate of average weight of salmon exhibited a high variance, indicating less certainty can be placed on the value of the average salmon weight. This may, in part be due to the relatively small number of fish sampled. Whitefish and brook trout weights are within the range of values found in previous years. The total estimated harvested-weight of the three species combined has increased to 18,671 kg.

A separate report, which summarizes mercury analyses of fish sampled since 1988, has been prepared by Nunavik Research Centre staff. The mercury concentration in salmon, whitefish and brook trout, lie within the limits set by Health and Welfare Canada. Persons interested in more information on the acceptable amount of fish to be safely consumed should contact the Nunavik Health Board.

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