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Assessment of Voisey Bay, Anaktalik Bay, and Okak Bay Arctic charr stocks in 1983 and projections for 1984

by

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Abstract

Using a method developed to account for the additional exploitation of the Anaktalik Bay Arctic charr stock in offshore fishing areas, cohort analyses were performed on adjusted catch at age data from 1977-83. Stock projections using population numbers generated from a terminal fishing mortality of 0.2 for Anaktalik Bay and 0.5 for Okak Bay indicated an $F_{0.1}$ yield in 1984 of 8 t and 27 t for the two stocks respectively. Owing to the low catch in Voisey Bay in 1983 and the problem of not being able to account for Voisey Bay charr losses in the Antons area, it was decided that there was insufficient new information to recommend a TAC different from the 16 t quota of 1983.

Résumé

A l'aide d'une méthode mise au point pour prendre en considération l'exploitation supplémentaire dont est l'objet la population d'omble chevalier de la baie Anaktalik dans les zones de pêche au large, des analyses de cohorte ont été effectuées sur des données revisées des prises par âge de 1977 à 1983. Des projections de stock effectuées à partir des chiffres de population obtenus par une mortalité par pêche de dernière année de 0,2 pour la baie Anaktalik et de 0,5 pour la baie Okak révélaient un rendement à $F_{0.1}$ en 1984 de 8 t et de 27 t pour les deux stocks respectivement. En raison de la faiblesse des prises dans la baie Voisey en 1983 et de l'incapacité de prendre en considération les pertes d'omble chevalier de la baie Voisey dans la région de Antons, on en est venu à la conclusion qu'on ne disposait pas d'information nouvelle suffisante pour recommander un TPA différent du contingent de 16 t de 1983.

Introduction

Catch statistics from the Arctic charr fishery in Voisey Bay, Anaktalik Bay, and Okak Bay (Fig. 1) have been available since 1974. Quotas have been applied to Voisey Bay and Anaktalik Bay catches since 1979 and Okak Bay catches since 1981 (Dempson and LeDrew, 1982). Quotas were obtained in Voisey Bay in 1979 and 1981 and in Anaktalik Bay in 1981 and 1982. The 1983 quotas of 16 t and 11 t for Voisey and Anaktalik Bay respectively were not reached but the Okak Bay quota of 21 t was surpassed. The expansion of the northern Labrador Arctic charr fishery into the Hebron-Saglek region in 1981-82 resulted in a redistribution of fishing effort away from these areas. Increased catch per unit effort for Arctic charr in offshore fishing areas suggests increased movement out of the inner bay areas in recent years.

This paper examines the results of the 1983 fishery and provides an outlook for 1984.

Catch and effort data

Landings of Arctic charr from 1974-83 are summarized in Table 1. Catches in 1983 from Voisey Bay and Anaktalik Bay were very low. Fishermen, anticipating a fishery in the Hebron-Saglek region, were reluctant to devote themselves to a fishery in the Voisey-Anaktalik area until it was confirmed that the northern fishery would not occur. The increased catch per unit effort of charr in the offshore areas suggests that by early-mid July many charr had moved into offshore areas. As a result, catches from these two areas were the lowest or second lowest on record as were the catch per unit effort estimates.

The Okak Bay catch of 31 t was back at levels attained in 1977-79. The decreased effort in 1981 and 1982 was largely the result of the expanded northern fishery.

Catches of Arctic charr in the offshore fishing areas of Dog Island and Black Island have increased over the past several years and these fish are largely from the inner bay areas. The same method used to apportion Tikkoatokak Bay catches into inshore and offshore components was applied to both Voisey Bay and Anaktalik Bay catches in order to provide a more complete evaluation of total stock losses by the commercial fishery.

Recaptures of Voisey Bay charr in the Anton's area indicate that Voisey Bay charr are caught in varying numbers in this area as well. Losses to the Anton's area, however, cannot as yet be quantified.

A similar problem exists in the Okak Bay area where the catch of Arctic charr in the offshore Cutthroat region is likely composed of a composite of stocks from Okak Bay, Napartok Bay, and the Kiglapait area. From 1979-83 landings of Arctic charr from the Cutthroat area have averaged 26.4 t. The geographic position of Cutthroat in relation to Okak Bay (Fig. 1) would tend to indicate that a substantial portion of the catch is of Okak Bay origin which to date have not been accounted for in assessments of the Okak Bay charr stock.

Information, however, is not available to apportion the Cutthroat catches back into the respective inner bay or coastal areas.

Adjusted catch data are summarized in Table 2 for Voisey Bay and Anaktalik Bay. For Anaktalik Bay, the impact of adjusting catch data is substantial only for the last five years. Owing to the low catch in Voisey Bay in 1983 and the problem of being unable to account for Voisey Bay losses in the Anton's, area, it was decided that there was insufficient new information to recommend a TAC different from the 16 t quota of 1983.

Numbers at age were available from annual commercial sampling programs for Okak Bay charr since 1977 (Table 3). For Anaktalik Bay, numbers at age were available from 1977-78 and 1980-83. An estimate for numbers at age in the 1979 catch was derived from average proportion at age for 1977-78 and 1980-82 (Table 4a adjusted catch, 4b non-adjusted catch).

Weights at age were calculated from commercial samples (1974, 1977-78 for yield per recruit analysis, and 1982-83 for stock projections) and were converted from gutted head-on to whole weight using the conversion factor 1.24 (Coady and Best, 1976) (Table 5).

Partial recruitment rates were calculated from a matrix of fishing mortality rates generated from cohort analyses run on 1977-83 data. F values were averaged at age for 1977-81 and are presented in Table 5.

Yield per recruit was calculated by the method of Thompson and Bell (Ricker, 1975) using partial recruitment values and mean weight at age data from 1974, 1977-78. Natural mortality was assumed constant at 0.2. Age range extended from 6-15 for Voisey Bay, 6-16 for Anaktalik Bay, and 6-20 for Okak Bay. $F_{0.1}$ values were: 0.3979, 0.4050, and 0.4013 for Voisey Bay, Anaktalik Bay, and Okak Bay respectively. Tikkoatokak Bay had a value of 0.3868 (0.39). Owing to the fact that all input parameters are subject to error and the similarity of the values, all $F_{0.1}$ values were standardized at 0.39; the first value chosen and used for Tikkoatokak Bay. $F_{0.1}$ values for Anaktalik Bay and Okak Bay are lower than estimates used in previous assessments (Dempson and LeDrew, 1983). The lower updated values resulted from using longer age span and historical weight at age data.

Total mortality rate (z) calculated using the Paloheimo method gave an average value of 0.61 for Okak Bay (averaging 1979-80 to 1982-83 except 1981-82 where z = 0.10) (Table 3). The total mortality as estimated from a catch curve was 0.66 (95% C.L. = 0.56-0.75) and estimates the average mortality in effect from 1974-75 to 1981-82. Owing to the large variation in catch per unit effort at age data for Anaktalik Bay, an estimate of total mortality was also derived from a catch curve. The total mortality rate of 0.57 (95% C.L. = 0.31 - 0.84), however, refers to the average mortality in effect from 1976-77 to 1981-82 and is likely an overestimate in relation to the decrease in both catch and effort during the past several years.

Cohort analyses for Okak Bay were performed using terminal fishing mortalities ranging from 0.4 to 0.6. The r^2 values for regressions of F on effort showed little variation (r^2= 0.92-0.94) Table 6. For regressions of biomass on

catch per unit effort highest r^2 was at F_T = 0.6 (r^2 = 0.89) but this appears high in relation to other areas. As the estimated average total mortality rate derived from a catch curve was 0.66 (F ≈ 0.46), and considering the above information, an F_T of 0.5 was used for 1983.

With F_T = 0.5 and fishing at $F_{0.1}$, the projected available catch for the Okak Bay stock in 1984 is 27 t (Table 7) and it is recommended that this is the TAC for 1984. The long-term projected catch (recruits of 39,601 x yield per recruit of 0.796 kg) is 29 t. It is recognized that Okak Bay Arctic charr stocks likely contribute to the charr fishery in the Cutthroat area and that attempts should be made to clarify the contribution and thus be able to account for the total losses of Okak charr in the commercial fishery.

Given the low estimated catch for Anaktalik Bay Arctic charr in 1983, and that the catch curve total mortality rate refers to the period of time when these fish were being recruited into the fishery, a stock projection for 1984 was run using a terminal fishing mortality of 0.2. The projected available catch at $F_{0.1}$ = 0.39 is 8.2 t (Table 7); a decrease from last years TAC of 11 t, and it is recommended that this is the TAC for 1984. In comparison, the long-term projected yields at F_T = 0.2 and F_T = 0.3 were 12.8 and 10.8 t respectively (recruits of 11,178 and 9,417 with a yield per recruit of 1.143 kg).

The projected available catch for Anaktalik Bay can be apportioned into respective offshore and inshore allocations. The approximated inshore and offshore catch for 1984 is 6.1 t and 2.1 t respectively, which could range from 4.8-7.0 t inshore and 1.2-3.4 t offshore.

References

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TABLE 1. ARCTIC CHARR CATCH STATISTICS , 1974 - 1983 ;
SUMMARY OF CATCH, EFFORT,AND SIZE COMPOSITION

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
VOISEY BAY										
QUOTAS						22500	22500	16100	16100	16000
CATCH (KG)	20045	238	12232	22488	33597	21880	11557	16325	7688	2953
EFFORT (MAN-WEEKS)	64	2	45	56	85	59	52	53	38	17
C/E (KG)	313	119	272	402	395	371	222	308	202	174
Ø/Ø) 2,3KG			42.0	35.0	34.0	32.0	17.0	16.0	17.0	16.7
ANAKTALIK BAY										
QUOTAS						21500	21500	8660	8660	11000
CATCH (KG)	7821	2548	14670	21604	13075	14913	8045	9157	10836	2359
EFFORT (MAN-WEEKS)	28	10	45	63	55	76	53	32	27	24
C/E (KG)	279	255	326	343	238	196	152	286	401	98
Ø/Ø) 2,3KG			36.0	38.0	27.0	20.0	12.0	10.0	11.0	10.9
OKAK BAY										
QUOTAS								27300	27300	21000
CATCH (KG)	34250	2354	17812	27592	36125	26171	17434	11049	9031	30732
EFFORT (MAN-WEEKS)	105	15	52	107	104	123	65	46	26	147
C/E (KG)	326	157	343	258	347	213	268	240	347	209
Ø/Ø) 2,3KG			29.0	26.0	18.0	11.0	8.0	10.0	7.0	6.5

Table 2. Summary of adjusted landings of Arctic charr from Voisey Bay and Anaktalik Bay, 1974-83.

	Year									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Voisey Bay										
Quota (kg)						22500	22500	16100	16100	16000
Catch (kg)	20513	240	12316	22676	33769	22407	12128	16968	7959	3252
Anaktalik Bay										
Quota (kg)						21500	21500	8660	8660	11000
Catch (kg)	9074	2732	15360	22841	13533	17397	10773	11631	13453	3997

Table 3. Estimated numbers at age for Okak Bay Arctic charr, 1977-83.

Age	1977	1978	1979	1980	1981	1982	1983
6	84	102	-	26	39	62	318
7	84	1228	1227	353	419	314	1307
8	251	4040	4546	2126	791	1004	3056
9	752	2762	3067	3305	1733	859	3815
10	1839	2813	2020	2517	1693	987	3258
11	2173	1892	1191	867	922	901	2957
12	3595	1944	541	391	197	406	2180
13	1505	1381	469	129	121	105	1002
14	1087	256	325	162	60	82	390
15	920	511	253	219	51	45	118
16	501	153	216	-	-	16	107
17	84	205	144	-	34	23	11
18	84	51	72	-	-	15	43
19	84	51	36	-	-		
20			36	-	-		
Total	13,043	17,389	14,143	10,095	6060	4819	18562
Effort	107	104	123	65	46	26	147

Paloheimo total mortality rates.

1979-80*	1980-81*	1981-82	1982-83
= 0.31	= 0.76	= 0.10	= 0.75

$$z = \ln \frac{\sum_{11}^{16} C/E_i + 1}{\sum_{10}^{15} C/E_i}$$

Average z = 0.61
1979-80 to 1982-83
(except 1981-82)

* For 1979-80 and 1980-81 age 11-15 for year i+1 and age 10-14 for year i were used.

Table 4a. Estimated numbers at age for Anaktalik Bay Arctic charr, 1977-83. Numbers have been adjusted to account for losses of Anaktalik charr in the offshore fishing areas.

Age	1977	1978	1979*	1980	1981	1982	1983
6	99	134	88	89	18	18	37
7	599	2202	956	239	497	131	268
8	2995	1896	1835	964	1105	930	451
9	2098	977	2335	2558	2262	1710	627
10	2145	440	1588	1314	1475	1435	226
11	1348	192	1029	659	765	1473	231
12	449	134	509	340	298	911	153
13	199	77	221	309	94	238	47
14	100	38	128	178	54	154	16
15	2	38	30	31	1	40	
16	2	19	12	1	9	15	
17							11
18							
19						21	
Total	10036	6147	8731	6682	6578	7076	2067
Effort	89	69	107	79	52	51	38

* 1979 values generated from the mean proportion at age for 1977-78 and 1980-82.

Table 4b. Estimated numbers at age for Arctic charr caught in the Anaktalik Bay commercial fishery.

Age	1977	1978	1979*	1980	1981	1982	1983
6	93	129	74	66	14	15	21
7	559	2122	805	177	395	106	153
8	2795	1827	1545	714	879	751	257
9	1957	941	1966	1895	1799	1380	358
10	2001	424	1337	973	1173	1158	129
11	1258	185	866	488	608	1189	132
12	419	129	429	252	237	735	87
13	186	74	186	229	75	192	27
14	93	37	108	132	43	124	9
15	1	37	25	23	1	32	-
16	1	18	10	1	7	12	-
17						-	6
18						-	-
19						17	-
Total	9363	5923	7351	4950	5231	5711	1179
Effort	63	55	76	53	32	27	24

*1979 values generated from mean proportion at age for 1977-78 and 1980-82.

Table 5. Summary of weight (kg round) at age data, partial recruitment rates and calculated $F_{0.1}$ values for Voisey Bay, Anaktalik Bay, and Okak Bay Arctic charr.

	Voisey Bay			Anaktalik Bay			Okak Bay		
	Weight		Partial	Weight		Partial	Weight		Partial
Age	1974, 77-78	1982-83	recruitment	1974, 77-78	1982-83	recruitment	1974, 77-78	1982-83	recruitment
6	1.70	1.29	0.031	1.54	1.44	0.02	1.58	1.18	0.003
7	1.84	1.63	0.240	1.89	1.76	0.212	1.63	1.45	0.056
8	2.11	1.82	0.712	2.20	1.82	0.578	1.76	1.63	0.262
9	2.59	2.22	1.0	2.64	2.04	1.0	2.05	1.78	0.469
10	2.71	1.36	1.0	3.04	2.15	1.0	2.25	1.93	0.829
11	2.86	2.66	1.0	3.15	2.17	1.0	2.30	1.90	1.0
12	3.32	2.52	1.0	3.22	2.10	1.0	2.54	2.00	1.0
13	3.16	2.67	1.0	3.44	2.22	1.0	2.57	1.89	1.0
14	3.90	2.78	1.0	3.03	2.41	1.0	2.75	1.69	1.0
15	4.23		1.0	3.03	2.40	1.0	2.96	1.71	1.0
16				3.16		1.0	3.20	1.66	1.0
17							2.02	2.49	1.0
18							2.45	2.07	1.0
19							3.30		1.0
							2.23		1.0
	$F_{0.1}$ = 0.3979 at Y/R of 1.105 kg			$F_{0.1}$ = 0.4050 at Y/R of 1.143 kg			$F_{0.1}$ = 0.4013 at Y/R of 0.796 kg		

Table 6. Regressions of average F on effort for Okak Bay, 1977-83.

Year	Effort (man-weeks)	Okak Bay F_T 0.4	Okak Bay F_T 0.5	Okak Bay F_T 0.6
1977	107	0.724	0.728	0.731
1978	104	0.805	0.825	0.840
1979	123	0.710	0.751	0.782
1980	65	0.336	0.376	0.408
1981	46	0.152	0.176	0.196
1982	26	0.105	0.124	0.142
1983	147	0.400	0.500	0.600
r^2 (1977-82)		0.922	0.935	0.941

Table 7. Projection of available catch in 1984 from cohort analyses run at (A) F_T = 0.2 for Anaktalik Bay, and (B) F_T = 0.5 for Okak Bay.

A - Anaktalik Bay
F_T = 0.2

POPULATION NUMBERS

	1983	1984
6	11178	11178
7	6572	9118
8	4194	5139
9	3804	3027
10	1371	2550
11	1401	919
12	928	939
13	285	623
14	97	191
15	22	65
6+	29852	33749
7+	18674	22571
8+	12102	13453
9+	7908	8314

POPULATION BIOMASS (AVERAGE)

	1983	1984
6	14563.07	14528.51
7	10253.84	13979.47
8	6513.71	7617.70
9	6395.98	4664.84
10	2429.45	4141.27
11	2505.64	1506.41
12	1607.25	1489.64
13	521.45	1044.61
14	192.66	347.75
15	33.56	117.86
6+	45016.62	49438.86
7+	30453.55	34909.55
8+	20199.71	20930.08
9+	13686.00	13312.38

CATCH BIOMASS

	1983	1984
6	53	125
7	472	1156
8	821	1717
9	1279	1819
10	466	1615
11	501	587
12	319	581
13	184	407
14	39	136
15	26	46
6+	4181	8189
7+	4047	8065
8+	3576	6909
9+	2755	5192

B - Okak Bay
F_T = 0.5

POPULATION NUMBERS

	1983	1984
6	36301	36301
7	52202	29434
8	27599	41559
9	20408	19842
10	10409	13276
11	8223	5600
12	6063	4083
13	2787	3011
14	1085	1384
15	328	539
16	298	163
17	76	148
6+	165779	155339
7+	129478	119038
8+	77276	89604
9+	49677	48045

POPULATION BIOMASS (AVERAGE)

	1983	1984
6	38641.86	38801.56
7	67683.97	38269.00
8	38316.94	58388.36
9	29524.87	29417.66
10	14971.78	19948.97
11	11235.83	8036.54
12	8720.75	6168.84
13	3788.31	4298.59
14	1318.84	1766.95
15	403.31	696.13
16	355.90	204.16
17	92.59	278.60
6+	215054.86	206275.35
7+	176413.00	167473.80
8+	108729.03	129204.80
9+	70412.09	70816.44

CATCH BIOMASS

	1983	1984
6	375	45
7	1895	851
8	4981	6126
9	5791	5220
10	6268	6450
11	5618	3134
12	4360	2406
13	1894	1676
14	659	689
15	282	271
16	178	88
17	134	189
6+	33376	27857
7+	33000	27012
8+	31105	26161
9+	26124	20035

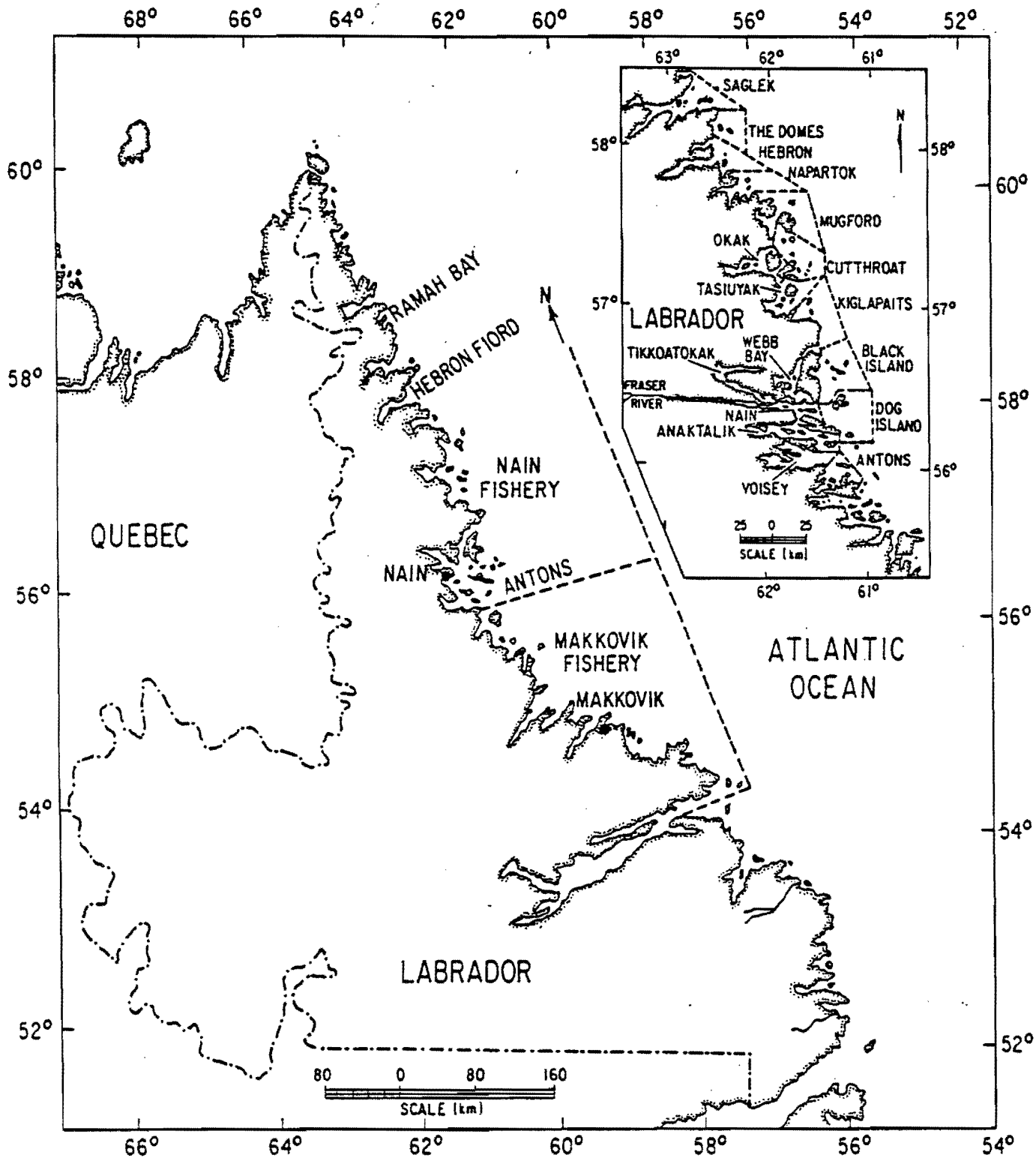

Fig. 1. Location of the Nain and Makkovik Arctic charr commercial fishing regions in northern Labrador. Insert illustrates the fishing area breakdown within the Nain fishing region.