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Assessment of the Voisey Assessment Unit Arctic Charr Population in 1985

by

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### Abstract

The Voisey assessment unit consists of the Voisey Bay and Antons subareas. Annual landings from this assessment unit have ranged from 4 to 41 t and have averaged 22 t over the past 12 years (1974-85). From 1977 to 1985 these landings have represented 14% of the total commercial production of Arctic charr from the Nain fishing region. The TAC in 1985 was 25 t. Landings in 1985 totalled 16 t and were 25% lower than the previous year. Effort, however, decreased by 44% from 1985. A sequential population analysis was carried out on catch at age data from 1977 to 1985. Regressions of fishing mortality on fishing effort, and population biomass on catch per unit effort indicated a terminal fishing mortality in 1985 of 0.45. Paloheimo and catch curve estimates indicated a fishing mortality of 0.6. Projections of the TAC in 1986 were run for a range of  $F_T$  (0.45-0.6) and indicated an  $F_{0.1}$  yield of 14.2 to 19.4 t.

### Résumé

Pour l'unité d'évaluation de Voisey, qui couvre les sous-zones de la baie de Voisey et d'Antons, les débarquements annuels se sont situés entre 4 et 41 t, la moyenne des 12 dernières années (1974-1985) s'établissant à 22 t. De 1977 à 1985, ces débarquements ont représenté 14 % de la production commerciale totale de la pêche de l'omble chevalier dans le secteur de pêche de Nain. En 1985, le TPA était de 25 t, et les débarquements se sont chiffrés à 16 t, soit 25 % de moins que l'année précédente. L'effort de pêche a toutefois diminué de 44 % en 1985. Une analyse séquentielle de population a été effectuée sur les prises par catégorie d'âge de 1977 à 1985. Des régressions de la mortalité due à la pêche sur l'effort de pêche et de la biomasse de la population sur les prises par unité d'effort ont indiqué une mortalité globale due à la pêche de 0,45 en 1985. Des estimations des Z's par la méthode de Paloheimo et des courbes de prises établissent cette mortalité à 0,6. Les projections du TPA pour 1986 effectuées pour une fourchette de  $F_T$  (0,45-0,6) donnent un rendement à  $F_{0,1}$  de 14,2 à 19,4 t.

## Introduction

Catch statistics for the Voisey Bay and Antons subareas (Fig. 1) have been available since 1974. On the basis of tag recapture information these areas were considered as one assessment unit and assessed as such last year (Dempson and LeDrew 1985). Quotas were applied to Voisey Bay beginning in 1979 while the 1985 TAC of 25 t also included the Antons subarea and an offshore component of 1.6 t. Annual landings have ranged from a low of 4 t in 1975 to 41 t in 1979 with an average of 22 t over the 12-year period. Since 1977, landings from this assessment unit have represented 14% of the total commercial production of Arctic charr from the Nain Fishing Region.

This paper examines the results of the 1985 fishery and provides a forecast of available catch for 1986.

## Stock Assessment

### Catch and Effort Data

Catch and effort data for the Voisey assessment unit are summarized in Table 1 for 1974-85. Landings in 1985 totalled 16 t and were 25% lower than the previous year and were 33% below the TAC for Voisey and Antons. Effort, however, decreased by 44% while catch per unit effort was 33% higher than in 1984. Combined landings for the Voisey assessment unit have exceeded the TAC in four out of seven years (Table 1). Total landings from 1979-85 (160 t) have exceeded the combined TAC by 19%. It should be remembered that until 1985, the TAC only applied to the Voisey Bay subarea.

Numbers at age were available since 1977 and are summarized in Table 2. Data were derived from annual commercial sampling programs. Numbers at age were estimated for each of the two subareas then added together. Numbers were then adjusted to reflect the total estimated number of fish caught for the entire assessment unit. Mean age of the catch has varied from 8.2 to 9.1 years with no apparent increasing or decreasing trend (Table 2).

Weights at age were calculated from commercial samples (1974, 1977-78 for yield per recruit analysis, and 1983-85 for stock projections) and were converted from gutted head-on to whole weight using the conversion factor 1.22 (Dempson 1984) (Table 3).

Total mortality ( $Z$ ) was calculated using the Paloheimo method (Ricker 1975) and the average value for all years (1977-78 to 1984-85) was 0.80. Assuming a natural mortality rate of 0.2 yields an estimate of fishing mortality of 0.6. As in past years there was a considerable amount of variation in the estimates and a catch curve was also used to provide an alternative measure of  $Z$ . Using catch per unit of effort at age data from 1983-85 similarly resulted in a  $Z$  of 0.83.

An initial cohort analysis was run using partial recruitment values and terminal fishing mortality ( $F_T$ ) from the 1985 assessment (Dempson and LeDrew 1985) ( $F_T = 0.45$ ). An iterative procedure was used to obtain estimates of

fishing mortality for the oldest age group ( $F_B$ ) (Rivard 1982). Following this the cohort analysis procedure was rerun using the newly derived values for  $F_B$ .

Partial recruitment rates were calculated using the historical averaging method from the matrix of fishing mortality rates generated from the last cohort run and are listed in Table 3.

Yield per recruit was calculated by the method of Thompson and Bell (Ricker 1975) using partial recruitment rates and mean weight at age.  $F_{0.1}$  was 0.37 at a yield per recruit of 1.11 kg. For the projections,  $F_{0.1}$  was rounded to 0.4, the same value used for the Nain stock unit.

Cohort analyses were performed using a range of terminal fishing mortality rates from 0.2 to 0.7 using newly derived estimates of partial recruitment. In each cohort run, fishing mortality rates for the oldest age group ( $F_B$ ) were re-evaluated using the iterative procedure. Regressions of  $F$  on effort, and population biomass of fully recruited fish on catch per unit effort of fully recruited fish were used in tuning the analysis to key in on an appropriate value for  $F_T$  in 1985.

Regressions of  $F$  on effort produced the highest correlations at  $F_T = 0.25$ . The best predicted value for  $F_T$  in 1985 was obtained from a cohort analysis run with  $F_T = 0.45$  (Table 4). Although this regression was not quite statistically significant ( $P = 0.059$ ), the input and output values of  $F_T$  were virtually identical (Table 4). Regressions of biomass on catch per unit effort also had the highest correlation at  $F_T = 0.25$  with the best predicted estimate of population biomass when  $F_T = 0.45$  (Table 4). Table 5 summarizes the population numbers and fishing mortality matrix for the cohort analysis run with  $F_T = 0.45$ .

Average fishing mortality from the Paloheimo method and catch curves suggested an  $F$  of  $\approx 0.6$ . Catch curves, however, tend to estimate 'historical' mortality rates, i.e. the average rate in effect during the period of time fish were recruited into the fishery. As previously stated, Paloheimo estimates were highly variable. As a result, a series of stock projections were run with  $F_T$  varying from 0.45 to 0.6. Recruitment was estimated from the geometric mean of population numbers for age six fish for the years 1977-83. Weights at age for the projection were based on 1983-85 data. Table 6 summarizes the results of these projections.

Total allowable catch in 1986 for the Voisey assessment unit ranges from 14.2 to 19.4 t. The highest value (19.4 t) was obtained by assuming that  $F_T$  in 1985 was 0.45, and is similar to the average landings from the Voisey stock unit for the past five years (1981-85,  $\bar{X} = 19.8$  t). It is, however, 22% lower than the TAC set for the Voisey assessment unit in 1985. The TAC for the Voisey assessment unit is for both the Voisey Bay and Antons subareas.

### References

- Dempson, J. B. 1984. Conversion factors for northern Labrador Arctic charr landings statistics. CAFSAC Res. Doc. 84/6.
- Dempson, J. B., and L. J. LeDrew. 1985. An assessment of Arctic charr stock in Voisey Bay, Anaktalik Bay, and Okak Bay in 1984 with stock projections for 1985. CAFSAC Res. Doc. 85/12.
- Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191.
- Rivard, D. 1982. APL programs for stock assessment (revised). Can. Tech. Rep. Fish. Aquat. Sci. 1091.

Table 1. Summary of catch and effort statistics for the Voisey assessment unit, 1974-1985. Quotas and landings are in kg-round weight, effort is expressed as man-weeks fished.

Year	Quota	Landings	Effort	CUE
1974		29,180		
1975		3,727		
1976		14,652	57	257
1977		24,108	75	321
1978		36,991	102	363
1979	22,500	40,590	116	350
1980	22,500	19,694	82	240
1981	16,100	23,810	90	265
1982	16,100	13,309	60	222
1983	16,100	25,593	80	320
1984	16,100	20,873	101	207
1985	25,000	15,648	57	275

TABLE 2. ESTIMATED CATCH AT AGE FOR THE VOISEY STOCK UNIT, 1977 - 85.

	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	318	619	475	132	75	255	1841	253	1
7	2085	4374	4914	666	983	770	2870	2306	2012
8	4030	5372	7928	3349	2607	1628	3100	3352	3213
9	2086	2330	3382	4086	4780	2297	4125	2374	3396
10	1237	1236	1163	1341	2350	1140	1790	1577	454
11	600	1141	634	521	941	595	1196	806	336
12	389	380	212	260	406	62	801	401	247
13	212	380	159	166	43	12	68	377	69
14	108	334	55	64	19	20	8	136	91
TOTAL	11065	16166	18922	10585	12204	6779	15799	11582	9819
MEAN									
AGE	8.6	8.5	8.2	8.9	9.1	8.8	8.5	8.8	8.5

Table 3. Summary of weight (kg round) at age data, partial recruitment rates and calculated  $F_{0.1}$  for the Arctic charr population in the Voisey assessment unit.

Age	Weight		Partial recruitment
	1974, 1977-78	1983-85	
6	1.66	1.25	0.030
7	1.82	1.50	0.270
8	2.08	1.90	0.787
9	2.72	2.23	1.0
10	2.82	2.49	1.0
11	2.93	2.51	1.0
12	3.36	2.56	1.0
13	3.21	2.42	1.0
14	3.84	2.15	1.0
15	3.75	2.70	1.0
16	3.75	-	1.0

$F_{0.1} = 0.37$  at a Y/R of 1.11 kg.



Table 4. Results of regressions of F on effort and population biomass on catch per unit effort from cohort analyses run with various terminal fishing mortalities ( $F_T$ ) for the Arctic charr population in the Voisey assessment unit.

Regression	Parameter	$F_T$						
		0.2	0.25	0.3	0.4	0.45	0.5	0.6
F (weighted 9+) on effort 1977-84	r	0.75	0.77	0.76	0.71	0.69	0.66	0.62
	residual (absolute value)	0.20	0.17	0.13	0.05	0.04	0.04	0.14
9+ biomass on CUE of 9+ fish 1977-84	r	0.81	0.85	0.83	0.76	0.73	0.71	0.66
	residual (t) (absolute value)	25	16	9	2	1	3	6

## POPULATION NUMBERS

	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	40402	31179	19650	19103	14068	28383	22783	23840	79
7	21257	32791	24967	15658	15521	11450	23007	16987	19289
8	11634	15518	22889	15995	12217	11818	8677	16240	11821
9	5732	5878	7844	11566	10065	7644	8202	4300	10263
10	3645	2805	2705	3362	5773	3915	4180	2983	1372
11	1597	1865	1179	1162	1539	2600	2174	1803	1015
12	1049	765	494	391	480	409	1590	698	746
13	756	507	282	213	85	26	278	577	209
14	152	427	71	87	24	31	10	166	131
6+	86225	91735	80081	67538	59771	66275	70903	67593	44927

## FISHING MORTALITY

	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	0.009	0.022	0.027	0.008	0.006	0.010	0.094	0.012	0.014
7	0.115	0.159	0.245	0.048	0.073	0.077	0.148	0.163	0.122
8	0.483	0.482	0.483	0.263	0.269	0.165	0.502	0.259	0.354
9	0.514	0.576	0.647	0.495	0.744	0.404	0.811	0.942	0.450
10	0.470	0.667	0.645	0.581	0.598	0.388	0.641	0.878	0.450
11	0.536	1.128	0.903	0.684	1.126	0.292	0.936	0.682	0.450
12	0.527	0.796	0.642	1.326	2.732	0.184	0.813	1.008	0.450
13	0.371	1.762	0.973	1.978	0.818	0.731	0.315	1.280	0.450
14	0.496	0.716	0.674	0.548	0.744	0.372	0.770	0.893	0.450
9+	0.497	0.749	0.678	0.564	0.783	0.374	0.776	0.901	0.450

Table 5. Summary of population numbers and fishing mortality matrix for the cohort analysis run at  $F_T = 0.45$  on the catch at age data for the Voisey stock unit Arctic charr population.

Table 6. Summary of projected available catch for 1986 with  $F_T$  in 1985 varying from 0.45 to 0.6.

	$F_T$ in 1985			
	0.45	0.50	0.55	0.60
TAC in 1986 (kg)	19,443	17,489	15,862	14,200

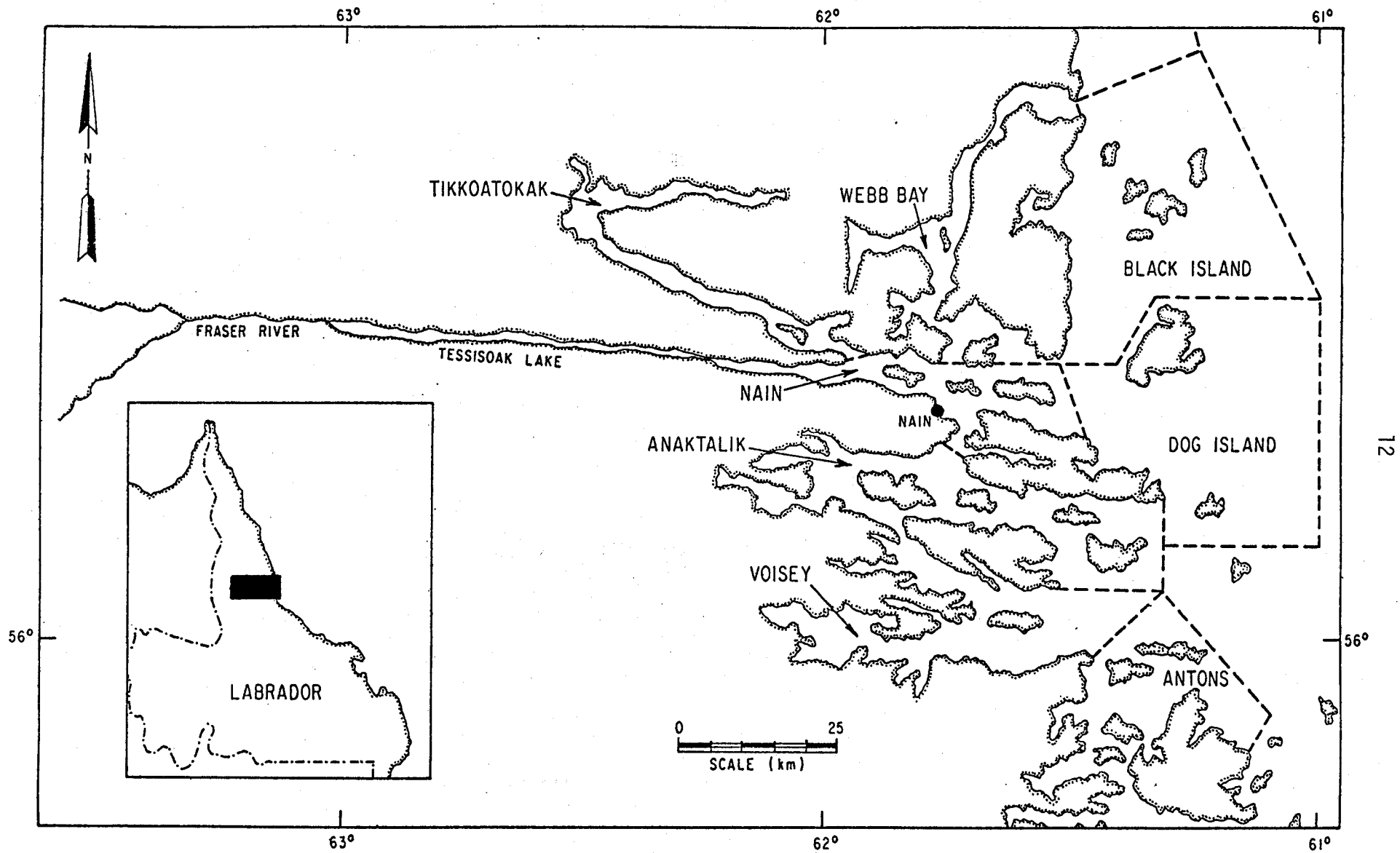


Fig. 1. Location of the Voisey Bay and Antons subareas of the Voisey stock unit.