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Analysis of the Voisey Assessment Unit Arctic Charr Populations in 1986

by

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Abstract

The Voisey assessment unit, made up of Voisey Bay and the Antons subarea, was first assessed as a homogeneous unit at the end of the 1984 fishery. Annual landings have ranged from 4 to 41 t (mean = 22 t) and from 1977 to 1986 have represented 17% of the total commercial catch of Arctic charr from the Nain fishing region. Total allowable catch in 1986 was 20 t. Landings in 1986 were 17 t or 83% of the TAC. Effort increased by 44% and catch per unit effort decreased by 26% in comparison with 1985. A sequential population analysis was carried out on catch at age data from 1977 to 1986 and suggested a reference level catch of 17 t remain in effect for 1987.

Résumé

L'unité d'évaluation de Voisey, constituée de la baie de Voisey et de la sous-zone Antons, a été évaluée pour la première fois comme unité homogène à la fin de la saison de pêche de 1984. Les débarquements annuels ont varié de 4 à 41 t (moyenne = 22 t) et, de 1977 à 1986, ils ont constitué 17 % de la pêche commerciale totale d'omble chevalier pour la zone de pêche de Nain. En 1986, le TPA était de 20 t et les débarquements ont été de 17 t, ou 83 % du TPA. L'effort a augmenté de 44 % et les prises par unité d'effort ont diminué de 26 % comparativement à 1985. Une analyse séquentielle de population a été réalisée à partir des données sur les prises par âge de 1977 à 1986 et cette analyse a indiqué un taux de prise de référence de 17 t pour 1987.

Introduction

Catch statistics for the Voisey assessment unit (Fig. 1) have been available since 1974. On the basis of tag recapture information these areas were considered as one unit and assessed as such beginning in 1985. The quota area catch column in Table 1 summarizes landings from this subarea only. Annual landings for the entire assessment unit have ranged from a low of 4 t in 1975 to 41 t in 1979 with an average of 22 t over the 13-year period. Since 1977, landings from this assessment unit have represented 17% of the total commercial catch of Arctic charr from the Nain Fishing Region. The TAC recommended for 1986 was 20 t.

This paper examines the results of the 1986 fishery and provides a reference level catch for 1987 as derived from a sequential population analysis.

Stock Assessment

<u>Catch and effort data</u> for the Voisey assessment unit are summarized in Table 1 for 1974-86. Landings in 1986 totaled 17 t; an increase of 6% from 1985. This catch was 83% of the recommended TAC. Effort increased by 44% although catch per unit effort decreased by 26% to 203 kg/man-week. This was similar to the value recorded for 1984. The majority of the catch from this assessment unit was taken from the Antons subarea. The quota area catch in Table 1 summarizes landings from the subarea specifically under quota regulation only (Voisey Bay) prior to the formation of the assessment unit in 1985.

Numbers at age were available since 1977 and are summarized in Table 2. Data were derived from annual commercial sampling programs. Mean age of the catch has ranged from 8.2 to 9.1 years with no apparent increasing or decreasing trend (Table 2). From 1977 to 1986, 58% of the catch has been made up of 8 and 9 year old fish. Eleven per cent of the fish were 11 years of age or older.

<u>Weights at age</u> were calculated from commercial samples obtained from 1977 to 1986. Gutted head-on weights were converted to whole weight using the conversion factor of 1.22 (Dempson 1984). For the yield per recruit analysis, mean weight at age from 1977 to 1979 was used. For stock projections, mean weight at age for the period 1984-86 was used (Table 3).

As observed in the Nain assessment unit, mean weight at age has decreased over time. For 7-10 year old Arctic charr the average percentage decrease in weight was 15% (0.33 kg) (average 1977-79 to 1984-86), while the average decline for 11 to 14 year old fish was 23% (0.76 kg). Both the Voisey Bay and Antons subareas have had declines in the proportion of large Arctic charr (charr greater than 2.3 kg gutted head-on weight) similar to that observed in subareas within the Nain assessment. This may suggest a selective removal of the larger fish from the population. Total mortality (Z) was calculated using the Paloheimo method (Ricker

1975) for all years (1977-78 to 1985-86) was 0.82. 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. The use of catch per unit of effort at age data from 1984-86 resulted in a Z of 0.70.

An initial cohort analysis was run using partial recruitment values and terminal fishing mortality (F_T) from the 1985 assessment (Dempson and LeDrew 1986) (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 0.39 at a yield per recruit of 1.08 kg.

<u>Cohort analyses</u> were performed using a range of terminal fishing mortality (F_T) 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 (weighted mean F for fully recruited fish) on fishing effort, and population biomass on catch per unit effort for fully recruited fish were used in tuning the analysis to identify an appropriate value for 1986. Regression were based on data from 1977 to 1985.

Regressions of F on effort produced the highest correlation at $F_T = 0.35$ (Table 4). The distance from the last point to the regression line was lowest when $F_T = 0.6$. The sum of the residuals for the last three years (1984-86) and the sum of squares of the residuals for the last three years was the lowest when $F_T = 0.55$ and $F_T = 0.60$ respectively.

Regressions of biomass on CUE produced the highest correlation coefficient obtained when $F_T = 0.4$. The residual of the last year to the regression line was lowest when $F_T = 0.6$. Similarly, the sum of the squares of the residuals for the last three years were lowest when $F_T = 0.5$ and 0.55 respectively.

In summary, on the basis of the best correlations F_T for 1986 would be 0.35-0.4 while an analysis of the residuals would suggest F_T is 0.5-0.6. On the basis of the analyses of the residuals and in consideration of the Paloheimo and catch curve estimates, F_T in 1986 would appear to be 0.55-0.60.

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<u>Stock projections</u>, however, were run with F_T varying from 0.45 to 0.6. Recruitment for projections was estimated from the geometric mean of population numbers for age 6 and 7 year-old fish for years 1977-84. Weights at age were based on 1984-86 data. Table 5 summarizes the population numbers and fishing mortality matrix for the cohort analysis run with $F_T = 0.50$.

Results of the projections are summarized in Table 6. With $F_T = 0.55$ to 0.60 suggests a 'reference level' catch in 1987 of approximately 17 t.

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Year	Quota	Quota ^a area catch	Landings	Effort	CUE
1974 1975 1976 1977 1978 1979 1980 1981 1981 1982 1983 1984 1985 1986	22,500 22,500 16,100 16,100 16,100 16,100 23,400 20,000	21,880 11,557 16,325 2,688 2,953 8,113	29,180 3,727 14,652 24,108 36,991 40,590 19,694 23,810 13,309 25,593 20,873 15,648 16,655	57 75 102 116 82 90 60 80 101 57 82	257 321 363 350 240 265 222 320 207 275 203

Table 1. Summary of catch and effort statistics for the Voisey assessment unit, 1974-86. Quotas and landings are in kg-round weight, effort is expressed as man-weeks fished.

^aQuota applied to the Voisey Bay subarea only from 1979 to 1984.

FOR ARCTIC CHARR FROM THE -B6. TABLE 2. ESTIMATED CATCH AT AGE UOISEY STOCK UNIT, 1977-

1986	1110 12055 130257 130257 1110 1110 1110	9945	8.9
1985	2012 3213 3396 3396 2454 2436 919	9819	8.5
1984	253 23355 33555 2374 1577 1577 1577 1577 1577 1577 1577	11582	8.8
1983	1841 2870 2870 1196 801 801 801 801	15799	8.5
1982	255 255 255 255 255 255 202 202 202 202	6779	8.8
1981	2350 2350 2350 2350 2350 2350 2350 2350	12204	9.1
1980	132 6666 1349 1341 1560 1560 1560 1560	10585	8.9
1979	4425 7928 1163 1563 1563 1563 1563 1563 1563 1563	18922	8.2
1978	619 5372 5372 2330 2330 11236 3380 3380 3380 3380 3380	16166	8.5
1977	2085 2085 2085 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 2085 1237 1237 1237 2085 1237 1237 1237 1237 1237 1237 1237 1237	11065	8.6
	90-860-10M4	TOTAL	MEAN AGE

	W	eight	Doutial	
Age	1977-79	1984-86	recruitment	
6	1.53	1.18	0.023	
7	1.77	1.41	0.195	
8	2.07	1.86	0.607	
9	2.60	2.14	1.0	
10	2.78	2.50	1.0	
11	2.94	2.41	1.0	
12	3.24	2.61	1.0	
13	3.33	2.51	1.0	
14	3.50	2.46	1.0	
15	3.46		1.0	
16	3.46		1.0	

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.

						· · · · · · · · · · · · · · · · · · ·					· · · · · · · · · · · · · · · · · ·
					T	ermina	1 F				
Regressic	on Parameter	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.7
F (weighted mean for fully recruited fish)	1										
on errort	r residual-1986 normalized intercept normalized residuals (1984-86) (residuals) ² (1984-86)	0.73 -0.33 -0.60 -0.01 -0.02 -0.64 0.16	0.75 -0.30 -0.53 0.03 0.04 -0.53 0.12	0.77 -0.26 -0.45 0.06 0.10 -0.43 0.09	0.77 -0.23 -0.38 0.09 0.15 -0.34 0.06	0.77 -0.19 -0.31 0.11 0.19 -0.25 0.04	0.75 -0.15 -0.24 0.14 0.23 -0.17 0.02	0.74 -0.11 -0.17 0.16 0.26 -0.08 0.01	0.72 -0.06 -0.10 0.18 0.29 -0.00 0.01	0.69 -0.02 -0.03 0.20 0.32 -0.07 0.00	0.64 0.07 0.28 0.24 0.37 -0.22 0.02
Population (fully re fish) on	biomas ecruited CUE										
	r residual (t)-1986 normalized intercept (t) normalized residuals (1984-86) (residuals) ² 1 (1984-86)	0.50 41 1.52 13 0.47 60 882	0.63 26 1.13 12 0.49 40	0.74 21 0.84 12 0.50 27 454	0.81 15 0.62 12 0.51 18 228	0.82 11 0.45 12 0.51 11 112	0.81 7 0.31 12 0.52 5	0.78 4 0.20 12 0.52 1 26	0.74 2 0.10 12 0.53 -3 17	0.70 0 0.02 12 0.53 -6	0.64 -2 -0.11 12 0.54 -10 37

Table 4. Results of regressions (1977-85) of F on effort and population biomass on catch per unit effort for various terminal fishing mortality rates (F_T) for the Voisey assessment unit.

Table 5. Summary of the population numbers and fishing mortality matrix for the cohort analysis run at $F_{T} = 0.50$ on the catch at age data for the Voisey assessment unit Arctic charr population.

. 1	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6 1	40390	31436	19657	19466	17007	24648	28910	21894	11488	3792
7 1	21293	32781	25178	15664	15818	13856	19949	22004	17696	9405
8 1	11634	15543	22881	16167	12222	12061	10648	13736	15929	12668
9 1	5732	5879	7867	11560	10206	7648	8402	5912	8213	10134
0 1	3645	2306	2705	3381	5767	4031	4183	3146	2693	3651
1 1	1597	1865	1179	1162	1555	2595	2269	1805	1149	1794
2 1	1049	765	494	391	480	422	1587	776	749	637
3 1	756	507	282	213	85	26	289	574	272	389
4 1	152	427	71	87	24	31	10	175	129	130
6+1	86248	92012	80315	68093	63165	65317	76246	70022	58317	42630
7+1	45858	60576	60658	48626	46158	40670	47336	48129	46829	38838
8+1	24566	27795	35480	32962	30340	26814	27387	26125	27133	29434
9+1	12932	12249	12599	16795	18118	14752	16740	12389	13205	16766

FISHING MORTALITY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6 7 8 9 10 11 12 13 14	0.009 0.115 0.483 0.514 0.470 0.536 0.527 0.371 0.496	0.022 0.160 0.481 0.573 0.667 1.128 0.796 1.761 0.716	0.027 0.243 0.483 0.645 0.645 0.902 0.642 0.973 0.673	0.008 0.048 0.260 0.495 0.577 0.684 1.325 1.976 0.548	0.005 0.071 0.269 0.729 0.598 1.105 2.730 0.816 0.735	0.011 0.063 0.162 0.403 0.375 0.292 0.177 0.728 0.369	0.073 0.173 0.388 0.782 0.640 0.874 0.816 0.301 0.749	0.013 0.123 0.314 0.587 0.807 0.680 0.847 1.293 0.695	0.000 0.134 0.252 0.611 0.206 0.390 0.454 0.329 0.479	0.012 0.098 0.304 0.500 0.500 0.500 0.500 0.500 0.500 0.500
+	0.497	0.749	 0.676	0.563	0.773	0.370	0.754	0.707	0,493	0.500

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Peference level		F _T i	n 1986		
catch	0.45	0.50	0.55	0.60	
1987	20.7	19.0	17.6	16.5	
1988	21.8	20.6	19.6	18.8	

Table 6. Summary of projected available catch (t) for 1987 and 1988 with $\rm F_{T}$ in 1986 varying from 0.45 to 0.6.



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

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