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Evaluation of the status of the Nain stock unit Arctic charr population in 1992

by

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Abstract

Reported landings of Arctic charr from the Nain assessment unit totalled 20 t in 1992, an increase of 23% from the previous year but only 42% of the 47 t TAC which has been in effect since 1987. Landings had been moderately stable from the mid-1980s until 1990. Severe environmental conditions along the northern Labrador coast again contributed to the disruption of normal fishing activities. Mean timing of the 1992 commercial charr fishery for the total Nain stock unit was 27 days later than the average over the period 1977-90. Catch at age data from the 1992 fishery indicated that the 1984 year class was the most abundant in the fishery contributing 26% of the catch. Standardized catch rates, estimated separately for both inshore and offshore fishing zones, were derived using a multiplicative model and used in an age desegregated formulation of ADAPT to estimate fishing mortality and stock size in 1992. The assessment indicated that fishing mortality in 1992 was 0.23 on 9+ fish and 0.30 on 10+ fish. Population size was estimated to be about 159,500 fish, comparable with stock size estimates for 1982-90.

Résumé

Les débarquements déclarés d'omble chevalier provenant de l'unité d'évaluation de Nain ont été de 20 t en 1992, soit 23 % de plus qu'en 1991, mais seulement 42 % du TPA de 47 t, en vigueur depuis 1987. Ils sont demeurés assez stables depuis le milieu des années 80 jusqu'aux années 90. Les conditions climatiques rigoureuses qui ont régné le long du nord du Labrador a nui à nouveau aux activités de pêche normales. En moyenne, la pêche commerciale de l'omble chevalier dans l'unité de Nain a commencé 27 jours plus tard en 1992 que la date moyenne de 1977-1990. Les données sur les prises selon l'âge en 1992 révèlent que la classe d'âge de 1984 était la plus abondante dans la pêche, représentant 26 % des prises. On a eu recours à un modèle multiplicatif pour établir des taux de prises normalisés et distincts pour la pêche côtière et pour la pêche hauturière, puis on a appliqué ces taux de prises à une formulation de la méthode ADAPT décomposée par âge afin d'estimer la mortalité due à la pêche et la grosseur des stocks en 1992. Selon cette estimation, la mortalité due à la pêche dans les stocks de poissons de 9 + et de 10 + étaient respectivement de 0,23 et de 0,30 et la population se chiffrait approximativement à 159 500 poissons, ce qui est comparable aux estimations de grosseur du stock pour 1982-1990.

1. Introduction

The Nain stock unit (Fig. 1) consists of an inshore zone made up of Anaktalik Bay, Nain Bay, Tikkoatokak Bay, and Webb Bay subareas, and an offshore island zone consisting of the Dog Island and Black Island subareas (Dempson and Kristofferson 1987). It was first assessed as a single unit in 1985 (Dempson and LeDrew 1986). Prior to this, individual assessments were conducted separately on Arctic charr populations from Nain-Tikkoatokak Bay and Anaktalik Bay. Annual landings from the Nain unit have ranged from 16 to 76 t (mean = 49 t, 1974-92). In recent years, 48% of the Nain region catch has originated from the Nain stock unit. In 1991 and 1992, however, this stock unit contributed only 29% and 32%, respectively, of the total region catch. Results of the assesment conducted on the 1991 data suggested that the reference level catch should be reduced by about 20% to 37.1 t. However, the Total Allowable Catch (TAC) in 1992 was maintained at 47 t. Catches and catch rates in 1991 may have been unusually low as a result of anomalous environmental conditions that year. It is noted that conditions in northern Labrador in 1992 were generally similar to those in 1991 (Dempson 1992).

This paper summarizes information from the 1992 fishery and updates estimates of current stock size derived from a formulation of the adaptive framework (Gavaris 1988).

2. Trends in catch and effort data - conventional series

Catch and effort data for the Nain stock unit are summarized in Table 1 for the period 1974-92. The highest catch of 76 t occurred in 1977, the lowest catch of 16 t occurred in 1991. TACs listed in Table 1 for 1979 to 1983 applied only to the specific subareas of Anaktalik Bay and Nain-Tikkoatokak Bay. In 1984 and 1985, an offshore component was included in the TAC. The quota area catch (QAC) in Table 1 summarizes landings for those subareas specifically under quota restrictions only, prior to the derivation of the assessment (stock) units in 1986. Since 1986, the TAC has applied to the entire stock unit.

Landings in 1992 totaled 20 t; an increase of 23% from the previous year but only 42% of the TAC. Landings had been moderately stable from the mid-1980s until 1990 (coefficient of variation = 12%, 1984-90) and generally close to the recommended TAC (Fig. 2). Effort in 1991 and 1992 are the lowest recorded. Catch per unit effort (CUE, unstandardized) was up 39% from the previous year, but still among the lowest values recorded (Table 1). Unstandardized catch rates increased in both inshore and offshore zones.

2.1 Timing of the fishery

In 1991, severe ice conditions contributed to the disrutption of normal fishing activities along the northern Labrador coast. In many areas, fisherpersons were delayed or prevented from accessing traditional fishing berths. Similar conditions were experienced in 1992. The impact can be seen by comparing the timing of landings in the fishery (Fig. 3). Median timing (50%) of the 1992 commercial charr fishery for the total Nain stock unit was 27 days later (Julian day 234 = August 22) than the average during the 14 years 1977-90 (Julian day 207 = July 25) (Fig. 3). The fishery was compressed over a much shorter interval as illustrated by the 25th and 75th percentiles of the timing of the catch. In 1991, the median date was 22 days later. The median date of landings from the inshore zone in 1992 was 31 days later in comparison with the 1977-1990 period while landings in the offshore zone were 14 days later. Normally peak return runs of charr to rivers in the Nain area occur during early August (Dempson and Green 1985) again suggesting that catches and catch rates in 1992 may have been lower as a result of fish having already returned to the local rivers. In the absence of specific information on run timing of charr to specific rivers, this cannot be certain.

3. Catch and average weights at age

Catch at age data are available since 1977 and are summarized in Table 2. Catch at age, along with the estimated standard error and coefficient of variation for the 1992 data are provided in Table 3. Those ages that contribute to the majority of the catch (ages 7 - 10, 87% of the total catch) appear to have been estimated reasonably with the coefficients of variation less than 10%. The 1984 year classes (year of hatching) represented by 8 year old fish in 1992 was the most abundant representing 26% of the catch (Table 2). A summary of the percent at age in the catch is provided in Table 4. Mean age of the catch in 1992 was 8.7 years and has ranged from 8.5 years in 1977 to 9.83 in 1982.

Weights at age were derived from length-weight relationships obtained from sampling the commercial fishery as explained in past years (Dempson 1990). A summary of the relationships used since 1980 are provided in Table 5. Gutted head-on weights were converted to whole weight using the conversion factor 1.22 (Dempson 1984). A comparison of recorded total landings with the cross product total (sum of the matrix of estimated numbers at age x matrix of weights at age) agrees quite well with the discrepancy between the two of only 0.23% for 1992. Weight at age data are summarized in Table 6. As noted in past assessments, mean weights have declined from the late 1970s and early 1980s but had been relatively stable during the past six years (Table 6). In 1992, mean weight at age for fish 6 to 14

years was, on average, about 14% lighter than the average for 1988-91. The later timing of the fishery may be directly related to this as larger charr enter the rivers first (Dempson and Green 1985). Alternatively, or in conjunction with the confounding influence of timing, poor environmental conditions may have impacted on feeding patterns. The following table summarizes the frequency of occurrence (number of stomachs examined with the food item present) of capelin and launce in stomach samples of Arctic charr caught in the Nain stock unit (at least four of six subareas sampled).

		Frequency of Occurrence (%)		
Year	N	Capelin	Sand launce	% empty
1983-85	498	24.4	9.7	9.0
1991	72	0	34.7	5.6
1992	90	2.2	17.8	10.0

During the mid 1980's, the contribution of capelin by weight was 54%. A detailed analysis of feeding characteristics may shed additional insight to the apparent changes noted above.

Condition of Arctic charr from the Nain stock unit was modelled following the methods of Patterson (1992). In the current analysis, the model includes month and year effects with length as a covariate. Coefficients correspond to the natural log of the geometric means of the deviation of the condition from unity (Patterson 1992). The model explained 88% of the variation in weight of fish ($P = 0.0$). Both year and month factors were significant. Charr caught in July and September had higher coefficients than those caught in June or August. Year coefficients, illustrated in Figure 4, indicate that the lowest values occurred in 1991 and 1992. Reasons for this are not entirely clear.

4. Standardization of catch rates

A multiplicative model (Gavaris 1980) was used to account for differences in catch rates among years and weeks separately for inshore and offshore fishing zones. A combined analysis with classification variables zone, week, and year was also carried out. The regression of ln catch rate for the period 1977 to 1992 was initially fitted using SAS REG procedures (SAS 1985) to avail of the various diagnostics available. Diagnostics included leverage estimates (diagonal elements of the hat matrix) and

influence statistics using the DFFITS calculation (Freund and Littell 1986; Myers 1986). Cumulative probability plots of residuals were used in assessing normality of residuals. Standardized catch rates were obtained using the STANDAR (APL) version of the multiplicative analysis program.

With respect to the inshore zone, the regression of ln catch rate of Arctic charr for the 1977-92 period explained 69% of the variation in the data. Normal probability plots confirmed the general log normal distribution of the data. Both year and week classification variables were significant (Table 7). Highest catch rates occurred during weeks 31 to 33 (July 30 - August 19) and during the late 1970s and early 1980s (Table 8). The lowest catch rate recorded was in 1992. Standardized catch rates for the inshore zone are illustrated in Figure 5.

For offshore zone, the regression of ln catch rate of charr for the 1977-92 period explained 73% of the variation in the data. Normal probability plots confirmed the general log normal distribution of the data. Both year and week classification variables were significant (Table 9). Highest catch rates occurred during weeks 30 to 32 (July 23 - August 12) and have been generally increasing over time (Table 8) with some stability in recent years (Fig. 5).

Catch and effort data for the two zones were also analysed in a combined model with zone included as a classification variable. The regression of ln catch rate of charr for the 1977-92 period in this combined model explained 51% of the variation. Normal probability plots confirmed the general log normal distribution of the data. All classification variables were significant (Table 10). A comparison of the standardized and unstandardized catch rates for the combined inshore/offshore model is provided in Fig. 5.

Catch rate indices at age were estimated for the inshore (1977-92) and offshore (1982-91) zones (Table 11). Indices were derived using the catch at age of the inshore and offshore and combined total stock unit along with the estimated effort obtained from the standardization of commercial catch rates.

5. Estimation of stock size

The ADAPT framework (Gavaris 1988) was run to estimate population size in 1992. Formulations were consistent with those used in past years. The formulation was calibrated using the inshore catch rate series from 1977-92 and the offshore catch rate series from 1982-92, both disaggregated by age. Previously it had been established that intercepts were not significant and thus were not included in the current analysis. The ADAPT process is based on established methods for nonlinear paramater

estimation. The minimization procedure is applied to determine a set of paramater values such that the predicted catch at age and abundance indices by age group are closest to the observed values (further details provided in CAFSAC 1988 p. 32).

The formulation was:

Parameters:

- Year-class estimates

  $N_{i,1992}$ $i = 6$ to 14

- Calibration coefficients for inshore and offshore numbers

  $K_{1,i}$ $i = 6$ to 14 (inshore - IN)

  $K_{2,i}$ $i = 6$ to 14 (offshore - OFF)

Structure:

- Natural mortality assumed to be 0.2;
- Error in catch at age assumed negligible;
- Fishing mortality (F) for age groups 15-17 set equal to the weighted F for age groups 10-14;
- Intercepts not fitted.

Input data:

$C_{i,t}$	$i = 6$ to 17,	$t = 1977$-92
$IN_{i,t}$	$i = 6$ to 14,	$t = 1977$-92
$OFF_{i,t}$	$i = 6$ to 14,	$t = 1982$-92

Objective function:

- Minimize:

$$\sum_{it} \{obs(\ln IN_{i,t}) - pred(\ln IN_{i,t})\}^2 + \sum_{it} \{obs(\ln OFF_{i,t}) - pred(\ln OFF_{i,t})\}^2$$

Summary:

- Number of observations = 243
- Number of paramaters = 27

5.1 Assessment Results

Abundances were estimated with coefficients of variation (CV) ranging from 25 to 32% for ages 8 to 14 (Table 12). CVs on the slopes ranged from 16 to 20%. The mean square residual was

0.398. Correlations among parameter estimates were low. As noted in past years, residuals for both index series displayed some patterns (Table 13). Predicted values were higher than observed values in the inshore index for 1986, 88, 91-92 but were lower than observed values in the offshore index for 1989-91 (Table 13).

A summary of the estimated population numbers and fishing mortality are provided in Table 14. Fishing mortality in 1992 was estimated to be about 0.30 on age 10+ fish and 0.23 on 9+ fish. A conservative approach using a geometric mean from 1983-90 to estimate age 6 and 7 year old fish in 1992 results in a total estimated population size of about 159,500 fish. The 1991 population size was now estimated to be about 158,000 fish or 11.7% less than that estimated in the previous year. If a geometric mean for age 6 fish had been used, the population is estimated to be about 145,000 fish, or 19% less. The assessment suggests that estimated population size in 1992 is comparable with the average population for the period 1982-90 (Fig. 6).

A retrospective analysis carried out last year noted that there was no appreciable bias associated with the characteristic change in the terminal population size as an additional year of data is added. However, in a number of stocks, including this one, estimates of fishing mortality and population size are sensitive to changes in the abundance indices used in the callibration (Baird et al. 1992). Often there is a tendency to underestimate F and thus overestimate population size in the recent year. Undoubtedly, the late timing of the fishery in 1991 and 1992 may have contributed to low catch rates and subsequent lower estimates of stock size.

It is emphasized that independent estimates of stock size are not available either to calibrate SPA runs, or to provide actual information on current stock sizes. With this in mind, caution is advised in interpreting results on an absolute basis. At best, the historic estimates of stock size are reasonably stable. Recent years are where problems can develop. Given the data used in the current assessment, stock size does not appear to have increased.

6. Prognosis

Parameters used for projections of reference level catches were derived from the above ADAPT results and are summarized in Table 15. Weights at age were averages of values from 1989-92. Partial recruitment was obtained by averaging values from the matrix of fishing mortalities for 1983-90. Natural mortality was assumed to be 0.2 while $F_{0.1}$ was again 0.4. Recruitment for the projection was based on the geometric mean population numbers for age 6 fish (1983-90).

Results of the projections suggest that the reference level catch for 1993 should be reduced from the current 47 t TAC by about 30% to 32 t. Maintaining the current reference level catch at 47 t could increase fishing mortality to over 0.6 in 1993.

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Table 1. Summary of catch and effort statistics for the Nain assessment unit, 1974-92. Quotas and landings are in kg round weight, effort is expressed as person-weeks fished. Refer to text for information on quotas and quota area catch.

	Inshore			Offshore				Total				
	Catch	Effort	CUE	Catch	Effort	CUE	% Catch offshore	Catch	Effort*	CUE	TAC	Quota area catch
1974	30,822			6,923			18.1	37,745				
1975	31,076			2,754			8.1	33,830				
1976	50,813	146	348	2,500	52	48	4.7	53,313	196	272		
1977	70,908	183	387	5,347	114	47	7.0	76,255	291	262		
1978	70,465	212	332	3,298	106	31	4.5	73,763	314	235		
1979	54,967	189	291	11,877	152	78	17.8	66,844	336	199	61,000	52,832
1980	52,328	183	286	22,727	215	106	30.3	75,055	390	192	61,000	50,176
1981	49,956	157	318	15,676	131	120	23.9	65,632	278	236	37,160	37,223
1982	43,108	119	362	12,509	117	107	22.2	55,617	235	237	43,660	39,119
1983	33,603	147	229	17,599	149	118	34.4	51,202	289	177	51,000	19,102
1984	24,558	131	187	14,342	128	112	36.9	38,900	244	159	43,200	29,063
1985	21,527	125	172	19,631	130	151	47.7	41,158	252	163	30,500	36,019
1986	16,347	91	180	20,748	101	205	55.9	37,095	185	201	43,000	
1987	17,840	71	251	28,032	135	208	61.1	45,872	200	229	47,000	
1988	14,535	90	162	23,759	149	159	62.1	38,295	229	167	47,000	
1989	30,449	103	296	21,016	87	242	40.8	51,465	183	281	47,000	
1990	17,069	88	194	28,205	108	261	62.3	45,275	188	241	47,000	
1991	10,162	102	100	5,730	50	115	36.1	15,892	149	107	47,000	
1992	10,504	71	148	9,051	60	151	46.3	19,555	131	149	47,000	

*Total effort should be equal to or less than the sum of the inshore and offshore effort.

Table 2. Estimated catch at age from the commercial Arctic charr fishery in the Nain stock unit, 1977-92.

CATCH AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6	2003	371	430	75	145	83	470	182	103	210
7	9250	6703	4306	960	2118	977	2791	2612	2463	4129
8	12453	13122	11568	10519	6877	4782	5842	4619	6506	7713
9	7630	7984	9593	16342	15435	7255	6996	5671	4722	5862
10	5052	4406	4208	8345	9787	7987	4177	4374	4111	2857
11	2454	2367	2168	4077	3746	4936	4357	2173	2494	1284
12	988	1688	1573	1340	991	2976	2762	1495	1605	625
13	358	312	418	813	304	561	600	738	901	240
14	180	272	312	522	151	451	557	281	534	199
15	1	118	34	43	42	59	70	96	322	205
16	1	97	14	1	13	46	27	57	93	50
17	1	1	1	66	10	23	95	89	21	42
6+	40371	37441	34625	43103	39619	30136	28744	22387	23875	23416
7+	38368	37070	34195	43028	39474	30053	28274	22205	23772	23206

AGE	1987	1988	1989	1990	1991	1992
6	483	204	903	459	203	269
7	5462	6288	4750	4726	1365	3195
8	6293	7166	9707	6115	2085	3809
9	7548	4688	8464	8844	2631	3166
10	4498	3607	3785	4681	2175	2574
11	2013	1631	2853	1908	874	905
12	1375	650	1234	927	444	422
13	898	324	665	378	183	241
14	306	136	277	137	92	48
15	357	52	28	186	48	32
16	180	20	6	1	36	1
17	37	40	1	1	2	1
6+	29450	24806	32673	28363	10138	14663
7+	28967	24602	31770	27904	9935	14394

Table 3. Summary of catch-at-age data for the Nain stock unit in 1992, with standard error and coefficient of variation (C.V.).

Age	Catch at age	Standard Error	C.V. (%)
6	269	56.8	21.1
7	3195	222.7	7.0
8	3809	241.9	6.4
9	3166	226.9	7.2
10	2574	207.3	8.1
11	905	124.7	13.8
12	422	92.0	21.8
13	241	67.4	28.0
14	48	33.4	69.7
15	32	21.4	66.8

Table 4. Summary of percent at age in the commercial catch of Arctic charr from the Nain stock unit, 1977-92.

PERCENT AT AGE

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	5.0	1.0	1.2	0.2	0.4	0.3	1.6	0.8	0.4	0.9	1.6	0.8
7	22.9	17.9	12.4	2.2	5.3	3.2	9.7	11.7	10.3	17.6	18.5	25.3
8	30.8	35.0	33.4	24.4	17.4	15.9	20.3	20.6	27.3	32.9	21.4	28.9
9	18.9	21.3	27.7	37.9	39.0	24.1	24.3	25.3	19.8	25.0	25.6	18.9
10	12.5	11.8	12.2	19.4	24.7	26.5	14.5	19.5	17.2	12.2	15.3	14.5
11	6.1	6.3	6.3	9.5	9.5	16.4	15.2	9.7	10.4	5.5	6.8	6.6
12	2.4	4.5	4.5	3.1	2.5	9.9	9.6	6.7	6.7	2.7	4.7	2.6
13	0.9	0.8	1.2	1.9	0.8	1.9	2.1	3.3	3.8	1.0	3.0	1.3
14	0.4	0.7	0.9	1.2	0.4	1.5	1.9	1.3	2.2	0.8	1.0	0.5
15	0.0	0.3	0.1	0.1	0.1	0.2	0.2	0.4	1.3	0.9	1.2	0.2
16	0.0	0.3	0.0	0.0	0.0	0.2	0.1	0.3	0.4	0.2	0.6	0.1
17	0.0	0.0	0.0	0.2	0.0	0.1	0.3	0.4	0.1	0.2	0.1	0.2

	1989	1990	1991	1992
6	2.8	1.6	2.0	1.8
7	14.5	16.7	13.5	21.8
8	29.7	21.6	20.6	26.0
9	25.9	31.2	26.0	21.6
10	11.6	16.5	21.5	17.6
11	8.7	6.7	8.6	6.2
12	3.8	3.3	4.4	2.9
13	2.0	1.3	1.8	1.6
14	0.8	0.5	0.9	0.3
15	0.1	0.7	0.5	0.2
16	0.0	0.0	0.4	0.0
17	0.0	0.0	0.0	0.0

Table 5. Summary of slope and intercept parameters from log - log weight length relationship for Arctic charr from the Nain Stock unit.

Year	N	Slope	Intercept	R^2	P
1980	640	3.228	-5.330	0.877	0.0001
1981	736	3.156	-5.215	0.912	0.0001
1982	888	2.894	-4.738	0.852	0.0001
1983	1030	2.911	-4.754	0.851	0.001
1984	1017	2.688	-4.386	0.874	0.0001
1985	1272	2.725	-4.462	0.878	0.0001
1986	1160	2.527	-4.099	0.8573	0.0001
1987	1506	2.537	-4.122	0.8587	0.0001
1988	1635	2.587	-4.218	0.837	0.0001
1989	931	2.523	-4.096	0.807	0.0001
1990	852	2.549	-4.144	0.860	0.0001
1991	889	2.527	-4.128	0.874	0.0001
1992	966	2.720	-4.470	0.879	0.0001

Table 6. Average weight at age (kg-round) from the Nain stock unit commercial catch of Arctic charr, 1977-92.

AVERAGE WEIGHT AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	0.89	1.31	1.37	0.89	0.79	1.13	1.27	1.18	1.10	1.15	1.14	1.13
7	1.28	1.71	1.52	1.20	1.18	1.37	1.56	1.40	1.43	1.37	1.33	1.38
8	1.77	1.86	1.85	1.52	1.51	1.68	1.66	1.63	1.65	1.56	1.53	1.55
9	2.07	2.24	2.02	1.78	1.70	1.84	1.84	1.78	1.78	1.69	1.62	1.63
10	2.59	2.41	2.08	1.93	1.76	1.89	1.88	1.88	1.83	1.69	1.65	1.64
11	2.86	2.35	2.18	1.83	1.78	1.93	1.88	1.87	1.81	1.68	1.68	1.67
12	2.74	2.67	2.41	1.91	1.80	1.96	1.92	1.89	1.83	1.70	1.71	1.71
13	3.16	3.34	2.25	1.93	1.74	2.11	1.96	1.93	1.82	1.95	1.68	1.70
14	3.28	2.88	1.94	1.97	1.72	1.93	1.77	2.07	1.90	1.79	1.74	1.44
15	2.65	2.65	2.65	2.71	2.87	2.26	1.84	1.84	1.89	1.61	1.80	1.68
16	2.15	2.15	2.15	2.15	3.88	2.69	2.05	1.46	1.53	1.71	1.61	1.75
17	2.45	2.45	2.45	4.43	2.45	2.69	2.28	1.91	1.64	1.64	2.03	1.75

AGE	1989	1990	1991	1992
6	1.16	1.17	1.29	0.94
7	1.38	1.42	1.38	1.20
8	1.56	1.50	1.54	1.33
9	1.63	1.66	1.59	1.37
10	1.71	1.76	1.63	1.41
11	1.68	1.68	1.71	1.54
12	1.64	1.77	1.70	1.44
13	1.69	1.65	1.76	1.49
14	1.74	1.75	1.65	1.52
15	1.97	1.46	1.66	1.93
16	2.56	1.97	1.47	1.87
17	1.64	1.81	4.65	2.38

MEAN AGE OF INDIVIDUALS IN CATCH

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	8.46	8.75	8.87	9.34	9.28	9.83	9.52	9.40	9.47	8.77	9.10	8.65

AGE	1989	1990	1991	1992
	8.86	8.92	9.16	8.73

MEAN WEIGHT OF INDIVIDUALS IN CATCH

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	1.88	2.06	1.93	1.75	1.66	1.85	1.79	1.74	1.73	1.59	1.56	1.55

AGE	**1989**	**1990**	**1991**	**1992**
	1.58	**1.60**	**1.57**	**1.34**

Table 7. Results of the analysis of variance of log transformed catch rate from the inshore zone of the Nain stock unit, 1977-92.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	28	69.88743542	2.49597984	10.54	0.0001	0.687664	9.4489
ERROR	134	31.74281295	0.23688666		ROOT MSE		CUE MEAN
CORRECTED TOTAL	162	101.63024837			0.48671004		5.15097374

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
YY	15	37.96424772	10.68	0.0001	15	32.02006699	9.01	0.0001
WK	13	31.92318770	10.37	0.0001	13	31.92318770	10.37	0.0001

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	6.38264394	0.22248682	28.688	0.0001
YY78	1	0.06084179	0.27318616	0.223	0.8241
YY79	1	0.02538378	0.27386063	0.093	0.9263
YY80	1	-0.358331	0.23768506	-1.508	0.1340
YY81	1	-0.287597	0.24171760	-1.190	0.2362
YY82	1	-0.0920769	0.23754864	-0.388	0.6989
YY83	1	-0.592154	0.23465667	-2.523	0.0128
YY84	1	-0.688186	0.24151661	-2.849	0.0051
YY85	1	-0.659642	0.23465667	-2.811	0.0057
YY86	1	-1.10118	0.23754864	-4.636	0.0001
YY87	1	-0.510114	0.23566173	-2.165	0.0322
YY88	1	-1.09964	0.23162215	-4.748	0.0001
YY89	1	-0.910846	0.23398300	-3.893	0.0002
YY90	1	-0.98639	0.23754864	-4.152	0.0001
YY91	1	-1.33688	0.23934429	-5.586	0.0001
YY92	1	-1.68172	0.26526713	-6.340	0.0001
WK24	1	-1.74008	0.38373600	-4.535	0.0001
WK25	1	-0.70367	0.22417130	-3.139	0.0021
WK26	1	-0.638303	0.18985157	-3.362	0.0010
WK27	1	-0.69055	0.18301676	-3.773	0.0002
WK28	1	-0.630561	0.18301676	-3.445	0.0008
WK29	1	-0.748155	0.18634919	-4.015	0.0001
WK30	1	-0.550987	0.18634919	-2.957	0.0037
WK32	1	0.08159312	0.18774991	0.435	0.6646
WK33	1	0.07022223	0.19174998	0.366	0.7148
WK34	1	-0.483807	0.19292398	-2.508	0.0133
WK35	1	-0.651676	0.19612522	-3.323	0.0011
WK36	1	-1.2585	0.23278754	-5.406	0.0001
WK37	1	-2.06249	0.26288694	-7.846	0.0001

Table 8. Standardized catch rates (C/E, kg/person-week fished) with standard error (SE) for the Nain stock units, 1977-92.

	Inshore Unit		Offshore Unit		Total		
Year	C/E	SE	C/E	SE	C/E	SE	Effort
1977	650	143	66	14	288	60	264
1978	687	168	53	12	259	57	285
1979	663	162	130	28	408	89	164
1980	457	89	170	35	440	84	170
1981	490	98	192	42	475	93	138
1982	596	116	179	39	531	102	105
1983	362	69	195	41	417	79	123
1984	328	65	233	46	416	79	94
1985	338	65	297	60	482	90	85
1986	217	42	290	63	363	70	102
1987	393	76	292	59	494	92	93
1988	218	41	235	48	326	60	117
1989	263	52	367	77	461	88	112
1990	243	48	287	58	397	75	114
1991	172	34	227	54	281	56	57
1992	121	27	222	48	274	57	71

Table 9. Results of the analysis of variance of log transformed catch rate from the offshore zone of the Nain stock unit, 1977-92.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	26	77.93129800	2.99735762	11.65	0.0001	0.726519	11.1885
ERROR	114	29.33546764	0.25732866		ROOT MSE		CUE MEAN
CORRECTED TOTAL	140	107.26676565			0.50727573		4.53390932

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
YY	15	34.16585177	8.85	0.0001	15	31.71361005	8.22	0.0001
WK	11	43.76544623	15.46	0.0001	11	43.76544623	15.46	0.0001

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	4.08254817	0.21837714	18.695	0.0001
YY78	1	-0.222778	0.26318741	-0.846	0.3991
YY79	1	0.68277859	0.25714622	2.655	0.0091
YY80	1	0.94331019	0.24702481	3.819	0.0002
YY81	1	1.06998033	0.25714622	4.161	0.0001
YY82	1	0.99795038	0.25545017	3.907	0.0002
YY83	1	1.08042918	0.24910635	4.337	0.0001
YY84	1	1.25981239	0.23828193	5.287	0.0001
YY85	1	1.50194958	0.24187240	6.210	0.0001
YY86	1	1.48311147	0.25545017	5.806	0.0001
YY87	1	1.48600572	0.24219982	6.135	0.0001
YY88	1	1.26698167	0.24620691	5.146	0.0001
YY89	1	1.71459615	0.25166957	6.813	0.0001
YY90	1	1.46766165	0.24471761	5.997	0.0001
YY91	1	1.24125509	0.26438091	4.695	0.0001
YY92	1	1.21507689	0.25477781	4.769	0.0001
WK25	1	-2.29329	0.39742839	-5.770	0.0001
WK26	1	-0.694683	0.29474069	-2.357	0.0201
WK27	1	-0.991014	0.21734006	-4.560	0.0001
WK28	1	-1.10273	0.18987326	-5.808	0.0001
WK29	1	-0.66687	0.18987326	-3.512	0.0006
WK30	1	-0.305352	0.18523091	-1.648	0.1020
WK32	1	-0.0463057	0.18274124	-0.253	0.8004
WK33	1	-0.264153	0.18274124	-1.446	0.1511
WK34	1	-0.708087	0.18274124	-3.875	0.0002
WK35	1	-1.29523	0.19406212	-6.674	0.0001
WK36	1	-2.07424	0.23918531	-8.672	0.0001

Table 10. Results of the analysis of variance of log transformed catch rate from the Nain stock unit, 1977-92.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	29	120.24330209	4.14632076	9.67	0.0001	0.505896	13.4577
ERROR	274	117.44056225	0.42861519		ROOT MSE		CUE MEAN
CORRECTED TOTAL	303	237.68386434			0.65468709		4.86476952

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
YY	15	19.12970819	2.98	0.0002	15	13.60573637	2.12	0.0095
ZN	1	27.96321830	65.24	0.0001	1	37.28969590	87.00	0.0001
WK	13	73.15037560	13.13	0.0001	13	73.15037560	13.13	0.0001

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	5.47118636	0.20873046	26.212	0.0001
YY78	1	-0.105314	0.24863331	-0.424	0.6722
YY79	1	0.34810943	0.24495346	1.421	0.1564
YY80	1	0.41950454	0.22414537	1.872	0.0623
YY81	1	0.49730974	0.23007786	2.161	0.0315
YY82	1	0.60669815	0.22718687	2.670	0.0080
YY83	1	0.36551787	0.22226165	1.645	0.1012
YY84	1	0.36168973	0.22173319	1.631	0.1040
YY85	1	0.51024118	0.22011420	2.318	0.0212
YY86	1	0.22675893	0.22718687	0.998	0.3191
YY87	1	0.53431446	0.21979954	2.431	0.0157
YY88	1	0.11870875	0.21891258	0.542	0.5881
YY89	1	0.46640109	0.22158322	2.105	0.0362
YY90	1	0.31485920	0.22228278	1.416	0.1578
YY91	1	-0.0272423	0.23084316	-0.118	0.9061
YY92	1	-0.0524174	0.24074042	-0.218	0.8278
ZN2	1	-0.727733	0.07802097	-9.327	0.0001
WK24	1	-2.03946	0.49093221	-4.154	0.0001
WK25	1	-1.02217	0.24637198	-4.149	0.0001
WK26	1	-0.511784	0.20060161	-2.551	0.0113
WK27	1	-0.724935	0.18138069	-3.997	0.0001
WK28	1	-0.742661	0.17246203	-4.306	0.0001
WK29	1	-0.615887	0.17418233	-3.536	0.0005
WK30	1	-0.364223	0.17243832	-2.112	0.0356
WK32	1	0.0181072	0.17217431	0.105	0.9163
WK33	1	-0.1408	0.17372552	-0.810	0.4184
WK34	1	-0.572175	0.17394278	-3.289	0.0011
WK35	1	-1.02908	0.18086652	-5.690	0.0001
WK36	1	-1.79879	0.21750625	-8.270	0.0001
WK37	1	-2.35759	0.32557334	-7.241	0.0001

Table 11. Catch rate indices for the inshore and offshore zones of the Nain stock unit used in the ADAPT calibration process.

NAIN UNIT INSHORE COMMERCIAL CATCH RATE AT AGE

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	17.1	3.4	4.3	0.5	1.1	0.9	2.3	0.9	0.2	1.4	4.5	1.3
7	78.9	62.2	42.7	5.9	15.8	7.4	17.2	18.3	14.6	23.5	44.9	37.4
8	106.2	121.7	114.6	63.7	51.3	47.6	36.6	33.7	42.1	44.5	48.0	41.2
9	65.1	74.0	95.0	99.0	115.2	82.5	46.9	46.7	37.6	33.3	62.2	25.3
10	43.1	40.9	41.7	50.6	73.1	84.9	29.7	41.4	37.8	16.0	40.5	18.7
11	20.9	22.0	21.5	24.7	28.0	56.4	30.0	19.0	22.9	7.3	19.6	8.8
12	8.4	15.7	15.6	8.1	7.4	33.3	22.2	13.6	15.0	4.3	12.6	3.5
13	3.1	2.9	4.1	4.9	2.3	5.8	4.7	6.0	7.9	1.6	9.3	2.1
14	1.5	2.5	3.1	3.2	1.1	4.5	3.9	1.2	4.8	1.4	3.3	1.0

	1989	1990	1991	1992
6	5.0	3.1	2.3	2.1
7	26.4	28.0	15.5	24.1
8	49.1	32.0	20.5	24.2
9	43.6	46.0	29.1	16.7
10	17.9	23.8	23.5	16.4
11	13.8	11.0	9.2	6.1
12	5.2	4.8	3.9	2.0
13	2.4	1.8	1.9	1.5
14	1.5	0.8	1.3	0.4

NAIN UNIT OFFSHORE COMMERCIAL CATCH RATE AT AGE

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
6	0.3	3.0	1.5	2.6	0.4	2.0	1.0	6.6	1.9	2.2	2.1
7	11.8	13.1	16.6	30.8	33.7	40.4	34.0	30.4	24.9	14.6	26.9
8	22.0	28.3	32.9	72.3	60.7	59.4	42.4	70.1	40.1	36.6	42.5
9	12.6	32.1	35.8	34.8	50.9	54.9	31.4	59.7	58.4	35.3	44.5
10	30.4	15.9	22.2	19.7	26.3	24.3	26.0	30.2	33.3	32.3	27.4
11	9.7	18.8	13.2	10.2	10.5	5.6	11.2	21.5	10.8	13.2	7.8
12	8.8	5.4	8.0	5.6	1.9	7.0	4.4	11.7	6.3	9.5	6.4
13	1.5	1.8	5.1	5.1	1.0	1.6	1.4	7.7	2.7	2.8	3.1
14	1.3	2.3	2.7	2.6	0.5	0.0	0.4	2.0	0.9	0.4	0.5

Table 12. Parameter estimates from ADAPT using inshore (1977-92) and offshore (1982-92) catch rates, ages 6-14, in a single analysis.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.061620
MEAN SQUARE RESIDUALS 0.398415

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
6	ABUNDANCE	6.57530E4	3.06054E4	2.14842E0	0.47
7	ABUNDANCE	5.22630E4	1.69705E4	3.07965E0	0.32
8	ABUNDANCE	2.80973E4	7.51413E3	3.73926E0	0.27
9	ABUNDANCE	2.23851E4	5.58807E3	4.00587E0	0.25
10	ABUNDANCE	9.97629E3	2.44906E3	4.07352E0	0.25
11	ABUNDANCE	4.81168E3	1.40303E3	3.42950E0	0.29
12	ABUNDANCE	1.78287E3	5.29628E2	3.36627E0	0.30
13	ABUNDANCE	9.67006E2	2.81659E2	3.43326E0	0.29
14	ABUNDANCE	2.84973E2	9.05594E1	3.14680E0	0.32
6	RV1 SLOPE	3.77011E_5	6.19657E_6	6.08419E0	0.16
7	RV1 SLOPE	5.67494E_4	9.16683E_5	6.19074E0	0.16
8	RV1 SLOPE	1.68050E_3	2.69623E_4	6.23278E0	0.16
9	RV1 SLOPE	2.97993E_3	4.76778E_4	6.25013E0	0.16
10	RV1 SLOPE	3.82889E_3	6.13712E_4	6.23890E0	0.16
11	RV1 SLOPE	4.03968E_3	6.48896E_4	6.22546E0	0.16
12	RV1 SLOPE	4.48567E_3	7.20837E_4	6.22286E0	0.16
13	RV1 SLOPE	4.01542E_3	6.44560E_4	6.22972E0	0.16
14	RV1 SLOPE	5.20247E_3	8.31604E_4	6.25595E0	0.16
6	RV2 SLOPE	3.36043E_5	6.77856E_6	4.95744E0	0.20
7	RV2 SLOPE	6.63734E_4	1.30639E_4	5.08067E0	0.20
8	RV2 SLOPE	1.82619E_3	3.55979E_4	5.13004E0	0.19
9	RV2 SLOPE	2.70878E_3	5.25919E_4	5.15056E0	0.19
10	RV2 SLOPE	3.50137E_3	6.81553E_4	5.13734E0	0.19
11	RV2 SLOPE	3.04477E_3	5.94512E_4	5.12146E0	0.20
12	RV2 SLOPE	3.58732E_3	7.00872E_4	5.11837E0	0.20
13	RV2 SLOPE	3.29004E_3	6.41774E_4	5.12647E0	0.20
14	RV2 SLOPE	2.22251E_3	4.30921E_4	5.15758E0	0.19

Table 13. Residuals from ADAPT using inshore (1977-92) and offshore (1982-92) zone catch rates, ages 6-14, in a single analysis.

LOG RESIDUALS FOR INSHORE INDEX

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6	1.418	0.004	0.852	_1.317	_0.357	_0.380	0.312	_0.716	_1.971	_0.289
7	0.658	0.247	0.043	_1.319	_0.264	_0.948	0.063	_0.095	_0.416	0.259
8	0.553	0.406	0.106	_0.309	0.095	0.074	_0.095	0.012	0.024	_0.012
9	0.249	0.182	0.084	_0.097	0.270	0.544	_0.004	0.095	0.065	_0.248
10	0.079	0.206	_0.073	_0.172	0.031	0.451	_0.050	0.311	0.310	_0.420
11	_0.083	0.009	0.209	0.083	_0.117	0.454	0.182	0.175	0.490	_0.733
12	0.222	0.240	0.273	_0.087	_0.490	0.843	0.238	0.101	0.827	_0.544
13	0.247	0.000	_0.330	0.077	_0.566	_0.053	_0.124	_0.216	0.503	_0.348
14	_0.554	0.990	0.758	_0.154	_0.988	0.741	0.056	_1.108	_0.020	_0.733

	1987	1988	1989	1990	1991	1992
6	0.780	_0.167	1.056	0.729	0.058	_0.049
7	0.712	0.458	0.437	0.347	_0.148	_0.072
8	0.302	_0.051	0.104	_0.019	_0.744	_0.483
9	0.348	_0.373	0.078	0.188	_0.224	_1.195
10	0.420	_0.411	_0.280	0.157	_0.024	_0.572
11	0.484	_0.395	0.137	0.038	_0.038	_0.933
12	0.444	_0.578	_0.118	0.113	_0.383	_1.139
13	1.526	_0.460	0.221	0.016	0.181	_0.710
14	1.327	0.674	_0.365	0.283	0.241	_1.186

SUM OF INDEX 1 RESIDUALS : _0.3458899074 MEAN RESIDUAL : _0.0024020132

LOG RESIDUALS FOR OFFSHORE INDEX

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
6	_1.566	0.687	_0.082	0.622	_1.434	0.087	_0.320	1.457	0.332	0.126
7	_0.635	_0.367	_0.347	0.175	0.465	0.448	0.205	0.423	0.073	_0.362
8	_0.783	_0.435	_0.094	0.482	0.215	0.432	_0.106	0.377	0.124	_0.248
9	_1.243	_0.289	_0.075	0.082	0.272	0.318	_0.062	0.489	0.523	0.067
10	_0.485	_0.589	_0.220	_0.253	0.165	_0.000	0.011	0.333	0.582	0.385
11	_1.026	_0.001	0.094	_0.033	_0.088	_0.485	0.135	0.862	0.297	0.611
12	_0.265	_0.954	_0.204	0.061	_1.138	0.081	_0.133	0.924	0.596	0.738
13	_1.182	_0.887	_0.172	0.277	_0.608	_0.062	_0.651	1.594	0.625	0.769
14	0.363	0.379	0.510	0.227	_0.844	_3.591	0.761	0.803	1.267	0.044

	1992
6	0.052
7	_0.117
8	_0.003
9	_0.120
10	0.032
11	_0.405
12	0.257
13	0.257
14	0.042

SUM OF INDEX 2 RESIDUALS : _0.3455697023 MEAN RESIDUAL : _0.0034906031

Table 14. Estimated population numbers and fishing mortality from ADAPT using inshore (1977-92) and offshore (1982-92) catch rates, ages 6-14, in a single analysis.

POPULATION NUMBERS

	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	122369	100563	53575	50488	46089	40525	50081	54511	46068
7	84838	98375	81998	43474	41269	37603	33104	40577	44465
8	47637	61090	74478	63238	34725	31871	29903	24578	30858
9	23499	27734	38143	50510	42257	22208	21767	19196	15943
10	14627	12336	15482	22549	26567	20631	11618	11491	10585
11	7728	7404	6113	8868	10910	12896	9664	5732	5450
12	2297	4107	3920	3043	3572	5543	6092	3970	2727
13	884	987	1835	1786	1279	2028	1846	2488	1898
14	674	400	526	1124	727	772	1152	968	1370
15	137	389	81	148	448	458	224	439	538
16	4	111	212	36	82	329	322	120	273
17	3	3	3	161	28	56	228	239	47
6+	304698	313498	276366	245426	207954	174921	166001	164312	160223

	1986	1987	1988	1989	1990	1991	1992
6	56483	61192	44060	51420	44083	63878	65639
7	37624	46054	49663	35889	41282	35677	52115
8	34176	27068	32764	34971	25085	29523	27975
9	19378	21002	16467	20341	19849	15005	22285
10	8781	10561	10365	9240	8995	8248	9904
11	4947	4604	4577	5223	4141	3129	4785
12	2206	2888	1948	2271	1694	1664	1771
13	780	1240	1121	1007	743	549	960
14	738	422	203	624	222	266	284
15	638	425	68	43	260	58	135
16	149	337	25	9	10	45	4
17	139	77	113	2	2	7	4
6+	166040	175871	161374	161040	146368	158049	185861

FISHING MORTALITY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
6	0.018	0.004	0.009	0.002	0.003	0.002	0.010	0.004	0.002	0.004	0.009
7	0.128	0.078	0.060	0.025	0.058	0.029	0.098	0.074	0.063	0.129	0.140
8	0.341	0.271	0.188	0.203	0.247	0.181	0.243	0.233	0.265	0.287	0.297
9	0.444	0.383	0.326	0.442	0.517	0.448	0.439	0.395	0.396	0.407	0.506
10	0.481	0.502	0.357	0.526	0.523	0.558	0.506	0.546	0.561	0.446	0.636
11	0.432	0.436	0.498	0.709	0.477	0.550	0.690	0.543	0.705	0.338	0.660
12	0.645	0.606	0.586	0.667	0.366	0.900	0.695	0.538	1.051	0.376	0.747
13	0.593	0.430	0.290	0.699	0.305	0.365	0.445	0.397	0.744	0.415	1.610
14	0.350	1.393	1.067	0.720	0.261	1.037	0.764	0.387	0.564	0.354	1.618
15	0.008	0.408	0.621	0.387	0.109	0.153	0.423	0.276	1.082	0.439	2.649
16	0.286	3.365	0.076	0.031	0.192	0.168	0.097	0.743	0.472	0.462	0.892
17	0.481	0.510	0.429	0.595	0.487	0.600	0.609	0.523	0.673	0.401	0.740

	1988	1989	1990	1991	1992
6	0.005	0.020	0.012	0.004	0.005
7	0.151	0.158	0.135	0.043	0.070
8	0.277	0.366	0.314	0.081	0.162
9	0.378	0.616	0.678	0.215	0.170
10	0.485	0.603	0.856	0.344	0.336
11	0.501	0.926	0.712	0.369	0.233
12	0.460	0.917	0.928	0.350	0.303
13	0.385	1.310	0.826	0.460	0.322
14	1.348	0.674	1.141	0.481	0.206
15	1.830	1.261	1.557	2.426	0.302
16	2.298	1.338	0.117	2.167	0.302
17	0.490	0.775	0.829	0.358	0.302

Table 15. Parameters used as input for the reference level catch projections of the Nain Stock Unit.

Age	Mean Weight (kg)	Population Numbers	Partial Recruitment
6	1.14	50664	0.013
7	1.35	40758	0.199
8	1.48	27975	0.475
9	1.56	22285	0.773
10	1.63	9904	1.0
11	1.65	4785	1.0
12	1.64	1771	1.0
13	1.65	960	1.0
14	1.67	284	1.0
15	1.76	134	1.0
16	1.97	4	1.0
17	2.62	4	1.0

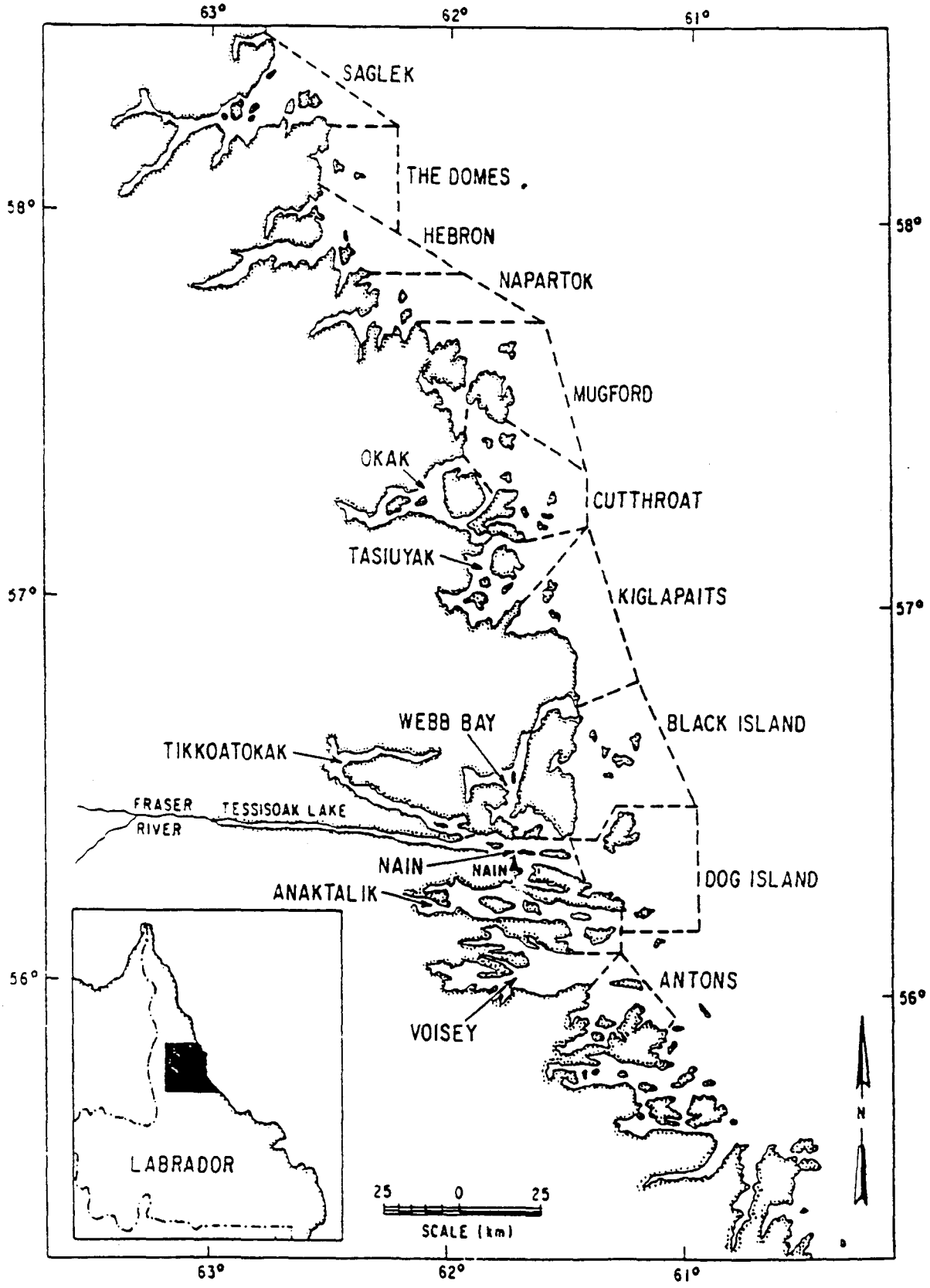


Figure 1. Geographical separation of the Nain Fishing Region subareas.

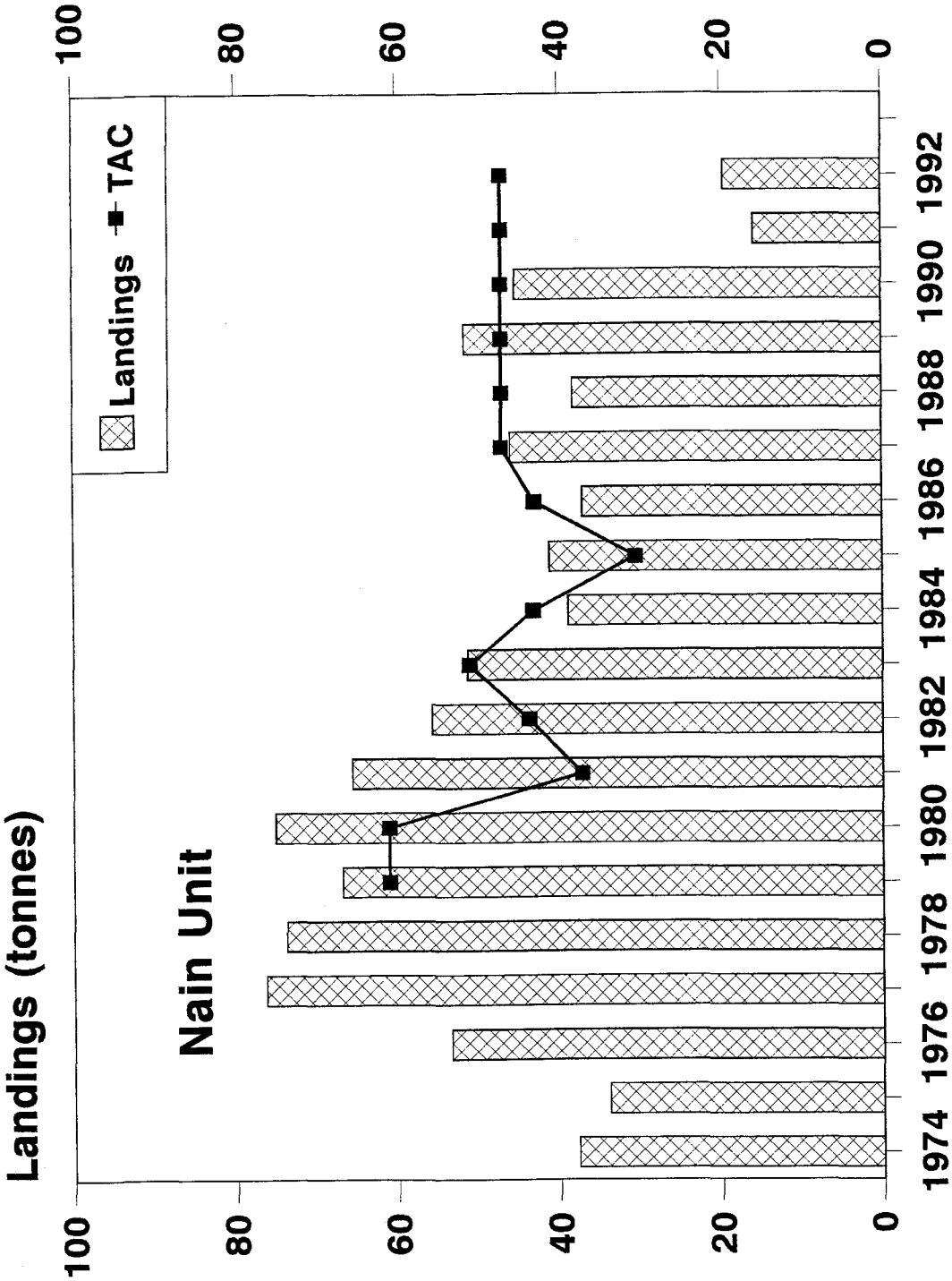


Fig. 2. Summary of Arctic charr landings from the Nain stock unit in relation to the total allowable catch (TAC).

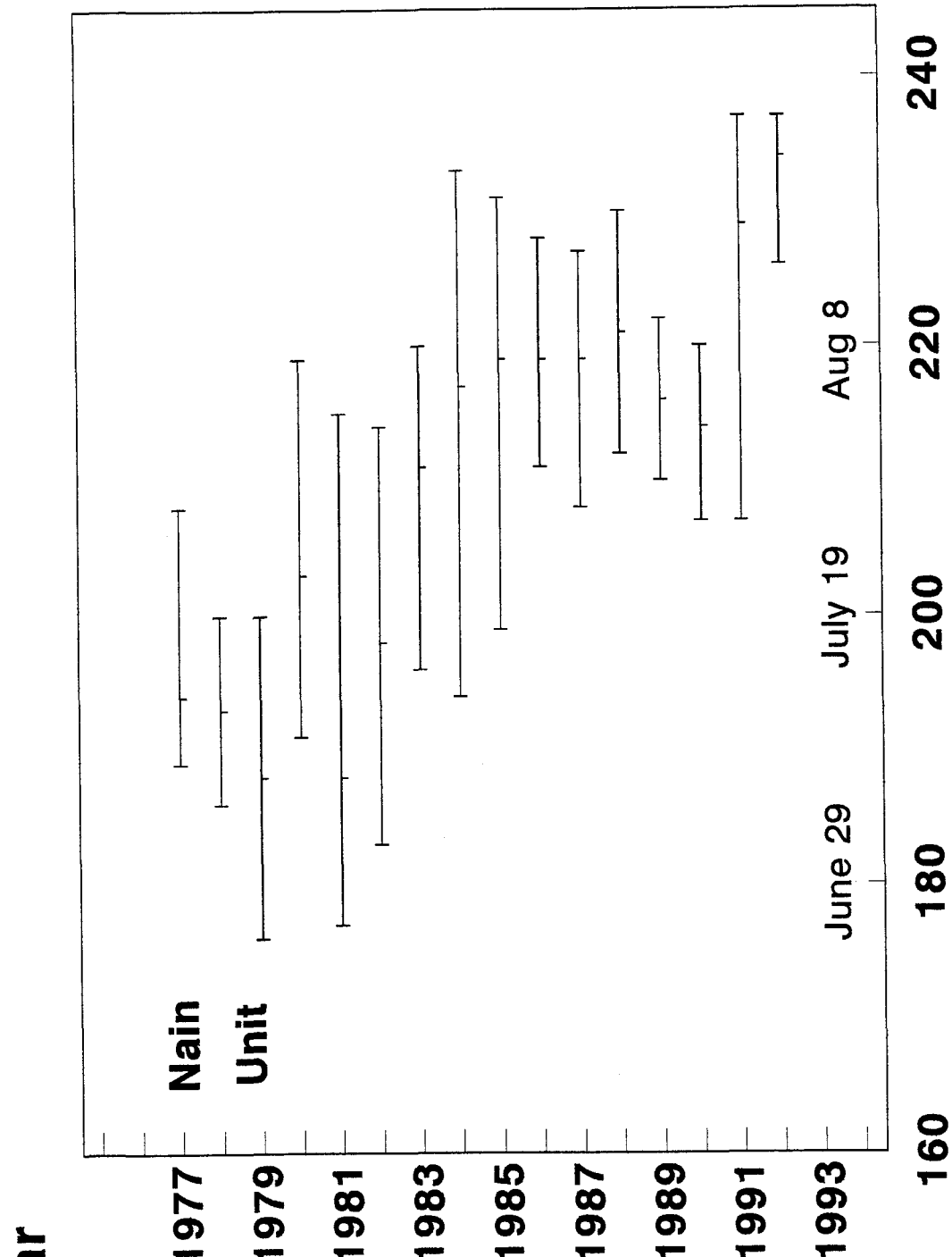


Fig. 3. Catch timing of the Nain stock unit Arctic charr commercial fishery, 1977-92. The median point, along with the 25th and 75th percentiles are illustrated.

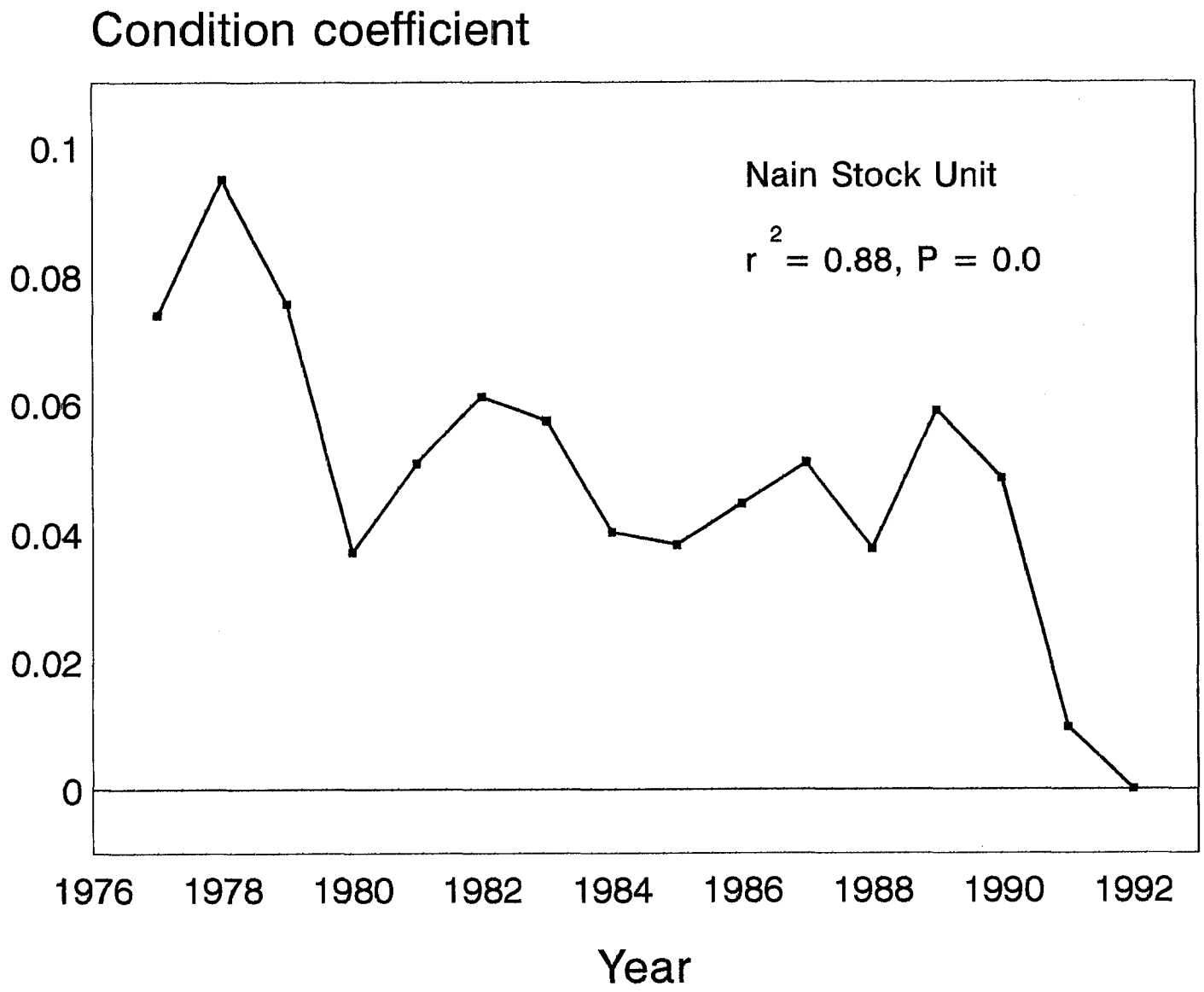
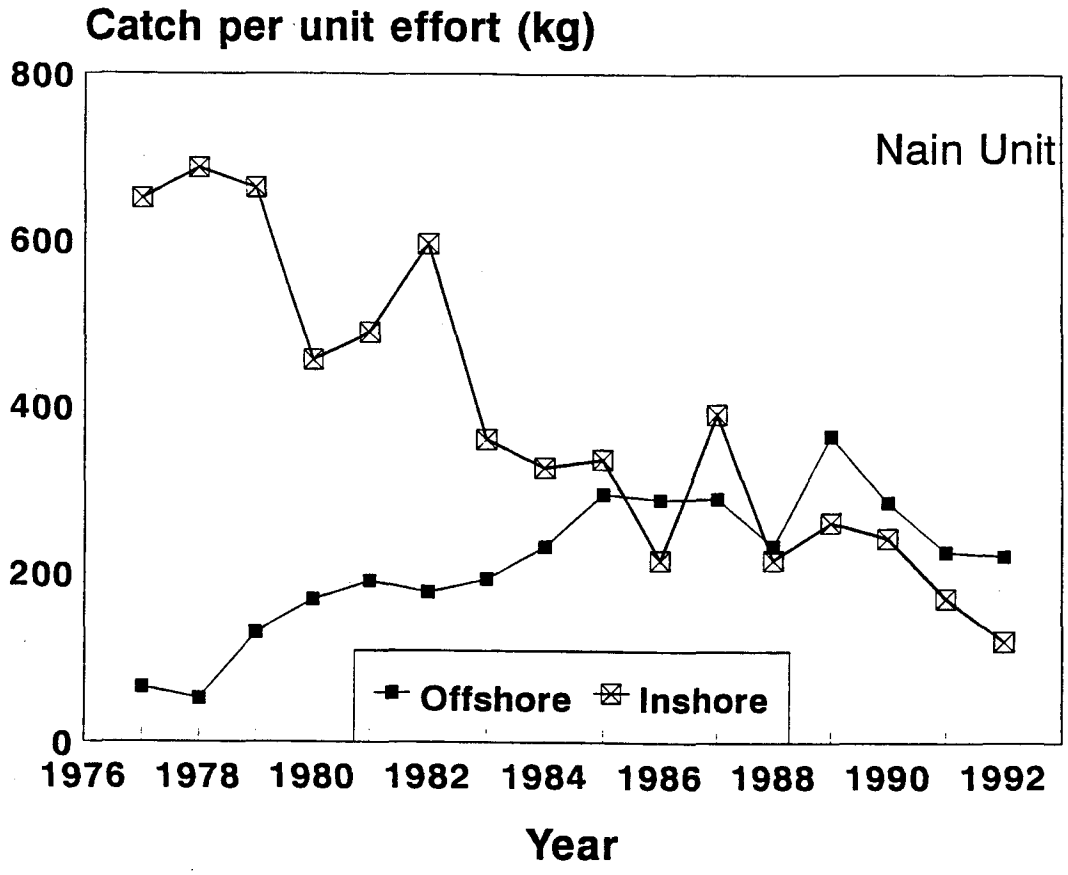


Fig. 4. Index of annual change in condition of Arctic charr (see text) from the Nain stock unit, 1977-92.



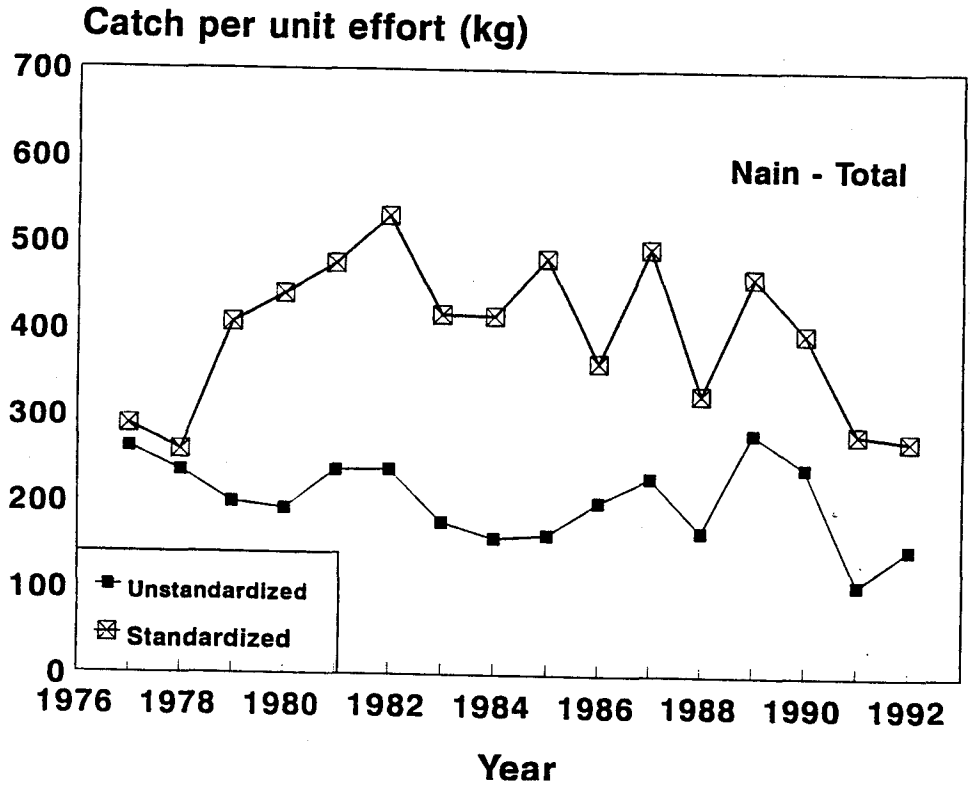


Fig. 5. Top pannel - standardized catch rates for the inshore and offshore fishing zones of the Nain stock unit. Bottom pannel - comparison of standardized and unstandardized catch rates for the Nain stock unit, isnhore and offshore zones combined.

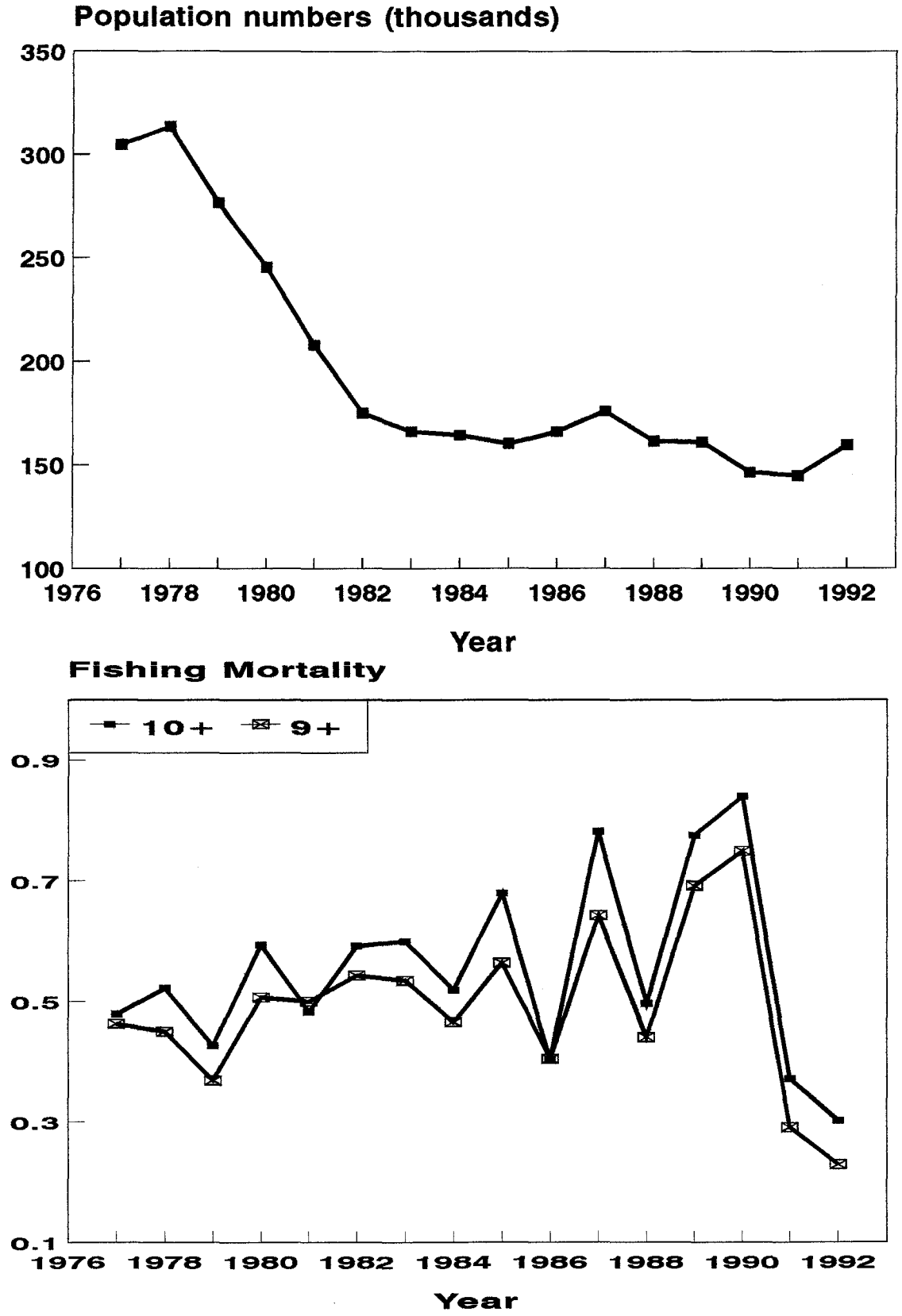


Fig. 6. Estimated population numbers and fishing mortality rates for the Nain stock unit Arctic charr population, 1977-92.