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An assessment of American plaice in NAFO Divisions 3LNO

by

W. B. Brodie and T. K. Pitt

Fisheries Research Branch, Department of Fisheries and Oceans,
P. O. Box 5667, St. John's, Newfoundland A1C 5X1

INTRODUCTION

TAC regulation:

This stock has been under quota regulation since 1973, when a TAC of 60,000t was set (Table 1). The TAC was lowered to 47,000t in 1976 where it remained until 1981, at which time it was raised to the current level of 55,000t.

Catch trends:

This stock has been exploited since the early 1950's and the nominal catch reached a peak of 94,000t in 1967 (Table 1). There were significant catches by the USSR in the period 1965-1976, after which time the fishery became almost exclusively Canadian, with the average annual catch close to 50,000t since 1976. In most years, the majority of the catch has come from Division 3L (Table 2), with catches in recent years averaging close to 30,000t.

Catch/effort:

Catch rates of American plaice by Can (N) TC5 otter trawls (Table 3) declined steadily from a level of approximately 0.9 t/hr in the early to mid 1960's to a level close to 0.4 t/hr in the mid 1970's (Fig. 1). Since then, catch rates have shown an overall increasing trend with the 1983 value equal to 0.62 t/hr and the average 1980-83 value equal to 0.59 t/hr.

STOCK ASSESSMENT

As has been the case in recent years, only the portion of the stock in Divisions 3LN was assessed. In previous years, an amount for Division 3Ø (where recent catches have averaged less than 5,000t) was added to the figure calculated for Divisions 3LN to produce a TAC for the stock area.

Sampling:

The length measurements and otolith samples used (Table 4) were collected by the Canadian Commercial Groundfish Sampling Section in St. John's.

Number caught at age:

These were determined in the usual manner by applying quarterly age-length keys (sexes separate) to monthly length frequencies (when available) for each NAFO Division. Total catch at age for 1983 is shown in Table 5 and was obtained by combining male and female numbers at age for Divisions 3LN. Table 6 shows the catch at age for 1960-83 and Table 7 contains the corresponding percent at age. Although numbers at age are available for 1960-83, the pre-1965 data were not used in cohort analysis calibrations because the sampling level during this period was considerably lower than that of subsequent years (Pitt and Brodie, 1981).

Weights at age:

These were determined for the 1983 catch in the usual fashion by applying a length-weight equation to monthly average lengths at age (weighted by numbers caught at age). The 1983 weights are given in Table 5 and are higher at ages 6-10 than those observed in recent years

(Table 8), although it can be seen from this table that weights at age often change significantly between years. Table 9 contains the calculated catch biomass (numbers at age multiplied by weights at age) which compares favorably most years with the nominal catch in Divisions 3LN (Table 2).

Natural mortality:

The value of 0.2 used in previous assessments was used.

Discard estimates:

Stevenson (1980, 1981, 1982, 1983) calculated estimates of discarding of American plaice by Can(N) TC5 otter trawlers fishing in Divisions 3LNO in the period 1978-82. These estimates, given in Table 10, show that significant numbers of young (age 6-10) plaice were discarded during this time. Also, noticeable is the increase in discarding in all 5 age groups between 1980 and 1982. There are no comparable estimates of discarding by age for 1983. Because of the relatively short time series (compared to the catch matrix) of discard estimates, no adjustment for discarding has been made to the numbers at age and as such they represent numbers landed rather than numbers caught.

Research vessel survey data:

Tables 12-14 give the results of random stratified surveys conducted by Canadian research vessels in selected strata in Divisions 3LN in the spring over the period 1971-84. Survey coverage in Division 3Ø was incomplete in many years and is not presented. The 1971-82 surveys were carried out by the A. T. Cameron, the 1984 survey by the A. Needler, and there was no spring survey in Divisions 3LNØ in 1983. Tables 15 and 16 contain the results of random stratified surveys conducted by Canadian research vessels in selected strata in Division 3L in the fall in the years 1981-83. The first 2 were conducted by the A. T. Cameron and the latter by the W. Templeman.

Table 12 shows that estimates of total population numbers were highest in 1977 and 1978 and that while 2+ numbers declined between 1980 and 1982, 8+ numbers increased slightly. Table 12 also suggests that recruitment at ages 6-8 in the period 1977-80 may have been stronger than that observed in 1981 and 1982. Tables 13 and 14 show that the numbers and weights per tow in Division 3L have been relatively stable over the 1977-82 period, significantly higher than the levels observed in the 1972-75 period. These tables also show that the estimates for Division 3N show greater fluctuations over the entire 1971-82 period. It should be noted that the 1984 survey was conducted by the A. Needler and that preliminary analysis has shown that there may be significant differences between the ability of the gear used by both the A. Needler and the W. Templeman and that used by the A. T. Cameron in catching American plaice. This analysis has also suggested that the size of the fish is an important factor in assessing the efficiencies of the two gear-types.

Tables 15 and 16 indicate that the population size and mean numbers and weights per tow in Division 3L have remained relatively stable over the period 1981-83. However, the results for 1983 must be regarded with caution as this survey was carried out by the W. Templeman, and the same arguements discussed in the previous paragraph concerning catchabilities apply here. It should be noted that these estimates are not directly comparable with those of the spring surveys because of differences in survey coverage.

Partial recruitment:

The PR used to estimate population size in 1983 in the cohort analysis was calculated from average F's from a preliminary cohort run using the 1980-83 catch at age data. The resulting values were then averaged and input into another cohort run and this iterative procedure continued until the difference between input values and averaged output values was minimal. These values were normalized to age 13 and are given in Table 11. These values are higher at ages 6-10 than those used in the 1983 assessment (Brodie and Pitt, 1983) when adjustments were made at these ages to compensate for seemingly low catch numbers (due in part to higher discarding, Table 10) in 1982. The calculated PR for this year is also significantly lower at ages 6-11 than that which was used for catch projections in last year's assessment, those values being based on average F's in the 1979-81 period (Table 11).

Terminal fishing mortality in 1983:

Several methods were used in attempting to calibrate the cohort analysis. A summary of the results from several of these methods at levels of F_T from 0.25 to 0.30 is given in Table 17. Of the methods tried, the following 2 showed the best relationships:

1)   Average midyear exploitable biomass vs CPUE, 1965-83. These values were calculated by applying average (1960-83) selectivity-coefficients at age to midyear biomass estimates from cohort. Results show that the correlation coefficient (r) reaches a peak at F_T = 0.275 and that the 1983 residual is minimized in the run at F_T = 0.3 and the 1982 + 1983 residuals combined are minimized in the run at 0.275. The plot at F_T = 0.275 is shown, for illustrative purposes, in Fig. 2.

2)   Midyear population numbers (8+) vs spring research vessel survey abundance, 1971-82, excluding 1973 and 1976, when surveys were incomplete. Results show that r is highest at F_T = 0.250, although it changes only slightly over the runs from F_T = 0.25 to 0.30. The 1982 residual (there was no 1983 survey) is minimized at a level of F_T closest to 0.25. The plot of the relationship using the values from the run at F_T = 0.275 is shown in Fig. 3.

Regressions of true midyear exploitable biomass (calculated from yearly selectivities) against CPUE for 1965-83 while significant, produced an r value of only 0.610 at F_T = 0.275, Fig. 4). Regressions of 8+ midyear population biomass vs CPUE for 1965-83 showed r to be increasing over the range of F_T tested, which can be explained in part by the plot at F_T = 0.275 (Fig.5), which shows 6 of the last 7 points (1977-83) to be above the regression line. Given the serial correlation which is apparent in the residuals from this relationship and the corresponding one of weighted fishing mortality on effort (Fig. 6), it was decided that these regressions would not be used to calibrate the cohort analysis.

Based primarily on 1) and 2) above, it was decided that a value of 0.275 was the best estimate of terminal fishing mortality in 1983. Results of the cohort analysis at this level of F_T are shown in Table 18.

Catch projections:

Projections to 1985 were carried out using the following parameters as input:

1)   Population numbers in 1983 from the cohort run at F_T = 0.275.

2)   Catch at age in 1983.

3)   Average weights at age, 1981-83.

4)   Average partial recruitment, 1979-81.

5)   Geometric mean (1976-82) of age 6 numbers from cohort run at F_T = 0.275 was used as an estimate of recruitment at age 6 in 1984 and 1985. This value was 224 x 10^6 fish.

The projected catch in 1984 for Divisions 3LN is 44,400 t (Table 19). The TAC for Divisions 3LNO should include an amount for Division 3Ø, where catches in the period 1978-82 averaged 4,300 t.

REFERENCES

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   1981. Summary of discarding and estimates of total removals by Canadian trawlers during the 1980 Divisions 3LNO American plaice fishery. NAFO SCR Doc. 81/VI/55.

   1982. Summary of discarding and estimates of total removals by Canadian trawlers during the 1981 Divisions 3LNO American plaice fishery. CAFSAC Res. Doc. 82/19.

   1983. Summary of discarding and estimates of total removals by Canadian (Newfoundland) trawlers during the 1982 Divisions 3LNO American plaice fishery. NAFO SCR Doc. 83/VI/27, Ser. No. N678.

Table 1. Nominal catches of American plaice for ICNAF Divisions 3LNO 1960-83 and TAC's from 1973-84.

Year	Canada	France	Poland	USSR	Other	Total	TAC
1960	21,352	2,106	-	569	20	24,047	-
1961	14,903	1,473	286	1,248	3	17,913	-
1962	15,217	973	171	1,841	4	18,206	-
1963	24,591	93	558	72	132	25,446	-
1964	35,474	1,582	539	680	292	38,567	-
1965	45,365	2,056	977	4,544	319	53,261	-
1966	51,225	1,246	860	11,484	196	65,011	-
1967	54,190	1,326	3,234	35,139	524	94,413	-
1968	48,674	406	203	23,751	133	73,167	-
1969	64,815	43	34	14,493	52	79,437	-
1970	54,929	389	40	10,232	1,055	66,645	-
1971	49,394	323	370	17,173	628	67,888	-
1972	41,605	322	2,515	14,164	755	59,361	-
1973	38,586	310	1,116	12,516	315	52,843	60,000
1974	35,101	418	615	10,074	89	46,297	60,000
1975	34,015	442	537	7,682	545	43,221	60,000
1976	47,806	305	5	3,280	429	51,825	47,000
1977	42,579	31	0	1,023	348	43,981	47,000
1978	48,634	168	0	1,048	178	50,028	47,000
1979	47,131	113	0	1,190	135	48,569	47,000
1980	48,296	183	0	336	271	49,086	47,000
1981	48,177	210	-	847	924	50,158	55,000
1982[a]	49,617	132	-	67	938	50,754	55,000
1983[a]	35,878	41	-	170	52	36,141	55,000
1984							55,000

[a]: Provisional

Table 2. Breakdown of plaice nominal catches in Divisions 3LNO by Division (metric tons).

Year	Division 3L	Division 3N	Division 3O	Total
1960	19,397	3,912	738	24,047
1961	13,398	3,498	1,017	17,913
1962	13,584	3,923	699	18,206
1963	16,512	7,465	1,469	25,446
1964	21,391	14,587	2,589	38,567
1965	25,034	26,270	1,957	53,261
1966	18,572	34,698	11,741	65,011
1967	38,515	24,364	31,534	94,413
1968	39,126	20,038	14,003	73,167
1969	52,880	14,442	12,115	79,437
1970	39,347	21,032	6,266	66,645
1971	37,851	22,873	7,164	67,888
1972	33,330	17,387	8,644	59,361
1973	20,103	20,883	11,857	52,843
1974	16,610	21,126	8,561	46,297
1975	15,171	21,308	6,742	43,221
1976	25,122	18,623	8,080	51,825
1977	23,763	16,543	3,675	43,981
1978	30,145	13,443	6,440	50,028
1979	28,708	14,712	5,149	48,569
1980	31,717	15,119	2,250	49,086
1981	37,269	10,628	2,261	50,158
1982[a]	32,897	12,598	5,259	50,754
1983[a]	23,400	8,363	4,378	36,141

[a]: Provisional

Table 3. Catch and effort data for American plaice for NAFO Division 3L and 3N. Directed catch (Column 2) refers to catch directed for plaice by Canada (N) otter trawls tonnage class 5.

Year	Directed catch (tons)	CPUE (tons/hr)	Total catch (tons)	Total effort (hours calculated)
1960	12,502	1.067	23,309	21,849
1961	9,301	0.942	16,896	17,928
1962	11,777	0.789	17,507	22,187
1963	17,503	0.914	23,977	26,232
1964	19,359	0.954	35,978	37,729
1965	18,082	0.905	51,304	56,690
1966	29,536	0.876	53,270	60,811
1967	34,416	0.818	62,879	76,869
1968	31,344	0.629	59,164	94,060
1969	39,251	0.548	67,322	122,850
1970	24,020	0.516	60,379	117,014
1971	24,439	0.479	60,724	126,772
1972	23,137	0.481	50,717	105,441
1973	20,027	0.517	40,986	79,277
1974	20,957	0.434	37,736	86,949
1975	27,111	0.416	36,479	87,690
1976	35,710	0.430	43,745	101,733
1977	32,117	0.406	40,306	99,276
1978	33,290	0.460	43,588	94,757
1979	30,763	0.495	43,420	87,717
1980	34,982	0.597	46,836	78,452
1981	34,199	0.570	47,897	84,030
1982[a]	33,052	0.562	45,495	80,952
1983[a]	18,215	0.622	31,763	51,066

[a]Provisional

Table 4. List of commercial sampling, by quarter and division, available for 1983 American plaice, Division 3LNO, provided by the St. John's Commercial Sampling Section.

Division		Quarter				Total
		1	2	3	4	
3L (Offshore)	Catch (t)	836	7,788	5,149	4,525	18,298 (t)
	Samples	9	31	24	16	80
	Measured	3,834	12,096	8,576	5,432	29,938
	Otoliths	403	755	768	757	2,683
3L (Inshore)	Catch (t)	2	1,226	2,339	224	3,791 (t)
	Samples	-	8	17	5	30
	Measured	-	2,523	5,666	1,536	9,725
	Otoliths	-	583	992	314	1,889
3N	Catch (t)	766	1,051	2,811	3,266	7,894
	Samples	2	4	9	20	35
	Measured	870	1,424	2,698	6,081	11,073
	Otoliths	228	377	616	846	2,067
3Ø	Catch (t)	1,287	1,617	621	608	4,133 (t)
	Samples	10	3	-	4	17
	Measured	4,152	908	-	1,615	6,675
	Otoliths	721	166	-	462	1,349

Table 5. Average weights, lengths, and numbers at age for Divisions
3LN American plaice in 1983.

AGE	AVERAGE WEIGHT	AVERAGE LENGTH	CATCH MEAN	CATCH STD. ERR.	C.V.
4	0.115	22.878		0.80	0.55
5	0.317	32.939	114	18.46	0.16
6	0.401	35.411	937	76.71	0.08
7	0.506	37.774	2668	141.34	0.05
8	0.584	39.339	4498	203.52	0.05
9	0.677	41.355	6399	248.05	0.04
10	0.708	41.348	7757	254.62	0.04
11	0.756	42.732	7135	255.18	0.04
12	0.967	46.217	4428	183.86	0.05
13	1.219	49.120	2379	117.23	0.05
14	1.560	53.129	1170	69.75	0.06
15	2.170	58.149	354	27.56	0.08
16	2.423	60.834	122	15.99	0.13
17	2.805	63.032	43	9.32	0.22
18	3.085	65.488	13	4.26	0.32

TABLE 6. AMERICAN PLAICE, DIV 3LN, CATCH MATRIX (NUMBERS(10^3))

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	209	189	428	960	1788	3041	5139	2229	1994	2079	1968	1565	2199	937	5222	2945	3400	4537	3538	4069	2924	538	271	937
7	318	501	632	1740	4662	5969	8224	7216	3347	6674	2314	7524	2023	4909	7305	5693	7388	8065	7874	12560	9110	2038	1578	2669
8	1324	1161	1054	1237	3035	8964	9122	5093	7915	12023	9066	9354	6578	8158	8070	8266	15983	10827	9238	13872	11601	4330	4303	4492
9	1395	2324	1139	1442	5760	6739	7798	8320	9665	15409	12264	13888	7656	10096	6675	7802	15168	12253	11583	13242	13571	7134	7878	6698
10	2210	2994	1605	2086	8180	7265	5954	9133	9405	10830	10225	13670	10907	7789	7741	6445	10772	10303	12370	11329	13735	10761	11345	6399
11	2462	2327	2335	2894	6493	5521	5823	7104	6255	10793	10129	9833	10866	7741	5901	4524	6667	5954	8859	8075	10796	13178	14704	7757
12	3367	2145	2594	3892	5737	5578	4644	9700	11193	8811	7473	9074	9147	5245	3839	3880	4273	3750	5825	3406	7676	11622	13687	7135
13	2668	3673	2317	3633	3028	5023	4896	6324	7098	5978	5034	4647	5796	5111	2940	3110	2415	2014	2977	1640	3385	8553	7418	4428
14	2488	2433	2151	3591	2930	4174	4105	4377	5124	4496	4223	3328	3720	2896	1642	2175	1994	1311	1738	594	1460	5527	3836	2379
15	1661	1746	2217	2309	2124	1773	2959	3615	2558	2955	3851	2920	2151	1560	866	1091	1178	872	1161	294	619	2903	1718	1170
16	1387	1408	1320	1296	1350	2054	1626	2501	2075	1586	2176	1753	1808	1828	595	595	448	306	469	148	244	1099	524	354
17	731	581	942	623	697	1270	1037	1314	1230	1051	1236	698	1239	802	187	393	193	161	152	57	79	383	146	122
18	293	775	771	620	563	556	933	1110	515	609	834	447	527	913	65	190	45	93	53	13	25	231	69	43
19	236	303	480	395	534	618	390	293	330	296	315	360	286	337	20	80	20	25	18	5	2	101	9	13
6+	21775	22558	20989	26817	46693	59615	62450	68320	68104	93590	71107	77241	66899	58222	51068	48189	70110	62873	65855	74304	75247	68398	67483	44595

TABLE 7 AMERICAN PLAICE, DIV 3LN, PROPORTION OF NUMBERS AT AGE

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	0.0142	0.0084	0.0204	0.0358	0.0383	0.0510	0.0823	0.0326	0.0278	0.0249	0.0277	0.0203	0.0329	0.0144	0.1023	0.0611	0.0485	0.1040	0.0537	0.0817	0.0369	0.0079	0.0040	0.0210
7	0.0375	0.0222	0.0301	0.0649	0.0998	0.2169	0.1317	0.1056	0.0491	0.0798	0.0325	0.0974	0.0302	0.0843	0.1430	0.1389	0.1054	0.1283	0.1196	0.1690	0.1211	0.0298	0.0234	0.0598
8	0.2608	0.0515	0.0502	0.0499	0.0650	0.1504	0.1461	0.0745	0.1162	0.1438	0.1275	0.1211	0.0983	0.1401	0.1580	0.1715	0.2277	0.1722	0.1403	0.2271	0.1542	0.1542	0.0638	0.1007
9	0.0774	0.1030	0.0543	0.0538	0.1234	0.1139	0.1249	0.0926	0.1331	0.1843	0.1725	0.1795	0.1443	0.1734	0.1307	0.1619	0.2163	0.2012	0.1759	0.1782	0.1804	0.1043	0.1167	0.1502
10	0.1015	0.1327	0.0765	0.0778	0.1752	0.1222	0.0953	0.1337	0.1381	0.1296	0.1438	0.1640	0.1630	0.1338	0.1516	0.1337	0.1536	0.1639	0.1878	0.1525	0.1825	0.1573	0.1681	0.1435
11	0.1131	0.1032	0.1114	0.1077	0.1391	0.0926	0.0932	0.1333	0.0918	0.1291	0.1424	0.1273	0.1624	0.1330	0.1156	0.0939	0.0979	0.0947	0.1345	0.1087	0.1435	0.1927	0.2179	0.1739
12	0.1546	0.0950	0.1236	0.1451	0.1229	0.0936	0.0744	0.1420	0.1644	0.1054	0.1051	0.1045	0.1367	0.0901	0.0752	0.0805	0.0609	0.0596	0.0885	0.0458	0.1023	0.1699	0.2028	0.1600
13	0.1225	0.1628	0.1104	0.1355	0.0648	0.3343	0.0752	0.0926	0.1042	0.0715	0.0708	0.0602	0.0886	0.0878	0.0576	0.0645	0.0344	0.0320	0.0452	0.0221	0.0456	0.1250	0.1099	0.0993
14	0.1142	0.1077	0.1501	0.1339	0.0606	0.0720	0.0657	0.0641	0.0753	0.0538	0.0594	0.0431	0.0556	0.0497	0.0322	0.0451	0.0283	0.0209	0.0264	0.0080	0.0194	0.0808	0.0568	0.0533
15	0.0735	0.0774	0.1056	0.0861	0.0455	0.0297	0.0474	0.0529	0.0376	0.0354	0.0542	0.0378	0.0322	0.0268	0.0170	0.0226	0.0188	0.0139	0.0176	0.0040	0.0082	0.0424	0.0255	0.0262
16	0.0637	0.0624	0.0629	0.0483	0.0239	0.0345	0.0260	0.0366	0.0305	0.0190	0.0306	0.0322	0.0270	0.0314	0.0117	0.0123	0.0064	0.0049	0.0071	0.0020	0.0032	0.0161	0.0078	0.0079
17	0.0429	0.0258	0.0449	0.0222	0.0130	0.0213	0.0166	0.0192	0.0181	0.0126	0.0174	0.0227	0.0185	0.0138	0.0037	0.0082	0.0028	0.0026	0.0023	0.0008	0.0010	0.0056	0.0022	0.0027
18	0.0135	0.0344	0.0367	0.0231	0.0121	0.0093	0.0149	0.0162	0.0090	0.0073	0.0117	0.0058	0.0079	0.0057	0.0013	0.0039	0.0006	0.0015	0.0008	0.0002	0.0003	0.0034	0.0010	0.0010
19	0.0108	0.0134	0.0229	0.0147	0.0115	0.0104	0.0062	0.0041	0.0048	0.0035	0.0044	0.0047	0.0043	0.0058	0.0004	0.0017	0.0003	0.0004	0.0003	0.0001	0.0000	0.0015	0.0001	0.0003

TABLE 8 AMERICAN PLAICE, DIV 3LN, WEIGHTS AT AGE(KG)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	0.193	0.189	0.177	0.227	0.285	0.289	0.277	0.287	0.276	0.290	0.275	0.259	0.278	0.244	0.252	0.248	0.261	0.264	0.266	0.320	0.323	0.381	0.313	0.401
7	0.274	0.279	0.276	0.297	0.378	0.365	0.369	0.383	0.348	0.332	0.330	0.331	0.372	0.292	0.339	0.347	0.345	0.359	0.363	0.374	0.410	0.408	0.375	0.506
8	0.363	0.373	0.380	0.384	0.491	0.498	0.499	0.469	0.450	0.412	0.397	0.404	0.484	0.380	0.416	0.418	0.403	0.431	0.414	0.448	0.483	0.453	0.444	0.589
9	0.487	0.493	0.522	0.525	0.547	0.625	0.640	0.610	0.602	0.564	0.536	0.494	0.527	0.519	0.568	0.578	0.548	0.623	0.515	0.546	0.537	0.480	0.512	0.694
10	0.594	0.596	0.611	0.621	0.637	0.703	0.798	0.788	0.697	0.670	0.680	0.612	0.629	0.629	0.694	0.706	0.658	0.676	0.618	0.594	0.570	0.523	0.550	0.717
11	0.695	0.741	0.738	0.731	0.760	0.827	0.976	0.847	0.851	0.785	0.795	0.772	0.753	0.816	0.917	0.922	0.841	0.884	0.773	0.683	0.653	0.542	0.609	0.698
12	0.857	0.865	0.885	0.857	0.851	0.889	0.988	1.030	0.991	0.982	0.841	0.909	0.867	1.041	1.108	1.099	1.029	1.013	0.928	0.906	0.742	0.670	0.752	0.756
13	0.903	0.868	0.905	0.987	0.920	0.932	0.984	1.064	1.075	1.050	1.043	1.034	0.935	1.243	1.360	1.339	1.152	1.199	1.199	1.188	0.989	0.786	0.995	0.967
14	1.193	1.199	1.206	1.152	1.208	1.258	1.287	1.369	1.397	1.401	1.166	1.132	1.175	1.334	1.567	1.536	1.327	1.389	1.389	1.659	1.352	1.000	1.299	1.219
15	1.262	1.264	1.272	1.255	1.289	1.377	1.413	1.631	1.597	1.602	1.311	1.279	1.380	1.524	1.922	1.813	1.658	1.768	1.768	1.886	1.739	1.300	1.602	1.560
16	1.308	1.324	1.330	1.541	1.596	1.614	1.656	1.890	1.881	1.870	1.673	1.600	1.654	1.816	2.387	2.319	2.137	2.196	2.196	2.118	1.770	1.782	2.054	2.170
17	1.411	1.423	1.423	1.872	1.921	1.905	1.922	2.166	2.197	2.240	1.854	1.911	1.854	1.939	2.458	2.578	2.318	2.324	2.324	2.302	2.140	2.099	2.211	2.423
18	1.516	1.516	1.525	1.891	1.934	1.943	1.917	2.305	2.297	2.348	2.073	2.117	1.915	2.104	2.871	2.880	2.716	2.546	2.546	3.199	2.700	2.368	2.677	2.805
19	1.562	1.558	1.572	1.962	1.997	1.757	2.025	2.527	2.488	2.595	2.283	2.285	2.129	2.294	3.004	2.942	2.864	3.072	3.072	3.243	3.000	2.558	3.437	3.085

TABLE 9 AMERICAN PLAICE,DIV 3LN,CALCULATED CATCH BIOMASS(T)

AGE	1950	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	60	36	76	218	510	879	1424	639	523	603	541	405	611	204	1316	730	887	1726	941	1942	959	205	85	376
7	224	140	174	517	1762	2544	3035	2784	1165	2216	784	2490	753	1433	2476	2322	2549	2895	2858	4897	3735	832	591	1350
8	481	433	401	513	1490	4464	4552	2389	3561	4953	3599	3779	3183	3100	3357	3455	6433	4666	3825	7559	5603	1961	1911	2546
9	821	1146	595	757	3151	4243	4991	3361	5457	8691	6574	5851	5089	5240	3791	4510	8311	7883	5965	7230	7288	3424	4034	4648
10	1313	1784	981	1295	5227	5121	4692	7197	6555	7256	6953	7754	8861	4899	5372	4550	7088	6965	7645	6729	7829	5628	6240	4588
11	1711	1724	1723	2116	4935	4566	5883	7713	5323	8473	8052	7591	8182	6317	5411	4171	5775	5263	6848	5515	7050	7142	8955	5414
12	2886	1854	2296	3339	4852	4847	4588	9991	11092	9652	6285	7239	7930	5460	4254	4234	4397	3799	5406	3086	5710	7787	10293	5394
13	2409	3282	2097	3150	2756	4681	4621	6729	7630	6277	5250	4605	5419	6353	3998	4154	2782	2415	3589	1948	3348	6723	7381	4282
14	2966	2917	3800	4137	3419	5251	5283	5592	7161	6299	4924	3767	4371	3863	2573	3341	2633	1921	2414	985	1974	5527	4983	2900
15	2020	2297	2920	2897	2738	2441	4181	5896	4085	4734	5049	3735	2968	2377	1664	1978	1950	1542	2053	554	1076	3774	2752	1825
16	1814	1864	1756	1997	2155	3315	2693	4727	3903	2966	3640	2805	2957	3320	1420	1380	957	676	1030	313	432	1936	1078	788
17	1314	827	1340	1165	1163	2419	1993	2846	2702	2354	2292	1716	2297	1555	460	1013	447	374	353	131	169	804	323	296
18	444	1175	1178	1173	1099	1080	1789	2559	1413	1430	1729	946	1009	1921	137	547	122	237	135	42	67	547	185	121
19	369	472	755	775	1070	1209	790	715	821	766	719	823	609	773	60	235	57	77	55	16	6	258	27	40
5+	18830	19840	19991	23999	33379	47062	50313	64017	61392	65672	56370	54807	52269	46816	36340	36662	44389	40339	43097	40750	45247	46549	46834	34648

Table 10. Estimates of ratios of numbers caught to numbers landed for American plaice aged 6-10 in the Canada (N) otter trawl fishery in Divisions 3LN, 1978-82.

C = estimated catch (nos. x 10^{-3})
L = estimated landings (nos. x 10^{-3})

		YEAR													
	1978			1979			1980			1981			1982		
Age	C	L	C/L	C	L	C/L	C	L	C/L	C	L	C/L	C	L	C/L
6	3528	1475	2.39	13226	5594	2.36	4672	2105	2.22	1123	403	2.79	2189	339	6.46
7	9123	5244	1.74	16375	9969	1.64	10686	7030	1.52	4977	1834	2.71	4587	1424	3.22
8	13149	9131	1.44	16133	12962	1.24	11816	9161	1.29	9923	4115	2.41	8441	4086	2.07
9	13844	11200	1.24	10535	8676	1.21	11884	10088	1.18	13706	6957	1.97	12331	7413	1.66
10	12176	10422	1.17	9277	8085	1.15	10088	8957	1.13	16333	11080	1.47	13790	9921	1.39
Catch (t) used to est. C and L in Div. 3LN	37790			37188			39192			40532			40133		
Nom. Catch (t) in 3LN	43588			43420			46836			47897			45495		

Table 11. Partial recruitment vectors for American plaice in NAFO Divisions 3LN.

Age	1983 Assessment	Average 1979-81 (used for projections in 1983 and 1984)	Current
6	.008	.067	.014
7	.037	.194	.068
8	.123	.305	.130
9	.231	.369	.240
10	.515	.502	.391
11	.750	.668	.625
12	.800	.872	.897
13	1.000	1.000	1.000
14	1.000	1.000	1.000
15	1.000	1.000	1.000
16	1.000	1.000	1.000
17	1.000	1.000	1.000
18	1.000	1.000	1.000
19	1.000	1.000	1.000

Table 12. American plaice population numbers estimated from research vessel surveys in NAFO Division 3L and 3N (x 10^-5) for selected strata.

	1971	1972	1973[a]	1974	1975	1976[a]	1977	1978	1979	1980	1981	1982
1		1.1						0.2	2.9		4.7	0.3
2		4.0			12.5	5.8	4.1	7.5	6.5	8.5	9.9	4.9
3	55.0	8.9		12.3	50.8	114.9	38.6	194.7	18.3	55.2	78.4	46.3
4	158.5	159.0		75.3	86.8	208.1	205.3	317.9	196.6	115.9	106.8	165.7
5	527.3	313.0		114.6	121.3	281.6	550.7	967.5	651.7	580.8	200.1	163.0
6	679.7	567.9		311.6	269.6	269.7	1,010.9	963.2	1,012.7	1,009.8	547.3	387.8
7	905.5	570.9		368.6	428.8	615.5	1,553.4	1,189.7	1,034.2	1,070.1	823.5	611.8
8	381.6	456.0		376.0	541.2	1,080.8	1,473.2	1,114.3	1,188.4	1,275.0	1,136.6	953.7
9	658.2	300.9		322.1	407.4	816.6	927.5	754.4	838.2	989.9	905.8	1,158.2
10	327.9	344.0		323.8	334.3	691.5	844.2	570.8	710.7	628.9	587.1	860.4
11	297.7	212.7		176.2	169.6	415.6	374.3	214.4	359.3	284.3	312.2	505.3
12	266.7	206.7		149.6	116.8	255.2	249.9	148.6	154.1	184.6	136.7	229.0
13	187.9	104.3		94.6	61.1	125.5	108.2	69.9	57.0	94.5	64.9	118.1
14	130.3	83.4		48.6	34.5	39.9	46.0	44.6	32.6	38.9	22.5	62.4
15	67.5	58.1		31.3	17.0	34.4	31.6	22.9	22.4	23.3	25.1	22.8
16	49.9	40.2		11.0	13.3	16.9	18.4	9.4	10.7	18.7	14.6	18.2
17	26.4	12.8		2.3	3.5	11.3	8.0	5.9	4.0	8.8	7.8	11.4
18	20.8	4.5		0.4	1.3	3.1	4.4	1.2	0.9	3.2	3.2	3.8
19	5.6	2.4		0.8	0.7	0.9	0.8		0.2	0.8		0.2
20	3.2	2.7						0.5				
21	1.1											
22	1.6											
2+	4,752.4	3,452.3		2,419.1	2,670.5	4,987.3	7,449.5	6,597.4	6,298.5	6,391.2	4,982.5	5,323.0
4+	4,697.4	3,439.4		2,406.8	2,607.2	4,866.6	7,406.8	6,395.2	6,273.7	6,327.5	4,894.2	5,271.8
6+	4,011.6	2,967.4		2,216.9	2,399.1	4,376.9	6,650.8	5,109.8	5,425.4	5,630.8	4,587.3	4,943.1
8+	2,426.4	1,828.6		1,536.7	1,700.7	3,491.7	4,086.5	2,956.9	3,378.5	3,550.9	3,216.5	3,943.5
12+	761.0	515.0		338.6	248.2	487.2	467.3	303.0	281.9	372.8	274.8	465.9

[a]: Indicates inadequate coverage by research vessel.

Table 13. Mean numbers per tow (with upper and lower 95% confidence limits) from research vessel surveys (spring) in NAFO Divisions 3L and 3N. Estimates are from the same selected strata each year.

Year	Upper	3L Mean	Lower	Upper	3N Mean	Lower
1971	(441.8)	297.6	(153.4)	(112.7)	67.8	(22.9)
1972	(418.1)	213.8	(9.6)	(72.4)	62.3	(52.2)
1973[a]						
1974	(177.0)	136.3	(95.6)	(69.9)	49.5	(29.0)
1975	(387.1)	228.1	(69.0)	(123.1)	64.3	(5.4)
1976[a]						
1977	(609.2)	495.2	(381.1)	(176.1)	99.8	(23.5)
1978	(515.3)	397.2	(279.1)	(186.1)	123.8	(61.5)
1979	(494.4)	393.8	(293.1)	(164.2)	94.0	(23.7)
1980	(582.9)	411.4	(239.8)	(88.6)	68.0	(47.4)
1981	(384.2)	291.7	(199.2)	(257.5)	180.1	(102.8)
1982	(529.1)	365.7	(202.4)	(68.8)	52.3	(35.8)
1984				(98.7)	77.2	(55.7)

[a]Indicates inadequate coverage by research vessel.

Table 14. Mean weight caught (kg) per tow (with upper and lower 95% confidence limits) for research vessel surveys (spring) in NAFO Divisions 3L and 3N. Estimates are from the same strata each year.

Year	Upper	3L Mean	Lower	Upper	3N Mean	Lower
1971	(196.0)	130.2	(64.4)	(104.2)	58.5	(12.9)
1972	(127.9)	75.3	(22.6)	(76.1)	58.2	(40.2)
1973[a]						
1974	(73.9)	53.1	(32.2)	(39.7)	30.0	(20.4)
1975	(117.1)	69.8	(22.6)	(31.6)	25.2	(18.9)
1976[a]						
1977	(145.8)	124.1	(102.3)	(64.3)	47.0	(29.7)
1978	(120.1)	99.5	(78.9)	(63.4)	47.4	(31.4)
1979	(130.7)	106.5	(82.4)	(73.3)	38.6	(3.9)
1980	(173.8)	122.0	(70.3)	(44.7)	34.7	(24.8)
1981	(123.1)	95.7	(68.3)	(127.3)	87.7	(48.2)
1982	(145.9)	111.7	(77.6)	(43.2)	33.9	(24.7)
1984				(80.0)	63.2	(46.4)

[a]Indicates inadequate coverage by research vessel.

Table 15. American plaice population numbers (x 10⁻⁵) estimated from research vessel surveys (fall) in NAFO Division 3L. Estimates in each year are for the same strata.[a]

Age	Year 1981 ATC 323,324,325	1982 ATC 333,334	1983 WT 7,8,9
1	16.6	2.6	0.0
2	22.1	33.6	2.0
3	160.0	106.3	22.8
4	239.8	374.3	89.2
5	428.4	686.2	474.7
6	598.8	1235.2	1024.5
7	1621.7	1550.2	1732.6
8	1400.5	1526.3	1535.7
9	1176.0	829.3	784.2
10	1059.9	452.6	436.2
11	429.1	228.6	187.2
12	311.2	100.5	140.2
13	119.4	36.3	83.2
14	32.9	13.4	12.8
15	9.2	14.7	14.9
16	2.2	5.8	6.9
17		2.4	2.0
18		0.3	
Totals:			
2+	7611.1	7196.1	6549.1
4+	7429.0	7056.2	6524.3
6+	6760.8	5995.7	5960.4
8+	4540.3	3210.3	3203.3
12+	474.8	173.5	260.0
No. sets	95	107	116

[a] 3 out of 23 strata not surveyed in 1983.

Table 16. Mean numbers and weights (kg) caught per tow (with upper and lower 95% confidence limits) from research vessel surveys (fall) in NAFO Division 3L. Estimates in each year are for the same strata.[a]

Year	Numbers Upper	Mean	Lower	Weights Upper	Mean	Lower
1981	(395.5)	306.2	(216.9)	(151.9)	109.1	(66.3)
1982	(355.7)	289.2	(222.6)	(99.3)	82.0	(64.8)
1983	(349.6)	280.4	(211.2)	(133.6)	106.4	(79.2)

[a] 3 out of 23 strata not surveyed in 1983.

Table 17. Results of cohort analysis calibration for 3LN American plaice.

Regression	Parameter	0.250	0.275	0.300
Average midyear exploitable biomass vs CPUE, 1965-83	r	.895	.898	.895
	int.	-11.903	-12.777	-13.603
	slope	146.777	146.636	146.738
	83 resid	+11.2	+4.4	-1.4
	82 resid	+2.1	-1.9	-5.4
Midyear population numbers (8+) vs R. V. Survey abundance, 1971-82 (1973 and 1976 excluded)	r	.861	.860	.855
	int	80.773	95.270	107.364
	slope	.848	.760	.688
	82 resid	-3.3	-16.0	-26.6

Table 18. Cohort analysis for American plaice in Div. 3LN at F_{IT} 0.275.

POPULATION NUMBERS

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	198?	1993
6	175941	206528	199457	186166	183811	183770	193185	171807	155556	122220	119772	114922	147888	198238	241191	244418	262151	242273	229165	195681	223678	213133	173331	269035
7	124342	143767	168920	162947	151551	148874	147707	153517	135348	125853	98184	96280	92674	119091	153383	192745	197448	211563	209176	184422	154866	180436	174012	159843
8	107516	101064	117255	137728	131835	119861	115582	113491	119159	110487	96837	78292	72090	74045	93062	118970	151750	154772	165916	154434	139627	118550	145442	141043
9	76461	86829	81694	95046	111553	105192	90023	86377	88310	90359	79586	71080	55537	53014	53241	68899	89925	109799	117084	127481	119115	103820	92143	115580
10	50605	61076	68986	65855	76513	86120	79981	66649	64991	64100	60070	54058	45647	36814	34269	37550	49343	59901	73447	85379	92391	85244	73545	69131
11	42210	53432	47298	55029	52636	55242	63917	60075	46303	44701	42681	39929	32274	27564	23605	21053	24912	30652	35721	53634	59652	53218	60355	54042
12	32497	32331	30179	36606	42435	34723	40332	47035	40332	32250	26832	25730	23374	17018	15514	13556	13143	14183	13705	24505	36114	39090	35233	35824
13	20445	23551	24531	22361	28449	29552	25019	29737	29754	23409	18432	15236	13801	11204	7187	9228	7597	6894	8219	10865	16981	22604	21472	20228
14	16858	14325	15559	17988	15020	16915	17850	16235	17805	17936	13757	10538	8245	6055	4547	4662	4741	4035	3822	4035	7412	10840	10989	10989
15	12877	11553	9527	10215	11473	9737	11709	12374	9332	9740	10618	7442	5615	3384	2337	2258	2012	2086	2117	1557	2766	4747	3974	5530
16	7351	9094	7879	5774	6275	7475	6368	6709	6860	5325	5465	5209	3451	2851	1359	1130	946	583	919	683	1009	1735	1260	1417
17	5735	4764	6172	5256	3571	3916	4262	3742	3394	3739	2925	2505	2679	1191	516	575	387	287	199	328	425	605	401	557
18	2718	3853	3375	4201	3740	2374	2057	2551	1875	1866	2110	1276	1238	1072	250	253	115	142	69	25	217	277	149	195
19	1604	1960	2453	2065	2878	2553	1441	840	1094	979	813	973	641	537	52	146	35	53	32	25	9	155	19	59
6+	677150	740129	783722	607257	819139	810304	801133	770385	724045	652805	578075	523489	506134	541846	632002	715626	804416	857864	874612	852335	854261	844451	523765	882398
7+	501206	533601	584225	651091	635326	624533	607748	599578	568479	530585	458303	408567	358235	353581	390812	471207	542255	595151	645449	656474	630584	631318	629453	613373
8+	376866	389832	415305	458144	483777	477657	460241	445062	429831	404933	360119	312287	255581	234490	237426	278462	344807	383588	436273	472052	475718	450632	455442	454530
9+	266350	288768	298050	320416	351941	387798	344659	331571	310672	294446	263282	233994	193541	160445	144367	159493	193057	228616	270257	307916	336091	332282	309516	313487
10+	192889	201939	216356	225370	240389	252627	254634	245195	223362	204947	183702	162914	137905	107430	91126	90602	103132	116918	153273	180436	216975	235462	216373	197907
11+	142234	140863	147369	159515	163676	165497	174656	175546	157371	139947	123632	109657	92258	70816	58655	53052	53789	59919	74827	95957	124584	143216	139355	128774
12+	100075	101430	100073	104486	111846	111245	110739	116451	111667	95247	80951	65928	59464	43313	33763	31999	28677	28264	35566	42603	64933	90062	77771	74733
13+	67588	69100	69995	67877	69411	74522	70506	71389	70105	82996	54119	43147	35669	26075	18250	18431	15733	14082	15378	17519	28619	40932	37941	39850

Table 18 continued.

POPULATION BIOMASS (MID-YEAR)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	30748	35531	31957	38196	47233	47709	47808	44380	38861	31831	29590	26781	38966	41536	54449	54584	61585	62021	54792	55860	63030	73499	55082	97594
7	30771	36287	42171	43612	51063	48007	47914	51540	43164	36726	28995	27660	30880	30818	45917	59487	60497	57428	67428	60209	55719	66338	58856	72193
8	35140	33956	40190	47685	57944	51907	50035	47076	46853	38806	33068	26794	30024	23967	33434	43376	52247	58247	60384	62910	58366	47717	57793	74008
9	33350	38240	38362	44859	53764	57507	49781	45856	45487	41851	35375	28369	24020	22298	25526	33856	40497	58092	51705	59512	54364	43486	41237	70430
10	26603	32120	37726	36435	41727	52351	54817	44019	37788	35287	33535	28037	22528	18507	18923	21745	25832	33207	40116	42618	43823	37612	36043	42670
11	25750	25638	30792	35424	33389	39151	53739	42282	33065	27482	26451	24062	18109	17087	16424	15479	16018	21904	24351	30075	31760	27440	29577	31502
12	23807	24438	33076	28409	30301	26503	33753	38882	31089	24256	17217	17428	14493	13224	13407	11315	9966	11073	13781	18585	21394	19697	21756	21867
13	15535	17324	19087	15994	20674	22615	19987	24259	25101	19065	14725	11759	8791	9177	9243	7021	6485	6245	7051	10726	13531	12545	15495	15370
14	16749	14104	15526	16692	14724	18902	20248	17066	18850	19558	11984	8851	6414	5210	5106	4961	4292	4131	3503	5576	8086	6770	10057	10545
15	13726	12133	7548	10147	12032	10924	12357	15246	11406	11984	9957	6642	5449	3383	3192	2594	1913	2518	2242	2382	3813	3417	4138	6637
16	7801	9981	8315	7078	7985	9230	8179	9346	9673	7491	6348	6087	3514	2369	2175	1607	1105	785	1260	1152	1398	1588	1769	2793
17	6676	5734	7290	8340	5632	5500	6407	5852	5335	6378	3686	3436	3253	1168	908	736	566	393	196	619	740	683	634	1075
18	3515	4700	4066	6614	6012	3631	2605	3951	3166	2791	3045	1953	1608	707	554	319	218	188	129	51	498	223	261	439
19	2087	2533	3117	3284	4674	3915	2242	1553	2023	1907	1305	1586	912	679	109	259	60	107	59	66	21	212	40	146
6+	272258	292550	311536	340770	387153	397853	410352	351749	351662	305414	255481	217443	206959	190131	229269	259340	281282	326336	326996	350340	359544	341227	331739	447470
7+	241511	257189	279568	302574	339920	350144	362544	347369	313001	273582	225892	190662	168994	148594	174821	204756	219696	264315	272204	294481	293514	267728	276656	349876
8+	210740	220902	237397	258962	288857	302137	314630	295429	269836	236857	196897	163003	139113	117776	128903	145269	159199	196889	204778	234271	237795	201390	217800	277683
9+	175600	186946	197207	211277	230913	250230	264595	248353	222983	198050	163828	136209	109089	93809	95449	101893	106952	138642	144394	171361	179429	153672	160007	203675
10+	142250	148706	158846	166418	177149	192723	214834	202495	177496	156199	128453	107840	85069	71511	69943	68037	66456	80550	92689	111849	125065	110186	113770	133245
11+	115647	116586	121119	129983	135422	140372	160017	158477	139705	120912	94918	81803	62543	53005	51117	46292	40623	47344	52572	69231	81242	72574	82727	90575
12+	89898	90947	90328	94559	102033	101221	106278	116196	106644	93430	68267	57740	44434	35918	34693	30813	24605	25439	28221	39156	49482	45134	54150	59073
13+	66089	66510	67251	68150	71732	74718	72525	77314	75555	69174	51050	40314	29940	22694	21287	19498	14639	14366	14440	20571	28087	25438	32394	37206

Table 18 continued

FISHING MORTALITY

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	0.002	0.001	0.002	0.006	0.011	0.018	0.030	0.014	0.014	0.019	0.018	0.015	0.017	0.005	0.024	0.013	0.014	0.028	0.017	0.035	0.015	0.003	0.002	0.004
7	0.007	0.004	0.004	0.012	0.035	0.053	0.034	0.053	0.027	0.060	0.026	0.090	0.024	0.047	0.054	0.039	0.042	0.043	0.042	0.078	0.067	0.013	0.010	0.019
8	0.014	0.013	0.010	0.011	0.036	0.086	0.091	0.051	0.076	0.128	0.109	0.142	0.106	0.130	0.101	0.080	0.124	0.080	0.064	0.121	0.096	0.041	0.033	0.036
9	0.025	0.030	0.016	0.017	0.059	0.074	0.101	0.084	0.120	0.209	0.187	0.243	0.213	0.236	0.149	0.134	0.206	0.136	0.116	0.122	0.135	0.079	0.098	0.066
10	0.049	0.055	0.026	0.036	0.126	0.098	0.086	0.164	0.174	0.207	0.208	0.300	0.307	0.266	0.287	0.219	0.276	0.211	0.191	0.159	0.179	0.150	0.174	0.108
11	0.067	0.067	0.056	0.060	0.148	0.117	0.106	0.183	0.182	0.310	0.304	0.318	0.458	0.373	0.332	0.271	0.363	0.242	0.283	0.184	0.223	0.262	0.316	0.172
12	0.122	0.076	0.100	0.125	0.162	0.184	0.136	0.258	0.360	0.359	0.368	0.425	0.553	0.416	0.319	0.380	0.445	0.346	0.395	0.167	0.269	0.399	0.478	0.247
13	0.156	0.189	0.110	0.198	0.135	0.208	0.332	0.279	0.306	0.332	0.368	0.412	0.624	0.701	0.436	0.466	0.433	0.399	0.511	0.183	0.249	0.542	0.481	0.275
14	0.173	0.206	0.246	0.249	0.233	0.290	0.263	0.354	0.383	0.324	0.414	0.429	0.690	0.752	0.509	0.682	0.621	0.445	0.698	0.178	0.246	0.829	0.500	0.275
15	0.148	0.163	0.297	0.287	0.229	0.225	0.328	0.390	0.361	0.398	0.512	0.569	0.551	0.712	0.527	0.774	1.038	0.629	0.931	0.234	0.284	1.127	0.674	0.275
16	0.234	0.188	0.205	0.284	0.272	0.362	0.332	0.511	0.407	0.399	0.580	0.465	0.864	1.436	0.661	0.872	0.881	0.876	0.830	0.274	0.311	1.247	0.616	0.275
17	0.199	0.145	0.185	0.140	0.208	0.444	0.313	0.491	0.512	0.372	0.629	0.504	0.716	1.363	0.512	1.410	0.802	0.768	1.860	0.213	0.230	1.203	0.514	0.275
18	0.127	0.251	0.291	0.178	0.182	0.299	0.696	0.656	0.450	0.518	0.574	0.489	0.635	2.835	0.339	1.766	0.568	1.288	1.069	0.835	0.136	2.557	0.718	0.275
19	0.177	0.186	0.242	0.236	0.309	0.352	0.460	0.406	0.403	0.551	0.519	0.668	1.138	0.552	0.910	0.948	0.716	0.941	0.247	0.279	1.218	0.686	0.275

SELECTIVITY COEFFICIENTS CALCULATED WITHOUT SMOOTHING

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
6	0.01	0.00	0.01	0.02	0.04	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.02	0.00	0.04	0.01	0.05	0.04	0.05	0.06	0.00	0.00	0.01	
7	0.03	0.02	0.01	0.04	0.12	0.13	0.09	0.12	0.08	0.05	0.04	0.16	0.03	0.02	0.08	0.04	0.03	0.09	0.22	0.00	0.01	0.07		
8	0.06	0.05	0.03	0.04	0.09	0.19	0.13	0.09	0.15	0.25	0.17	0.25	0.12	0.05	0.15	0.05	0.09	0.14	0.31	0.02	0.05	0.13		
9	0.11	0.12	0.05	0.06	0.22	0.17	0.14	0.13	0.24	0.40	0.30	0.43	0.25	0.08	0.23	0.20	0.11	0.06	0.15	0.43	0.03	0.14	0.24	
10	0.21	0.22	0.09	0.12	0.46	0.22	0.12	0.25	0.34	0.40	0.33	0.53	0.36	0.09	0.43	0.27	0.18	0.17	0.58	0.06	0.03	0.39		
11	0.28	0.27	0.19	0.21	0.55	0.28	0.15	0.19	0.29	0.60	0.48	0.56	0.53	0.13	0.50	0.35	0.19	0.22	0.72	0.10	0.44	0.42		
12	0.52	0.30	0.34	0.44	0.60	0.41	0.20	0.39	0.70	0.69	0.64	0.75	0.64	0.15	0.46	0.32	0.43	0.21	0.29	0.84	0.16	0.56	0.69	
13	0.67	0.75	0.37	0.69	0.50	0.47	0.53	0.43	0.60	0.64	0.57	0.72	0.72	0.25	0.66	0.42	0.30	0.27	0.60	0.21	0.67	1.00		
14	0.74	0.82	0.83	0.87	0.86	0.63	0.38	0.54	0.75	0.63	0.66	0.73	0.80	0.27	0.77	0.39	0.35	0.21	0.79	0.32	0.70	1.00		
15	0.63	0.73	1.00	0.84	0.51	0.47	0.59	0.71	0.77	0.81	0.92	0.54	0.25	0.77	0.80	0.44	0.50	0.29	0.91	0.44	0.94	1.00		
16	1.00	0.75	0.69	0.99	0.82	0.49	0.48	0.79	0.80	0.77	1.00	0.82	1.00	0.51	0.49	0.45	0.33	0.45	1.00	0.49	0.36	1.00		
17	0.85	0.58	0.62	0.49	1.00	1.00	0.45	1.00	1.00	0.72	1.00	0.89	0.83	1.00	0.51	0.60	0.77	1.00	0.26	0.74	0.47	1.00	0.72	1.00
18	0.54	1.00	0.98	0.62	0.67	0.57	1.00	1.00	0.88	1.00	0.81	0.36	0.74	1.00	0.51	1.00	0.55	1.00	0.57	1.00	0.44	1.00	1.00	1.00
19	0.76	0.74	0.81	0.84	0.70	0.51	0.60	0.51	0.70	0.79	0.78	0.91	0.77	0.40	0.84	0.52	0.51	0.51	0.30	0.90	0.48	0.96	1.00	

Table 18 continued.

MIDYEAR POPULATION NUMBERS (×10^3)

AVERAGE MIDYEAR EXPLOITABLE BIOMASS (T)

Table 19. Projection of 3LN plaice stock status to 1985.

POPULATION NUMBERS

AGE	1983	1984	1985
6	269025	224000	224000
7	158843	219413	179833
8	141043	127541	169721
9	115580	111421	95576
10	69131	88585	81882
11	54042	50829	62614
12	35864	37259	34223
13	20228	22944	23632
14	10868	12579	14017
15	5345	6756	7685
16	1617	3324	4129
17	557	1006	2031
18	196	347	614
19	59	122	212
6+	882398	906227	900169
7+	613373	682227	676169
8+	454530	462815	496336
9+	313487	335174	326615

CATCH NUMBERS

AGE	1983	1984	1985
6	937	3945	3534
7	2668	10991	8084
8	4492	9897	11830
9	6698	10350	7996
10	6399	11001	9166
11	7757	8210	9138
12	7135	7641	6357
13	4428	5304	4938
14	2379	2908	2741
15	1170	1562	1612
16	354	766	866
17	122	232	426
18	43	80	129
19	13	28	44
6+	44595	72928	67084
7+	43658	68983	63551
8+	40990	57992	55466
9+	36498	48095	43637

FISHING MORTALITY

AGE	1983	1984	1985
6	0.004	0.020	0.018
7	0.019	0.057	0.051
8	0.036	0.089	0.080
9	0.066	0.108	0.097
10	0.108	0.147	0.132
11	0.172	0.196	0.175
12	0.247	0.255	0.228
13	0.275	0.293	0.262
14	0.275	0.293	0.262
15	0.275	0.293	0.262
16	0.275	0.293	0.262
17	0.275	0.293	0.262
18	0.275	0.293	0.262
19	0.275	0.293	0.262
6+	0.060	0.096	0.088

POPULATION BIOMASS (AVERAGE)

AGE	1983	1984	1985
6	88832.47	73404.78	73477.73
7	61302.17	83142.49	68339.69
8	62235.81	54908.98	73327.77
9	57034.48	53892.53	46478.79
10	35508.67	44660.99	41583.22
11	27816.13	25873.82	32180.73
12	20999.33	21729.23	20208.46
13	14749.27	16593.83	17335.06
14	10144.63	11546.90	13163.45
15	6327.93	7935.54	9153.52
16	2568.54	5236.36	6597.54
17	995.67	1782.05	3649.60
18	409.15	716.04	1287.43
19	143.08	291.72	513.21
6+	389070.34	401808.15	407296.19
7+	300237.87	328403.37	333818.46
8+	238935.70	245260.88	265478.76
9+	176699.89	190359.90	192150.99

CATCH BIOMASS

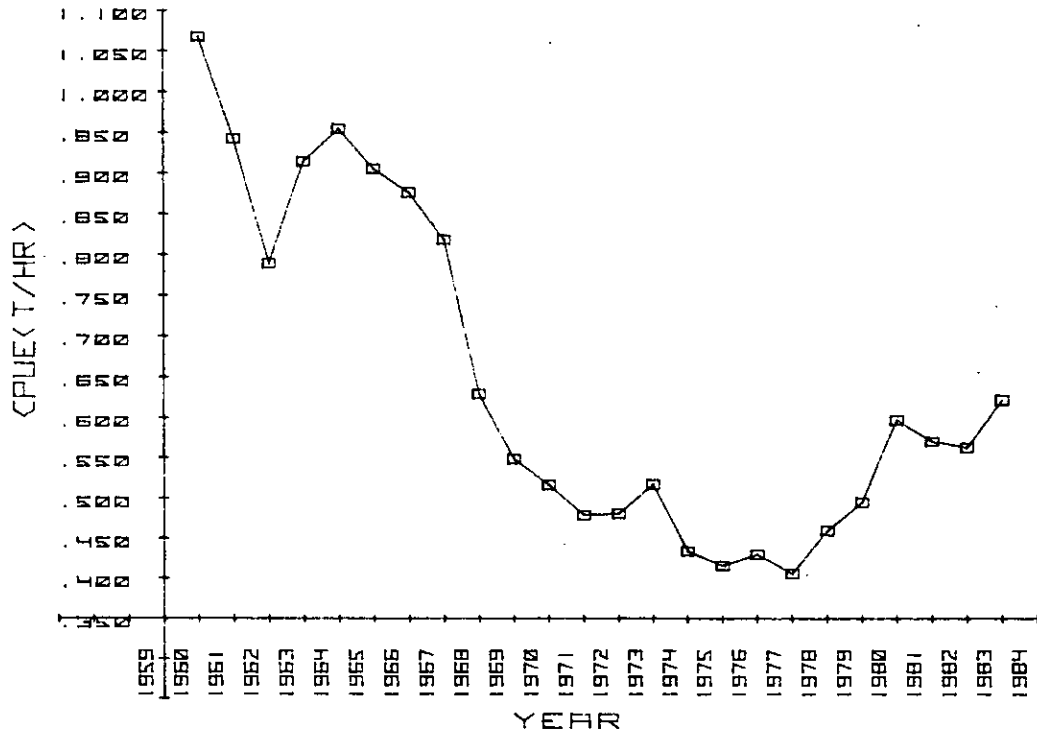| AGE	1983	1984	1985
6	342	1440	1290
7	1146	4722	3474
8	2225	4902	5860
9	3764	5822	4493
10	3818	6564	5469
11	4781	5060	5632
12	5180	5547	4617
13	4056	4858	4542
14	2790	3410	3449
15	1740	2324	2398
16	706	1533	1729
17	274	522	956
18	113	210	337
19	39	85	134
6+	30975	47000	44380
7+	30633	45560	43090
8+	29486	40838	39617
9+	27261	35935	33757

Fig. 1. Catch rate for American plaice in Div. 3LN by Canada (N) TC5 otter trawlers, 1960-83.
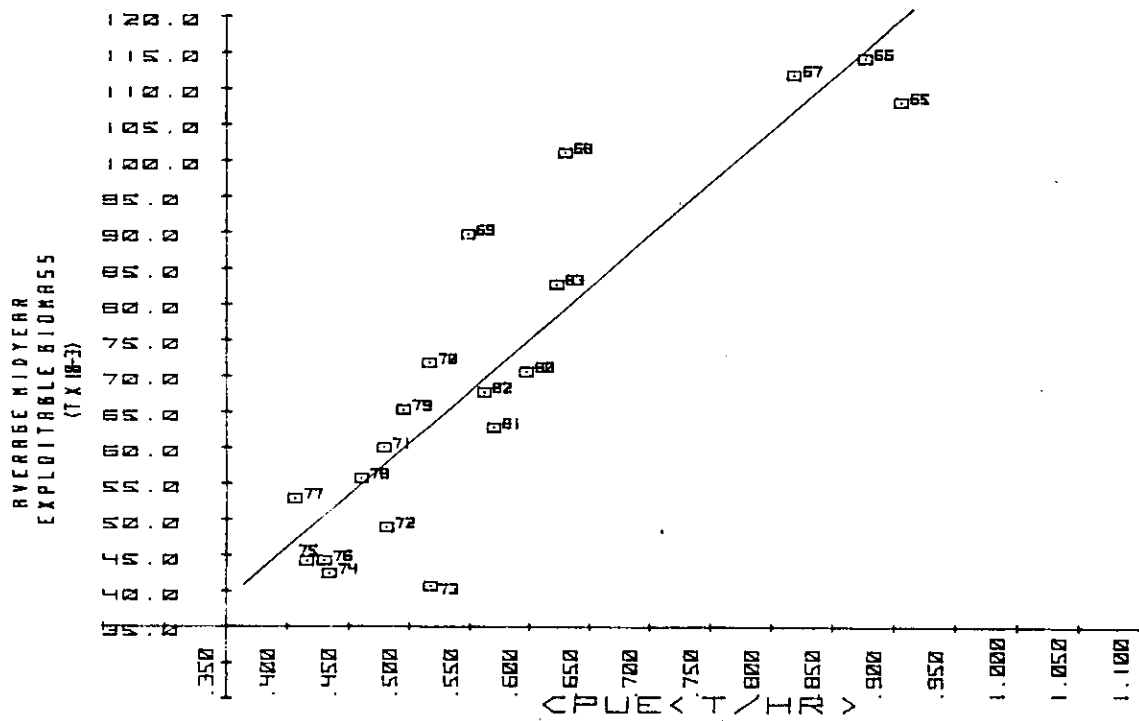

Fig. 2. Average midyear exploitable biomass from cohort run at F_T 0.275 vs. catch rate, Div. 3LN.
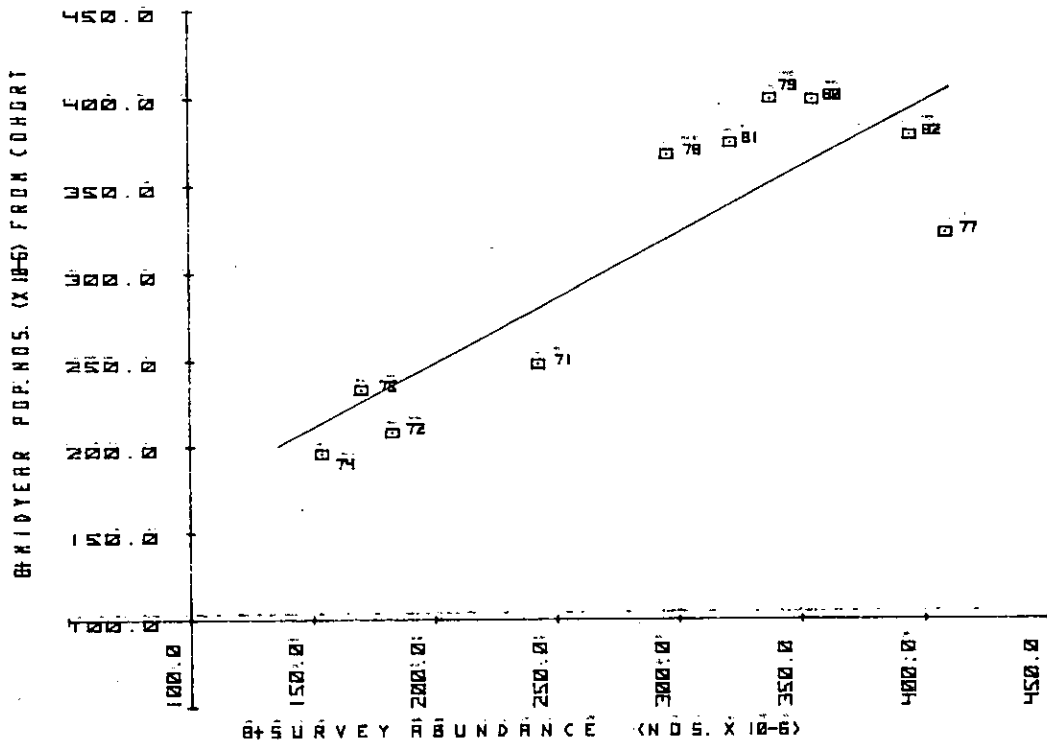
Fig. 3. 8+ midyear population numbers from cohort run at F_T 0.275 vs 8+ numbers from spring research vessel surveys, Div. 3LN.
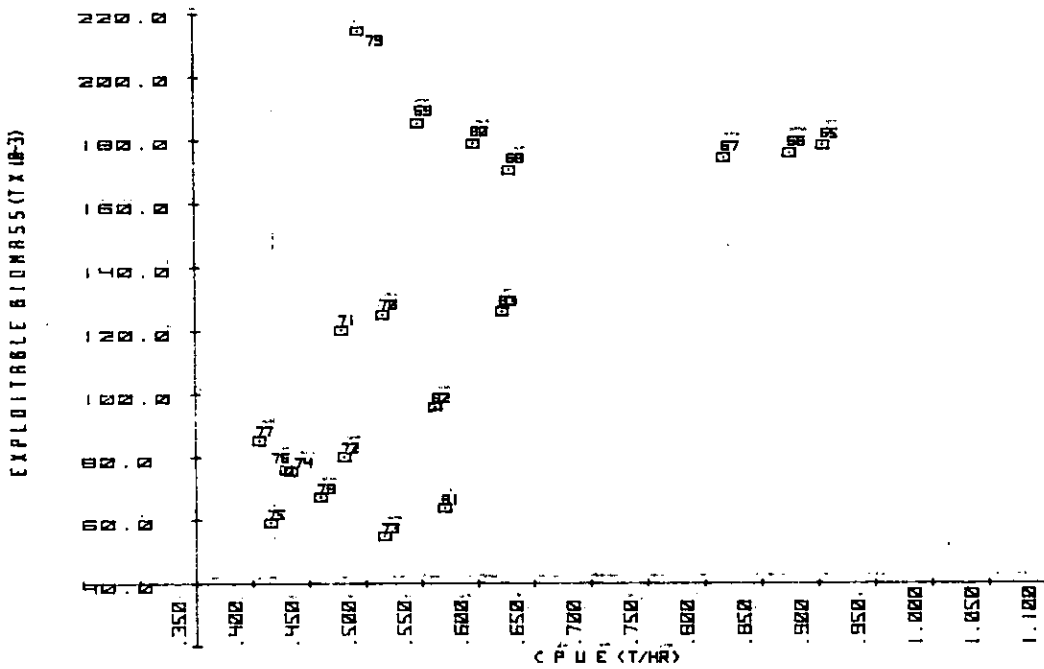

Fig. 4. Midyear exploitable biomass from cohort run at F_T 0.275 vs. catch rate, Div. 3LN.
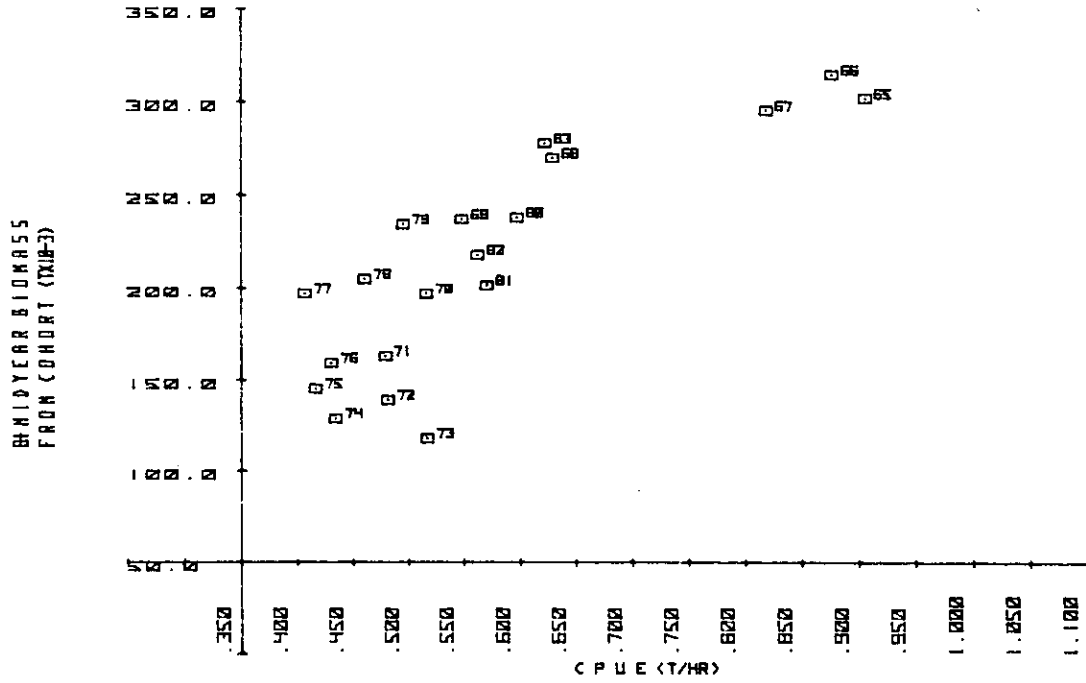
Fig. 5. 8+ midyear population biomass from cohort run at F_T 0.275 vs. catch rate, Div. 3LN.
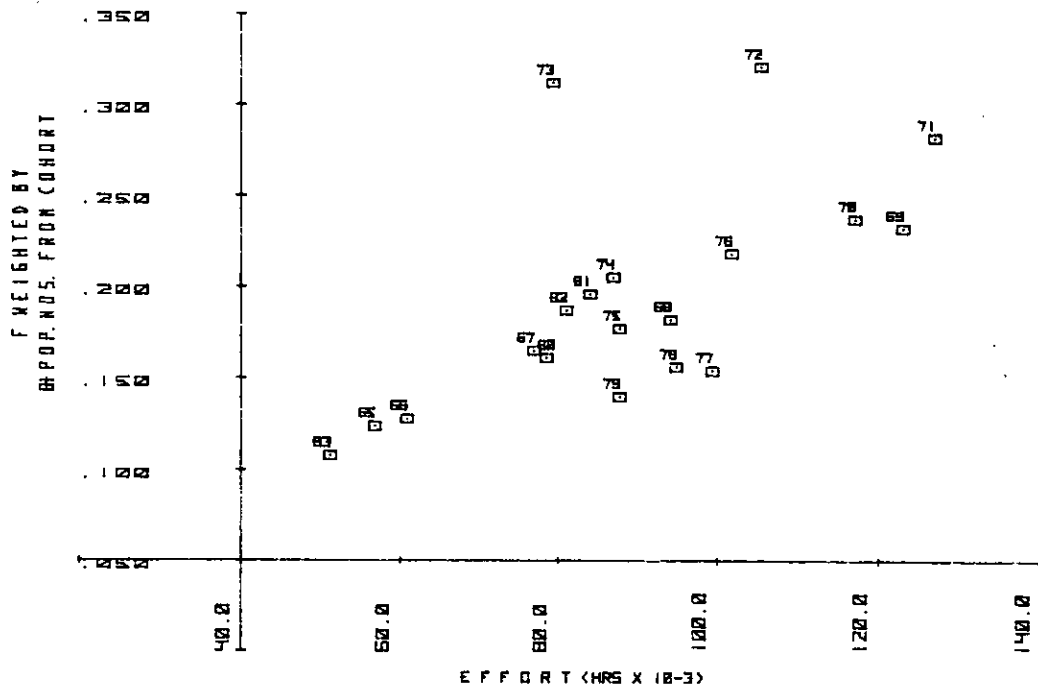

Fig. 6. Fishing mortality, weighted by 8+ population numbers from cohort run at F_T 0.275 vs. fishing effort, Div. 3LN.