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1979 Assessement of American Plaice (*Hippoglossoides platessoides F.*) in NAFO Division 4T

by

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Abstract

Commercial catches for 1979 were analyzed. Catch per unit of effort for Danish seiners (tonnage class 0-50 and 50-150 respectively) for 1979 indicate an increase in stock abundance since 1977. Research data has been collected since 1970, and the abundance index for 1979 also indicates an increase since 1976. Despite high discard rates, total landings for 1979 were higher than the past two years. All indices show evidence of an increase in plaice stock biomass.

Résumé

Les prises commerciales de plie canadienne ont été analysées. Les prises par unité d'effort des bateaux de pêche à la senne danoise (classe de tonnage de 0-50 et 50-150 respectivement) en 1979 indiquent que le stock augmente en nombre depuis 1977. On recueille des données sur des navires de recherche depuis 1970, et l'indice d'abondance de 1979 indique également qu'il y a augmentation depuis 1976. Malgré un taux élevé de rejet à la mer, les débarquements totaux de 1979 ont été supérieurs à ceux des deux années précédentes. Tous les indices montrent une augmentation de la biomasse du stock de plies canadiennes.

Introduction

American plaice (*Hippoglossoides platessoides F.*) landings accounted for the greatest proportion of flatfish landings since 1963, in the Gulf of St. Lawrence (Table 1). Provisional data for 1979 indicate that an increase of about 1000 t has occurred since 1978 (Table 2). The highest landings recently were in 1976 and 1977 when 11,193 t and 9,230 t, respectively, were reported.

This fishery is mainly a bycatch of the cod fishery, although the smaller Danish and Scottish seiners will direct some effort on flounders. In Table 3, landings by different fishing gears and tonnage classes are summarized in order to present a more complete picture of the complexity of this fishery.

Small plaice (less than 30 cm) are discarded since there is no market for them. Paucity of information regarding yearly discard rates, as well as commercial sampling prior to 1976, make a comprehensive assessment of this stock virtually impossible.

This paper presents an updated assessment of the American plaice stock in NAFO Division 4T for 1979.

Results

Sex Ratios

Although there is evidence from the research cruises that the proportion of females to males is roughly equal (Table 4), landings are predominantly composed of female plaice. The sex ratio for the numbers-at-age in the landings was determined from the sex ratio in commercial samples: the average ratio of female to male in the landings for 1979 was 4:1 (by number).

Landings at age in 1979

Samples of the commercial landings for 1979 for Danish seiners, otter trawlers and gill-netters were available. Samples of Danish seine landings were combined for all areas in 4T for the months of June, July and August in order to obtain one age-length key. The percentage by numbers of females was 77 percent, and this percentage was used to weight the landings and so to determine the number of females landed by Danish seiners. The removals-at-age of males were estimated in the same manner and added to the number of females to give the total removals-at-age for that gear.

Otter trawl samples were divided into the two age-length keys, one for January to June, and another for July to December. The percentage of females differed slightly; 84 percent for the first and 80 percent for the second key.

There was only one sample from a gill-net catch, and this sample (containing 70 percent females) was used for one age length key to be prorated for all areas for all fixed gear over the whole year.

Landed removals at age were estimated by taking removals at age by gear and adding them together. (Table 5).

Mean weights at age

The same weighting of samples was used to obtain the weights-at-age for 1979 for landed fish:

Male

Age	4	5	6	7	8	9
Weight (kg)	.03	-	.119	.159	.329	.262

Age	10	11	12	13	14	15
Weight (kg)	.305	.358	.465	.413	.294	.223

Female

Age	6	7	8	9	10	11
Weight (kg)	.118	.192	.350	.376	.458	.552

Age	12	13	14	15	16	17
Weight (kg)	.562	.760	.902	1.179	1.251	1.394

Age	18	19	20	21
Weight (kg)	1.519	1.677	1.861	1.961

The combined mean weights-at-age for 1979 for landed fish are given below.

Age	6	7	8	9	10	11
Weight (kg)	.118	.185	.340	.352	.426	.511
Age	12	13	14	15	16	17
Weight (kg)	.542	.688	.774	.979	.988	1.102
Age	18	19	20			
Weight (kg)	1.201	1.326	1.471			

Research mean weights-at-age show a small decline in 1979. This may be a density-dependent response to the increase in numbers. Mean weights from commercial landings for ages 6 - 10 will be biased up by discard of smaller fish at these ages.

However, both research mean weights-at-age (ages 2-16) and commercial mean weights-at-age (ages 6-20) show a similar trend in Figure 1.

Discards

Discard rates were estimated for this fishery in 1976 (McLaren Atlantic, 1977) and in 1979 (Metuzals, unpublished data) but because the 1979 data have not been aged, the results of the first study were used. The percent discarded at age, by sex, are given below and were used to calculate the number discarded for ages 6 - 13.

Percentage of Male and Female Plaice discarded at each age

Age	3	4	5	6	7	8
Male	100%	100%	97%	91%	81%	67%
Female	100%	100%	95%	86%	69%	27%

Age	9	10	11	12	13	14
Male	31%	17%	9%	4%	1%	0%
Female	9%	2%	0%	0%	0%	0%

The numbers of discards were added to the landed removals-at-age to obtain an estimated total catch-at-age table (Table 6).

Historical sampling coverage

The paucity of sampling for this stock is summarized on Tables 7a and 7b. The highest number of samples was taken in 1976 and coverage has declined since then; prior to 1976, an average of 3-4 samples per year were taken.

Given the nature of this fishery, i.e. the season is open throughout the year, and fishing occurs with a number of gears of differing tonnage classes, it seems that 3-4 samples are insufficient to cover the complete fishery.

Due to this poor sampling coverage, and also, because the results of one year's discard estimates were applied to all years, irregularities in the catch-at-age table may result.

The nominal catches for 1978 used in last year's assessment have been revised and the catch-at-age has been adjusted accordingly. The remainder of the catch-at-age table was taken from Gray (1978).

Abundance Indices

Research cruises in the fall provide information on relative plaice abundance. Population estimates are available at this time only for 1973-79, although data exist back to 1970.

The total number of males (Table 8) has gradually been increasing since 1973, except for a small decline in 1975 and 1978. Taking a three-year running average of 6+ males, a general increase in total numbers is evident. The values for 1973 and 1979 were calculated as straight averages.

The total number of females (Table 9) has also been increasing since 1973, except for 1975 and 1978. The same trend is evident when a three year running average of 6+ females is calculated.

In Table 10. where a total population estimate (males plus females plus numbers undetermined for sex) is given, the numbers indicate the same trend. A three-year running average for the 6+ plaice however, indicate a definite increase during 1973-79.

Total mortality values (Z) were calculated for research population estimates. Calculated Z values are variable, possibly due to year to year fluctuations in availability, and hence year to year changes are difficult to interpret. However, mean values of age 7+ mortality suggest that Z has been fairly low (0.31 for males and 0.36 for females).

Commercial abundance indices were obtained from NAFO Statistical Bulletins (Table 11). Detailed effort statistics are only available since 1972 for 4T plaice.

The total catch of plaice was divided by the total hours fished for Danish seine, tonnage class 25-50 tons and 50-150 tons, or class 2 and 3, as well as side trawler tonnage class 2 and 3. These gears combined catch over 50 percent of the plaice caught in most years, except in 1973 and 1976 (Fig. 2). The CPUE indices for otter trawlers indicate an increase in plaice abundance in 1979 but the Danish seiners' CPUE indicate a decrease.

Data for directed trips are available only since 1972 as well. For some years there were no directed trips reported (Table 12).

A method of deriving standardized CPUE figures for a mixed fishery is given by Chikuni (1976) in which the CPUE for one species is regressed against the percent catch of that species. The points on the curve corresponding to a constant percentage are taken from the CPUE series; and this percentage is then taken as the standard.

This method was tried for a number of gears such as Danish seiners, tonnage class 2 and 3, as well as for otter trawlers, tonnage class 4. Calculations were not restricted to certain months but calculated for the whole year in order to obain more reliable estimates. The standard percentage of 20 percent per gear of total plaice catch was taken from Danish seiners tonnage class 2, and otter trawlers tonnage class 4; 30 percent was used for Danish seiners tonnage class 3 (Table 13).

The resulting indices show a definite increase in landing rates from 1976-79 in the Danish seiners but a stabilization in landings per unit effort by otter trawlers.

The accuracy of the CPUE indices was investigated in the following way:

The commercial CPUE indices were regressed against research numbers per standardized tow since a longer time series of research numbers (1969-79) exists rather than the series of research population estimates (1973-79).

It should be noted however, that the early years of this research series (1969-70) had a more restricted range of coverage than the latter data which represent all of Division 4T.

The only commercial CPUE index that was significant at the 1 percent level, when regressed against the research data, was the CPUE (annual total landings) of Danish seine tonnage class 2 and 3 weighted by their landings. The correlation coefficient was 0.85 (r^2 = .72).

The CPUE of Danish seine class 2 and 3, weighted by their landings, will be commercial CPUE that is referred to throughout the remainder of the text.

Research CPUE (numbers-at-age calculated per standard 30-minute tow) indicate that the 1979 abundance is at the mean 1976-78 level (Table 14).

A gradual increase in total number per tow is evident from 1972 to 1977.

Natural Mortality

A value of M = 0.2 was used in this assessment. The value used in last year's assessment (0.15) was an average of Powles' (1969) estimates. However M = 0.15 is considered to be too low in view of Pitt's (1973) estimates for plaice on the Grand Banks.

Cohort Analysis

A cohort analysis was run using the removals at ages 6-21 for sexes combined. The partial recruitment pattern for 1979 and the fishing mortalities were adjusted so that the analysis gave correlations with the research abundance data and the commercial CPUE.

The abundance of the recruiting year class (taken to be the 6-years olds) in the research data (numbers per tow) was regressed against the estimated numbers of 6-year olds in the cohort. This relationship is shown in Fig. 3 and the correlation coefficient was 0.88 (r^2=.77).

Another relationship examined was the number of (6 + 7) year olds of the same year class in the cohort and in the research surveys. The correlation coefficient was 0.91 (r^2=.83). (Figure 4).

The total number of 6+ plaice in the cohort was also related to the total number of 6+ plaice in the research data. This relation ship although dependent on the previous correlations, is shown in Figure 5 and has a correlation coefficient of .93 (r^2=.87). This demonstrates that there is good agreement between cohort and research data.

A relationship of fishable biomass and the commercial CPUE index was not evident.

Another relationship was investigated. Fully recruited F and effort were regressed unsuccessfully. A correlation coefficient of 0.88 was obtained when the line was forced through the origin. It is included in Figure 6 to show some correlation between the fishing mortalities and the effort.

The resulting estimates of the population numbers-at-age and fishing mortalities are shown in Table 15.

Yield Per Recruit

A Thompson-Bell yield analysis was conducted, using the 1979 partial recruitments and 1979 weights-at-age.

The analysis produced a yield of 0.144 kg per recruit at an $F_{0.1}$ of 0.199 and an F_{max} of 0.442 (Table 16).

Partial Recruitment

The results of the above analysis produced the following pattern of recruitment for 1979:

Age	6	7	8	9	10
PR	.04	.24	.25	.25	.27
Age	11	12	13	14	15
PR	.81	.86	.88	.86	.95
Age	16	17	18	19	20
PR	1.00	1.00	1.00	1.00	1.00

This 1979 partial recruitment pattern gave the best correlations with survey data and commercial effort, yet it is not consistent with the pattern of recruitment in recent years, as shown by cohort analysis.

The recent partial recruitment pattern (1970-76) did not provide good agreement between survey data and cohort numbers.

Projections

The 1979 population abundance, estimated from cohort analysis was used to start projections for 1980-81. Weights-at-age and partial recruitment for 1979 were used.

Recruitment for 1980-81 was assumed to be the geometric mean of the number of 6-yr. olds also estimated from cohort analysis.

Year	Pop. numbers ($\times 10^{-6}$) Age 6+	Pop. Biomass ($\times 10^{-3}$) Age 6+	Catch Nos ($\times 10^{-6}$)	Catch Weight ($\times 10^{-3}$t)	Fully Recruited F
1979	847	220	32	12	0.22
1980	764	227	38	14	0.20
1981	692	244	42	19	0.20

It should also be noted that the calculation of catch is catch before discards. In 1979, the estimated catch of 12,000 t corresponds to reported landings of 8,000 t and discards account for about 33% of the catch by weight. This is consistent with the results of the 1976 discard study which showed 30-40% of catches were discarded (by weight). The projected landings associated with the calculated 1981 $F_{0.1}$ catch of 19,000 t would therefore be about 13,000 t.

Conclusion

Although discard rates are high in this fishery, there is evidence from the research cruises that there is good recruitment for the next few years. The total number of age 6+ for both male and female plaice have been increasing since 1973, with minor fluctuations during 1975-77.

In the past years, commercial CPUE indices have varied in estimating stock abundance. The CPUE index which correlated best with research data was the catch per unit of effort for Danish seiners tonnage class 2 and 3, weighted by their catch. This CPUE was used to examine the accuracy of the cohort analysis.

The TAC for the plaice stock has been 10,000 t since 1977.

These calculations suggest that, with recent good recruitment and increased stock abundance, landings associated with fishing at $F_{0.1}$ would be higher, about 13,000 t, in 1981. If partial recruitment pattern reverts to the historical average in 1981 the calculated $F_{0.1}$ catch would be higher, however, there is no basis for making this assumption.

There are substantial uncertainties however, about the fishery's response to increased abundance of small fish in most recent years and the extent to which increased abundance will be reflected in higher discards or higher landings. The 10,000 t TAC on landings has not been taken in any year since its imposition in 1977 and commercial landings per unit effort do not show a clear cut increase and do not agree well with research surveys. If the increase in abundance shown by surveys is real, the increase in potential yield may be dissipated in discards.

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Table 1. 4T Flatfish Landings 1963 - 1979

Year	A. Plaice	Witch	Yellowtail	Greenland Halibut	Atlantic Halibut	Winter Flounder	Non-Specified[1] Flounders	(t) Total Flatfish
1963	7,696	1,818	51	-	144	3,148	-	12,857
1964	7,836	1,170	39	-	74	3,002	-	12,121
1965	10,385	1,619	51	-	223	4,412	-	16,690
1966	11,780	2,188	125	126	123	3,056	-	17,398
1967	9,351	1,480	55	152	132	2,444	-	13,614
1968	9,568	1,832	6	120	124	550	-	12,200
1969	8,192	1,203	243	209	94	1,694	-	11,635
1970	9,201	1,203	44	235	126	2,684	-	13,493
1971	9,513	1,371	5	204	142	2,821	-	14,056
1972	8,294	1,049	3	105	119	1,822	1,201	12,593
1973	6,905	1,337	1	116	72	2,300	1,388	12,119
1974	8,485	727	21	92	68	1,920	602	11,915
1975	8,443	777	0	247	59	2,010	2,464	14,000
1976	11,193	1,534	29	135	68	1,407	668	15,034
1977	9,230	443	25	555	27	1,350	904	12,534
1978	7,414	213	3	555	2	1,120	-	9,307[2]
1979	8,478	464	50	-	8	1,548	-	10,548[2]

(1) Non-specified flounders (or flatfish) include American plaice, witch, yellowtail, Greenland halibut, Atlantic halibut, winter flounder, summer flounder and non-specified flounders.

(2) Preliminary catches only.

Table 2 4T Plaice monthly landings by country in tonnes.

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	NK	TOTAL
1972														
CAN-MQ	18	8	-	207	1630	1783	1479	780	625	451	739	251	-	7871
CAN-N	36	1	-	192	166	1	-	-	-	-	2	21	-	419
FRA-SP	-	-	-	4	-	-	-	-	-	-	-	-	-	4
TOTAL	54	9	-	403	1796	1784	1379	780	625	451	741	272	-	8294
1973														
CAN-MQ	4	-	-	59	714	1543	857	821	639	668	837	457	-	6599
CAN-N	-	-	-	253	9	-	-	-	-	-	4	22	-	288
FRA-SP	-	-	-	18	-	-	-	-	-	-	-	-	-	18
TOTAL	4	-	-	330	723	1543	857	821	639	668	841	479	-	6905
1974														
CAN-MQ	8	4	1	110	850	1462	1387	1153	987	740	1209	223	-	8134
CAN-N	4	-	-	114	99	7	-	-	-	-	-	103	-	327
FRA-M	-	-	-	9	1	-	-	-	-	-	-	-	-	10
FRA-SP	-	-	-	2	12	-	-	-	-	-	-	-	-	14
TOTAL	12	4	1	235	962	1469	1387	1153	987	740	1209	326	-	8485
1975														
CAN-MQ	6	2	-	41	1073	1314	1108	1155	1221	1043	843	254	-	8060
CAN-N	-	-	-	181	43	-	-	-	-	-	1	33	-	258
FRA-SP	1	-	-	87	-	-	-	-	-	-	3	21	-	112
PORT	11	2	-	-	-	-	-	-	-	-	-	-	-	13
TOTAL	18	4	-	309	1116	1314	1108	1155	1221	1043	847	308	-	8443
1976														
CAN-MQ	8	6	16	525	2531	1474	1084	1003	1065	605	309	69	-	8695
CAN-N	5	3	-	1497	890	-	-	-	-	2	15	-	-	2412
FRA-SP	-	-	-	36	-	-	-	-	-	-	38	12	-	86
TOTAL	13	9	16	2058	3421	1474	1084	1003	1065	607	362	81	-	11193
1977														
CAN-MQ	3	1	2	229	837	1464	1564	1592	1215	913	1323	10	-	9153
CAN-N	-	-	-	67	3	-	-	-	-	-	7	-	-	77
TOTAL	3	1	2	296	840	1464	1564	1592	1215	913	3330	10	-	9230
1978														
CAN-MQ	3	4	2	146	843	959	1018	905	955	1689	511	232	-	7267*
CAN-N	-	-	-	135	-	-	-	-	2	10	-	-	-	147
TOTAL	3	4	2	281	843	959	1018	905	957	1699	511	232	-	7414
1979														
CAN-M	21	17	5	544	1253	1274	949	952	934	1180	1089	122	-	8340*
CAN-N	-	4	-	-	-	-	3	-	-	-	88	43	-	138
TOTAL	21	21	5	544	1253	1274	952	952	934	1180	1177	165	-	8478

* NAFO Preliminary Catch Statistics.

Table 31 Landings for Maritimes, Quebec and Newfoundland by gear and tonnage class for 4T plaice in metric tonnes

YEAR	GEAR	OTTER TRAWL (SIDE)				OTTER TRAWL (STERN)					DANISH SEINE			SCOTTISH SEINE		GILLNETS[1]			OTHERS[2]					NK	TOTAL LAND-INGS
	TONNAGE CLASS	1	2	3	4	1	2	3	4	5	1	2	3	2	3	1	2	3	1	2	3	4	5		
1972		451	662	2461	701	-	-	59	149	652	-	1358	440	85	432	-	10	7	501	42	15	-	-	-	8025
1973		901	485	1097	604	203	-	26	79	163	-	970	951	275	547	233	3	5	306	4	30	18	-	-	6900
1974		766	1099	1213	478	-	111	115	149	200	341	874	1495	141	810	170	60	20	363	1	69	-	-	-	8475
1975		831	818	1399	164	-	72	189	43	491	232	836	1616	23	1171	273	18	26	227	9	101	-	-	-	8539
1976		866	651	954	1627	91	18	156	75	2524	238	881	1670	17	570	223	2	-	424	-	48	-	140	-	11175
1977		1330	1129	1758	44	16	26	311	7	13	325	1029	2240	-	410	237	-	5	294	3	49	-	-	-	9226
1978		992	26	1236	58	42	69	642	1	-	445	1079	1691	23	160	289	-	51	579	-	33	-	-	-	7414[3]
1979		733	291	966	154	268	64	463	12	54	421	1269	1531	45[4]	349	521	-	-	462	3	62	4	-	668	8478[3]
		(104)[5]				(34)[5]																			

1 Gillnets include set and drift nets.

2 Others include: midwater otter trawls, bottom otter trawls, longliners, shrimp trawls, pair-seines, boat dredge fixed gear, and miscellaneous gear.

3 NAFO preliminary statistics

4 Includes tonnage class 1

5 Preliminary statistics from Newfoundland with unspecified tonnage class

Table 4. 4T Plaice Age Composition of Research Cruises (1973-79)

Percentage of Females (numbers-at-age)

AGE	1973	1974	1975	1976	1977	1978	1979
1	0.316	50.000	98.667	50.000	0.508	50.000	50.000
2	67.370	0.030	48.673	80.831	64.192	0.162	48.649
3	46.664	54.345	39.143	51.253	48.609	8.832	43.406
4	45.614	33.810	44.832	43.195	37.720	14.234	46.374
5	40.514	42.011	43.815	43.921	40.056	18.984	44.578
6	41.519	42.979	34.914	41.898	41.697	21.451	37.446
7	43.242	30.951	31.163	47.818	52.947	23.119	36.837
8	40.861	33.373	40.819	43.808	48.617	46.997	43.085
9	54.178	42.339	29.954	38.847	45.360	47.381	57.166
10	51.859	79.884	48.095	32.929	48.165	53.465	48.500
11	47.754	65.949	52.142	63.423	54.536	49.020	51.982
12	43.304	56.476	69.260	69.951	58.660	69.864	58.056
13+	77.745	35.213	69.935	84.125	86.017	88.306	81.122
$\bar{X}$	48.66	46.30	46.49	50.99	51.38	43.28	50.51

Table 5. Landings-at-age of 4T plaice.

AGE	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
6	715	948	1075	854	873	748	231	252	227	208	230	254	639	808	758	312
7	1753	2323	2635	2091	2140	1832	1093	1189	1073	985	1089	1198	1679	2509	1847	853
8	2348	3112	3530	2802	2867	2455	1815	1975	1782	1636	1808	1990	2535	2650	3573	3331
9	2238	2966	3365	2671	2733	2340	2395	2607	2351	2159	2386	2625	2200	2237	2307	4527
10	2116	2804	3181	2525	2584	2212	3576	3893	3511	3224	3563	3920	2455	2002	2197	3151
11	1570	2081	2360	1874	1917	1641	2511	2732	2465	2263	2501	2752	2022	1516	1780	1799
12	1757	2328	2641	2096	2145	1837	1478	1609	1451	1332	1473	1620	2583	1746	1165	1280
13	951	1261	1430	1135	1162	995	970	1056	953	875	967	1064	1396	865	1104	873
14	528	700	794	630	645	552	749	815	735	675	746	821	781	435	540	949
15	305	404	458	363	372	318	618	673	607	557	616	678	420	210	407	254
16	304	402	456	362	371	317	479	522	471	432	478	525	431	117	113	155
17	165	218	248	197	201	172	726	790	712	654	723	795	374	73	77	104
18	115	152	173	137	140	120	57	62	56	51	57	62	233	101	83	31
19	113	150	170	135	138	118	7	7	7	6	7	7	274	53	44	63
20	90	119	135	107	110	94	5	5	5	5	5	6	187	62	27	77
21	42	55	63	50	51	44	12	13	12	11	12	13	111	11	179	109

Table 6. Catch at age 4T plaice.

AGE	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
6	6219	8243	9350	7422	7594	6502	2011	2189	1974	1813	2004	2205	5557	7026	5903	3110
7	7010	9291	10539	8366	8560	7329	4371	4757	4291	3940	4355	4891	6716	10036	7171	3958
8	4431	5872	6661	5287	5410	4632	3425	3727	3362	3087	3412	3754	4783	5000	5472	7034
9	2798	3708	4206	3339	3416	2925	2994	3258	2939	2698	2983	3282	2750	2796	2638	5503
10	2338	3099	3515	2790	2855	2444	3952	4301	3879	3562	3937	4332	2713	2212	2318	3403
11	1644	2179	2472	1962	2007	1719	2629	2861	2581	2370	2619	2882	2117	1587	1793	1859
12	1793	2376	2695	2139	2189	1874	1508	1642	1481	1360	1503	1653	2636	1782	1179	1290
13	956	1267	1438	1141	1168	1000	975	1061	957	879	972	1069	1403	869	1105	874
14	528	700	794	630	645	552	749	815	735	675	746	821	781	435	540	949
15	305	404	458	363	372	318	618	673	607	557	616	678	420	210	407	254
16	304	402	456	362	371	317	479	522	471	432	478	525	431	117	113	155
17	165	218	248	197	201	172	726	790	712	654	723	795	374	73	77	104
18	115	152	173	137	140	120	57	62	56	51	57	62	233	101	83	31
19	113	150	170	135	138	118	7	7	7	6	7	7	274	53	44	63
20	90	119	135	107	110	94	5	5	5	5	5	6	187	62	27	77
21+	42	55	63	50	51	44	12	13	12	11	12	13	111	11	179	109

Table 7 a Sampling of 4T Plaice in NAFO Area 4T (1972-1979)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
1979														
	21	17	5	544	1253	1274	949	952	934	1180	1089	122	8478[1]	Landings (t)
SAMPLES														
OTB	1	-	-	1	1	-	-	-	-	1	3	-	7	
SNU	-	-	-	-	-	2	1	4	-	-	-	-	7	
GN	-	-	-	-	-	1	-	-	-	-	-	-	1	
% landings														
	0.25%	-	-	6.5%	15%	15%	11%	11%	11%	14.2%	13%	2%	100%	
1978														
	3	4	2	281	843	959	1018	905	955	1699	511	232	7414[1]	Landings (t)
Samples														
OTB[2]	-	-	-	-	-	-	-	-	1	1	-	-	2	
SNU[3]	-	-	-	-	-	4	3	2	1	-	-	-	10	
% landings														
	-	-	-	4%	11%	13%	13%	12%	13%	22%	7%	3%	100%	
1977														
	3	1	2	296	840	1464	1564	1592	1215	913	1328	10	9230	Landings (t)
Samples														
OTB	-	-	-	-	-	5	-	-	-	-	-	-	5	
SNU	-	-	-	-	-	4	5	12	5	-	-	-	26	
% landings														
	-	-	-	3%	9%	16%	17%	17%	13%	9%	14%	-	100%	
1976														
	13	9	16	2058	3421	1474	1083	1003	1065	607	362	81	11193	Landings (t)
Samples														
OTB	-	-	-	2	11	1	-	-	-	-	-	-	14	
SNU	-	-	-	-	4	13	5	8	1	1	-	-	32	
% landings														
	-	-	-	18%	30%	13%	10%	8%	10%	5%	3%	1%	100%	
1975														
	18	4	-	309	1116	1314	1108	1155	1221	1043	847	308	8443	Landings (t)
Samples														
OTB	-	-	-	2	-	-	-	-	-	-	-	-	2	
SNU	-	-	-	-	1	1	1	-	-	-	-	-	3	
% landings														
	-	-	-	3%	13%	16%	13%	14%	15%	12%	10%	4%	100%	
1974														
	12	4	1	235	962	1469	1387	1153	987	740	1209	326	8485	Landings (t)
Samples														
OTB	-	-	-	-	-	-	-	-	-	-	2	-	2	
SNU	-	-	-	-	-	-	-	1	-	-	1	-	2	
% landings														
	-	-	-	3%	11%	17%	16%	14%	12%	9%	14%	4%	100%	
1973														
	4	-	-	330	723	1543	857	821	639	668	841	469	6905	Landings (t)
Samples														
OTB	-	-	-	-	-	-	-	-	-	1	-	-	1	
SNU	-	-	-	-	1	-	1	1	-	-	-	-	3	
% landings														
	-	-	-	5%	11%	22%	12%	12%	9%	9%	12%	7%	100%	
1972														
	54	9	-	403	1796	1784	1379	780	625	451	741	272	8294	Landings (t)
Samples														
OTB	-	-	-	-	-	-	-	-	-	-	-	-	-	
SNU	-	-	-	-	-	-	-	-	-	-	-	-	-	
% landings														
	-	-	-	5%	22%	22%	17%	10%	8%	5%	9%	2%	100%	

[1] Preliminary NAFO Statistics.

[2] OTB abbreviation for Bottom Otter Trawl.

[3] SNU abbreviation for Seine Unspecified; Danish and Scottish seines inclusive.

Table 7b Sampling of 4T Plaice in NAFO Area 4T (1948-1971).

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTALS
1971													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	7626
Samples													
OTB		-	-	-	-	1	-	-	-	-	-	-	1
1970													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	7582
SNU	-	-	-	-	1	-	-	-	-	-	-	-	1
1967													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	7534
Samples													
OTB	-	-	-	-	-	-	-	-	-	-	2	-	2
1966													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	9362
Samples													
OTB	-	-	-	-	-	-	-	-	-	-	1	-	1
1965													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	8778
Samples													
OTB	-	-	-	1	1	-	2	-	-	1	-	-	5
1964													
Landings (t)	-	-	-	-	-	-	-	-	-	-	-	-	6916
Samples													
OTB	-	-	-	-	-	1	1	-	-	1	-	-	3
1963													
OTB	-	-	-	-	-	1	1	1	1	-	-	-	4
SNU	-	-	-	-	-	1	-	1	-	-	-	-	2
1962													
OTB	-	-	-	-	-	-	-	-	-	1	-	-	1
1961													
OTB	-	-	-	-	-	3	-	-	1	1	-	-	5
1958													
OTB	-	-	-	-	-	1	-	-	-	-	-	-	1
1956													
OTB	-	-	-	-	-	1	-	-	-	-	-	-	1
1953													
OTB	-	-	-	-	-	1	-	-	-	-	-	1	2
1949													
OTB	-	-	-	-	-	-	1	-	-	-	-	-	1
LL [4]	-	-	-	-	-	1	-	-	-	-	-	-	1
1948													
OTB	-	-	-	-	-	-	1	-	-	1	-	-	2
LL	-	-	-	-	-	-	-	1	-	-	-	-	1

1 Preliminary NAFO Statistics. Quebec, Maritime and Newfoundland inshore catches missing.

2 OTB abbreviation for Bottom Otter Trawl unspecified.

3 SNU abbreviation for Seine Unspecified; Danish and Scottish Seines inclusive.

4 LL abbreviation for long-liners.

Table 8 Research cruise population estimate - 4T Plaice - Males - Numbers-at-age x 10^{-3} (strata 15-39)

AGE	1973	1974	1975	1976	1977	1978	1979
1	315	1	1	1	196	1	1
2	2228	3362	1876	180	1423	616	342
3	13927	29591	15731	18948	41255	8093	4330
4	19443	95789	52539	100472	158790	76178	39003
5	24679	60926	95898	154511	209225	93376	108318
6	18891	59688	58555	127306	119644	98208	114494
7	15383	36806	50375	53303	63379	96005	134283
8	19245	34069	26884	29066	32142	40941	90905
9	11725	26189	25604	29590	14071	13902	31242
10	5541	4840	11932	21747	8333	8435	19712
11	2919	1502	8399	8254	4450	4449	9959
12	2354	1502	1375	3974	2764	1373	4668
13+	3604	9729	3134	2783	1302	1047	3916
* UK	455	9951	140	248	387	1	71
	140710	373942	352441	550382	657361	442623	561243
5+	104796	245202	282296	430783	455727	357736	517568
6+	80117	184276	186398	276271	246502	264360	409250
7+	61226	124588	217843	148965	126858	166152	294756
8+	45843	87782	77468	95662	63479	70147	160473
9+	26598	53713	50584	66596	31337	29206	69568
10+	14873	27524	24980	37006	17236	15304	38326
11+	9332	22684	13048	15259	8903	6869	18614
12+	6413	21182	4649	7005	4453	2420	8655
3-year moving average							
6+	132196.5	150263.7	215648.3	236390.3	262377.7	306704	336805
7+	92907	104552.3	133798.7	134555.3	147325.0	195922	230454
Z 7+/8+	-0.360	0.475	0.290	0.853	0.593	0.035	
Z 8+/9+	-0.158	0.551	0.151	1.116	0.776	0.008	

* UK = Numbers of unknown ages (usually very young or very old fish with unreadable otoliths.

Table 9. Research cruise population estimate - 4T Plaice - Females - Numbers-at-age x 10^{-3} (strata 15-39)

AGE	1973	1974	1975	1976	1977	1978	1979
1	1	1	74	1	1	1	1
2	4600	1	1779	759	2551	1	324
3	12185	35224	10118	19922	39022	784	3321
4	16307	48929	42696	76401	96170	12643	33729
5	16808	44138	74784	121015	139808	21880	87124
6	13412	44989	31410	91803	85568	26820	68537
7	11720	16498	22805	48846	71319	28870	78316
8	13297	17065	18543	22660	30412	36302	68817
9	13863	19230	10949	18797	11681	12518	41695
10	5969	19221	11056	10677	7743	9691	18564
11	2668	2909	9151	14312	5338	4278	10781
12	1798	1949	3098	9251	3922	3183	6461
13+	12590	5288	7290	14748	8009	7906	16828
UK	118	1967	1	1050	1	1	221
	125336	257407	243752	450241	501543	164875	434718
5+	92243	173254	189086	353159	363800	151448	397344
6+	75435	129116	114302	232144	223992	129568	310220
7+	62023	84127	82892	140341	138424	102748	241683
8+	50303	67629	60087	91495	67105	73878	163367
9+	37006	50564	41544	68835	36693	37576	94550
10+	23143	31334	30595	50038	25012	25058	52855
11+	17174	12113	19539	39361	17269	15367	34291
12+	14506	9204	10388	25049	11931	11089	23510
3-year moving average							
6+	102276	106284	158521	190146	195235	221260	219894
7+	73075	76347.3	102453.3	120552.3	127171	160951.7	172215.5
Z 7+/8+	-0.087	0.337	-0.099	0.738	0.628	-0.464	
Z 8+/9+	-0.005	0.487	-0.136	0.914	0.580	-0.247	

Table 10. Research cruise population estimate - 4T Plaice - Total (males + females + undetermined)* numbers-at-age x 10^{-3} (Strata 15 - 39).

AGE	1973	1974	1975	1976	1977	1978	1979
1	1061	489	427	0	882	2	91
2	8064	4515	3939	4054	6258	925	1402
3	26112	65670	25849	62024	89637	9872	7681
4	35750	144718	95235	206401	257220	90304	72795
5	41487	105064	170682	276677	349033	115336	195472
6	32303	104677	89965	219109	205212	125028	183031
7	27103	53304	73180	102149	134698	124875	212599
8	32542	51134	45427	51726	62554	77243	159722
9	25588	45419	36553	48387	25752	26420	72937
10	11510	24061	22988	32424	16076	18126	38276
11	5587	4411	17550	22566	9788	8727	20740
12	4152	3451	4473	13225	6686	4556	11129
13	16194	15017	10424	17531	9311	8953	20744
UK	592	12495	1045	3894	3289	0	311
TOTAL	268045	634425	597737	1060168	1776396	610365	996930
5+	197058	419033	472287	787688	822399	509264	914961
6+	155571	313969	301605	511011	473366	393928	719489
7+	123268	209292	211640	291902	268154	268900	536458
8+	96165	155988	318460	181965	133456	144025	323859
9+	63623	104854	93033	138027	70902	66782	164137
10+	38035	59435	56480	89640	45150	40362	91200
11+	26525	35374	33492	57216	29074	22236	52924
12+	20938	30963	15942	34650	19286	13509	32184
3-year moving average							
6+	234770	257048	375528	428661	459435	528928	556709
7+	166280	181400	237011	257232	276319	357837	402679
Z 7+/8+	-0.237	0.415	-0.151	0.961	0.622	-0.186	
Z 8+/9+	-0.088	0.517	-0.836	1.247	0.692	-0.131	

* Undetermined = Sex undetermined; usually very young fish.

Table 11. Commercial CPUE (total plaice catch (t) whether directed or not and catch per hour)

	OTB1-2		OTB1-3		SDN-2		SDN-3		
	(t)	CPUE	(t)	CPUE	(t)	CPUE	(t)	CPUE	Total Catch all gears (t)
1972	270	0.008	2459	.380	1327	.144	440	.140	8294
1973	485	0.011	1066	.030	862	.151	951	.135	6905
1974	1097	0.029	1213	.056	874	.176	1495	.155	8485
1975	818	0.020	1399	.044	836	.217	1616	.168	8443
1976	652	0.025	937	.063	881	.243	1670	.177	11193
1977	1152	0.039	1688	.094	1029	.192	2240	.211	9230
1978*	344	0.040	1100	.170	1079	.230	1628	.163	7414
1979*	291	0.261	966	.183	1269	.188	1531	.147	8478

* Preliminary statistics from NAFO

Table 12. Commercial CPUE (directed plaice (t) and catch per hour for Jan-Dec).

Year	OTB1-2		OTB1-3		OTB1-4		OTB2-2		OTB2-3		OTB2-4		OTB2-5		SDN-2		SDN-3		SSC-3		Dir. Total[2] (all gears)
	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	
1972											61	.328									61
1973[1]											- NIL -										-
1974					87	.193	101	.076	58	.111	62	.282	47	.331	824	.160	1495	.162	810	.143	3675
1975					-	-	-	-	-	-	17	.113	215	.427	-	-	-	-	-	-	318
1976					884	.449	-	-	-	-	3	.250	1448	.681	-	-	-	-	-	-	2335
1977	168	.081	999	.217	12	.138	26	.173	196	.275	-	-	4	.500	932	.231	1414	.286	-	-	4501
1978	8	.127	675	.404	-	-	65	-	462	.486	1	.083	-	-	984	.266	698	.190	53	.174	2986
1979	134	.691	389	.229	54	.257	32	.194	303	.397	5	.833	10	.385	989	.285	660	.298	139	.187	2738

[1] No reported catch directed for plaice 4T from NAFO Statistical Bulletins.

[2] Total for all directed catch for all gears. Effort calculated for mobile gear.

Table 13. Chikuni CPUE

4T Plaice CPUE
Chikuni (SDN-2) where
X = 20% of plaice in total catch

				R	N	CPUE
1972	Y=.02539	+	.0028(x)	.79	15	.081
1973	Y=.054	+	.0025(x)	.53	14	.104
1974	Y=.0999	+	.0014(x)	.38	8	.128
1975	Y=.170	+	.0013(x)	.22	8	.196
1976	Y=-.150	+	.0069(x)	.46	9	.012
1977	Y=-.007	+	.0032(x)	.75	14	.057
1978	Y=.05	+	.0031(x)	.45	15	.112
1979	Y=.1128	+	.002451(x)	.44	8	.162

4T Plaice CPUE
Chikuni (SDN-3) where
x = 30%

				R	N	CPUE
1972	Y=.02466	+	.00228(x)	.66	8	.093
1973	Y=-.0619	x	.00518(x)	.909	15	.094
1974	Y=.102	+	.0009(x)	.642	8	.129
1975	Y=-0.03	+	.0039(x)	.641	8	.087
1976	Y=-0.0198	+	.0032(x)	.983	13	.076
1977	Y=.085	+	.0028(x)	.643	15	.169
1978	Y=.11096	+	.0016(x)	.256	26	.159
1979	Y=.05592	+	.0044(x)	.726	23	.176

4T Plaice CPUE
Chikuni (OTB 1-4)
x = 20% of plaice in total catch

				R	N	CPUE
1972	Y=0.1646	+	(.00573)(x)	.919	20	.279
1973	Y=.01256	+	(.00514)(x)	.771	21	.115
1974	Y=.00918	+	(.00375)(x)	.827	19	.084
1975	Y=.02104	+	(.00278)(x)	.763	10	.077
1976	Y=.05012	+	(.00403)(x)	.729	16	.131
1977	Y=.15844	+	(.00109)(x)	.133	4	.180
1978	Y=.00414	+	(.00619)(x)	.999	3	.128
1979	Y=.11363	+	(.00074)(x)	.321	6	.128

Table 14. Numbers of Plaice per Standard 30 min. tow in research cruises (1968-79)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.00	0.00	0.13	0.19	0.22	0.14	0.07	0.03	0.00	0.05	0.00	0.00
2	2.35	1.02	3.45	3.82	2.84	2.90	5.51	1.20	0.34	1.41	0.18	0.37
3	12.99	7.03	9.22	11.67	7.37	13.22	20.12	9.25	14.09	30.04	2.75	3.45
4	36.20	26.46	15.52	19.10	15.64	18.15	42.92	37.32	74.80	99.42	28.90	29.04
5.	40.57	37.78	24.73	19.83	14.01	19.75	34.96	70.14	141.61	157.33	39.53	76.97
6	34.41	34.56	28.14	21.42	14.31	15.10	26.73	33.97	115.89	107.46	44.29	74.35
7	29.12	30.93	27.82	22.38	15.93	12.50	16.86	25.87	54.68	78.99	45.54	89.16
8	17.50	18.97	17.43	13.80	10.91	14.71	12.73	15.98	24.39	35.15	29.19	68.65
9	6.14	6.78	4.94	4.11	4.92	11.75	14.81	12.38	22.04	13.14	11.21	31.62
10	4.34	5.02	3.65	2.70	2.96	5.32	7.88	8.10	14.82	7.77	8.01	16.52
11	4.05	4.76	3.89	2.41	1.44	2.56	3.65	6.31	10.90	4.73	4.61	9.24
12	2.81	3.52	3.30	1.59	1.57	1.86	1.51	1.92	6.92	3.10	2.64	5.20
13	1.35	1.63	1.60	0.99	.74	1.36	1.15	1.11	4.47	1.90	2.98	3.33
14	0.99	1.52	1.23	0.88	0.59	1.59	1.78	1.14	2.16	1.09	1.36	3.12
15	0.59	0.95	0.96	0.46	0.32	0.71	0.96	0.83	1.18	0.60	0.87	1.91
16+	1.35	2.31	1.61	1.24	0.51	2.40	1.40	3.08	2.41	0.92	1.59	2.55
TOTALS	194.76	183.24	146.63	126.59	94.28	124.02	193.04	228.63	490.70	543.11	223.64	415.88

Table 15. 4T Plaice Population Numbers and Fishing Mortalities

POPULATION NUMBERS

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
6	97378	87951	82737	72040	69297	65404	62426	69434	60739	54465	62803	168438	340407	233637	112513	344797
7	82125	74098	64549	59279	52266	49863	47665	49290	54867	47942	42952	49606	135910	273674	184928	84524
8	44566	60895	52259	43313	40964	35046	34193	35070	36050	41039	35686	31225	36278	105197	214984	146352
9	34157	32478	44542	36759	30677	28642	24501	24896	25339	26473	30807	26130	22168	25373	81604	170876
10	21036	25433	23236	32662	27075	22024	20804	17351	17434	18087	19232	22523	18424	15661	18243	64390
11	14013	15106	18019	15842	24216	19583	15819	13457	10313	10763	11584	12183	14520	13429	10820	12962
12	7838	9985	10396	12516	11195	18009	14478	10573	8428	6108	6668	7114	7367	9971	8903	7284
13	4764	4795	6025	6073	8311	7185	13049	10488	7171	5560	3770	4099	4328	3646	6551	6363
14	3329	3034	2778	3632	3939	5747	4978	9800	7626	5004	3756	2207	2388	2273	2198	4411
15	2482	2247	1850	1555	2402	2640	4205	3397	7286	5577	3485	2399	1063	1248	1467	1451
16	2599	1756	1474	1100	944	1630	1873	2883	2171	5415	4062	2295	1351	491	832	863
17	1748	1853	1073	793	572	437	1047	1099	1888	1352	4041	2893	1403	716	296	579
18	1118	1282	1319	654	471	286	201	200	185	901	514	2655	1648	810	520	173
19	753	811	911	923	411	258	125	113	107	101	690	369	2116	1139	572	351
20	454	513	528	591	633	211	104	96	86	81	76	559	295	1485	884	429
21	274	291	312	309	386	419	88	80	73	66	62	57	452	72	1160	700
	318634	322528	312009	288042	273759	257386	245556	248227	239763	228933	230189	334752	590117	688023	646474	846502

FISHING MORTALITY

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
6	0.073	0.109	0.133	0.121	0.129	0.116	0.036	0.035	0.037	0.037	0.036	0.015	0.018	0.034	0.086	0.010
7	0.099	0.149	0.199	0.170	0.200	0.177	0.107	0.113	0.090	0.095	0.119	0.113	0.056	0.041	0.034	0.053
8	0.116	0.113	0.152	0.145	0.158	0.158	0.117	0.125	0.109	0.087	0.112	0.143	0.158	0.054	0.030	0.055
9	0.095	0.135	0.110	0.106	0.131	0.120	0.145	0.156	0.137	0.120	0.113	0.149	0.147	0.130	0.037	0.057
10	0.131	0.145	0.183	0.099	0.124	0.131	0.236	0.320	0.282	0.246	0.257	0.239	0.178	0.170	0.142	0.040
11	0.139	0.174	0.164	0.147	0.096	0.102	0.203	0.268	0.324	0.279	0.288	0.303	0.176	0.150	0.196	0.190
12	0.291	0.305	0.338	0.209	0.243	0.122	0.122	0.188	0.216	0.282	0.287	0.297	0.503	0.220	0.136	0.190
13	0.251	0.346	0.306	0.233	0.169	0.167	0.086	0.119	0.160	0.192	0.335	0.340	0.444	0.306	0.196	0.195
14	0.193	0.295	0.380	0.213	0.200	0.112	0.182	0.097	0.113	0.162	0.248	0.530	0.449	0.238	0.215	0.190
15	0.146	0.222	0.320	0.299	0.188	0.143	0.178	0.248	0.097	0.117	0.218	0.374	0.574	0.206	0.331	0.210
16	0.138	0.293	0.419	0.454	0.570	0.243	0.333	0.223	0.274	0.093	0.139	0.292	0.435	0.306	0.163	0.220
17	0.110	0.140	0.295	0.321	0.494	0.575	1.454	1.581	0.540	0.767	0.220	0.363	0.349	0.120	0.339	0.220
18	0.121	0.141	0.157	0.263	0.401	0.624	0.375	0.427	0.407	0.066	0.131	0.027	0.170	0.148	0.194	0.220
19	0.183	0.230	0.232	0.178	0.467	0.711	0.064	0.081	0.075	0.080	0.011	0.024	0.154	0.053	0.089	0.220
20	0.247	0.299	0.335	0.226	0.213	0.677	0.066	0.071	0.067	0.070	0.091	0.012	1.206	0.047	0.034	0.220
21	0.185	0.238	0.251	0.196	0.157	0.123	0.163	0.198	0.198	0.204	0.239	0.288	0.314	0.183	0.177	0.188
	0.106	0.142	0.168	0.143	0.155	0.140	0.122	0.133	0.121	0.116	0.128	0.098	0.065	0.054	0.053	0.043

YIELD PER RECRUIT

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG, WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.040	0.12834	0.060	0.470	1.000
	0.080	0.22485	0.097	0.433	0.807
	0.120	0.29967	0.120	0.402	0.665
	0.160	0.35930	0.135	0.375	0.558
F0.1---	0.199	0.40633	0.144	0.353	0.479
	0.200	0.40799	0.144	0.352	0.477
	0.240	0.44860	0.150	0.333	0.413
	0.280	0.48310	0.153	0.317	0.362
	0.320	0.51286	0.155	0.303	0.322
	0.360	0.53886	0.156	0.290	0.288
	0.400	0.56182	0.157	0.280	0.260
	0.440	0.58230	0.157	0.270	0.237
FMAX---	0.442	0.58317	0.157	0.270	0.236
	0.480	0.60071	0.157	0.262	0.217
	0.520	0.61737	0.157	0.254	0.200
	0.560	0.63254	0.156	0.247	0.185
	0.600	0.64643	0.156	0.241	0.172
	0.640	0.65921	0.155	0.235	0.160
	0.680	0.67100	0.154	0.230	0.150
	0.720	0.68194	0.153	0.225	0.141
	0.760	0.69211	0.152	0.220	0.133
	0.800	0.70161	0.151	0.216	0.125

Table 16. Yield Per Recruit

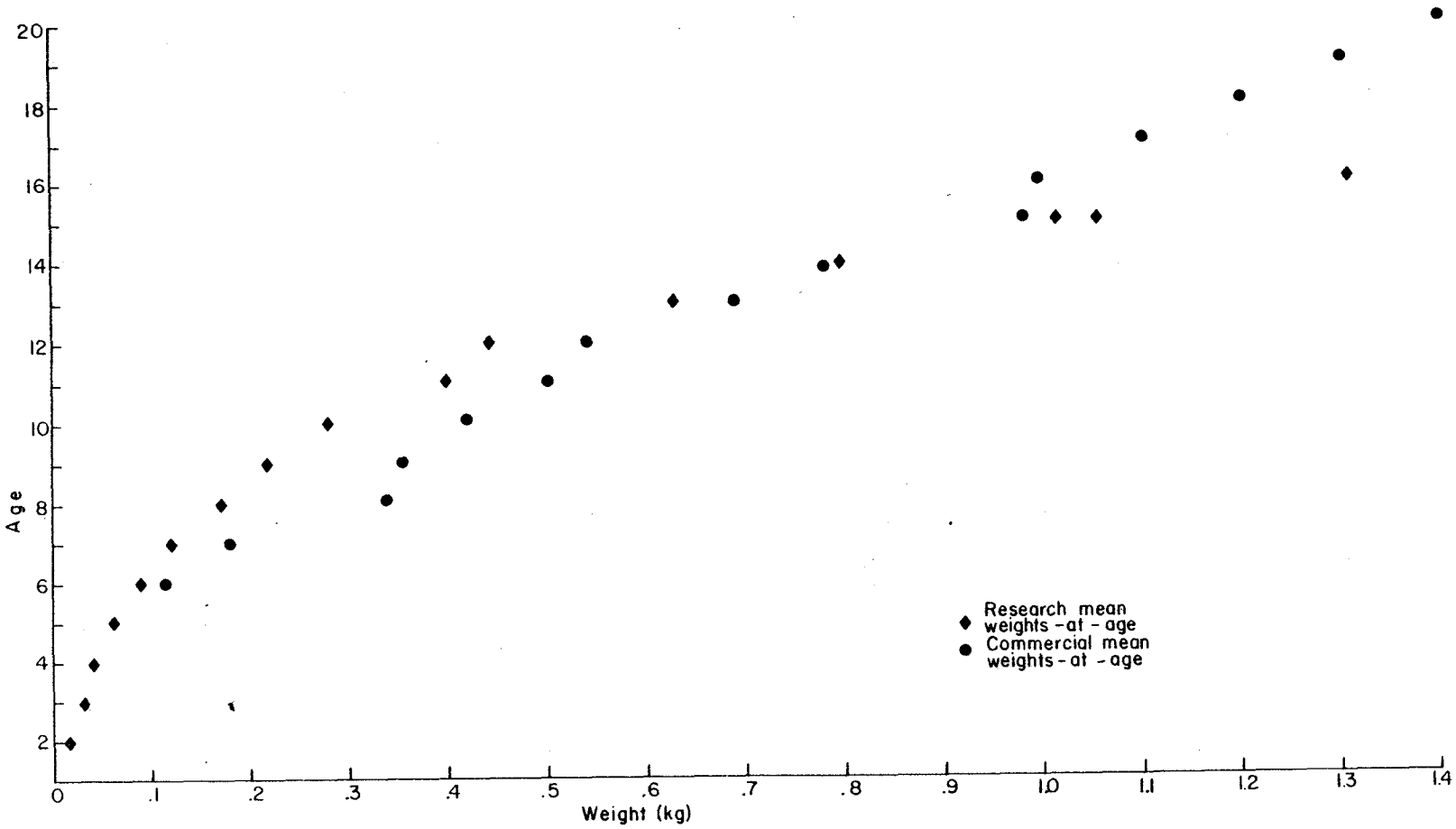


Fig 1. Mean weights-at-age for sexes combined for 1979 from research and commercial data.

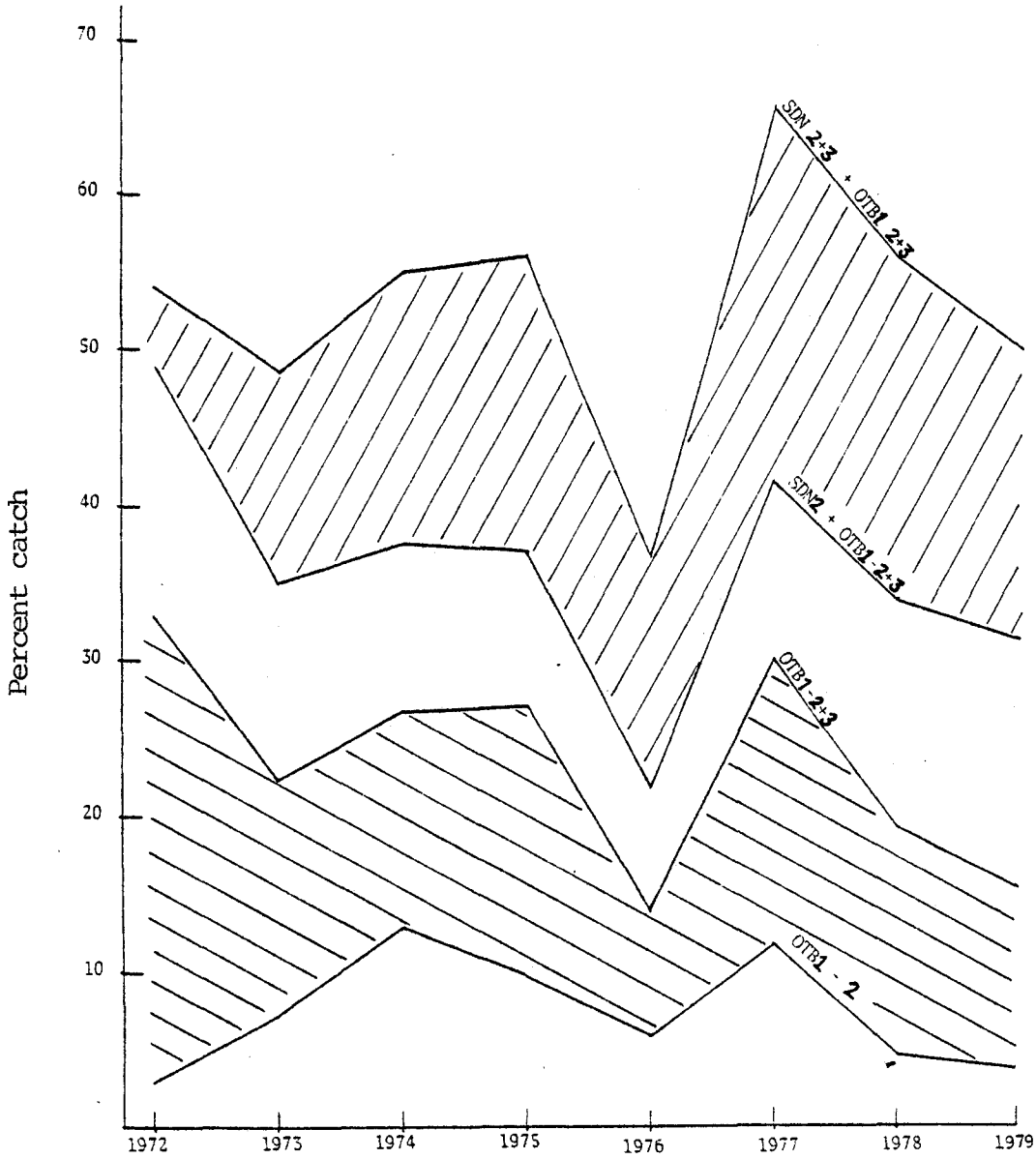
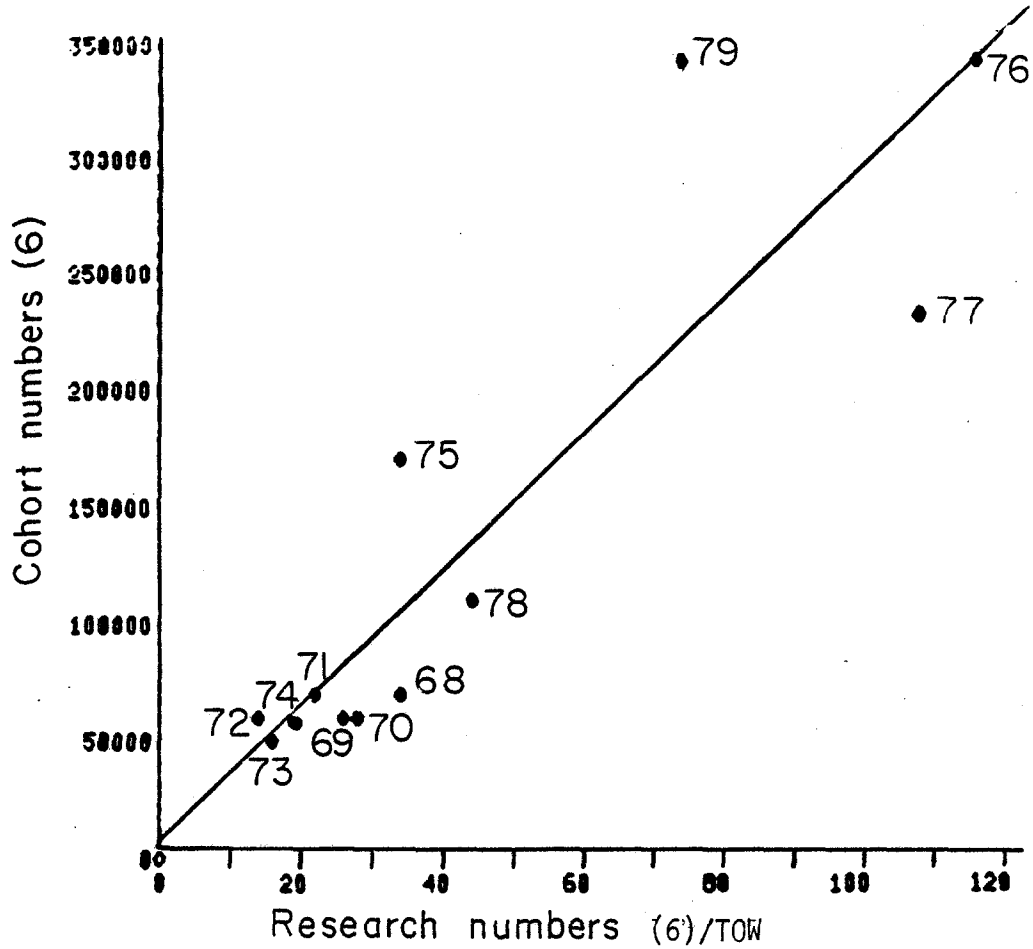
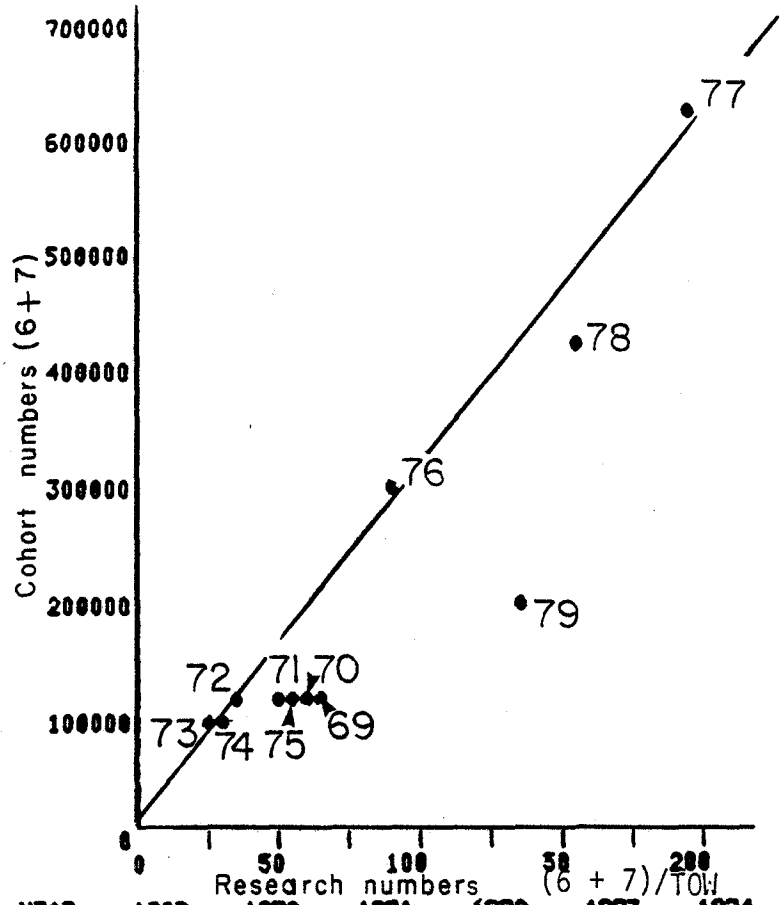


Figure 2 . Cumulative catch distribution by mobile gear for 4T Plaice.



REGRESSION COEFFICIENT	2794.981779
INTERCEPT	8779.906803
T-VALUE	5.765189256
STANDARD ERROR	484.8031269
DEGREES OF FREEDOM	11
OBSERVATIONS	12
R*2	0.7687187864

Figure 3. Linear Regression of Age 6 (VPA numbers) versus age 6 Research numbers-per-tow

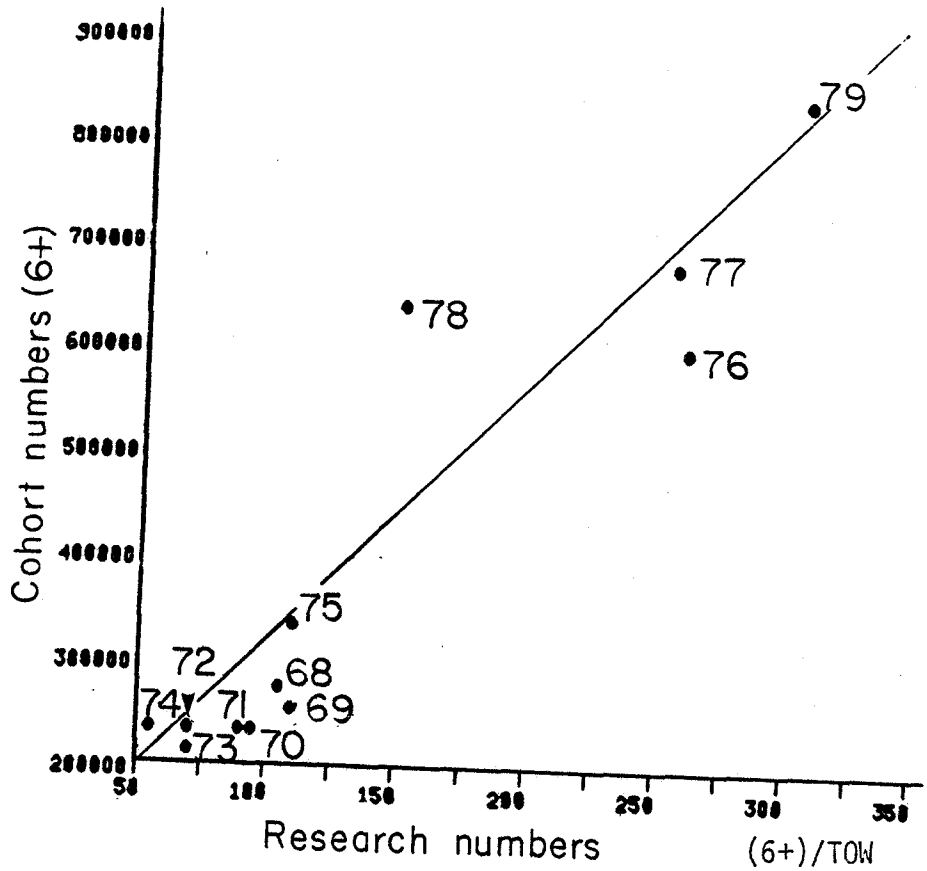


YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
VPA	119161	113869	111716	124302	108681	97417	112410	304340	614082	410566	197037
RES	65.340	62.300	50.520	37.350	26.810	31.960	52.600	80.650	194.000	153.000	133.450

THIS PLOTS 6 PLUS 7 YEAR OLDS OF VPA VS RES

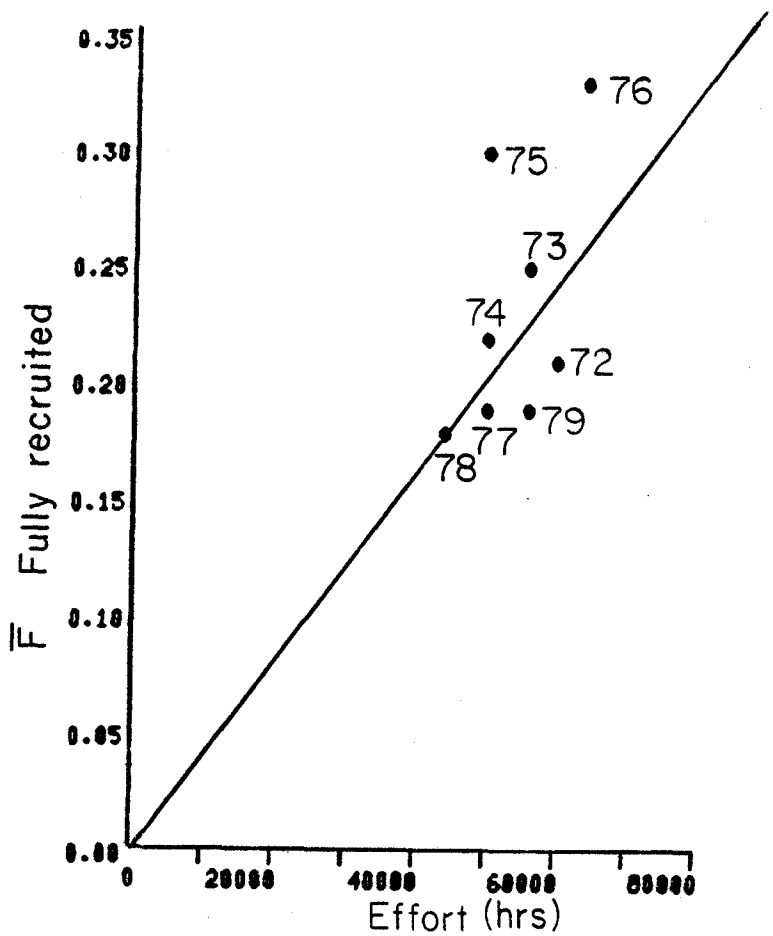
REGRESSION COEFFICIENT	2777.835197
INTERCEPT	15524.34864
T-VALUE	6.691904757
STANDARD ERROR	415.0900531
DEGREES OF FREEDOM	10
OBSERVATIONS	11
R*2	0.83265982

Figure 4. Linear Regression of VPA (6 plus 7 year olds) versus Research (6 plus 7 year olds) from numbers per tow.



REGRESSION COEFFICIENT	2448.342397
INTERCEPT	60389.83133
T-VALUE	8.139786891
STANDARD ERROR	300.787039
DEGREES OF FREEDOM	11
OBSERVATIONS	12
R*2	0.8688630827

Figure 5. Linear regression of VPA 6+ year olds versus Research 6+ year olds (from numbers per tow).



REGRESSION COEFFICIENT	4.351033747E⁻6
INTERCEPT	0.001187906927
T-VALUE	4.938696942
STANDARD ERROR	8.810884519E⁻7
DEGREES OF FREEDOM	8
OBSERVATIONS	9
R*2	0.7778042124

Figure 6. Linear Regression of fully recruited F of VPA versus effort of DSN-2 and DSN-3 weighted by their catch.