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Assessment of American plaice in NAFO 4T

by

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Abstract

Landings from the American plaice fishery in the Gulf of St. Lawrence have been stable since 1963. A series of commercial catch and effort data from 1972-1980 is presented using a median smoother. The commercial CPUE however, may not be indicative of trends in the overall fishery since the large vessels of the mobile fleet do not direct their effort on plaice.

Data from research vessel surveys indicate that a number of strong year-classes, especially those of 1971 and 1972 are entering the fishery. Biomass estimates for 1980 also indicate that the total plaice biomass has doubled since 1970.

Résumé

Les débarquements de plie canadienne de la pêcherie du golfe du Saint-Laurent sont stables depuis 1963. L'article qui suit présente une série de données sur les prises et l'effort de pêche commerciale de 1972 à 1980, lissées par médiane. Il se peut toutefois que les PUE commerciales ne soient pas représentatives des tendances de l'ensemble de la pêcherie car la flottille de grande pêche ne dirige pas ses efforts vers la plie canadienne.

Les relevés par navire de recherche indiquent que plusieurs importantes classes d'âge, notamment celles de 1971 et 1972, sont en train de rallier le stock pêchable. Les estimations de biomasse pour 1980 démontrent en outre que la biomasse totale de plies a doublé depuis 1970.

INTRODUCTION

The purpose of this assessment document is to update the status of the American plaice fishery in the Gulf of St. Lawrence for 1980. It reviews the recent results of the groundfish research vessel survey and commercial catch rates. Background information on the plaice fishery are reviewed in earlier documents, Powles (1960, 1964, 1965, 1969) and Jean (1963). Assessment information on this stock is compiled in Schweigert (1978), and Metzals (1979, 1980).

Provisional nominal catch statistics for all flatfish landings in the Gulf are presented in Table 1. American plaice is the dominant species landed, and it is also present in high proportions in the unspecified flounder category.

Provisional nominal catch statistics for 1980 show a slight decrease since 1979. Landings since 1970 (Figure 1) have averaged 8878 mt. This average, plus the average of non-specified flounder landings (1342 mt) over the past ten years, gives annual average landings for plaice of about 10,220 mt. The TAC for the past years has been maintained at 10,000 mt.

Landings by month are given in Table 2, Figures 2 and 3. Landings by gear are given in Table 3. The fishery is highly seasonal in nature, there being virtually no fishing from December to April due to ice conditions. Up to 40% of the total landings is taken on the average by side otter trawlers and 39% is the average by Danish seiners (Table 4). This is by tonnage class 2 and 3, or 25-50 and 50-150 GRT respectively. Small inshore boats, tonnage class 1 or 0-25 GRT take 23% of the total catch (Table 5).

AGE COMPOSITION IN COMMERCIAL LANDINGS

A total of ten (10) samples of the commercial plaice landings was available for 1980 (Table 6). Samples by Danish seiners were combined for all months for all areas in order to obtain one age-length key. The percentage of numbers of females in the samples was 78% and this percentage was used to weight the landings accordingly. The landings-at-age of males were estimated in the same manner and added to the number of females in order to obtain total landings-at-age by Danish seiners.

Otter trawl samples (4) were also combined for all areas in Div. 4T for all months to obtain one key. The percentage of females in the landings was 88%, slightly higher than in landings of Danish seiners. This percentage was used to estimate number of females in the landings. The number of males were estimated in the same manner and added to the females in order to obtain total landings-at-age by otter trawls. There was only one gillnet sample available and this one sample was used to obtain a representative key for all inshore gear. The percentage of females was estimated to be 97%.

Total landings-at-age were obtained by adding landings-at-age by Danish seiners, otter trawlers and inshore gear.

Percentage landings-at-age (Figure 4) indicate that plaice males are caught at a younger age by Danish seiners, than by otter trawlers. The percentage of numbers-at-age of female plaice caught by Danish seiners indicates that younger fish are caught by the seiners rather than the trawlers.

Female plaice are landed at ages 7-19, whereas male plaice are landed at ages 6-15.

Gillnetters are more selective on specific year-classes. In the analysis for 1981 it was evident that males are caught by gillnets mainly at age 8 and females are caught at age 9 (29%) and age 12 (20%).

Discard estimates (MacLaren 1977) were used again to obtain the total catch-at-age (Table 7). Details of the method are presented in Schweigert (1978) and Metzals (1979, 1980). Basically the method applies percentages of discards-at-age i.e. if 95% of the 5 year old female plaice are discarded by the fishery, landings of 5 year olds only represent 5% of the total catch and the landings are adjusted by multiplying by 20 to give the total catch.

Since these discard percentages are only approximations, the total number of 6-10 year olds obtained in the catch matrix, are probably underestimated.

COMMERCIAL CPUE

Commercial abundance indices were derived from data in NAFO (ICNAF) Statistical Bulletins. Detailed effort statistics for directed plaice fishery are only available since 1972 resulting in a very limited time series (Table 8). Landings for plaice before 1972 were grouped with other flatfishes under the headings of "Other Flounders" and "Mixed Flounders".

Total plaice landings and total hours fished were used as a CPUE for Danish seines tonnage class 2 (SDN-2) and tonnage class 3 (SDN-3). The CPUE values were smoothed using a median smoother program MED3R by S. Smith (personal communication) in Table 9. CPUE was also calculated for otter trawlers for illustrative purposes. Although otter trawlers and Danish seiners of tonnage class 2 and 3 are approximately equal in percentage landings of plaice (40%) it is the smaller Danish seiners that direct most effort on plaice (and other flatfishes).

Danish seine (directed) CPUE for SDN-2 and SDN-3 separately, as well as the CPUE combined for SDN-2 and SDN-3, weighted by the catch shows an increase in abundance since 1972. When the Danish seine combined CPUE is plotted with the CPUE obtained from research survey numbers per tow (Figure 5) the same trend is evident as when SDN-2 and SDN-3 CPUE are plotted with smoothed research CPUE numbers per tow (Figure 6). All CPUE indices show a decrease in abundance in 1980 from 1978 and 1979.

The accuracy of these CPUE indices was investigated by regressions against research CPUE (in mean numbers per tow in Table 10) for total numbers per tow, as well as ages 6, 6+, 7, 7+ and 8, 8+.

To standardize all sets of data, the years 1972 to 1980 were used, although surveys have been carried out in the Gulf of St. Lawrence since 1970.

The commercial CPUE index for 1972-1980 that correlated well when regressed against research data, was the CPUE derived from SDN-2 and SDN-3 weighted by their landings. The correlation coefficient was 0.77, the highest obtained. This is the same CPUE used in last year's assessment.

RESEARCH CPUE

Groundfish research surveys have been carried out in the Gulf of St. Lawrence since 1970. Estimates of total number of males in the population were obtained (Table 11) and total number of females (Table 12). An overall increase in the population is seen since 1972 in both males and females (Figure 7). Especially in 1976 and 1977, there was a four fold increase of the total fish since 1972. This large total is largely due to the strong 1970, 1971, and 1972 year-classes.

A slight decline is noted in 1980 from 1979 in numbers of 5+, 6+, 7+ and 8+ year olds (Figs. 8-10a, 10b) in both male and female plaice. Although a decline is evident in 1980, the number of 5+ year olds is still not as low as that in 1971 and 1972. An overall increase in numbers of 5+, 6+, 7+ and 8+ year olds is evident since 1972.

When total population numbers are plotted on the same figure as total biomass (Figure 11) a general increase is evident since the past ten years. For example, in 1970 the total population was estimated to be 300×10^6 numbers, and in 1980 it doubles to 600×10^6 .

Population estimates of 5, 6 and 7 year olds (Figure 12) as well as 8 and 9 year olds (Figure 13) indicate a great abundance of these in 1976 and 1977, suggesting that strong 1970, 1971 and possibly 1972 year-classes are coming through the fishery.

Research catch per effort, in number per standardized tow, was also examined. This is calculated as an arithmetic mean where all research tows are standardized to 30 minutes. Since 1978, a decline in numbers per tow is observed.

Research weights-at-age tables are available from 1971-1980 (Table 13). The average weight per fish in the catch (calculated as an arithmetic mean) has increased slightly since 1971. Average length per fish (Table 14) show an increase in the average length of the females in the catch, but not of males.

Total mortality (Z) was calculated for both males and females (see Tables 11 and 12). A substantial increase was observed in the estimate of Z between 1979 and 1980. However, this follows an unusually low estimate between 1978 and 1979 indicating that the data are too variable for weight to be put upon the estimate between any two years. The data suggest that, on average over the last five years, Z on ages 7+ has been about 0.70 for males and about half that for females.

CONCLUSION

With the current discarding practices, any potential for increased yield from strong year-classes coming through the fishery, may have already been dissipated.

References

- Jean, Y. 1963. Discards of fish at sea by northern New Brunswick draggers. J. Fish. Res. Bd. Canada 20(2): 497-524.
- MacLaren Atlantic Ltd. 1977. Analysis of discards in the Gulf of St. Lawrence plaice fishery (MS).
- Metuzals, K. 1979. Stock Assessment of American Plaice (Hippoglossoides platessoides F.) in ICNAF Division 4T. CAFSAC Research Document 79/51.
- Metuzals, K. 1980. Assessment of American Plaice (Hippoglossoides platessoides F.) in NAFO Division 4T in 1979. CAFSAC Research Document 80/41.
- Powles, P. 1960. Plaice studies Fish. Res. Bd. Canada Biol. Sta. St. Andrews, N.B. (MS).
- Powles, P. 1964. Some factors affecting stocks and landings of American plaice (Hippoglossoides platessoides F.) in the southwestern Gulf of St. Lawrence. McGill University. (MS).
- Powles, P. 1965. Life history and ecology of American plaice (Hippoglossoides platessoides F.) in the Magdalen Shallows. J. Fish. Res. Bd. Canada 22: 565-598.
- Powles, P. 1969. Size changes, mortality and equilibrium yields in an exploited stock of American plaice (Hippoglossoides platessoides F.) J. Fish. Res. Bd. Canada 26(5) 1205-1227.
- Schweigert, J. 1978. Simulation and assessment of the dynamics of American plaice stocks in the Gulf of St. Lawrence (4T). CAFSAC Res. Doc. 78/14 (MS).

Table 1. Nominal catch of flatfish in NAFO Div. 4T for 1963-1980¹

YEAR	AMERICAN PLAICE	WITCH	YELLOWTAIL	GREENLAND HALIBUT	ATLANTIC HALIBUT	WINTER FLOUNDER	NON-SPECIFIED ² FLOUNDERS
1963	7,696	1,818	51	-	144	3,148	2,218
64	7,836	1,170	39	-	74	3,002	1,419
1965	10,385	1,619	51	-	223	4,412	2,569
66	11,780	2,188	125	126	123	3,056	3,531
67	9,351	1,480	55	152	132	2,444	2,606
68	9,568	1,832	6	120	124	550	3,318
69	8,192	1,203	243	209	94	1,694	2,272
1970	9,201	1,203	44	235	126	2,684	2,327
71	9,513	1,371	5	204	142	2,821	2,747
72	8,294	1,049	3	105	119	1,822	1,201
73	6,905	1,337	1	116	72	2,300	1,388
74	8,485	727	21	92	68	1,920	602
1975	8,443	777	-	247	59	2,010	2,464
76	11,193	1,534	29	135	68	1,407	668
77	9,230	443	25	555	27	1,350	1,163
78	9,031	215	3	1,354	48	1,121	764
79	8,480	464	50	-	8	1,547	97
1980 ³	7,100	384	41	3	10	1,875	-

¹Statistics for 1963-1971 from ICNAF Statistical Bulletin, for 1973 revised catches of flounder species.

²Non-specified flounders (or flatfish) are mainly American plaice.

³ Provisional

Table 2. American plaice nominal catch in metric tons in NAFO Div. 4T by month

YEAR		MONTH												TOTAL
		J	F	M	A	M	J	J	A	S	O	N	D	
1972	CAN-MQ	18	8	-	207	1630	1783	1379	780	625	451	739	251	7871
	CAN-N	36	1	-	192	166	1	-	-	-	-	2	21	419
	FRA-SP	-	-	-	4	-	-	-	-	-	-	-	-	4
	<u>TOTAL</u>	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
	<u>TOTAL</u>	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
	<u>TOTAL</u>	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
	POR	11	2	-	-	-	-	-	-	-	-	-	-	13
	<u>TOTAL</u>	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
	<u>TOTAL</u>	13	9	16	2058	3421	1474	1084	1003	1065	607	362	81	11,193
1977	CAN-MQ	3	1	2	229	837	1464	1564	1592	1215	913	1323	10	9153
	CAN-N	-	-	-	67	3	-	-	-	-	-	7	-	77
	<u>TOTAL</u>	3	1	2	296	840	1464	1564	1592	1215	913	1330	10	9230
1978	CAN-MQ	2	4	2	342	1167	1179	1235	1146	1173	1876	525	233	8884
	CAN-N	-	-	-	135	-	-	-	-	2	10	-	-	147
	<u>TOTAL</u>	2	4	2	477	1167	1179	1235	1146	1175	1886	525	233	9031
1979	CAN-MQ	21	17	5	544	1253	1274	949	952	939	1180	1089	122	8345
	CAN-N	-	4	-	-	-	-	-	-	-	-	88	43	135
	<u>TOTAL</u>	21	21	5	544	1253	1274	949	952	939	1180	1177	165	8480
1980*	CAN-MQ	4	-	1	416	1040	1190	1107	987	868	930	417	99	7059
	CAN-N	-	-	-	39	-	-	-	-	-	-	-	2	41
	<u>TOTAL</u>	4	-	1	455	1040	1190	1107	987	868	930	417	101	7100

* Preliminary catch.

Table 3. Nominal catch for American plaice in Div. 4T in metric tons by gear for 1972-1980

YEAR	GEAR TONNAGE CLASS	OTTER TRAWL (SIDE)				OTTER TRAWL (STERN)					DANISH SEINE			SCOTTISH SEINE		GILLNETS ¹			OTHERS ²					TOTAL LAND- INGS	
		1	2	3	4	1	2	3	4	5	1	2	3	2	3	1	2	3	1	2	3	4	5		NK
1972		451	662	2461	701	-	-	59	149	652	-	1358	440	85	432	269	10	7	501	42	15	-	-	-	8294
1973		901	485	1097	604	203	-	26	79	163	-	970	951	275	547	233	3	5	306	4	30	18	-	5	6905
1974		766	1099	1213	478	-	111	115	149	200	341	874	1495	141	810	170	60	20	363	1	69	-	-	10	8485
1975		813	818	1399	164	-	72	189	43	491	232	836	1616	23	1171	173	18	26	227	9	101	-	22	-	8443
1976		866	651	954	1627	91	18	156	75	2524	238	881	1670	17	570	223	2	-	424	-	48	-	140	18	11193
1977		1330	1129	1758	44	16	26	311	7	13	325	1029	2240	-	410	237	-	5	294	3	49	-	-	4	9230
1978		992	865	1737	57	100	-	788	1	-	445	1008	1611	182	243	340	39	-	557	6	60	-	-	-	9031
1979		733	291	966	256	268	64	463	25	74	421	1269	1531	6	349	521	-	5	1147	2	84	4	-	-	8480
1980		1334	4	746	45	149	46	379	-	92	608	991	1398	37	244	590	-	-	370	3	6	-	-	58	7100 ³

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

Table 4. Nominal catch of American plaice in metric tons by gear 1972-1980,
 (The number in parenthesis is the percentage catch by gear) in NAFO Div. 4T,
 1972-1980

YEAR	SIDE OTTER TRAWLS	STERN OTTER TRAWLS	DANISH AND SCOTTISH SEINERS	GILLNETS	OTHER GEAR
1972	4275 (51)	860 (10)	2315 (28)	286 (3)	558 (6)
1973	3087 (45)	471 (7)	2743 (40)	241 (3)	363 (5)
1974	3556 (42)	575 (7)	3661 (43)	250 (3)	443 (5)
1975	3194 (38)	795 (9)	3878 (46)	217 (3)	359 (4)
1976	4098 (37)	2864 (25)	3376 (30)	225 (2)	630 (6)
1977	4261 (46)	373 (4)	4004 (43)	242 (3)	350 (4)
1978	3651 (40)	889 (10)	3489 (39)	379 (4)	623 (7)
1979	2246 (26)	894 (11)	3576 (42)	526 (6)	1237 (15)
1980	2129 (30)	666 (10)	3278 (46)	590 (8)	437 (6)
TOTAL	30,497 (40)	8,387 (11)	30,320 (39)	2,956 (4)	5,000 (6)

Table 5. Nominal catch of American plaice by tonnage class 1 in NAFO Div. 4T
1972-1980
(Percentage by gear in parenthesis)

YEAR	OTB1	OTB2	DSN	GN	OTHERS	PERCENTAGE OF TOTAL CATCH
1972	451 (37)	-	-	269 (22)	501 (41)	15
1973	901 (55)	203 (12)	-	233 (14)	306 (19)	24
1974	766 (47)	-	341 (21)	170 (10)	363 (22)	19
1975	813 (56)	-	232 (16)	173 (12)	227 (16)	17
1976	866 (47)	91 (5)	238 (13)	223 (12)	424 (23)	16
1977	1330 (60)	16 (1)	325 (15)	237 (11)	294 (13)	23
1978	992 (41)	100 (4)	445 (18)	340 (14)	557 (23)	27
1979	733 (24)	268 (9)	421 (13)	521 (17)	1147 (37)	36
1980	1334 (40)	149 (5)	608 (21)	590 (21)	370 (13)	40
TOTAL	8186 (44)	827 (4)	2610 (14)	2756 (15)	4189 (23)	23

Table 6 . Commercial sampling of 4T plaice, 1960 - 1980.

	OTTER TRAWL (Jan-Aug)			OTTER TRAWL (Sept-Dec)			DANISH SEINES (Jan-Dec)			GILLNETS (Jan-Dec)			LONGLINES (Jan-Dec)		
	Number of Samples	Number Measured	Number Aged	Number of Samples	Number Measured	Number Aged	Number of Samples	Number Measured	Number Aged	Number of Samples	Number Measured	Number Aged	Number of Samples	Number Measured	Number Aged
1960	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	3	450	50	2	288	0	-	-	-	-	-	-	-	-	-
62	-	-	-	1	200	0	-	-	-	-	-	-	-	-	-
63	2	300	0	2	385	0	2	400	0	-	-	-	-	-	-
64	2	309	0	1	109	0	-	-	-	-	-	-	-	-	-
1965	4	724	0	2	237	0	-	-	-	-	-	-	-	-	-
66	-	-	-	1	100	0	-	-	-	-	-	-	-	-	-
67	-	-	-	2	300	0	-	-	-	-	-	-	-	-	-
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	1	201	0	-	-	-	-	-	-
71	1	182	0	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	2	420	72	-	-	-	-	-	-	-	-	-
73	-	-	-	1	200	40	3	600	123	-	-	-	-	-	-
74	-	-	-	2	400	77	2	401	82	-	-	-	-	-	-
1975	2	400	67	-	-	-	3	601	120	-	-	-	-	-	-
76	14	2782	584	-	-	-	32	6400	1220	-	-	-	1	200	0
77	5	964	151	-	-	-	26	5154	856	-	-	-	-	-	-
78	-	-	-	2	407	79	10	1996	274	-	-	-	-	-	-
79	3	559	122	4	804	141	7	1400	220	1	200	33	-	-	-
1980	3	600	65	1	200	29	5	1048	147	1	203	34	-	-	-

Table 7. Landings-at-age and catch-at-age for 4T Plaice.

AGE	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
	<u>Landings</u>																
6	715	948	1075	854	873	748	231	252	227	208	230	254	639	808	758	312	40
7	1753	2323	2635	2091	2140	1832	1093	1189	1073	985	1089	1198	1679	2509	1847	853	423
8	2348	3112	3530	2802	2867	2455	1815	1975	1782	1636	1808	1990	2535	2650	3573	3331	922
9	2238	2966	3365	2671	2733	2340	2395	2607	2351	2159	2386	2625	2200	2237	2307	4527	1990
10	2116	2804	3181	2525	2584	2212	3576	3893	3511	3224	3563	3920	2455	2002	2197	3151	1723
11	1570	2081	2360	1874	1917	1641	2511	2732	2465	2263	2501	2752	2022	1516	1780	1799	1690
12	1757	2328	2641	2096	2145	1837	1478	1609	1451	1332	1473	1620	2583	1746	1165	1280	1955
13	951	1261	1430	1135	1162	995	970	1056	953	875	967	1064	1396	865	1104	873	1273
14	528	700	794	630	645	552	749	815	735	675	746	821	781	435	540	949	1099
15	305	404	458	363	372	318	618	673	607	557	616	678	420	210	407	254	762
16	304	402	456	362	371	317	479	522	471	432	478	525	431	117	113	155	416
17	165	218	248	197	201	172	726	790	712	654	723	795	374	73	77	104	267
18	115	152	173	137	140	120	57	62	56	51	57	62	233	101	83	31	90
19	113	150	170	135	138	118	7	7	7	6	7	7	274	53	44	63	67
20	90	119	135	107	110	94	5	5	5	5	5	6	187	62	27	77	32
21	42	55	63	50	51	44	12	13	12	11	12	13	111	11	179	109	23
	<u>Catch</u>																
6	6219	8243	9350	7422	7595	6502	2012	2189	1975	1813	2004	2205	5557	7027	5903	3110	444
7	7011	9291	10539	8366	8560	7329	4371	4758	4291	3940	4355	4792	6716	10036	7171	3958	1814
8	4431	5873	6661	5288	5411	4633	3425	3728	3362	3087	3412	3755	4784	5000	5472	7034	1782
9	2798	3708	4207	3339	3417	2925	2994	3259	2939	2699	2983	3282	2750	2797	2638	5503	2280
10	2339	3099	3516	2791	2856	2445	3952	4302	3880	3563	3938	4333	2713	2213	2318	3403	1888
11	1645	2179	2472	1962	2008	1719	2629	2862	2581	2370	2620	2882	2118	1588	1793	1859	1712
12	1793	2376	2695	2140	2189	1874	1509	1642	1481	1360	1503	1654	2636	1782	1179	1290	1966
13	957	1268	1438	1142	1168	1000	976	1062	958	880	972	1070	1404	870	1105	874	1277
14	529	701	795	631	646	553	750	816	736	676	747	822	781	435	540	949	1105
15	305	404	458	364	372	319	619	674	608	558	617	678	420	210	407	254	762
16	304	403	457	363	371	318	480	522	471	433	478	526	431	117	113	155	416
17	165	219	248	197	202	173	726	790	713	655	723	796	374	73	77	104	267
18	115	153	173	137	141	120	57	63	56	52	57	63	233	101	83	31	90
19	114	151	171	136	139	119	7	8	7	7	7	8	274	53	44	63	67
20	90	120	136	108	110	94	6	6	5	5	6	6	187	62	27	77	32
21	42	56	63	50	51	44	12	13	12	11	12	13	111	11	179	109	29

Table 8 Commercial CPUE¹ for American Plaice in Div. 4T for 1972-1980.

YEAR	OTB1-2 CPUE	OTB1-3 CPUE	OTB1-4 CPUE	OTB2-2 CPUE	OTB2-3 CPUE	OTB2-4 CPUE	OTB2-5 CPUE	SDN-2 CPUE	SDN-3 CPUE	SSC-3 CPUE
1972	-	-	-	-	-	.328	-	-	-	-
1973 ²	-	-	-	-	-	-	-	-	-	-
1974	-	-	.193	.075	.111	.282	.331	.160	.162	.143
1975	-	-	-	-	-	.113	.427	-	-	-
1976	-	-	.449	-	-	.250	.681	-	-	-
1977	.081	.217	.138	.173	.275	-	.500	.231	.286	-
1978	.196	.356	-	-	.420	.083	-	.305	.181	.162
1979	.691	.229	.257	.194	.397	.833	.385	.285	.298	.187
1980	-	.406	-	.195	.272	-	-	.278	.251	.238

¹ CPUE for directed plaice catch only.

² No reported catch directed for plaice 4T from (ICNAF) NAFO Statistical Bulletins.

Table 9. Commercial CPUE¹ for American plaice in Div. 4T for 1972-1980

YEAR	OTB1-2 CPUE	Smooth	OTB1-3 CPUE	Smooth	SDN-2 CPUE	Smooth	SND-3 CPUE	Smooth	SDN-2 SDN-3 weighted by Catch
1972	0.008	(.008)	.38	(.030)	.144	(.144)	.140	(.140)	(.143)
1973	0.011	(.011)	.030	(.044)	.151	(.151)	.135	(.140)	(.143)
1974	0.029	(.02)	.056	(.056)	.176	(.176)	.155	(.155)	(.163)
1975	0.020	(.025)	.044	(.056)	.217	(.217)	.168	(.168)	(.185)
1976	0.025	(.025)	.063	(.063)	.243	(.217)	.177	(.177)	(.200)
1977	0.039	(.032)	.094	(.094)	.192	(.202)	.211	(.177)	(.205)
1978	0.032	(.039)	.098	(.098)	.202	(.192)	.163	(.163)	(.176)
1979	0.262	(.091)	.183	(.183)	.191	(.191)	.147	(.147)	(.166)
1980 ²	0.091	(.091)	.219	(.219)	.165	(.165)	.113	(.113)	(.135)

¹ CPUE is calculated from total plaice catch and total hours fished.

² Preliminary catch.

Table 10. Numbers of Plaice (sex combined) per Standard 30 min. tow in research cruises (1971-1980)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.19	0.22	0.14	0.07	0.03	0.00	0.05	0.00	0.00	1.10
2	3.82	2.84	2.90	5.51	1.20	0.34	1.41	0.18	0.37	3.77
3	11.67	7.37	13.22	20.12	9.25	14.09	30.04	2.75	3.45	16.77
4	19.10	15.64	18.15	42.92	37.32	74.80	99.42	28.90	29.04	34.19
5	19.83	14.01	19.75	34.96	70.14	141.61	157.33	39.53	76.97	41.63
6	21.42	14.31	15.10	26.73	33.97	115.89	107.46	44.29	74.35	53.75
7	22.38	15.93	12.50	16.86	25.87	54.68	78.99	45.54	89.16	40.03
8	13.80	10.91	14.71	12.73	15.98	24.39	35.15	29.19	68.65	31.09
9	4.11	4.92	11.75	14.81	12.38	22.04	13.14	11.21	31.62	15.89
10	2.70	2.96	5.32	7.88	8.10	14.82	7.77	8.01	16.52	7.70
11	2.41	1.44	2.56	3.65	6.31	10.90	4.73	4.61	9.24	4.78
12	1.59	1.57	1.86	1.51	1.92	6.92	3.10	2.64	5.20	2.74
13	0.99	.74	1.36	1.15	1.11	4.47	1.90	2.98	3.33	2.20
14	0.88	0.59	1.59	1.78	1.14	2.16	1.09	1.36	3.12	1.10
15	0.46	0.32	0.71	0.96	0.83	1.18	1.60	0.87	1.91	0.60
16+	1.24	0.51	2.40	1.40	3.08	2.41	0.92	1.59	2.55	0.88
TOTALS	126.59	94.28	124.02	193.04	228.63	490.70	543.11	223.64	415.88	258.41

Table 11. Research cruise population estimate 4T Plaice - males - numbers-at-age x 10⁻³ (strata 15-39)

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	407	73	315	1	1	0	196	1	1	144
2	5287	2260	2228	3362	1876	180	1423	616	342	3556
3	15475	7820	13927	29591	15731	18948	41255	8093	4330	22725
4	25140	19840	19443	95789	52539	100472	158790	76178	39003	55058
5	24424	25336	24679	60926	95898	154511	209225	93376	108318	64801
6	28165	28117	18891	59688	58555	127306	119644	98208	114494	78816
7	26839	27515	15383	36806	50375	53303	63379	96005	134283	44561
8	16140	15176	19245	34069	26884	29066	32142	40941	90905	32912
9	5122	5513	11725	26189	25604	29590	14071	13902	31242	11483
10	3819	5732	5541	4840	11932	21747	8333	8435	19712	5779
11	3247	2212	2919	1502	8399	8254	4450	4449	9959	2774
12	1461	1827	2354	1502	1375	3974	2764	1373	4668	1044
13+	2996	731	3604	9729	3134	2783	1302	1047	3916	759
UK	250	0	455	9951	140	248	387	1	71	0
TOTAL	158775	142152	140710	373942	352441	550382	657361	442623	561243	324411
5+	112463	112159	104796	245202	282296	430783	455727	357736	517568	242929
6+	88039	86823	80117	184276	186398	276271	246502	264360	409230	178128
7+	59874	58706	61226	124588	217843	148965	126858	166152	294756	99312
8+	33035	31191	45843	87782	77468	95662	63479	70147	160473	54751
9+	16895	16015	26598	53713	50584	66596	31337	29206	69568	21839
10+	11773	10502	14873	27524	24980	37006	17236	15304	38326	10356
11+	7954	4770	9332	22684	13048	15259	8903	6869	18614	4577
12+	4707	2558	6413	21182	4649	7005	4453	2420	8655	1803
Z 7+/8+	.652	.247	-0.360	0.475	0.290	0.853	0.593	0.035	1.683	
Z 8+/9+	.724	.159	-0.158	0.551	0.151	1.116	0.776	0.008	1.994	

Table 12 . Research cruise population estimate - 4T Plaice - females - numbers-at-age x 10⁻³ (strata 15-39)

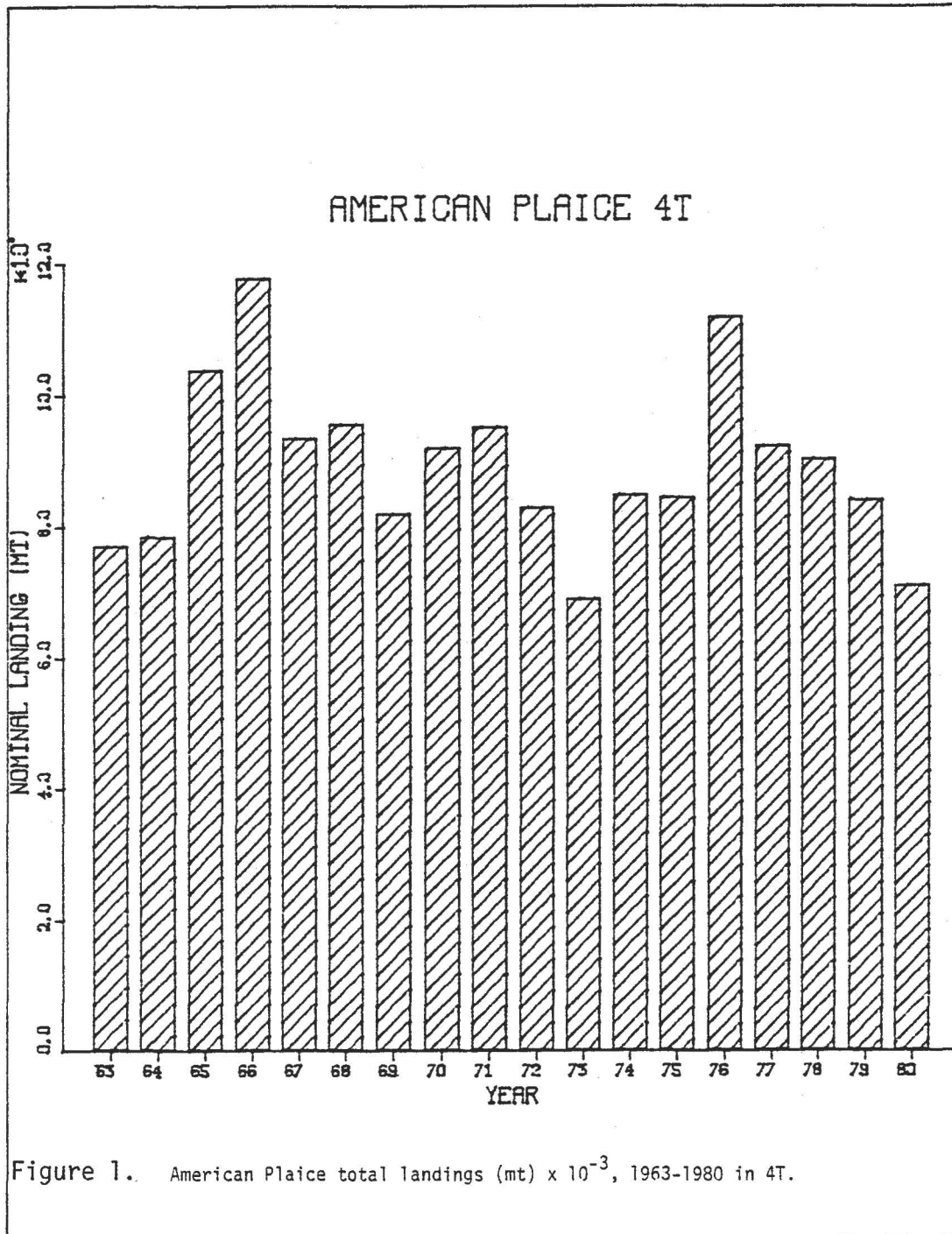
Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0	345	1	1	74	0	1	1	1	578
2	4082	3925	4600	1	1779	759	2551	1	324	3339
3	13777	8526	12185	35224	10118	19922	39022	784	3321	16002
4	23338	17065	16307	48929	42696	76401	96170	12643	33729	32916
5	22159	11880	16808	44138	74784	121015	139808	21880	87124	37626
6	20508	13474	13412	44989	31410	91803	85568	26820	68537	48621
7	24737	19675	11720	16498	22805	48846	71319	28870	78316	46747
8	16176	17913	13297	17065	18543	22660	30412	36302	68817	39658
9	5097	9423	13863	19230	10949	18797	11681	12518	41695	26390
10	3173	2795	5969	19221	11056	10677	7743	9691	18564	13537
11	3179	1612	2668	2909	9151	14312	5338	4278	10781	8597
12	2870	2189	1798	1949	3098	9251	3922	3183	6461	5198
13 +	7192	4345	12590	5288	7290	14748	8009	7906	16828	8533
UK	17	44	118	1967	1	1050	1	1	221	0
TOTAL	146305	113212	125336	257407	243752	450241	501543	164875	434718	287743
5+	105108	83350	92243	173254	189086	3513159	363800	151448	397344	234907
6+	82949	71470	75435	129116	114302	232144	223992	129568	310220	197281
7+	62441	57996	62023	84127	82892	140341	138424	102748	241683	148660
8+	37704	38321	50303	67629	60087	91495	67105	73878	163367	101913
9+	21528	20408	37006	50564	41544	68835	36693	37576	94550	62255
10+	16431	10985	23143	31334	30595	50038	25012	25058	52855	35865
11+	13258	8190	17174	12113	19539	39361	17269	15367	34291	22328
12+	10079	6578	14506	9204	10388	25049	11931	11089	23510	13731
Z 7+/8+	.488	.142	-0.087	0.337	-0.099	0.738	0.628	-0.464	.864	
Z 8+/9+	.614	.035	-0.005	0.487	-0.136	0.914	0.580	-0.247	.965	

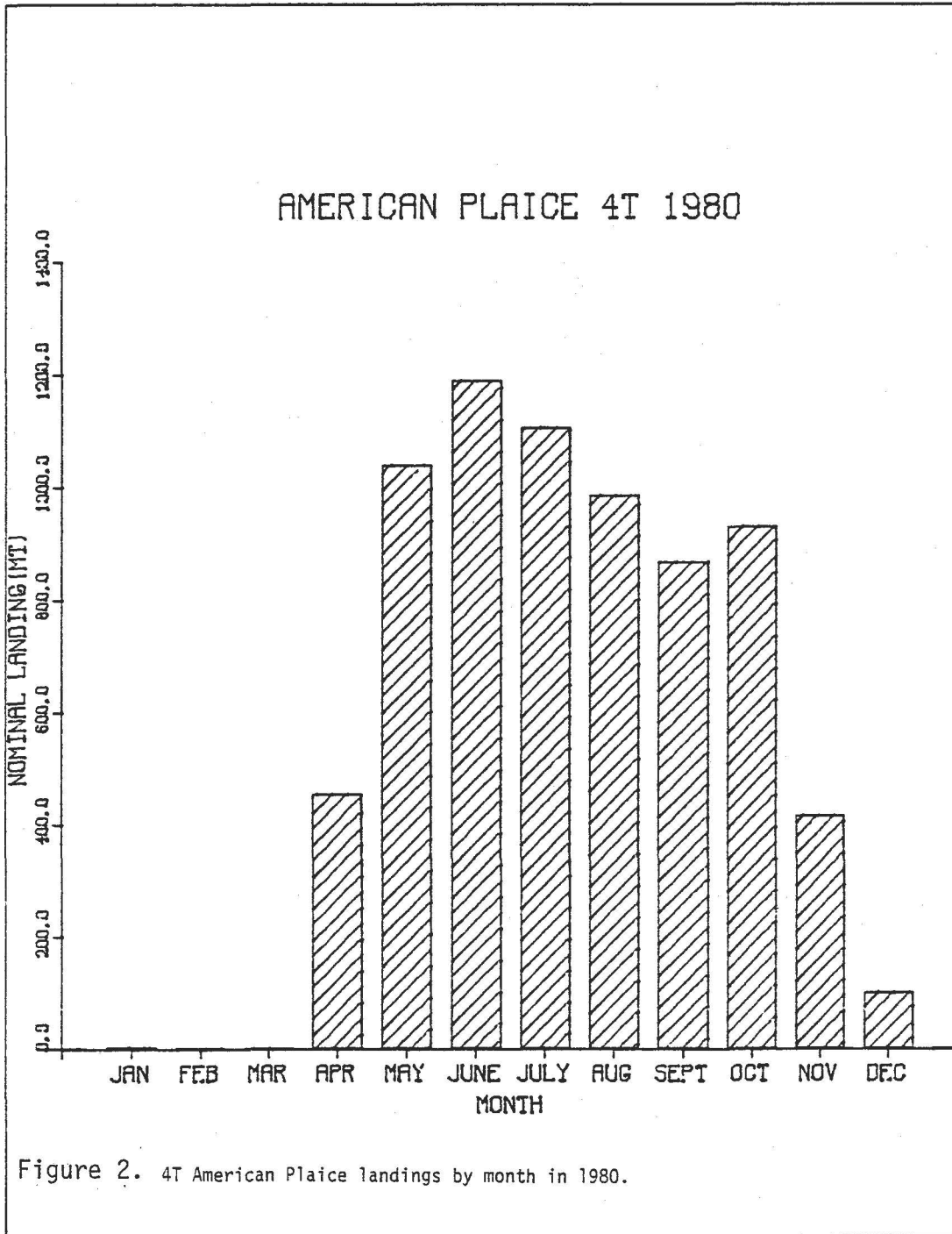
Table 13. Mean weights-at-age in kg of 4T Plaice (sex combined) caught during Research Cruises in Div. 4T (1971-1980) (strata 15-39).

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
1	.01	.01	.01	.00	.00	-	.01	-	0	0
2	.02	.01	.02	.01	.01	.02	.01	.03	.01	.02
3	.04	.03	.03	.02	.03	.04	.02	.05	.03	.04
4	.07	.07	.07	.04	.05	.17	.05	.07	.04	.06
5	.11	.11	.11	.09	.09	.11	.08	.11	.06	.09
6	.15	.15	.15	.13	.15	.16	.12	.14	.09	.11
7	.20	.19	.18	.17	.20	.23	.17	.23	.12	.15
8	.24	.25	.22	.22	.24	.29	.23	.27	.17	.20
9	.30	.35	.28	.26	.26	.35	.28	.38	.23	.25
10	.36	.40	.32	.36	.33	.39	.35	.44	.28	.32
11	.43	.52	.39	.42	.39	.54	.45	.59	.40	.45
12	.56	.68	.48	.48	.63	.63	.55	.54	.44	.56
13	.63	.74	.57	.61	.59	.83	.67	.71	.63	.69
14	.76	1.17	.76	.58	.97	.86	.82	1.25	.79	.84
15	.82	1.10	.87	.84	1.37	.86	.96	.78	1.07	1.00
16+	1.18	1.38	1.43	1.15	1.54	1.48	1.26	1.85	1.31	1.40
$\bar{W}T$.18	.19	.20	.14	.17	.19	.12	.21	.15	.39

Table 14. Mean length and size range (in cm) of American plaice, from autumn research surveys in Div. 4T.

	<u>MALE</u>	<u>FEMALE</u>	<u>SEXES COMBINED</u>
1971	24.71 (8.0 - 51.0)	26.41 (9.0 - 63.0)	25.49
1972	25.57 (9.0 - 49.0)	28.11 (9.0 - 60.0)	26.77
1973	25.27 (6.0 - 54.0)	28.00 (6.0 - 65.0)	26.64
1974	24.03 (8.0 - 46.0)	25.83 (8.0 - 62.0)	24.82
1975	24.92 (9.0 - 55.0)	27.16 (6.0 - 64.0)	25.94
1976	24.98 (12.0 - 47.0)	27.10 (10.0 - 66.0)	25.92
1977	23.62 (8.0 - 47.0)	25.45 (11.0 - 61.0)	24.46
1978	24.96 (12.0 - 53.0)	30.30 (14.0 - 67.0)	26.68
1979	25.25 (9.0 - 50.0)	28.53 (9.0 - 60.0)	26.69
1980	24.54 (8.0 - 47.0)	28.13 (9.0 - 67.0)	25.83





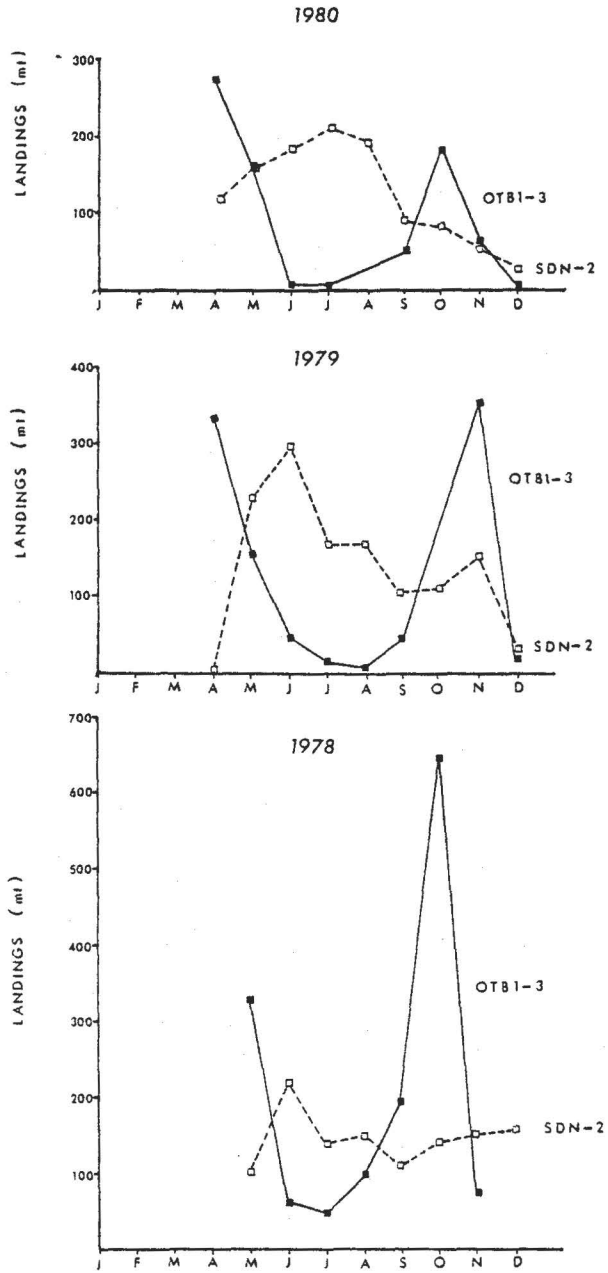


Figure 3. Landings by month for 1978-1980

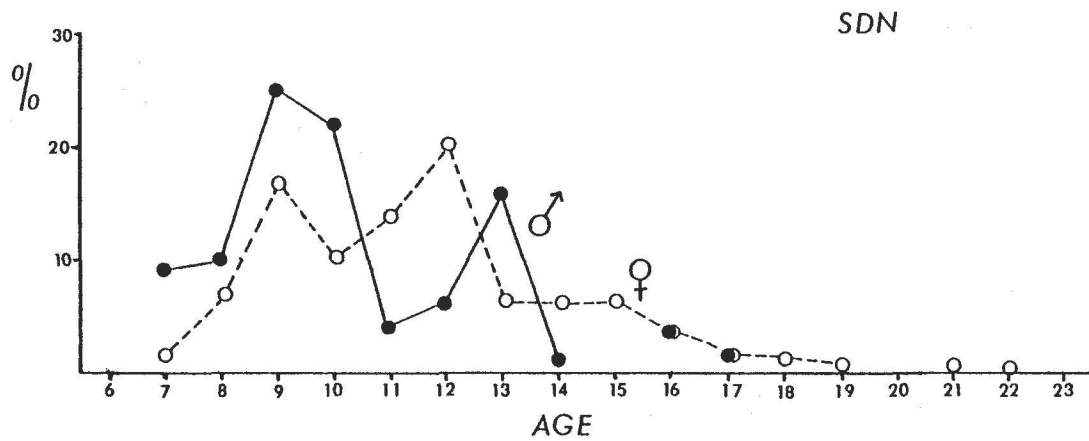
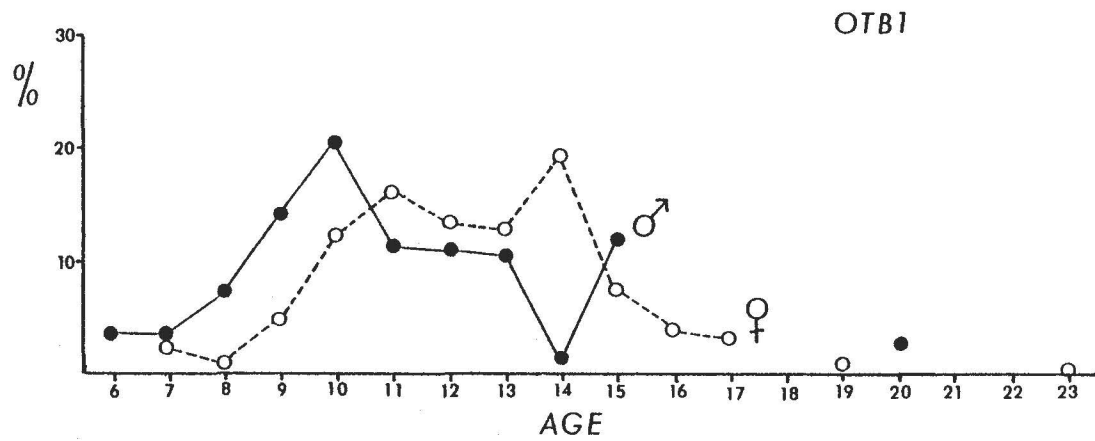


Figure 4. Percentage of numbers-at-age of plaice caught by gear OTB1 and SDN in 1980. OTB1 is the abbreviation for side otter trawler and SDN stands for Danish seine.

DANISH SEINES SDN-2 AND SDN-3 CPUE WEIGHTED BY CATCH (mt/hr)

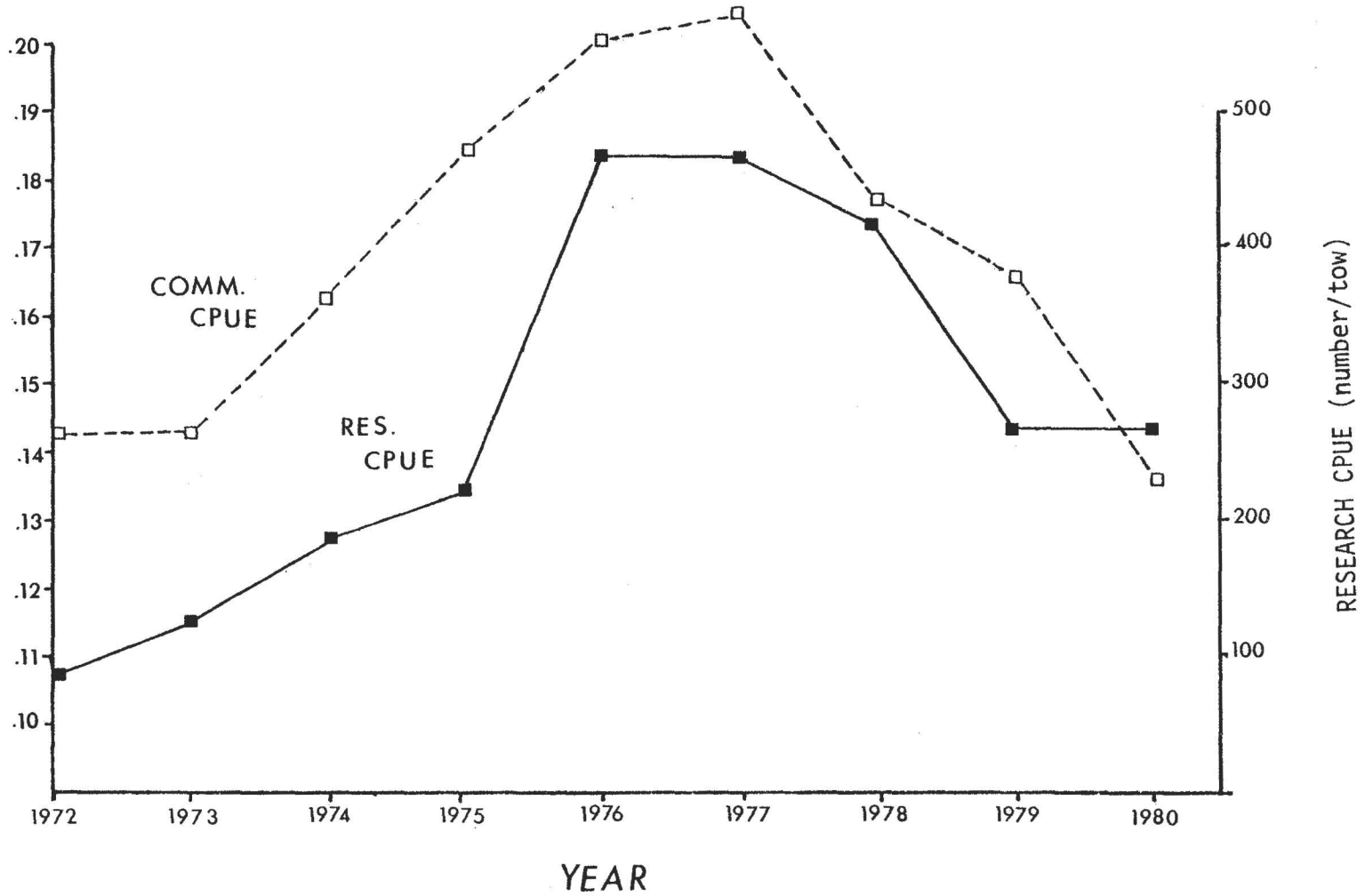


Figure 5. CPUE American plaice 4T of Danish seines SDN-2 and SDN-3 (mt/hr) weighted by catch vs. research (number/tow).

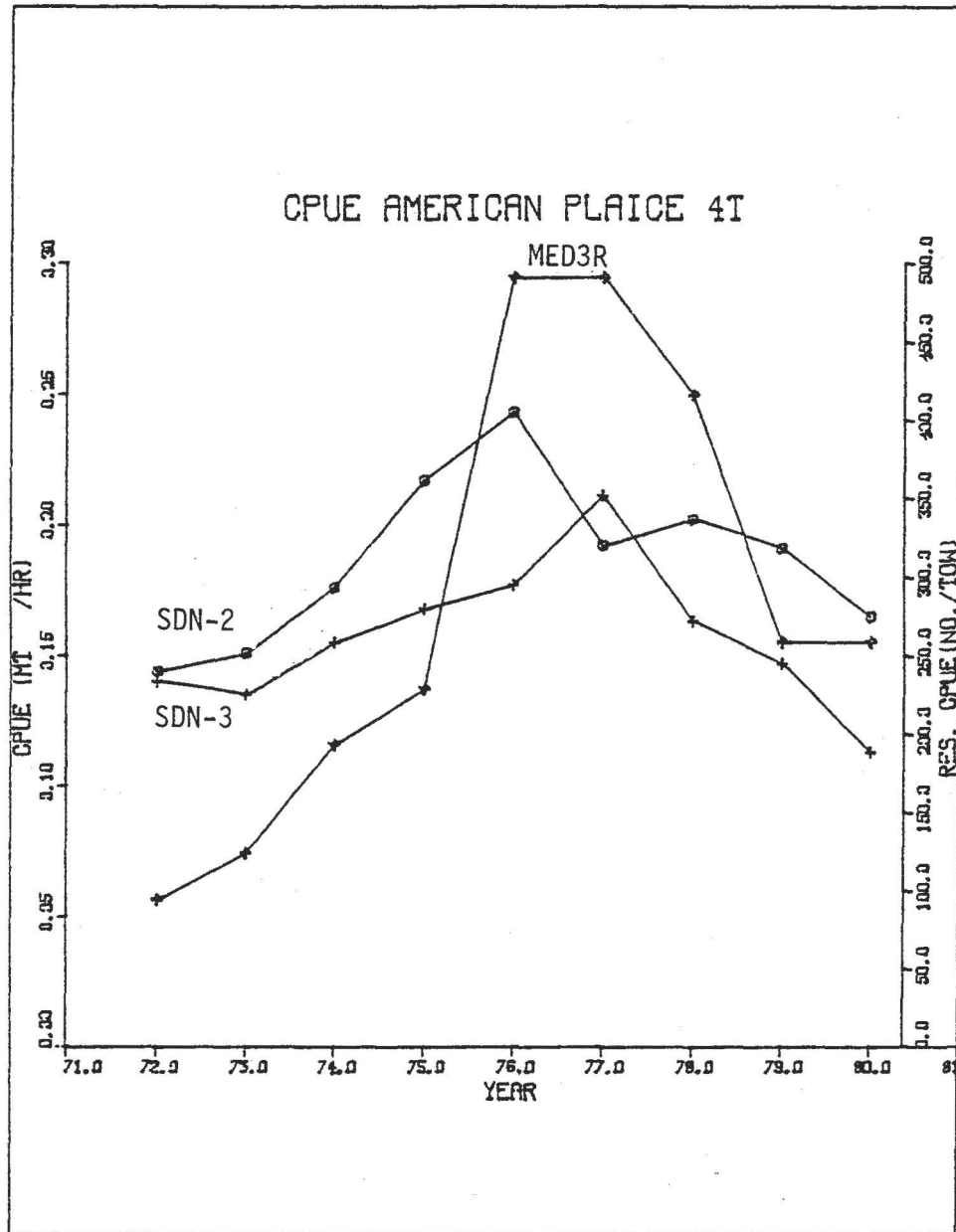


Figure 6. CPUE American plaice 4T of Danish seines SDN-2 and SDN-3 (mt/hr) vs. smoothed MED3R research (number/tow).

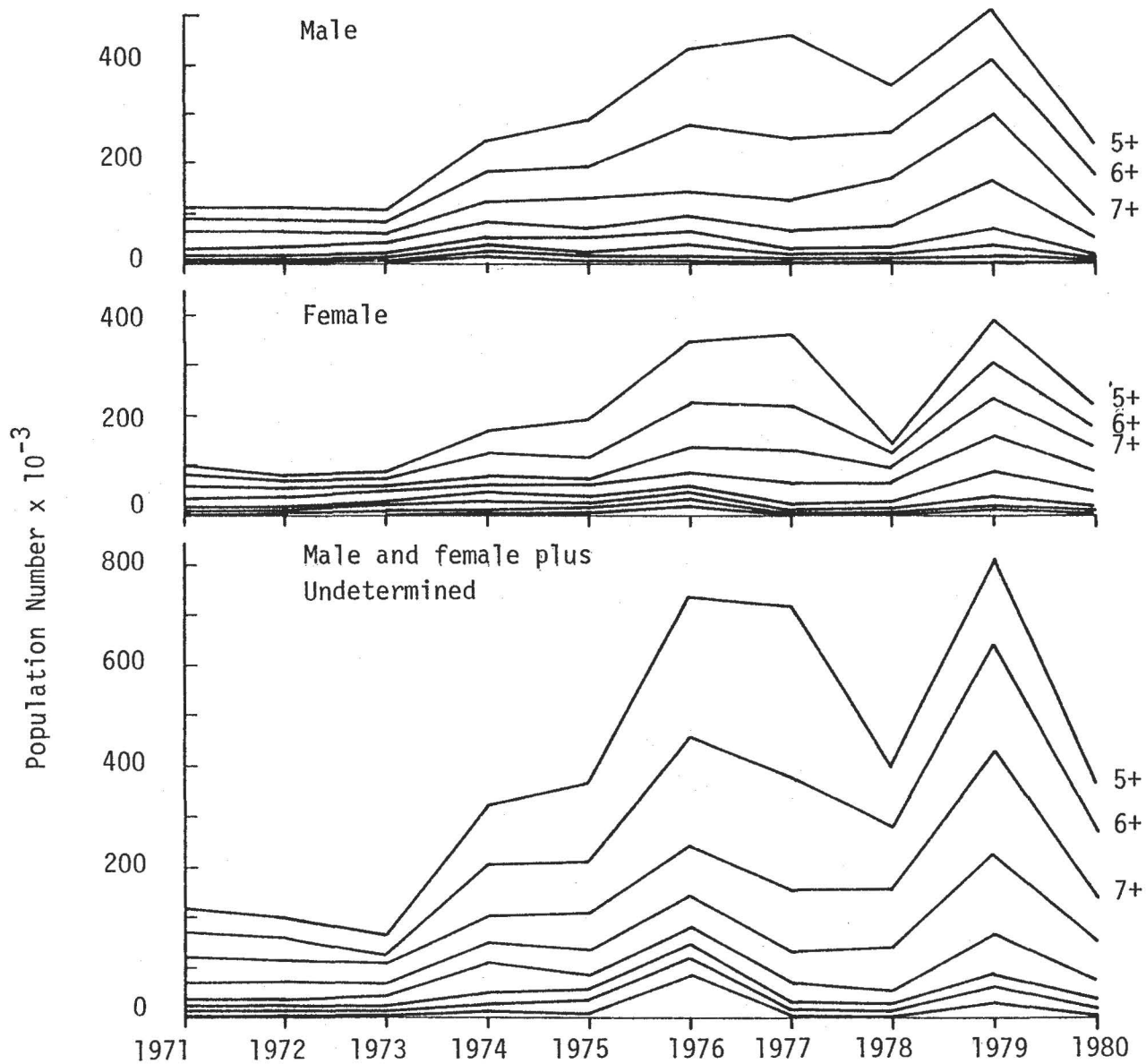


Figure 7.

Plaiice population estimates from the research cruises (1971-80) in the Gulf of St. Lawrence (Div. 4T).

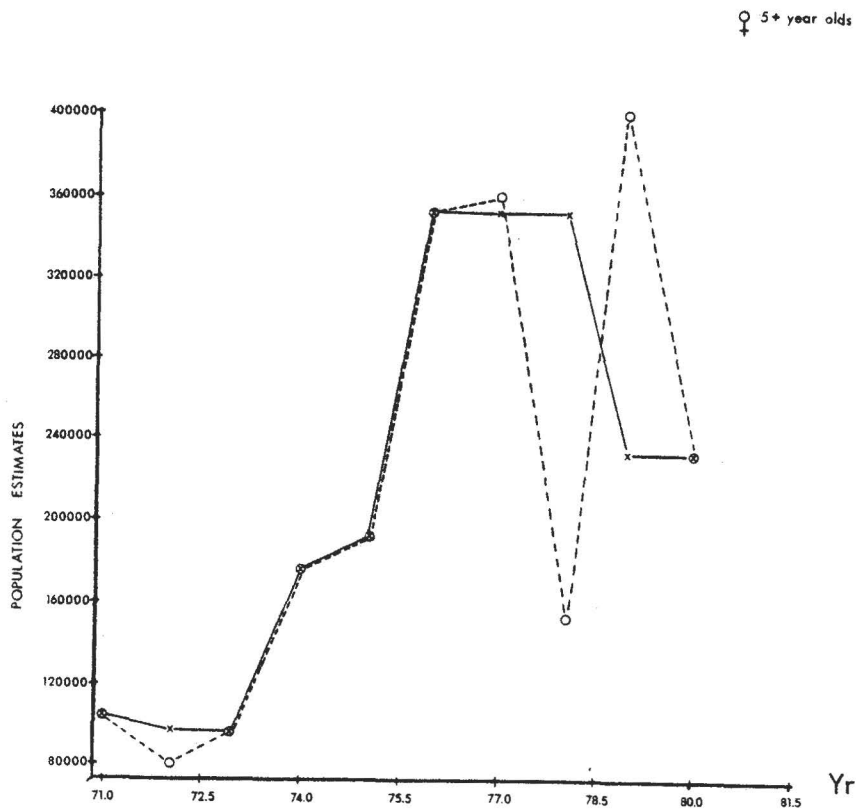
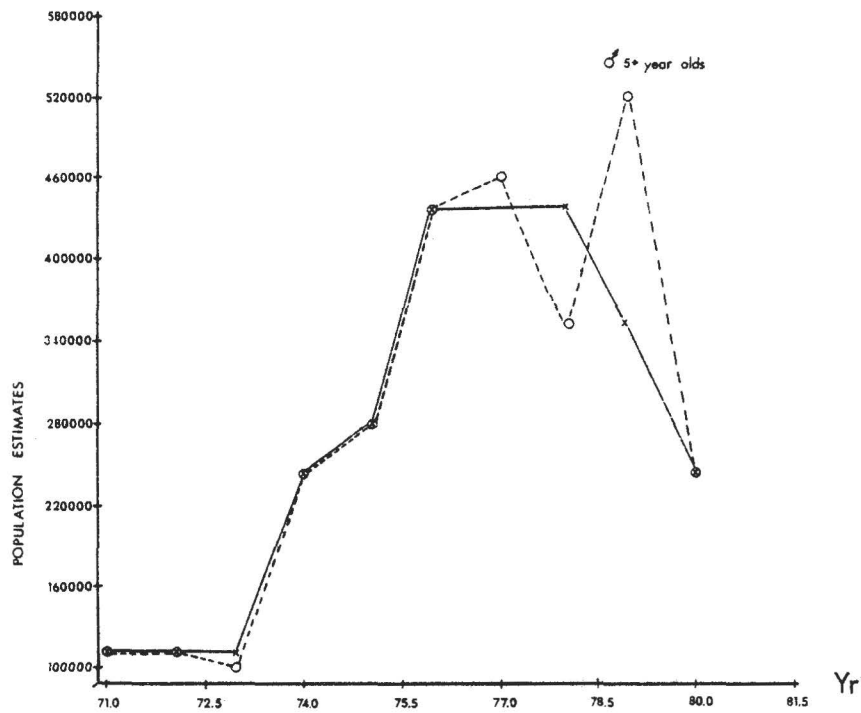


Figure 8. 4T plaiice population estimate (raw and MED3R smoothed) for 5+ from research surveys.

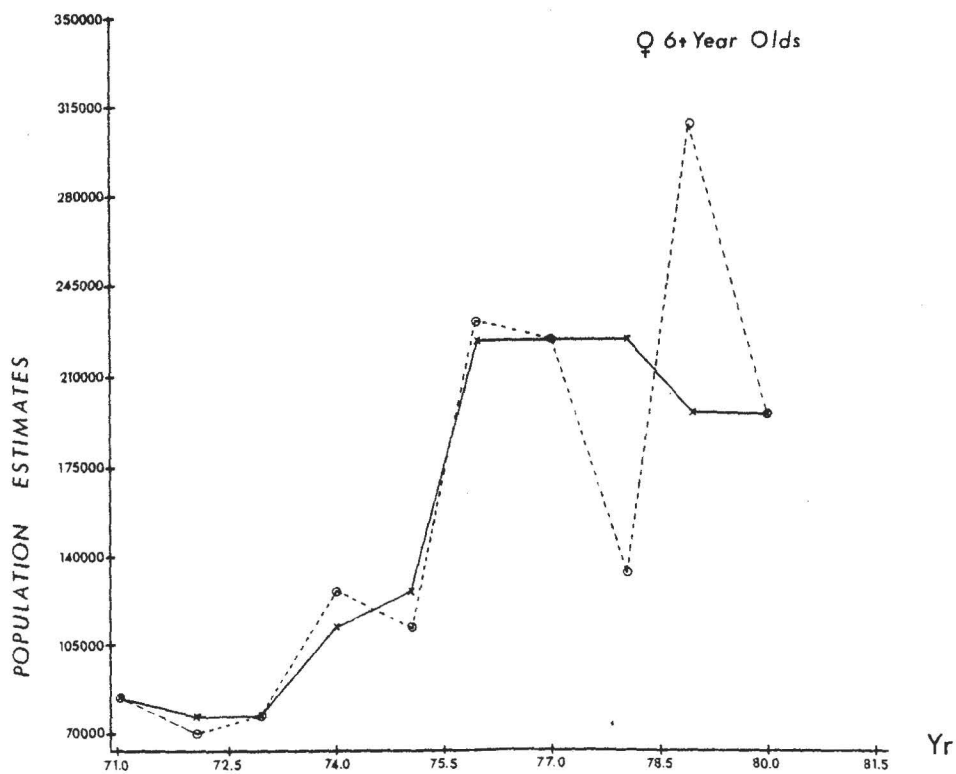
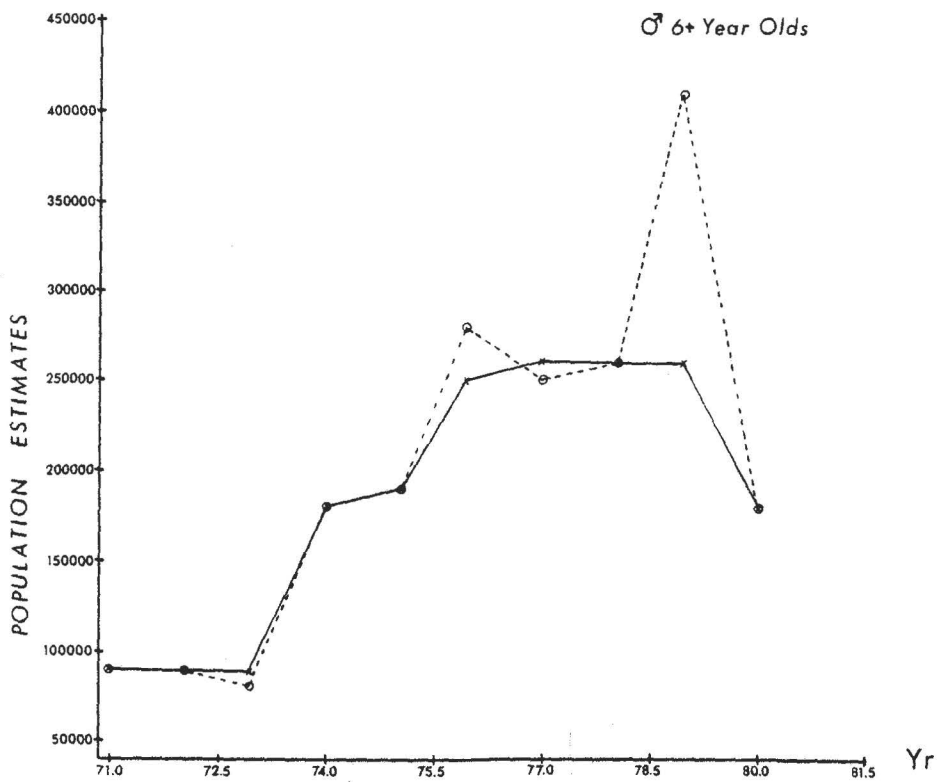


Figure 9. 4T plaice population estimate (raw data and MED3R smoothed) for 6+ from research surveys.

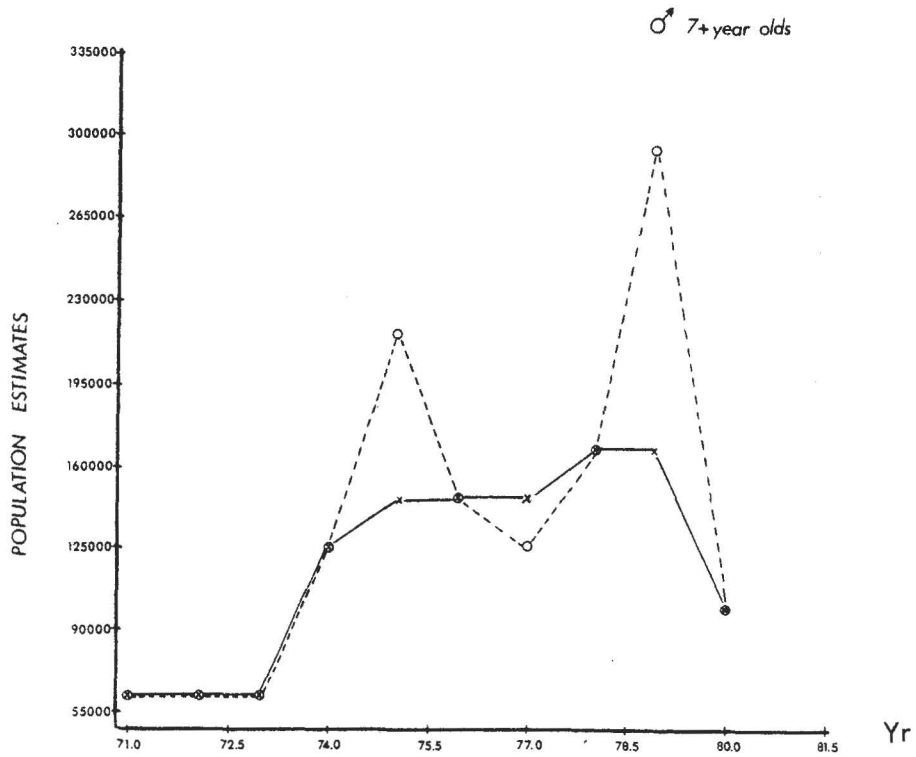
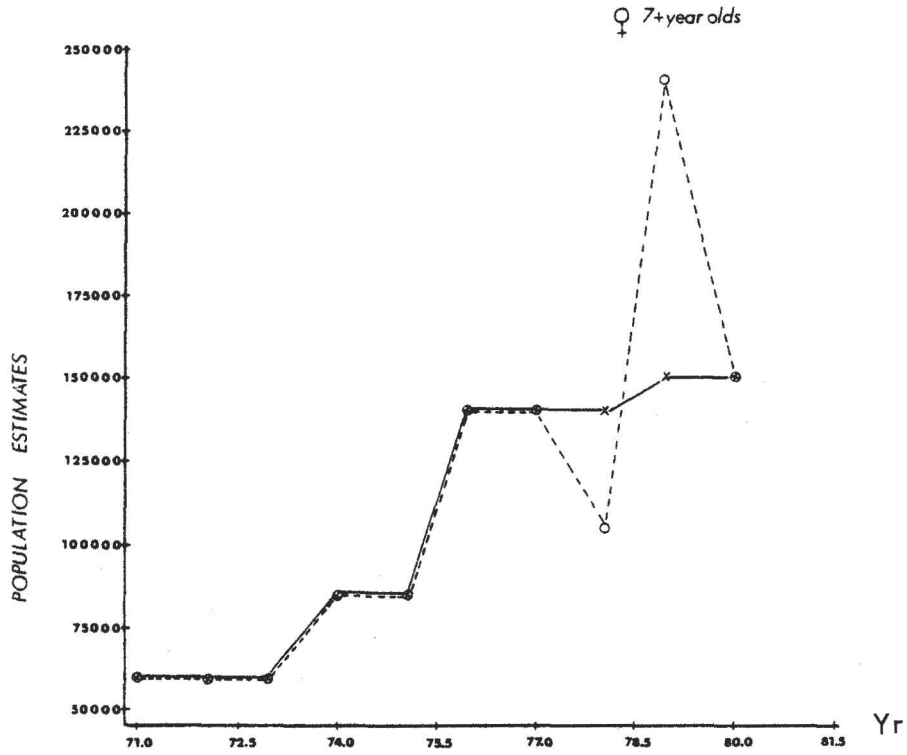


Figure 10a. 4T plaice population estimate (raw data and MED3R smoothed) for 7+ from research surveys.

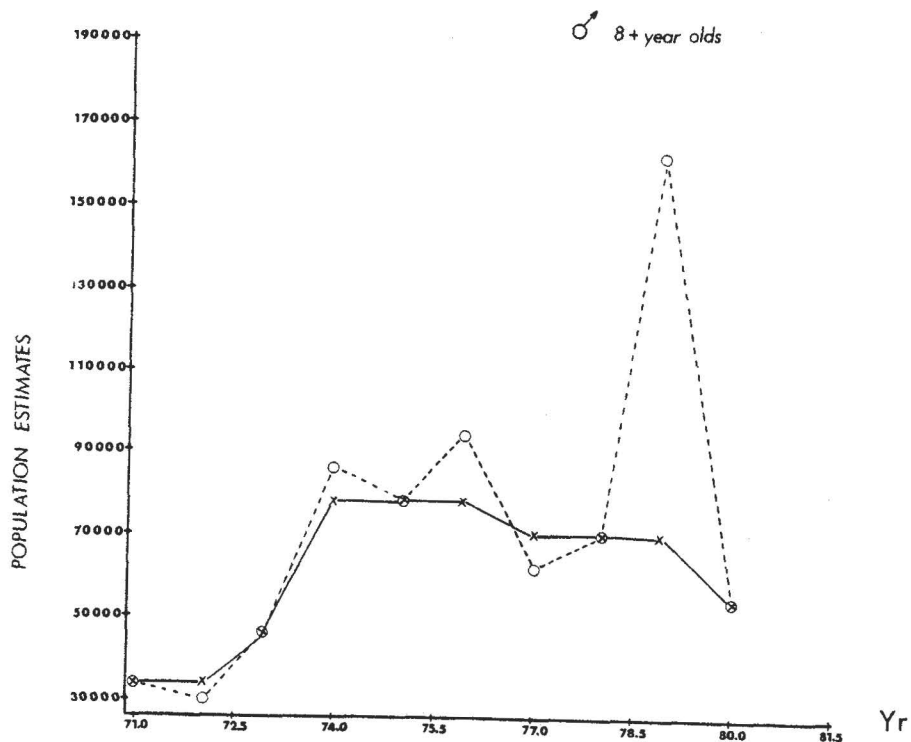
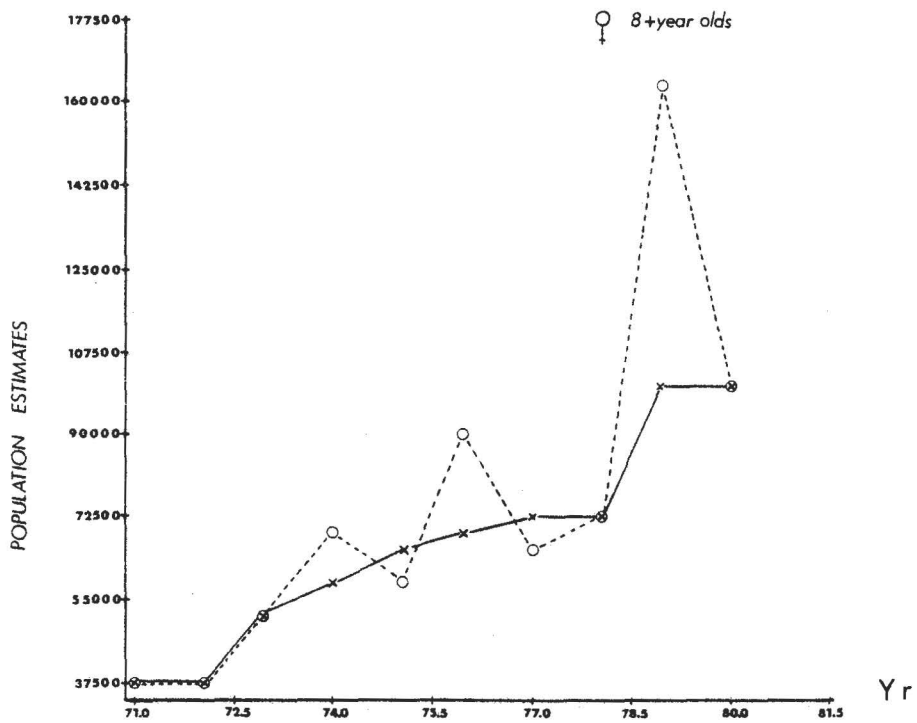


Figure 10b. 4T place population estimate (raw data and MED3R smoothed) for 8+ from research surveys.

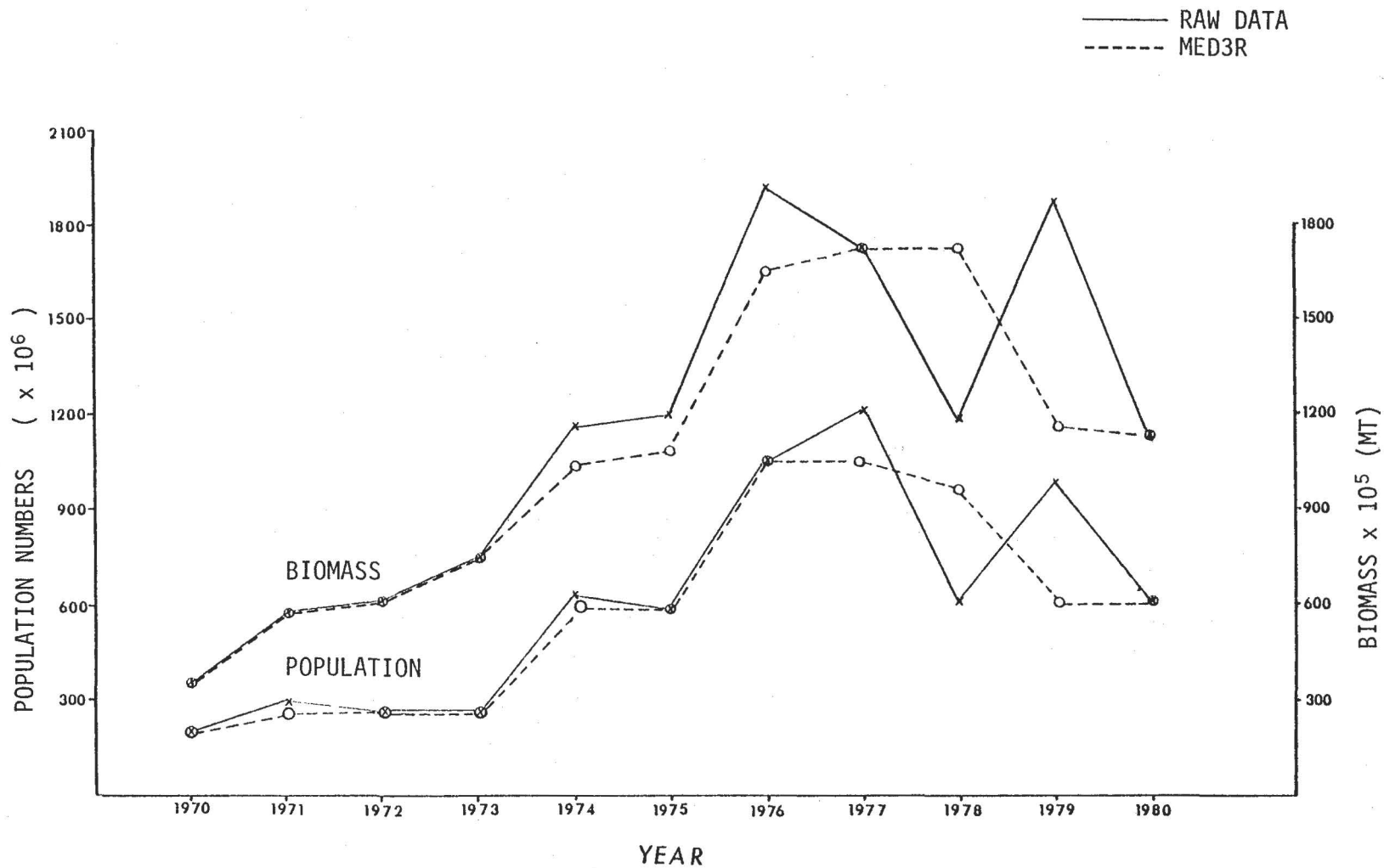


Figure 11. Estimated population numbers and biomass for 4T plaice 1970-1980 from research vessel surveys (raw and MED3R smoothed).

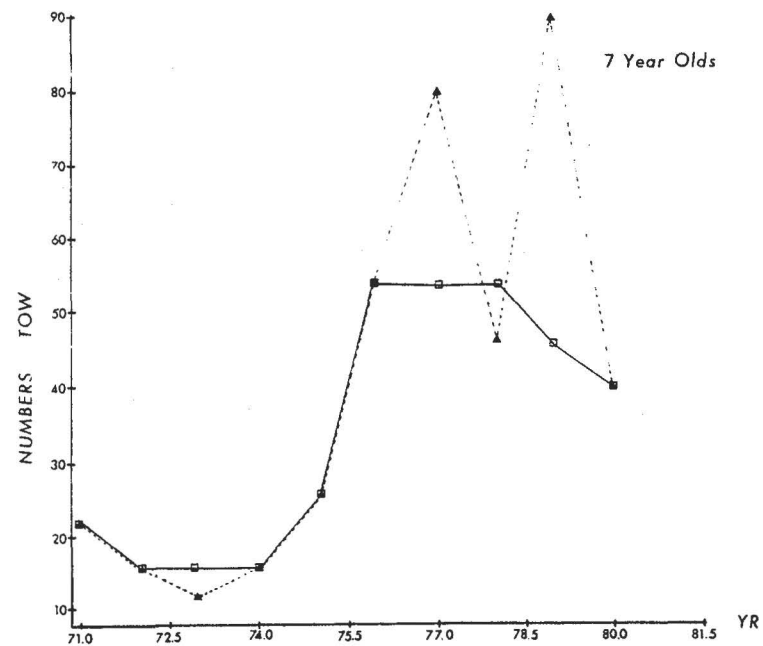
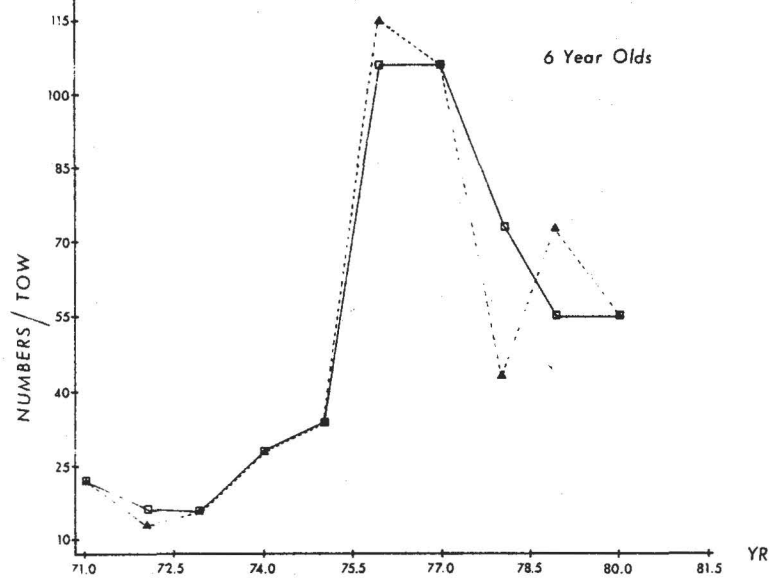
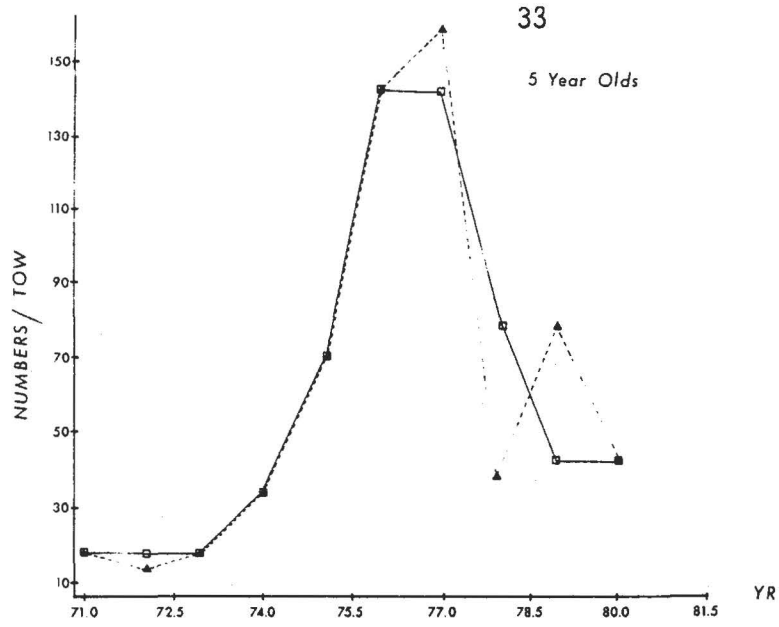


Figure 12. 4T plaice population estimate (raw data and MED3R smoothed) for 5, 6 and 7 year olds from research surveys.

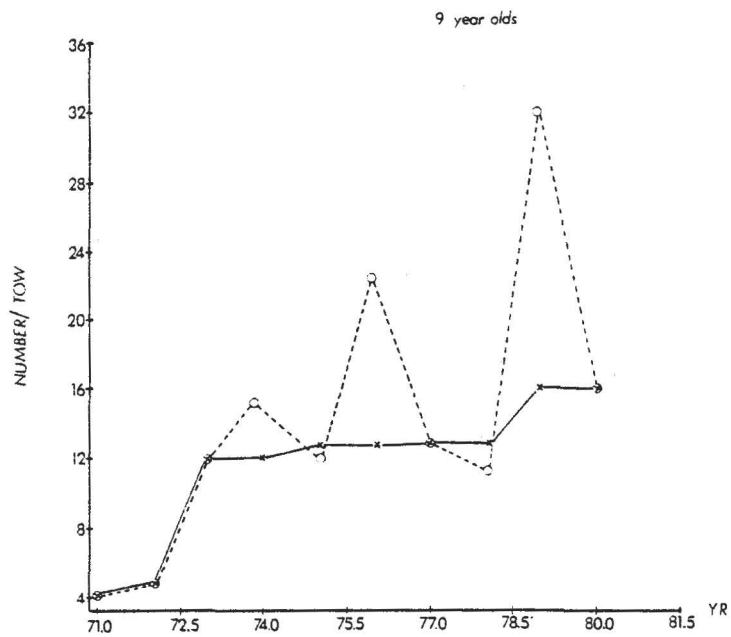
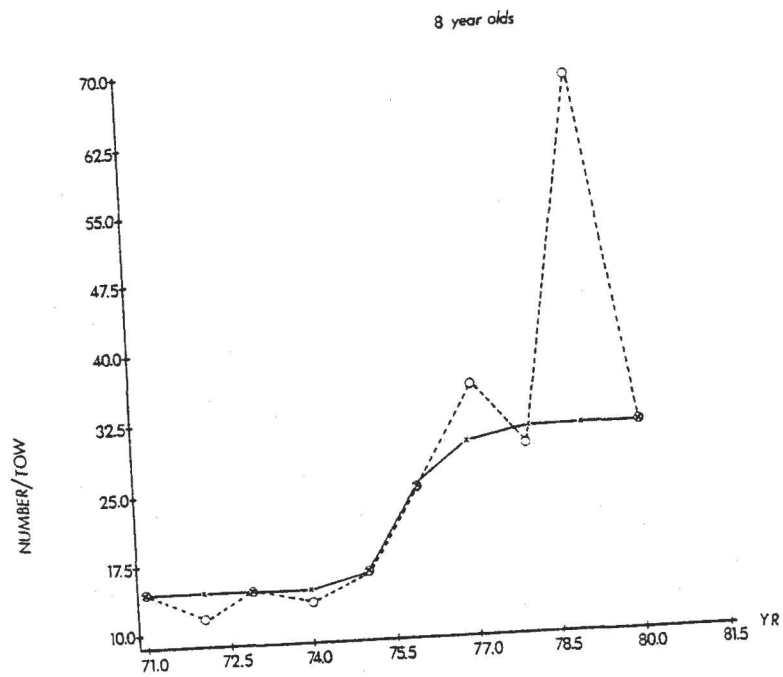


Figure 13. 4T plaice population estimate (raw data and MED3R smoothed) for 8 + 9 year olds from research surveys.