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A Biological Review of the Status of the 4WXX Flatfish Stocks

by

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Abstract

Landings for flatfish on the Scotian Shelf averaged 11,900 t during 1976-1982. The TAC has remained at 14,000 t since 1979. This is mainly a by-catch fishery.

Commercial catch rates calculated from Canadian side otter trawlers of tonnage class 4, indicate that the American plaice biomass has declined in recent years. Witch and yellowtail flounder abundance on the other hand appears to be increasing.

The research vessel survey abundance indices decreased for all three species between 1976 and 1978 but remained stable thereafter.

Although there is evidence of stock fluctuations, total biomass has remained stable and will continue to support the present level of fishing.

Résumé

Les débarquements de poissons plats du plateau Scotian ont été en moyenne de 11 900 t entre 1976 et 1982. Le TPA est demeuré à 14 000 t depuis 1979. Il s'agit en grande partie d'une pêche secondaire.

Les taux de capture commerciaux calculés à partir des chalutiers conventionnels canadiens de classe de tonnage 4 indiquent que la biomasse de plie canadienne a diminué ces dernières années. Par ailleurs, l'abondance de la plie grise et de la limande à queue jaune semble augmenter.

Les indices d'abondance des trois espèces dérivés des relevés par navires de recherche ont diminué entre 1976 et 1978, mais sont demeurés stables par la suite.

Bien qu'on ait des indications de fluctuations des stocks, la biomasse totale est demeurée stable et continuera de supporter le niveau de pêche actuel.

Introduction

Of the six flatfish species exploited commercially on the Scotian Shelf, only three, American plaice (Hippoglossoides platessoides (Fabricius)), witch flounder (Glyptocephalus cynoglossus (L.)), and yellowtail flounder (Limanda ferruginea (Storer)), are under quota management (Halliday, 1976). The status of these species as well as those of winter flounder (Pseudopleuronectes americanus (Walbaum)), Atlantic halibut (Hippoglossus hippoglossus (L.)), and Greenland halibut (Reinhardtius hippoglossoides (Walbaum)) are given in this document.

There is little known about stock structure of the flatfish community on the Scotian Shelf. Indication from catch statistics and ichthyoplankton surveys show stocks of plaice and witch in 4V and 4VW respectively, and for the present the catch-at-age was calculated assuming the presence of these stocks. However, before a Sequential Population Analysis (SPA) can be carried out the stock situation needs to be clarified.

Analytical assessments of plaice and witch populations were conducted in 1978 by R.N. O'Boyle and L. Cleary in an unpublished paper. The paucity of the sampling data seriously compromised the analysis and thus it was felt that until the data set became more extensive (i.e. at least 5 years of good sampling data) only biological updates will be conducted. Hopefully data will be at this stage by 1984.

Annual Trends in Reported Landings

Flatfish landings increased considerably from a low of 15,996 t in 1963 to a peak of 56,483 t in 1968 (Figure 1). Since then fluctuations have occurred but in general catches followed a declining trend until 1977 when they stabilized (Table 1). The drop was caused by the decline and eventual disappearance in USSR fishing effort directed to those species. American plaice and witch flounder comprised 59% of all flatfish landings in NAFO Division 4VWX during this period.

American plaice (Table 2) is predominantly fished in NAFO Division 4V (84% - 1977 - 1982 average) with large otter trawlers (TC4) making up the bulk of the landings (Table 8).

Historically 94% of witch flounder landings (1963-76) have been made in NAFO Divisions 4V and 4W (Table 3). Since 1978 catches have been rebuilding in 4X. A decrease in 4W catches has occurred during the same time, with overall landings remaining relatively consistent (around 2,000 t). From 1972-76 4VW witch flounder was caught primarily by stern otter trawls. Since then otter trawl landings have decreased to equal landings of Danish seiners.

Yellowtail flounder landings have remained stable within each NAFO Division with 4V making up approximately 90% of the total landings since 1977 (Table 4). Otter trawlers have traditionally been the main exploiters of 4VWX yellowtail flounder, however, since 1979 side trawlers made up the largest portion of the total catch.

Of the 3 remaining flatfish species, winter flounder total landings have remained fairly constant from 1975-1982, fluctuating between 1000 t - 1400 t (Table 5). Atlantic halibut landings show good landings in all areas with a gradual increase in the total since 1978 (Table 6). Landings for Greenland halibut have always been minimal averaging 329 t since 1977 (Table 7). Over 90% of the winter flounder and Greenland halibut catches are taken by trawlers, while longliners exploit 73% of the Atlantic halibut fishery (Tables 11 - 13).

Commercial Catch Age Composition

Commercial sampling for flatfish is limited to American plaice, witch, yellowtail, and winter flounder (Tables 8-11). This includes removal of otoliths for aging at a later date, length and weight measurements, sex determination and maturity stages of gonads. Age-size information (1948 to 1978) for this stock was provided by Cleary (1979). Historically, minimal sampling occurred from 1976 back, however, since 1977 this has improved and overall sampling has been good for all 4 species with exception of yellowtail flounder in 1979 and winter flounder in 1978.

Both catch-at-age and weight-at-age matrices were constructed for 4V plaice and 4VW witch from Canadian age-length keys by splitting the samples by gear, applying them to the appropriate catches, and combining the results (Tables 14-17). Data for 1982 are not available as age determinations are not yet complete. As sampling was poor before 1976, only data from 1976 on were included. Plaice and witch males recruit to the fishery earlier than females. Full recruitment occurs at about age 10 for both species. American plaice in 4V had a strong cohort in 1972 but it is no longer apparent to a large extent. There is no indication of a strong cohort for 4VW witch at any time.

Commercial CPUE

The commercial CPUE index was calculated from catch (t) per hour of side otter trawlers, tonnage class 4. These data were chosen because catches are highest for this tonnage class and side otter trawlers had a complete data set. The months March-May were chosen due to consistently high catch rates over the years. Only those trips directed for flatfish species which have recorded effort were included. A median smooth technique (MED3R) was applied to all CPUE data to better describe any trends that occur (Table 18). This APL program smoothes the data by choosing a median.

American plaice (Table 18a) catch rates fluctuated during 1970-75 then declined until 1982. Witch flounder catch rates peaked in 1973 (Table 18b) then declined to 1977. Since 1977 a slight increase in abundance is evident, with the highest catch rate in 9 years evident in 1982. Yellowtail flounder has also been increasing in abundance since 1977 with catch rates in 1982 doubling last years (Table 18c). Figure 3 gives an

overall picture of the smoothed catch rates values indicating a declining plaice fishery, a stabilizing witch fishery and a slight increase in the yellowtail fishery.

The flatfish fishery is a by-catch fishery and therefore catch rates are difficult to define.

Research CPUE

Research catch rates were calculated using data from the A.T. Cameron cruises in the summer months with the exception of 1982 when the Lady Hammond cruise was used. Stratified mean catch per tow was used as the index of abundance. The median smoothed technique was also used on these data.

The catch rates for American plaice declined in the early 70s then increased to a peak of 127.79 (number/tow) in 1976. A decrease in catch rate has continued to 1982. The more detailed catch-at-age for each sex (Table 19) gives a uniform trend of approximately an even number of males to females per tow.

Catch rates for witch flounder peaked in 1974, twice that of the previous year, then declined and levelled off from 1976-1982, with an average CPUE of 3.20 for those years. In Table 20 the proportions of females to males averaged more than 1.7 in the past 13 years. The data give little indication of a dominating year class.

Yellowtail flounder catch rates in 1982 were not available for this document. CPUEs are low in comparison with the peak, of 49.95 in 1977. A slightly stronger year class was apparent in 1973. Detailed information of this species shows that like plaice, even numbers of males and females are caught per tow (Table 21).

The median smoothed values for research CPUE indicates the flatfish fishery has remained stable in the past 4 years (Figure 3). Recruitment indices for ages 3 and 4 of the same cohort for 4V American plaice were calculated (Table 22). Two strong year classes were detected in 1972 and 1977 (Figure 2), supported by the commercial age composition table. The 1972 cohort supported the fishery in 1979 and 1980 and now the 1977 cohort is adding strength to the stock although on a smaller scale. When a recruitment index was calculated for witch flounder data there was no indication of a particularly strong cohort. In addition, research and commercial catch totals show this species to be stable.

Figure 4 shows trends in number of adults (age 6+) for the 3 major species. American plaice adults decreased in the past 2 years. Witch flounder decreased in 1974 and remained stable while yellowtail increased in 1973 and then levelled off.

Mortality coefficients by sex for 4V American plaice and 4VW witch flounder (Tables 23 and 24) were calculated with 1, 2, and 3 year median

smoothing. American plaice data were incomplete while witch flounder data are adequate for total numbers and kg/tow but not for age structure. From this point in time the data are too variable to allow further interpretation.

Conclusion

Research survey smoothed data show CPUE values have remained stable since 1977. Commercial CPUEs have decreased in recent years for American plaice with increases appearing in both witch flounder and yellowtail flounder in 1982.

With these two factors plus the strong 1977 cohort for 4V American plaice adding to the fishery, the data do not support a change to the 1983 advice and the TAC should remain at 14,000 t.

References

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- Halliday, R.G. 1976. Scotian Shelf Flatfish Stocks - Implications of 1975 data. ICNAF Res. Doc. 76/VI/24.
- Metuzals, K. 1981. Flatfish Stock Trends of the Scotian Shelf. CAFSAC Res. Doc. 81/62.

Table 1. Total landings (t) for 4VWX flatfish between 1963-1982.

YEAR	American Plaice	Witch Flounder	Yellowtail Flounder	Winter Flounder	Atlantic Halibut	Greenland Halibut	Flatfish (N.S.)	TOTAL
1963	2309	7486	3972	696	1533	-	-	15,996
1964	3082	8629	5399	1311	1541	2	194	20,158
1965	8198	12943	6104	1339	1609	-	90	30,283
1966	14206	14512	4851	1346	1176	1	30	36,122
1967	10770	7816	5196	944	1248	2	-	25,976
1968	19265	21682	13128	1181	1217	10	-	56,483
1969	13735	14093	3826	1416	1064	39	-	34,173
1970	8358	6048	3682	1530	830	20	11	20,479
1971	14301	17864	1775	3084	1005	24	1	38,054
1972	10653	11351	1485	1454	850	18	724	26,535
1973	12432	13969	1513	1909	774	12	873	31,482
1974	16772	7415	939	2756	655	35	817	29,389
1975	11747	8922	1568	1374	649	29	1118	25,407
1976	11147	5742	904	1297	714	69	1043	20,916
1977	7756	2431	1443	1257	713	215	944	14,759
1978	6756	2291	1628	1207	1092	519	1060	14,553
1979	6354	2071	2090	1088	1224	882	1303	15,012
1980 ¹	7572	2321	2491	1174	1458	231	1887	17,134
1981 ²	6695	1700	2887	1448	1393	128	1577	15,828
1982	5394	1344	2541	1225	1632	10	-	12,146

¹ All countries except USA

² Provisional (Maritime catches only)

Table 2. Total American plaice catch (t) for NAFO Division 4VWX for 1963-1982.

Year	4V	4W	4X	Total	% Canadian Catch	% Foreign Catch
1963	1376	683	250	2309	2108 (91)	201 (9)
1964	1967	603	512	3082	2838 (92)	244 (8)
1965	4707	2797	694	8198	5542 (68)	2656 (32)
1966	8167	5313	726	14206	9113 (64)	5093 (36)
1967	8884	780	1106	10770	10524 (98)	246 (2)
1968	10489	7830	946	19265	9828 (51)	9437 (49)
1969	9076	4789	870	13735	9300 (68)	4435 (32)
1970	5242	2481	635	8358	6303 (75)	2055 (25)
1971	7765	5991	545	14301	7513 (53)	6788 (47)
1972	6912	3175	566	10653	6855 (64)	3798 (36)
1973	8686	3407	339	12432	5146 (41)	7286 (59)
1974	11363	4951	458	16772	6967 (42)	9805 (58)
1975	7336	4115	296	11747	6623 (56)	5124 (44)
1976	8488	2350	309	11147	5932 (62)	4215 (38)
1977	6716	592	449	7757	7659 (99)	98 (1)
1978	5501	743	512	6756	6679 (99)	77 (1)
1979	5028	498	828	6354	6329 (100)	25 (0)
1980 ¹	6293	598	681	7572	7490 (99)	82 (1)
1981 ²	5677	581	437	6695	6586 (98)	109 (2)
1982	4720	384	290	5394	5394 (100)	-

¹ All countries except USA

² Provisional (Maritime catches only)

Table 3. Total witch flounder catch (t) in NAFO Division 4VWX for 1963-1982.

YEAR	4V	4W	4X	TOTAL	% Canadian Catch	% Foreign Catch
1963	4971	2440	75	7486	6972 (93)	514 (7)
1964	5808	2564	257	8629	8406 (97)	223 (3)
1965	5068	7454	421	12943	7710 (60)	5233 (40)
1966	5241	9047	224	14512	7046 (49)	7466 (51)
1967	5740	1693	383	7816	7496 (96)	320 (4)
1968	7598	13349	735	21682	8772 (40)	12910 (60)
1969	4338	8963	792	14093	6671 (47)	7422 (53)
1970	3282	1959	807	6048	4920 (81)	1128 (19)
1971	5640	11083	1141	17864	6816 (38)	11048 (62)
1972	4894	5759	698	11351	5909 (52)	5442 (48)
1973	6572	6862	535	13969	5854 (42)	8115 (58)
1974	4913	2004	498	7415	5830 (79)	1585 (21)
1975	3284	5307	331	8922	3406 (38)	5516 (62)
1976	2718	2683	341	5742	2466 (43)	3276 (57)
1977	1555	455	421	2431	2307 (95)	124 (5)
1978	1540	563	188	2291	2139 (93)	152 (7)
1979	1572	209	290	2071	2057 (99)	14 (1)
1980 ¹	1801	189	331	2321	2298 (99)	23 (1)
1981 ²	1123	156	421	1700	1687 (99)	13 (1)
1982 ²	730	91	523	1344	1344 (100)	-

¹

All countries except USA

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Provisional (Maritime catches only)

Table 4. Total yellowtail flounder catch (t) for NAFO Division 4VWX for 1963-1982.

YEAR	4V	4W	4X	TOTAL	% Canadian Catch	% Foreign Catch
1963	1740	2148	34	3972	3784 (95)	188 (5)
1964	4084	1165	150	5399	5288 (98)	111 (2)
1965	4330	1550	224	6104	5378 (88)	726 (12)
1966	3521	1164	166	4851	3770 (78)	1081 (22)
1967	3808	1163	225	5196	5152 (99)	44 (1)
1968	6953	5970	205	13128	5377 (41)	7751 (59)
1969	2491	1134	201	3826	1263 (33)	2563 (67)
1970	670	2686	326	3682	947 (26)	2735 (74)
1971	889	668	218	1775	1033 (58)	742 (42)
1972	697	624	164	1485	1007 (68)	478 (32)
1973	980	394	139	1513	424 (28)	1089 (72)
1974	573	130	236	939	593 (63)	346 (37)
1975	1101	254	213	1568	1083 (69)	485 (31)
1976	473	201	230	904	610 (67)	294 (33)
1977	1101	40	302	1443	1424 (99)	19 (1)
1978	1085	156	387	1628	1610 (99)	18 (1)
1979	1655	144	291	2090	2088 (100)	2 (0)
1980 ¹	2158	78	255	2491	2486 (100)	5 (0)
1981 ²	2539	123	225	2887	2881 (100)	5 (0)
1982 ²	2291	43	207	2541	2541 (100)	-

¹ All countries except USA

² Provisional (Maritime catches only).

Table 5. Total winter flounder (t) for NAFO Division 4VWX for 1963-1982.

YEAR	4V	4W	4X	TOTAL	% Canadian Catch	% Foreign Catch
1963	17	65	614	696	668 (96)	28 (4)
1964	12	19	1280	1311	1282 (98)	29 (2)
1965	32	179	1128	1339	1237 (92)	102 (8)
1966	55	34	1257	1346	997 (74)	349 (26)
1967	37	5	902	944	926 (98)	18 (2)
1968	10	28	1143	1181	1128 (96)	53 (4)
1969	4	12	1400	1416	1392 (98)	24 (2)
1970	8	44	1478	1530	1480 (97)	50 (3)
1971	237	1364	1483	3084	1430 (46)	1654 (54)
1972	78	551	825	1454	824 (57)	630 (43)
1973	480	655	774	1909	904 (47)	1005 (53)
1974	777	1005	974	2756	1321 (48)	1435 (57)
1975	179	525	670	1374	802 (58)	572 (42)
1976	235	345	717	1297	908 (70)	389 (30)
1977	226	9	1022	1257	1244 (99)	13 (1)
1978	186	137	884	1207	1202 (100)	5 (0)
1979	228	13	847	1088	1085 (100)	3 (0)
1980 ¹	30	10	1134	1174	1173 (100)	1 (0)
1981 ²	26	11	1411	1448	1448 (100)	-
1982 ²	80	8	1137	1225	1225 (100)	-

¹ All countries except USA

² Provisional statistics NAFO

Table 6. Total Atlantic halibut catches (t) for NAFO Division 4VWX for 1963 - 1982.

YEAR	4V	4W	4X	TOTAL	% Canadian Catch		% Foreign Catch
						(%)	
1963	214	479	840	1533	1453	(90)	80 (10)
1964	332	358	861	1551	1461	(94)	90 (6)
1965	486	458	665	1509	1574	(98)	35 (2)
1966	532	313	331	1176	1030	(88)	146 (12)
1967	380	322	546	1248	1236	(99)	12 (1)
1968	250	363	604	1217	1175	(97)	42 (3)
1969	192	431	441	1064	1024	(96)	40 (4)
1970	115	349	366	830	818	(99)	12 (1)
1971	231	360	414	1005	946	(94)	59 (6)
1972	178	216	456	850	825	(97)	25 (3)
1973	147	226	401	774	765	(99)	9 (1)
1974	124	127	404	655	641	(98)	14 (2)
1975	114	159	376	649	638	(98)	11 (2)
1976	144	148	422	714	708	(99)	6 (1)
1977	88	177	448	713	705	(99)	8 (1)
1978	244	283	565	1092	1082	(99)	10 (1)
1979	230	358	636	1224	1224	(100)	-
1980 ₁	339	371	748	1458	1454	(100)	4 (0)
1981 ₂	250	379	764	1393	1389	(100)	4 (0)
1982 ₂	293	459	880	1632	1632	(100)	-

¹ All countries except USA.

² Provisional (Maritime catches only).

Table 7. Total Greenland halibut catch (t) for NAFO Division 4VWX for 1963-1982.

YEAR	4V	4W	4X	TOTAL	% Canadian Catch		% Foreign Catch
						(%)	
1963	-	-	-	-	-	-	-
1964	1	-	1	2	-	-	2 (100)
1965	-	-	-	-	-	-	-
1966	1	-	-	1	1	(100)	-
1967	2	-	-	2	2	(100)	-
1968	10	-	-	10	10	(100)	-
1969	36	-	3	39	19	(49)	20 (51)
1970	14	3	3	20	17	(85)	3 (15)
1971	19	2	3	24	24	(100)	-
1972	11	-	7	18	18	(100)	-
1973	10	1	1	12	12	(100)	-
1974	35	-	-	35	31	(89)	4 (11)
1975	27	2	-	29	28	(97)	1 (3)
1976	57	6	6	69	63	(91)	6 (9)
1977	197	9	9	215	215	(100)	-
1978	498	6	15	519	516	(99)	3 (1)
1979	868	11	3	882	882	(100)	-
1980 ₁	179	51	1	231	231	(100)	-
1981 ₂	110	1	17	128	128	(100)	-
1982 ₂	5	1	4	10	10	(100)	-

¹ All countries except USA

² Provisional (Maritime catches only).

Table 8. Nominal catch (in t) for American plaice by gear in NAFO Division 4V for all countries, 1972-1982.
(# of Canadian commercial samples taken in parentheses.)

YEAR	SIDE OTTER TRAWL	STERN OTTER TRAWL	DANISH SEINE	LONGLINE	OTHER ¹	TOTAL
1972	3012 (4)	3267	364	189	80	6912 (4)
1973	1971 (2)	5987 (2)	482	152	94	8686 (4)
1974	2193 (7)	8318	510	125	217	11363 (7)
1975	2779 (5)	3455 (1)	657	171	274	7336 (6)
1976	2438 (4)	4678 (3)	1178 (8)	87	107	8488 (15)
1977	2661 (5)	2285 (4)	1443 (17)	218	104	6711 (26)
1978	1766 (9)	2150 (6)	1222 (11)	164	199	5501 (26)
1979	1745 (11)	2201 (4)	806 (1)	192	84	5028 (16)
1980	1871 (12)	2674 (9)	1523 (3)	211	14	6293 (24)
1981 ²	2020 (14)	2222 (7)	941 (1)	431 (4)	3	5677 (26)
1982 ³	1715	1486 (20)*	716 (3)	786 (1)	17	4720 (24)

¹ Includes NK and MISC gears

* Stern and side otter trawl samples combined

² All countries except USA

³ Provisional (Maritime catches only)

Table 9. Nominal catch (in t) of witch flounder by gear in NAFO Division 4VW for all countries, 1972-1982.
(# of Canadian commercial samples taken in parentheses.)

YEAR	SIDE OTTER TRAWL	STERN OTTER TRAWL	DANISH & SCOTTISH SEINE	OTHER ¹	TOTAL
1972	2459 (2)	6925	1257 (2)	12	10,653 (4)
1973	2194 (2)	9700 (1)	1464 (1)	76	13,434 (4)
1974	1968 (4)	3675 (2)	1221 (2)	53	6,917 (8)
1975	1121 (5)	6360 (4)	995 (1)	115	8,591 (10)
1976	751	3709 (2)	869 (12)	72	5,401 (14)
1977	272 (2)	785 (6)	838 (8)	115	2,010 (16)
1978	406 (11)	715 (3)	930 (12)	52	2,103 (26)
1979	419 (1)	512 (1)	792 (7)	58	1,781 (9)
1980	290 (7)	791 (5)	866 (5)	43	1,990 (17)
1981 ²	342 (6)	354 (3)	564 (1)	19	1,279 (10)
1982 ³	135	368 (2)*	312 (2)	6	821 (4)

¹ Includes NK and MISC gears

* Stern and side otter trawl samples combined

² All countries except USA

³ Provisional (Maritime catches only)

Table 10. Nominal catch (in t) for yellowtail flounder by gear in NAFO Division 4VWX for all countries, 1972-1982.
(# of Canadian commercial samples taken in parentheses).

YEAR	SIDE OTTER TRAWL	STERN OTTER TRAWL	DANISH SEINE	LONG LINE	OTHER ¹	TOTAL
1972	787 (1)	622	63	11	2	1485 (1)
1973	327 (1)	1094	71	20	1	1513 (1)
1974	208 (1)	640	56	32	3	939 (1)
1975	647	832 (1)	40	49	-	1568 (1)
1976	209	610	61	24	-	904
1977	769 (3)	444 (3)	141	14	75	1443 (6)
1978	684 (6)	729 (1)	92 (3)	18	105	1628 (10)
1979	1239	653	132	42	24	2090
1980	1306 (10)	837 (6)	299	11	38	2491 (16)
1981 ²	1622 (19)	1032 (10)	174	13	46	2887 (29)
1982 ³	1831	627 (25)*	61	14	8	2541 (25)

¹ Includes NK and MISC gears

* Stern and side otter trawl samples combined

² All countries except USA

³ Provisional (Maritime catches only)

Table 11. Nominal catch (in t) of winter flounder by gear in NAFO Division 4VWX for all countries 1972-1982. (# of Canadian commercial samples taken in parentheses.)

YEAR	SIDE OTTER TRAWL	STERN OTTER TRAWL	LONG LINE	DANISH SEINE	OTHER ¹	TOTAL
1972	249	1135	39	1	30	1454
1973	527 (2)	1290	39	2	51	1909 (2)
1974	784	1818	2	98	54	2756
1975	456	810	14	32	62	1374
1976	546 (10)	661 (1)	41	15	34	1297 (11)
1977	566	480 (3)	40	2	169	1257 (3)
1978	512	575	50	8	62	1207
1979	290	635 (1)	70	18	75	1088 (1)
1980	2 (1)	962	52	21	137	1174 (1)
1981 ²	18	1303 (9)	57	8	62	1448 (9)
1982 ³	166	954 (13)	35	5	65	1225 (13)

¹ Includes NK and MISC gears

² All countries except USA

³ Provisional (Maritime catches only)

Table 12. Nominal catch (in t) for Atlantic halibut by gear in NAFO Division 4VWX for all countries for 1972-1982.*

YEAR	SIDE OTTER TRAWL	STERN OTTER TRAWL	LONGLINE	DANISH SEINE	OTHER ¹	TOTAL
1972	60	89	639	1	61	850
1973	45	60	658	3	3	774
1974	12	54	555	1	33	655
1975	42	84	514	3	6	649
1976	74	79	544	1	16	714
1977	40	129	492	1	51	713
1978	56	265	689	5	77	1092
1979	70	219	824	5	106	1223
1980	81	312	1021	2	42	1458
1981 ²	40	268	1049	2	34	1393
1982 ³	44	250	1327	0	12	1633

¹ Includes NK and MISC gears

* No commercial samples taken for this species

² All countries except USA

³ Provisional (Maritime catches only)

Table 13. Nominal catch (in t) of Greenland halibut by gear in NAFO Division 4VWX for all countries, 1972-1982*.

YEAR	OTTER TRAWL	LONGLINE	OTHER ¹	TOTAL
1972	9	8	1	18
1973	11	1	-	12
1974	27	5	3	35
1975	29	-	-	29
1976	63	5	1	69
1977	207	4	4	215
1978	513	-	6	519
1979	382	-	-	382
1980	230	-	1	231
1981 ²	127	1	-	128
1982 ³	10	-	-	10

¹ Includes Danish Seine + miscellaneous gear

* No commercial samples taken for this species

² All countries except USA

³ Provisional (Maritime catches only)

Table 14. Catch-at-age ($\times 10^{-3}$) of male and female American plaice in 4V for 1976-1981.

AGE	M A L E					F E M A L E						
	1976	1977	1978	1979	1980	1981	1976	1977	1978	1979	1980	1981
3	-	-	-	-	-	-	-	2	-	-	-	-
4	-	-	-	-	-	4	-	-	-	-	-	1
5	6	36	1	59	19	7	-	12	3	16	20	22
6	25	66	71	128	157	41	23	114	67	87	28	92
7	131	232	95	363	368	331	30	359	149	431	239	210
8	240	363	143	567	1004	375	107	671	260	231	760	453
9	581	714	362	521	620	589	427	592	412	269	319	1038
10	758	447	401	543	305	293	534	1212	400	214	529	503
11	1762	945	494	385	333	113	1243	1147	636	291	279	315
12	1130	505	245	246	466	347	750	924	897	627	327	409
13	714	265	260	220	460	173	820	803	817	560	631	137
14	405	78	128	63	239	157	607	535	373	370	675	386
15	113	15	107	23	159	97	228	379	312	249	501	345
16	45	1	70	6	56	17	266	87	271	105	363	399
17	14	-	24	3	29	49	183	50	200	53	152	153
18	35	-	12	-	18	2	246	50	94	23	153	200
19	31	-	-	-	5	3	141	25	65	13	20	54
20	3	-	12	-	4	3	120	19	43	17	31	41
21	2	-	-	-	-	-	77	23	17	-	71	14
22	-	-	-	-	-	-	57	17	18	4	74	20
23	-	-	-	-	-	-	26	1	12	2	13	2
24	-	-	-	-	-	-	26	2	8	-	4	26
25	-	-	-	-	-	-	-	-	6	-	-	-
26+	-	-	-	-	-	-	-	-	14	5	34	16

Table 15. Catch-at-age ($\times 10^{-3}$) of male and female Witch in 4VII for 1976-1981.

AGE	M A L E					F E M A L E						
	1976	1977	1978	1979	1980	1981	1976	1977	1978	1979	1980	1981
4	-	-	-	-	-	1	-	-	-	-	-	-
5	-	3	-	107	20	10	-	1	8	1	21	1
6	95	15	20	286	87	21	20	3	24	26	15	2
7	151	46	67	164	175	37	18	12	80	100	90	8
8	351	27	73	105	392	57	69	10	98	48	259	17
9	809	42	113	67	316	95	-	14	120	150	165	17
10	607	117	75	164	122	97	181	117	43	120	114	22
11	1507	101	108	783	191	78	142	66	317	67	107	51
12	1535	196	138	88	181	59	433	252	263	212	90	43
13	987	284	147	185	248	104	311	298	295	151	329	31
14	742	203	110	218	128	126	304	261	387	314	278	65
15	620	97	66	62	94	43	391	195	340	445	137	125
16	399	59	71	26	47	59	402	165	159	123	253	71
17	122	33	49	7	58	-	316	303	200	54	130	121
18	85	55	26	-	7	10	352	83	157	176	44	11
19	20	11	19	-	27	20	158	108	87	71	46	105
20	35	6	10	-	11	-	149	70	77	4	34	67
21	33	1	15	-	-	-	68	22	60	-	13	0
22	-	3	3	-	-	3	41	43	13	17	16	24
23	74	-	-	-	-	-	1	12	5	-	25	-
24	-	-	-	-	-	-	6	17	27	8	-	21
25	-	-	-	-	-	-	37	9	5	26	10	2
26+	-	-	7	-	-	-	62	22	20	17	12	18

Table 16. Commercial weight (kg) at age of male and female American plaice for all gears in NAFO Division 4V for 1976-1981.

Table 17. Commercial weight (kg) at age of male and female witch flounder for all gears in NAFO Division 4VW for 1976-1981.

Table 18a. American plaice research and commercial CPUE in NAFO Division 4V for 1970-1982.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Canadian OTB1/TC4 (t/hr)	.401	.275	.300	.225	.254	.340	.296	.296	.242	.238	.153	.197	.144
Median Smoothed	.275	.275	.275	.254	.254	.296	.296	.296	.242	.238	.197	.197	.197
Research #/tow	80.27	79.11	69.64	40.62	77.85	60.50	127.79	58.59	26.77	56.84	71.69	55.04	58.38
Median Smoothed	80.27	79.11	69.64	69.64	69.64	60.5	60.5	58.59	56.84	56.84	56.84	56.84	56.84

Table 18b. Witch flounder research and commercial CPUE in NAFO Division 4VW for 1970-1982.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Canadian OTB1/TC4 (t/hr)	.186	.184	.171	.260	.235	.105	.066	.016	.077	.057	.069	.065	.255
Median Smoothed	.184	.184	.184	.235	.235	.105	.066	.066	.066	.066	.066	.066	.066
Research #/tow	5.13	5.92	4.23	9.13	18.39	5.55	3.08	3.52	3.12	2.41	3.24	3.84	3.23
Median Smoothed	5.92	5.92	5.92	9.13	9.13	5.55	3.52	3.12	3.12	3.12	3.24	3.24	3.24

Table 18c. Yellowtail flounder research and commercial CPUE in NAFO Division 4VWX for 1970-1982.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Canadian OTB1/TC4 (t/hr)	.099	.341	.277	.126	.052	.170	.120	.086	.139	.170	.154	.157	.346
Median Smoothed	.277	.277	.277	.126	.126	.120	.120	.120	.139	.154	.157	.157	.157
Research #/tow	20.00	17.17	18.43	19.01	25.56	30.71	19.18	49.95	12.64	26.96	17.09	19.71	*
Median Smoothed	18.43	18.43	18.43	19.01	25.56	25.56	25.56	25.56	19.71	19.71	19.71	19.71	*

* 1982 yellowtail research data unavailable.

Table 19. Stratified mean catch per tow at age (number) calculated for American plaice from Canadian summer bottom trawl survey in NAFO Division 4V, 1970-82.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
<u>M A L E</u>														
1	-	-	-	-	-	-	0.047	-	0.090	0.020	0.00	0.00	0.00	
2	0.069	0.473	0.841	0.084	1.893	0.878	0.260	0.085	0.153	0.510	0.240	0.28	0.62	
3	2.453	0.542	2.075	1.000	3.359	5.817	3.863	0.878	0.099	0.910	3.190	0.90	1.40	
4	4.201	7.369	0.979	1.203	3.471	2.727	18.292	2.671	0.901	1.470	1.210	7.54	2.86	
5	11.550	7.462	2.744	1.177	5.331	2.523	6.166	5.741	1.328	4.980	2.210	1.80	5.72	
6	8.608	12.575	4.205	3.087	1.368	1.792	6.650	2.339	2.902	4.110	4.930	1.22	3.53	
7	7.036	6.865	12.237	3.910	5.927	1.606	4.208	3.131	1.806	7.150	6.210	4.70	3.33	
8	5.015	4.669	2.916	5.536	6.530	4.006	4.929	3.068	1.574	3.200	7.880	3.38	2.75	
9	2.467	3.299	2.847	2.043	5.341	2.699	8.009	3.918	1.369	2.890	4.280	4.07	2.48	
10	0.725	1.664	3.245	0.933	2.346	3.486	5.965	2.314	1.448	2.420	3.330	1.43	2.06	
11	0.624	0.931	0.689	0.697	1.199	2.356	2.464	0.636	0.858	1.530	2.050	0.55	0.23	
12	0.405	0.567	1.022	0.417	1.265	0.628	1.351	0.457	0.960	1.220	1.980	0.38	0.04	
13+	0.246	1.526	0.976	0.163	0.377	1.456	0.626	0.488	0.122	0.620	0.740	1.47	0.74	
NK	0.516	0.237	-	1.121	0.495	0.956	0.023	0.076	-	-	-	-	-	
TOTAL	44.014	48.164	34.768	21.362	38.240	30.930	62.792	25.841	13.528	31.100	38.270	27.70	25.75	
<u>F E M A L E</u>														
1	-	-	0.275	0.231	0.137	1.488	0.328	1.137	0.015	0.053	0.400	0.450	0.23	1.53
2	-	-	0.252	1.051	0.977	3.204	5.436	3.466	0.200	0.099	-0.370	3.190	0.79	2.67
3	1.398	-	-	-	-	-	-	-	-	-	-	-	-	-
4	4.514	2.061	2.354	1.440	3.559	2.483	16.305	1.989	0.771	0.530	1.740	4.74	2.64	-
5	7.513	2.991	4.015	0.611	4.009	2.707	6.661	8.515	1.115	2.690	1.790	1.48	6.92	-
6	6.462	6.987	4.158	3.065	2.687	1.587	7.544	2.339	2.953	3.090	2.670	1.28	1.87	-
7	5.999	2.727	7.348	3.182	3.466	1.028	5.106	5.188	1.088	6.060	2.780	4.05	2.21	-
8	3.494	3.669	4.981	4.527	5.850	2.521	3.258	4.501	1.154	1.950	4.450	2.04	3.27	-
9	2.276	3.065	1.817	1.678	6.815	2.697	7.269	2.058	0.937	2.260	3.070	4.17	2.37	-
10	1.055	2.123	3.729	1.183	2.727	4.191	4.298	2.681	0.925	1.620	2.810	1.13	2.97	-
11	0.649	0.887	1.168	0.366	2.305	1.853	4.714	2.537	1.144	1.290	2.070	1.05	0.85	-
12	0.557	1.990	0.660	0.504	1.034	1.886	2.847	1.606	0.889	1.380	1.260	0.69	1.00	-
13+	1.636	3.760	3.370	0.412	2.557	2.467	3.701	1.127	2.077	4.160	7.140	5.68	4.25	-
NK	0.615	0.157	-	1.177	-	0.401	0.092	-	0.031	-	-	-	-	-
TOTAL	36.257	30.942	34.868	19.262	39.613	29.574	66.994	32.745	13.240	25.740	33.420	27.34	32.63	-

Table 20. Stratified mean catch per tow at age (number) calculated for Witch flounder from Canadian summer bottom trawl surveys in NAFO Division 4VW, 1970-1982.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
<u>M A L E</u>														
2	-	-	-	-	.016	.038	-	-	.011	-	.07	.02	-	
3	.021	-	.007	-	.118	.103	-	.125	.022	.021	.070	.23	.03	
4	-	-	.091	.249	.086	.107	.039	.082	-	.070	.35	.18	-	
5	.238	.029	.114	.047	.080	.051	.134	.219	.166	.032	.120	.25	.22	-
6	.211	.029	.137	.021	.047	.141	.091	.195	.198	.074	.160	.10	.23	-
7	.325	.098	.244	.090	.278	.100	.127	.126	.150	.106	.210	.16	.09	-
8	.402	.165	.429	.174	.359	.267	.045	.039	.078	.127	.210	.25	.13	-
9	.228	.197	.284	.361	1.112	.325	.233	.069	.102	.159	.110	.38	.12	-
10	.110	.079	.185	.345	1.262	.224	.167	.230	.192	.042	.030	.18	.13	-
11	.021	.137	.061	.136	1.149	.207	.229	.166	.122	.064	.150	.05	.07	-
12	.096	.086	.100	.192	.810	.081	.128	.142	.087	.032	.040	.05	.03	-
13+	.021	-	.047	.183	1.076	.041	.182	.472	.368	.095	.070	.28	.19	-
NK	.604	.609	.047	.371	.062	.300	.173	.023	.034	-	-	-	-	-
TOTAL	2.268	1.437	1.650	2.047	6.618	1.964	1.675	1.841	1.602	0.762	1.240	2.38	1.45	-
<u>F E M A L E</u>														
2	-	-	.056	-	-	.038	-	-	.007	.021	.010	.02	.03	-
3	.010	.007	.003	.054	.033	.093	.017	.007	.044	.900	.030	.08	.05	-
4	-	-	.495	.131	.188	.103	.041	.022	.053	.030	.1	.14	-	-
5	.183	.096	.100	.244	.064	.055	.065	.114	.023	.042	.110	.17	.18	-
6	.145	.063	.069	.102	.083	.071	.041	.176	.151	.074	.260	.11	.22	-
7	.217	.121	.197	.636	.318	.144	.021	.034	.172	.095	.180	.08	.16	-
8	.371	.572	.569	.823	.966	.406	.031	.027	.095	.042	.320	.10	.10	-
9	.223	.669	.313	.637	1.121	.425	.072	.023	.261	.064	.150	.10	.16	-
10	.113	.510	.260	.732	1.311	.484	.081	.175	.133	.032	.130	.03	.15	-
11	.110	.419	.275	.457	2.214	.240	.159	.147	.081	.085	.090	.06	.05	-
12	.301	.274	.263	.576	1.697	.399	.163	.176	.094	.032	.050	.04	.07	-
13+	.306	.325	.348	1.198	3.374	.701	.579	.693	.421	.211	.640	.57	.49	-
NK	.882	1.432	.123	1.014	.409	.353	.057	.049	.018	-	-	-	-	-
TOTAL	2.863	4.486	2.581	7.078	11.776	3.587	1.405	1.674	1.521	1.652	2.000	1.46	1.78	-

Table 21. Stratified mean catch per tow at age (number) calculated for yellowtail, from Canadian summer bottom trawl surveys in NAFO Div. 4VW, 1970-1982.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
<u>M A L E</u>													
1	-	-	-	-	-	0.003	-	-	-	.042	-	-	-
2	0.453	0.145	-	0.214	1.099	0.145	0.687	0.208	0.089	.192	-	-	-
3	1.423	0.704	0.165	1.080	1.733	2.895	1.671	1.365	0.454	1.043	0.220	0.080	-
4	1.812	1.357	0.451	1.674	1.824	2.226	1.994	10.342	1.219	2.909	0.760	0.340	-
5	3.175	1.986	1.011	2.168	2.312	3.218	1.159	6.522	1.899	3.903	2.090	1.790	-
6	2.469	2.252	1.279	2.162	2.142	2.667	1.586	3.205	1.654	3.549	1.970	2.410	-
7	1.216	1.409	3.437	1.663	2.149	2.451	1.553	4.256	1.015	1.843	1.230	5.130	-
8	0.268	0.664	1.388	0.683	0.981	1.585	0.599	2.889	0.239	0.295	0.400	1.430	-
9	0.032	0.043	0.398	0.036	0.192	0.085	0.110	0.353	0.043	0.022	0.280	0.090	-
10	0.015	-	0.192	0.045	-	0.069	-	-	-	-	0.040	-	-
11	-	-	0.033	-	0.003	-	-	-	-	-	0.070	0.900	-
12	-	-	0.007	-	-	-	-	-	-	-	-	-	-
13+	-	-	0.008	-	-	-	-	-	-	-	-	-	-
NK	0.043	0.115	0.018	0.081	-	0.769	0.011	-	0.028	-	-	-	-
TOTAL	10.908	8.679	9.383	9.804	12.435	16.118	9.369	29.739	6.635	13.7	7.060	12.18	-
<u>F E M A L E</u>													
1	-	-	-	-	-	0.035	0.035	-	-	0.020	-	-	-
2	0.326	0.151	0.007	0.197	0.360	0.542	0.095	0.086	0.031	0.054	0.100	0.060	-
3	0.921	0.932	0.167	0.427	1.250	2.205	1.051	1.808	0.263	0.725	0.810	0.200	-
4	1.646	0.974	0.460	1.189	1.362	2.789	1.659	6.349	1.114	1.445	0.900	1.740	-
5	3.267	1.853	0.963	1.801	2.030	1.838	1.595	4.762	1.449	3.025	2.010	0.820	-
6	1.624	2.452	1.264	1.968	3.018	1.794	1.572	2.294	1.477	3.979	2.190	0.710	-
7	0.710	1.390	2.277	1.682	2.538	2.067	1.796	2.065	1.118	2.454	1.880	1.700	-
8	0.383	0.283	2.250	1.311	1.513	1.271	1.316	2.086	0.444	1.075	1.230	1.570	-
9	0.135	0.106	1.141	0.437	0.459	0.657	0.462	0.617	0.095	0.524	0.510	0.700	-
10	0.048	0.059	0.361	0.095	0.039	0.100	0.231	0.095	0.014	0.048	0.260	0.020	-
11	-	0.023	0.107	0.037	0.022	0.007	0.002	0.031	-	0.015	0.100	-	-
12	0.007	-	0.026	0.017	-	0.007	0.013	-	-	-	0.020	-	-
13+	-	0.004	0.015	-	-	-	-	0.009	-	-	0.020	-	-
NK	0.020	0.284	-	0.051	-	1.274	0.007	0.011	-	-	-	-	-
TOTAL	9.087	8.490	9.044	9.209	13.128	14.587	9.806	20.210	5.999	13.26	10.030	7.52	-

Table 22. Recruitment index of American plaice, based on ages 3 and 4 of the same cohort, in NAFO Division 4V, for 1970-1981 (year class 1967-1978).

YEAR CLASS	RECRUITMENT INDEX	
	MALE	FEMALE
1967	1.4746	.6912
1968	.2489	.4102
1969	.6517	.5039
1970	.5564	.7883
1971	1.1473	2.5229
1972	7.1870	3.8821
1973	1.2643	1.2642
1974	.6443	.1675
1975	.1984	.1043
1976	.3666	.3381
1977	1.6757	1.5826
1978	.5595	.6031

Table 23. Z values averaged over 1, 2, and 3 years for American plaice stratified mean catch per tow at age calculated from summer bottom trawl surveys in NAFO Division 4V. 1970-1982.

<u>Z</u> (7-11/8-12)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
<u>M A L E</u>												
1 year	.355	.486	.824	-.241	.482	-.475	.901	.744	-.468	-.472	.884	.625
2 year average	.421	.660	.287	.143	.137	.343	.845	.141	-.470	.203	.780	
3 year average	.562	.349	.357	.020	.390	.429	.495	-.135	.058	.305		
<u>F E M A L E</u>												
1 year	.138	.009	.836	-.538	.476	-.600	.611	1.212	-.483	-.036	.514	.173
2 year average	.074	.425	.105	.007	.184	.256	.814	.494	-.184	.221	.346	
3 year average	.330	.051	.242	-.012	-.320	.436	.554	.263	.073	.206		

Table 24. Z values averaged over 1, 2, and 3 years for witch flounder stratified mean catch per tow at age calculated from summer bottom trawl surveys in NAFO Division 4VW, 1970-1982.

<u>Z</u> (7-11/8-12)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
<u>M A L E</u>												
1 year	.492	-.449	-.004	-1.444	1.327	.253	.299	.081	.418	-.081	-.248	.754
2 year average	.022	-.188	-.938	-.096	.983	.273	.202	-.015	-.092	-.183	.219	
3 year average	.012	-.846	-.079	-.043	.853	.223	.101	-.034	-.155	.144		
<u>F E M A L E</u>												
1 year	-.860	.310	.019	-.624	1.110	1.211	-.410	-.414	1.068	-.845	.969	-.359
2 year average	-.215	-.248	-.775	-.005	1.132	.672	-.454	.222	.063	.105	.366	
3 year average	-.411	-.538	-.151	.111	.977	.363	.030	-.124	.376	-.027		

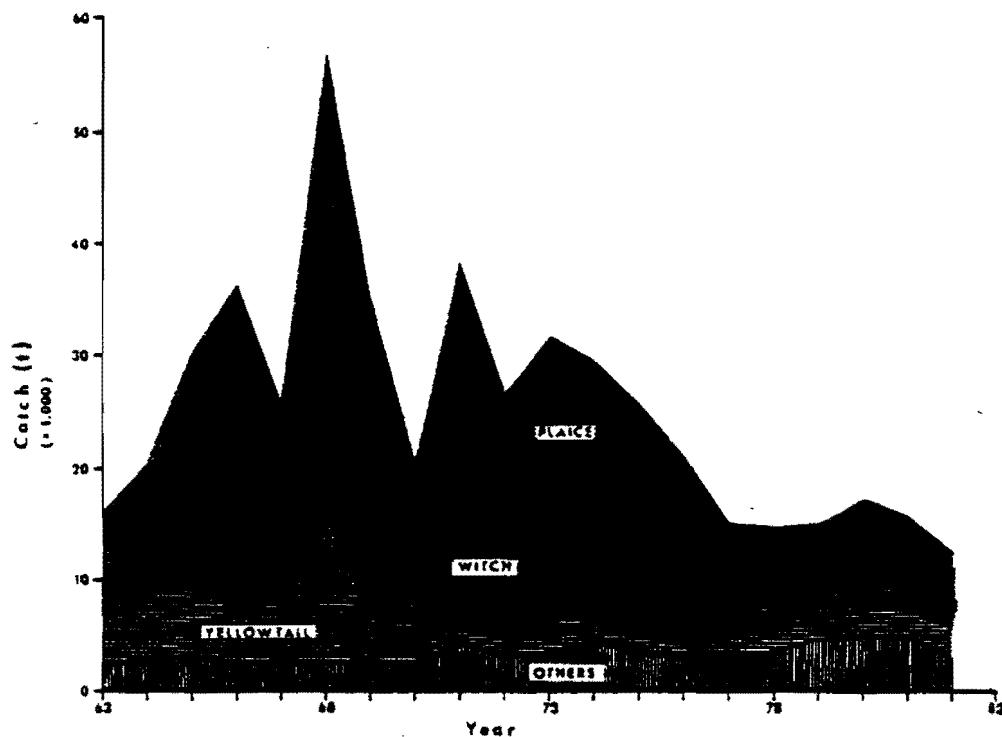


Figure 1. Total catch for all flatfish species in NAFO Division 4VWX for all countries, 1963-1982.

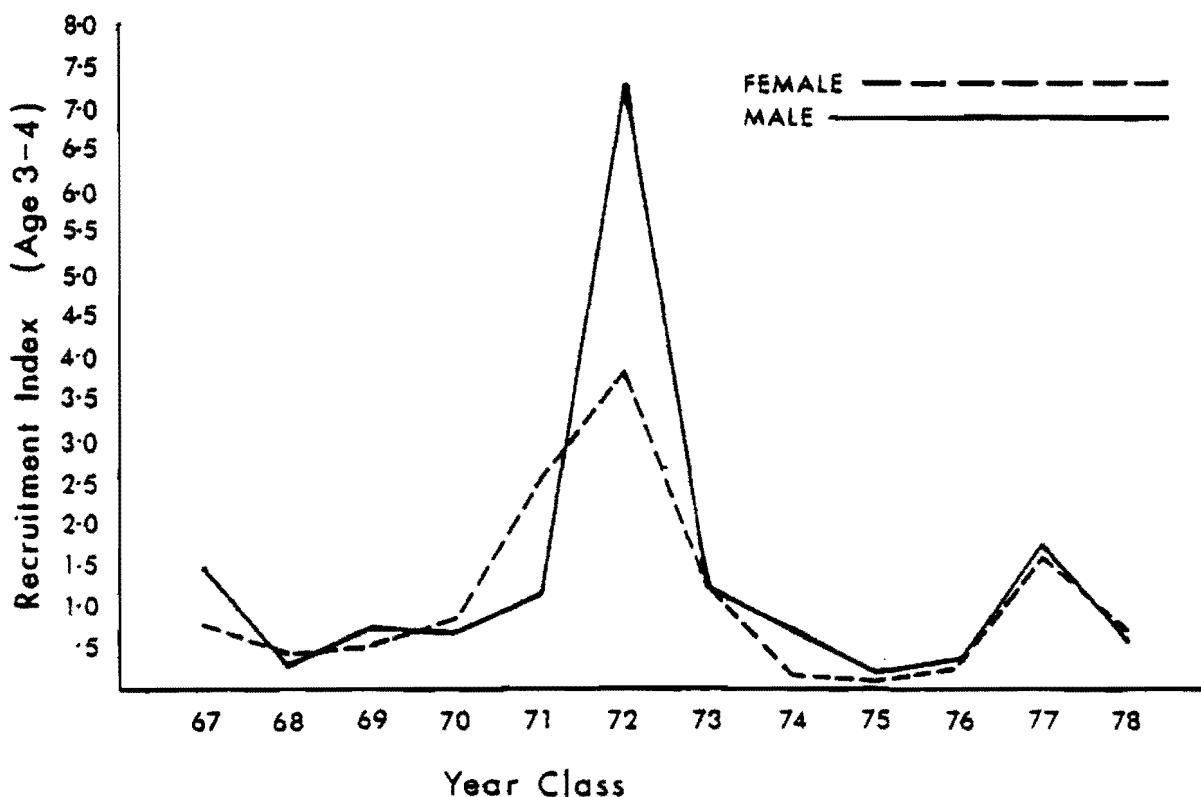


Figure 2. Recruitment index of American plaice, based on ages 3 and 4 of the same cohort, in NAFO Division 4V, for 1970-1981 (year class 1967-1978).

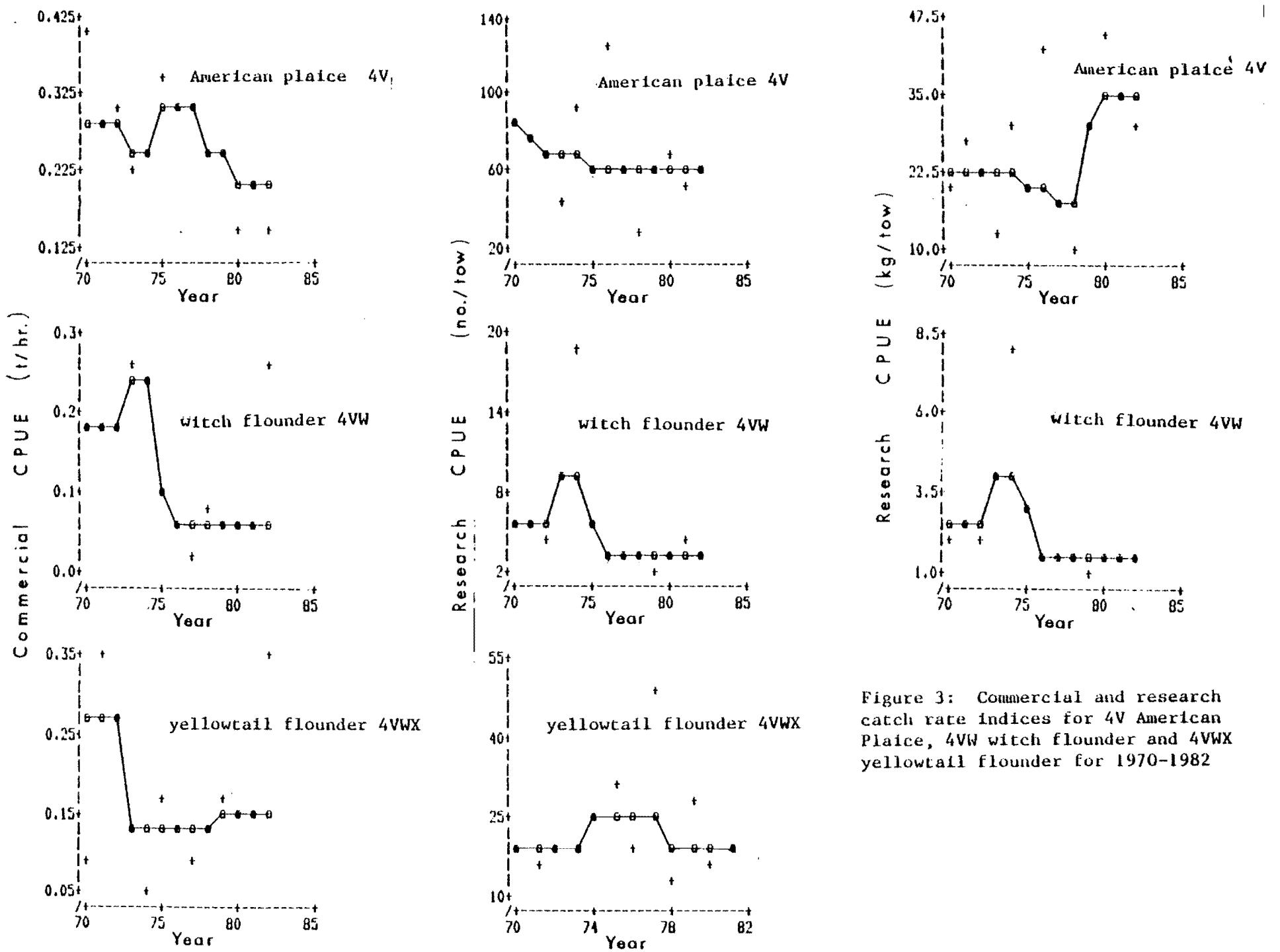


Figure 3: Commercial and research catch rate indices for 4V American Plaice, 4VW witch flounder and 4VWX yellowtail flounder for 1970-1982

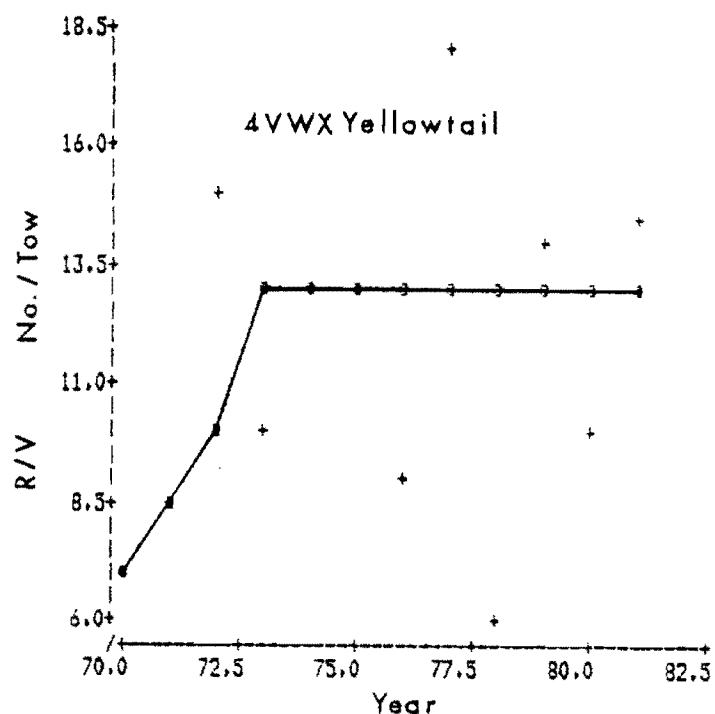
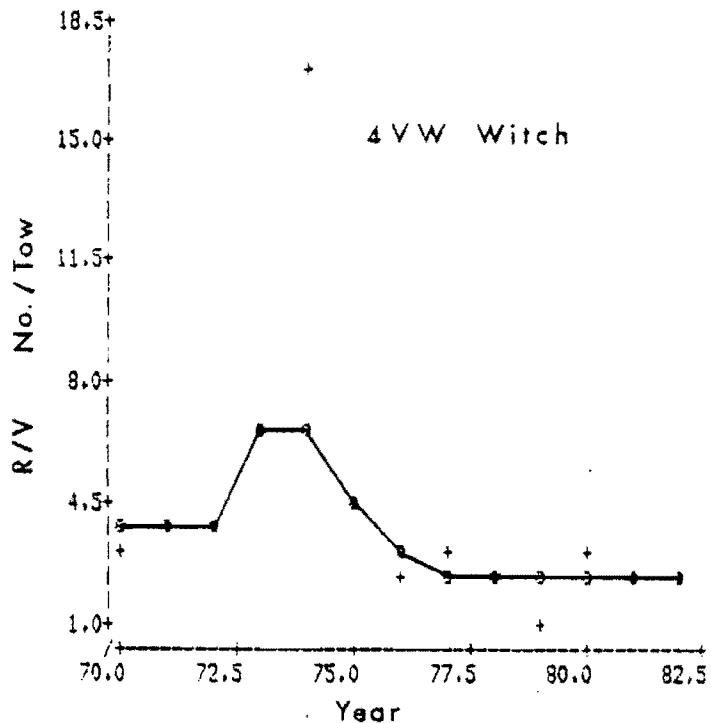
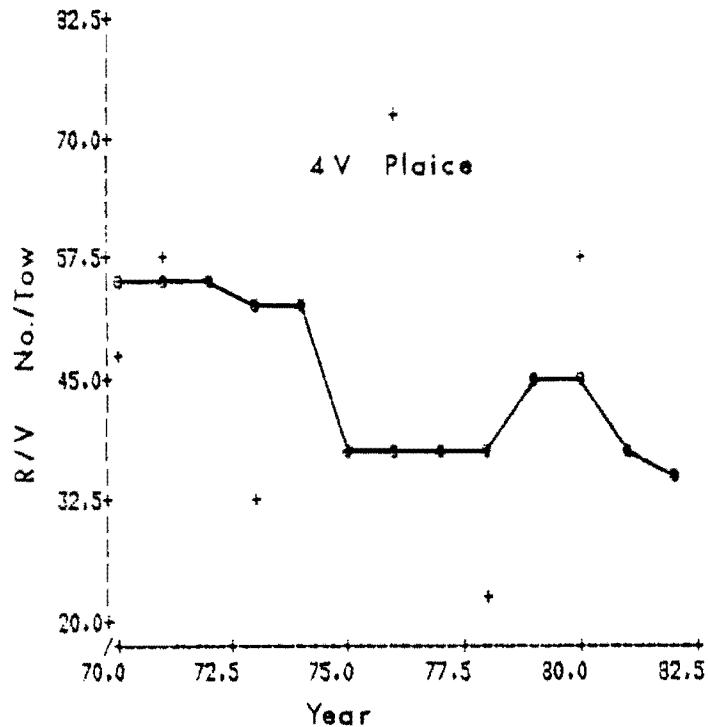


Figure 4. Stratified mean catch per tow of adults (age 6+) of 4V American plaice, 4VW witch flounder and 4VWX yellowtail flounder research surveys 1970-1982.
(Note: Yellowtail only has data to 1981.)