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A review of the status of the 4VWX flatfish stocks

by

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Abstract

The biology and status of Scotian Shelf flatfish were reviewed. New information pertaining to the flatfish stock structure was presented, supporting the view that separate spawning aggregations of both American plaice and yellowtail flounder occur. Flatfish are generally taken as by-catch to other fisheries. Commercial catch rates of American plaice calculated for otter trawlers TC4 (directed trips only) have declined in recent years (1977-1983). Abundance indices of American plaice from research vessel surveys conducted from 1984-1983 have also indicated a decreasing trend. However, witch and yellowtail flounder commercial catch rates have shown increasing trends from 1977-1983. A continuation of the Total Allowable Catch (TAC) of 14,000 t was recommended.

Résumé

Ce qui suit est une revue de la biologie et de l'état des stocks de poissons plats sur la plate-forme Scotian. On y présente l'information récente sur la structure de ces stocks, qui confirme l'existence de groupements reproducteurs séparés, à la fois pour la plie canadienne et la limande à queue jaune. Les poissons plats sont généralement capturés accidentellement dans la poursuite d'autres espèces. Les taux de capture commerciaux de plie canadienne des chalutiers de classe de tonnage 4 (seulement voyages dirigés vers cette espèce) ont diminué ces dernières années (1977-1983). Les indices d'abondance de plie canadienne découlant des relevés par navires de recherche menés en 1983-84 indiquent également une tendance à la baisse. Par contre, les taux de capture commerciaux de plie grise et de limande à queue jaune montrent des tendances à la hausse entre 1977 et 1983. On recommande le maintien d'un TPA (total des prises admissibles) de 14 000 t.

Introduction

Six members of the Pleuronectid family are exploited commercially on the Scotian Shelf. Listed in order of decreasing landings in 1983, they are:

American plaice (Hippoglossoides platessoides)
Yellowtail flounder (Limanda ferruginea)
Atlantic halibut (Hippoglossus hippoglossus)
Witch flounder (Glyptocephalus cynoglossus)
Winter flounder (Pseudopleuronectes americanus)
Greenland halibut (Reinhardtius hippoglossoides)

Of these, only American plaice, witch flounder and yellowtail flounder are under quota management. Greenland halibut, winter flounder and Atlantic halibut have not been sufficiently abundant on the Scotian Shelf to warrant quota management. The landings of winter flounder are comparatively low as it is a coastal species, only abundant along the Nova Scotia coast and in the Bay of Fundy. The only significant offshore fishery is around Sable Island (Halliday MS 1973). It is unlikely that Greenland halibut will ever be sufficiently abundant to comprise a major portion of the flatfish fishery on the Scotian Shelf. However, as will be shown later, landings of Atlantic halibut have been increasing in recent years and this highly valued species is becoming a more significant component of the fishery.

A review of the biology of Scotian Shelf flatfish, exclusive of Atlantic halibut, is given in Halliday (MS 1973).

Stock Structure

As noted by Dale and O'Boyle (MS 1983), little is known regarding flatfish stock structure on the Scotian Shelf. An initial appreciation of stock structure was obtained through examination of the distributions of eggs and sexually mature adults. We have provided plots of data extracted from the Scotian Shelf Ichthyoplankton Program (SSIP) data base showing the distribution of eggs plotted over quarterly periods throughout the year, based on data from cruises conducted from 1979-82. Supplementing the egg distribution data, we have included plots of the distributions of ripe adults, based on data collected on 43 groundfish cruises conducted from 1970-81 (Scott 1983). In the case of both the groundfish and SSIP cruises, combining the data over several years resulted in good coverage of the Scotian Shelf. Hence, apparent concentrations of eggs or ripe adults shown in the plots were probably a result of spawning aggregations and were not a sampling anomaly associated with incomplete coverage.

Plots of American plaice egg distribution and that of ripe adult females are shown in Fig. 1. Eggs first appeared in the water column in the northeastern part of the Shelf (during the first quarter of the year) and subsequently were found more to the southwest. The distribution of ripe adults provided data supporting the view that the distribution of eggs in the second quarter was a result of separate spawning aggregations and not

due to the movement of eggs from the northeast. Little possibility of interchange of adults between the northeast and southwest of the Shelf exists, as Bigelow and Schroeder (1953) have noted that American plaice are largely sedentary and exhibit little seasonal movement. We therefore concluded that the existing convention of treating 4V American plaice as a separate stock (Hare 1977; Dale and O'Boyle MS 1983) was warranted. However, the combination of data from 4V and 4W might constitute an equally valid approach, given the non-discrete distribution of eggs over those areas.

The distributions of witch flounder eggs and ripe females are shown in Fig. 2. Witch eggs were first found in the second quarter of the year in the southwest portion of the Shelf and were broadly distributed throughout the Shelf by the third quarter of the year. The distribution of ripe adult females was quite diffuse, with the only aggregations occurring on the Sable Island- Banquereau Banks. However, the distribution of ripe females in 4X appeared discontinuous with that to the northeast. On those grounds, the current practice of combining data for stock assessment purposes from NAFO Areas 4V and 4W seems justified.

The distributions of ripe yellowtail flounder and their eggs are shown in Fig. 3. Spawning concentrations appeared to be in association with the banks defined by the 50-m contour, with populations occurring on Browns, Emerald, Western, Sable Island and Banquereau Banks. Hare (1977) has also postulated the presence of separate stocks on Sable Island and Banquereau Banks. Although occurrences of yellowtail flounder eggs were relatively rare in the SSIP data series, the distribution in the third quarter of the year follows that of ripe adults. We concluded that the current practice of combining data from NAFO Areas 4V, 4W and 4X is questionable and separate assessments could be feasible as more complete data become available. However, the lack of detailed commercial fishery sampling of this species precludes more detailed stock assessment at present.

The 4VWX Flatfish Fishery: Patterns of Exploitation and Landings

Flatfish landings increased considerably from 15,996 t in 1963 to 56,483 t in 1968 (Fig. 4). Since then, fluctuations have occurred but catches have generally followed a declining trend until 1977 when they stabilized (Table 1). Stabilization of catches may have been a result of a reduction and eventual disappearance of USSR fishing effort directed to flatfish during the mid to late 1960's (Dale and O'Boyle MS 1983). However, recent total landings have not increased. Indeed, the trend over the last 5 yr remained stable with some indication of decline with 1983 being the first year in which the quota of 14,000 t was not reached.

American plaice typically comprise the largest fraction of all flatfish landings (Table 1) with catches in 4V making the largest contribution to the total plaice catch (Table 2). Use of large otter trawlers of Tonnage Class (TC) 4 was the preferred method for exploiting the fishery (Table 8).

Witch flounder usually were the next largest contribution to the total flatfish landings. However, since 1971 when 17,864 t were landed, catches

have decreased markedly with only 1376 t reported in 1983 (Table 1). The witch flounder fishery was largely pursued in NAFO Divisions 4V and 4W. However, since 1977, the catch from 4X has comprised a significant fraction of the total landings (Table 3) and has equalled or exceeded that from 4W. The gear employed in the 4VW witch fishery has been the stern otter trawler, with the Danish seine being increasingly employed recently (Table 9).

Yellowtail flounder landings have remained stable over recent years (Table 1). NAFO Division 4V contributes the bulk of the landings (Table 4). Use of otter trawlers has been the preferred means of prosecuting the fishery (Table 10).

Of the three remaining flatfish species, winter flounder total landings have remained fairly constant from 1975-82, fluctuating between 1000 and 1400 t (Table 5). Atlantic halibut landings have increased since 1978 (Table 6). Landings of Greenland halibut have averaged only 287 t since 1977 (Table 7) and have declined to a negligible amount. Over 90% of the winter flounder and Greenland halibut catches are taken by trawlers, while longliners exploit 73% of the Atlantic halibut fishery (Table 11-13).

Age Composition of the Commercial Catch

Commercial sampling for flatfish has been limited to American plaice, witch, yellowtail and winter flounder (Table 8-11). Age-size information (1948-78) for these stocks was provided by Cleary (MS 1979). Minimal sampling occurred prior to 1976. However, since 1977 the situation has improved and sampling has been adequate for all four species with the exception of yellowtail flounder in 1979 and winter flounder in 1978. However, the trends in landings of unidentified flounder are again increasing and should be viewed with concern (Table 1).

Both catch-at-age and weight-at-age matrices were constructed for 4V plaice and 4VW witch from Canadian commercial fishery age-length keys by splitting the samples by gear, applying them to the appropriate catches by gear type and combining the results (Table 14-17). The commercial samples were collected throughout the year, with sampling intensity generally reflecting seasonal trends in fishing activity. Data for 1982 and 1983 witch flounder and 1982 American plaice were unavailable as age determinations were not yet complete.

The 1972 year-class of American plaice appeared quite strong and has contributed substantially to the NAFO 4V fishery. However, no one cohort of witch flounder appeared which was notable in terms of abundance in the catch.

Catch-Per-Unit-Effort Indices from the Commercial Fishery

The commercial CPUE index was calculated from catch per hour (t) 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. Data were smoothed using the '4253H twice' algorithm proposed by Tukey and developed by Velleman (1980). The algorithm consists of successive applications of running median smoothers followed by the Hamming running average:

$$Z(t) = 0.25\ y(t-1) + 0.5\ y(t) + 0.25\ y(t+1)$$

This procedure was used for smoothing all time series data presented here.

American plaice catch rates have generally declined since 1970 (Table 18a, Fig. 5). However, witch flounder catch rates have followed an increasing trend since 1977 (Table 18b, Fig. 5). Yellowtail flounder catch rates have followed a similar trend, with the increasing trend evident somewhat earlier (Table 18c, Fig. 5).

Catch-Per-Unit-Effort Indices from Research Cruises

Catch rates from 1970-81 were calculated using data from cruises conducted during the summer months onboard the A.T. Cameron. In 1982, the data were collected from a cruise on the Lady Hammond and in 1983, from the Alfred Needler. The indices of abundance, stratified mean catch per tow (numbers and weight), were obtained by use of the 'Strat' program for analyses of research cruise data. As recommended by Fanning (pers. comm.), no conversion factor was used between the catch rate series of American plaice from the Lady Hammond and the Alfred Needler cruises. It was assumed that conversion factors were also not necessary for the other flatfish species or between catch rates derived from the A.T. Cameron and Lady Hammond cruises.

American plaice catch rates have declined somewhat since 1970, with the exception of a relatively large value in 1976 (Fig. 6). The more detailed catch per tow-at-age values presented in Table 19 indicated that equal numbers of males and females were caught (two-sample t-test, $p = 0.81$).

Witch flounder catch rates have declined until 1980 and then gave some indication of recovery (Fig. 6). Note that as 'Strat' data were not available for the 1983 witch flounder catches, the 1983 datum appearing in Fig. 6 was computed by hand and should be viewed as preliminary. The catch per tow-at-age values broken down by sex indicated that there were no significant differences in numbers of males and females caught (two-sample t-test, $p = 0.17$, Table 20), although there was a tendency for more females to be caught than males in 1970-75.

Yellowtail flounder catch rates have declined since the peak value observed in 1977 (Fig. 6). The numbers of males and females caught in the research surveys (Table 21) did not significantly differ ($p = 0.54$).

When we re-examined the trends in catch rates using adult (fish 6 yr and older) catches only, American plaice catch rates still followed a downward trend (Fig. 7), as did witch flounder and yellowtail. With the exception of witch flounder, the trends were similar to those shown in Fig.

5. The difference in the witch flounder catch rates may reflect an increasing proportion of younger fish in the total catch, a view supported by examination of the detailed catch-at-age data in Table 20.

We also calculated the trends in biomass/tow for American plaice and witch. In both cases, the trends were similar to those shown in the plots of stratified mean catch per tow.

Recruitment and Mortality

We calculated recruitment of American plaice using a formula suggested by Dale and O'Boyle (1983):

$$R = \frac{\frac{X_3}{\overline{X_3}} + \frac{X_4}{\overline{X_4}}}{2}$$

where X_3 = catch-at-age 3 (year t)
X_4 = catch-at-age 4 (year t+1).

The index was calculated separately for males and females and the data are shown in Table 22. A time series plot of the index is also provided (Fig. 8). On the basis of this index, it appears that recruitment to the adult fishery will improve somewhat. We could not calculate a similar index for witch flounder as age determinations for 1982 and 1983 otolith collections were not complete.

Dale and O'Boyle (MS 1983) provided estimates of total mortality (Z) based on research cruise data. However, the analysis seemed to produce erroneous results, as negative Z values were often obtained. As yet unresolved problems with the survey may be responsible. We therefore discontinued the calculation of total mortality.

Conclusions and Recommendations

American plaice, the species comprising the bulk of flatfish landings, continued to decline causing an overall decline in flatfish landings. The impact of this worrisome aspect is lessened somewhat by the indication of increased recruitment to the American plaice fishery. The catch-per-unit index from the commercial fishery also has increased for witch and yellowtail flounders (Fig. 5). However, indices of abundance of yellowtail and witch flounder from the research vessel cruises continued to decline (Fig. 7).

On the basis of these apparently contradictory indicators, we recommend no change to the TAC of 14,000 t suggested last year. Note that total landings in 1983 (12,181 t) were less than the TAC.

It is also worthwhile to note that changes in the TAC probably would not be an effective management measure. In 1982, the number of tons landed in the directed American plaice fishery was 1345, compared with 4076 in the indirected or bycatch fishery. Similarly, the percentage landed as a result of directed fishing effort was 26, 52, 1 and 17% for witch flounder, yellowtail flounder, winter flounder and Atlantic halibut, respectively in 1982. However, despite the fact that the fishery is largely by-catch in nature, the landed value of flatfish (exclusive of halibut) increased 24.4% in 1983 relative to 1982. The value of halibut increased 22.1% (Anon. 1984) over the same period. As the halibut fishery is becoming more significant, particularly in NAFO Area 4X, it may be desirable to conduct a separate assessment of this species in the future.

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Table 1. Total landings (t) for 4VWX flatfish between 1963-83.

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	1551	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	7572	2321	2491	1174	1458	231	1887	17,134
1981[1]	6772	1741	2889	1448	1395	128	1577	15,950
1982[2]	5631	1417	2622	1231	1721	34	1774	14,430
1983[2]	5771	1376	2288	987	1752	4	-	12,178

[1]All countries except USA.
[2]Provisional (Maritime catches only).

Table 2. Total American plaice catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch		Foreign catch	
1963	1376	683	250	2309	2108	(91)[3]	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	8076	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	6932	(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	6293	598	681	7572	7490	(99)	82	(1)
1981[1]	5677	581	514	6772	6586	(97)	186	(3)
1982[1]	4920	400	311	5631	5621	(100)	10	(0)
1983[2]	4935	378	458	5771	5771	(100)	-	

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 3. Total witch flounder catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch		Foreign catch	
1963	4971	2440	75	7486	6972	(93)[3]	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	1801	189	331	2321	2298	(99)	23	(1)
1981[1]	1123	156	462	1741	1687	(97)	54	(3)
1982[1]	789	101	527	1417	1411	(100)	6	(0)
1983[2]	790	108	478	1376	1376	(100)	-	

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 4. Total yellowtail flounder catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch		Foreign catch	
1963	1740	2148	84	3972	3784	(95)[3]	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	2158	78	255	2491	2486	(100)	5	(0)
1981[1]	2539	123	227	2889	2881	(100)	8	(0)
1982[1]	2360	51	211	2622	2620	(100)	2	(0)
1983[2]	1927	57	304	2288	2288	(100)	-	

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 5. Total winter flounder catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch		Foreign catch	
1963	17	65	614	696	668	(96)[3]	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	(52)
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	30	10	1134	1174	1173	(100)	1	(0)
1981[1]	26	11	1411	1448	1448	(100)	-	
1982[1]	82	10	1139	1231	1231	(100)	-	
1983[2]	70	7	910	987	987	(100)	-	

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 6. Total Atlantic halibut catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch		foreign catch	
1963	214	479	840	1533	1453	(90)[3]	80	(10)
1964	332	358	861	1551	1461	(94)	90	(6)
1965	486	458	665	1609	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	339	371	748	1458	1454	(100)	4	(0)
1981[1]	250	379	766	1395	1389	(100)	6	(0)
1982[2]	342	476	903	1721	1720	(100)	1	(0)
1983[2]	391	535	826	1752	1752	(100)	-	

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 7. Total Greenland halibut catch (t) for NAFO Division 4VWX for 1963-83.

Year	4V	4W	4X	Total	Canadian catch	foreign catch
1963	-	-	-	-	-	-
1964	1	-	1	2	-	2 (100)
1965	-	-	-	-	-	-
1966	1	-	-	1	1 (100)[3]	-
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	179	51	1	231	231 (100)	-
1981[1]	110	1	17	128	128 (100)	-
1982[1]	29	1	4	34	34 (100)	-
1983[2]	1	1	2	4	4 (100)	-

[1]All countries except USA.
[2]Provisional (Maritime catches only).
[3]Percentage of total catch.

Table 8. Nominal catch (t) of American plaice by gear in NAFO Division 4V for all countries, 1972-83 (# of Canadian commercial fishery samples indicated in parentheses).

Year	Side otter trawl	Stern otter trawl[4]	Danish and Scottish 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]	2080 (14)	2222 (7)	941 (1)	431 (4)	3	5677 (26)
1982[3]	1868 (12)	1546 (8)	716 (3)	786 (1)	4	4920 (24)
1983[3]	1188 (1)	2007 (14)	1019 (7)	690 (2)	31	4935 (24)

[1]Includes NK and MISC gears.
[2]All countries except USA.
[3]Provisional (Maritime catches only).
[4]On the basis of purchase slip information and log records, catches recorded as unspecified otter trawl were assumed to be from stern otter trawlers. This assumption also holds for data in Tables 9-13.

Table 9. Nominal catch (t) of witch flounder by gear in NAFO Division 4VW for all countries, 1972-83 (# of Canadian commercial fishery samples taken indicated 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]	164 (1)	209 (1)	511 (2)	6	890 (4)
1983[3]	85	134 (6)	665 (6)	14	898 (12)

[1]Includes NK and MISC gears.
[2]All countries except USA.
[3]Provisional (Maritime catches only).

Table 10. Nominal catch (t) of yellowtail flounder by gear in NAFO Division 4VWX for all countries, 1972-83 (# of Canadian commercial fishery samples taken indicated in parentheses).

Year	Side otter trawl	Stern otter trawl	Danish and Scottish seine	Longline	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	48	2889 (29)
1982[2]	1853 (18)	693 (7)	62	14	-	2622 (25)
1983[3]	1390 (9)	621 (19)	187	31	59	2288 (28)

[1]Includes NK and MISC gears.
[2]All countries except USA.
[3]Provisional (Maritime catches only).

Table 11. Nominal catch (t) of winter flounder by gear in NAFO Division 4VWX for all countries, 1972-83 (# of Canadian commercial fishery samples taken in parentheses).

Year	Side otter trawl	Stern otter trawl	Longline	Danish and Scottish 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[2]	69	1062 (13)	35	7	58	1231 (13)
1983[3]	-	877 (13)	10	6	94	987 (13)

[1]Includes NK and MISC gears.
[2]All countries except USA.
[3]Provisional (Maritime catches only).

Table 12. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 4VWX for all countries, 1972-83.*

Year	Side otter trawl	Stern otter trawl	Longline	Danish and Scottish seine	Other[1]	Total
1972	60	89	639	1	61	850
1973	45	60	658	3	8	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]	42	268	1049	2	34	1395
1982[3]	60	270	1371	0	20	1721
1983	27	214	1445	0	66	1752

[1]Includes NK and MISC gears.
[2]All countries except USA.
[3]Provisional (Maritime catches only).
*No commercial fishery samples were taken for this species.

Table 13. Nominal catch (t) of Greenland halibut by gear in NAFO Division 4VWX for all countries, 1972-83.*

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	882	-	-	882
1980	230	-	1	231
1981[2]	127	1	-	128
1982[3]	34	-	-	34
1983	2	-	2	4

[1]Includes Danish seine + miscellaneous gear.
[2]All countries except USA.
[3]Provisional (Maritime catches only).
*No commercial fishery samples were taken for this species.

Table 14. Catch-at-age (x 10^3) of male and female American plaice in 4V for 1976-83.

Age	MALE							FEMALE						
	1976	1977	1978	1979	1980	1981	1982* 1983	1976	1977	1978	1979	1980	1981	1982* 1983
3	–	–	–	–	–	–	–	–	2	–	–	–	–	–
4	–	–	–	–	–	4	3	–	–	–	–	–	1	–
5	6	19	1	37	19	6	10	–	4	2	8	21	21	9
6	60	50	39	108	158	40	122	38	85	66	109	28	85	181
7	139	161	105	309	373	327	108	1	444	129	406	245	208	84
8	330	255	218	840	1003	364	41	179	666	199	226	772	454	96
9	872	745	458	481	618	590	212	718	601	439	524	322	999	285
10	983	708	529	672	304	345	334	775	1102	390	294	537	500	339
11	1020	837	524	328	333	129	376	1403	994	657	423	283	405	711
12	1289	679	298	217	466	354	372	851	999	732	546	333	434	532
13	942	208	310	433	452	250	245	1060	778	694	719	639	169	351
14	414	70	145	64	239	186	168	664	541	364	343	684	443	272
15	141	13	101	26	159	112	128	130	417	284	209	505	373	216
16	52	18	24	11	56	68	112	239	145	242	126	368	486	325
17	13	–	37	5	29	52	56	113	50	195	39	154	210	280
18	78	–	1	–	18	1	51	186	64	100	19	155	202	222
19	40	1	–	–	5	8	62	127	15	66	7	20	58	142
20	4	–	6	–	4	3	42	57	11	43	10	32	37	113
21	–	–	6	–	–	–	12	43	31	17	–	70	26	61
22	2	–	–	10	–	–	–	18	60	16	2	75	21	69
23	–	–	–	–	–	–	–	7	1	15	1	14	1	18
24	–	–	–	–	–	–	5	28	6	14	–	4	29	30
25	–	–	–	–	–	–	6	–	–	4	–	–	–	16
26	–	–	–	–	–	–	–	2	–	12	–	35	21	27
27	–	–	–	–	–	–	–	–	–	–	–	–	3	10
28+	–	–	–	–	–	–	–	–	–	–	–	–	–	–

*Catch-at-age data unavailable for 1982.

Table 15. Catch-at-age (x 10^3) of male and female witch in 4V for 1976-81.*

Age	MALE						FEMALE					
	1976	1977	1978	1979	1980	1981	1976	1977	1978	1979	1980	1981
4	-	-	30	1	-	1	-	-	-	4	-	-
5	-	3	1	31	21	23	-	-	40	1	22	44
6	14	12	31	128	89	44	8	3	40	65	15	39
7	17	39	211	293	176	24	3	14	86	107	92	89
8	81	30	85	134	395	117	15	9	58	78	268	9
9	405	45	167	171	321	57	-	18	125	79	171	64
10	175	149	65	105	123	94	228	106	43	81	117	57
11	543	114	136	41	195	73	146	60	291	156	108	85
12	579	185	108	316	184	25	363	239	345	126	91	17
13	225	306	122	207	253	65	333	271	347	149	341	83
14	378	211	107	74	131	129	238	240	351	185	288	39
15	285	86	101	198	95	21	87	202	395	154	112	114
16	236	88	33	57	49	24	239	193	246	75	261	67
17	44	38	30	25	59	-	575	248	204	135	135	79
18	10	61	17	12	7	3	154	58	167	63	44	5
19	2	18	5	4	27	8	114	79	101	30	48	37
20	3	-	6	1	11	-	124	67	57	4	33	7
21	1	-	2	-	-	-	112	16	60	-	14	-
22	-	-	1	-	-	1	4	34	17	3	16	16
23	7	-	4	-	-	-	-	13	7	-	26	-
24	-	-	-	-	-	-	26	12	9	2	-	6
25	-	-	-	-	-	-	4	6	6	5	11	1
26+	-	-	-	-	-	-	7	13	18	3	13	11

*Catch-at-age data were unavailable for 1982 and 1983.

Table 16. Commercial weight-at-age (kg) of male and female American plaice for all gears in NAFO Division 4V for 1976-83.

Age	MALE								FEMALE							
	1976	1977	1978	1979	1980	1981	1982*	1983	1976	1977	1978	1979	1980	1981	1982*	1983
3	-	-	-	-	-	-		-	-	0.12	-	-	-	-		-
4	-	-	-	-	-	0.17		0.10	-	-	-	-	-	0.18		-
5	0.20	0.19	0.17	0.16	0.23	0.22		0.18	-	0.14	0.21	0.28	0.24	0.36		0.29
6	0.32	0.19	0.21	0.27	0.24	0.31		0.29	0.38	0.35	0.27	0.40	0.27	0.42		0.34
7	0.30	0.28	0.25	0.25	0.30	0.39		0.32	0.23	0.37	0.39	0.38	0.38	0.46		0.39
8	0.32	0.34	0.36	0.30	0.30	0.37		0.42	0.44	0.38	0.41	0.54	0.38	0.47		0.53
9	0.35	0.37	0.40	0.35	0.40	0.40		0.38	0.55	0.46	0.52	0.44	0.60	0.52		0.47
10	0.41	0.41	0.44	0.41	0.42	0.52		0.40	0.64	0.52	0.53	0.63	0.55	0.69		0.58
11	0.43	0.43	0.48	0.56	0.49	0.65		0.43	0.64	0.61	0.60	0.69	0.66	0.69		0.60
12	0.51	0.45	0.55	0.63	0.50	0.54		0.46	0.71	0.76	0.76	0.88	0.78	0.76		0.62
13	0.56	0.57	0.55	0.64	0.49	0.50		0.48	0.85	0.85	0.79	0.88	0.85	0.68		0.77
14	0.68	0.71	0.72	1.01	0.51	0.52		0.52	0.94	0.86	0.93	1.06	0.98	1.05		0.89
15	0.73	0.68	0.93	1.48	0.67	0.53		0.58	1.36	1.10	1.00	1.43	0.85	1.09		1.01
16	0.87	1.23	1.02	1.17	0.66	0.52		0.72	1.01	1.24	1.21	1.60	1.18	1.18		1.14
17	1.17	-	0.93	1.48	0.99	0.52		0.66	1.70	1.44	1.26	1.53	1.17	1.12		1.16
18	0.57	-	1.28	-	0.74	1.67		0.68	1.56	1.65	1.47	1.33	1.34	1.31		1.28
19	0.49	0.97	-	-	0.74	1.07		0.73	1.83	1.81	1.61	1.68	1.92	1.51		1.38
20	1.49	-	0.84	-	0.92	0.74		0.84	1.69	1.62	1.57	1.99	1.82	1.41		1.33
21	-	-	0.84	-	-	-		0.79	1.98	1.34	1.79	-	1.42	1.73		1.70
22	1.34	-	-	2.16	-	-		-	2.03	1.50	2.49	3.27	1.46	1.78		1.63
23	-	-	-	-	-	-		-	2.14	1.91	1.62	3.10	1.39	2.10		2.21
24	-	-	-	-	-	-		0.91	-	2.59	2.21	-	2.24	2.14		1.72
25	-	-	-	-	-	-		1.12	-	-	3.05	-	-	-		2.52
26	-	-	-	-	-	-		-	3.32	-	2.85	-	2.30	2.13		2.10
27	-	-	-	-	-	-		-	-	-	-	-	-	2.19		2.44

*Weight-at-age data unavailable for 1982.

Table 17. Commercial weight-at-age (kg) of male and female witch flounder for all gears in NAFO Division 4VW for 1976-81.*

Age	MALE						FEMALE					
	1976	1977	1978	1979	1980	1981	1976	1977	1978	1979	1980	1981
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	0.12	0.11	-	0.12	-	-	-	0.14	-	-
5	-	0.11	0.12	0.19	0.16	0.17	-	-	0.14	0.14	0.52	0.17
6	0.20	0.21	0.17	0.24	0.21	0.26	0.23	0.19	0.19	0.30	0.19	0.29
7	0.24	0.40	0.23	0.23	0.22	0.29	0.28	0.28	0.31	0.31	0.28	0.39
8	0.14	0.29	0.30	0.23	0.29	0.36	0.32	0.35	0.28	0.34	0.37	0.46
9	0.29	0.41	0.34	0.34	0.31	0.36	-	0.41	0.31	0.33	0.36	0.56
10	0.35	0.37	0.35	0.35	0.38	0.49	0.56	0.33	0.32	0.35	0.35	0.47
11	0.37	0.42	0.38	0.42	0.42	0.51	0.66	0.47	0.36	0.69	0.50	0.69
12	0.44	0.43	0.37	0.35	0.41	0.51	0.93	0.45	0.40	0.41	0.45	0.69
13	0.48	0.42	0.39	0.39	0.42	0.60	0.83	0.56	0.43	0.53	0.47	0.77
14	0.48	0.51	0.45	0.48	0.46	0.62	0.96	0.64	0.48	0.53	0.56	0.65
15	0.58	0.53	0.59	0.40	0.50	0.56	1.04	0.67	0.56	0.55	0.78	0.89
16	0.64	0.64	0.56	0.53	0.41	0.65	1.19	0.72	0.66	0.62	0.60	0.87
17	0.73	0.59	0.66	0.59	0.50	-	1.39	0.73	0.68	0.70	0.64	0.86
18	0.64	0.69	0.62	0.57	0.70	0.94	1.58	0.89	0.76	0.80	0.76	0.93
19	0.66	0.75	0.68	0.65	0.62	0.86	1.74	0.81	0.93	0.84	0.78	0.96
20	0.64	-	0.78	0.82	0.81	-	1.80	0.99	0.87	0.76	0.94	1.16
21	0.88	-	0.85	-	-	-	1.59	1.11	0.91	-	0.92	-
22	-	-	0.99	-	-	1.09	1.66	0.98	0.95	1.24	0.88	1.10
23	1.01	-	0.92	-	-	-	-	1.12	0.97	-	0.95	-
24	-	-	-	-	-	-	2.10	1.24	1.11	1.32	-	1.53
25	-	-	-	-	-	-	1.53	0.99	1.27	1.16	0.88	1.53
26	-	-	0.81	-	-	-	1.86	1.44	1.26	1.41	1.05	1.58
27	-	-	-	-	-	-	-	-	-	-	-	-

*Weight-at-age data were unavailable for 1982 and 1983.

Table 18a. American plaice commercial and research CPUE in NAFO Division 4V for 1970-83.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Canadian OTB1/TC4														
(t/h)	.401	.275	.300	.225	.254	.340	.296	.296	.242	.238	.153	.197	.144	.155
Smoothed	.370	.306	.269	.263	.273	.284	.288	.281	.259	.228	.195	.169	.156	.154
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	61.21
Smoothed	80.27	76.48	72.39	69.02	67.22	65.56	62.45	58.62	56.43	56.20	57.77	57.79	59.18	60.90

Table 18b. Witch flounder commercial and research CPUE in NAFO Division 4VW for 1970-83.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Canadian OTB1/TC4														
(t/h)	.186	.184	.171	.260	.235	.105	.066	.016	.077	.057	.069	.065	.255	.244
Smoothed	.186	.190	.197	.201	.183	.130	.078	.057	.055	.056	.069	.118	.189	.244
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	8.41*
Smoothed	5.13	5.93	6.89	7.30	7.13	6.11	4.40	3.31	3.00	2.30	3.09	3.54	4.89	7.15

Table 18c. Yellowtail flounder commercial and research CPUE in NAFO Division 4VWX for 1970-83.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Canadian OTB1/TC4														
(t/h)	.099	.341	.277	.126	.052	.170	.120	.086	.139	.170	.154	.157	.346	.332
Smoothed	.191	.191	.191	.174	.139	.119	.119	.124	.133	.145	.165	.213	.279	.332
Research														
#/tow	20.00	17.17	18.43	19.01	25.56	30.71	19.18	49.95	12.64	26.96	17.09	23.84	22.20[1]	14.82
Smoothed	19.51	19.51	19.64	20.66	22.78	24.34	24.74	24.32	23.36	22.67	27.61	22.11	19.95	16.23

*Preliminary value.

[1]No summer datum available. March survey datum reported, to allow completion of time series for data smoothing purposes.

Table 19. Stratified mean catch per tow at age (number) calculated for American plaice from Canadian summer bottom trawl surveys in NAFO Division 4V, 1970-83.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
							MALE							
1	-	-	-	-	-	-	-	0.047	-	0.090	0.020	0.00	0.00	0.02
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	0.51
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	1.88
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	3.00
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	3.41
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	6.02
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	2.68
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	2.23
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	2.71
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	2.32
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	1.74
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	0.55
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	1.17
NK	0.616	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	28.25
							FEMALE							
1	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20
2	-	0.275	0.231	0.137	1.488	0.328	1.137	0.015	0.053	0.400	0.450	0.23	1.53	0.63
3	1.398	0.252	1.051	0.977	3.204	5.436	3.466	0.200	0.099	0.310	3.190	0.79	2.67	2.33
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	2.69	3.99
5	7.613	2.991	4.015	0.611	4.009	2.707	6.661	8.515	1.115	2.690	1.790	1.48	6.92	3.65
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	7.66
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	2.35
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	1.53
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	2.80
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	1.50
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	2.01
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	0.83
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	3.48
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	32.96

Table 20. Stratified mean catch per tow at age (number) calculated for witch flounder from Canadian summer bottom trawl surveys in NAFO Division 4VW, 1970-83.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983*
						M A L E								
2	-	-	-	-	0.016	0.038	-	-	-	0.011	-	0.07	0.02	
3	0.021	-	0.007	-	0.118	0.103	-	0.125	0.022	0.021	0.070	0.23	0.03	
4	-	-	-	0.091	0.249	0.086	0.107	0.039	0.082	-	0.070	0.35	0.18	
5	0.238	0.029	0.114	0.047	0.080	0.051	0.134	0.219	0.166	0.032	0.120	0.25	0.22	
6	0.211	0.029	0.137	0.021	0.047	0.141	0.091	0.195	0.198	0.074	0.160	0.10	0.23	
7	0.325	0.098	0.244	0.090	0.278	0.100	0.127	0.126	0.150	0.106	0.210	0.16	0.09	
8	0.402	0.165	0.429	0.174	0.359	0.267	0.045	0.039	0.078	0.127	0.210	0.25	0.13	
9	0.228	0.197	0.284	0.361	1.112	0.325	0.233	0.069	0.102	0.159	0.110	0.38	0.12	
10	0.110	0.079	0.185	0.345	1.262	0.224	0.167	0.230	0.192	0.042	0.030	0.18	0.13	
11	0.021	0.137	0.061	0.136	1.149	0.207	0.229	0.166	0.122	0.064	0.150	0.05	0.07	
12	0.096	0.086	0.100	0.192	0.810	0.081	0.128	0.142	0.087	0.032	0.040	0.05	0.03	
13+	0.021	-	0.047	0.183	1.076	0.041	0.182	0.472	0.368	0.095	0.070	0.28	0.19	
NK	0.604	0.609	0.047	0.371	0.062	0.300	0.173	0.023	0.034	-	-	-	-	
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	
						F E M A L E								
2	-	-	0.056	-	-	0.038	-	-	0.007	0.021	0.010	0.02	0.03	
3	0.010	0.007	0.003	0.054	0.033	0.093	0.017	0.007	0.044	0.900	0.030	0.08	0.05	
4	-	-	-	0.495	0.131	0.188	0.103	0.041	0.022	0.053	0.030	0.10	0.14	
5	0.183	0.096	0.100	0.244	0.064	0.055	0.065	0.114	0.023	0.042	0.110	0.17	0.18	
6	0.145	0.063	0.069	0.102	0.083	0.071	0.041	0.176	0.151	0.074	0.260	0.11	0.22	
7	0.217	0.121	0.197	0.636	0.318	0.144	0.021	0.034	0.172	0.095	0.180	0.08	0.16	
8	0.371	0.572	0.569	0.823	0.966	0.406	0.031	0.027	0.095	0.042	0.320	0.10	0.10	
9	0.223	0.669	0.313	0.637	1.121	0.425	0.072	0.023	0.261	0.064	0.150	0.10	0.16	
10	0.113	0.510	0.260	0.732	1.311	0.484	0.081	0.175	0.133	0.032	0.130	0.03	0.15	
11	0.110	0.419	0.275	0.457	2.214	0.240	0.159	0.147	0.081	0.085	0.090	0.06	0.05	
12	0.301	0.274	0.263	0.676	1.697	0.399	0.163	0.176	0.094	0.032	0.050	0.04	0.07	
13+	0.306	0.325	0.348	1.198	3.374	0.701	0.579	0.693	0.421	0.211	0.640	0.57	0.49	
NK	0.882	1.432	0.123	1.014	0.409	0.353	0.057	0.049	0.018	-	-	-	-	
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	

*No data.

Table 21. Stratified mean catch per tow at age (number) calculated for yellowtail from Canadian summer bottom trawl surveys in NAFO Division 4VWX, 1970-83.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982*	1983
						M A L E								
1	-	-	-	-	-	0.003	-	-	-	0.042	-	0.04		0.00
2	0.453	0.145	-	0.214	1.099	0.145	0.687	0.208	0.089	0.192	-	0.21		0.01
3	1.423	0.704	0.165	1.080	1.733	2.895	1.671	1.965	0.454	1.043	0.220	0.77		0.36
4	1.812	1.357	0.451	1.674	1.824	2.226	1.994	10.342	1.219	2.809	0.760	2.67		1.41
5	3.176	1.986	1.011	2.168	2.312	3.218	1.159	6.522	1.899	3.903	2.090	3.57		1.96
6	2.469	2.252	1.279	2.162	2.142	2.667	1.586	3.205	1.654	3.549	1.970	2.40		1.97
7	1.216	1.409	3.437	1.663	2.149	2.451	1.553	4.256	1.015	1.843	1.230	1.91		0.95
8	0.266	0.664	1.888	0.683	0.981	1.585	0.599	2.889	0.239	0.295	0.400	0.62		0.62
9	0.032	0.043	0.898	0.036	0.192	0.085	0.110	0.353	0.043	0.022	0.280	0.07		0.18
10	0.015	-	0.192	0.045	-	0.069	-	-	-	-	0.040	0.08		0.07
11	-	-	0.033	-	0.003	-	-	-	-	-	0.070	0.18		-
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	13.70	7.060	12.53		7.53
						F E M A L E								
1	-	-	-	-	0.035	0.035	-	-	-	0.020	-	0.02		0.00
2	0.326	0.151	0.007	0.197	0.860	0.542	0.095	0.086	0.031	0.054	0.100	0.42		0.01
3	0.921	0.932	0.167	0.427	1.250	2.205	1.051	1.808	0.263	0.725	0.810	1.55		0.32
4	1.646	0.974	0.460	1.189	1.362	2.789	1.659	6.349	1.114	1.445	0.900	1.36		0.86
5	3.267	1.853	0.963	1.801	2.030	1.838	1.595	4.762	1.449	3.025	2.010	2.04		1.82
6	1.624	2.452	1.264	1.968	3.018	1.794	1.572	2.294	1.477	3.979	2.190	2.19		1.84
7	0.710	1.390	2.277	1.682	2.538	2.067	1.796	2.065	1.118	2.454	1.880	1.93		1.26
8	0.383	0.263	2.250	1.311	1.513	1.271	1.316	2.086	0.444	1.075	1.230	1.03		0.69
9	0.135	0.106	1.141	0.437	0.459	0.657	0.462	0.617	0.095	0.524	0.510	0.64		0.37
10	0.048	0.059	0.361	0.095	0.039	0.100	0.231	0.095	0.014	0.048	0.260	0.12		0.10
11	-	0.023	0.107	0.037	0.022	0.007	0.002	0.031	-	0.015	0.100	-		0.01
12	0.007	-	0.026	0.017	-	0.007	0.013	-	-	-	0.020	-		0.01
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	8.491	9.048	9.209	13.128	14.587	9.806	20.210	5.999	13.26	10.030	11.31		7.29

*No data.

Table 22. Recruitment index of American plaice, based on ages 3 and 4 of the same cohort, in NAFO Division 4V, for 1970-81 (year-class 1967-79).

Year-class	Recruitment index	
	Male	Female
1967	1.4746	0.6912
1968	0.2489	0.4102
1969	0.6517	0.5039
1970	0.6564	0.7883
1971	1.1473	2.5229
1972	7.1870	3.8821
1973	1.2643	1.2642
1974	0.6443	0.1675
1975	0.1984	0.1043
1976	0.3666	0.3381
1977	1.6757	1.5826
1978	0.5595	0.6031
1979	0.7082	2.6105

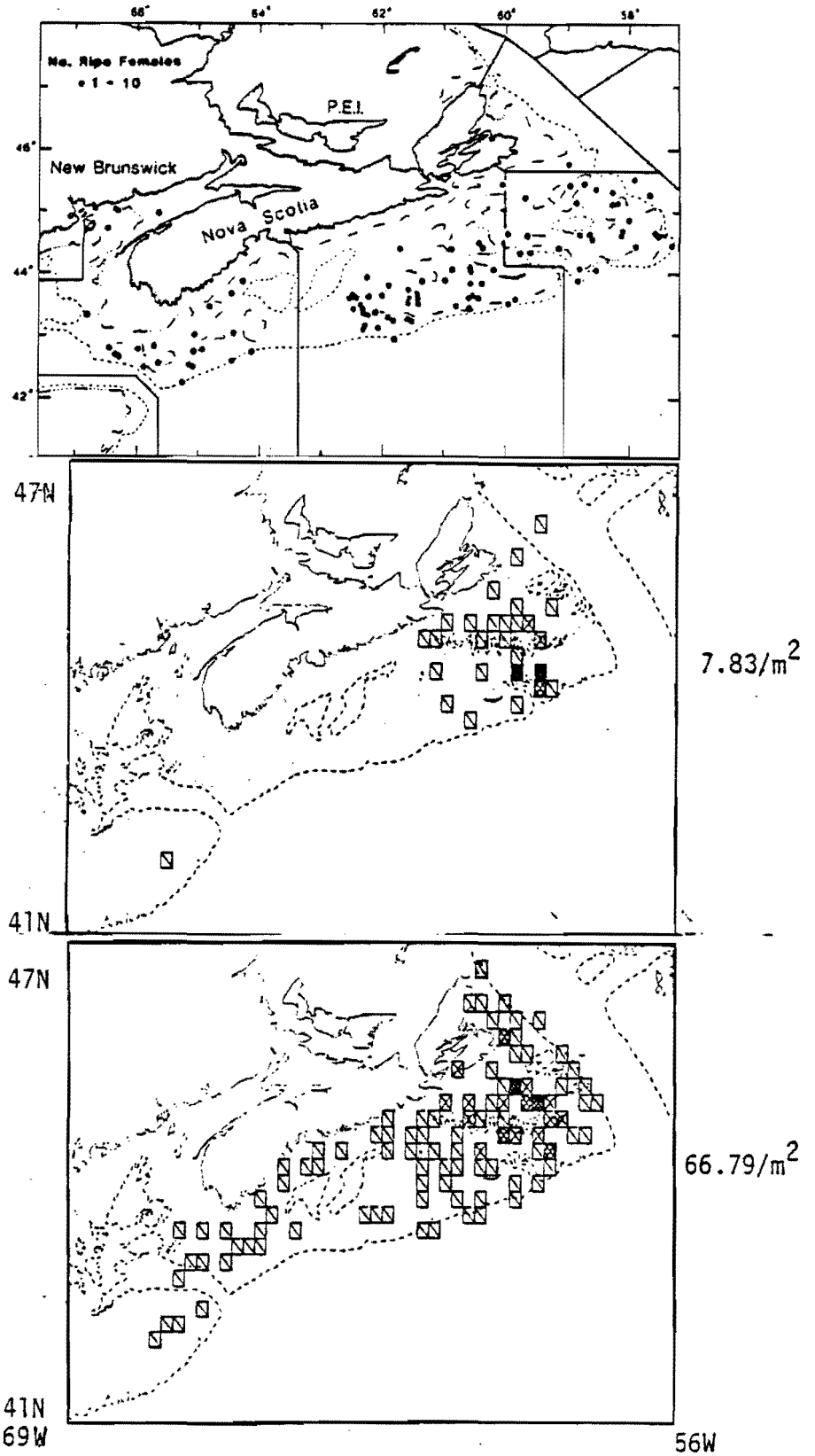

Fig. 1. Distributions of ripe female American plaice in summer groundfish cruises from 1970 to 1981 and distributions of plaice eggs from SSIP cruises conducted from 1979 to 1982. The middle plot is occurrences of eggs from January to March and the bottom plot is from April to June. Boxes are 15' latitude by 15' longitude. The degree of crosshatching corresponds to the number caught in oblique bongo tows (▨ - 1-20%, ▩ - 21-40%, etc.) expressed in 20 percentiles of the maximum number caught, shown to the right of the plot.

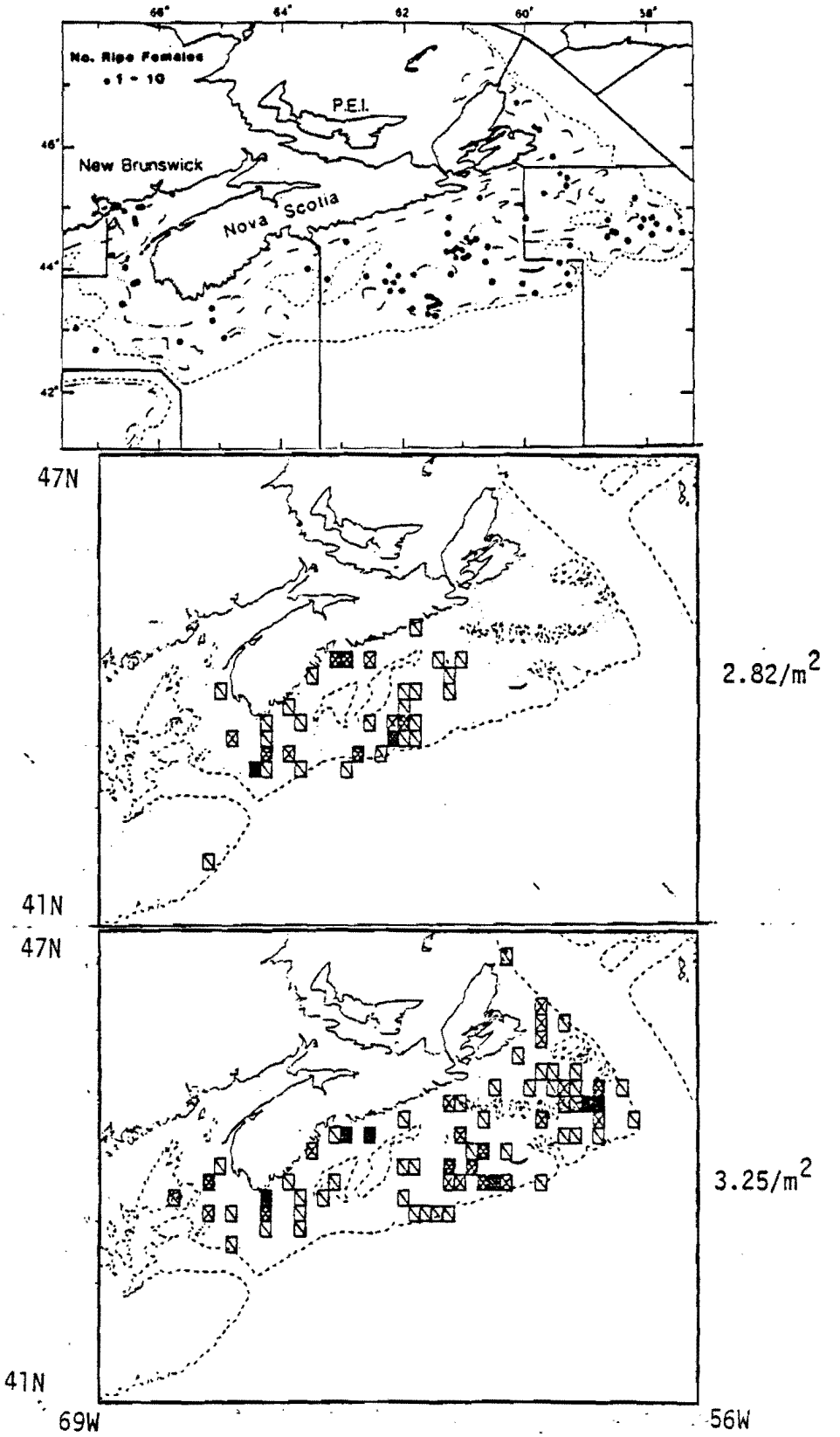

Fig. 2. Distributions of ripe female witch flounder in summer groundfish cruises from 1970 to 1981 and distributions of witch eggs from SSIP cruises conducted from 1979 to 1982. The middle plot is occurrences of eggs from April to June and the bottom plot is from July to September. Boxes are 15' latitude by 15' longitude. The degree of crosshatching corresponds to the number caught in oblique bongo tows (▨ - 1-20%, ▩ - 21-40%, etc.) expressed in 20 percentiles of the maximum number caught, shown to the right of the plot.

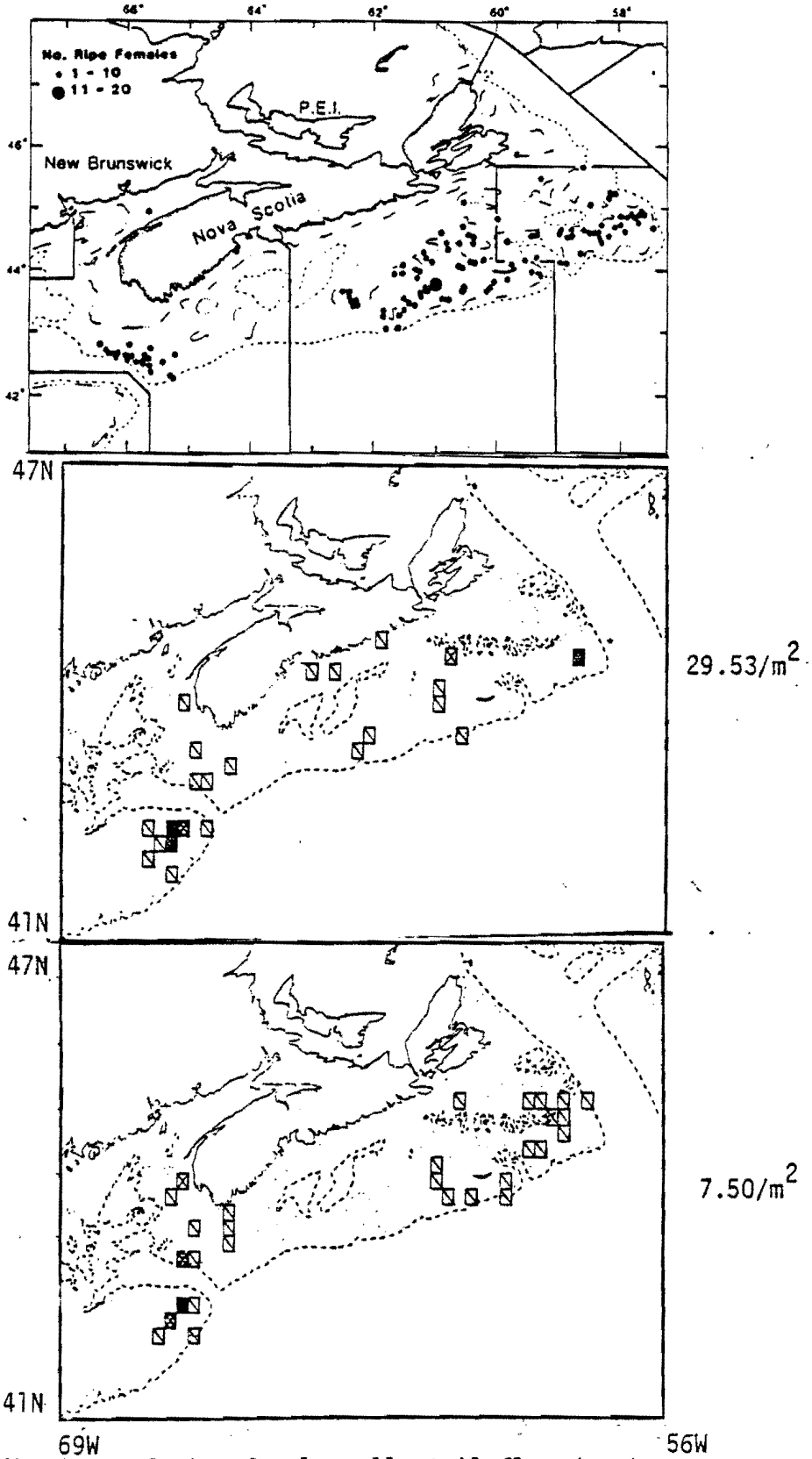

Fig. 3. Distributions of ripe female yellowtail flounder in summer groundfish cruises from 1970 to 1981 and distributions of yellowtail eggs from SSIP cruises conducted from 1979 to 1982. The middle plot is occurrences of eggs from April to June and the bottom plot is from July to September. Boxes are 15' latitude by 15' longitude. The degree of crosshatching corresponds to the number caught in oblique bongo tows (⊠ - 1-20%, ⊠ - 21-40%, etc.) expressed in 20 percentiles of the maximum number caught, shown to the right of the plot.

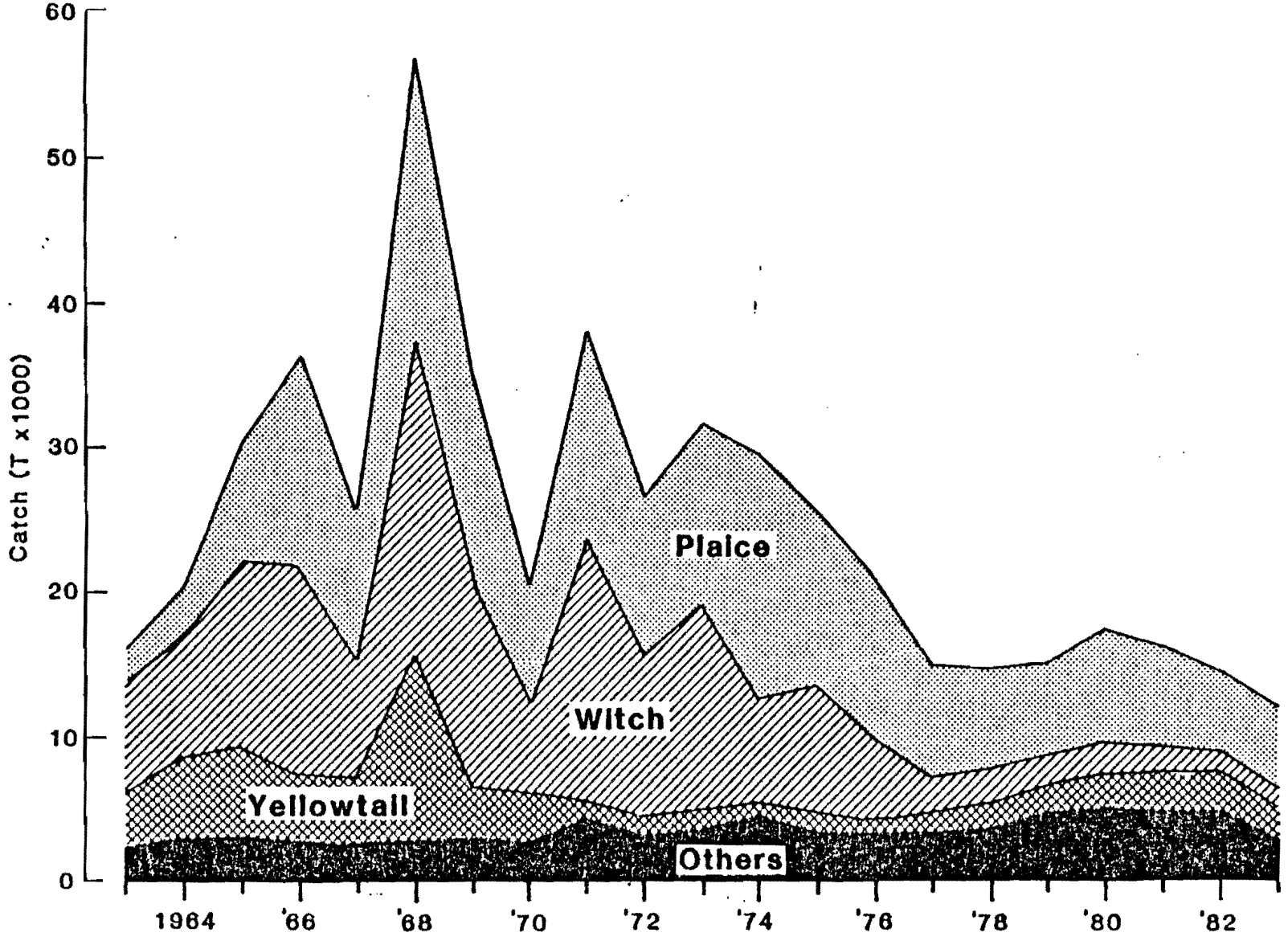

Fig. 4. Total catch of flatfish species in NAFO Divisions 4VWX, 1963-1983.

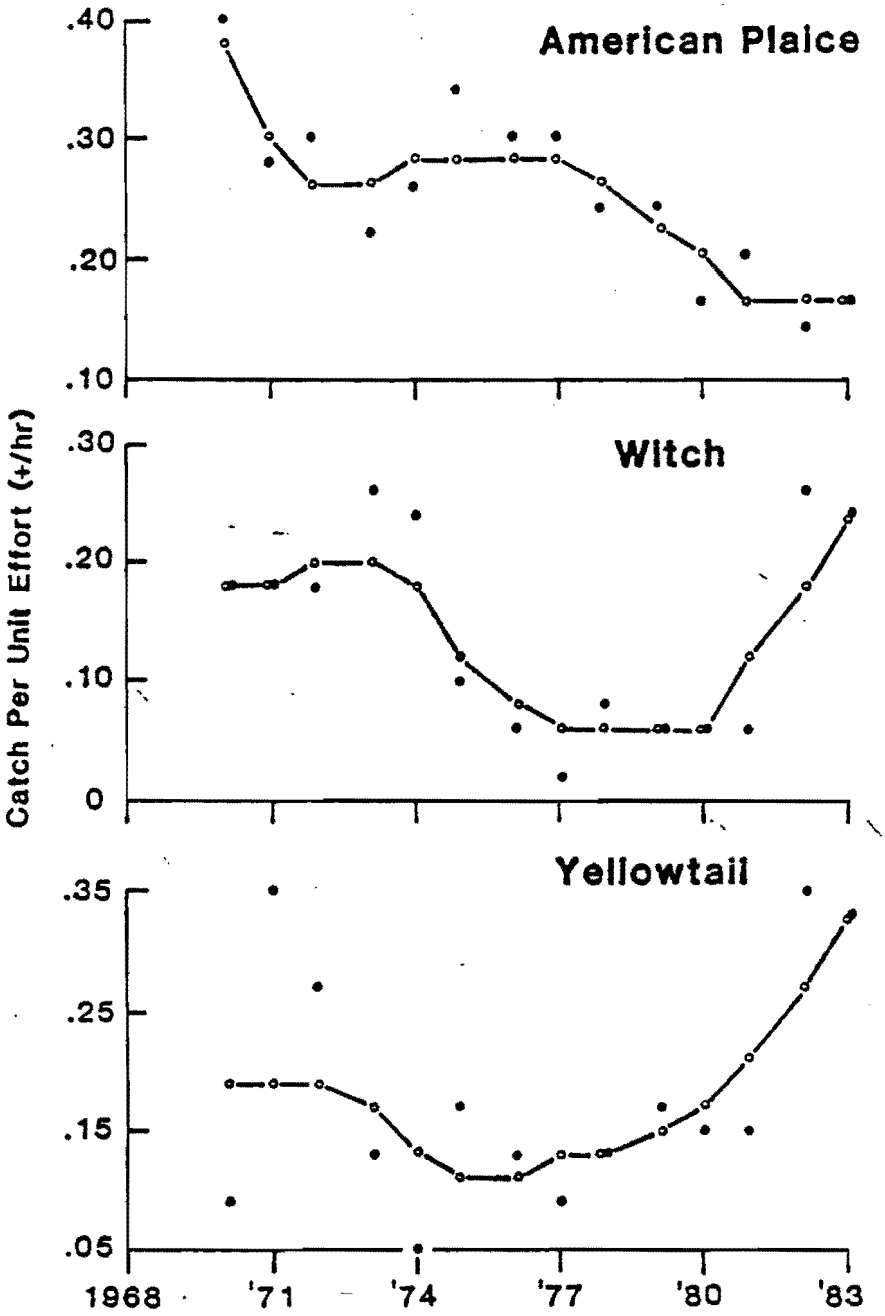

Fig. 5. Trends in catch per unit effort for 4V American plaice, 4VW witch flounder and 4VWX yellowtail flounder, 1968-1983. CPUE statistics from Canadian stern trawlers, TC4.

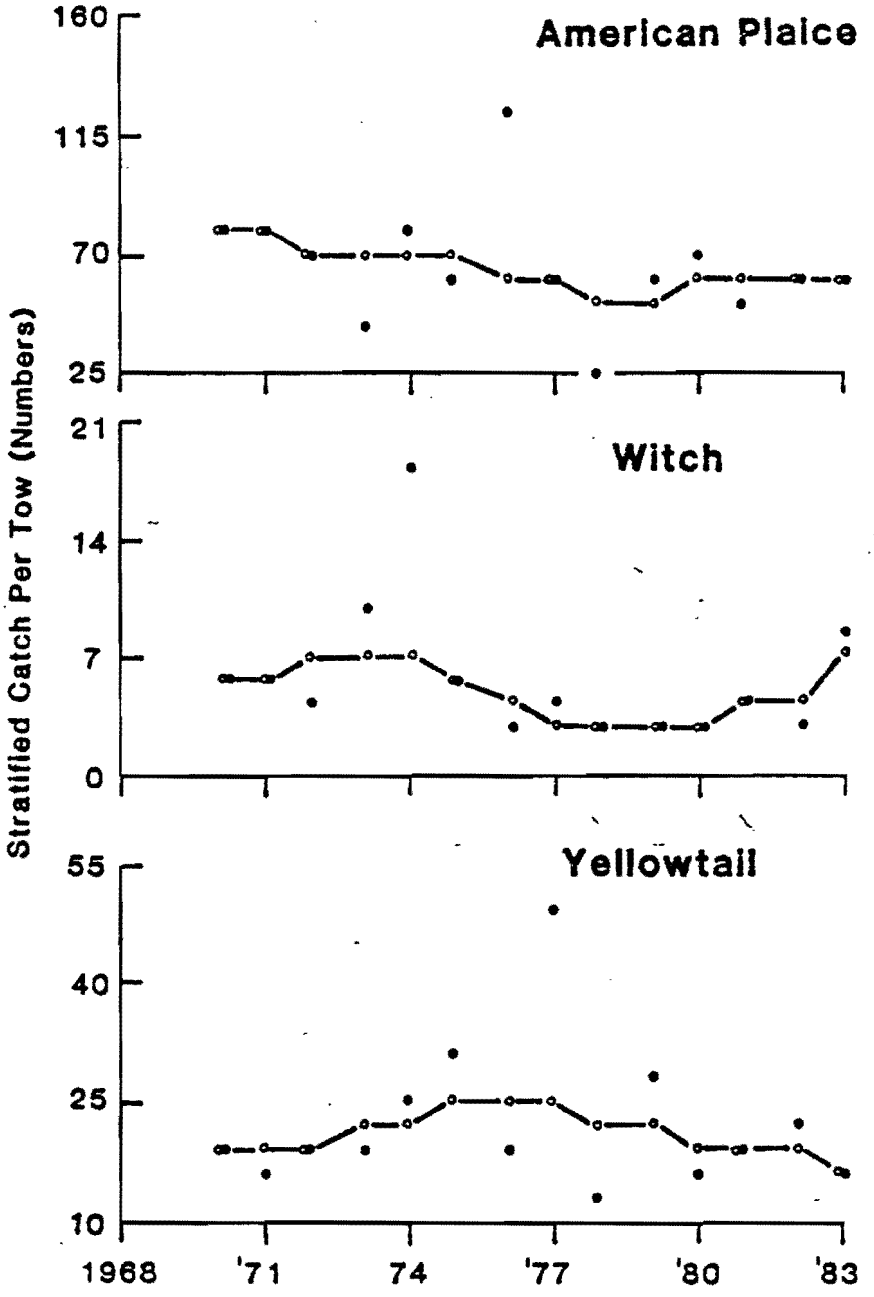

Fig. 6. Trends in stratified catch per tow (numbers caught) of flatfish in summer research cruises, 1968-83.

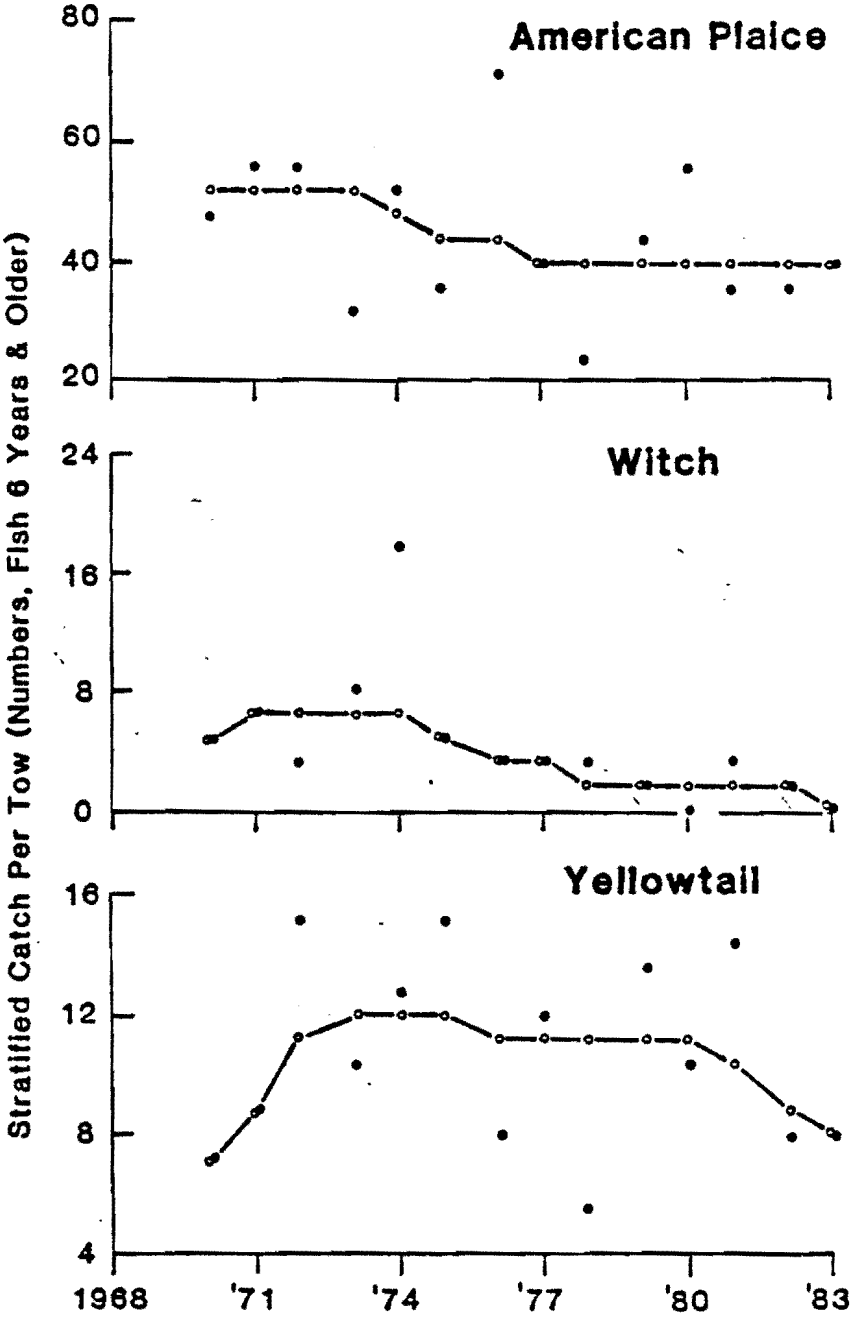

Fig. 7. Trends in stratified catch per tow (numbers caught, adults only) of flatfish in summer research cruises, 1968-1983.

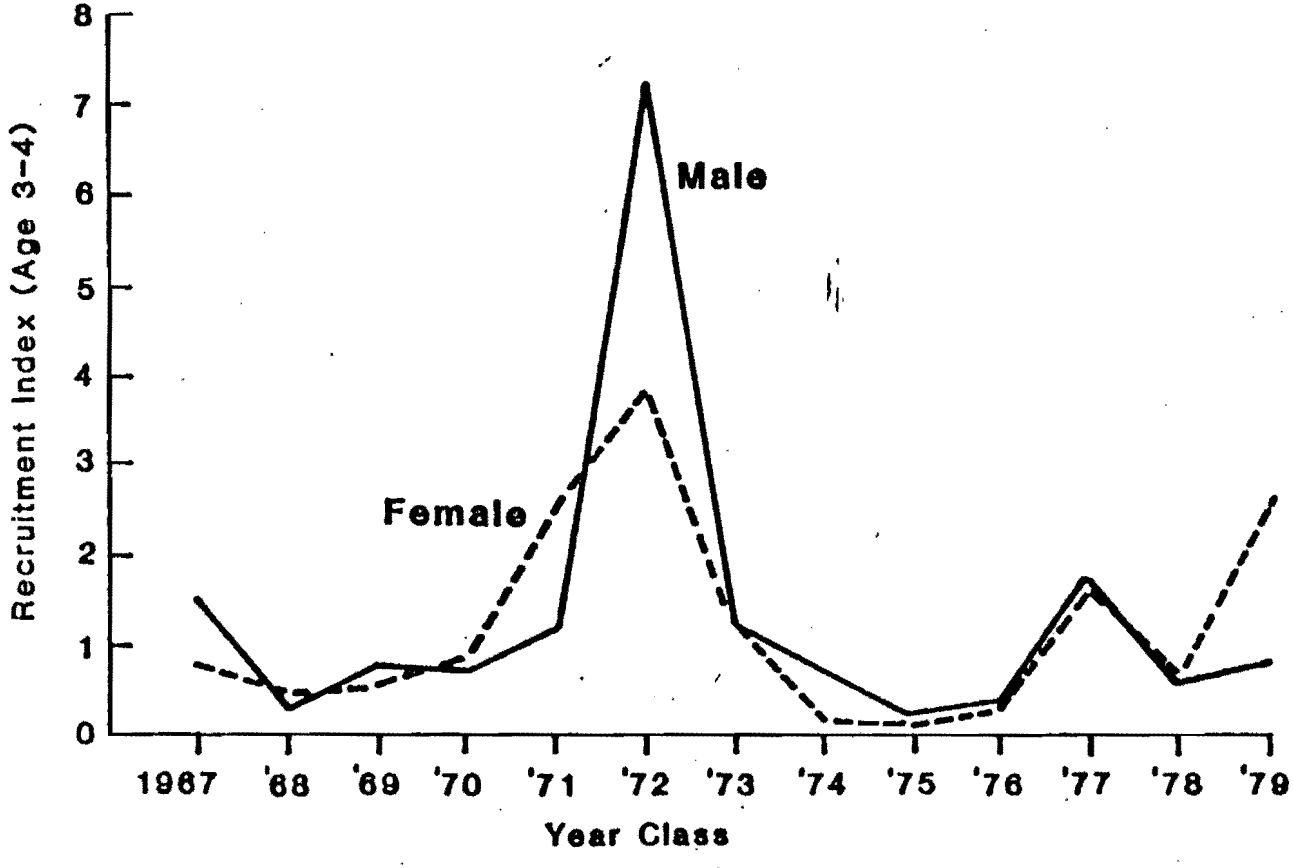

Fig. 8. Recruitment index of NAFO Division 4V American plaice, based on years 3 and 4 of the same cohort, for 1970-1982 (year-classes 1967-1979).