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AN UPDATE OF THE STATUS OF THE STOCK OF AMERICAN PLAICE IN SUBAREA 2 + DIV. 3K

by

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ABSTRACT

The stock of American plaice in NAFO Subarea 2 plus Division 3K is currently at the lowest level on record. Catches have declined to an average of less than 100 t per year during 1992-1994. Research vessel surveys indicate that the stock size is currently less than 5% of the values measured in the early 1980's. The relatively small catches from this stock cannot explain the large decline in abundance. The prospects for stock rebuilding in the short to medium term are extremely poor.

RÉSUMÉ

Le stock de plie canadienne de la sous-zone 2 et de la division 3K de l'OPANO est actuellement au plus bas niveau jamais enregistré. Les prises ont chuté pour atteindre une moyenne annuelle de moins de 100 t de 1992 à 1994. D'après les relevés de recherche, l'abondance du stock se situe actuellement à moins de 5 % des valeurs observées au début des années 1980. Les prises relativement basses dans ce stock n'expliquent pas la chute importante de l'abondance. Les possibilités de reconstitution du stock à court et moyen termes sont extrêmement faibles.

Description of the fishery

Catches increased steadily throughout the 1960's, peaking at 12,686 t in 1970 (Fig. 1). After the declaration of the 200 mile limit in 1977, catches by non-Canadian fleets were greatly reduced, with the result that the total catch from the stock exceeded 2,000 t on only 2 occasions after 1981. Catches from 1992 to 1994 averaged less than 100 t per year, and are by far the lowest in the time series. This is due to a drastic reduction in the TAC in 1994 (Fig. 1), as well as the moratorium on the northern cod fishery, which, beginning in July 1992, eliminated the by-catch of plaice in that fishery.

In most years prior to 1992, a large percentage of the catch came from Div. 3K, with recent exceptions of 1989 and 1990 when a directed fishery occurred in the autumn in Div. 2J. Catches from Div. 2GH combined have not exceeded 125 t in any year since 1972 (Table 1), and have been negligible in many years. In most years prior to 1991, the inshore catch from the stock ranged between 500 and 2,000 t. The offshore catch fluctuated widely, as it was often more economical for the offshore fleet to fish for plaice in the southern divisions of Subarea 3.

In its November 1994 report, the FRCC recommended that there be no directed catch from this stock in 1995 and that by-catches be limited to 100 t. This was similar to the advice in the previous year, which limited by-catches to a maximum of 500 t.

Available Data

1) Commercial fishery

Catch/effort

CPUE data are available from Canadian offshore otter trawlers for the period 1976-92. However, in only 2 of the last 11 years did the main species plaice catch exceed 500 t, and in many years it was negligible. Therefore these data cannot be used as an index of abundance for this stock and by-catch catch rates are not considered to be representative of stock abundance (Brodie et al., 1993).

Catch at age and mean weights at age

Catch at age data for this stock are available for the period 1984-90, based on samples from the Canadian fisheries. For many years prior to 1984, and for 1991 to 1994, sampling data are either non-existent or inadequate to calculate catch at age. In most years, ages 9-12 comprised the bulk of the commercial fishery, and there was a declining trend in the catch numbers of older individuals up to 1990 (Brodie et al., 1993).

2) Research vessel surveys

Abundance and biomass estimates

Stratified random surveys have been conducted in Div. 2G, 2H, 2J, and 3K since the late 1970's, although not annually in Div. 2GH. The trawlable biomass index in Div. 2G was relatively low in all surveys although coverage was poor in most years except 1987 and 1988. In both Div. 2G and 2H, the biomass estimates declined substantially from the late 1970's to the late 1980's (Tables 2 and 3).

In Div. 2J, where survey coverage has been virtually complete since 1981 (Table 4), the trawlable biomass index has declined drastically from estimates of about 90,000 t in 1982-83 to around 2,000 t in each year from 1992-1994 (Fig. 2). Div. 3K shows a similar pattern, with the biomass declining from a range of 25,000 to 40,000 tons between 1979 and 1987 to a level around 3,000 t in the 3 most recent surveys (Table 5, Fig. 2). The 1994 values are the lowest on record in both Div. 2J and 3K (Table 6). It should be noted that Div. 2J and 3K were restratified in 1993 to account for corrections to the depth contours on new navigational charts of these areas (Bishop, 1994). Therefore the stratum by stratum comparisons are split into 2 periods: prior to the 1993 survey, and from the 1993 survey onward (Tables 4-6), as there were changes to some stratum boundaries.

There has been a gradual reduction in the numbers of older fish caught in the surveys, consistent with the commercial fishery data. Virtually all cohorts declined at very high rates from 1990 to 1993 (Tables 7 and 8), and current estimates of spawning stock (RV survey ages 9+) are in the range of 1 to 3 percent of peak values. There has also been decreased recruitment in recent years (Fig. 3), although the decline is not as severe as the overall decline in stock abundance (Figs. 4 and 5). Mean weights at age from fish sampled during the surveys do not indicate any substantial trends (Fig. 6). Age specific data from the 1994 survey are not available at this time.

Distribution

Shifts in the depth distribution of the biomass to deeper water occurred during 1986-89 in both divisions, and were followed by rapid declines to very low levels (Fig. 7). In Div. 2J, plaice in the shallowest depth zone (101-200 m) accounted for 45 to 85 percent of the biomass in that division in the years 1977 to 1988. In 1989, this percentage dropped to less than 5, and has remained at a level less than 20 % in all subsequent surveys. This pattern is easily seen in Fig. 8, as the concentrations of plaice on Hamilton Bank and in the southwestern portion of Div. 2J, present in most surveys up to 1988, were not found in subsequent surveys. In 1989 and 1990, before the biomass declined to the current low level, plaice in Div. 2J were found to the east of Hamilton Bank, and in the Hawke Channel. Similar patterns were observed in Div. 3K, with plaice becoming less abundant in the shallower areas west of Funk Island Deep (Figs. 7 and 8).

Discussion

It is clear from the RV survey data that this stock has declined to an extremely low level in recent years. Catches in the commercial fishery, even before the moratorium on northern cod in 1992, had been decreasing, and the catch in 1991 of 500 t was then the lowest in about 30 years. Catches in the 3 years since then have not exceeded 105 t in any year, yet the biomass has remained at a very low level, and may still be declining.

With the stock size estimated from surveys in the early to mid 1980's, and the relatively low catches in the commercial fishery since then, it is evident that fishing mortality alone cannot explain the magnitude of the declines in stock size which have occurred. Using catch in year n divided by the RV biomass index in year n-1 (surveys are November-December) as a proxy for fishing mortality, reveals that during the period of greatest decline (1982/83 to 1987), this ratio did not exceed 5% in any year, and was below 2% in each year from 1981-84 (Fig. 9). In fact, the ratio never exceeded 9% and was less than 5% in 13 of the 16 years in the series. These values are substantially lower than the peak and mean values calculated for stocks of A.plaice in Div. 3LNO, and Subdiv. 3Ps. Myers (1994) examined the mortalities at age from the RV survey data, and concluded that there was high total mortality since the mid 1970's on the older ages, and that there may have been an increase in mortality during the last few years.

At present there is no explanation for the decline in this stock, or why it continues to decline with virtually no fishery in the past 3 years. It has been speculated that anomalously low water temperatures since the mid-1980's may have affected distribution and abundance, but no mechanism has been established. Predation by seals has been hypothesized as a reason for the decline, particularly by many in the fishing industry. Recent studies show that A.plaice do not constitute a major portion of seal diets in this area, although total consumption of plaice by seals is not yet available. It is unlikely that plaice migrated out of the area altogether, as no increase in abundance was observed in any other nearby plaice stocks (in fact, the adjacent stock in Div. 3LNO has declined at a similar rate). In any case, plaice are not generally known to make long range migrations. Dumping and/or misreporting are also unlikely, given that quotas on this stock throughout the 1980's were non-restrictive, and year-round markets existed for this valuable catch. Some discarding undoubtedly occurred, but at low levels relative to the total reported catches.

Prognosis

Given the current stock size estimates from surveys, there can be no optimism in the short or medium term. Even with negligible catches, the stock size has remained extremely low since 1991. The prospects for rebuilding in the longer term are unknown, although "a recovery of the fishery is unlikely before at least 10 years" (FRCC report, Nov. 1994). The 1995 TAC of 100 t is for by-catch only, with no provision for a directed fishery. Any fishery in 1996 could be detrimental to stock rebuilding.

References

Bishop, C.A. 1994. Revisions and additions to stratification schemes used during research vessel surveys in NAFO Subareas 2 and 3. NAFO SCR Doc. 94/43 (rev), Ser. No. N2413, 23 p.

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Table 1 Nominal catch by Division, American plaice in Subarea 2 plus Division 3K, 1963-94.

	2G	2H	2J	3K	Unknown	Total
1963	0	0	238	1,183		1,421
1964	0	21	1,193	1,854		3,068
1965	1	694	2,657	2,236		5,588
1966	2	102	575	2,270		2,949
1967	1	440	1,267	1,883		3,591
1968	0	32	938	4,981		5,951
1969	1	160	2,268	4,473		6,902
1970	11	103	2,128	10,444		12,686
1971	746	58	925	3,619		5,348
1972	1	196	4,818	4,106		9,121
1973	0	26	1,788	3,326		5,140
1974	0	11	938	4,671		5,620
1975	73	0	1,101	4,573		5,747
1976	24	43	645	5,395		6,107
1977	0	0	224	7,301		7,525
1978	1	49	145	3,327		3,522
1979	0	11	221	2,733		2,965
1980	0	36	142	4,862		5,040
1981	0	38	96	7,411		7,545
1982	0	108	204	1,588		1,900
1983	0	124	168	1,341		1,633
1984	0	54	92	1,029		1,175
1985	0	11	34	708		753
1986	0	4	100	2,914		3,018
1987	0	1	239	823		1,063
1988	0	50	106	797		953
1989	0	9	3,225	1,014		4,248
1990	1	1	991	816		1,809
1991	0	1	69	428		498
1992[a]	0	2	5	97		104
1993[a]					79	79
1994[a]					74	74

[a]Provisional.

Table 2. Biomass (t) of A. plaice, by stratum, from r.v. surveys in Div. 2G.

Stratum	Depth (m)	Year-trip GA 13 1978	GA 24 1979	GA 57 1981	GA 143 1987	GA 156 1988	AN 161 1991
901	201-300	459	318	310	223	220	25
902	301-400	-	-	-	0	0	-
903	401-500	-	1	0	0	0	0
904	501-750	-	-	0	0	0	-
905	751-1000	-	-	-	-	0	-
906	1001-1250	-	-	-	0	0	-
907	1251-1500	-	-	-	-	-	-
908	201-300	100	33	0	12	8	4
909	< 200	1563	272	1184	-	-	12
910	< 200	887	174	303	-	-	0
911	201-300	142	38	104	42	0	65
912	301-400	-	-	-	0	0	-
913	401-500	-	-	-	0	0	-
914	501-750	-	-	-	0	0	-
915	751-1000	-	-	-	-	0	-
916	1001-1250	-	-	-	-	0	-
917	1251-1500	-	-	-	-	-	-
918	1251-1500	-	-	-	-	-	-
919	1001-1250	-	-	-	-	0	-
920	751-1000	-	-	-	0	0	-
921	501-750	-	0	-	0	0	-
922	401-500	0	-	0	-	-	-
923	301-400	0	-	3	0	0	-
924	201-300	52	103	71	11	32	-
925	< 200	645	200	158	-	-	-
926	201-300	-	-	-	-	10	-
927	301-400	-	-	-	0	0	-
928	401-500	-	-	-	0	0	-
929	501-750	-	0	16	0	0	-
Total biomass		3848	1140	2148	288	270	107
# sets		53	59	52	54	60	27

Table 3. Biomass (t) of A. plaice, by stratum, from r.v. surveys in Div. 2H.

Stratum	Depth (m)	Year-Trip GA 13 1978	GA 24 1979	GA 57 1981	WT 52 1986	GA 143 1987	GA 156 1988	AN 161 1991
930	< 200	2908	7614	9969	5324	672	900	39
931	201-300	577	1919	86	21	289	245	3
932	301-400	-	-	-	-	1	0	2
933	401-500	-	-	-	-	-	0	0.3
934	501-750	-	0	-	0	0	0	-
935	751-1000	-	-	-	-	0	0	-
936	1001-1250	-	-	-	-	0	0	-
937	1251-1500	-	-	-	-	-	-	-
938	1251-1500	-	-	-	-	-	-	-
939	1001-1250	-	-	-	-	0	0	-
940	751-1000	-	-	-	-	0	0	-
941	501-750	-	-	-	0	0	0	-
942	401-500	-	0	0	0	0	2	3
943	201-300	235	2099	286	47	19	844	0
944	301-400	57	353	46	124	14	12	34
945	401-500	-	143	13	-	115	29	166
946	501-750	197	442	155	-	50	16	-
947	501-750	-	58	75	-	9	0	-
948	401-500	-	-	-	-	-	-	-
949	301-400	-	-	-	-	-	-	-
950	201-300	-	-	-	-	-	-	-
951	401-500	8	36	14	-	26	4	141
952	301-400	-	18	169	-	115	74	9
953	201-300	208	1320	117	-	3360	395	106
954	< 200	452	410	3614	-	286	356	24
955	201-300	93	172	10	-	33	67	9
956	< 200	027	370	1824	-	900	230	33
957	< 200	2271	475	1149	-	469	727	5
958	201-300	-	80	0	-	22	26	1
959	301-400	-	11	0	-	0	0	1
960	401-500	-	0	0	-	7	0	0.1
961	501-750	-	0	0	-	0	0	-
962	751-1000	-	-	-	-	0	0	-
963	1001-1250	-	-	-	-	0	0	-
964	1251-1500	-	-	-	-	-	-	-
Total biomass		8031	15522	17527	5516	6388	3927	577
# sets		51	75	83	20	121	118	48

Table 4. Mean weight (kg) of A. plaice per tow, per stratum from research vessel surveys in Div. 2J, 1977-92. No.sets in brackets.

Depth (m)	Stratum	Units ('000)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
101-200	201	107	52.7(2)	56.5(3)	69.4(2)	121.2(3)	71.2(5)	151.0(6)	81.0(6)	59.5(3)	41.2(6)	29.5(5)	47.6(6)	1.6(8)	0.2(8)	0.3(6)	0.1(3)	1.1(3)
201-300	202	33	45.9(2)	14.5(2)	7.0(2)	17.8(2)	18.8(2)	46.8(2)	51.5(2)	7.0(2)	7.0(2)	14.3(2)	3.6(2)	-	0.4(2)	0.1(2)	4.0(3)	2.3(3)
301-400	203	36	7.4(2)	-	-	16.0(2)	2.3(2)	0.9(3)	0.7(3)	1.5(2)	0.3(3)	17.8(2)	0.9(3)	0.9(2)	2.5(3)	6.9(2)	2.6(3)	0.9(3)
401-500	204	27	16.3(2)	-	-	-	6.9(2)	2.7(3)	9.0(3)	4.3(2)	2.9(2)	12.9(2)	4.0(2)	14.0(2)	72.5(2)	14.2(2)	7.9(3)	1.2(3)
101-200	205	137	75.3(4)	13.7(4)	51.7(2)	27.9(4)	74.9(8)	181.8(12)	67.1(8)	23.6(8)	31.5(8)	11.2(7)	9.7(10)	4.9(6)	0.5(10)	0.3(8)	0.3(2)	0.6(4)
101-200	206	194	253.3(11)	129.4(7)	31.0(8)	62.5(7)	131.0(11)	120.7(18)	213.6(14)	150.3(11)	50.8(14)	60.6(11)	27.0(14)	75.7(14)	3.3(13)	7.1(11)	4.2(6)	1.2(10)
101-200	207	169	72.6(5)	21.9(4)	30.0(5)	10.3(5)	22.3(9)	68.7(15)	33.7(10)	25.9(7)	21.6(13)	3.4(7)	12.3(11)	4.5(7)	0.2(10)	0.7(7)	0.3(2)	0.1(3)
301-400	208	34	16.9(4)	15.3(3)	25.4(2)	15.8(2)	15.0(2)	3.3(3)	3.5(2)	2.2(3)	10.1(3)	34.5(2)	4.6(2)	36.0(2)	143.2(2)	13.7(2)	8.8(3)	2.5(3)
201-300	209	121	54.1(7)	20.5(4)	21.9(5)	66.3(4)	52.0(6)	22.4(11)	15.8(7)	22.6(7)	21.4(9)	34.8(7)	36.1(8)	15.1(5)	11.6(8)	5.4(6)	1.1(7)	0.5(5)
201-300	210	58	12.8(6)	40.9(4)	18.8(2)	16.3(3)	13.4(3)	17.5(6)	272.8(2)	20.8(4)	9.1(4)	38.7(3)	2.8(4)	22.8(3)	14.0(4)	10.3(3)	1.7(7)	0.7(7)
301-400	211	25	8.9(2)	24.7(2)	28.6(2)	44.4(3)	1.6(2)	2.5(2)	7.5(2)	2.3(2)	10.0(3)	8.5(2)	3.4(2)	29.5(2)	10.4(2)	30.0(2)	5.2(5)	1.6(6)
501-750	212	50	2.2(4)	-	-	-	0.3(2)	0.1(5)	0.1(3)	0.1(3)	0.3(4)	6.7(3)	1.6(4)	30.5(2)	0.9(4)	18.1(3)	24.6(2)	3.5(2)
201-300	213	129	61.8(8)	48.4(4)	17.9(4)	100.2(5)	43.1(6)	45.5(10)	37.1(10)	12.0(5)	56.1(9)	52.2(9)	14.3(9)	51.3(8)	38.7(9)	48.6(8)	6.8(14)	3.2(19)
201-300	214	88	23.6(6)	26.6(4)	11.7(4)	11.5(3)	13.1(5)	4.0(8)	36.4(8)	39.6(4)	79.6(6)	2.7(6)	2.3(6)	17.3(6)	148.9(6)	10.9(5)	4.9(15)	2.6(14)
201-300	215	95	27.8(4)	59.0(5)	26.8(4)	4.0(2)	12.0(5)	4.1(9)	11.6(8)	1.5(3)	3.8(6)	3.3(5)	2.0(7)	4.5(7)	1.6(6)	4.7(6)	2.1(15)	1.8(10)
301-400	216	29	0.6(2)	-	2.0(2)	0.2(2)	0.5(2)	0.5(2)	0.0(3)	1.3(2)	0.3(2)	0.3(2)	1.2(2)	0.0(2)	2.0(2)	1.0(2)	0.7(3)	0.7(3)
401-500	217	20	0.2(3)	-	-	-	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.7(2)	0.0(2)	0.0(2)	1.8(2)	2.5(3)	1.1(3)
501-750	218	32	0.0(2)	-	-	-	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.6(2)	2.6(2)	2.2(2)	0.6(2)
751-1000	219	16	-	-	-	-	0.0(2)	-	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.9(2)	0.0(2)	0.6(2)	1.3(2)
301-400	222	33	3.2(4)	2.7(3)	4.1(2)	8.0(2)	0.4(2)	2.3(3)	0.0(3)	0.2(3)	0.5(2)	0.0(2)	0.2(2)	0.1(2)	1.3(2)	3.4(2)	8.2(3)	2.6(3)
401-500	223	14	0.0(2)	-	-	-	0.1(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.5(2)	0.3(2)	2.0(2)	6.5(3)	1.7(3)
501-750	224	20	0.0(2)	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.2(2)	1.4(2)	0.1(2)	7.6(2)	5.0(2)
1001-125	225	13	0.0(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401-500	227	51	0.6(4)	-	-	-	0.2(2)	1.0(5)	0.3(4)	0.0(3)	0.1(4)	0.4(3)	0.7(4)	0.2(3)	7.5(4)	2.4(2)	4.9(6)	1.1(6)
201-300	228	107	21.9(8)	-	8.3(4)	6.2(3)	8.8(6)	3.9(10)	4.5(6)	5.0(7)	9.1(7)	28.8(6)	13.3(7)	2.7(5)	6.2(8)	4.5(6)	4.1(3)	0.4(5)
301-400	229	43	7.0(4)	0.5(2)	1.6(2)	1.5(2)	0.1(2)	0.9(4)	1.3(4)	0.2(3)	0.1(3)	1.0(3)	0.4(3)	0.0(3)	2.3(3)	0.8(2)	1.8(3)	1.0(3)
501-750	230	18	0.0(3)	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.3(2)	0.0(2)	3.4(2)	0.0(2)	8.3(2)	0.0(2)
751-1000	231	14	0.0(2)	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.8(2)	0.0(2)	0.1(2)	0.2(2)
1001-125	232	18	0.0(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201-300	234	38	23.6(2)	9.8(2)	6.4(2)	32.8(2)	5.0(2)	3.5(3)	14.5(3)	14.7(2)	1.7(3)	3.3(2)	1.9(3)	1.5(2)	-	0.3(2)	1.2(3)	0.2(3)
401-500	235	32	14.3(4)	-	-	-	16.8(2)	1.3(3)	2.3(2)	1.2(3)	0.0(2)	8.0(2)	0.9(2)	20.8(2)	7.5(2)	64.2(2)	5.0(3)	2.7(3)
751-1000	236	9	0.0(2)	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.2(2)	0.0(2)	0.0(2)	-	0.2(2)	3.0(2)	10.8(2)

Table 5. Mean weight (kg) of A. plaice per tow, per stratum from research vessel surveys in Div. 3K, 1977-92. No. sets in brackets.

Depth (m)	Stratum	Units ('000)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
101-200	618	109	-	-	-	-	-	-	23.3(5)	25.5(6)	3.2(5)	2.8(7)	0.3(6)	0.1(8)	0.3(4)	0.0(5)	0.0(3)
101-200	619	119	-	-	-	-	-	-	10.7(7)	4.3(7)	0.8(5)	0.5(8)	0.3(7)	0.1(8)	0.1(5)	0.1(4)	0.0(3)
201-300	620	203	112.9(7)	29.5(7)	50.2(9)	33.5(10)	37.9(9)	38.4(10)	51.9(13)	21.8(14)	24.7(9)	19.9(14)	1.9(12)	1.2(15)	0.5(9)	0.3(14)	0.2(3)
201-300	621	215	92.8(7)	64.3(8)	21.0(10)	66.0(11)	29.4(14)	39.7(12)	41.7(14)	39.8(15)	10.3(14)	12.4(12)	4.5(10)	2.3(17)	0.5(11)	0.3(5)	1.6(3)
401-500	622	47	-	-	-	9.5(2)	16.2(3)	8.3(2)	9.4(4)	1.2(4)	28.0(2)	6.1(3)	22.7(3)	29.0(3)	10.2(2)	8.2(3)	3.6(3)
301-400	623	77	50.4(3)	16.0(3)	88.4(4)	50.2(4)	15.0(5)	23.3(6)	18.7(5)	3.3(6)	23.6(4)	19.6(5)	14.6(5)	11.8(6)	5.2(5)	2.3(6)	4.2(3)
201-300	624	50	18.3(3)	11.3(2)	5.0(2)	25.3(2)	17.0(4)	13.9(4)	17.6(4)	16.1(4)	9.0(2)	17.8(4)	5.8(3)	2.3(3)	2.6(4)	2.8(2)	1.2(3)
301-400	625	64	12.3(3)	7.7(3)	5.3(4)	9.9(4)	7.3(2)	16.8(3)	10.3(5)	11.6(5)	12.7(3)	8.6(3)	8.2(4)	11.0(4)	1.4(4)	1.9(3)	0.2(3)
301-400	626	69	7.2(4)	21.2(3)	40.5(3)	58.4(5)	20.3(5)	31.8(4)	38.5(6)	17.3(5)	85.8(4)	23.6(5)	16.5(5)	18.9(5)	1.5(4)	4.3(3)	4.1(3)
401-500	627	89	-	-	-	14.6(6)	6.1(7)	6.2(6)	12.5(8)	11.4(7)	41.7(5)	20.2(6)	31.2(5)	41.5(6)	24.8(5)	2.8(3)	2.1(3)
301-400	628	81	5.6(5)	22.2(2)	6.6(4)	3.9(6)	2.3(6)	16.3(6)	17.0(7)	11.8(6)	7.9(4)	13.8(5)	11.5(5)	7.5(4)	2.1(5)	3.4(3)	1.9(3)
301-400	629	37	6.8(3)	6.6(2)	8.0(3)	7.5(3)	3.3(2)	8.8(3)	5.3(4)	4.5(4)	16.9(3)	11.3(3)	10.4(2)	7.5(3)	4.3(2)	2.0(4)	1.2(3)
301-400	630	41	-	5.4(2)	24.9(2)	8.5(2)	-	4.3(2)	4.9(3)	3.6(4)	3.4(2)	4.7(3)	2.6(3)	5.7(3)	2.3(2)	2.9(3)	0.3(3)
401-500	631	90	-	-	-	7.4(5)	4.0(2)	3.8(5)	6.9(5)	7.9(7)	24.8(4)	20.8(6)	15.9(6)	23.5(7)	8.4(6)	12.9(6)	1.1(3)
201-300	632	34	9.2(3)	14.1(2)	6.4(2)	8.5(2)	5.3(3)	10.2(3)	-	5.3(3)	3.5(2)	2.5(2)	15.0(2)	1.6(2)	3.0(2)	1.0(10)	0.4(13)
301-400	633	164	5.9(5)	4.8(6)	2.3(7)	2.6(8)	3.2(7)	2.4(12)	1.7(10)	1.3(12)	14.3(8)	2.4(11)	6.3(8)	5.9(10)	2.9(11)	2.0(25)	0.6(25)
201-300	634	121	5.5(5)	4.3(6)	4.6(5)	6.5(7)	5.3(11)	2.4(5)	4.5(7)	2.2(9)	3.8(5)	4.1(11)	6.7(6)	5.2(7)	0.6(7)	1.8(25)	0.3(25)
201-300	635	96	10.5(5)	7.5(5)	13.8(4)	13.2(5)	16.8(5)	26.5(6)	18.8(8)	4.9(7)	7.5(6)	5.7(6)	6.1(5)	4.0(7)	0.7(6)	0.8(4)	0.2(3)
201-300	636	109	14.2(3)	7.0(5)	4.7(5)	4.4(6)	8.3(10)	11.4(6)	14.4(8)	6.5(8)	4.7(4)	8.1(7)	8.2(6)	5.3(5)	1.4(7)	1.3(3)	0.8(3)
201-300	637	85	7.5(4)	7.0(4)	7.3(4)	9.0(6)	16.9(7)	9.5(5)	15.6(6)	4.1(7)	7.0(4)	13.6(6)	9.7(8)	7.1(5)	1.5(5)	0.4(6)	1.3(3)
301-400	638	155	11.8(5)	10.1(7)	10.0(6)	12.1(8)	5.6(15)	8.0(11)	5.9(10)	12.3(11)	13.9(4)	16.6(10)	10.5(8)	7.5(11)	8.8(9)	9.0(25)	3.6(25)
301-400	639	110	6.4(5)	1.0(2)	5.2(4)	2.1(6)	3.9(10)	1.0(7)	6.0(8)	1.4(8)	5.8(6)	2.9(7)	4.5(6)	2.6(8)	2.3(7)	4.4(3)	0.6(25)
401-500	640	15	-	-	-	0.0(2)	0.0(2)	-	0.0(2)	0.3(3)	4.1(2)	3.2(2)	2.3(2)	10.6(2)	5.0(2)	1.5(3)	4.1(3)
501-750	641	44	-	-	-	0.0(2)	0.0(4)	0.0(3)	0.0(3)	0.3(4)	-	1.1(3)	-	-	16.2(2)	1.6(2)	0.2(2)
751-1000	642	70	-	-	-	0.0(3)	0.0(6)	-	0.0(6)	0.0(5)	-	0.1(5)	-	-	5.0(3)	4.3(2)	4.5(2)
1001-1250	643	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1251-1500	644	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401-500	645	15	-	-	-	0.0(2)	0.0(3)	0.1(2)	0.0(2)	0.1(3)	-	1.5(2)	0.9(2)	2.9(2)	5.6(2)	0.5(3)	0.3(3)
501-750	646	25	-	-	-	0.0(2)	0.0(2)	0.3(2)	0.0(2)	0.0(3)	-	0.0(2)	-	-	0.8(2)	0.8(3)	0.2(3)
751-1000	647	31	-	-	-	0.0(2)	0.0(2)	-	-	0.0(3)	-	-	-	-	0.5(2)	0.5(3)	0.4(3)
1001-1250	648	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1251-1500	649	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6 . Average weight (kg) per 30-minute set of A. plaice from the autumn survey of the GADUS ATLANTICA in Div. 2J and 3K during 1993-94. Based on the new stratification system.

Depth Range (m)	2J Stratum	Area (sq. nm)	Trawlable Units (000)	1993	1994
101-200	205	1594	120	0.28(7)	0.21(3)
	206	1870	140	1.62(8)	0.31(2)
	207	2264	170	0.39(6)	0.00(3)
	237	733	55	0.28(2)	0.00(2)
	238	778	58	-	0.00(2)
201-300	202	621	47	0.60(2)	0.20(3)
	209	680	51	1.55(3)	0.12(2)
	210	1035	78	0.75(4)	0.15(6)
	213	1583	119	2.47(6)	1.02(3)
	214	1341	101	1.86(5)	0.59(6)
	215	1302	98	1.99(5)	1.10(5)
	228	2196	165	1.29(9)	1.57(3)
	234	530	40	0.17(2)	0.10(3)
301-400	203	487	37	0.57(2)	1.70(2)
	208	588	44	1.41(2)	1.95(3)
	211	251	19	2.21(2)	0.22(3)
	216	360	27	0.59(2)	0.90(2)
	222	450	34	1.18(2)	0.64(3)
	229	536	40	0.00(2)	0.95(3)
401-500	204	288	22	3.99(2)	2.15(3)
	217	241	18	0.03(2)	1.73(3)
	223	158	12	0.98(2)	0.91(3)
	227	598	45	0.63(3)	0.47(5)
	235	414	31	2.57(3)	5.83(3)
	240	133	10	0.00(2)	0.12(3)
501-750	212	557	42	4.50(2)	4.15(3)
	218	362	27	0.31(2)	2.13(2)
	224	228	17	0.13(2)	1.29(3)
	230	185	14	0.00(2)	0.37(3)
	239	120	9	6.65(2)	9.30(3)
751-1000	219	283	21	0.30(2)	0.18(2)
	231	186	14	0.00(2)	0.11(3)
	236	193	14	0.29(2)	0.00(3)
1001-1250	220	303	23	-	-
	225	195	15	-	-
	232	228	17	-	-
1251-1500	221	330	25	-	-
	226	201	15	-	-
	233	237	18	-	-

Depth Range(m)	3K Stratum	Area (sq. nm.)	Trawlable Units ('000)	1993	1994
101-200	618	1347	101	0.00(3)	0.00(7)
	619	1753	132	0.00(2)	0.00(2)
201-300	620	2545	191	0.36(3)	0.39(5)
	621	2736	205	2.26(3)	0.38(3)
	624	1105	83	0.26(7)	0.33(3)
	634	1555	117	0.53(16)	0.25(4)
	635	1274	96	0.37(3)	0.02(4)
	636	1455	109	0.58(3)	0.01(3)
	637	1132	85	1.66(3)	0.25(14)
301-400	617	593	45	3.52(3)	1.24(4)
	623	494	37	0.66(4)	3.89(3)
	625	888	67	0.56(3)	0.61(3)
	626	1113	84	1.99(3)	4.90(3)
	628	1085	81	1.78(3)	3.28(6)
	629	495	37	2.07(3)	0.67(4)
	630	332	25	0.76(3)	0.27(3)
	633	2067	155	0.52(18)	0.42(5)
	638	2059	155	2.18(20)	1.26(21)
	639	1463	110	1.22(15)	0.98(8)
401-500	622	691	52	2.44(4)	2.68(5)
	627	1255	94	7.03(3)	2.10(8)
	631	1321	99	1.35(3)	1.90(4)
	640	69	5	1.01(3)	1.07(3)
	645	216	16	0.24(3)	1.24(3)
	650	134	10	1.09(3)	0.52(4)
501-750	641	230	17	1.15(3)	0.60(3)
	646	325	24	0.22(3)	0.55(3)
	651	359	27	0.52(3)	1.73(4)
751-1000	642	418	31	2.00(3)	1.38(3)
	647	360	27	0.00(3)	0.50(3)
	652	516	39	5.42(3)	1.51(4)
1001-1250	643	733	55	-	-
	648	228	17	-	-
	653	531	40	1.98(3)	-
1251-1500	644	474	36	-	-
	649	212	16	-	-
	654	479	36	-	-

TABLE 7. MEAN NO./TOW FROM RV SURVEYS IN 2J.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00
3	0.00	0.02	0.00	0.00	0.01	0.12	0.04	0.00	0.04	0.08	0.06	0.00	0.07	0.04	0.06	0.01	0.00
4	0.15	0.42	0.24	0.05	0.59	0.27	0.61	0.25	0.12	0.19	0.32	0.14	0.36	0.16	0.19	0.08	0.21
5	6.45	3.90	1.67	0.50	2.48	2.72	1.34	0.97	1.20	0.98	0.48	0.99	1.74	0.64	1.04	0.41	0.64
6	13.26	11.85	7.17	4.14	15.39	7.63	7.37	3.33	4.72	3.75	3.31	2.83	5.90	3.16	2.39	1.11	1.46
7	26.07	18.06	12.90	21.00	21.17	23.30	22.94	11.67	11.08	9.03	4.80	5.10	6.01	5.27	2.72	1.59	1.13
8	36.56	15.16	13.38	16.55	16.69	27.03	29.48	16.85	13.89	9.85	5.85	7.86	7.80	4.30	2.71	1.09	0.88
9	20.86	11.53	8.08	10.00	6.48	27.23	17.00	13.52	12.60	9.55	4.46	7.40	7.41	4.26	1.29	0.52	0.26
10	9.64	7.30	4.47	6.64	4.35	12.03	12.20	5.79	4.35	4.13	3.15	4.49	3.10	3.17	0.48	0.23	0.16
11	6.14	4.10	2.02	3.68	1.56	4.80	6.28	3.00	1.63	1.05	0.89	1.59	1.87	0.94	0.23	0.10	0.03
12	4.24	3.29	2.69	3.37	0.63	2.95	1.79	0.98	1.02	0.83	0.55	0.57	0.75	0.59	0.08	0.06	0.00
13	2.80	2.76	1.60	1.50	0.05	1.80	1.16	0.82	0.50	0.33	0.20	0.23	0.17	0.20	0.03	0.01	0.00
14	1.59	1.27	0.47	0.89	0.00	0.80	0.30	0.15	0.08	0.07	0.05	0.02	0.03	0.02	0.00	0.00	0.00
15	0.66	0.91	0.12	0.26	0.00	0.16	0.11	0.06	0.00	0.03	0.01	0.00	0.04	0.01	0.00	0.00	0.00
16	0.00	0.43	0.05	0.11	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
17	0.00	0.15	0.00	0.04	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1+	128.42	81.17	54.86	68.75	69.41	110.94	100.63	57.39	51.24	39.87	24.14	31.22	35.27	22.78	11.22	5.21	4.77
2+	128.42	81.17	54.86	68.75	69.41	110.94	100.63	57.39	51.24	39.87	24.14	31.22	35.27	22.78	11.22	5.21	4.77
3+	128.42	81.17	54.86	68.75	69.40	110.93	100.63	57.39	51.23	39.87	24.13	31.22	35.25	22.78	11.22	5.21	4.77
4+	128.42	81.15	54.86	68.75	69.39	110.81	100.59	57.39	51.19	39.79	24.07	31.22	35.18	22.74	11.16	5.20	4.77
5+	128.27	80.73	54.62	68.70	68.80	110.54	99.98	57.14	51.07	39.60	23.75	31.08	34.82	22.58	10.97	5.12	4.56
6+	121.82	76.83	52.95	68.20	66.32	107.82	98.64	56.17	49.87	38.62	23.27	30.09	33.08	21.94	9.93	4.71	3.92
7+	108.56	64.98	45.78	64.06	50.93	100.19	91.27	52.84	45.15	34.87	19.96	27.26	27.18	18.78	7.54	3.60	2.46
8+	82.49	46.92	32.88	43.06	29.76	76.89	68.33	41.17	34.07	25.84	15.16	22.16	21.17	13.51	4.82	2.01	1.33
9+	45.93	31.76	19.50	26.51	13.07	49.86	38.85	24.32	20.18	15.99	9.31	14.30	13.37	9.21	2.11	0.92	0.45
10+	25.07	20.23	11.42	16.51	6.59	22.63	21.85	10.80	7.58	6.44	4.85	6.90	5.96	4.95	0.82	0.40	0.19
11+	15.43	12.93	6.95	9.87	2.24	10.60	9.65	5.01	3.23	2.31	1.70	2.41	2.86	1.78	0.34	0.17	0.03
12+	9.29	8.83	4.93	6.19	0.68	5.80	3.37	2.01	1.60	1.26	0.81	0.82	0.99	0.84	0.11	0.07	0.00

TABLE 8. MEAN NO./TOW FROM RV SURVEYS IN 3K.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.00
2	0.00	0.00	0.01	0.00	0.02	0.01	0.06	0.16	0.08	0.03	0.16	0.07	0.00	0.01	0.00	0.00
3	0.19	0.01	0.07	0.12	0.24	0.44	0.14	0.19	1.21	0.39	0.32	0.47	0.09	0.02	0.06	0.24
4	3.20	0.32	0.10	0.18	0.43	0.61	1.44	0.60	1.79	1.96	0.80	0.96	0.34	0.45	0.13	0.54
5	8.19	1.87	0.97	0.85	0.93	2.28	2.02	1.74	2.14	2.18	3.36	1.51	0.88	1.08	0.53	1.29
6	12.05	4.10	3.28	1.82	2.29	4.19	5.76	2.52	4.05	3.47	2.87	4.07	1.54	1.69	0.98	1.95
7	10.83	5.58	8.43	6.37	4.46	7.26	5.95	4.66	4.25	3.90	2.92	3.81	2.39	1.87	1.29	0.96
8	8.01	6.08	5.93	9.08	5.97	7.46	10.57	5.21	5.35	3.99	3.08	2.42	1.80	1.28	0.85	0.71
9	6.89	4.95	4.33	5.23	4.88	3.07	5.91	4.08	4.68	3.59	2.41	2.90	1.40	1.12	0.59	0.29
10	5.76	3.60	3.67	5.60	2.54	2.38	2.85	2.04	2.37	1.38	1.31	1.56	0.74	0.55	0.30	0.20
11	3.45	1.68	2.14	1.75	1.69	0.87	1.72	0.91	0.99	0.66	0.56	0.79	0.42	0.15	0.09	0.08
12	2.96	2.14	1.71	2.36	0.82	0.91	1.18	0.97	0.79	0.43	0.29	0.53	0.19	0.10	0.04	0.02
13	2.57	1.07	0.84	1.13	0.67	0.43	0.57	0.48	0.37	0.16	0.15	0.21	0.14	0.04	0.02	0.00
14	1.33	0.35	0.54	0.48	0.33	0.23	0.25	0.10	0.15	0.11	0.10	0.08	0.01	0.03	0.01	0.00
15	1.04	0.14	0.21	0.29	0.17	0.09	0.17	0.07	0.04	0.07	0.02	0.04	0.02	0.00	0.00	0.00
16	0.53	0.12	0.08	0.20	0.05	0.02	0.04	0.03	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00
17	0.20	0.01	0.04	0.00	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.06	0.02	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1+	67.27	32.05	32.37	35.49	25.54	30.25	38.66	23.76	28.28	22.37	18.36	19.43	9.97	8.39	4.89	6.28
2+	67.27	32.04	32.37	35.49	25.54	30.25	38.65	23.76	28.26	22.35	18.35	19.43	9.96	8.39	4.89	6.28
3+	67.27	32.04	32.36	35.49	25.52	30.24	38.59	23.60	28.18	22.32	18.19	19.36	9.96	8.38	4.89	6.28
4+	67.08	32.03	32.29	35.37	25.28	29.80	38.45	23.41	26.97	21.93	17.87	18.89	9.87	8.36	4.83	6.04
5+	63.88	31.71	32.19	35.19	24.85	29.19	37.01	22.81	25.18	19.97	17.07	17.93	9.53	7.91	4.70	5.50
6+	55.69	29.84	31.22	34.34	23.92	26.91	34.99	21.07	23.04	17.79	13.71	16.42	8.65	6.83	4.17	4.21
7+	43.64	25.74	27.94	32.52	21.63	22.72	29.23	18.55	18.99	14.32	10.84	12.35	7.11	5.14	3.19	2.26
8+	32.81	20.16	19.51	26.15	17.17	15.46	23.28	13.89	14.74	10.42	7.92	8.54	4.72	3.27	1.90	1.30
9+	24.80	14.08	13.58	17.07	11.20	8.00	12.71	8.68	9.39	6.43	4.84	6.12	2.92	1.99	1.05	0.59
10+	17.91	9.13	9.25	11.84	6.32	4.93	6.80	4.60	4.71	2.84	2.43	3.22	1.52	0.87	0.46	0.30
11+	12.15	5.53	5.58	6.24	3.78	2.55	3.95	2.56	2.34	1.46	1.12	1.66	0.78	0.32	0.16	0.10
12+	8.70	3.85	3.44	4.49	2.09	1.68	2.23	1.65	1.35	0.80	0.56	0.87	0.36	0.17	0.07	0.02

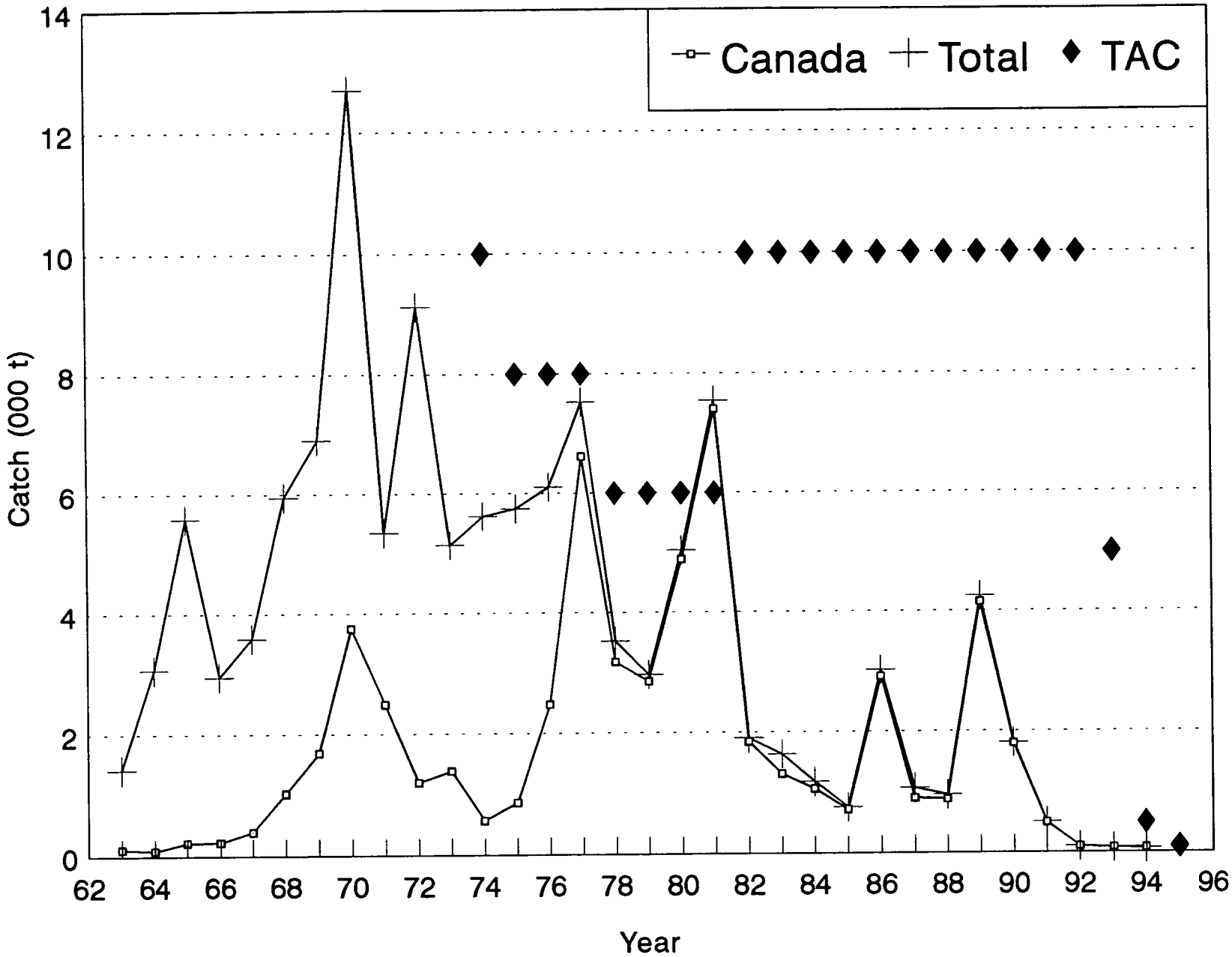

Fig.1. Catches and TAC's (000t) of A. plaice in NAFO SA 2 + Div. 3K.

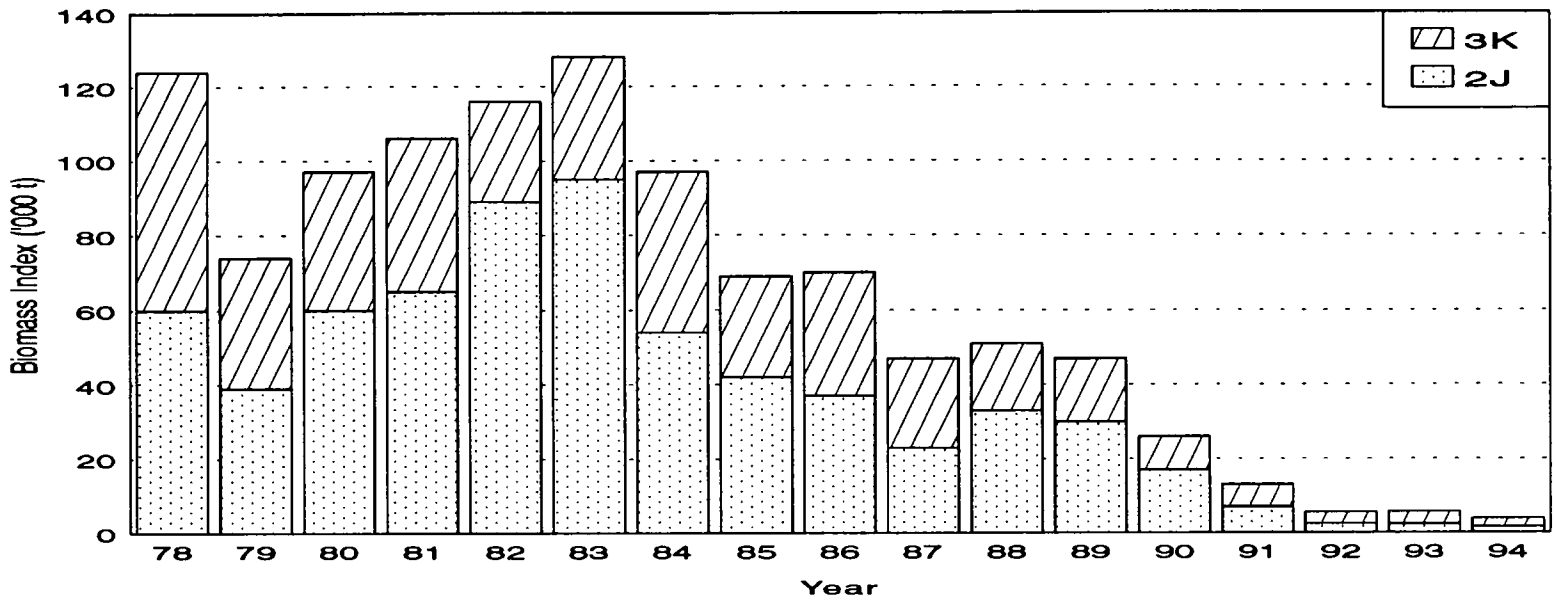

Fig. 2 . Estimated trawlable biomass of A.plaice from RV surveys in Div. 2J and 3K.

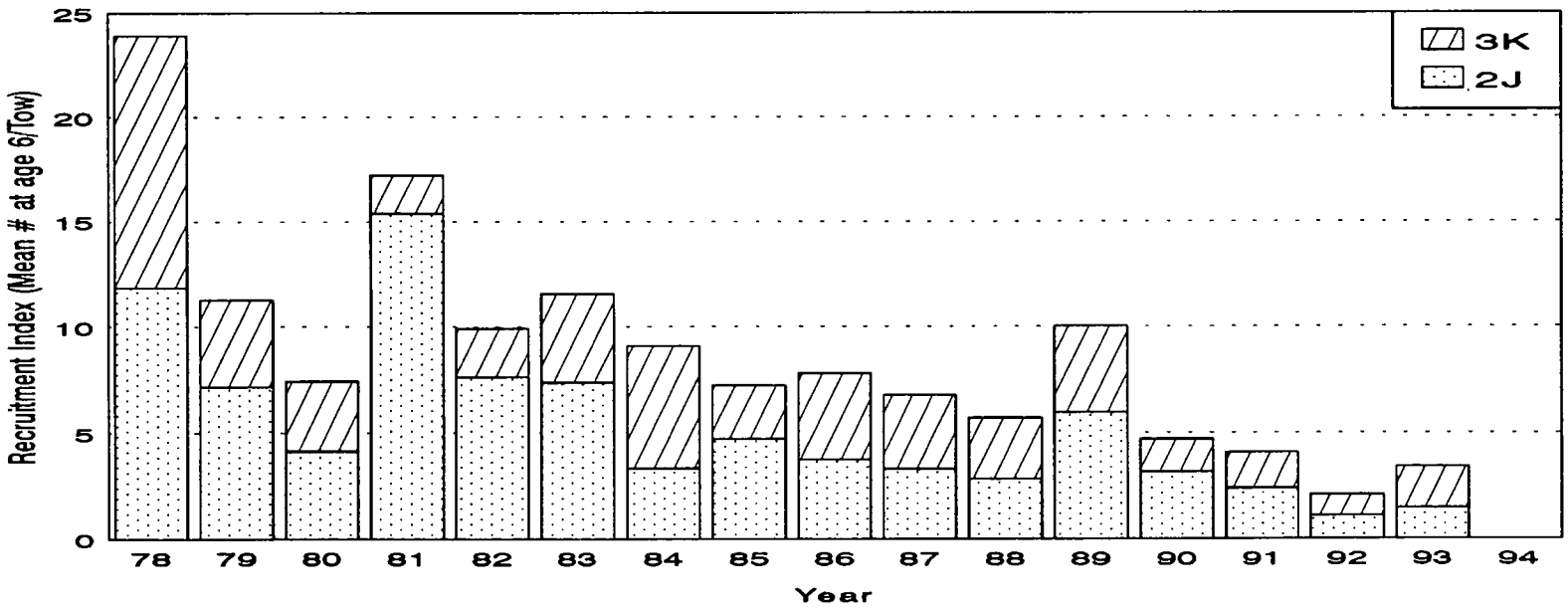

Fig. 3 . Estimated recruitment (age 6) of A.plaice from RV surveys in Div. 2J and 3K.

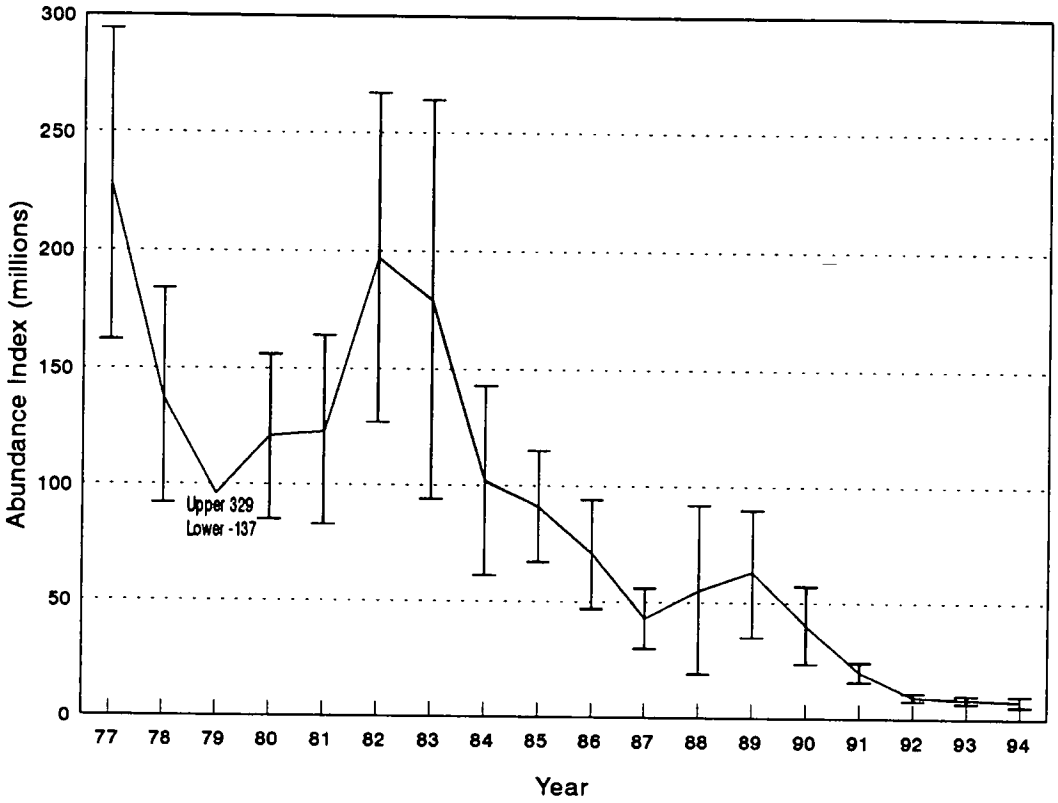

Fig. 4 . Abundance estimates of A.plaice (with 95% C.I.) from Canadian fall surveys in Div. 2J.

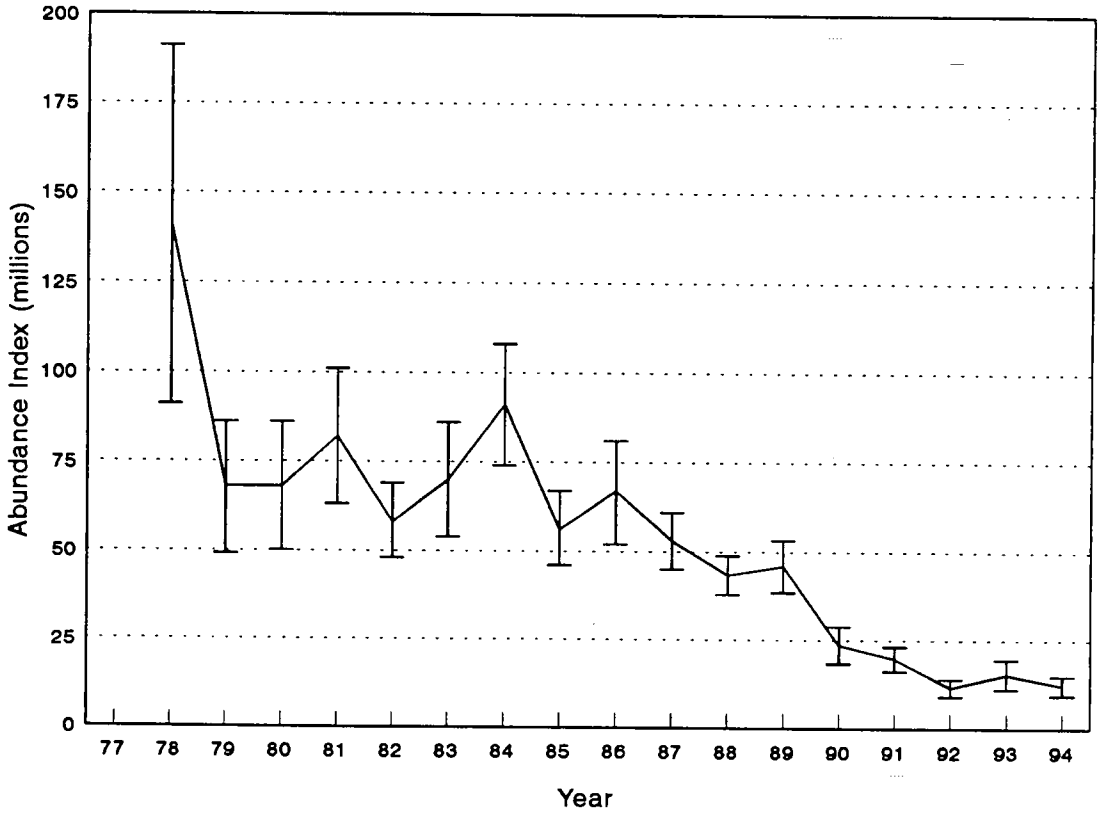

Fig. 5 . Abundance estimates of A.plaice (with 95% C.I.) from Canadian fall surveys in Div. 3K.

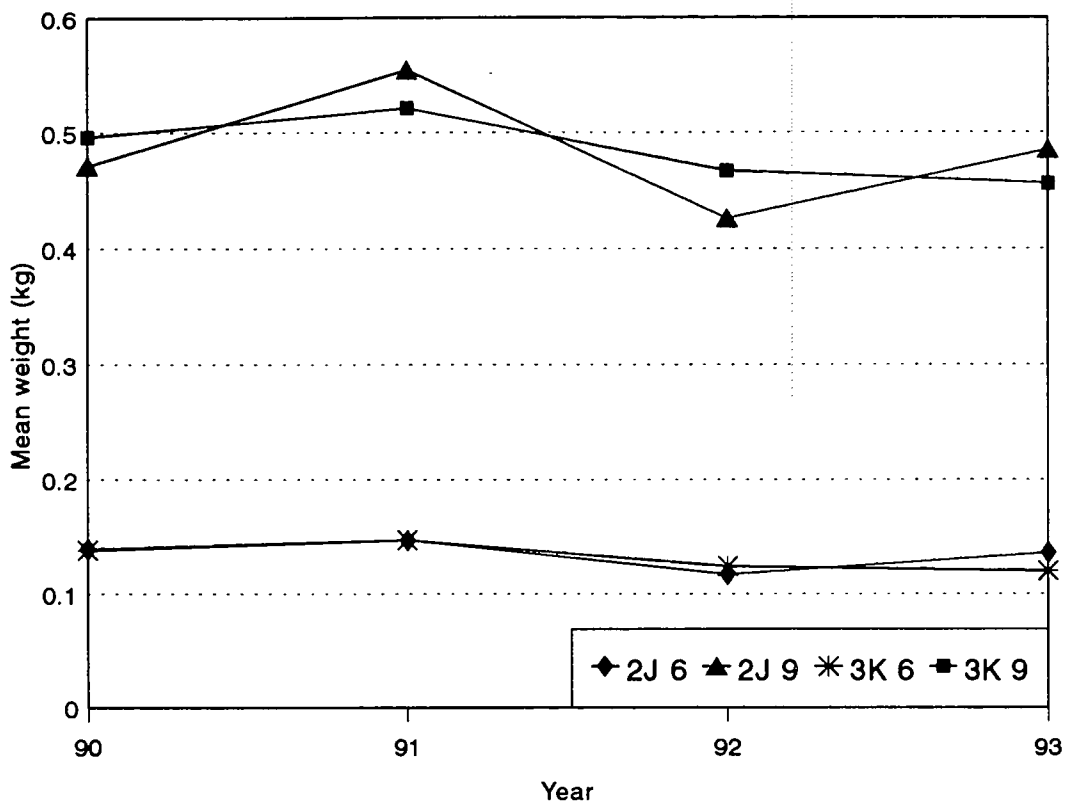

Fig. 6 . Mean weights at ages 6 and 9 of A.plaice from RV surveys in Div. 2J and 3K, 1990-93.

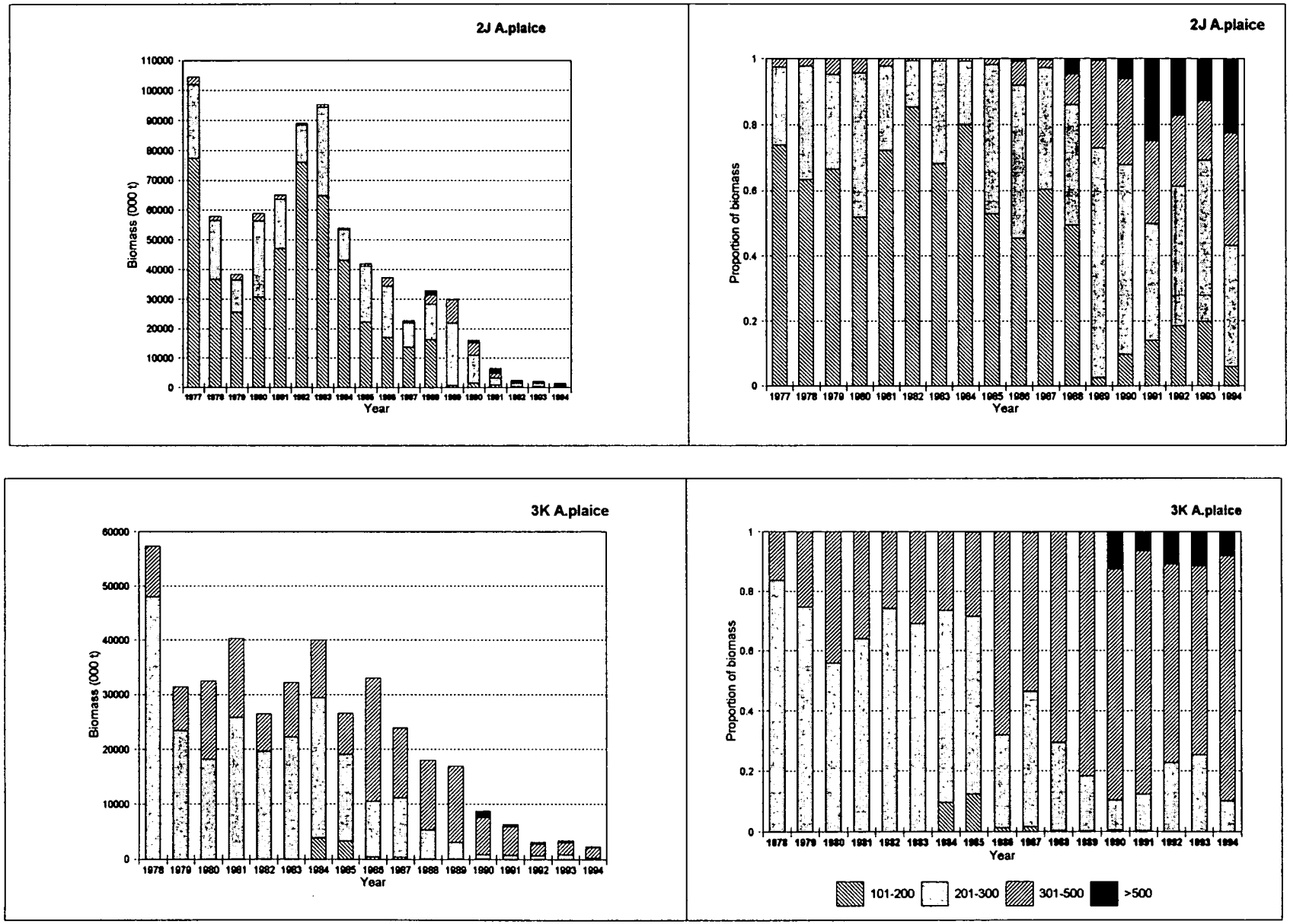

Fig. 7. Estimates of biomass, and proportion of biomass, by depth zone, for A.plaice in Divs. 2J and 3K from RV surveys from 1977 to 1994.

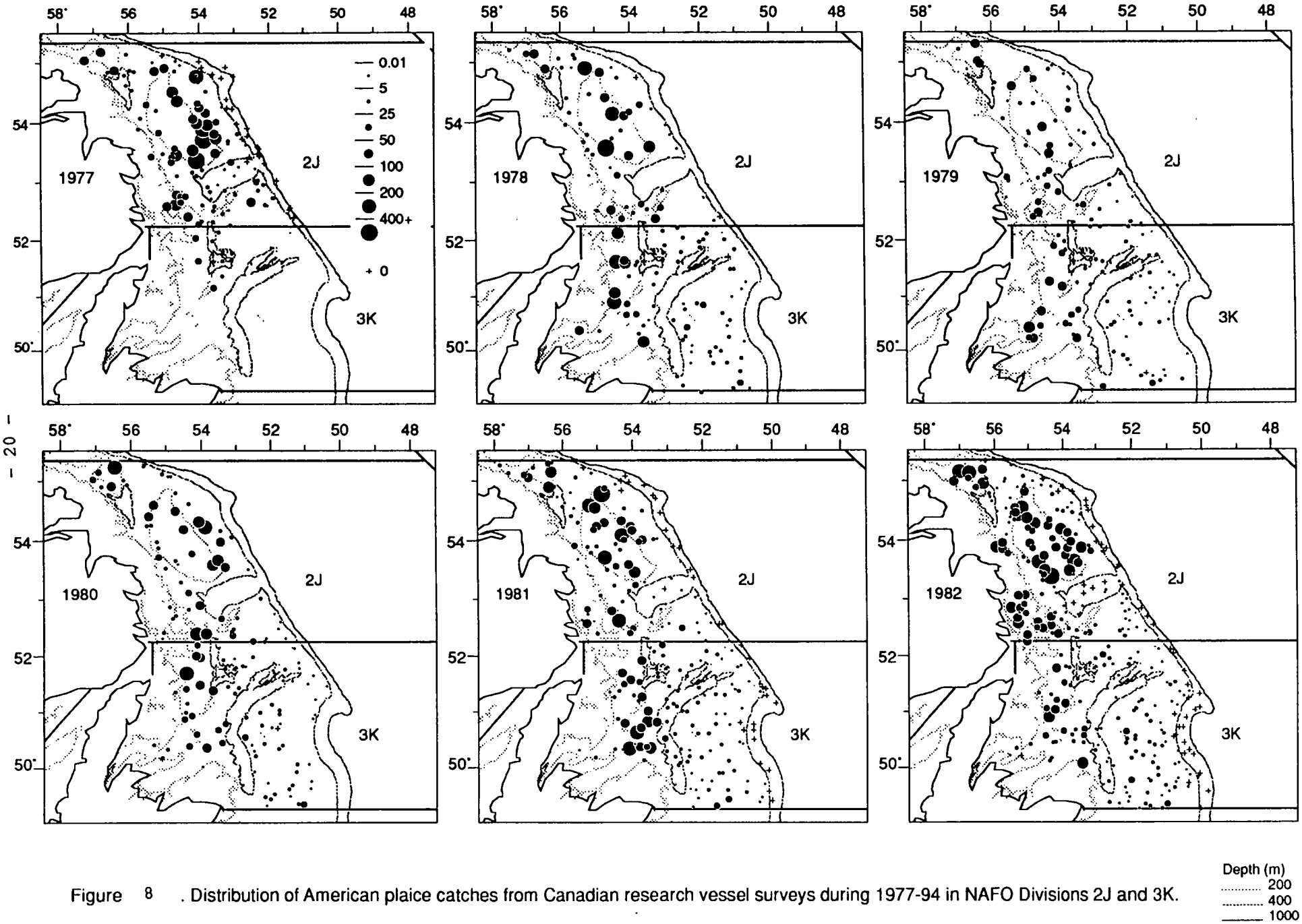

Figure 8 . Distribution of American plaice catches from Canadian research vessel surveys during 1977-94 in NAFO Divisions 2J and 3K.

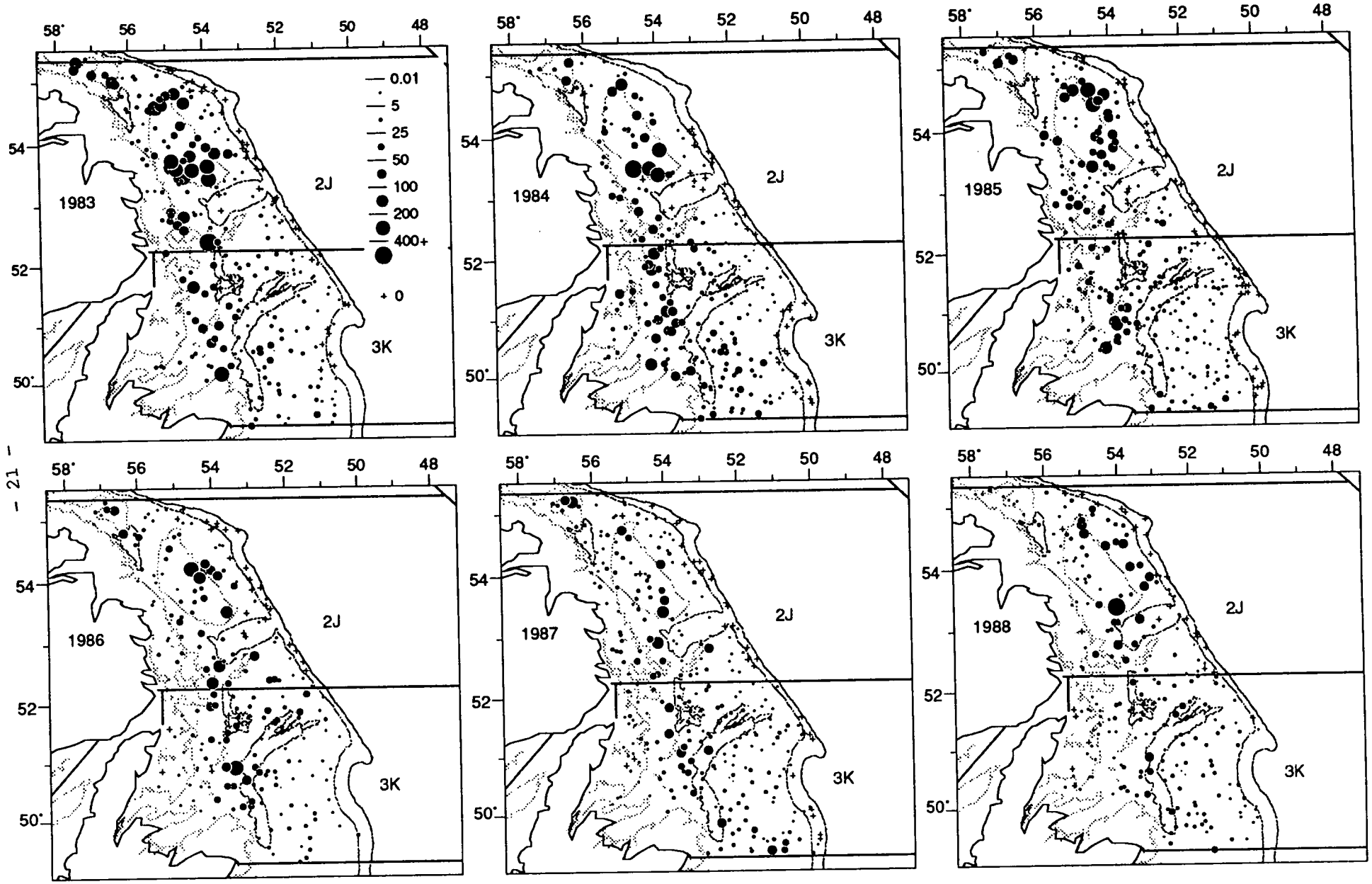

Figure 8 cont'd. Distribution of American plaice catches from Canadian research vessel surveys during 1977-94 in NAFO Divisions 2J and 3K.

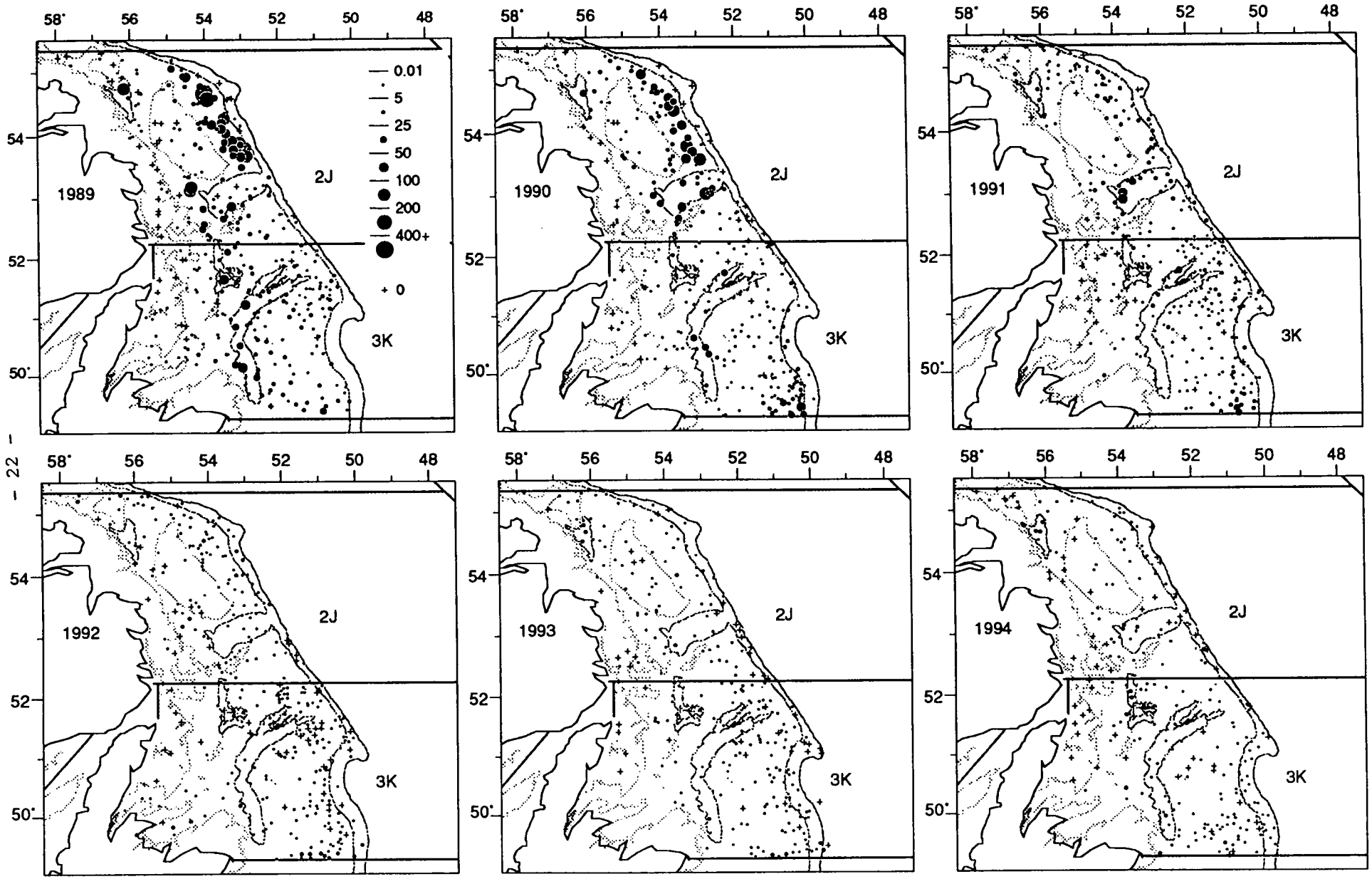

Figure 8 cont'd. Distribution of American plaice catches from Canadian research vessel surveys during 1977-94 in NAFO Divisions 2J and 3K.

Depth (m)
200
400
1000

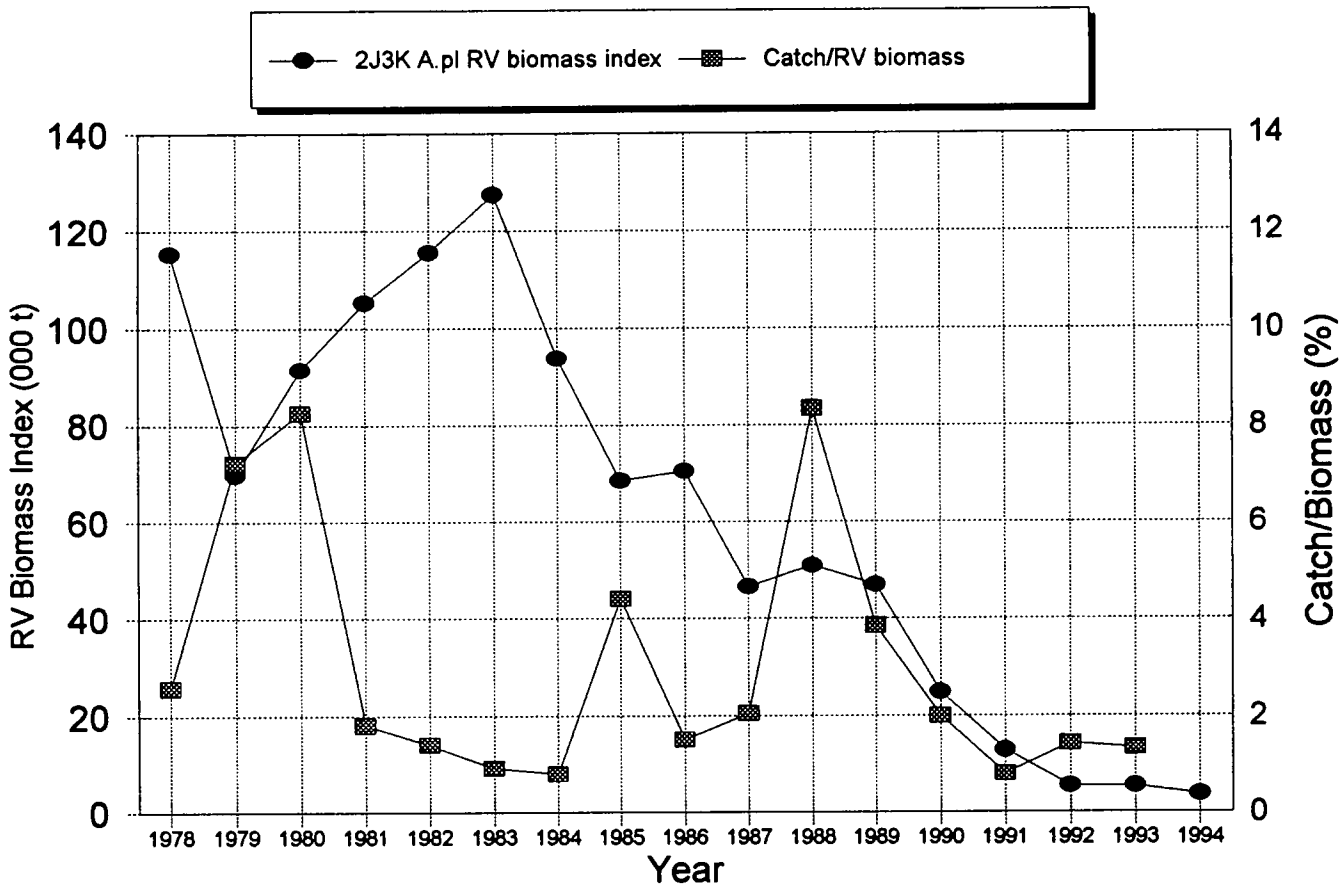

Fig.9. Comparison of RV biomass and Comm. catch as % of RV biomass.