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An assessment of the American plaice stock in NAFO Subdivision 3Ps

by

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ABSTRACT

Catches of American plaice from Subdivision 3Ps increased from 2000-3000 t in the early 1980's to 4000-5000 t from 1985-1990, exceeding the TAC in 1986, 1987, and 1990. The catch rate from Canadian trawlers was relatively stable from 1987-1990, at about the same level observed in 1981-1983. Research vessel surveys conducted by Canada and France indicate a decline in stock abundance in recent years.

It was not possible to use the indices of abundance to arrive at an acceptable formulation of the Adaptive framework. The assessment indicates that the stock is at a relatively low level and that fishing mortality has increased in recent years. A catch in the range of 2200 to 3400 t would approximate F 0.1.

RÉSUMÉ

Les prises de plie canadienne de la sous-division 3Ps sont passées de 2 000-3 000 t au début des années quatre-vingt à 4 000-5 000 t de 1985 à 1990 et ont dépassé le TPA en 1986, 1987 et 1990. Le taux de prises des chalutiers de pêche canadiens a été relativement stable de 1987 à 1990, demeurant à peu près au même niveau que durant la période 1981-1983. Les campagnes d'évaluation des navires scientifiques canadiens et français ont révélé une diminution de l'abondance du stock ces dernières années.

Il n'a pas été possible d'utiliser les indices d'abondance pour parvenir à une formulation acceptable du cadre Adapt. L'évaluation révèle que le stock est relativement bas et que la mortalité due à la pêche a augmenté au cours des dernières années. Des prises de l'ordre de 2 200 à 3 400 t correspondraient environ à $F_{0.1}$.

Introduction

TAC-assessment history

This stock has been under TAC regulation since 1974, when a TAC of 11,000 t was set, based primarily on average catches. The TAC was unchanged at 5000 t from 1980 to 1989. Sequential population analysis was attempted for this stock in the 1987-89 assessments; however, the results in 1988 and 1989 were generally inconclusive. In 1989, CAFSAC noted that a catch of 3000 t for 1990 would approximate $F_{0.1}$ and the TAC was set subsequently at 4000 t, using the 50% rule.

In 1990, the stock was assessed within the Newfoundland Region. Given the problems in the 1989 assessment in interpreting the ADAPT calibrations, SPA was not attempted in 1990. The conclusion of the assessment was that there was insufficient evidence to recommend a change in the advice - i.e., that the 1991 TAC should remain at 3000 t. Concern was also expressed at the low level of confidence in the knowledge of stock status and that it should be reviewed in 1991, before multi-year advice was adopted. However, the CAFSAC advice for the stock recommended that there be no change in the current TAC and suggested that 4000 t be put in place for 1991-93.

Catch trends

Catches from this stock were highest from 1968 to 1973, exceeding 12,000 t on three occasions in this period (Table 1, Fig. 1). Catches by foreign vessels peaked at about 8800 t in 1968, due mainly to the USSR catch, and have not exceeded 800 t since 1973. Catches by France have ranged from 540 t to 770 t from 1986-90.

The Canadian inshore catch in 1987 was substantially higher than in most other years from 1972 onward, due to the increase in the gillnet catch (Table 2, Fig. 2). However, the inshore catch declined in 1988-90 to about the level reported in 1986. After a decline in the early 1980s, the catch by Canadian offshore trawlers increased to over 3200 t in 1985 and 1986, with most of the catch (70-90%) being taken in the first quarter (Table 3). In 1987-89, the catch by this fleet declined and was spread more evenly over the entire year. However, in 1990, the catch by this fleet returned to about the same level and seasonal pattern observed in 1985 and 1986. Overall, the total catch in 1990 of 4842 t (Table 4) was up by 23% over 1989 but was down slightly from the catches of just over 5000 t in 1987-88.

Assessment

Catch at age and mean weights at age

The catch at age and mean weights at age for this stock are based on sampling from the Canadian fishery (Table 5), as no sampling data were available for the French catches. In 1990 (Table 6), the catch was comprised mainly of fish aged 8-12. This is similar to most years (Table 7), although there are several years, most notably 1981 and 1987, where more old fish appear in the catch matrix. The mean weights at age in 1990 were similar to recent values up to age 13, and higher at ages 14+ (Table 8). There appears

to be an increasing trend in the mean weights at ages 11+ since 1987, with recent values being above the long-term averages.

Catch effort data

A multiplicative analysis of commercial catch rates of American plaice for the Canadian offshore trawler fleet in Subdiv. 3Ps from 1974 to 1990 was conducted. Results from the model are shown in Table 9 and Figure 3. The CPUE series shows relative stability from 1974 to 1980, an increase from 1980 to 1983, followed by very large increases in 1984 and 1985. The CPUE has been relatively stable from 1987 to 1990, at about the same level observed in 1981-83. The magnitude of the increase from 1983 to 1984, then 1985, and the subsequent 40% decline to 1986 suggest that the 1985 and possibly the 1984 points are outliers. An analysis conducted on the data for 1985 (Brodie 1989) revealed that 85% of the catch by the offshore fleet was taken in March and that virtually all of that catch occurred in one unit area and one depth range, where the CPUE was very much higher than normal.

Additional evidence that unusually large concentrations may have existed at this time can be found in the data from the 1985 Canadian R.V. survey, which was also conducted in March. Table 11 shows that stratum 317, which is in the same depth range and adjacent to the area of high catch rates, had an average catch of over 1300 kg in 1985, which is several times larger than any other stratum average in the 18-year series. The 1985 point was also very high in the French survey series (Fig. 7) with the catch per tow in strata 319 and 317 being higher than any other strata in the 13-year series (Moguedet and Mahé, 1991). Data from the Canadian and French surveys show that bottom temperatures in 1985 were anomalously cold throughout most of Subdiv. 3Ps; this may be the reason for the unusual distribution of American plaice at that time.

C/E at age

To determine an index of abundance at age from the commercial fishery, the catch at age from the Canadian otter trawler fleet was divided by the effort for the same fleet. Effort was obtained from the multiplicative analysis of C/E described above, except that the otter trawl catch was substituted for the total catch in the CPUE calculation. The resulting index is shown in Table 10 and indicates substantial variability, particularly in the proportions of younger vs. older fish in some adjacent years - e.g., 1986-87-88.

Research vessel survey data

Stratified-random surveys have been conducted by Canada in Subdiv. 3Ps in each year from 1972 to 1991, using the stratification scheme shown in Figure 8. Table 11 shows the results from these surveys, and it can be seen that survey coverage was poor in many years prior to 1979. To account for the missing strata, a multiplicative model was used, with input data consisting of mean weight per tow in each stratum. Two separate analyses were done, one for the ATC surveys of 1972-82 and one for the WT/AN surveys of 1983-91 because catch weights from these two time-series are not directly comparable. Even with the values for the missing strata filled by the model, the biomass estimates in Table 11 are highly variable between years - e.g., 1983-86.

Although the biomass index had been relatively stable from 1986 to 1988, around 30,000 t, the value from the 1989 survey was substantially lower at 17,000 t, followed by a further decline to only 7000 t in 1990 (Fig. 4). As can be seen in Table 11, several strata were missed in the 1990 survey, casting some doubt on the reliability of the low estimate, despite the use of the multiplicative model to estimate the missing values. However, the 1991 survey, which covered all strata, produced an estimate of just over 12,000 t, which is the second lowest value in the index, and about the mean of the 1989 and 1990 survey estimates. Most of the biomass in recent surveys was in deeper areas than usual but litle of the biomass was found beyond 200 fathoms (366 m).

To provide age-by-age estimates of abundance from the R.V. surveys, a multiplicative model using mean number per stratum was employed. The catch numbers at length for the 1977-82 surveys carried out by the A. T. CAMERON were adjusted by the appropriate conversion factors to make them comparable with the data from the 1983 to 1991 surveys (Gavaris and Brodie, 1984). The resulting values for total abundance from the model were then broken down on an age-by-age basis, using yearly population estimates at age from the surveyed strata. This index is contained in Table 12.

Figure 5 shows the decline in abundance in this stock in recent years, with 1989-91 being the lowest points in the 15-year series. Figure 6 shows the decline in age groups 1-7 and 8-12 up to 1990, indicating a sharp drop in both recruitment and in the population contributing the bulk of the commercial catch. Age-by-age data from the 1991 survey are not yet available.

Data from the French R.V. surveys in 3Ps (P. Moguedet, IFREMER, St. Pierre, and Miquelon, pers. comm.) also show a decline in abundance (Fig. 7). Both French and Canadian surveys show a peak abundance in the early 1980s, followed by a decline, with recent values in both series being well below historic lows. Age-by-age estimates are not available from the French surveys at this time.

ADAPT/SPA

1989 model. In 1989, ADAPT calibrations were attempted for this stock using the Canadian R.V. survey data and the C/E from the multiplicative model. Age by age data were available for the R.V. formulations only, but it was noted that most relationships were not significant. It was concluded that although neither of the indices gave good relationships in the Adaptive framework, the use of age 8+ aggregated data for both indices, used in one formulation, gave a reasonable view of the stock.

1991 model. In the current assessment, age disaggregated data were available for both indices, so no attempts were made to use the same formulation as 1989, given the uncertainties expressed with that model. Several formulations were attempted with the current information, three of which are presented here.

Table 13 shows the results using Canadian R.V. data (ages 7-15, 1979-90) only. Fs are extremely high in recent years, particularly 1990. Given the strong year effects present in the residuals, the U-shaped pattern in the slopes of the age by age relationships, and the fact that the 1990 survey

estimates are less than half those of 1989 and 1991, little faith can be placed in the population estimates from this formulation.

Table 14 gives the results using the C/E at age data (ages 8-15, 1974-90). Fs are much lower in recent years than in the R.V. model and are comparable to the mean Fs in the time series. However, there are also strong year effects present in this residual pattern, with most negative values occurring at the start and end of the time period used.

Table 15 shows the results using the R.V. and C/E data (both for 1979-90) in a combined run. As expected, the results are intermediate between the individual formulations, showing an increase in F in latter years. The R.V. data show the same pattern in the slopes and the previously noted year effects are present in both residual patterns. The CVs on the population estimates for most ages ranged from about 0.2 to 0.35 in all three formulations.

Given the concerns with the indices of abundance and with the ADAPT results, none of the formulations of ADAPT was accepted. As in the past, it was felt that there was some useful information available from the SPA. Fs from the converged part of the SPA were related to catches during that period, and compared with catches at a target F of $F_{0.1} = 0.25$. Two approaches were used: the first calculated the mean F, weighted by population numbers, at ages 11-14. In this method, F at the oldest age (18) was estimated as the mean F at ages 14-16. The second calculated the mean F, at the same ages and years from a cohort analysis up to age 15 only, where F on age 15 was estimated as the mean F on ages 13 and 14. This approach was taken to address concerns that the Fs on ages 15+ in the first method were introducing spurious values in the F matrix. As expected, mean Fs in the second method were lower but the patterns of high and low values in the F matrix were not completely eliminated.

To examine the sensitivity of the methods to the time period chosen, both analyses were done for 1974-84 and 1978-84. The following table summarizes the results:

	1974-84	1978-84
Mean catch	3,748 t	2,907 t
F from Method 1	0.34	0.33
$F_{0.1}$/F x Catch	2,756 t	2,202 t
F from Method 2	0.28	0.25
$F_{0.1}$/F x Catch	3,346 t	2,907 t

Prognosis

This assessment indicates that the stock appears to be at a relatively low level and that there has been an increase in F in recent years. Although it was not possible to quantify this increase, a mean catch of about 3750 t from 1974-84 produced a mean F above $F_{0.1}$, and catches from 1985 to 1990 averaged about 4650 t. A catch of 2200-3400 t would approximate $F_{0.1}$; this is consistent with the recent assessments of this stock. The 1990 catch of

4800 t is above this range, although it is not possible to evaluate the effect of catches at a level above $F_{0.1}$ in 1991-92 on the status of the stock.

References

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Gavaris, S., and W. B. Brodie. 1984. Results of comparative fishing between the A. T. CAMERON and the WILFRED TEMPLEMAN during July-August 1983. CAFSAC Res. Doc. 84/41, 16 p.

Moguedet, P., and J. C. Mahé. 1991. Yearly distribution of American plaice in late winter in Subdivision 3Ps in the period 1978-1990. NAFO SCR Doc. 91/26, Ser. No. N1906, 14 p.

Table 1. Catches and TACs (tons) of American plaice in NAFO Subdivision 3Ps, 1960-91.

Year	Canada			France	USSR	Other	Total	TAC
	Nfld	M&Q	Total					
1960	422	405	827	60	-	-	887	-
1961	764	660	1,424	31	-	-	1,455	-
1962	659	363	1,022	2	-	-	1,024	-
1963	504	25	529	208	1	16	754	-
1964	1,132	230	1,362	152	-	28	1,542	-
1965	574	1,275	1,849	162	-	11	2,022	-
1966	1,162	1,332	2,494	667	218	27	3,406	-
1967	2,201	1,074	3,275	533	678	8	4,494	-
1968	4,007	1,516	5,523	524	8,233	-	14,280	-
1969	2,888	1,178	4,066	245	2,180	-	6,491	-
1970	7,368	4,227	11,595	397	336	-	12,328	-
1971	4,667	1,286	5,953	820	409	-	7,182	-
1972	4,301	1,621	5,922	383	220	13	6,538	-
1973	10,972	1,840	12,812	547	1,368	42	14,769	-
1974	5,887	443	6,330	268	-	-	6,598	11,000
1975	2,517	1,301	3,818	65	128	200	4,211	11,000
1976	5,302	128	5,430	5	9	14	5,458	8,000
1977	4,235	307	4,542	63	-	-	4,605	6,000
1978	3,419	192	3,611	47	-	-	3,658	4,000
1979	3,405	187	3,592	74	-	-	3,666	4,000
1980	2,516	213	2,729	206	-	-	2,935	5,000
1981	2,703	57	2,760	457	-	-	3,217	5,000
1982	1,823	46	1,869	317	-	-	2,186	5,000
1983	1,421	83	1,504	222	-	-	1,726	5,000
1984	2,487	138	2,625	338	-	-	2,963	5,000
1985	3,608	206	3,814	406	-	-	4,220	5,000
1986	4,367	98	4,465	665	-	-	5,130	5,000
1987	4,669	119	4,788	543	-	-	5,331	5,000
1988	3,745	56	3,801	605	-	-	4,406	5,000
1989[a]	3,087	96	3,183	766	-	-	3,949	5,000
1990[a]	3,727	376	4,103	739	-	-	4,842	4,000
1991								4,000

[a]Provisional

Table 2. Catches by Canadian vessels, 3Ps American plaice, 1972-90.

Year	Gear					
	Seines	Gillnets	Longline	Other	Subtotal	Ottertrawl
1972	11	174	143	7	335	5,587
1973	63	233	212	17	525	12,287
1974	3	195	235	20	453	5,877
1975	62	322	127	63	574	3,244
1976	28	245	44	13	330	5,100
1977	140	291	119	17	567	3,975
1978	65	256	185	29	535	3,076
1979	117	292	176	13	598	2,994
1980	17	373	266	15	671	2,058
1981	84	671	370	19	1,144	1,616
1982	35	265	199	4	503	1,366
1983	9	113	219	9	350	1,154
1984	-	86	102	15	203	2,422
1985	2	118	273	6	399	3,415
1986	10	887	354	12	1,262	3,203
1987	20	1,650	300	50	2,020	2,768
1988	9	1,089	225	21	1,344	2,457
1989[a]	-	1,071	190	30	1,291	1,892
1990[a]	12	737	285	19	1,053	3,050

[a]Provisional.

Table 3. Nominal catch by month, American plaice in Subdivision 3Ps, 1972-90.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	UNK	Total
1972	1,118	105	311	161	110	109	391	520	604	880	1,044	1,185	-	6,538
1973	1,681	500	2,599	1,527	96	350	969	2,607	931	504	2,237	768	-	14,769
1974	162	133	1,576	2,575	123	137	165	399	567	128	364	269	-	6,598
1975	6	6	1,495	616	332	280	186	115	120	82	441	532	-	4,211
1976	98	254	461	191	91	284	439	512	353	433	984	1,358	-	5,458
1977	28	547	663	339	309	287	414	204	105	261	712	736	-	4,605
1978	250	141	185	1,066	853	121	433	427	40	41	55	46	-	3,658
1979	467	376	1086	212	189	262	225	265	124	161	246	53	-	3,666
1980	14	464	180	63	216	359	166	170	170	191	256	686	-	2,935
1981	423	57	236	371	363	331	302	156	214	263	273	228	-	3,217
1982	53	4	285	315	181	156	133	195	125	95	463	181	-	2,186
1983	98	47	161	71	61	155	169	91	327	372	149	25	-	1,726
1984	128	1,933	101	43	125	126	85	60	31	194	94	43	-	2,963
1985	3	55	2,814	240	35	154	134	80	199	146	343	17	-	4,220
1986	1,960	447	500	52	149	334	444	493	302	275	91	83	-	5,130
1987	455	260	1,312	349	241	512	711	581	200	189	250	271	-	5,331
1988	236	714	389	73	130	509	805	363	342	263	341	241	-	4,406
1989[a]	69	4	234	259	221	467	735	334	214	226	287	133	766	3,949
1990[a]	287	397	1,653	260	138	334	307	416	207	63	7	34	739	4,842

[a]Provisional.

Table 4. Catch of American plaice in Subdiv. 3Ps in 1990.

	OT		LL		GN	Other		
	Can(n)	Can(M)	Can(N)	Can(M)	Can	Can	Fra	Total
Jan	284	3						287
Feb	388	4				5		397
Mar	1,583	65	1			4		1,653
Apr	250	1	1		8			260
May	83	3	2		50			138
Jun	118	2	5		207	2		334
Jul	53		6	48	196	4		307
Aug	39	51	46	76	198	6		416
Sep	18	51	58	13	59	8		207
Oct		19	23	1	18	2		63
Nov	2	1	4					7
Dec	13	19	1		1			34
UNK							739	739
Total	2,831	219	147	138	737	31	739	4,842

Table 5. Commercial samples and catch used to calculate catch at age and average weights at age for A. plaice in Subdiv. 3Ps in 1990. Figures in parentheses are the number of observations.

Age-length key	Length frequency	# Samples	Catch (t)	Description
(370) ALKOT2CN3PS	(1422) LFGNMAYCN3PS	4	71	Canada inshore,[1] Jan-May
	(1005) JUN	3	214	Canada inshore, Jun
(525) ALKOT3CN3PS	(1036) LFGNJULCN3PS	4	254	Canada inshore, Jul
	(587) AUG	2	326	Canada inshore, Aug
(147) ALKOT4CN3PS	(711) LFGNSEPCN3PS	2	188	Canada inshore, Sep-Dec
	(701) JAN	2	287	Canada otter trawl,[2] Jan
(788) ALKSO1CN3PS	(1728) LFOTFEBCN3PS	5	392	Canada otter trawl, Feb
	(1280) MAR	4	1648	Canada otter trawl, Mar
(140) ALKSO2CN3PS	(235) LFOTAPRCN3PS	1	251	Canada otter trawl, Apr
	(355) MAY	1	472	Canada otter trawl, May-Dec

[1]All gears except otter trawl.
[2]Total otter trawl catch at age for Canada was adjusted upward by 739 t to account for French catches.

Table 6. Catch at age and mean weights at age for 3Ps A.plaice in the commercial fishery in 1990.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
6	0.285	31.852	30	12.48	0.41
7	0.345	33.819	232	42.69	0.18
* 8	0.419	35.834	743	68.08	0.09
9	0.551	38.764	884	59.27	0.07
*10	0.663	40.989	923	66.85	0.07
11	0.894	44.999	746	51.06	0.07
12	1.220	49.503	543	34.56	0.06
*13	1.604	53.767	347	24.28	0.07
*14	2.077	58.194	251	18.63	0.07
*15	2.635	62.536	216	15.35	0.07
16	3.300	66.938	86	9.73	0.11
*17	4.160	71.763	12	3.71	0.32
*18	5.124	76.500	2	0.02	0.01

TABLE 7 . CATCH AT AGE (000) FOR 3PS A.PLAICE, 1974-90.

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	326	391	121	18	49	130	2	8	2	5	4	3	3	5	13	10	30
7	903	839	445	133	196	240	121	89	28	83	14	28	90	90	181	195	232
8	889	721	1117	330	482	574	491	434	186	401	107	378	357	277	842	563	743
9	1140	644	1514	803	964	908	737	1032	377	476	603	995	613	349	1167	570	884
10	1263	383	1266	905	1011	820	725	670	774	670	1151	1214	949	521	1164	667	923
11	717	423	979	952	756	608	600	466	1103	501	1203	1008	1133	621	958	703	746
12	792	490	715	343	726	349	545	291	447	328	656	579	917	834	651	532	543
13	801	361	460	288	324	225	364	297	191	256	351	290	397	681	321	451	347
14	422	258	223	245	225	149	71	369	121	89	230	193	335	580	197	320	251
15	186	61	162	223	123	117	81	341	43	15	110	130	175	396	132	173	216
16	198	91	127	235	75	43	50	143	21	12	42	68	72	195	47	58	86
17	132	79	50	157	20	23	23	104	12	3	12	45	21	95	14	9	12
18	137	51	41	102	11	3	14	38	5	1	6	17	7	53	1	1	2
19	57	44	2	34	6	1	1	20	1	1	1	4	1	1	1	1	1

TABLE 8. MEAN WEIGHTS (KG) FOR 3PS A.PLAICE, 1974-90.

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	0.276	0.277	0.285	0.250	0.295	0.348	0.151	0.283	0.288	0.271	0.263	0.192	0.278	0.235	0.281	0.242	0.285
7	0.343	0.381	0.335	0.301	0.306	0.428	0.316	0.301	0.405	0.396	0.288	0.259	0.346	0.320	0.303	0.308	0.345
8	0.414	0.515	0.419	0.330	0.370	0.453	0.372	0.362	0.400	0.438	0.340	0.341	0.427	0.400	0.382	0.392	0.419
9	0.516	0.561	0.522	0.415	0.469	0.560	0.469	0.433	0.428	0.534	0.401	0.462	0.533	0.513	0.494	0.562	0.551
10	0.685	0.760	0.626	0.620	0.551	0.731	0.547	0.604	0.491	0.645	0.492	0.620	0.673	0.623	0.648	0.692	0.663
11	0.855	0.852	0.797	0.747	0.783	0.989	0.756	0.756	0.629	0.686	0.612	0.851	0.819	0.738	0.818	0.863	0.894
12	1.109	1.220	0.998	1.011	0.940	1.290	0.938	0.922	0.890	0.824	0.809	1.172	1.113	0.938	1.082	1.114	1.220
13	1.377	1.368	1.238	1.362	1.105	1.729	1.313	0.862	1.143	0.913	1.036	1.475	1.407	1.168	1.325	1.362	1.604
14	1.790	1.621	1.474	1.560	1.197	2.084	2.025	0.958	1.492	1.458	1.270	1.850	1.805	1.497	1.627	1.780	2.077
15	2.004	1.997	1.682	1.779	1.716	2.320	2.037	1.164	1.919	1.866	1.712	2.289	2.252	1.901	2.064	2.254	2.635
16	2.540	2.334	1.981	2.010	2.409	2.902	2.453	1.619	2.273	2.348	2.355	2.665	2.762	2.450	2.603	3.078	3.300
17	2.530	2.613	2.367	2.294	2.624	3.124	2.898	1.849	2.665	2.781	2.538	3.139	3.478	3.107	3.313	3.504	4.160
18	3.163	2.963	2.932	2.662	2.662	2.902	3.103	2.204	3.244	3.640	3.034	3.366	3.772	3.511	4.148	4.489	5.124
19	3.740	2.890	3.352	3.159	4.021	3.124	3.103	2.633	3.568	4.687	3.212	3.545	5.118	4.116	0.000	0.000	0.000

Table 9. Results of C/E standardization for 3Ps A.plaice.

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	-0.716	0.087	298
3	3				
4	74				
1	2125	1	0.072	0.089	23
	3114	2	-0.230	0.056	55
	3124	3	-0.132	0.052	67
3	1	4	-0.197	0.091	20
	2	5	-0.211	0.085	25
	4	6	-0.394	0.076	36
	5	7	-0.757	0.097	19
	6	8	-0.409	0.102	19
	7	9	0.014	0.096	19
	8	10	-0.105	0.093	23
	9	11	-0.415	0.096	19
	10	12	-0.532	0.087	29
	11	13	-0.355	0.081	27
	12	14	-0.316	0.083	26
4	75	15	0.040	0.100	18
	76	16	-0.167	0.091	26
	77	17	-0.078	0.092	26
	78	18	-0.099	0.098	22
	79	19	0.040	0.094	27
	80	20	-0.103	0.104	21
	81	21	0.103	0.104	19
	82	22	0.328	0.107	16
	83	23	0.203	0.117	14
	84	24	0.579	0.148	8
	85	25	0.861	0.136	8
	86	26	0.422	0.122	11
	87	27	0.184	0.107	16
	88	28	0.207	0.102	17
	89	29	0.079	0.114	12
	90	30	0.226	0.127	9

TYPE 1= VSL/GEAR/TC
2125=CAN(M) OTB2 TC5
3114=CAN(N) OTB1 TC4
3124=CAN(N) OTB2 TC4
3125=CAN(N) OTB2 TC5

TYPE 3= MONTH
TYPE 4= YEAR

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.740
MULTIPLE R SQUARED..... 0.547

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.446E1	2.446E1	
REGRESSION	30	3.002E0	1.001Ee1	10.767
TYPE 1	3	2.039Ee1	6.796Ee2	7.312
TYPE 2	11	1.012E0	9.200Ee2	9.899
TYPE 3	16	1.097E0	6.859Ee2	7.380
RESIDUALS	267	2.481E0	9.294Ee3	
TOTAL	298	2.995E1		

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1974	-0.7159	0.0075	0.489	0.042	5877	12014
1975	-0.6756	0.0087	0.509	0.048	3244	6374
1976	-0.8825	0.0070	0.414	0.035	5100	12312
1977	-0.7944	0.0072	0.452	0.038	3975	8788
1978	-0.8150	0.0080	0.443	0.040	3076	6945
1979	-0.6764	0.0071	0.509	0.043	2994	5882
1980	-0.8191	0.0095	0.441	0.043	2058	4669
1981	-0.6125	0.0096	0.542	0.053	1616	2982
1982	-0.3884	0.0101	0.678	0.068	1366	2015
1983	-0.5130	0.0128	0.598	0.068	1154	1931
1984	-0.1371	0.0203	0.867	0.123	2422	2793
1985	0.1455	0.0149	1.153	0.140	3415	2961
1986	-0.2935	0.0127	0.744	0.084	3203	4303
1987	-0.5318	0.0095	0.588	0.057	2768	4711
1988	-0.5086	0.0089	0.601	0.057	2457	4085
1989	-0.6371	0.0106	0.528	0.054	1897	3590
1990	-0.4904	0.0133	0.611	0.070	3050	4990

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.101

TABLE 10. C/E AT AGE (#FISH/HR) FROM THE CANADIAN OFFSHORE FISHERY FOR A.PLAICE IN 3PS.

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
7	56	106	34	13	24	28	20	29	11	31	4	7	17	6	31	38	37
8	59	90	85	34	57	77	114	129	70	143	37	100	67	40	146	109	115
9	79	80	116	82	115	124	153	297	111	168	214	275	114	70	216	102	128
10	89	46	96	90	115	115	133	189	311	226	387	331	159	71	218	92	116
11	53	52	74	94	94	87	99	133	310	151	342	271	124	56	123	76	85
12	61	59	54	33	87	50	81	75	134	96	164	164	104	63	67	53	61
13	62	43	35	27	38	32	47	28	51	74	93	78	45	49	34	55	37
14	33	32	17	23	25	21	8	16	27	28	52	55	41	38	15	43	29
15	14	7	12	22	15	17	9	4	8	5	26	39	27	31	7	19	24

Table 11. Mean weight (kg) of American plaice per tow, by stratum, from r.v. surveys in Subdivision 3Ps. Numbers in parentheses are the number of successful 30-minute tows in each stratum. The stratified mean weight per tow and the biomass estimates are given at the bottom of the table. (ATC, AN, WT, refers to the research vessels, A.T. CAMERON, A.T. NEEDLER, and W. TEMPLEMAN respectively).

Depth (fm)	Stratum	Year - Survey 1972 ATC 197	1973 ATC 207	1974 ATC 221	1975 ATC 234	1976 ATC 247	1977 ATC 261	1978 ATC 275	1979 ATC 287	1980 ATC 302	1981 ATC 316
101-150	306	-	-	0.3(6)	0.4(4)	0.6(2)	0.5(6)	1.0(6)	1.4(5)	1.1(2)	0.6(3)
51-100	307	0.0(3)	0.0(5)	1.9(7)	0.4(4)	1.4(4)	1.1(4)	0.1(4)	0.1(4)	1.6(2)	0.9(3)
31-50	308	-	0.7(2)	28.1(2)	17.3(4)	16.3(2)	18.8(4)	-	0.7(4)	4.0(2)	306.5(2)
101-150	309	0.0(2)	1.2(3)	0.1(4)	2.6(6)	0.5(3)	1.1(6)	1.3(6)	3.9(6)	0.7(2)	1.5(2)
101-150	310	-	-	0.2(3)	1.5(6)	-	0.3(6)	0.5(6)	1.7(6)	3.0(2)	3.0(2)
51-100	311	8.1(4)	109.1(9)	13.4(8)	8.8(4)	12.6(6)	3.9(4)	5.9(4)	40.4(4)	108.5(2)	10.0(2)
31-50	312	249.5(2)	-	43.3(2)	18.4(3)	20.6(5)	12.5(4)	-	0.1(3)	-	1.2(2)
101-150	313	0.5(2)	168.3(2)	0.7(5)	0.4(3)	1.2(3)	0.5(10)	4.1(2)	4.0(5)	2.6(2)	21.5(2)
0-30	314	28.6(2)	-	0.2(2)	-	1.1(2)	16.3(4)	-	-	0.5(2)	0.3(5)
31-50	315	71.7(2)	48.3(2)	103.0(2)	-	32.7(2)	27.2(4)	-	5.3(3)	48.1(4)	33.0(2)
101-150	316	3.2(2)	23.0(3)	0.4(6)	-	0.8(4)	3.7(6)	4.0(6)	12.0(3)	7.5(2)	18.9(2)
51-100	317	64.9(4)	161.7(7)	30.2(8)	9.9(4)	5.1(4)	3.7(6)	4.0(6)	12.0(3)	318.4(2)	56.0(2)
101-150	318	-	134.3(2)	1.8(2)	0.0(4)	1.9(2)	0.7(6)	10.9(2)	3.9(2)	8.9(2)	-
51-100	319	14.0(4)	15.6(5)	61.2(2)	11.8(4)	63.0(4)	48.6(6)	34.2(4)	8.1(2)	39.3(4)	79.5(2)
0-30	320	-	2.7(2)	-	-	11.2(3)	-	-	-	12.3(6)	7.0(2)
31-50	321	90.5(2)	3.4(2)	-	-	88.5(2)	-	-	-	30.5(5)	45.5(2)
51-100	322	-	-	-	-	75.1(4)	-	-	2.8(2)	67.1(8)	21.5(2)
51-100	323	222.6(3)	-	-	-	111.0(4)	34.5(2)	-	-	162.5(3)	108.5(2)
51-100	324	-	-	-	-	53.6(2)	-	-	4.0(2)	26.8(2)	-
31-50	325	-	-	-	-	60.4(2)	-	-	2.7(2)	7.7(4)	4.6(2)
31-50	326	-	-	-	-	-	-	-	15.7(2)	13.9(2)	1.9(2)
151-200	705	0.9(2)	1.4(2)	0.8(4)	0.3(2)	2.2(2)	1.1(4)	0.2(3)	2.8(4)	0.5(2)	0.9(2)
151-200	706	4.4(2)	8.2(2)	2.2(7)	-	-	3.1(4)	1.6(2)	5.6(3)	1.4(2)	6.8(2)
151-200	707	14.9(2)	-	0.0(2)	0.4(4)	0.1(2)	0.0(4)	3.6(2)	2.1(2)	4.5(2)	-
201-300	708	-	-	-	0.0(3)	-	0.2(4)	-	0.5(2)	0.6(2)	-
301-400	709	-	-	-	-	-	-	-	-	-	-
301-400	710	-	-	-	-	-	-	-	-	-	-
201-300	711	-	-	-	-	-	-	-	-	0.2(2)	0.7(2)
201-300	712	-	-	-	-	-	-	-	1.4(2)	0.0(2)	0.2(2)
201-300	713	-	-	-	0.6(3)	-	-	-	-	0.2(2)	0.9(6)
201-300	714	-	-	-	-	-	-	0.9(2)	-	1.0(2)	0.1(8)
151-200	715	0.0(2)	-	0.0(4)	0.0(2)	0.2(2)	0.2(4)	0.3(4)	0.4(3)	0.5(2)	0.3(2)
151-200	716	0.0(2)	-	0.1(3)	-	-	0.9(6)	0.4(4)	2.1(4)	0.5(2)	1.8(4)
Mean (No. sets)		56.8(42)	26.8(48)	25.2(79)	5.1(60)	42.3(66)	15.8(102)	8.6(61)	9.5(78)	27.8(80)	21.0(80)
Biomass (t) from surveyed strata		33,826	13,654	12,999	1,901	37,757	9,109	3,785	7,236	35,776	25,974
Biomass (t) from multiplicative model		50,004	27,107	33,222	18,205	38,095	23,284	17,623	11,699	35,846	27,528

Table 11. (Cont'd.)

Depth (fm)	Stratum	Year - Survey 1982 ATC 330	1983 AN 9	1984 AN 26	1985 WT 26	1986 WT 45	1987 WT 55,56	1988 WT 68	1989 WT 81	1990 WT 91	1991 WT 103
101-150	306	0.5(3)	0.2(4)	0.1(2)	2.7(2)	0.6(3)	0.2(4)	0.3(4)	0.8(3)	0.1(3)	0.0(4)
51-100	307	2.5(4)	1.3(4)	0.0(2)	0.1(3)	1.0(3)	0.4(3)	0.9(4)	0.1(3)	0.2(3)	0.0(3)
31-50	308	49.3(2)	101.2(3)	1.5(2)	3.7(2)	0.0(2)	0.0(2)	0.5(2)	0.0(2)	0.0(2)	0.0(2)
101-150	309	0.4(2)	0.3(3)	7.3(2)	1.6(3)	0.2(2)	0.5(2)	1.1(3)	0.1(2)	1.2(2)	0.9(3)
101-150	310	1.0(3)	0.2(3)	0.5(2)	4.2(3)	2.0(2)	3.5(2)	5.7(3)	10.3(2)	14.8(2)	3.6(2)
51-100	311	2.7(3)	2.0(3)	2.6(2)	16.2(4)	77.0(3)	27.0(2)	74.1(4)	3.4(3)	15.2(3)	3.8(3)
31-50	312	5.3(2)	12.2(3)	0.6(2)	1.5(2)	4.0(2)	2.8(2)	0.0(2)	1.5(3)	6.9(3)	0.2(2)
101-150	313	1.2(2)	2.9(3)	0.7(2)	0.9(2)	9.7(2)	1.6(2)	8.5(2)	9.3(2)	71.8(2)	52.4(2)
0-30	314	23.3(5)	11.9(7)	5.3(4)	0.5(7)	2.0(8)	6.0(5)	0.0(7)	0.9(9)	0.1(6)	2.4(7)
31-50	315	53.5(3)	61.4(8)	35.3(5)	40.9(7)	62.5(6)	33.1(8)	39.5(6)	14.6(7)	1.2(2)	9.4(7)
101-150	316	-	5.3(4)	1.7(2)	3.8(3)	7.0(2)	196.8(3)	19.8(3)	25.1(3)	8.2(2)	163.1(2)
51-100	317	34.2(3)	52.0(3)	6.0(2)	1312.8(2)	29.3(2)	80.0(3)	62.5(2)	151.8(2)	71.3(2)	8.7(2)
101-150	318	0.3(2)	3.6(3)	7.3(2)	-	7.0(2)	37.1(2)	70.0(2)	2.0(2)	-	71.2(2)
51-100	319	33.0(7)	112.1(7)	43.3(6)	26.5(2)	27.1(8)	104.3(9)	8.9(8)	33.7(8)	-	54.5(9)
0-30	320	18.8(4)	34.0(14)	9.4(8)	38.3(5)	17.0(9)	7.0(11)	4.5(11)	2.6(10)	1.4(5)	0.9(12)
31-50	321	27.3(4)	47.2(10)	28.0(6)	23.1(7)	26.9(10)	21.8(10)	5.7(11)	53.7(9)	1.7(8)	1.0(11)
51-100	322	58.0(8)	71.2(11)	64.3(8)	179.2(13)	55.5(12)	22.9(10)	9.4(12)	5.2(14)	2.2(16)	7.7(14)
51-100	323	256.5(2)	125.7(6)	44.4(4)	68.0(3)	170.5(5)	164.8(6)	324.0(5)	52.6(7)	19.1(4)	10.1(6)
51-100	324	71.3(2)	91.5(4)	15.5(3)	202.3(2)	7.5(5)	95.7(4)	0.3(4)	11.5(5)	8.5(5)	8.5(4)
31-50	325	41.4(5)	53.4(8)	27.0(5)	25.7(3)	6.5(8)	1.6(6)	2.6(6)	6.1(8)	0.3(2)	1.8(9)
31-50	326	44.3(2)	40.8(3)	29.8(2)	-	8.0(2)	14.3(2)	0.6(2)	36.7(2)	1.1(2)	0.2(2)
151-200	705	0.6(2)	0.5(3)	0.4(2)	3.5(2)	2.2(2)	3.5(2)	6.5(2)	13.0(2)	1.8(2)	1.7(2)
151-200	706	0.6(4)	1.9(5)	0.3(2)	1.8(4)	7.3(4)	9.7(5)	13.5(4)	3.3(4)	9.0(4)	5.3(4)
151-200	707	-	0.0(3)	8.1(2)	-	4.0(2)	1.0(2)	10.3(2)	0.1(2)	-	39.8(2)
201-300	708	-	0.2(2)	1.4(2)	-	3.6(2)	1.5(2)	0.0(2)	3.0(2)	-	21.8(2)
301-400	709	-	0.2(2)	0.0(2)	-	-	-	-	7.0(2)	-	4.0(2)
301-400	710	-	0.0(3)	2.5(2)	1.3(2)	0.7(2)	-	36.0(2)	-	-	9.2(2)
201-300	711	0.0(2)	0.8(8)	0.9(5)	1.0(8)	1.4(9)	2.2(7)	23.1(7)	1.7(7)	1.1(3)	1.9(8)
201-300	712	0.0(3)	0.9(7)	-	1.0(6)	0.4(9)	0.3(4)	13.2(7)	1.9(8)	4.9(5)	0.6(8)
201-300	713	0.3(2)	0.4(7)	-	0.4(8)	0.1(5)	1.0(4)	7.5(7)	1.2(8)	0.2(7)	4.5(8)
201-300	714	0.0(6)	0.3(10)	-	-	8.8(5)	0.5(4)	16.5(9)	0.8(10)	0.8(7)	1.0(11)
151-200	715	0.2(2)	0.8(3)	0.0(2)	-	1.8(2)	0.4(2)	0.0(2)	0.1(2)	2.3(2)	0.1(2)
151-200	716	0.4(2)	1.5(4)	0.2(3)	4.2(5)	1.8(4)	3.8(3)	33.0(5)	1.5(4)	4.9(5)	1.3(5)
Mean (No. sets)		30.7(91)	34.7(171)	20.8(95)	54.9(110)	23.2(144)	25.9(134)	20.8(152)	12.9(157)	4.8(109)	9.2(164)
Biomass (t) from surveyed strata		39,076	45,200	22,549	64,494	30,450	33,923	27,326	17,004	5,835	12,119
Biomass (t) from multiplicative model		39,415	45,583	22,787	64,802	30,451	33,917	27,325	16,998	7,007	12,119

TABLE 12. ABUNDANCE (MILLIONS) OF A.PLAICE FROM CANADIAN R.V.SURVEYS IN 3PS FROM 1977-90.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.1	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.7	0.4	0.2	2.3	0.6	1.6	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.0
4	1.8	0.4	0.8	3.1	3.6	6.7	1.2	0.2	0.4	0.6	0.4	0.5	0.5	0.2
5	5.1	2.0	2.0	8.0	4.3	8.9	7.1	1.9	2.7	2.2	1.9	2.5	1.2	1.0
6	3.6	3.2	3.3	12.8	6.9	10.7	16.7	7.6	7.6	8.7	5.5	8.0	3.7	1.1
7	6.9	4.7	8.8	32.6	14.3	15.7	19.6	9.0	14.5	15.2	11.9	10.3	6.0	1.7
8	6.9	6.0	7.8	31.4	19.2	22.2	18.8	8.2	10.4	10.7	14.9	13.8	4.9	1.9
9	5.1	6.5	4.2	21.9	12.7	27.3	16.0	6.6	10.5	5.9	9.7	7.4	4.5	2.0
10	3.8	2.9	1.6	14.0	7.3	13.3	8.0	5.4	9.4	4.7	6.9	4.6	2.5	1.5
11	3.0	3.1	1.3	5.6	2.9	5.5	5.2	3.0	5.6	2.7	3.2	2.0	1.6	0.9
12	1.6	2.2	1.2	3.5	2.4	4.6	2.7	1.7	3.9	2.3	2.8	1.4	1.5	0.6
13	0.4	1.0	0.6	1.6	1.0	2.2	1.7	0.7	3.8	1.7	1.8	0.8	1.0	0.2
14	0.6	0.4	0.4	0.8	0.9	1.4	1.1	0.5	2.6	0.9	1.1	0.6	0.6	0.3
15	0.1	0.1	0.3	0.1	0.3	0.7	0.7	0.3	2.5	0.9	1.0	0.5	0.4	0.3
16	0.1	0.3	0.2	0.4	0.5	0.5	0.7	0.1	2.1	0.6	0.7	0.3	0.5	0.2
17	0.0	0.1	0.0	0.1	0.2	0.3	0.2	0.1	1.2	0.2	0.2	0.3	0.2	0.1
18	0.0	0.0	0.0	0.2	0.3	0.6	0.1	0.1	1.3	0.2	0.1	0.0	0.1	0.1
19	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0
1+	39.9	33.3	32.6	139.0	77.6	122.3	100.0	45.4	78.7	57.6	62.2	52.8	29.4	12.2
2+	39.9	33.3	32.6	139.0	77.6	122.3	100.0	45.4	78.7	57.6	62.2	52.8	29.4	12.2
3+	39.8	33.3	32.6	138.5	77.5	122.2	100.0	45.4	78.7	57.6	62.2	52.8	29.4	12.2
4+	39.2	33.0	32.4	136.1	77.0	120.7	99.9	45.4	78.7	57.5	62.1	52.7	29.3	12.1
5+	37.3	32.5	31.5	133.0	73.4	113.9	98.7	45.2	78.2	56.9	61.7	52.3	28.9	11.9
6+	32.2	30.5	29.6	125.0	69.1	105.1	91.6	43.3	75.5	54.7	59.7	49.8	27.6	10.9
7+	28.6	27.3	26.3	112.3	62.2	94.3	74.9	35.7	67.9	46.0	54.2	41.8	23.9	9.8
8+	21.7	22.6	17.5	79.6	47.9	78.7	55.3	26.7	53.4	30.8	42.3	31.5	17.9	8.1
9+	14.8	16.6	9.7	48.3	28.8	56.5	36.5	18.5	43.0	20.1	27.5	17.7	13.0	6.2
10+	9.7	10.1	5.5	26.4	16.1	29.2	20.5	12.0	32.5	14.2	17.8	10.4	8.5	4.2
11+	5.9	7.2	4.0	12.4	8.8	15.9	12.5	6.5	23.1	9.5	10.9	5.8	6.0	2.7
12+	2.9	4.2	2.7	6.7	5.9	10.4	7.4	3.5	17.5	6.8	7.7	3.8	4.3	1.8
13+	1.3	2.0	1.5	3.2	3.4	5.8	4.6	1.9	13.6	4.6	4.9	2.5	2.8	1.2
14+	0.9	0.9	0.9	1.7	2.4	3.6	2.9	1.2	9.8	2.9	3.2	1.7	1.8	1.0
15+	0.3	0.6	0.5	0.9	1.5	2.1	1.8	0.7	7.2	2.0	2.0	1.1	1.2	0.7
16+	0.2	0.4	0.2	0.8	1.2	1.4	1.2	0.3	4.7	1.1	1.1	0.6	0.8	0.5
17+	0.1	0.1	0.0	0.4	0.7	0.9	0.5	0.2	2.5	0.4	0.4	0.3	0.4	0.3
18+	0.0	0.0	0.0	0.3	0.5	0.6	0.2	0.1	1.4	0.2	0.2	0.0	0.2	0.1
19+	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0

Table 13. Results of ADAPT using Canadian RV data from 1979-90.

POPULATION NUMBERS (000S)

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	15600	16592	15992	12264	9494	8595	8086	6913	4587	2832	1306	5087
7	12534	12655	13583	13086	10039	7768	7034	6620	5657	3751	2307	1060
8	9481	10045	10251	11040	10688	8145	6348	5733	5338	4550	2907	1712
9	6305	7243	7780	8000	8871	8388	6571	4855	4371	4120	2964	1871
10	3834	4341	5263	5436	6209	6832	6322	4480	3420	3263	2318	1911
11	2551	2397	2898	3703	3750	4477	4552	4077	2809	2329	1618	1294
12	1839	1539	1419	1951	2034	2617	2577	2815	2313	1736	1039	688
13	1010	1190	767	899	1193	1368	1549	1586	1475	1139	834	370
14	550	623	645	359	563	745	803	1006	939	591	643	275
15	398	316	446	194	184	380	402	482	520	244	306	237
16	159	220	185	57	120	137	212	211	237	68	80	94
17	121	91	135	22	27	88	74	112	108	17	13	13
18	11	79	54	16	7	20	61	20	73	2	2	2
6+	54393	57329	59417	57027	53180	49560	44593	38911	31847	24644	16337	14614

FISHING MORTALITY

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	0.009	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.005	0.008	0.007
7	0.021	0.011	0.007	0.002	0.009	0.002	0.004	0.015	0.018	0.055	0.098	0.275
8	0.069	0.056	0.048	0.019	0.042	0.015	0.068	0.071	0.059	0.229	0.241	0.642
9	0.173	0.119	0.159	0.053	0.061	0.083	0.183	0.150	0.092	0.375	0.239	0.724
10	0.270	0.204	0.152	0.171	0.127	0.206	0.239	0.267	0.184	0.502	0.383	0.748
11	0.306	0.324	0.196	0.399	0.160	0.352	0.281	0.367	0.280	0.607	0.654	0.984
12	0.235	0.497	0.257	0.292	0.196	0.324	0.285	0.446	0.508	0.534	0.834	1.866
13	0.283	0.412	0.559	0.268	0.271	0.333	0.232	0.324	0.714	0.372	0.910	4.030
14	0.355	0.135	1.000	0.466	0.192	0.417	0.309	0.459	1.147	0.458	0.799	3.264
15	0.393	0.333	1.864	0.280	0.094	0.385	0.442	0.512	1.840	0.914	0.979	3.264
16	0.356	0.290	1.917	0.528	0.117	0.412	0.438	0.472	2.415	1.479	1.608	3.264
17	0.235	0.327	1.918	0.903	0.129	0.164	1.103	0.232	3.614	2.057	1.551	3.264
18	0.369	0.218	1.435	0.413	0.161	0.407	0.366	0.476	1.536	0.658	0.916	3.264

Table 13. Continued.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.026687
MEAN SQUARE RESIDUALS 0.250638

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
7	ABUNDANCE	1.06684E3	5.29440E2	2.01504E0	0.50
8	ABUNDANCE	1.73356E3	6.10703E2	2.83864E0	0.35
9	ABUNDANCE	1.89640E3	6.06940E2	3.12452E0	0.32
10	ABUNDANCE	1.93752E3	5.90410E2	3.28164E0	0.30
11	ABUNDANCE	1.31701E3	4.02993E2	3.26808E0	0.31
12	ABUNDANCE	7.09991E2	1.70383E2	4.16703E0	0.24
13	ABUNDANCE	3.90432E2	1.90417E1	2.05041E1	0.05
14	ABUNDANCE	2.68430E2	2.75408E1	1.04728E1	0.10
7	RV SLOPE	1.77583E-3	2.80908E-4	6.32174E0	0.16
8	RV SLOPE	1.84720E-3	2.82380E-4	6.54155E0	0.15
9	RV SLOPE	1.65833E-3	2.50346E-4	6.62414E0	0.15
10	RV SLOPE	1.37513E-3	2.05669E-4	6.68611E0	0.15
11	RV SLOPE	1.09786E-3	1.63663E-4	6.70802E0	0.15
12	RV SLOPE	1.31988E-3	1.98064E-4	6.66392E0	0.15
13	RV SLOPE	1.28672E-3	1.94676E-4	6.60956E0	0.15
14	RV SLOPE	1.49225E-3	2.29137E-4	6.51248E0	0.15

LOG RESIDUALS FOR RV SURVEY INDEX

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
7	-0.891	0.408	-0.492	-0.361	0.130	-0.390	0.183	0.293	0.203	0.479	0.437	0.000
8	-0.768	0.567	0.053	0.120	-0.009	-0.577	-0.080	0.053	0.455	0.565	-0.028	-0.351
9	-0.857	0.653	0.042	0.765	0.128	-0.702	0.025	-0.256	0.336	0.169	-0.017	-0.287
10	-1.135	0.921	0.071	0.635	-0.012	-0.480	0.151	-0.197	0.441	0.140	-0.129	-0.406
11	-0.694	0.849	-0.020	0.409	0.284	-0.406	0.197	-0.408	0.114	-0.136	0.063	-0.252
12	-0.658	0.657	0.328	0.655	0.080	-0.640	0.215	-0.390	0.031	-0.400	0.256	-0.133
13	-0.666	0.126	0.178	0.743	0.204	-0.834	0.720	-0.113	0.083	-0.575	0.144	-0.009
14	-0.673	-0.133	0.123	1.093	0.298	-0.717	0.869	-0.413	0.009	-0.293	-0.319	0.157

SUM OF RV 1 RESIDUALS : 0.0008438395 MEAN RESIDUAL : 0.0000087900

PARAMETER CORRELATION MATRIX

AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000	0.063	0.051	0.042	0.031	0.017	0.003	0.007	-0.301	-0.029	-0.020	-0.014	-0.009	-0.005	-0.001	-0.003
2	0.063	1.000	0.071	0.058	0.043	0.023	0.004	0.010	-0.210	-0.245	-0.028	-0.019	-0.012	-0.006	-0.002	-0.003
3	0.051	0.071	1.000	0.074	0.052	0.027	0.005	0.012	-0.168	-0.175	-0.227	-0.024	-0.014	-0.008	-0.002	-0.004
4	0.042	0.058	0.074	1.000	0.067	0.032	0.006	0.014	-0.138	-0.141	-0.164	-0.215	-0.018	-0.009	-0.003	-0.005
5	0.031	0.043	0.052	0.067	1.000	0.042	0.007	0.016	-0.104	-0.103	-0.110	-0.145	-0.227	-0.012	-0.003	-0.006
6	0.017	0.023	0.027	0.032	0.042	1.000	0.009	0.018	-0.055	-0.054	-0.056	-0.063	-0.097	-0.266	-0.004	-0.006
7	0.003	0.004	0.005	0.006	0.007	0.009	1.000	0.023	-0.010	-0.010	-0.010	-0.011	-0.014	-0.024	-0.288	-0.008
8	0.007	0.010	0.012	0.014	0.016	0.018	0.023	1.000	-0.025	-0.024	-0.025	-0.027	-0.033	-0.044	-0.073	-0.338
9	-0.301	-0.210	-0.168	-0.138	-0.104	-0.055	-0.010	-0.025	1.000	0.097	0.067	0.045	0.029	0.016	0.004	0.008
10	-0.029	-0.245	-0.175	-0.141	-0.103	-0.054	-0.010	-0.024	0.097	1.000	0.069	0.045	0.028	0.015	0.004	0.008
11	-0.020	-0.028	-0.227	-0.164	-0.110	-0.056	-0.010	-0.025	0.067	0.069	1.000	0.051	0.030	0.016	0.005	0.008
12	-0.014	-0.019	-0.024	-0.215	-0.145	-0.063	-0.011	-0.027	0.045	0.045	0.051	1.000	0.039	0.018	0.005	0.009
13	-0.009	-0.012	-0.014	-0.018	-0.227	-0.097	-0.014	-0.033	0.029	0.028	0.030	0.039	1.000	0.027	0.006	0.011
14	-0.005	-0.006	-0.008	-0.009	-0.012	-0.266	-0.024	-0.044	0.016	0.015	0.016	0.018	0.027	1.000	0.010	0.015
15	-0.001	-0.002	-0.002	-0.003	-0.003	-0.004	-0.288	-0.073	0.004	0.004	0.005	0.005	0.006	0.010	1.000	0.025
16	-0.003	-0.003	-0.004	-0.005	-0.006	-0.006	-0.008	-0.338	0.008	0.008	0.008	0.009	0.011	0.015	0.025	1.000

Table 14. Results of ADAPT using Canadian C/E data from 1974-90.

POPULATION NUMBERS (000S)

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
6	14374	12067	12603	14440	15396	15765	17560	17946	14188	11908	11809	11808	14731	16512	21265	24263
7	13152	11474	9526	10209	11806	12561	12790	14375	14686	11615	9745	9665	9665	12058	13514	17399
8	10387	9951	8635	7397	8238	9489	10067	10362	11689	11998	9434	7966	7888	7832	9791	10901
9	6375	7700	7495	6059	5757	6309	7249	7798	8091	9402	9460	7627	6180	6135	6161	7254
10	5360	4188	5722	4766	4234	3841	4344	5268	5451	6283	7267	7200	5344	4505	4707	3969
11	3440	3246	3082	3539	3083	2552	2403	2900	3707	3762	4538	4908	4796	3517	3217	2800
12	2694	2168	2275	1638	2036	1840	1539	1425	1953	2037	2627	2627	3106	2902	2317	1767
13	2052	1489	1331	1215	1030	1010	1191	767	903	1194	1371	1557	1627	1714	1621	1309
14	1149	955	892	674	735	551	623	646	359	567	746	805	1013	973	787	1037
15	766	559	549	529	330	398	316	446	195	185	383	403	484	526	272	466
16	543	459	402	303	231	159	220	185	57	121	138	214	212	238	72	102
17	439	266	293	214	35	121	91	135	22	27	88	75	114	109	19	16
18	410	240	146	195	33	11	79	54	16	7	20	61	20	74	3	3
6+	61142	54761	52951	51177	52946	54606	58472	62307	61316	59106	57627	54917	55181	57094	63747	71307

AGE	1990
6	30634
7	19856
8	14069
9	8416
10	5424
11	2662
12	1657
13	965
14	663
15	560
16	225
17	31
18	5
6+	85167

FISHING MORTALITY

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	0.025	0.036	0.011	0.001	0.004	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001
7	0.079	0.084	0.053	0.015	0.019	0.021	0.011	0.007	0.002	0.008	0.002	0.003	0.010	0.008	0.015	0.012	0.013
8	0.099	0.083	0.154	0.051	0.067	0.069	0.055	0.047	0.018	0.038	0.013	0.054	0.051	0.040	0.100	0.059	0.060
9	0.220	0.097	0.253	0.158	0.205	0.173	0.119	0.158	0.053	0.058	0.073	0.156	0.116	0.065	0.235	0.091	0.123
10	0.302	0.107	0.280	0.236	0.306	0.269	0.204	0.151	0.171	0.125	0.192	0.206	0.218	0.137	0.319	0.204	0.207
11	0.262	0.156	0.432	0.353	0.316	0.306	0.323	0.195	0.399	0.159	0.347	0.257	0.303	0.217	0.399	0.325	0.367
12	0.393	0.287	0.427	0.263	0.501	0.235	0.497	0.256	0.292	0.196	0.323	0.279	0.395	0.382	0.371	0.405	0.445
13	0.565	0.312	0.481	0.304	0.427	0.283	0.412	0.559	0.266	0.270	0.333	0.230	0.314	0.578	0.247	0.479	0.500
14	0.521	0.355	0.323	0.514	0.413	0.355	0.135	0.999	0.466	0.191	0.416	0.308	0.455	1.076	0.323	0.417	0.534
15	0.312	0.129	0.395	0.627	0.531	0.393	0.333	1.863	0.260	0.094	0.381	0.441	0.510	1.785	0.774	0.528	0.548
16	0.515	0.247	0.429	1.953	0.444	0.355	0.289	1.915	0.527	0.117	0.412	0.432	0.470	2.351	1.286	0.982	0.541
17	0.404	0.398	0.209	1.660	0.991	0.235	0.327	1.917	0.900	0.129	0.164	1.099	0.228	3.404	1.676	0.938	0.541
18	0.455	0.266	0.368	0.842	0.448	0.368	0.218	1.433	0.412	0.160	0.405	0.364	0.472	1.466	0.493	0.485	0.541

Table 14. Continued.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.015218
MEAN SQUARE RESIDUALS 0.224338

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
8	ABUNDANCE	1.41061E4	6.79161E3	2.07698E0	0.48
9	ABUNDANCE	8.44699E3	2.93426E3	2.87874E0	0.35
10	ABUNDANCE	5.45147E3	1.61798E3	3.36930E0	0.30
11	ABUNDANCE	2.68313E3	7.75730E2	3.45884E0	0.29
12	ABUNDANCE	1.67154E3	4.91973E2	3.39763E0	0.29
13	ABUNDANCE	9.74689E2	2.95356E2	3.30005E0	0.30
14	ABUNDANCE	6.70393E2	2.00368E2	3.34581E0	0.30
15	ABUNDANCE	5.65685E2	1.67063E2	3.38607E0	0.30
8	RV SLOPE	8.72542E-4	1.07493E-4	8.11720E0	0.12
9	RV SLOPE	1.98418E-3	2.38085E-4	8.33391E0	0.12
10	RV SLOPE	3.04467E-3	3.61592E-4	8.42018E0	0.12
11	RV SLOPE	3.71188E-3	4.39798E-4	8.43997E0	0.12
12	RV SLOPE	4.13237E-3	4.89839E-4	8.43618E0	0.12
13	RV SLOPE	4.15739E-3	4.93914E-4	8.41723E0	0.12
14	RV SLOPE	4.19547E-3	5.00369E-4	8.38475E0	0.12
15	RV SLOPE	4.13296E-3	4.91141E-4	8.41504E0	0.12

LOG RESIDUALS FOR COMMERCIAL C/E INDEX

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	198
8	-0.358	0.106	0.213	-0.591	-0.170	-0.007	0.320	0.416	-0.322	0.371	-0.760	0.423	0.035	-0.483	0.610	0.19
9	-0.371	-0.569	-0.131	-0.291	0.108	0.086	0.142	0.743	-0.304	-0.039	0.200	0.685	0.005	-0.489	0.677	-0.26
10	-0.482	-0.937	-0.472	-0.364	0.015	0.101	0.107	0.253	0.721	0.249	0.656	0.513	0.084	-0.573	0.551	-0.17
11	-0.770	-0.756	-0.280	-0.198	-0.066	0.040	0.237	0.309	0.962	0.166	0.844	0.512	-0.239	-0.741	0.177	-0.18
12	-0.454	-0.288	-0.394	-0.596	0.212	-0.304	0.413	0.358	0.630	0.234	0.541	0.535	-0.061	-0.491	-0.221	-0.16
13	-0.124	-0.244	-0.293	-0.485	0.045	-0.158	0.104	0.054	0.415	0.510	0.624	0.298	-0.272	-0.179	-0.586	0.18
14	-0.205	-0.101	-0.684	-0.023	-0.065	0.056	-1.110	-0.242	0.761	0.260	0.660	0.610	0.132	0.253	-0.679	0.15
15	-0.660	-1.102	-0.513	0.207	0.276	0.182	-0.263	-1.093	0.167	-0.314	0.632	1.007	0.475	0.844	-0.249	0.17

AGE	1990
8	0.000
9	-0.183
10	-0.251
11	-0.012
12	0.051
13	0.107
14	0.227
15	0.226

SUM OF RV 1 RESIDUALS : -0.0000234789 MEAN RESIDUAL : -0.0000001726

Table 14. Continued.

PARAMETER CORRELATION MATRIX

AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000	0.047	0.038	0.029	0.023	0.018	0.016	0.013	0.252	0.020	0.014	0.011	0.008	0.007	0.005	0.004
2	0.047	1.000	0.054	0.041	0.033	0.026	0.022	0.018	0.185	0.193	0.020	0.015	0.012	0.009	0.008	0.006
3	0.038	0.054	1.000	0.054	0.041	0.032	0.028	0.022	0.149	0.158	0.171	0.019	0.015	0.012	0.010	0.008
4	0.029	0.041	0.054	1.000	0.052	0.039	0.034	0.027	0.115	0.121	0.143	0.173	0.018	0.014	0.012	0.009
5	0.023	0.033	0.041	0.052	1.000	0.050	0.042	0.034	0.093	0.095	0.104	0.134	0.180	0.018	0.014	0.012
6	0.018	0.026	0.032	0.039	0.050	1.000	0.055	0.044	0.072	0.074	0.080	0.095	0.131	0.188	0.019	0.015
7	0.016	0.022	0.028	0.034	0.042	0.055	1.000	0.002	0.062	0.064	0.071	0.083	0.104	0.146	0.223	0.080
8	0.013	0.018	0.022	0.027	0.034	0.044	0.002	1.000	0.051	0.052	0.055	0.066	0.085	0.114	0.151	0.243
9	0.252	0.185	0.149	0.115	0.093	0.072	0.062	0.051	1.000	0.080	0.055	0.042	0.033	0.027	0.022	0.017
10	0.020	0.193	0.158	0.121	0.095	0.074	0.064	0.052	0.080	1.000	0.058	0.043	0.034	0.027	0.022	0.018
11	0.014	0.020	0.171	0.143	0.104	0.080	0.071	0.055	0.055	0.058	1.000	0.049	0.037	0.030	0.024	0.019
12	0.011	0.015	0.019	0.173	0.134	0.095	0.083	0.066	0.042	0.043	0.049	1.000	0.046	0.035	0.028	0.023
13	0.008	0.012	0.015	0.018	0.180	0.131	0.104	0.085	0.033	0.034	0.037	0.046	1.000	0.046	0.036	0.029
14	0.007	0.009	0.012	0.014	0.018	0.188	0.146	0.114	0.027	0.027	0.030	0.035	0.046	1.000	0.050	0.039
15	0.005	0.008	0.010	0.012	0.014	0.019	0.223	0.151	0.022	0.022	0.024	0.028	0.036	0.050	1.000	0.054
16	0.004	0.006	0.008	0.009	0.012	0.015	0.080	0.243	0.017	0.018	0.019	0.023	0.029	0.039	0.054	1.000

Table 15. Results of ADAPT using Canadian RV and C/E data from 1979-90.

POPULATION NUMBERS (000S)

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	15640	16828	16380	12818	10113	9560	9120	9057	7424	5617	1529	12441
7	12540	12688	13776	13403	10493	8275	7823	7464	7413	6073	4587	1242
8	9483	10050	10278	11198	10948	8516	6763	6380	6030	5987	4809	3579
9	6306	7244	7784	8022	9000	8601	6875	5195	4900	4686	4140	3428
10	3836	4341	5264	5439	6227	6938	6496	4729	3698	3696	2781	2874
11	2551	2398	2898	3704	3753	4492	4639	4220	3013	2557	1973	1673
12	1840	1539	1421	1951	2034	2619	2589	2886	2430	1905	1226	979
13	1010	1190	767	900	1193	1369	1551	1596	1533	1235	971	522
14	550	623	645	359	564	745	803	1007	947	639	721	387
15	398	316	446	194	184	381	402	483	522	251	345	301
16	159	220	185	57	120	137	213	212	237	69	86	126
17	121	91	135	22	27	88	74	112	108	18	14	18
18	11	79	54	16	7	20	61	20	73	3	2	3
6+	54445	57608	60033	58085	54665	51741	47410	43361	38328	32735	23183	27574

FISHING MORTALITY

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
6	0.009	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.002	0.007	0.003
7	0.021	0.011	0.007	0.002	0.009	0.002	0.004	0.013	0.014	0.033	0.048	0.230
8	0.069	0.056	0.048	0.019	0.041	0.014	0.064	0.064	0.052	0.169	0.139	0.259
9	0.173	0.119	0.158	0.053	0.060	0.081	0.174	0.140	0.082	0.322	0.165	0.333
10	0.270	0.204	0.152	0.171	0.127	0.203	0.231	0.251	0.169	0.428	0.308	0.434
11	0.306	0.324	0.196	0.399	0.160	0.351	0.275	0.352	0.259	0.535	0.501	0.666
12	0.235	0.497	0.257	0.292	0.196	0.324	0.284	0.433	0.477	0.474	0.653	0.923
13	0.283	0.412	0.559	0.267	0.271	0.333	0.231	0.321	0.675	0.338	0.720	1.267
14	0.355	0.135	1.000	0.466	0.192	0.417	0.309	0.458	1.129	0.415	0.674	1.211
15	0.393	0.333	1.864	0.280	0.094	0.384	0.442	0.512	1.826	0.875	0.807	1.487
16	0.356	0.290	1.917	0.527	0.117	0.412	0.436	0.472	2.401	1.426	1.381	1.332
17	0.235	0.327	1.918	0.902	0.129	0.164	1.102	0.231	3.559	1.957	1.328	1.332
18	0.369	0.218	1.435	0.413	0.161	0.407	0.366	0.475	1.519	0.608	0.767	1.332

Table 15. Continued.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001426
MEAN SQUARE RESIDUALS 0.289624

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
7	ABUNDANCE	1.24930E3	6.72614E2	1.85738E0	0.54
8	ABUNDANCE	3.60065E3	1.13775E3	3.16472E0	0.32
9	ABUNDANCE	3.45251E3	8.99897E2	3.83656E0	0.26
10	ABUNDANCE	2.89965E3	6.86980E2	4.22087E0	0.24
11	ABUNDANCE	1.69477E3	4.01756E2	4.21841E0	0.24
12	ABUNDANCE	9.95527E2	2.36666E2	4.20647E0	0.24
13	ABUNDANCE	5.33939E2	1.18607E2	4.50176E0	0.22
14	ABUNDANCE	3.95060E2	9.00271E1	4.38823E0	0.23
15	ABUNDANCE	3.08479E2	6.26944E1	4.92036E0	0.20
7	RV SLOPE	2.28605E-3	3.84740E-4	5.94182E0	0.17
8	RV SLOPE	2.37920E-3	3.83844E-4	6.19834E0	0.16
9	RV SLOPE	2.23731E-3	3.56654E-4	6.27305E0	0.16
10	RV SLOPE	1.92648E-3	3.05292E-4	6.31029E0	0.16
11	RV SLOPE	1.56436E-3	2.47559E-4	6.31915E0	0.16
12	RV SLOPE	1.86200E-3	2.94857E-4	6.31493E0	0.16
13	RV SLOPE	1.77987E-3	2.82512E-4	6.30015E0	0.16
14	RV SLOPE	2.10083E-3	3.34310E-4	6.28407E0	0.16
15	RV SLOPE	2.59374E-3	4.12969E-4	6.28071E0	0.16
8	C/E SLOPE	1.26545E-3	2.04407E-4	6.19085E0	0.16
9	C/E SLOPE	2.71190E-3	4.32828E-4	6.26554E0	0.16
10	C/E SLOPE	4.28267E-3	6.79636E-4	6.30142E0	0.16
11	C/E SLOPE	5.03153E-3	7.97989E-4	6.30527E0	0.16
12	C/E SLOPE	5.36128E-3	8.51872E-4	6.29353E0	0.16
13	C/E SLOPE	5.21890E-3	8.32689E-4	6.26603E0	0.16
14	C/E SLOPE	5.16841E-3	8.27173E-4	6.24828E0	0.16
15	C/E SLOPE	5.37659E-3	8.62938E-4	6.23056E0	0.16

Table 15. Continued.

LOG RESIDUALS FOR CANADIAN RV SURVEY INDEX

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
7	-0.725	0.571	-0.340	-0.219	0.252	-0.287	0.243	0.339	0.098	0.159	-0.093	-0.000
8	-0.603	0.732	0.216	0.271	0.132	-0.456	0.022	0.111	0.498	0.446	-0.382	-0.986
9	-0.738	0.772	0.161	0.881	0.233	-0.608	0.097	-0.206	0.339	0.151	-0.244	-0.838
10	-1.054	1.003	0.152	0.716	0.067	-0.414	0.204	-0.172	0.442	0.084	-0.242	-0.785
11	-0.629	0.913	0.044	0.473	0.348	-0.345	0.241	-0.380	0.105	-0.177	-0.096	-0.497
12	-0.583	0.732	0.401	0.730	0.154	-0.567	0.285	-0.342	0.051	-0.427	0.135	-0.568
13	-0.572	0.221	0.272	0.836	0.298	-0.740	0.813	-0.026	0.132	-0.567	0.055	-0.722
14	-0.596	-0.057	0.199	1.169	0.373	-0.641	0.945	-0.338	0.074	-0.301	-0.378	-0.450
15	-0.704	-1.701	-0.512	0.826	0.805	-0.552	1.413	0.250	0.444	0.412	-0.270	-0.410

SUM OF RV RESIDUALS : 0.0000050095 MEAN RESIDUAL : 0.0000000464

LOG RESIDUALS FOR CANADIAN C/E INDEX

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
8	-0.378	-0.050	0.052	-0.651	0.091	-1.029	0.218	-0.122	-0.590	0.747	0.664	1.047
9	-0.226	-0.169	0.433	-0.608	-0.307	-0.015	0.481	-0.128	-0.573	0.660	-0.003	0.455
10	-0.238	-0.234	-0.088	0.382	-0.083	0.366	0.280	-0.127	-0.709	0.479	-0.129	0.099
11	-0.264	-0.065	0.005	0.659	-0.136	0.551	0.269	-0.403	-0.880	0.136	-0.095	0.223
12	-0.564	0.153	0.100	0.370	-0.025	0.284	0.291	-0.238	-0.550	-0.259	0.002	0.436
13	-0.385	-0.123	-0.173	0.192	0.284	0.398	0.075	-0.478	-0.271	-0.519	0.315	0.685
14	-0.153	-1.319	-0.450	0.553	0.057	0.453	0.403	-0.071	0.084	-0.656	0.372	0.727
15	-0.081	-0.526	-1.356	-0.094	-0.576	0.375	0.746	0.216	0.599	-0.408	0.286	0.819

SUM OF C/E RESIDUALS : 0.0000060286 MEAN RESIDUAL : 0.0000000628

Table 15. Continued.

PARAMETER CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000	0.055	0.044	0.036	0.027	0.020	0.013	0.011	0.008	-0.298	-0.021	-0.014	-0.010	-0.007	-0.005	-0.004
2	0.055	1.000	0.074	0.060	0.045	0.033	0.021	0.019	0.014	-0.185	-0.192	-0.023	-0.016	-0.011	-0.008	-0.006
3	0.044	0.074	1.000	0.079	0.059	0.042	0.027	0.024	0.017	-0.147	-0.148	-0.163	-0.021	-0.015	-0.010	-0.008
4	0.036	0.060	0.079	1.000	0.075	0.051	0.032	0.029	0.021	-0.120	-0.120	-0.130	-0.149	-0.018	-0.013	-0.009
5	0.027	0.045	0.059	0.075	1.000	0.064	0.038	0.034	0.024	-0.091	-0.090	-0.093	-0.115	-0.155	-0.016	-0.011
6	0.020	0.033	0.042	0.051	0.064	1.000	0.051	0.041	0.029	-0.067	-0.066	-0.066	-0.072	-0.100	-0.167	-0.014
7	0.013	0.021	0.027	0.032	0.038	0.051	1.000	0.055	0.038	-0.042	-0.042	-0.042	-0.045	-0.054	-0.085	-0.177
8	0.011	0.019	0.024	0.029	0.034	0.041	0.055	1.000	0.040	-0.038	-0.037	-0.037	-0.041	-0.048	-0.062	-0.096
9	0.008	0.014	0.017	0.021	0.024	0.029	0.038	0.040	1.000	-0.028	-0.027	-0.027	-0.029	-0.034	-0.045	-0.066
10	-0.298	-0.185	-0.147	-0.120	-0.091	-0.067	-0.042	-0.038	-0.028	1.000	0.072	0.047	0.032	0.023	0.017	0.012
11	-0.021	-0.192	-0.148	-0.120	-0.090	-0.066	-0.042	-0.037	-0.027	0.072	1.000	0.047	0.032	0.023	0.016	0.012
12	-0.014	-0.023	-0.163	-0.130	-0.093	-0.066	-0.042	-0.037	-0.027	0.047	0.047	1.000	0.034	0.023	0.016	0.012
13	-0.010	-0.016	-0.021	-0.149	-0.115	-0.072	-0.045	-0.041	-0.029	0.032	0.032	0.034	1.000	0.027	0.018	0.013
14	-0.007	-0.011	-0.015	-0.018	-0.155	-0.100	-0.054	-0.048	-0.034	0.023	0.023	0.023	0.027	1.000	0.024	0.015
15	-0.005	-0.008	-0.010	-0.013	-0.016	-0.167	-0.085	-0.062	-0.045	0.017	0.016	0.016	0.018	0.024	1.000	0.022
16	-0.004	-0.006	-0.008	-0.009	-0.011	-0.014	-0.177	-0.096	-0.066	0.012	0.012	0.012	0.013	0.015	0.022	1.000
17	-0.003	-0.005	-0.006	-0.007	-0.009	-0.011	-0.014	-0.198	-0.096	0.010	0.010	0.010	0.010	0.012	0.016	0.024
18	-0.002	-0.004	-0.005	-0.006	-0.007	-0.008	-0.011	-0.052	-0.215	0.008	0.007	0.007	0.008	0.009	0.012	0.018
19	-0.022	-0.196	-0.150	-0.121	-0.091	-0.066	-0.042	-0.038	-0.027	0.073	0.074	0.047	0.032	0.023	0.016	0.012
20	-0.014	-0.024	-0.167	-0.132	-0.096	-0.067	-0.043	-0.038	-0.027	0.048	0.048	0.051	0.034	0.024	0.017	0.012
21	-0.010	-0.017	-0.022	-0.155	-0.118	-0.074	-0.046	-0.042	-0.029	0.033	0.033	0.035	0.040	0.028	0.018	0.013
22	-0.007	-0.012	-0.015	-0.019	-0.165	-0.105	-0.057	-0.050	-0.035	0.024	0.024	0.024	0.029	0.038	0.025	0.016
23	-0.005	-0.009	-0.011	-0.014	-0.017	-0.182	-0.091	-0.065	-0.047	0.018	0.018	0.018	0.019	0.025	0.041	0.024
24	-0.004	-0.007	-0.008	-0.010	-0.012	-0.015	-0.202	-0.103	-0.069	0.013	0.013	0.013	0.014	0.017	0.025	0.047
25	-0.003	-0.005	-0.007	-0.008	-0.010	-0.012	-0.016	-0.221	-0.102	0.011	0.011	0.011	0.012	0.014	0.018	0.027
26	-0.003	-0.004	-0.005	-0.006	-0.008	-0.009	-0.012	-0.057	-0.247	0.009	0.008	0.008	0.009	0.011	0.014	0.021

	17	18	19	20	21	22	23	24	25	26
1	-0.003	-0.002	-0.022	-0.014	-0.010	-0.007	-0.005	-0.004	-0.003	-0.003
2	-0.005	-0.004	-0.196	-0.024	-0.017	-0.012	-0.009	-0.007	-0.005	-0.004
3	-0.006	-0.005	-0.150	-0.167	-0.022	-0.015	-0.011	-0.008	-0.007	-0.005
4	-0.007	-0.006	-0.121	-0.132	-0.155	-0.019	-0.014	-0.010	-0.008	-0.006
5	-0.009	-0.007	-0.091	-0.096	-0.118	-0.165	-0.017	-0.012	-0.010	-0.008
6	-0.011	-0.008	-0.066	-0.067	-0.074	-0.105	-0.182	-0.015	-0.012	-0.009
7	-0.014	-0.011	-0.042	-0.043	-0.046	-0.057	-0.091	-0.202	-0.016	-0.012
8	-0.198	-0.052	-0.038	-0.038	-0.042	-0.050	-0.065	-0.103	-0.221	-0.057
9	-0.096	-0.215	-0.027	-0.027	-0.029	-0.035	-0.047	-0.069	-0.102	-0.247
10	0.010	0.008	0.073	0.048	0.033	0.024	0.018	0.013	0.011	0.009
11	0.010	0.007	0.074	0.048	0.033	0.024	0.018	0.013	0.011	0.008
12	0.010	0.007	0.047	0.051	0.035	0.024	0.018	0.013	0.011	0.008
13	0.010	0.008	0.032	0.034	0.040	0.029	0.019	0.014	0.012	0.009
14	0.012	0.009	0.023	0.024	0.028	0.038	0.025	0.017	0.014	0.011
15	0.016	0.012	0.016	0.017	0.018	0.025	0.041	0.025	0.018	0.014
16	0.024	0.018	0.012	0.012	0.013	0.016	0.024	0.047	0.027	0.021
17	1.000	0.029	0.010	0.010	0.011	0.013	0.017	0.026	0.052	0.033
18	0.029	1.000	0.007	0.007	0.008	0.010	0.013	0.019	0.031	0.055
19	0.010	0.007	1.000	0.048	0.033	0.024	0.018	0.013	0.011	0.008
20	0.010	0.007	0.048	1.000	0.035	0.025	0.018	0.013	0.011	0.008
21	0.011	0.008	0.033	0.035	1.000	0.029	0.020	0.014	0.012	0.009
22	0.013	0.010	0.024	0.025	0.029	1.000	0.027	0.018	0.014	0.011
23	0.017	0.013	0.018	0.018	0.020	0.027	1.000	0.026	0.019	0.015
24	0.026	0.019	0.013	0.013	0.014	0.018	0.026	1.000	0.029	0.022
25	0.052	0.031	0.011	0.011	0.012	0.014	0.019	0.029	1.000	0.035
26	0.033	0.055	0.008	0.008	0.009	0.011	0.015	0.022	0.035	1.000

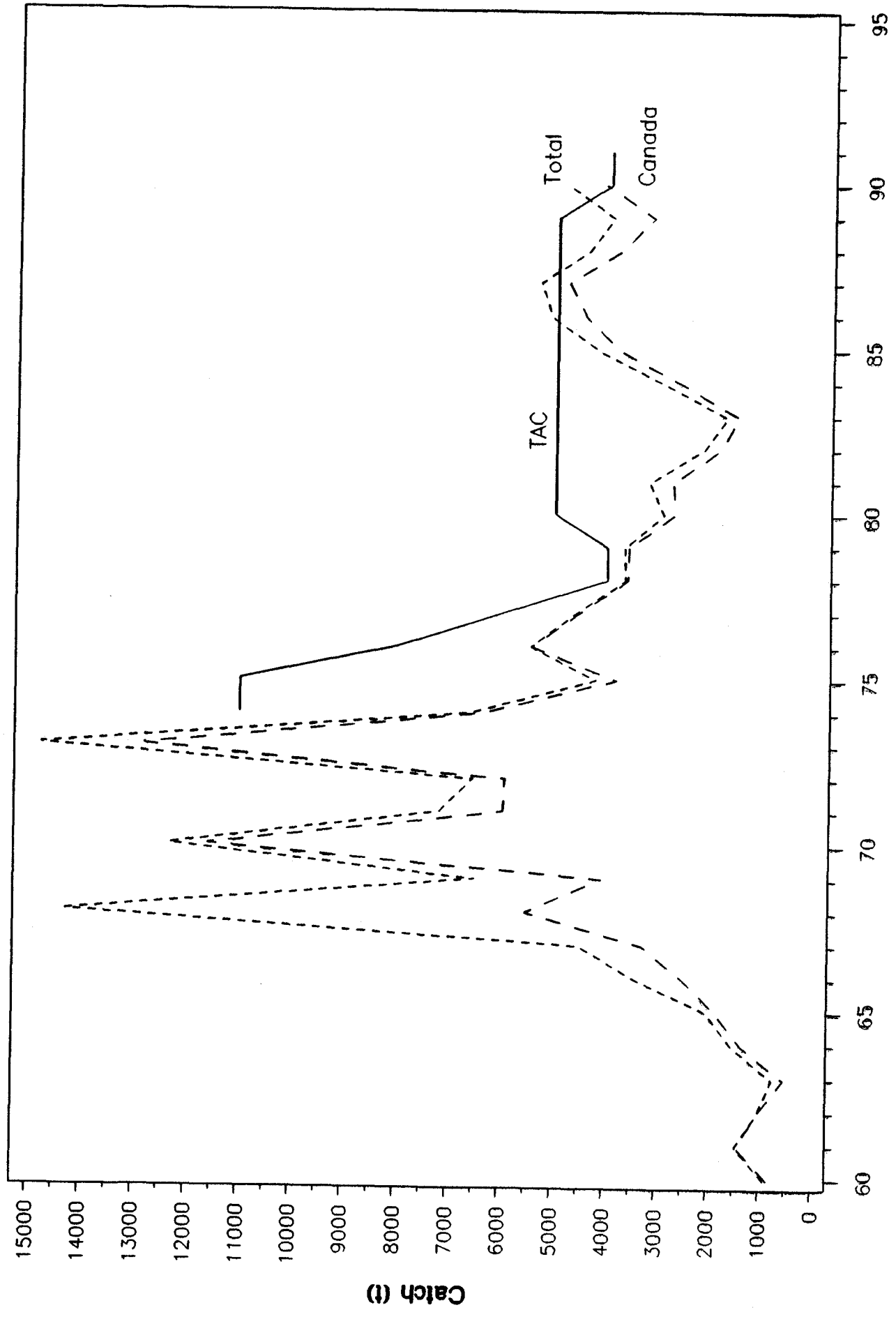

Fig.1. Catches and TAC's of A.plaice in 3Ps from 1960-91.

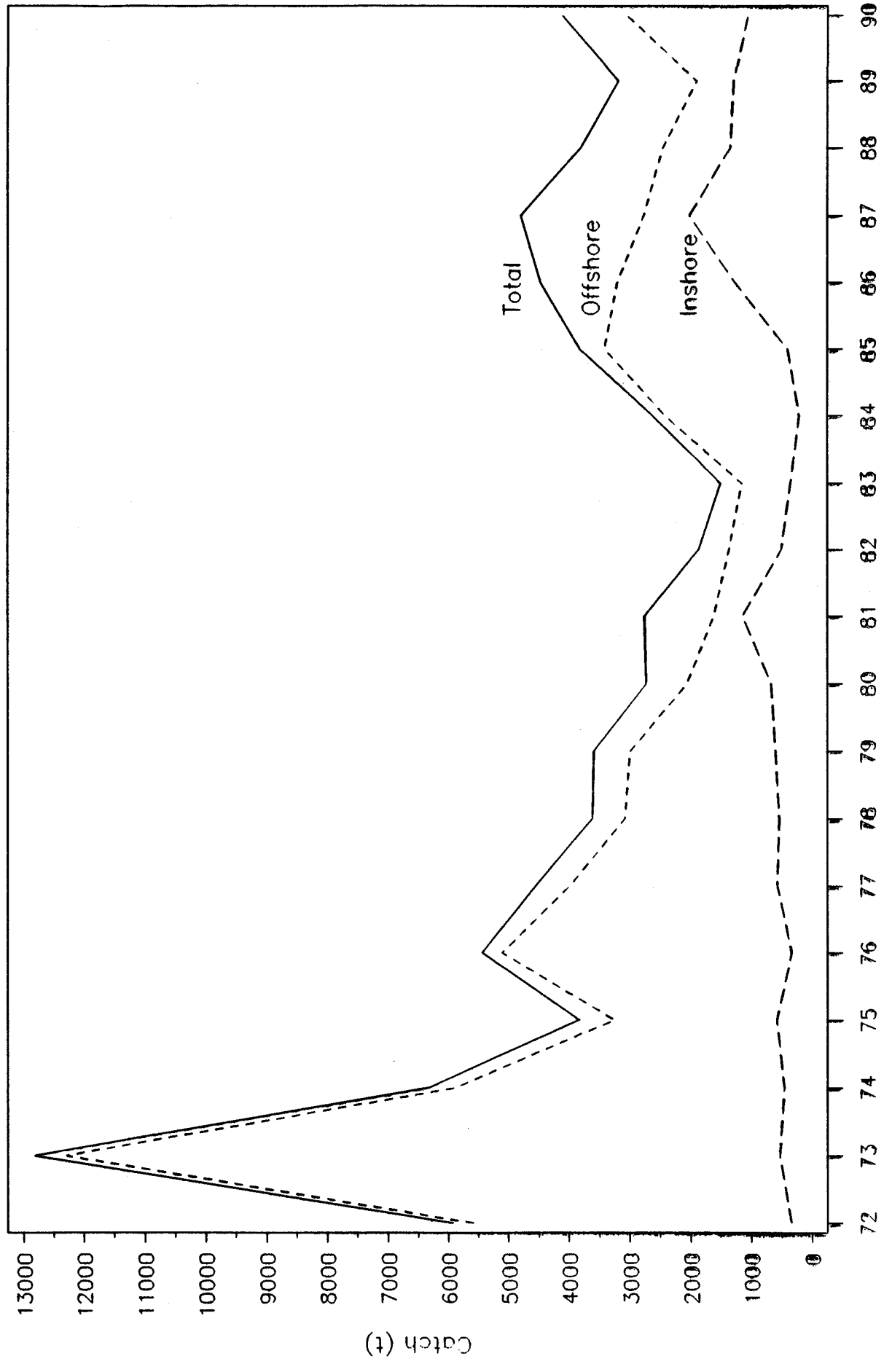

Fig.2. Catches of A.plaice in 3Ps by Canadian vessels from 1972-90.

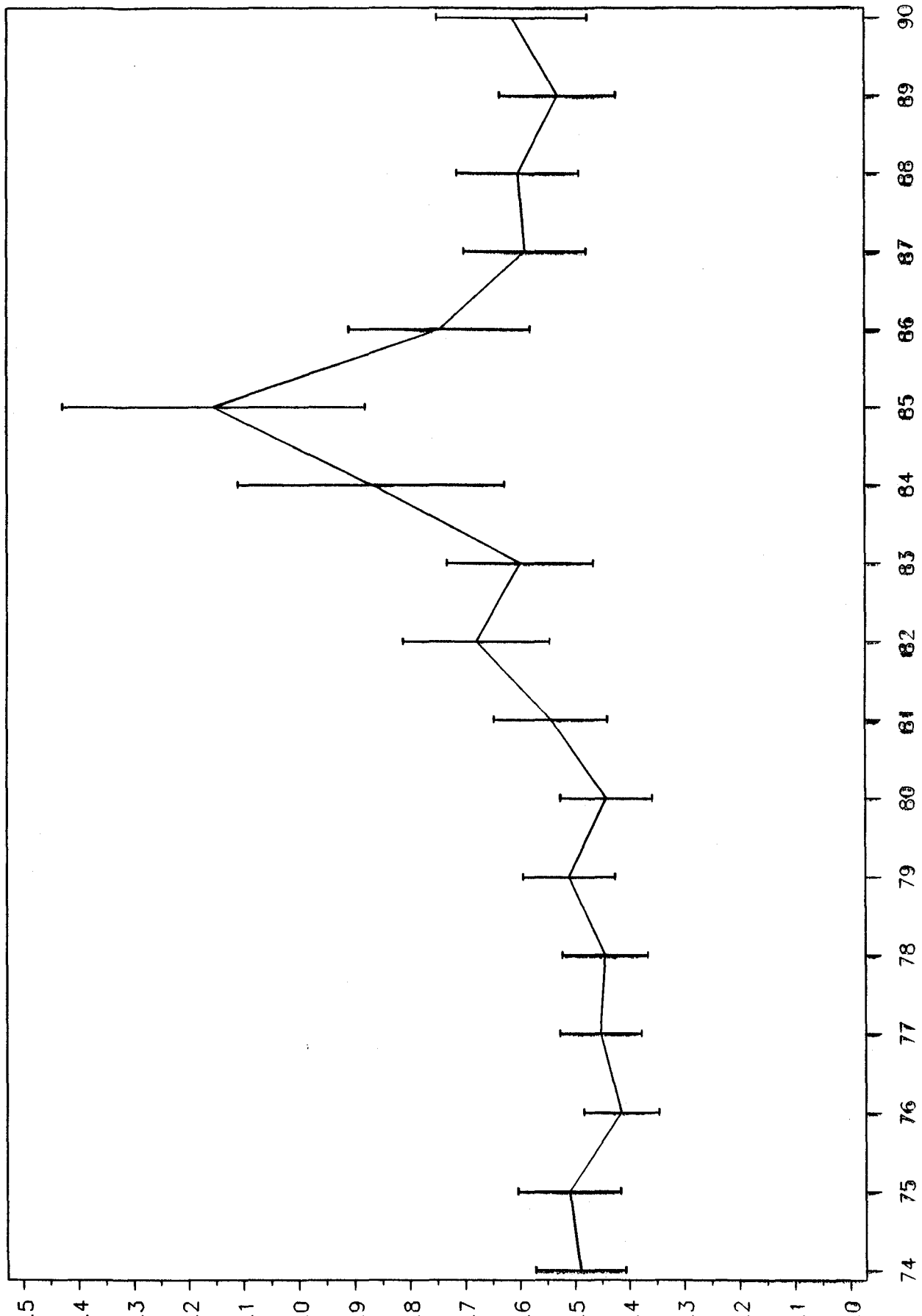

Fig.3. C/E index (with approx 90% C.I.) from the Canadian fishery for A.plaice in 3Ps from 1974-90.

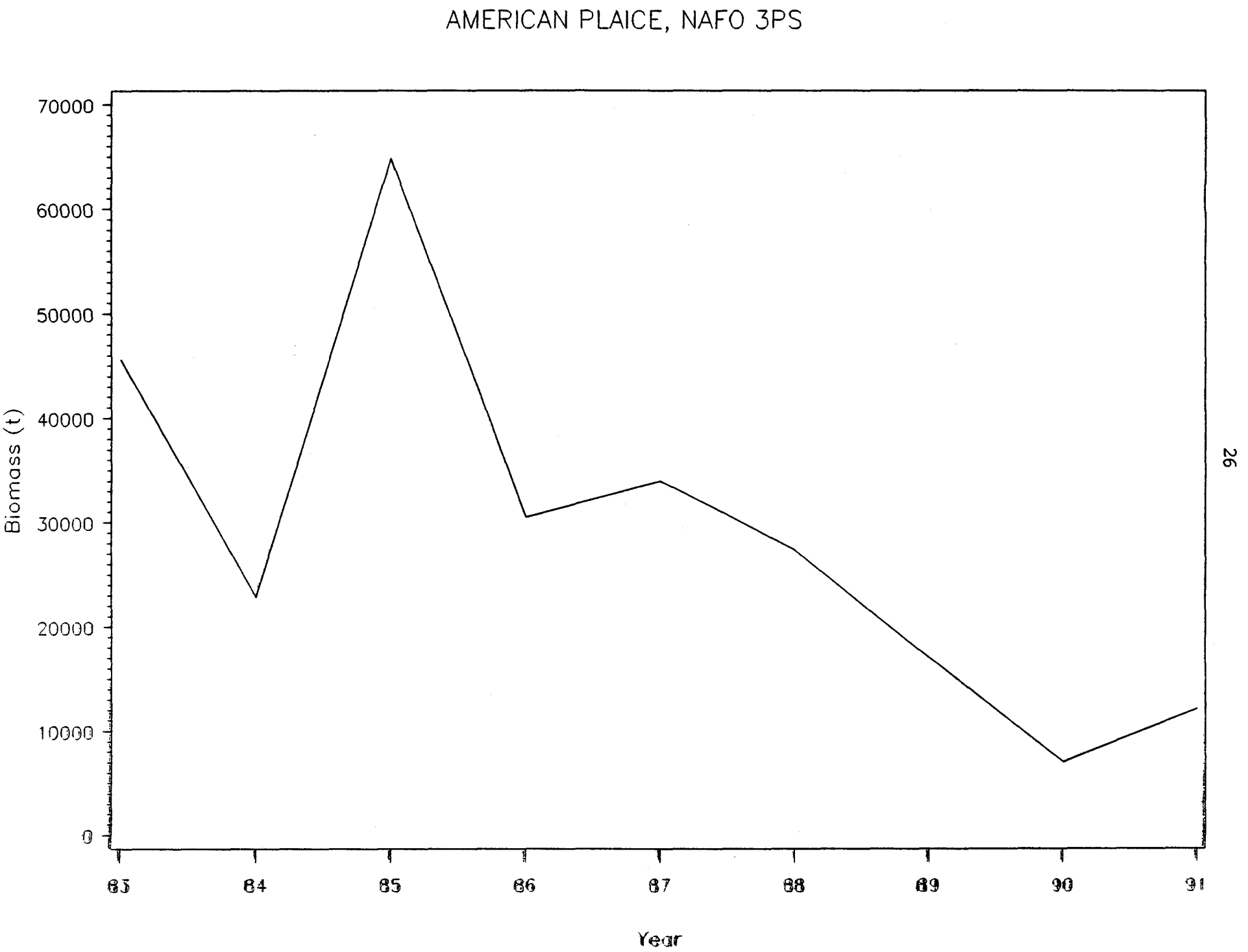

Fig.4. Biomass index for A.plaice from Canadian research vessel surveys in 3Ps from 1983-91.

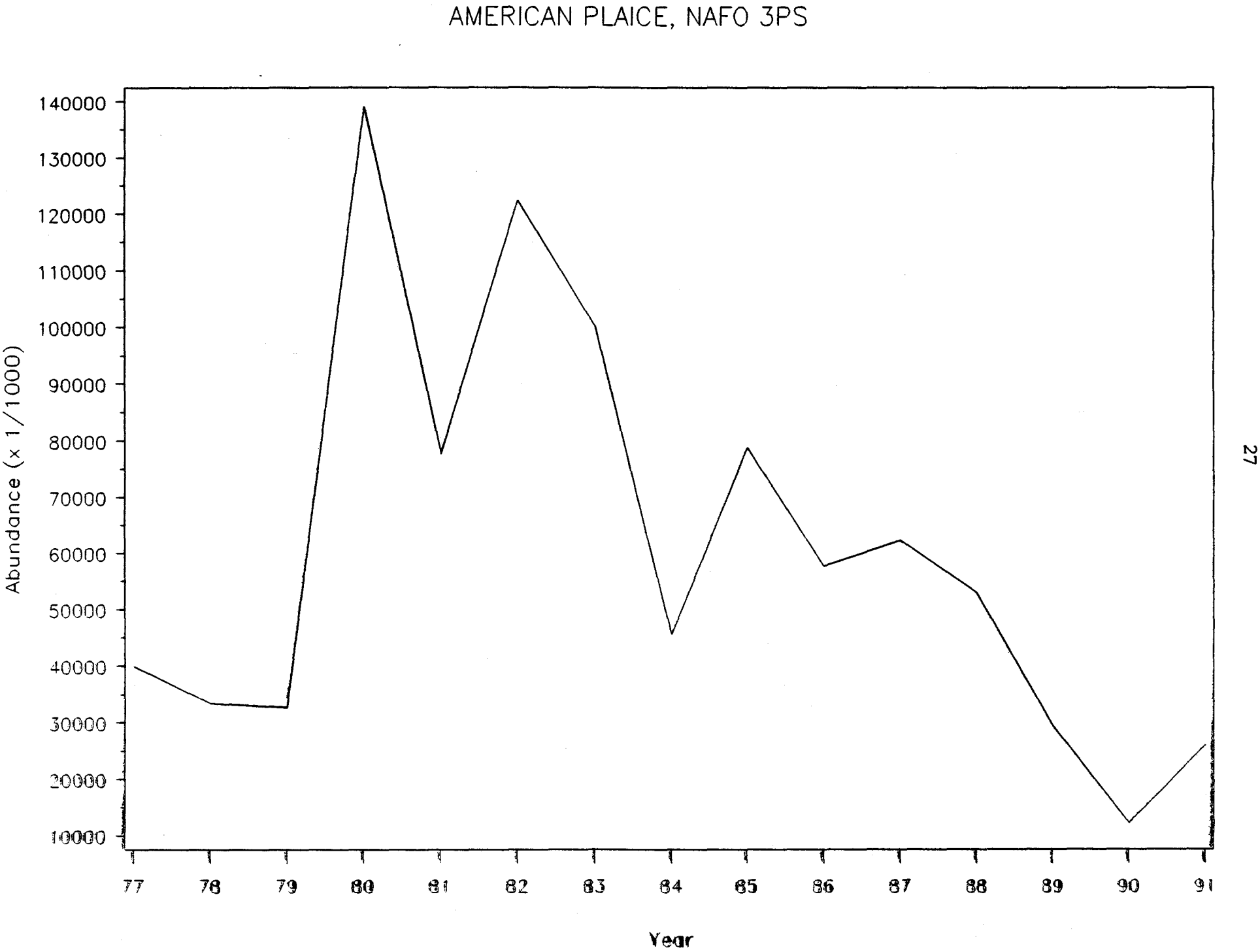

Fig.5. Abundance index for A.plaice from Canadian research vessel surveys in 3Ps from 1977-91.

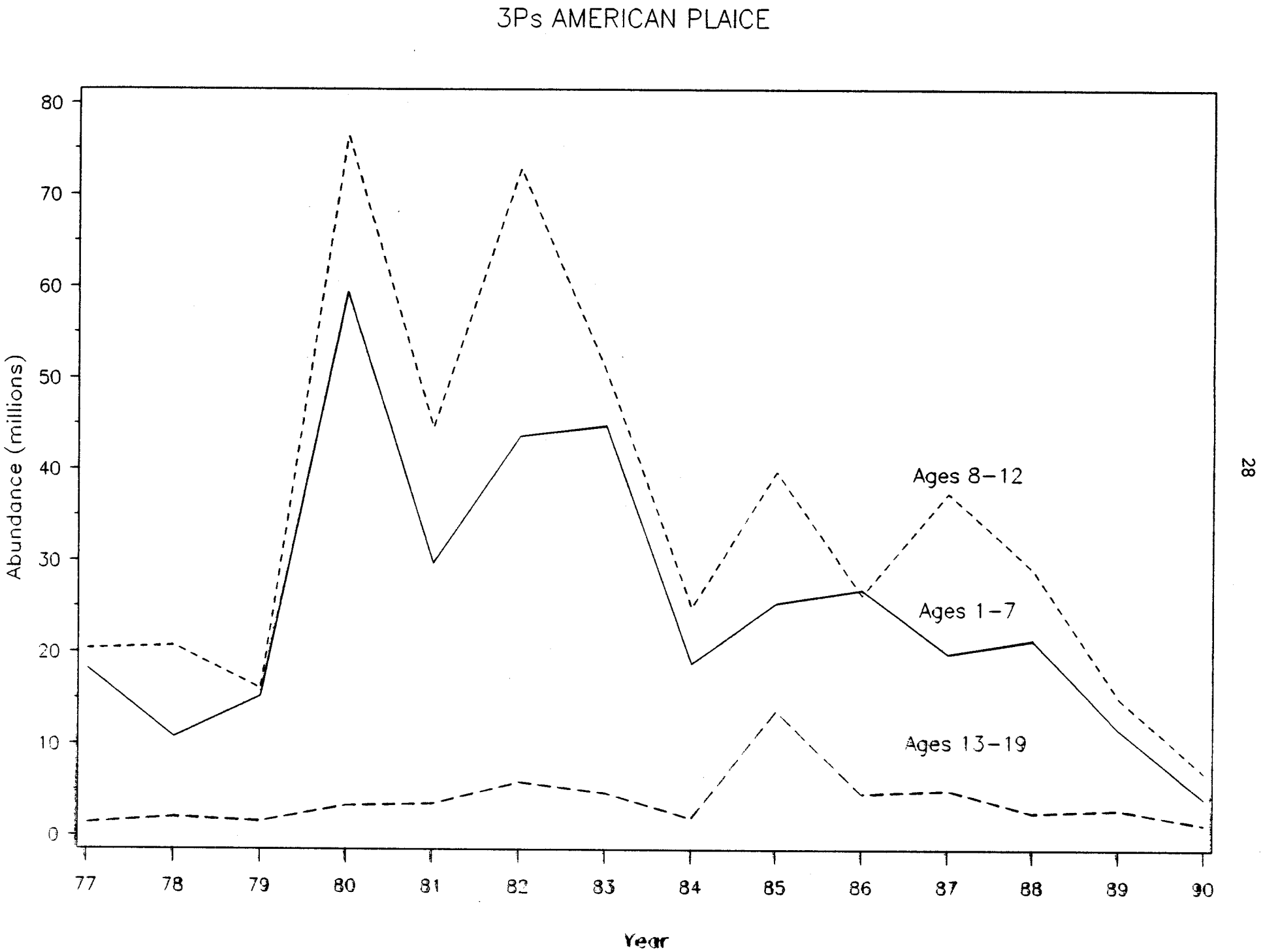

Fig.6. Abundance index for different age groups of A.plaice from Canadian research vessel surveys in 3Ps from 1977-91.

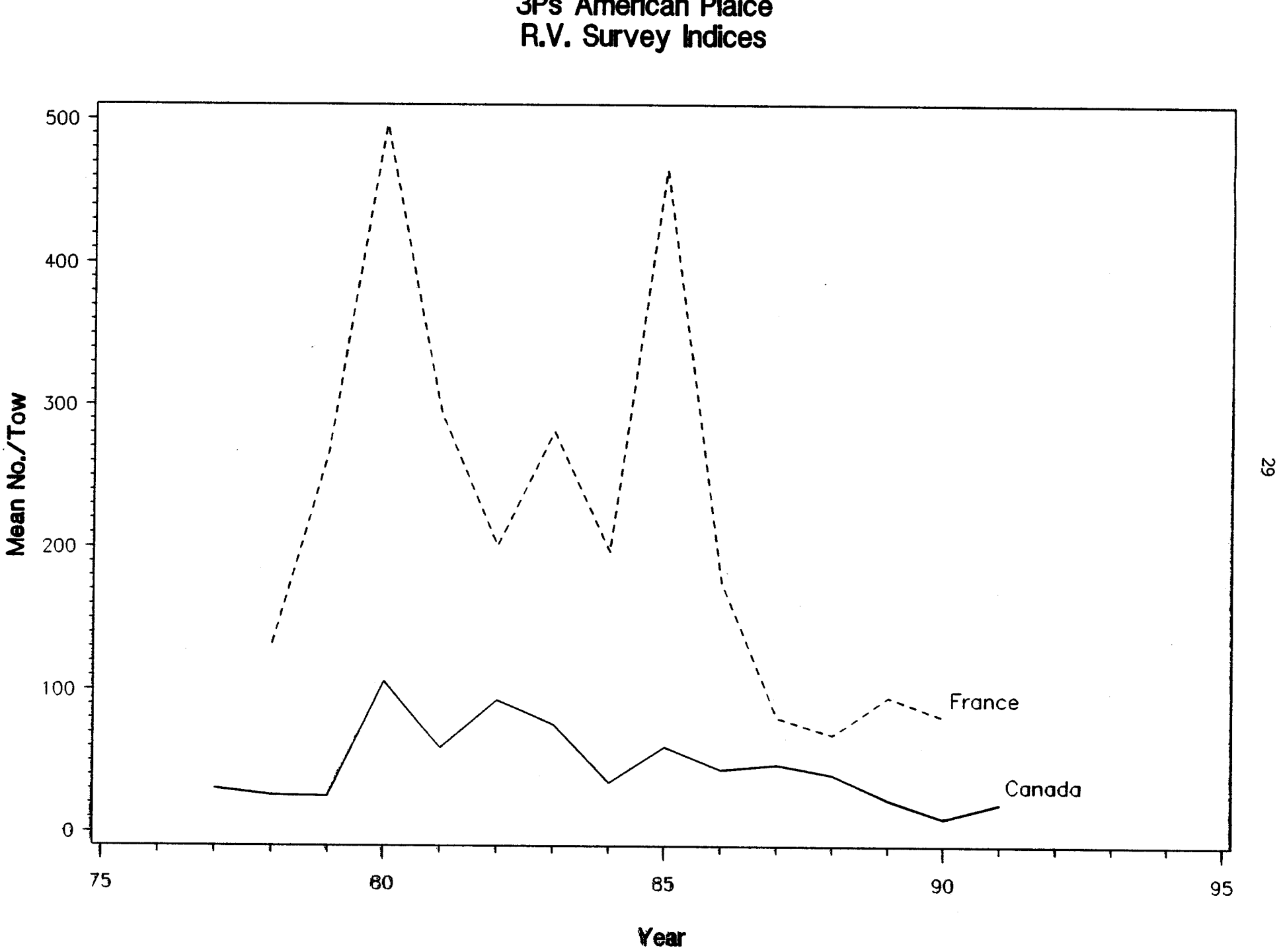

Fig.7. Comparison of mean no./tow of A.plaice from Canadian and French R.V. surveys in 3Ps from 1977-90.

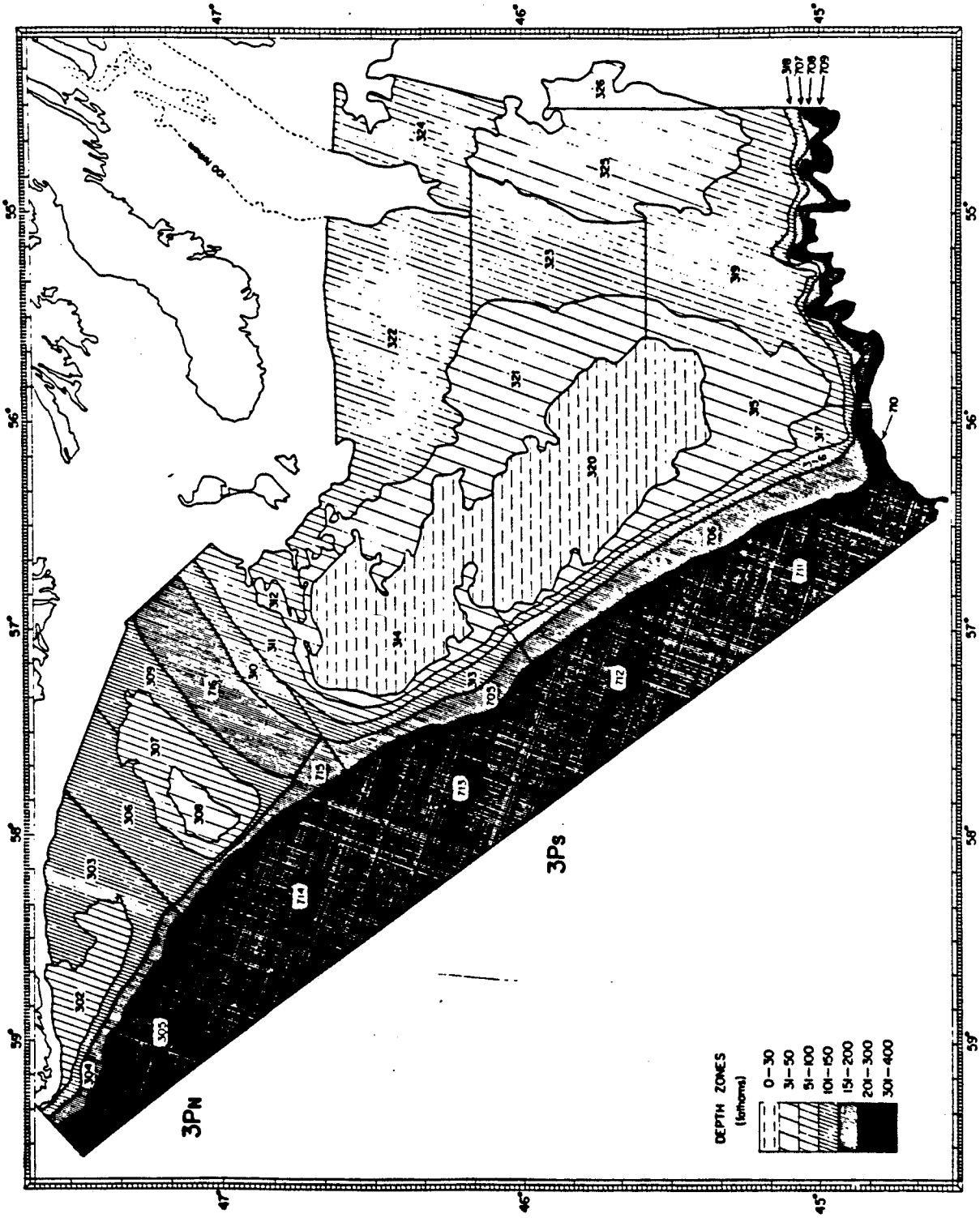

Fig.8. Stratification scheme used in R.V. surveys in 3Ps.