An Assessment of the American Plaice Stock in NAFO Subdivision 3Ps

by

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Abstract

After increasing to over 5000 t in 1986 and 1987, the catch declined to about 4200 t in 1988, with most of the decline occurring in the inshore sector. The commercial catch rate from Canadian offshore trawlers has decreased about 13% from 1986 to 1988. The research vessel survey index, after a period of relative stability in 1986-88, declined by about 40% in 1989.

Using the CPUE and research vessel survey indices in the adaptive framework showed the terminal fishing mortality in 1988 to be about 0.4, indicating an $F_{0.1}$ catch for 1990 of approximately 3000 t.

Résumé

Après avoir atteint plus de 5 000 t en 1986 et en 1987, les prises sont tombées à environ 4 200 t en 1988, la baisse la plus marquée se produisant dans la pêche côtière. Le taux de prises commerciales des chalutiers de pêche hauturière canadiens a diminué d'environ 13 % de 1986 à 1988. L'indice établi d'après les relevés des navires de recherche, après avoir été relativement stable de 1986 à 1988, a diminué d'environ 40 % en 1989.

En utilisant les PUE et les indices provenant des relevés de recherche dans le cadre adaptatif, on a chiffré à environ 0,4 la mortalité due à la pêche en 1988, ce qui permet d'établir à environ 3 000 t les prises prévues pour 1990 au niveau $F_{0,1}$.

Introduction

TAC - catch 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 current TAC of 5000 t is unchanged since 1980. Sequential population analysis was used as the basis for advice in the 1987 assessment, and was attempted unsuccessfully in the 1988 assessment.

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 8,800 t in 1968, due mainly to the USSR catch, and have not exceeded 650 t since 1973. Catches by France have ranged from 200 to 600 t in recent years. The figure of 4068 t for the 1986 French catch reported in NAFO SCS Doc. 88/01 is incorrect, and has not been used in the 1987-89 assessments of this stock. Figure 2 shows the trends in the inshore catches, which declined in 1988 to about the level reported in 1986. The inshore catch in the 1986-88 period was substantially higher than in most other years from 1972 onward, due to the increase in the gillnet catch (Table 3). After a decline in the early 1980s, the catch by Canadian offshore trawlers increased in 1984-87, with most of the catch (70-90%) being taken in the first quarter (Table 2). In 1988, the catch by this fleet was spread more evenly over the entire year (Table 4a). Overall, the catch in 1988 was down about 20% from the 1986-87 level, although complete data for France are not available for those years.

Assessment

Catch at age and average weights at age

The commercial sampling available for this stock in 1988 is shown in Tables 4a and 4b. As was the case in recent years, no sampling was available from the French catch, so the total Canadian (Quarter 1+2) offshore catch at age was adjusted to include the French landings.

In 1988, the catch at age was dominated by ages 8-11 (Table 4(C)). This is quite different from the catch at age in 1987, although it is similar to the pattern observed in some other years, eg. 1976, 1979-81, and 1985 (Table 5). Part of the reason for the change in 1988 is the decline in the gillnet catch of about 540 t (33%), which reduces the number of older fish in the catch. However, the biggest change between 1987 and 1988 was in the otter trawl catch at age. In 1987, this fleet caught a higher proportion of older fish than in most recent years, and, combined with the high gillnet catch, resulted in the 1987 catch at age having the largest portion of catch at ages 12+ in the 16 year series (Table 6). This variation from year to year in the catch at age is not unusual for this stock and has been documented for some years in recent assessments. Possible reasons for this include the seasonal variations in the offshore catches and the amount and location of effort in the inshore sectors.

The average weights at age from the 1988 fishery are quite similar to those in 1985-87 (Table 7). The catch biomass (sum of products) in Table 8 shows close agreement with the nominal catch in most years.

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 1988 was conducted. Results from the model, using an unweighted regression, are shown in Table 9. The CPUE series (Fig. 3) shows relative stability from 1974 to 1980, an increase from 1980 to 1983, followed by very large increases in 1984 and 1985. Over the 1986-88 period, the average CPUE was at the same level as in 1981-83, although there was a decline of about 13% from 1986-88. 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. In fact, these two points were excluded from the SPA calibration of biomass vs CPUE done for this stock in 1987. Further examination of the data for 1985 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 for the 1985 RV survey, which was also conducted in March. Table 10 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.

Research vessel survey data

Stratified random surveys have been conducted by Canada in Subdiv. 3Ps in each year from 1972 to 1989, using the stratification scheme shown in Fig. 4. Table 10 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 1983-89 because 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 10 are highly variable between years, eg. 1983-86. Although the biomass 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.

Table 11 shows the distribution of biomass by depth range from the 1983 to 1989 surveys, which were all conducted by the same vessel-gear type. In all years, over 50% of the biomass is found in the 51-100 fm (93-183 m) depth range, and it is in this depth that the decline from 1986-88 to 1989 occurred. In the 1985 survey, in which the biomass was anomalously high, an estimate of 19,000 t was obtained for stratum 317, compared to an average for this stratum of about 920 t in 1983-84 and 1986-89.

To provide age by age estimates of abundance from the RV surveys, a multiplicative model using mean number per stratum was employed. The values for the 1972-82 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 1988 surveys. 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 (i.e. STRAP Age run using all available strata). The abundance estimates at age are shown in Table 12 for 1977-88, and are plotted in Fig. 5 for ages 4-15. As can be seen from the totals in Table 12 and from some of the age plots in Fig. 5, the abundance estimates are highly variable between years. However, for most of the ages, recent population estimates are lower than the averages over the

1977-88 period. It should be noted that the 1989 survey results, which indicated that the biomass was down considerably from 1988, were not included in the abundance at age estimates because the ages have not yet been determined from the otoliths collected in that survey.

Yield per recruit analysis

A Thompson-Bell yield per recruit (Y/R) analysis was conducted, using the long-term average (1973-87) partial recruitment values and weights at age, as noted in the analysis presented in the 1988 assessment. In previous Y/R analyses for this stock and the adjacent A. plaice stock on the Grand Banks, the age range has usually extended to 19 or 20. However, examination of the catch matrix (Table 5) shows very little catch at age 19 in most years (all recent years) so age 18 was chosen as the upper limit. Weights at age for ages 1-5 were extrapolated by eye from the lower portion of the plot of average weights at ages 6-18. Results of the Y/R analysis (Table 13) show $F_{0.1}$ to be 0.24 with Y/R at age 1 of 0.095. With the same parameters, using 6 as the first age, the Y/R is 0.26 at $F_{0.1}$. Some caution should be advised in taking the F_{max} values to be meaningful reference points. As is the case with other Y/R analyses for A. plaice, the Y/R curve shows little vertical change over a large range of fishing mortality values. For some analyses, F_{max} has been calculated to be greater than 3.0.

SPA-ADAPT

Standard calibrations of SPA using the adaptive framework were attempted. For the Biomass vs CPUE calibrations, 8+ Average Biomass from SPA was used, along with the CPUE series in Table 9. It should be noted that in the SPA calibration done in the 1987 assessment of this stock, exploitable biomass vs CPUE did not give significant results, because of large fluctuations in the annual PR vectors. Additional analyses using slope and intercept estimation were not successful, as was the case using the standard error of the CPUE.

For the RV data, initial ADAPT runs using Ages 6-17 to estimate slopes and intercepts showed only 2 ages to have barely significant parameter estimates. Using all ages (6-17) and estimating only slopes did not give meaningful results at all ages so it was decided to use an age-aggregated analysis. Log models were used in all analyses of RV data in ADAPT, as the SE values were not available for the age by age estimates. This was because these values were derived from a model which used mean number per stratum to estimate missing values.

Although neither of the indices gave good relationships in the Adaptive framework, it was felt that using age 8+ aggregated data for both indices, in one formulation (fitted through the origin) gave a reasonable view of the stock. This formulation is described in Appendix 1 and the results of the ADAPT/SPA given in Table 14 and Figures 6 and 7. At this level of F_T (0.37), the stock size is relatively stable from 1973-88. This SPA also indicates F to be somewhat higher in recent years than was previously thought.

Catch projections

Using the parameters in Table 15, catch projections were done for 1990, and the results are shown in Table 16. It was concluded that given the assumptions and uncertainties present in this assessment, a TAC of 3000 t in 1990 would approximate the $F_{0.1}$ level.

Appendix 1

The formulation used for ADAPT with CPUE + RV data is as follows:

Parameters:

- Population estimate
  $N_{11,1988}$
- Calibration coefficients
  K_1 for CPUE
  K_2 for RV survey data, age 8+ aggregated

Structure:

- Error in catch at age assumed negligible
- Natural mortality assumed to be 0.20
- F on oldest age group (19) set equal to total F for ages 11-15
- PR assumed for 1988 was that calculated for 1987 assessment

Age	6	7	8	9	10	11-19
PR	.002	.024	.2	.49	.79	1.00

- Intercepts not fitted

Input:

- $C_{i,t}$ i = 6-19, t = 1974-88
- $CPUE_t$ t = 1974-88
- CPUE related to age 8+ population biomass
- RV_t (8+ nos.) t = 1977-88

Objective function:

- Minimize

$$\sum_t \{obs(\ln RV_t)-pred(\ln RV_t)\}^2 + \sum_t \{obs(\ln CPUE_t)-pred(\ln CPUE_t)\}^2$$

Summary:

- Number of observations = 27
- Number of parameters = 3

Results:

- See Table 14 and Figures 6 and 7.

Table 1. Catches and TACs (tons) of American plaice in NAFO Subdivision 3Ps, 1960-89.

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[a]	4,355	97	4,452	615	-	-	5,067	5,000
1987[a]	4,644	87	4,731	533[b]	-	-	5,264	5,000
1988[a]	3,746	53	3,799	400[b]	-	-	4,199	5,000
1989								5,000

[a]Provisional
[b]Estimated

Table 2. Nominal catch by month, American plaice in Subdivision 3Ps, 1972-88.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	UNK	Total
1972	1118	105	311	161	110	109	391	520	604	880	1044	1185	-	6538
1973	1681	500	2599	1527	96	350	969	2607	931	504	2237	768	-	14769
1974	162	133	1576	2575	123	137	165	399	567	128	364	269	-	6598
1975	6	6	1495	616	332	280	186	115	120	82	441	532	-	4211
1976	98	254	461	191	91	284	439	512	353	433	984	1358	-	5458
1977	28	547	663	339	309	287	414	204	105	261	712	736	-	4605
1978	250	141	185	1066	853	121	433	427	40	41	55	46	-	3658
1979	467	376	1086	212	189	262	225	265	124	161	246	53	-	3666
1980	14	464	180	63	216	359	166	170	170	191	256	686	-	2935
1981	423	57	236	371	363	331	302	156	214	263	273	228	-	3217
1982	53	4	285	315	181	156	133	195	125	95	463	181	-	2186
1983	98	47	161	71	61	155	169	91	327	372	149	25	-	1726
1984	128	1933	101	43	125	126	85	60	31	194	94	43	-	2963
1985	3	55	2814	240	35	154	134	80	199	146	343	17	-	4220
1986[a]	1960	447	498	51	148	333	444	491	299	251	80	65	-	5067
1987[a]	452	257	1170	302	208	427	631	571	195	78	211	229	533	5264
1988[a]	218	547	125	61	124	479	809	362	337	220	311	206	400	4199

[a]Provisional

Table 3. Catches by Canadian "inshore gears", 3Ps American plaice, 1972-88.

	Gear						
Year	Seines	Gillnets	Longline	Handline	Trap	Other	Total
1972	11	174	143	2	4	1	335
1973	63	233	212	3	2	12	525
1974	3	195	235	2	6	12	453
1975	62	322	127	4	58	1	574
1976	28	245	44	5	8	-	330
1977	140	291	119	14	3	-	567
1978	65	256	185	11	15	3	535
1979	117	292	176	5	8	-	598
1980	17	373	266	10	5	-	671
1981	84	671	370	16	3	-	1144
1982	35	265	199	3	1	-	503
1983	9	113	219	8	1	-	350
1984	-	86	102	13	1	1	203
1985	2	118	273	5	1	-	399
1986[a]	1	887	350	13	4	1	1256
1987[a]	-	1631	289	53	10	-	1983
1988[a]	6	1095	196	12	6	-	1315

[a]Provisional

Table 4a. List of commercial sampling by quarter available for 1988, for American plaice in Subdivision 3Ps.

	Quarter				Total
	1	2	3	4	
Can(N) Offshore catch (t)	869	233	651	678	2431
Samples	6	2	3	8	19
Measured	2699	883	1207	3448	8237
Otoliths	515	145	179	449	1288
Can(N) Inshore catch (t)	2	88	1080	145	1315
Samples	-	-	5	1	6
Measured	-	-	1684	191	1875
Otoliths	-	-	307	90	397

Table 4b. Commercial samples and catch used to calculate catch at age and average weights at age for A. plaice in Subdiv. 3Ps in 1988. Figures in parentheses are the number of observations.

Age-length key	Length frequency	No. samples	Catch (t)	Description
(307) ALKOT3CN3PS	(352) LFGN JUN CN3PS	1	424	Can(N) Inshore, Jan-Jun
(90) ALKOT4CN3PS	(379) JUL	1	507	" " July
	(953) AUG	3	239	" " Aug
	(191) SEP	1	145	" " Sep-Dec
(515) ALKSO1CN3PS	(1838) LFOT JAN CN3PS	4	216	Can(M+N) Offshore Jan
(145) ALKSO2CN3PS	(455) FEB	1	546	" " Feb
	(406) MAR	1	124	" " Mar
	(397) APR	1	94	" " Apr-May
	(486) JUN	1	143	" " June
(179) ALKSO3CN3PS	(1207) LFOT SEP CN3PS	3	652	Can(M+N) Offshore Jul-Sep
(449) ALKSO4CN3PS	(2294) OCT	5	180	" " Oct
	(849) NOV	2	304	" " Nov
	(305) DEC	1	203	" " Dec

Table 4(c). Catch at age and average weights at age for A.plaice caught in the commercial fishery in Subdiv. 3Ps in 1988.

AGE	AVERAGE WEIGHT	AVERAGE LENGTH	CATCH MEAN	CATCH STD. ERR.	CATCH C. V.
5	0.192	28.500		0.47	1.16
* 6	0.281	31.761	12	5.17	0.42
* 7	0.303	32.576	172	18.82	0.11
8	0.382	34.929	801	39.15	0.05
9	0.494	37.730	1110	50.52	0.05
10	0.648	40.926	1108	48.83	0.04
11	0.818	43.842	912	40.21	0.04
12	1.082	47.754	619	34.76	0.06
*13	1.325	50.825	305	25.23	0.08
14	1.627	54.062	187	16.72	0.09
*15	2.064	58.087	126	11.49	0.09
*16	2.603	62.273	45	6.33	0.14
*17	3.313	67.027	13	2.97	0.23
*18	4.148	71.645	1	0.34	0.57

TABLE 5. CATCH AT AGE FOR 3PS A.PLAICE.

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	1	326	391	121	18	49	130	2	8	2	5	4	3
7	11	903	839	445	133	196	240	121	89	28	83	14	28
8	864	889	721	1117	330	482	574	491	434	186	401	107	378
9	2874	1140	644	1514	803	964	908	737	1032	377	476	603	995
10	4516	1263	383	1266	905	1011	820	725	670	774	670	1151	1214
11	4207	717	423	979	952	756	608	600	466	1103	501	1203	1008
12	2433	792	490	715	343	726	349	545	291	447	328	656	579
13	1095	801	361	460	288	324	225	364	297	191	256	351	290
14	667	422	258	223	245	225	149	71	369	121	89	230	193
15	294	186	61	162	223	123	117	81	341	43	15	110	130
16	125	198	91	127	235	75	43	50	143	21	12	42	68
17	66	132	79	50	157	20	23	23	104	12	3	12	45
18	19	137	51	41	102	11	3	14	38	5	1	6	17
19	4	57	44	2	34	6	1	1	20	1	1	1	4

AGE	1986	1987	1988
6	3	5	12
7	90	90	172
8	357	277	801
9	613	349	1110
10	949	521	1108
11	1133	621	912
12	917	834	619
13	397	681	305
14	335	580	187
15	175	396	126
16	72	195	45
17	21	95	13
18	7	53	1
19	1	1	1

TABLE 6. PERCENT CATCH AT AGE FOR 3PS A.PLAICE.

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	0.00	0.04	0.08	0.02	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.11	0.17	0.06	0.03	0.04	0.06	0.03	0.02	0.01	0.03	0.00	0.01	0.02	0.02	0.03
8	0.05	0.11	0.15	0.15	0.07	0.10	0.14	0.13	0.10	0.06	0.14	0.02	0.08	0.07	0.06	0.15
9	0.17	0.14	0.13	0.21	0.17	0.19	0.22	0.19	0.24	0.11	0.17	0.13	0.20	0.12	0.07	0.21
10	0.26	0.16	0.08	0.18	0.19	0.20	0.20	0.19	0.16	0.23	0.24	0.26	0.25	0.19	0.11	0.20
11	0.24	0.09	0.09	0.14	0.20	0.15	0.15	0.16	0.11	0.33	0.18	0.27	0.20	0.22	0.13	0.17
12	0.14	0.10	0.10	0.10	0.07	0.15	0.08	0.14	0.07	0.14	0.12	0.15	0.12	0.18	0.18	0.11
13	0.06	0.10	0.07	0.06	0.06	0.07	0.05	0.10	0.07	0.06	0.09	0.08	0.06	0.08	0.14	0.06
14	0.04	0.05	0.05	0.03	0.05	0.05	0.04	0.02	0.09	0.04	0.03	0.05	0.04	0.07	0.12	0.03
15	0.02	0.02	0.01	0.02	0.05	0.02	0.03	0.02	0.08	0.01	0.01	0.02	0.03	0.03	0.08	0.02
16	0.01	0.02	0.02	0.02	0.05	0.02	0.01	0.01	0.03	0.01	0.00	0.01	0.01	0.01	0.04	0.01
17	0.00	0.02	0.02	0.01	0.03	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.02	0.00
18	0.00	0.02	0.01	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
19	0.00	0.01	0.01	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

TABLE 7. AVERAGE WEIGHTS AT AGE (KG) FOR 3PS A.PLAICE.

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
6	0.276	0.276	0.277	0.285	0.250	0.295	0.348	0.151	0.283	0.288
7	0.276	0.343	0.381	0.335	0.301	0.306	0.428	0.316	0.301	0.405
8	0.349	0.414	0.515	0.419	0.330	0.370	0.453	0.372	0.362	0.400
9	0.460	0.516	0.561	0.522	0.415	0.469	0.560	0.469	0.433	0.428
10	0.625	0.685	0.760	0.626	0.620	0.551	0.731	0.547	0.604	0.491
11	0.844	0.855	0.852	0.797	0.747	0.783	0.989	0.756	0.756	0.629
12	1.142	1.109	1.220	0.998	1.011	0.940	1.290	0.938	0.922	0.890
13	1.401	1.377	1.368	1.238	1.362	1.105	1.729	1.313	0.862	1.143
14	1.763	1.790	1.621	1.474	1.560	1.197	2.084	2.025	0.958	1.492
15	2.195	2.004	1.997	1.682	1.779	1.716	2.320	2.037	1.164	1.919
16	2.569	2.540	2.334	1.981	2.010	2.409	2.902	2.453	1.619	2.273
17	3.022	2.530	2.613	2.367	2.294	2.624	3.124	2.898	1.849	2.665
18	3.129	3.163	2.963	2.932	2.662	2.662	2.902	3.103	2.204	3.244
19	3.545	3.740	2.890	3.352	3.159	4.021	3.124	3.103	2.633	3.568

AGE	1983	1984	1985	1986	1987	1988
6	0.271	0.263	0.192	0.278	0.235	0.281
7	0.396	0.288	0.259	0.346	0.320	0.303
8	0.438	0.340	0.341	0.427	0.400	0.382
9	0.534	0.401	0.462	0.533	0.513	0.494
10	0.645	0.492	0.620	0.673	0.623	0.648
11	0.686	0.612	0.851	0.819	0.738	0.818
12	0.824	0.809	1.172	1.113	0.938	1.082
13	0.913	1.036	1.475	1.407	1.168	1.325
14	1.458	1.270	1.850	1.805	1.497	1.627
15	1.866	1.712	2.289	2.252	1.901	2.064
16	2.348	2.355	2.665	2.762	2.450	2.603
17	2.781	2.538	3.139	3.478	3.107	3.313
18	3.640	3.034	3.366	3.772	3.511	4.148
19	4.687	3.212	3.545	5.118	4.116	0.000

TABLE 8. CATCH BIOMASS(T) FOR 3PS A.PLAICE.

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	0	90	108	34	5	14	45	0	2	1	1	1	1	1	1	3
7	3	309	320	149	40	60	103	38	27	11	33	4	7	31	29	52
8	302	368	371	468	109	178	260	182	157	74	176	36	129	152	111	306
9	1321	588	361	791	333	452	509	346	447	161	254	242	460	327	179	548
10	2824	865	291	793	562	557	600	396	405	380	432	567	753	639	325	718
11	3551	613	360	781	711	592	601	454	353	694	343	736	858	928	458	746
12	2779	878	598	713	347	683	450	511	268	398	270	531	679	1021	783	670
13	1534	1103	494	569	392	358	389	478	256	218	234	364	428	558	795	404
14	1176	755	418	329	382	269	311	144	353	180	130	292	357	605	868	304
15	645	373	122	273	397	211	271	165	397	83	28	188	298	394	753	260
16	321	503	212	252	472	181	125	123	231	48	28	99	181	199	478	117
17	199	334	206	118	360	52	72	67	192	32	8	30	141	73	295	43
18	59	433	151	120	271	29	9	43	84	16	4	18	57	26	186	4
19	14	213	127	7	107	24	3	3	53	4	5	3	14	5	4	0
6+	14729	7426	4141	5397	4488	3661	3747	2951	3225	2300	1946	3112	4363	4958	5264	4176

Table 9. Results of multiplicative analysis of catch rates, 3Ps A.Plaice.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.726
MULTIPLE R SQUARED,..... 0.528

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.917E2	2.917E2	
REGRESSION	28	3.235E1	1.155E0	9.860
TYPE 1	3	2.946E0	9.820E⁻1	8.381
TYPE 2	11	1.135E1	1.031E0	8.803
TYPE 3	14	1.300E1	9.284E⁻1	7.923
RESIDUALS	247	2.894E1	1.172E⁻1	
TOTAL	276	3.530E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	⁻0.791	0.092	276
3	3				
4	74				
1	2125	1	0.076	0.086	20
	3114	2	⁻0.246	0.058	55
	3124	3	⁻0.155	0.052	67
3	1	4	⁻0.142	0.103	18
	2	5	⁻0.133	0.095	24
	4	6	⁻0.353	0.085	34
	5	7	⁻0.706	0.105	17
	6	8	⁻0.433	0.105	17
	7	9	0.059	0.105	17
	8	10	⁻0.050	0.098	21
	9	11	⁻0.367	0.104	18
	10	12	⁻0.510	0.090	28
	11	13	⁻0.330	0.092	26
	12	14	⁻0.205	0.095	24
4	75	15	0.001	0.105	18
	76	16	⁻0.159	0.094	26
	77	17	⁻0.042	0.094	26
	78	18	⁻0.087	0.100	22
	79	19	0.055	0.093	27
	80	20	⁻0.071	0.100	21
	81	21	0.145	0.103	19
	82	22	0.348	0.109	16
	83	23	0.218	0.114	14
	84	24	0.634	0.141	8
	85	25	0.864	0.140	8
	86	26	0.369	0.124	11
	87	27	0.289	0.111	15
	88	28	0.225	0.107	17

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1974	⁻0.7907	0.0085	0.479	0.044	6598	13776
1975	⁻0.7897	0.0109	0.479	0.050	4211	8793
1976	⁻0.9497	0.0089	0.408	0.039	5458	13363
1977	⁻0.8332	0.0087	0.459	0.043	4605	10033
1978	⁻0.8778	0.0097	0.439	0.043	3658	8337
1979	⁻0.7355	0.0085	0.506	0.047	3666	7243
1980	⁻0.8617	0.0104	0.446	0.045	2935	6585
1981	⁻0.6458	0.0106	0.553	0.057	3217	5817
1982	⁻0.4431	0.0116	0.677	0.073	2186	3229
1983	⁻0.5725	0.0131	0.594	0.068	1726	2904
1984	⁻0.1563	0.0193	0.898	0.124	2963	3298
1985	0.0737	0.0170	1.132	0.147	4220	3728
1986	⁻0.4219	0.0142	0.691	0.082	5067	7337
1987	⁻0.5014	0.0114	0.639	0.068	5264	8241
1988	⁻0.5656	0.0111	0.599	0.063	4198	7008

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.107

Table 10 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	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
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)	0.5(3)	0.2(4)	0.1(2)	2.7(2)	0.6(3)	0.2(4)	0.3(4)	0.8(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)	2.5(4)	1.3(4)	0.0(2)	0.1(3)	1.0(3)	0.4(3)	0.9(4)	0.1(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)	49.3(2)	101.2(3)	1.5(2)	3.7(2)	0.0(2)	0.0(2)	0.5(2)	0.0(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)	0.4(2)	0.3(3)	7.3(2)	1.6(3)	0.2(2)	0.9(2)	1.1(3)	0.1(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)	1.0(3)	0.2(3)	0.5(2)	4.2(3)	2.0(2)	3.5(2)	5.7(3)	10.3(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)	2.7(3)	2.0(3)	2.6(2)	16.2(4)	77.0(3)	27.0(2)	74.1(4)	3.4(3)
31-50	312	249.5(2)	-	43.3(2)	18.4(3)	20.6(5)	12.5(4)	-	0.1(3)	-	1.2(2)	5.3(2)	12.2(3)	0.6(2)	1.5(2)	4.0(2)	2.8(2)	0.0(2)	1.5(3)
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)	1.2(2)	2.9(3)	0.7(2)	0.9(2)	9.7(2)	1.6(2)	8.5(2)	9.3(2)
0-30	314	28.6(2)	-	0.2(2)	-	1.1(2)	16.3(4)	-	-	0.5(2)	0.3(5)	23.3(5)	11.9(7)	5.3(4)	0.5(7)	2.0(8)	6.0(5)	0.0(7)	0.9(9)
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)	53.5(3)	61.4(8)	35.3(5)	40.9(7)	62.5(6)	33.1(8)	39.5(6)	14.6(7)
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)	-	5.3(4)	1.7(2)	3.8(3)	7.0(2)	196.8(3)	19.8(3)	25.1(3)
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)	34.2(3)	52.0(3)	6.0(2)	1312.8(2)	29.3(2)	80.0(3)	62.5(2)	151.8(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)	-	0.3(2)	3.6(3)	7.3(2)	-	7.0(2)	37.1(2)	70.0(2)	2.0(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)	33.0(7)	112.1(7)	43.3(6)	26.5(2)	27.1(8)	104.3(9)	8.9(8)	33.7(8)
0-30	320	-	2.7(2)	-	-	11.2(3)	-	-	-	12.3(6)	7.0(2)	18.8(4)	34.0(14)	9.4(8)	38.3(5)	17.0(9)	7.0(11)	4.5(11)	2.6(10)
31-50	321	90.5(2)	3.4(2)	-	-	88.5(2)	-	-	-	30.5(5)	45.5(2)	27.3(4)	47.2(10)	28.0(6)	23.1(7)	26.9(10)	21.8(10)	5.7(11)	53.7(9)
51-100	322	-	-	-	-	75.1(4)	-	-	2.8(2)	67.1(8)	21.5(2)	58.0(8)	71.2(11)	64.3(8)	179.2(13)	55.5(12)	22.9(10)	9.4(12)	5.2(14)
51-100	323	222.6(3)	-	-	-	111.0(4)	34.5(2)	-	-	162.5(3)	108.5(2)	256.5(2)	125.7(6)	44.4(4)	68.0(3)	170.5(5)	164.8(6)	324.0(5)	52.6(7)
51-100	324	-	-	-	-	53.6(2)	-	-	4.0(2)	26.8(2)	-	71.3(2)	91.5(4)	15.5(3)	202.3(2)	7.5(5)	95.7(4)	0.3(4)	11.5(5)
31-50	325	-	-	-	-	60.4(2)	-	-	2.7(2)	7.7(4)	4.6(2)	41.4(5)	53.4(8)	27.0(5)	25.7(3)	6.5(8)	1.6(6)	2.6(6)	6.1(8)
31-50	326	-	-	-	-	-	-	-	15.7(2)	13.9(2)	1.9(2)	44.3(2)	40.8(3)	29.8(2)	-	8.0(2)	14.3(2)	0.6(2)	36.7(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)	0.6(2)	0.5(3)	0.4(2)	3.5(2)	2.2(2)	3.5(2)	6.5(2)	13.0(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)	0.6(4)	1.9(5)	0.3(2)	1.8(4)	7.3(4)	9.7(5)	13.5(4)	3.3(4)
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)	-	-	0.0(3)	8.1(2)	-	4.0(2)	1.0(2)	10.3(2)	0.1(2)
201-300	708	-	-	-	0.0(3)	-	0.2(4)	-	0.5(2)	0.6(2)	-	-	0.2(2)	1.4(2)	-	3.6(2)	1.5(2)	0.0(2)	3.0(2)
301-400	709	-	-	-	-	-	-	-	-	-	-	-	0.2(2)	0.0(2)	-	-	-	-	7.0(2)
301-400	710	-	-	-	-	-	-	-	-	-	-	-	0.0(3)	2.5(2)	1.3(2)	0.7(2)	-	36.0(2)	-
201-300	711	-	-	-	-	-	-	-	-	0.2(2)	0.7(2)	0.0(2)	0.8(8)	0.9(5)	1.0(8)	1.4(9)	2.2(7)	23.1(7)	1.7(7)
201-300	712	-	-	-	-	-	-	-	1.4(2)	0.0(2)	0.2(2)	0.0(3)	0.9(7)	-	1.0(6)	0.4(9)	0.3(4)	13.2(7)	1.9(8)
201-300	713	-	-	-	0.6(3)	-	-	-	-	0.2(2)	0.9(6)	0.3(2)	0.4(7)	-	0.4(8)	0.1(5)	1.0(4)	7.5(7)	1.2(8)
201-300	714	-	-	-	-	-	-	0.9(2)	-	1.0(2)	0.1(8)	0.0(6)	0.3(10)	-	-	8.8(5)	0.5(4)	16.5(9)	0.8(10)
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)	0.2(2)	0.8(3)	0.0(2)	-	1.8(2)	0.4(2)	0.0(2)	0.1(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)	0.4(2)	1.5(4)	0.2(3)	4.2(5)	1.8(4)	3.8(3)	33.0(5)	1.5(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(71)	30.7(91)	34.7(171)	20.8(95)	54.9(110)	23.2(144)	25.9(134)	20.8(152)	12.9(157)
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	39,076	45,200	22,549	64,494	30,450	33,923	27,326	17,004
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	39,415	45,583	22,832	64,975	30,451	33,918	27,326	16,999

Table 11 American plaice biomass (t) by stratum and depth range, from surveys in Subdivision 3Ps from 1983 to 1989. Numbers in parentheses represent the percentages of the total, and asterisks indicate <0.1%.

Depth (fm)	Stratum	1983		1984		1985		1986		1987		1988		1989	
0-30	314	870	(1.9)	384	(1.7)	37	(0.1)	149	(0.5)	436	(1.3)	0		63	(0.4)
	320	3365	(7.4)	930	(4.1)	3797	(5.9)	1684	(5.5)	689	(2.0)	443	(1.6)	258	(1.5)
Total		**4235**	**(9.3)**	**1314**	**(5.8)**	**3834**	**(6.0)**	**1833**	**(6.0)**	**1125**	**(3.3)**	**443**	**(1.6)**	**321**	**(1.9)**
31-50	308	851	(1.9)	13	(0.1)	31	(*)	0		0		4	(*)	0	
	312	248	(0.5)	12	(0.1)	31	(*)	82	(0.3)	57	(0.2)	0		31	(0.2)
	315	3810	(8.4)	2191	(9.7)	2536	(3.9)	3880	(12.7)	2056	(6.1)	2453	(9.0)	909	(5.3)
	321	4213	(9.3)	2499	(11.1)	2059	(3.2)	2399	(7.9)	1944	(5.7)	512	(1.9)	4790	(28.2)
	325	3385	(7.5)	1913	(8.5)	1819	(2.8)	457	(1.5)	110	(0.3)	185	(0.7)	435	(2.6)
	326	515	(1.1)	371	(1.6)	-		100	(0.3)	178	(0.5)	7	(*)	457	(2.7)
Total		**13022**	**(28.7)**	**6999**	**(31.1)**	**6476**	**(9.9)**	**6918**	**(22.7)**	**4345**	**(12.8)**	**3161**	**(11.6)**	**6622**	**(39.0)**
51-100	307	39	(0.1)	0		3	(*)	30	(0.1)	11	(*)	27	(0.1)	1	(*)
	311	47	(0.1)	62	(0.3)	385	(0.6)	1832	(6.0)	642	(1.9)	1764	(6.5)	80	(0.5)
	317	753	(1.7)	87	(0.4)	19018	(29.5)	424	(1.4)	1159	(3.4)	905	(3.3)	2198	(12.9)
	319	8283	(18.3)	3195	(14.2)	1957	(3.0)	2004	(6.6)	7704	(22.7)	654	(2.4)	2485	(14.6)
	322	8378	(18.5)	7568	(33.6)	21073	(32.7)	6525	(21.4)	2696	(7.9)	1110	(4.1)	607	(3.6)
	323	6565	(14.5)	2318	(10.3)	3553	(5.5)	8908	(29.3)	8612	(25.4)	16927	(61.9)	2750	(16.2)
	324	3393	(7.5)	575	(2.6)	7500	(11.6)	278	(0.9)	3550	(10.5)	11	(*)	426	(2.5)
Total		**27458**	**(60.7)**	**13805**	**(61.4)**	**53489**	**(82.9)**	**20001**	**(65.7)**	**24374**	**(71.8)**	**21398**	**(78.3)**	**8547**	**(50.3)**
101-150	306	6	(*)	2	(*)	83	(0.1)	19	(0.1)	6	(*)	10	(*)	26	(0.2)
	309	7	(*)	161	(0.7)	35	(0.1)	3	(*)	11	(*)	25	(0.1)	3	(*)
	310	2	(80	6	(*)	53	(0.1	26	(0.1)	45	(0.1)	72	(0.3)	131	(0.8)
	313	36	(0.1)	9	(*)	11	(*)	120	(1.4)	19	(0.1)	105	(0.4)	115	(0.7)
	316	74	(0.2)	23	(0.1)	54	(0.1)	99	(0.3)	2792	(8.2)	281	(1.0)	357	(2.1)
	318	33	(0.1)	67	(0.3)	-		65	(0.2)	343	(1.0)	646	(2.4)	18	(0.1)
Total		**158**	**(0.4)**	**268**	**(1.1)**	**236**	**(0.4)**	**332**	**(1.1)**	**3216**	**(9.4)**	**1139**	**(4.2)**	**650**	**(3.9)**
151-200	705	8	(*)	6	(*)	51	(0.1)	31	(0.1)	51	(0.2)	94	(0.3)	190	(1.1)
	706	66	(0.1)	11	(*)	65	(0.1)	259	(0.9)	347	(1.0)	121	(0.4)	116	(0.7)
	707	0		57	(0.3)	-		28	(0.1)	7	(*)	36	(0.1)	1	(*)
	715	8	(*)	0		-		17	(0.1)	4	(*)	0		1	(*)
	716	61	(0.1)	8	(*)	171	(0.3)	72	(0.2)	152	(0.4)	267	(1.0)	61	(0.4)
Total		**143**	**(0.2)**	**82**	**(0.3)**	**287**	**(0.9)**	**407**	**(1.4)**	**561**	**(1.6)**	**518**	**(1.8)**	**369**	**(2.2)**
201-300	708	1	(*)	12	(0.1)	-		32	(0.1)	13	(*)	0		26	(0.2)
	711	59	(0.1)	63	(0.3)	72	(0.1)	103	(0.3)	156	(0.5)	238	(0.9)	124	(0.7)
	712	67	(0.1)	-		69	(0.1)	26	(0.1)	18	(0.1)	138	(0.5)	140	(0.8)
	713	31	(0.1)	-		27	(*)	4	(*)	71	(0.2)	76	(0.3)	86	(0.5)
	714	26	(0.1)	-		-		793	(2.6)	45	(0.1)	164	(0.6)	68	(0.4)
Total		**184**	**(0.4)**	**75**	**(0.4)**	**168**	**(0.2)**	**958**	**(3.1)**	**303**	**(0.9)**	**616**	**(2.3)**	**444**	**(2.6)**
301-400	709	0		0		-		-		-		-		50	(0.3)
	710	0		7	(*)	3	(*)	2	(*)	-		49	(0.2)	-	
Total		**0**		**7**	**(*)**	**3**	**(*)**	**2**	**(*)**	**-**		**49**	**(0.2)**	**50**	**(0.3)**
Total (t)		**45200**		**22550**		**64493**		**30451**		**33924**		**27324**		**17003**	

Table 12. Abundance ($x10^{-6}$) of American plaice from R.V. surveys in Subdiv. 3Ps. Results are based on a multiplicative analysis to account for missing strata.

Age		ATC 261 1977	ATC 275 1978	ATC 287 1979	ATC 302 1980	ATC 316 1981	ATC 330 1982	AN 9 1983	AN 26 1984	WT 26 1985	WT 45 1986	WT 55, 56 1987	WT 81 1988
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
2		0.03	0.00	0.07	0.49	0.09	0.07	0.00	0.01	0.00	0.00	0.00	0.00
3		0.94	0.64	0.26	2.35	0.58	1.56	0.16	0.00	0.02	0.05	0.12	0.07
4		2.54	0.72	1.08	3.15	3.67	6.73	1.20	0.19	0.42	0.64	0.38	0.46
5		7.07	3.36	2.53	7.98	4.38	8.87	7.12	1.95	2.75	2.18	1.95	2.48
6		4.98	5.29	4.21	12.76	7.03	10.72	16.65	7.57	7.65	8.71	5.52	8.00
7		9.50	7.78	11.29	32.64	14.55	15.67	19.61	9.04	14.54	15.21	11.87	10.30
8		9.43	9.91	9.96	31.37	19.56	22.18	18.78	8.16	10.38	10.68	14.89	13.76
9		7.01	10.82	5.35	21.90	12.94	27.34	16.01	6.58	10.51	5.88	9.66	7.35
10		5.27	4.77	2.01	14.03	7.48	13.26	7.99	5.44	9.42	4.68	6.86	4.59
11		4.09	5.09	1.65	5.64	2.98	5.54	5.15	2.99	5.63	2.71	3.19	1.95
12		2.19	3.66	1.50	3.49	2.46	4.57	2.72	1.67	3.90	2.26	2.80	1.36
13		0.58	1.71	0.79	1.57	1.06	2.25	1.74	0.70	3.82	1.67	1.77	0.75
14		0.82	0.62	0.49	0.77	0.91	1.43	1.06	0.49	2.63	0.89	1.13	0.59
15		0.19	0.20	0.39	0.09	0.33	0.70	0.67	0.34	2.54	0.94	0.99	0.54
16		0.15	0.58	0.23	0.42	0.49	0.52	0.70	0.15	2.15	0.62	0.67	0.31
17		0.06	0.14	0.04	0.11	0.17	0.31	0.22	0.11	1.17	0.24	0.22	0.25
18		0.01	-	-	0.23	0.34	0.57	0.13	0.08	1.29	0.18	0.14	0.03
19		0.01	-	-	0.06	0.22	0.04	0.11	0.01	0.07	0.03	0.03	0.01
20		-	-	-	-	-	0.03	-	-	0.04	-	-	-
UNK		0.01	0.58	0.00	-	-	0.04	-	0.01	0.07	-	-	-
Totals	1+	54.88	55.87	41.85	139.05	79.24	122.40	100.02	45.49	79.00	57.57	62.19	52.80
	4+	53.91	55.23	41.52	136.21	78.57	120.77	99.86	45.48	78.98	57.52	62.07	52.73
	6+	44.30	51.15	37.91	125.08	70.52	105.17	91.54	43.34	75.81	54.70	59.74	49.79
	8+	29.82	38.08	22.41	79.68	48.94	78.78	55.28	26.73	53.62	30.78	42.35	31.49
	10+	13.38	17.35	7.10	26.41	16.44	29.26	20.49	11.99	32.73	14.22	17.80	10.38
	12+	4.02	7.49	3.44	6.74	5.98	10.46	7.35	3.56	17.68	6.83	7.75	3.84

Table 13.

SUMMARY FOR THOMPSON-BELL YIELD PER RECRUIT.

Y/R FOR 3PS A.PLAICE, AGES 1-18

AGE	WEIGHT-AT-AGE	PARTIAL RECRUITMENT
1	0.040	0.000
2	0.090	0.000
3	0.140	0.000
4	0.180	0.000
5	0.230	0.000
6	0.294	0.019
7	0.368	0.070
8	0.434	0.190
9	0.530	0.460
10	0.673	0.710
11	0.843	0.930
12	1.096	1.000
13	1.347	1.000
14	1.692	1.000
15	2.039	1.000
16	2.513	1.000
17	2.884	1.000
18	3.248	1.000

NATURAL MORTALITY RATE : 0.2
F0.1 COMPUTED AS 0.2373 AT Y/R OF 0.0945
FMAX COMPUTED AS 0.5248 AT Y/R OF 0.1029

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.1000	0.059	0.065	1.097	1.633
	0.2000	0.094	0.090	0.961	1.129
F0.1---	0.2373	0.103	0.094	0.919	1.000
	0.3000	0.115	0.099	0.858	0.830
	0.4000	0.131	0.102	0.782	0.641
	0.5000	0.142	0.103	0.725	0.517
FMAX---	0.5248	0.144	0.103	0.713	0.492
	0.6000	0.151	0.103	0.681	0.430
	0.7000	0.158	0.102	0.647	0.367
	0.8000	0.164	0.102	0.620	0.320
	0.9000	0.170	0.102	0.599	0.284
	1.0000	0.174	0.101	0.581	0.254
	1.1000	0.179	0.101	0.566	0.231
	1.2000	0.182	0.101	0.553	0.211
	1.3000	0.186	0.101	0.541	0.194
	1.4000	0.189	0.100	0.532	0.180
	1.5000	0.192	0.100	0.523	0.168

Table 14. Results from ADAPT

POPULATION NUMBERS (000S)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	14272	11943	12610	14693	16055	16855	16984	15806	13862	12051	12139	14162	18822	26567	18136
7	12809	11390	9424	10215	12013	13100	13682	13904	12934	11347	9862	9935	11592	15408	21747
8	10463	9670	8566	7313	8243	9658	10508	11092	11303	10564	9215	8062	8109	9409	12533
9	6366	7762	7265	6003	5689	6313	7388	8159	8689	9086	8286	7448	6258	6316	7453
10	5348	4181	5773	4578	4188	3785	4347	5382	5746	6773	7008	6238	5198	4569	4855
11	3410	3236	3076	3581	2929	2514	2357	2903	3800	4004	4939	4696	4009	3397	3269
12	2720	2143	2266	1633	2070	1714	1508	1387	1955	2113	2825	2955	2933	2257	2219
13	2044	1510	1311	1209	1027	1038	1088	742	872	1196	1433	1720	1896	1571	1093
14	1113	948	910	657	729	547	646	561	338	541	748	856	1145	1193	670
15	659	529	543	543	317	393	313	465	126	168	363	404	526	635	452
16	619	372	378	298	243	148	216	183	72	64	124	197	213	272	161
17	224	328	222	195	31	131	82	132	21	40	41	63	100	109	47
18	429	64	197	136	17	8	86	46	14	6	30	23	11	63	4
19	190	227	6	124	19	4	3	58	4	7	4	19	4	3	4
	60666	54303	52548	51177	53570	56209	59210	60820	59735	57960	57017	56779	60816	71769	72643

ADAPTIVE FRAMEWORK

3PS PLAICE

FISHING MORTALITY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	0.026	0.037	0.011	0.001	0.003	0.009	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
7	0.081	0.085	0.054	0.014	0.018	0.020	0.010	0.007	0.002	0.008	0.002	0.003	0.009	0.006	0.009
8	0.099	0.086	0.156	0.051	0.067	0.068	0.053	0.044	0.018	0.043	0.013	0.053	0.050	0.033	0.073
9	0.221	0.096	0.262	0.160	0.207	0.173	0.117	0.151	0.049	0.060	0.084	0.160	0.115	0.063	0.179
10	0.302	0.107	0.278	0.247	0.310	0.274	0.204	0.148	0.161	0.116	0.200	0.242	0.225	0.135	0.288
11	0.264	0.156	0.433	0.348	0.336	0.311	0.330	0.195	0.387	0.149	0.314	0.271	0.374	0.226	0.365
12	0.388	0.291	0.429	0.264	0.490	0.255	0.510	0.264	0.291	0.188	0.297	0.244	0.424	0.525	0.365
13	0.568	0.307	0.490	0.306	0.429	0.274	0.462	0.584	0.277	0.270	0.316	0.206	0.263	0.652	0.365
14	0.543	0.358	0.316	0.531	0.417	0.358	0.129	1.297	0.503	0.201	0.415	0.287	0.390	0.771	0.365
15	0.374	0.136	0.400	0.605	0.561	0.399	0.337	1.664	0.476	0.104	0.408	0.439	0.458	1.170	0.365
16	0.436	0.316	0.464	2.052	0.418	0.388	0.295	1.986	0.389	0.233	0.471	0.479	0.467	1.566	0.365
17	1.052	0.310	0.286	2.218	1.222	0.216	0.370	2.063	1.033	0.087	0.386	1.543	0.264	3.218	0.365
18	0.436	2.117	0.262	1.749	1.207	0.577	0.197	2.337	0.517	0.204	0.250	1.682	1.200	2.666	0.365
19	0.399	0.240	0.426	0.357	0.413	0.299	0.379	0.473	0.354	0.180	0.320	0.261	0.374	0.512	0.365

ADAPTIVE FRAMEWORK

3PS PLAICE

STANDARDIZED RESIDUALS FOR RV INDEX (S.E.=1 FOR LOG MODEL)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	-0.175	0.098	-0.471	0.711	0.142	0.550	0.143	-0.586	0.184	-0.295	0.046	-0.349

STANDARDIZED RESIDUALS FOR CPUE INDEX

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	-0.455	-0.434	-0.376	-0.037	0.008	-0.138	-0.124	0.148	0.282	-0.068	0.496	0.519	0.026	0.139	0.011

ADAPTIVE FRAMEWORK

3PS PLAICE

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000085
MEAN SQUARE RESIDUALS 0.121419

PAR. EST.	STD. ERR.	T-STATISTIC
3.29484E3	6.08985E2	5.41037E0
2.91166E-4	3.42704E-5	8.49612E0
3.54191E-4	3.58475E-5	9.88048E0

PARAMETER CORRELATION MATRIX

	1	2	3
1	1.000	-0.519	-0.458
2	-0.519	1.000	0.238
3	-0.459	0.238	1.000

Table 15. Parameters used for catch projections for A. plaice in Subdiv. 3Ps.

Age	Population in 1989	PR	Average weight
6	14,200[a]	.002	.265
7	11,615[b]	.024	.323
8	9,342	.20	.403
9	8,532	.49	.513
10	5,102	.79	.648
11	2,979	1.00	.792
12	1,858	1.00	1.044
13	1,261	1.00	1.300
14	621	1.00	1.643
15	381	1.00	2.072
16	257	1.00	2.605
17	91	1.00	3.299
18	27	1.00	3.810
19	2	1.00	4.578

[a]Geometric mean, 1974-85. Also used at age 6 in 1990.
[b]Geometric mean, 1974-85.

Table 16. Results of catch projections for A. plaice in Subdiv. 3Ps.

POPULATION NUMBERS

	1988	1989	1990
6	14200	14200	14200
7	11600	11615	11615
8	11303	9342	9406
9	7453	8532	6982
10	4855	5102	5586
11	3269	2979	2914
12	2219	1858	1546
13	1093	1261	964
14	670	621	654
15	452	381	322
16	161	257	198
17	47	91	133
18	4	27	47
19	4	2	14
6+	57330	56267	54582
7+	43130	42067	40382
8+	31530	30452	28767
9+	20227	21110	19361

POPULATION BIOMASS (AVERAGE)

	1988	1989	1990
6	3402.85	3402.89	3403.57
7	3371.56	3385.01	3393.16
8	3967.73	3263.92	3351.64
9	3184.37	3570.28	3063.41
10	2489.18	2581.69	2987.49
11	1976.66	1729.23	1857.37
12	1770.44	1422.81	1300.15
13	1085.13	1201.93	1008.92
14	840.67	748.14	865.62
15	715.69	578.54	537.84
16	320.25	490.83	414.36
17	118.66	221.13	354.26
18	11.88	74.91	145.55
19	14.27	7.98	51.28
6+	23269.38	22629.33	22734.63
7+	19866.52	19226.45	19331.07
8+	16494.96	15841.44	15937.90

CATCH NUMBERS

	1988	1989	1990
6	12	12	6
7	172	115	63
8	801	739	416
9	1110	1554	731
10	1108	1407	910
11	912	996	587
12	619	621	311
13	305	422	194
14	187	208	132
15	126	127	65
16	45	86	40
17	13	31	27
18	1	9	10
19	1	1	3
6+	5412	6327	3494
7+	5400	6315	3488
8+	5228	6200	3425
9+	4427	5461	3009

CATCH BIOMASS

	1988	1989	1990
6	3	3	2
7	56	37	20
8	323	298	168
9	570	798	375
10	718	912	590
11	722	788	464
12	647	649	325
13	396	548	252
14	307	341	216
15	261	264	134
16	117	224	104
17	43	101	89
18	4	34	36
19	5	4	13
6+	4171	5000	2789
7+	4168	4997	2787
8+	4112	4960	2767
9+	3790	4662	2599

FISHING MORTALITY

	1988	1989	1990
6	0.001	0.001	0.000
7	0.016	0.011	0.006
8	0.081	0.091	0.050
9	0.179	0.223	0.123
10	0.288	0.360	0.197
11	0.365	0.456	0.250
12	0.365	0.456	0.250
13	0.365	0.456	0.250
14	0.365	0.456	0.250
15	0.365	0.456	0.250
16	0.366	0.456	0.250
17	0.361	0.456	0.250
18	0.321	0.456	0.250
19	0.321	0.456	0.250
6+	0.118	0.145	0.077

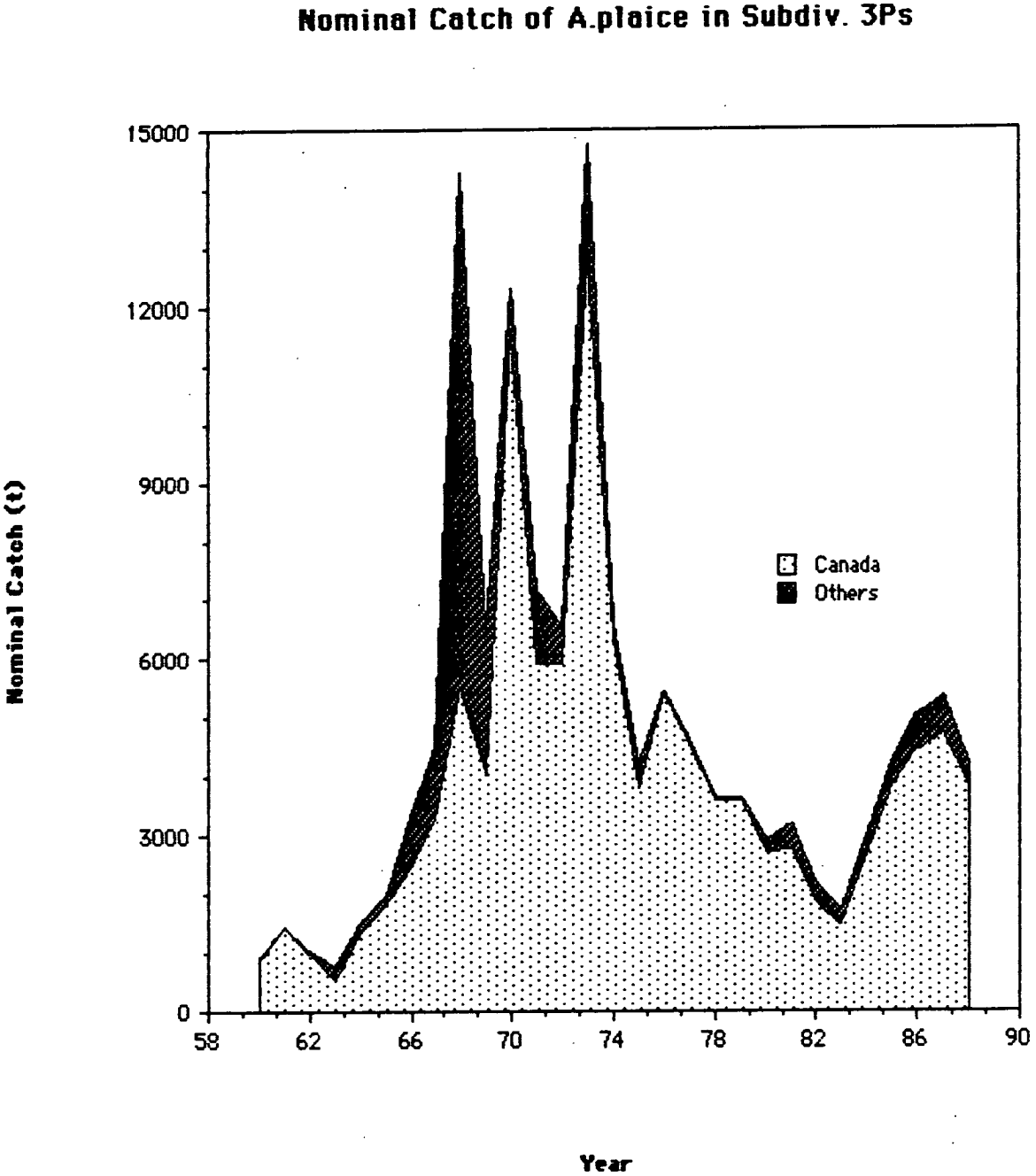


Fig.1 Nominal catch of A.plaice in Subdiv. 3Ps from 1960-1988.

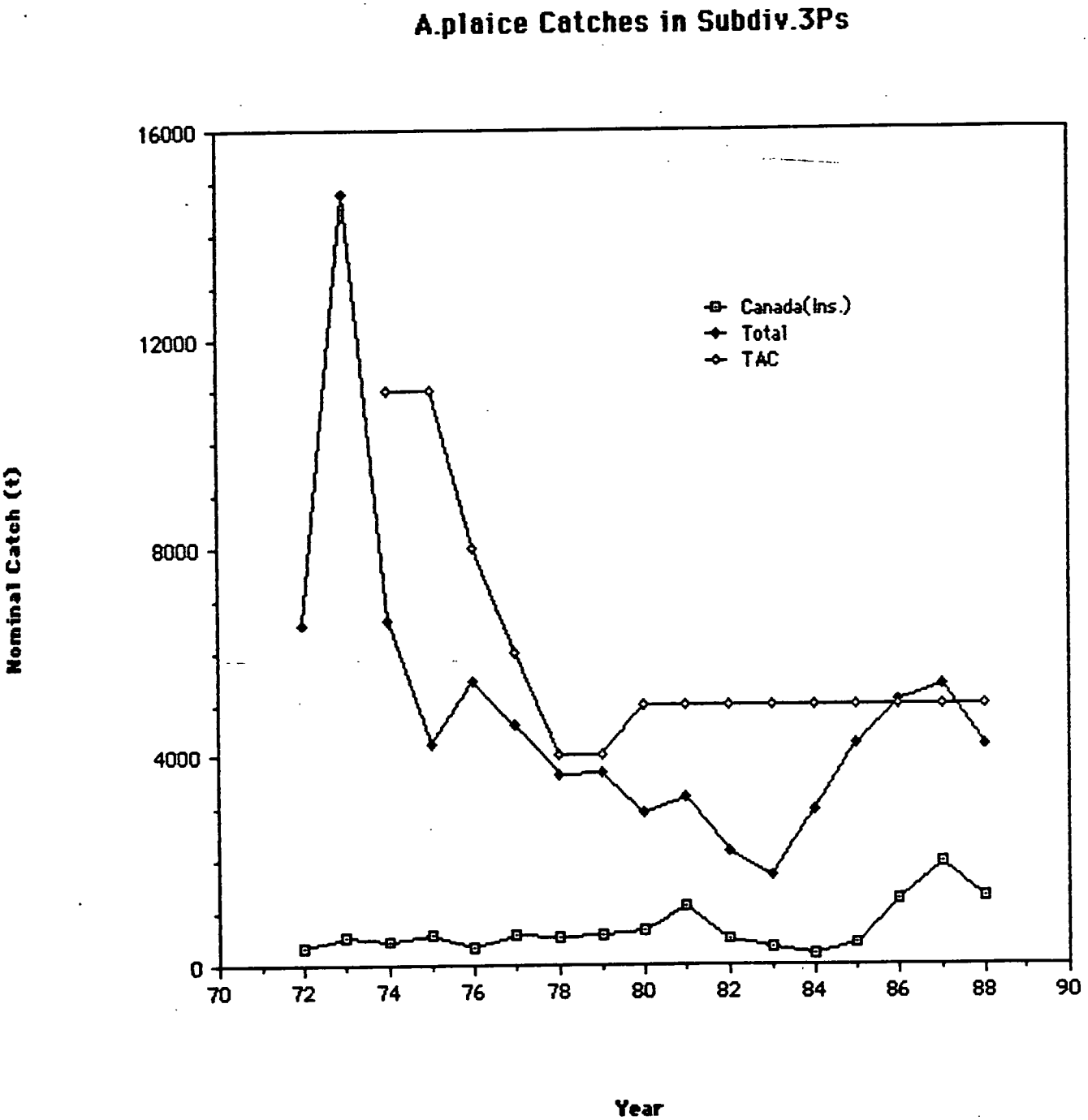


Fig.2 Total (all countries) and Canadian inshore catches in Subdivision 3Ps from 1972-88.

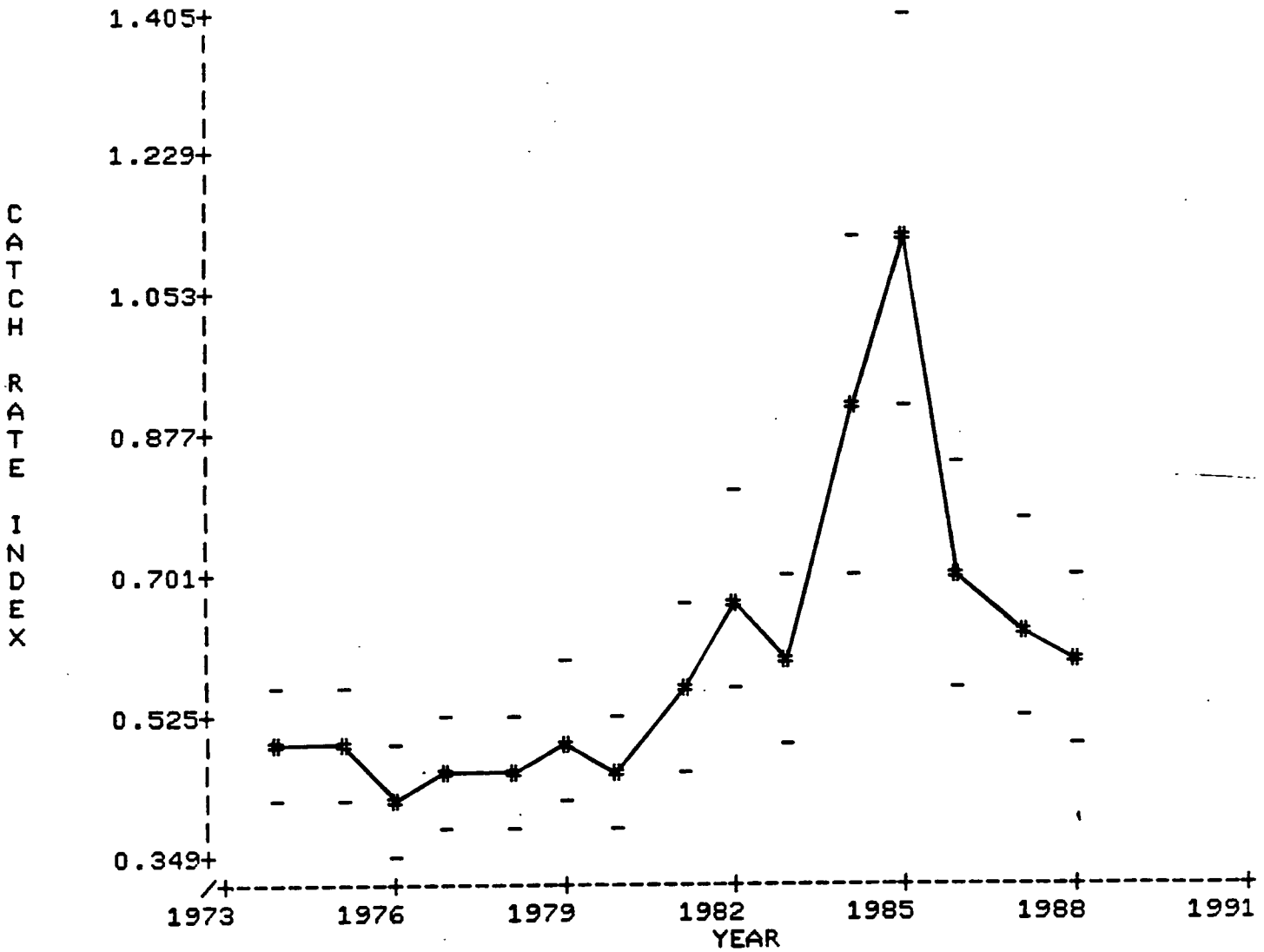


Fig 3. CPUE series for A.plaice in Subdiv 3Ps from 1974-88.

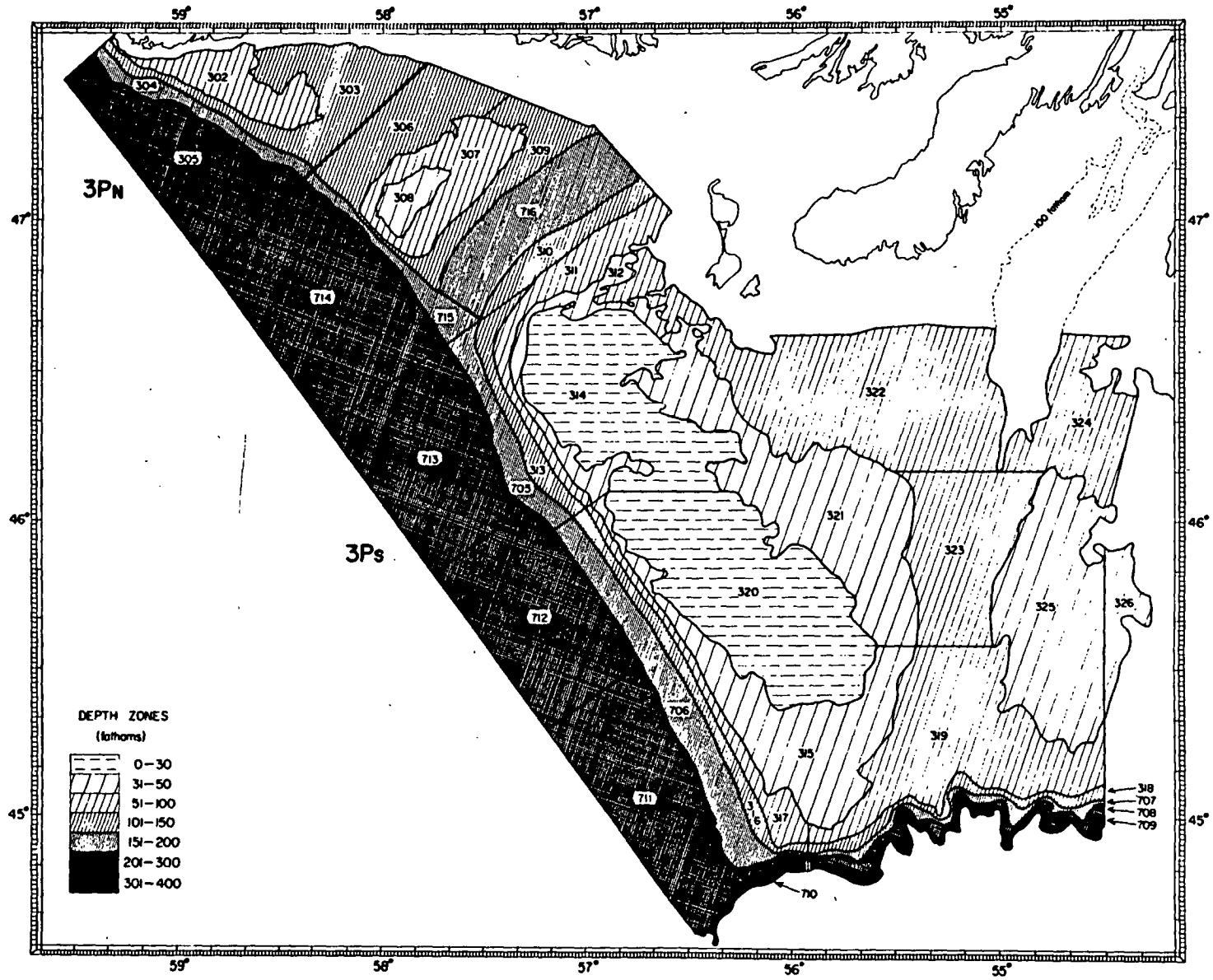


Fig. 4. Strata map of St. Pierre Bank (NAFO Subdivision 3Ps)

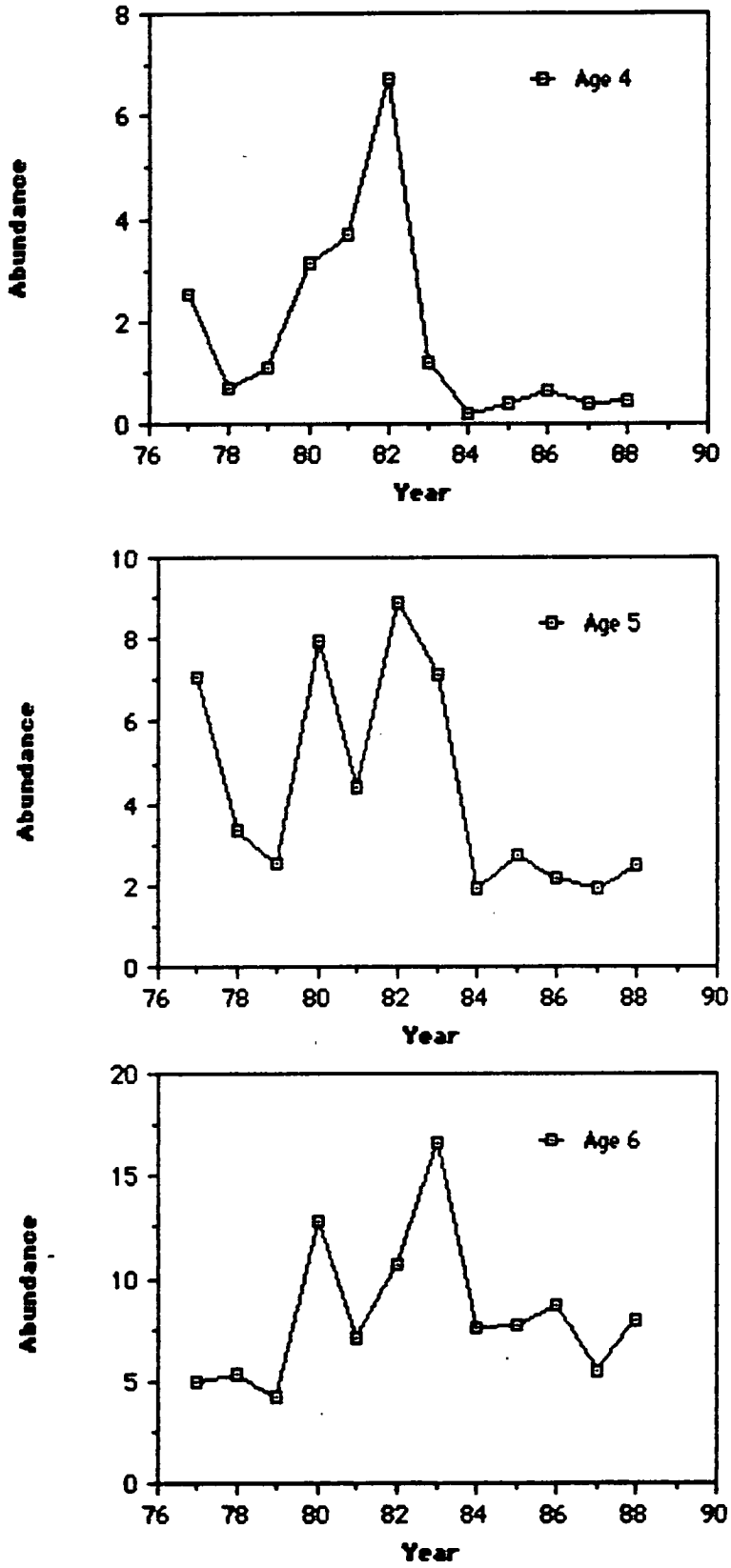
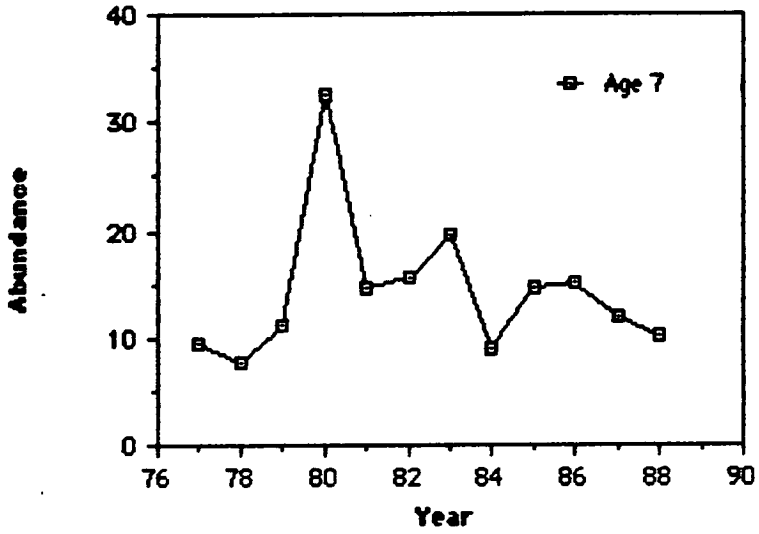
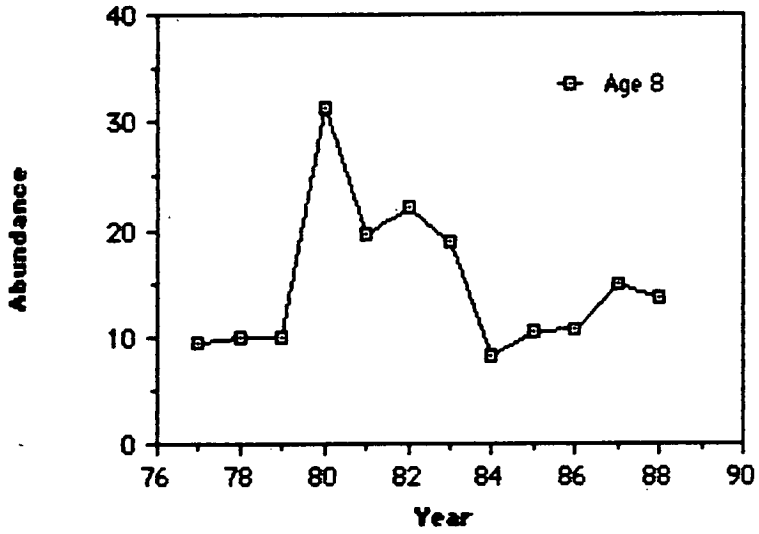


Fig 5. Abundance at ages 4 to 15 for A.plaice in Subdiv. 3Ps from 1977-88.





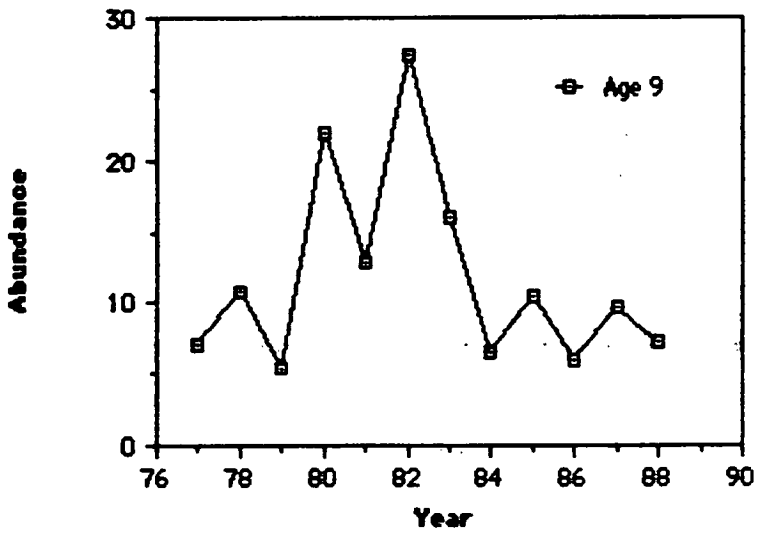
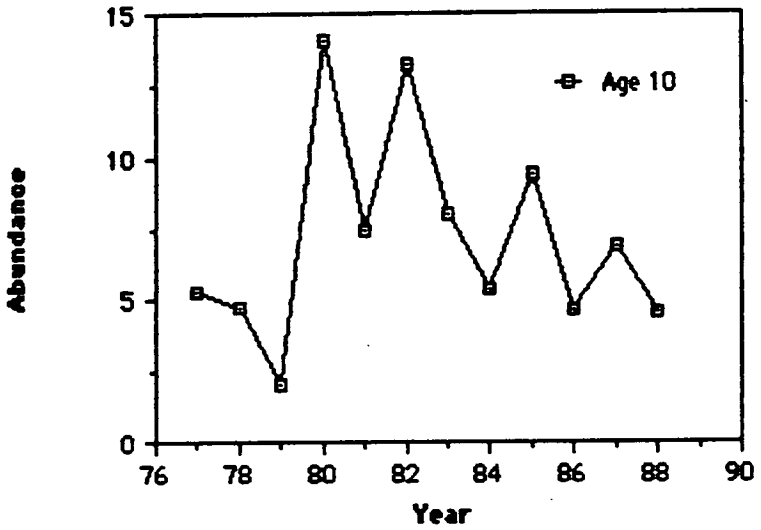
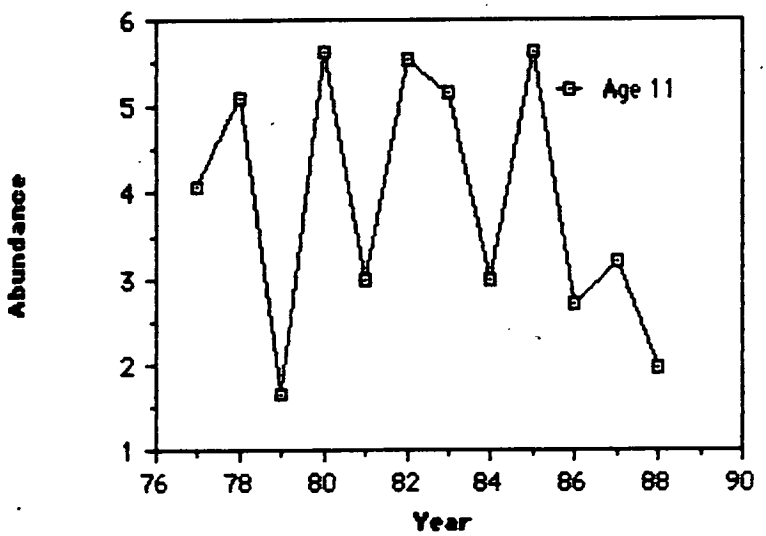


Fig 5. Continued





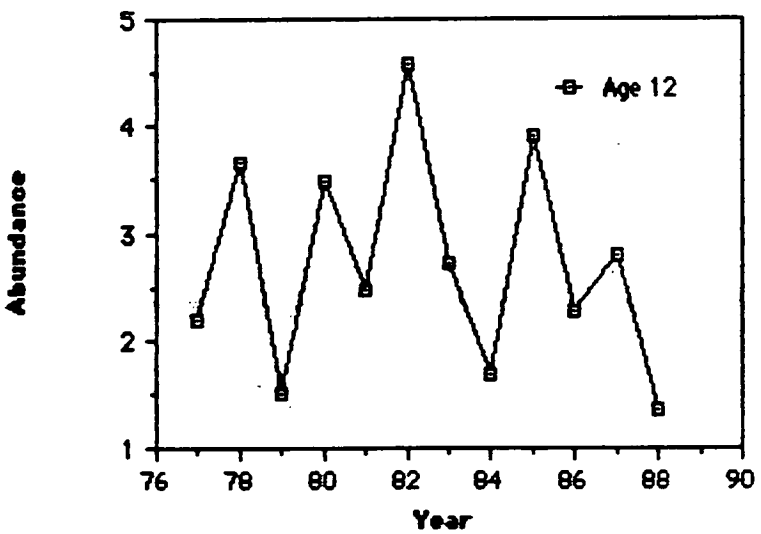
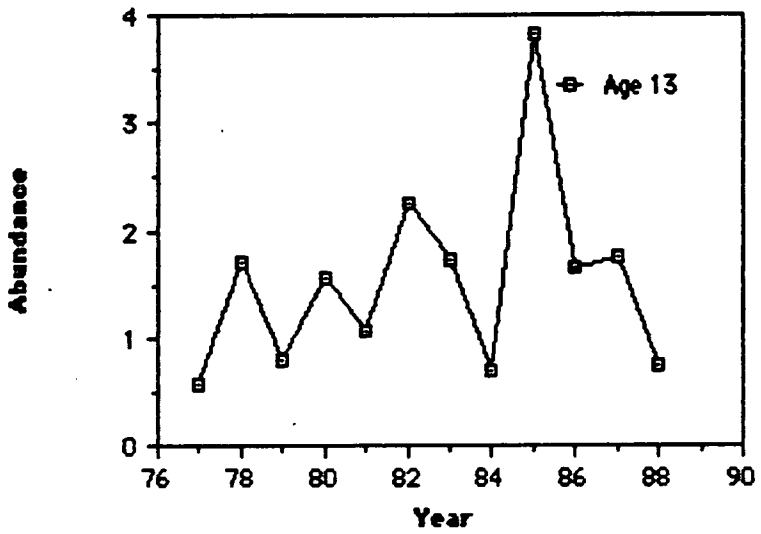
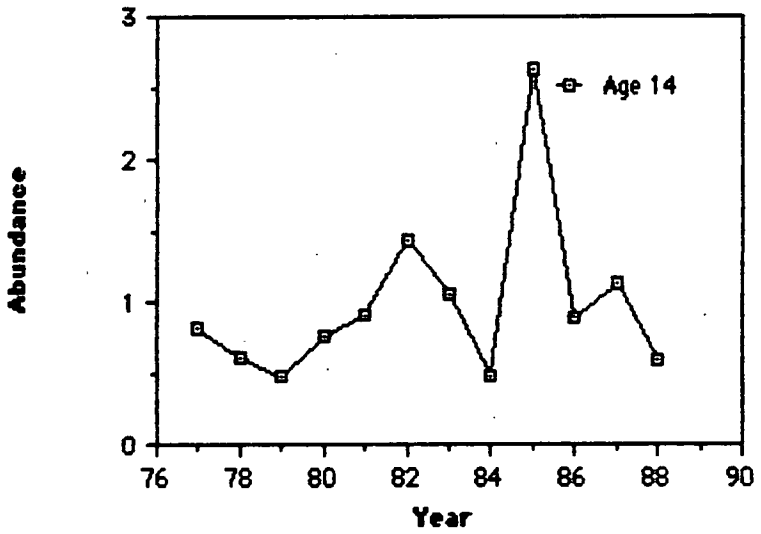


Fig 5. Continued





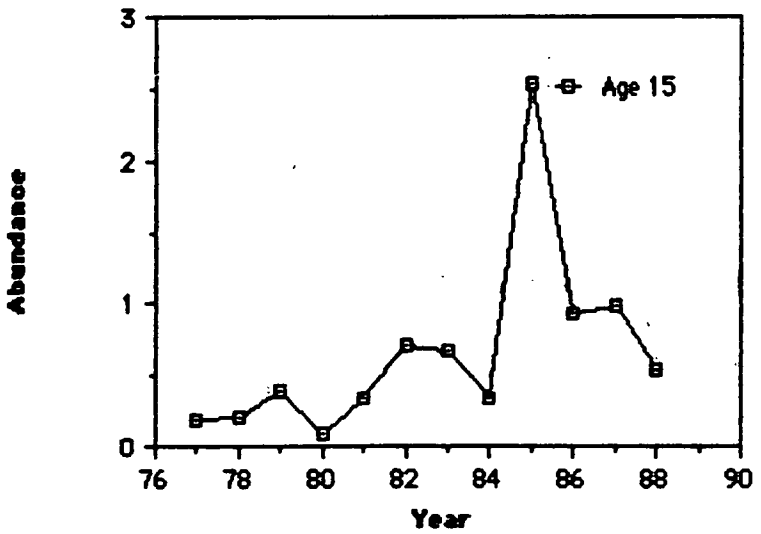
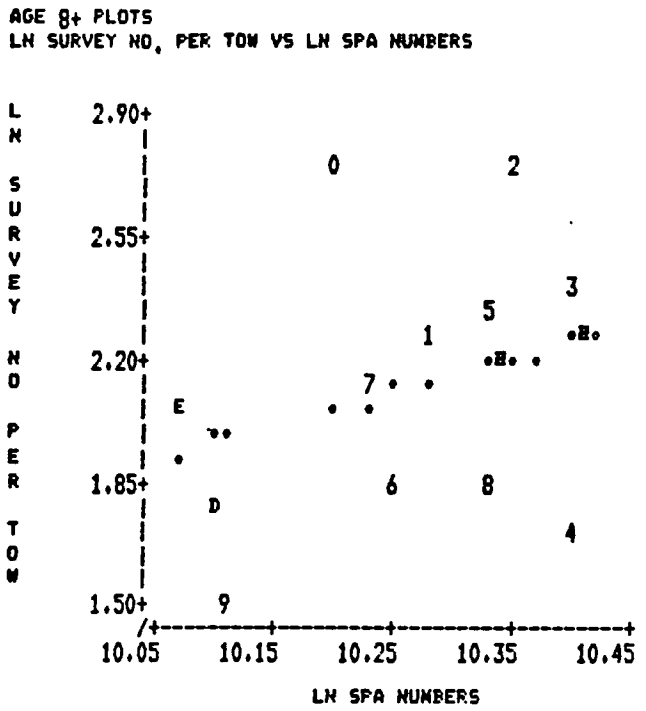
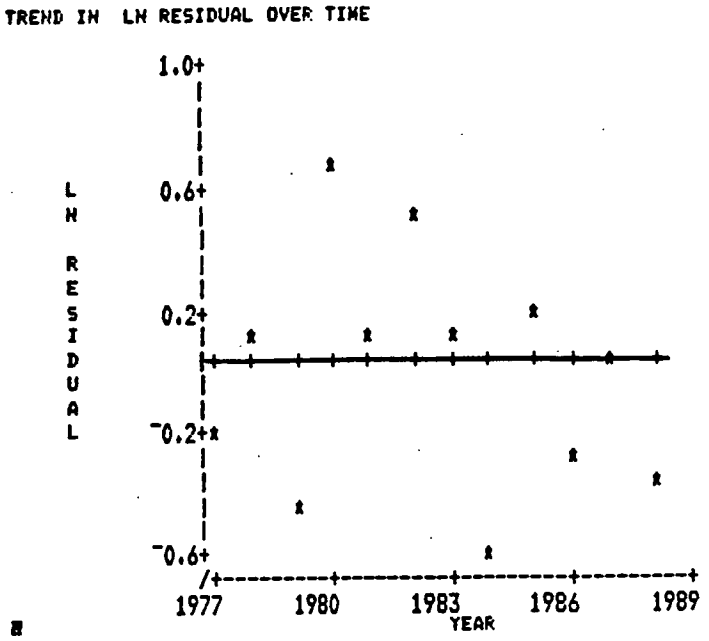
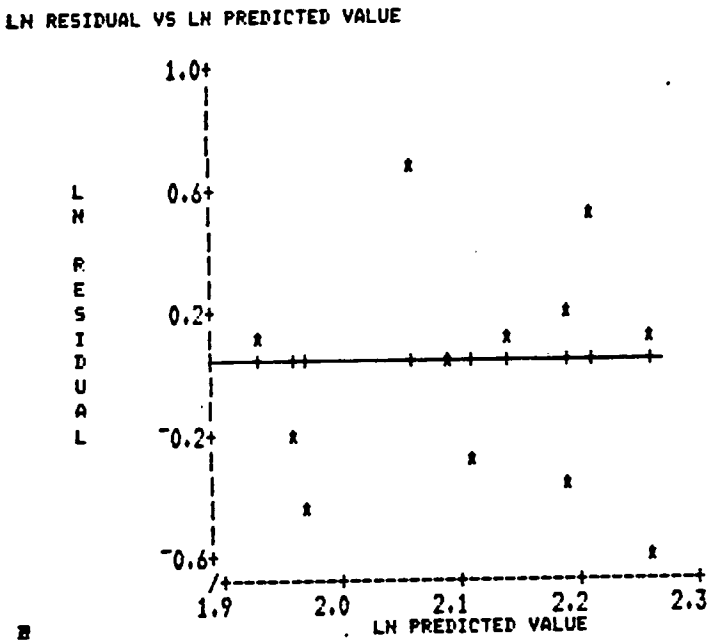


Fig 5. Continued







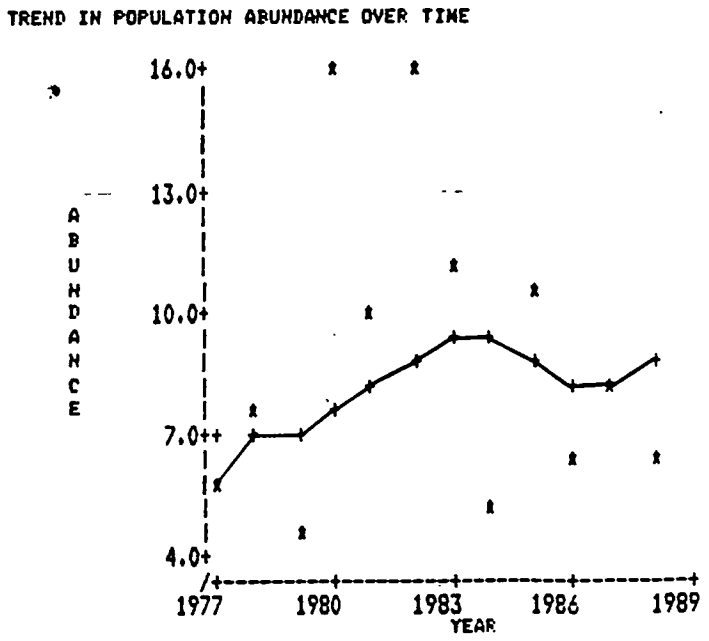
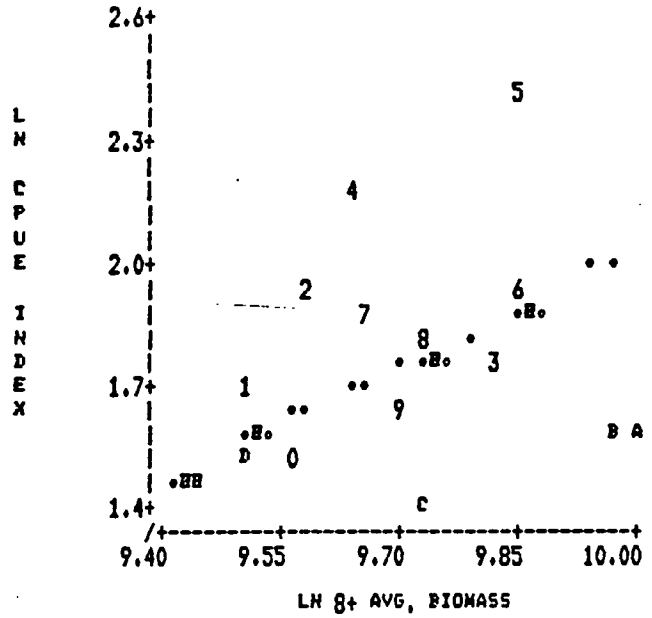
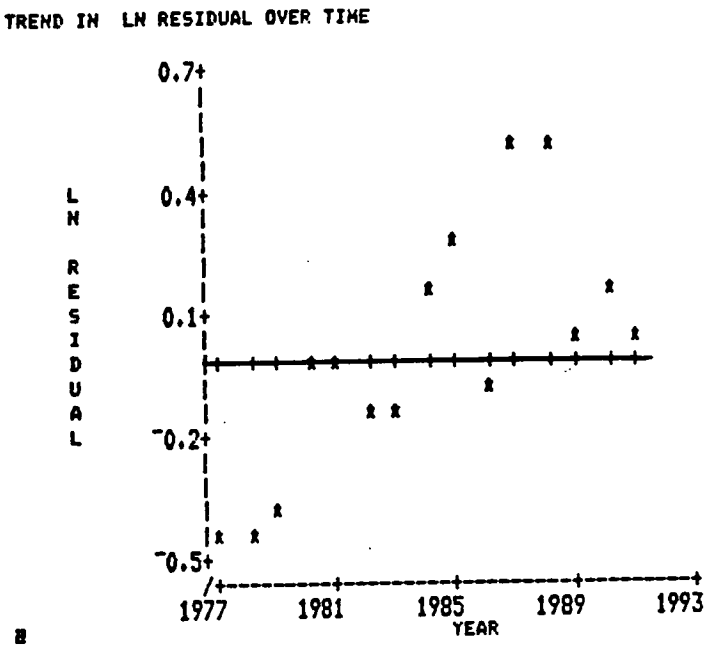
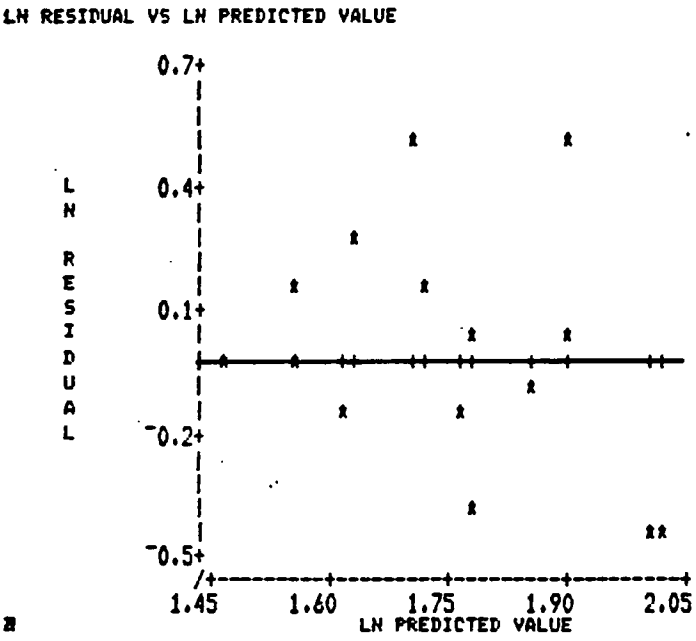


Fig. 6. Plots from ADAPT using RV survey 8+ pop. nos.







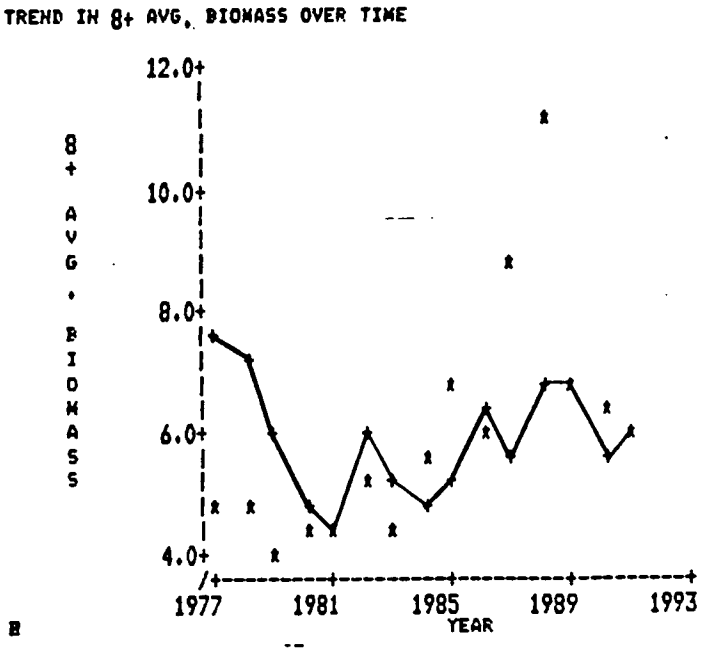


Fig. 7. Plots from ADAPT using CPUE and 8+ pop. biomass.