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An Assessment of the American Plaice Stock in Division 3LNO

by

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Introduction

TAC regulation

This stock has been under TAC management since 1973, when a level of 60,000 t was established (Table 1a). Up to 1987, the TAC has been set between 47,000 and 60,000 t. For 1988, a TAC of 40,000 t was established, pending the 1988 review of the stock status (1987 assessment produced an $F_{0.1}$ catch of 33,000 t for 1988).

Catch trends

The offshore fishery for this stock essentially began in the late 1940's and the nominal catch reached a maximum of 94,000 t in 1967 (Table 1a, Fig. 1). After a period of considerable foreign involvement in the fishery in the 1960's and early 1970's, catches were almost exclusively Canadian from the late 1970's to early 1980's, after the declaration by Canada of a 200 mile limit. Catches by non-Canadian vessels increased from about 1,400 t in 1982 to over 27,000 t in 1986, as many nations either joined the fishery for the first time or directed fleets at flatfish for the first time (Table 1b). Catches by Spain and Portugal were primarily responsible for this increase, totaling over 21,000 t in 1986. In 1987, the preliminary estimate of non-Canadian catch is considerably lower than 1986 and is slightly lower than the 1985 value. Catches by Canadian vessels have remained relatively stable between 33 and 40 thousand tons from 1983 to 1987. In most years since 1972, the inshore catch comprised slightly less than 10% of the total Canadian catch from the stock (Table 2), with gillnets being the predominant gear in this sector.

After a long period (1973-82) of relatively stable catches in the 43-53,000 t range, the catch declined to about 39,000 t in 1983 and 1984, then increased to 54,000 and 61,000 t in 1985 and 1986 respectively. The preliminary estimate for 1987 is down considerably to 45,000 t. This decrease occurred almost exclusively in Div. 3N (Table 3) where a substantial reduction in effort directed at flatfish by foreign vessels was observed by Canadian surveillance personnel in 1987. As can be seen in Table 1b, many countries caught much less A. plaice in 1987 than 1986 and the same magnitude of decline was also observed for yellowtail, which is often caught in the same area in Div. 3N as A. plaice. Canadian surveillance personnel reported that the catch rates of these flounder species by vessels of many nations were much lower in 1987 and that these vessels diverted much of their effort towards redfish and other species in deeper water in the NAFO regulatory area. Catches in Div. 3L and 3Ø have been relatively constant in most recent years.

Table 4 shows that the fishery in all three divisions is carried out on a 12 month basis in most years. In the past 3 years catches have generally peaked in the 3rd and 4th quarters, although a considerable portion of the catch in Div. 3N in 1985 and 1986 is not available by month.

Stock Assessment

As has been the case for several years for this stock, only the portion in Div. 3LN is assessed, because a longer time series of acceptable data is available for these two

1. Updated information for this stock, presented at the June, 1988, NAFO meeting, is contained in the Appendix.

divisions. In previous years, an amount for Div. 3Ø, usually equal to the recent average catch, has been added to the projected catch for Div. 3LN to produce a TAC for the entire stock. With the improvement in the data base for Div. 3Ø in recent years, an attempt will be made to incorporate this portion of the stock into the assessment in the near future.

Catch sampling, 1987

The length frequencies and age-length keys used to calculate the catch-at-age and average weights at age in the commercial fishery in 1987 are shown in Table 5. The level of sampling from this segment of the fishery remained high and was comparable to recent years. Length frequency data was available from USA catches in 1987, however, the data was in an unsexed format and as such, could not be used, at this time, to calculate catch at age in a manner similar to that applied to the Canadian data.

The catch and weight at age for the Canadian fishery in 1987 is shown in Table 6. Compared to the Canadian catch in 1986, these values show a shift to slightly smaller fish in 1987, with ages 9 and 10 being the peak ages (average size 38 and 41 cm respectively). In 1986 the peak age groups were 10 and 11, with average sizes of 41 and 43 cm respectively. Such variations from year to year are common in this stock and often reflect changes in the distribution of fishing effort by season and location.

Catch at age for the entire catch in 1987 was not calculated at this time as sampling for the 9,200 t catch by EEC countries was not available prior to the meeting. (see Appendix)

Commercial CPUE data

The multiplicative model of Gavaris 1980 was used in the analysis of catch and effort data for this stock, using the same formulation as in the 1987 assessment. The source of the data is the Canadian (Newfoundland) offshore trawler fleet, directing toward A. plaice, for the years 1956-87 (Table 7). A comparison of the multiplicative analysis done in 1987 with the non-standardized method used previously showed excellent agreement in the CPUE trends over time in the two series.

The results of the analysis conducted this year are shown in Table 8, and the resulting CPUE series is contained in Table 9 and is shown in Fig. 3. Residual plots from the weighted regression used are shown in Fig. 4 and 5. As can be seen in Fig. 3, the catch rates in 1986 and 1987 are considerably lower than the values calculated for 1980-85 and are approaching the CPUE level observed in the 1974-78 period, which is the lowest in the 32 year series. The 1987 value is virtually the same (2% lower) as the 1986 point.

Research vessel surveys

a) Biomass estimates, 1983-88 (post A. T. CAMERON era)

Tables 10-12 show the results (average weight per tow) on a stratified basis, from Canadian spring surveys conducted in Div. 3L, 3N, and 3Ø from 1971-82 and 1984-88. Fig. 6 shows the stratification scheme used in these surveys. In Div. 3L, the biomass has remained relatively stable over the past four surveys, ranging from 174- to 193,000 t. In Div. 3N the estimate of biomass declined from about 60,000 t in 1984-85 to 32,000 t in 1988. In Div. 3Ø the biomass has fluctuated between 48,000 t (1986) and 77,000 t (1985) in the past five surveys, with the 1988 estimate being 51,000 t.

In addition to the annual spring surveys in Div. 3LNO, a number of seasonal surveys have been conducted by Canadian vessels in Div. 3L from 1983 to 1987. Results of these surveys, in the form of biomass per depth zone, can be seen in Table 13. It should be noted that the spring surveys in this table are those contained in Table 10. Coverage in all these surveys was virtually complete to depths of 200 fath (366 m) in all years, and in some years was extended to 400 fath (732 m). In 1983-84, the average biomass was about 290,000 t. In 1985, the average from the four surveys was 209,000 t and three of the four estimates were between 212 and 227 thousand tons. 1986 produced three widely-different estimates with the winter value clearly being an anomaly. In 1987, three surveys indicated a biomass between 168 and 202,000 t, with the average (184,000 t) being very close to the spring 1988 value. A plot of the total biomass from each of these 13 surveys is shown in Fig. 7. Examination of the results by depth did not reveal any unusual patterns, with about 80% of the biomass being found in depths less than 100 fath (183 m) in most years.

To examine the biomass in the NAFO regulatory area in Div. 3N, all the strata <201 fath (368 m) which have all or almost all their area in this zone were selected (Table 14). These strata show a steady decline from 1984 to 1988, totaling 79%. Over the same period, the total biomass in the other strata in Div. 3N decreased by 44%, although there was not a continuous decline. In 1984-86 these strata in the regulatory area contained about 26% of the total biomass in Div. 3N. This figure declined to about 13% in 1987 and about 11% in 1988. These figures are not inconsistent with the increase in catch in the regulatory area in Div. 3N up to 1986 and the large decrease observed in 1987.

b) Population estimates for Div. 3L, 3N, 3Ø

i) Comparison of surveys from 1971 to 1982 with those from 1983 to 1987, Div. 3LN.

As has been noted in all recent assessments of this stock, the surveys carried out prior to 1983 were done by the side trawler A. T. CAMERON, towing a Yankee 41.5 otter trawl and those from 1983 onward have been done by either of the identical vessels, the WILFRED TEMPLEMAN and the ALFRED NEEDLER, towing an Engels otter trawl. An analysis of a comparative fishing experiment (Gavaris and Brodie, 1984) showed that there were differences in the two vessel-gear types (side vs stern) in their ability to catch A. plaice. Appropriate conversion factors were derived and have been applied to the length frequency data from the A. T. CAMERON catches to make them comparable with catch data from the later period. This methodology has been used in the assessments of this stock since 1984. In these assessments, groups of strata common to most surveys in Div. 3L and Div. 3N were chosen for which an index of abundance could be calculated (Tables 10 and 11). However, concern has been expressed that these strata may not be indicative of total stock abundance and that the age compositions obtained in the selected strata may not be representative of the population. Examination of Table 15 bears out the latter point for Div. 3N, although Div. 3L shows little difference in 1985 and 1986 between the two estimates of age composition.

To provide an estimate of abundance comparable over the 1971-88 period for both Div. 3L and 3N, a multiplicative model was employed, using year and stratum effects to fill in values for strata not fished in a given year. The data used were the mean number of A. plaice per tow from each stratum <201 fath in Div. 3L and 3N from the series of surveys shown in Tables 10 and 11. The numbers prior to 1983 were adjusted using the conversion factors noted previously and all data were increased by 0.5 to allow logarithms of zero catches to be included in the model. Regressions were done separately by divisions, using stratum areas to weight.

Results of the regressions are shown in Tables 17 and 18 for Div. 3L and 3N respectively. Both regressions were significant, although the percent of explained variation was higher in Div. 3L. Residual plots from the model are shown in Fig. 8 (Div. 3L) and 9 (Div. 3N). In Div. 3L, stratum 350 was chosen as the standard and in Div. 3N stratum 362 was selected, these being strata with no missing observations. In both analyses, 1985 was chosen as the standard for year, as no strata were missed in that year in either Div. 3L or 3N. Tables 19 and 20 show, for Div. 3L and 3N respectively, the estimates of abundance estimated by the model for missed strata, as well as the total estimated abundance for each year, weighted by stratum area. It should be noted that none of these estimates is corrected for the addition of 0.5 to the input data. To correct the overall totals for Div. 3L, 1380 must be subtracted from each estimate and the similar correction for Div. 3N is 626. The correct totals for each division are plotted in Fig. 10.

To obtain age by age estimates of abundance from the surveys, age compositions were applied to the abundance estimates from the multiplicative analysis. For Div. 3L the selected strata age compositions (Table 16) were used for all years except 1973 and 1984. For Div. 3N, however, it was shown previously (Table 15) that the selected strata did not show the same age composition as the population estimates from all strata. Therefore, the latter values were used. Results of these analyses are given in Table 21 for Div. 3L and Table 22 for Div. 3N. In Div. 3L, it is obvious from Fig. 11 and Table 21 that the abundance in recent years is substantially lower than the level estimated from 1976 to 1982. The 8+ values in 1985-87 are less than half the average from 1976 to 1982 and are similar to the levels estimated for 1973 and 1974. A positive indicator may be that the estimates of population size at ages 6, 7, and 8 were somewhat higher in 1987 than recent years, with the estimate for age 7 being the 3rd highest in the 16 year series (40% above the average). Although the abundance at age from the 1988 survey could not be derived in time for analysis here, the estimate of biomass was about 7% higher than that from the 1987 survey. In Div. 3N the abundance has shown more fluctuation from year to year than in Div. 3L, although similar trends exist, eg. the abundance in Div. 3N in recent years is also lower than the estimates for the late 1970's and early 1980's, and is similar to the levels around 1973-74. Unlike Div. 3L there is no evidence of above average recruitment in 1987. As well, the biomass estimate from the 1988 survey in Div. 3N was down considerably from recent values (Table 11).

ii) Spring surveys, Div. 3Ø

A multiplicative analysis was not carried out at this time, although such an analysis is planned for the next assessment. Table 23 shows the population estimates at age from surveys in Div. 3Ø from 1984 to 1987. The population size has been around the same level in 3 of these 4 years, with 1986 being somewhat lower. There is some evidence of good recruitment at younger ages in 1987, although the biomass estimate for 1988 (Table 12) is lower than 1987 and is similar to the 1986 value.

iii) Fall surveys and seasonal surveys, Div. 3L

From Tables 24 and 25, it can be seen that the population estimates from fall surveys in Div. 3L are much lower in 1985-87 than those from 1981 to 1984. Although ages 7 and 8 are dominant in the fall 1987 survey, (Table 25) as they were in the spring 1987 survey, these year-classes do not appear as strong (relative to others at the same age) as indicated in the spring series. Table 26 shows the age by age results from the fall survey compared to spring and summer surveys in Div. 3L in 1987. The spring survey is the one examined previously and the summer survey was conducted by a larger vessel (GADUS ATLANTICA) towing the same type of Engels otter trawl. The three surveys show virtually the same age composition of A. plaice in the catches, with ages 7-8 comprising about 50% of the catch in numbers. While this result would normally be expected, it is interesting to note that a series of seasonal surveys carried out in Div. 3L in 1985 showed wide differences in the age compositions from one survey to another (Table 27).

Table 1a. Nominal catches (t) of American plaice for NAFO Divisions 3LNO, 1960-87 and TAC's from 1973 to 1988. See Appendix for updated catches in 1987.

Year	Canada	France	Poland	USSR	South Korea[a]	Other	Total	TAC
1960	21,352	2,106	-	569	-	20	24,047	-
1961	14,903	1,473	286	1,248	-	3	17,913	-
1962	15,217	973	171	1,841	-	4	18,206	-
1963	24,591	93	558	72	-	132	25,446	-
1964	35,474	1,582	539	680	-	292	38,567	-
1965	45,365	2,056	977	4,544	-	319	53,261	-
1966	51,225	1,246	860	11,484	-	196	65,011	-
1967	54,190	1,326	3,234	35,139	-	524	94,413	-
1968	48,674	406	203	23,751	-	133	73,167	-
1969	64,815	43	34	14,493	-	52	79,437	-
1970	54,929	389	40	10,232	-	1,055	66,645	-
1971	49,394	323	370	17,173	-	628	67,888	-
1972	41,605	322	2,515	14,164	-	755	59,361	-
1973	38,586	310	1,116	12,516	-	315	52,843	60,000
1974	35,101	418	615	10,074	-	89	46,297	60,000
1975	34,015	442	537	7,682	-	545	43,221	60,000
1976	47,806	305	5	3,280	-	429	51,825	47,000
1977	42,579	31	-	1,023	-	348	43,981	47,000
1978	48,634	168	-	1,048	-	178	50,028	47,000
1979	47,131	113	-	1,190	-	135	48,569	47,000
1980	48,296	183	-	336	-	271	49,086	47,000
1981	48,177	210	-	847	-	924	50,158	55,000
1982	49,620	133	-	67	715	517	51,052	55,000
1983	35,907	41	-	170	815	1,602	38,535	55,000
1984	33,756	140	1	360	1,582	3,581	39,420	55,000
1985[b]	40,024	-	4	81	2,483	11,443	54,035	49,000
1986[b,c]	33,373	-	-	188	505	26,824	60,890	55,000
1987[b,c]	33,923	-	-	28	501	10,476	44,928	48,000
1988								40,000

[a]South Korean catches reported to NAFO in 1982-84 as unspecified flounder. The breakdown used for these catches is 60% yellowtail, 40% American plaice.

[b]Catches for S. Korea and some others are estimated.

[c]Provisional.

Table 1b. Breakdown of catches from Table 1a listed as "other" for 1984-87. See Appendix for updated catches in 1987.

Year	Spain	Portugal	Panama[b]	U.S.A.	Cayman Islands[b]	Other	Total
1984	1,622	-	1,775	-	-	184	3,581
1985[a]	5,498	27	3,762	1,310	750	96	11,443
1986[a]	11,882	9,240	3,515	1,605	571	11	26,824
1987[a]	-	-	-	1,249	-	9,227c	10,476

[a]Provisional.

[b]Not reported to NAFO. Catches estimated from surveillance reports.

[c]EEC, country unknown.

Table 2. Catches of American plaice by Canadian vessels using gears other than otter trawl, Div. 3L, 1972-87.

Year	Seines	Gillnets	Longline	Handline	Trap	Other	Total
1972		3359	28	19	16	31	3453
1973		2483	67	5	24	99	2678
1974		1386	45	4	249	3	1687
1975		2391	11	12	48	14	2476
1976	16	3430	15	8	35	5	3509
1977		3921	27	13	49		4010
1978		4084	51	18	72		4225
1979	230	4446	42	24	50		4792
1980		3339	45	6	24		3414
1981	25	4542	81	7	24		4679
1982		4267	106	6	23		4402
1983		3709	59	20	23		3811
1984	9	2567	58	16	17		2667
1985	17	2370	51	39	75		2552
1986[a]	1	3684	49	20	71		3825
1987[a]	15	3704	60	15	94	3	3891

[a]Provisional

Table 3. Breakdown of plaice nominal catches (t) in Divisions 3LNØ by Division, for the years 1960-87.

Year	Division 3L	Division 3N	Division 3Ø	UNK	Total
1960	19,397	3,912	738	-	24,047
1961	13,398	3,498	1,017	-	17,913
1962	13,584	3,923	699	-	18,206
1963	16,512	7,465	1,469	-	25,446
1964	21,391	14,587	2,589	-	38,567
1965	25,034	26,270	1,957	-	53,261
1966	18,572	34,698	11,741	-	65,011
1967	38,515	24,364	31,534	-	94,413
1968	39,126	20,038	14,003	-	73,167
1969	52,880	14,442	12,115	-	79,437
1970	39,347	21,032	6,266	-	66,645
1971	37,851	22,873	7,164	-	67,888
1972	33,330	17,387	8,644	-	59,361
1973	20,103	20,883	11,857	-	52,843
1974	16,610	21,126	8,561	-	46,297
1975	15,171	21,308	6,742	-	43,221
1976	25,122	18,623	8,080	-	51,825
1977	23,763	16,543	3,675	-	43,981
1978	30,145	13,443	6,440	-	50,028
1979	28,708	14,712	5,149	-	48,569
1980	31,717	15,119	2,250	-	49,086
1981	37,269	10,628	2,261	-	50,158
1982[a]	32,761	13,101	5,190	-	51,052
1983[a]	22,964	11,107	4,464	-	38,535
1984[a,b]	20,307	15,125	3,988	-	39,420
1985[a,b]	23,320	25,647	5,068	-	54,035
1986[a,b,c]	25,721	30,431	4,738	-	60,890
1987[a,b,c]	25,564	6,185	3,924	9,255	44,928

[a]Includes breakdown of unspecified flounder catches by S. Korea.

[b]Includes estimates of non-reported catch on the Tail of the Bank outside Canadian 200 mile limit. These catches are attributed 90%:10% to Divisions 3N:30.

[c]Provisional.

Table 4. Breakdown of plaice nominal catches (t) by Division and month, for the years 1977-87. Does not include reported monthly catches where Division is unknown.

	1977	1978	1979	1980	1981	1982[a]	1983[a]	1984[a,b]	1985[a,b]	1986[a,b,c]	1987[a,b,c]
						3L					
Jan.	34	247	2,003	2	135	23	529	1,335	6	230	2
Feb.	1,140	143	543	658	50	317	166	380	32	158	7
Mar.	175	123	1,475	1,056	2,414	578	151	2,719	2,924	1,033	56
Apr.	279	389	1,576	565	5,590	1,627	1,540	2,135	833	687	813
May	2,986	3,309	4,110	7,391	8,986	5,228	4,535	2,890	1,815	2,377	3,103
June	3,899	5,974	4,359	8,632	6,887	5,296	4,207	3,643	2,513	2,813	4,627
July	3,418	5,775	5,321	2,934	3,104	6,106	2,895	3,912	1,878	2,872	3,687
Aug.	3,314	4,990	4,080	1,784	2,759	3,142	1,843	1,679	2,324	5,175	2,711
Sept.	2,465	3,269	2,289	679	2,373	2,948	2,270	536	3,256	3,679	3,609
Oct.	2,128	2,149	1,146	3,094	1,872	2,765	2,087	223	4,173	2,192	2,688
Nov.	2,317	1,212	1,117	1,540	2,251	2,877	1,447	380	1,977	3,431	2,543
Dec.	1,608	2,565	689	3,382	848	1,854	1,294	475	1,589	1,074	1,718
Unk.	–	–	–	–	–	–	–	–	–	–	–
Total	23,763	30,145	28,708	31,717	37,269	32,761	22,964	20,307	23,320	25,721	25,564
						3N					
Jan.	4	798	510	28	482	16	314	508	2	586	47
Feb.	798	268	350	376	105	6	259	153	1,219	238	36
Mar.	338	469	135	519	154	42	248	397	409	802	29
Apr.	200	525	668	15	406	77	418	1,217	1,194	481	320
May	1,246	502	773	526	880	398	800	1,384	2,123	3,176	566
June	2,416	1,593	1,363	1,836	1,227	641	779	2,443	3,131	2,661	658
July	2,431	1,432	1,947	1,574	2,563	2,681	1,446	2,796	2,570	3,859	1,095
Aug.	2,418	1,931	2,055	1,641	1,759	2,685	1,202	876	2,835	3,107	955
Sept.	1,659	1,196	1,809	1,349	1,219	1,796	495	296	1,969	4,737	541
Oct.	1,668	2,013	1,259	3,386	1,055	3,132	1,545	471	2,321	2,610	766
Nov.	1,849	1,601	2,516	2,495	679	748	1,039	1,373	1,718	2,415	650
Dec.	1,516	1,115	1,327	1,374	99	235	1,828	189	654	1,576	71
Unk.	–	–	–	–	–	644	734	1,424	5,502	4,183	451
Total	16,543	13,443	14,712	15,119	10,628	13,101	11,107	15,125	25,647	30,431	6,185
						3Ø					
Jan.	1	274	274	4	188	–	767	98	62	294	96
Feb.	359	434	93	17	72	107	147	1,090	579	89	61
Mar.	120	216	189	477	214	548	397	523	218	270	508
Apr.	118	452	260	23	98	49	452	99	579	202	1,044
May	341	1,223	221	91	64	2,071	687	298	754	434	421
June	516	450	339	288	200	1,317	607	210	561	859	666
July	494	288	341	95	352	63	263	412	165	325	440
Aug.	546	303	270	29	82	123	124	205	433	234	184
Sept.	372	322	340	66	204	158	296	293	513	225	193
Oct.	331	879	437	335	281	219	234	275	216	188	144
Nov.	378	955	1,564	283	354	258	338	105	248	451	105
Dec.	99	644	821	542	152	206	71	45	287	759	12
Unk.	–	–	–	–	–	71	81	158	453	408	50
Total	3,675	6,440	5,149	2,250	2,261	5,190	4,464	3,988	5,068	4,738	3,924

aIncludes breakdown of unspecified flounder catches by S. Korea.

bProvisional. Includes estimates of non-reported catch on the Tail of the Bank outside Canadian 200 mile limit. These catches are attributed 90%:10% to Divisions 3N:3O.

Table 5. Commercial Samples and catch used to calculate catch at age and average weights at age for American plaice, Div. 3LNO, 1987. Numbers in parentheses are the numbers of observations.

Age-Length Key	Length Frequency	No. Samples	Catch (t)	Description
ALK0T2CN3L (707)	LFGNMAYCN3L (3355)	10	545	Canada, 3L, inshore, Jan-May
	(JUN (2666)	9	735	" " " June
ALK0T3CN3L (854)	(LFGNJULCN3L (1164)	4	1293	" " " July
	(AUG (1017)	4	1319	" " " Aug-Dec
	(APR (1487)	4	867	Canada, 3L, offshore, Jan-Apr
ALKS02CN3L (742)	(LFOTMAYCN3L (3300)	8	2569	" " " May
	(JUN (1360)	3	3893	" " " June
	(JUL (1140)	3	2394	" " " July
	(LFOTAUGCN3L (1235)	3	1712	" " " Aug
ALKS03CN3L (733)	(SC (385)	1		
	(LFOTSEPCN3L (3882)	10	3334	" " " Sep
	(SC (401)	1		
	(LFOTOCTCN3L (6147)	16	2648	" " " Oct
	(SC (765)	2		
ALKS0RCN3L (811)	(LFOTNOVCN3L (7476)	19	2538	" " " Nov
	(DEC (650)	2	1718	" " " Dec
ALKS03CN3N (55)	(AUG (259)	1	2728	Canada, 3N, all gears, Jan-Aug
+	(LFOTOCTCN3N (2061)	6	1100	" " " Sep-Oct
ALKS04CN3N (578)	(NOV (949)	3	655	" " " Nov-Dec
	(FEB (376)	1	157	Canada, 3O, all gears, Jan-Feb
ALKS01CN30 (721)	(LFOTMARCN30 (2816)	8	508	" " " March
	(APR (815)	2	1465	" " " Apr-May
ALKS02CN30 (380)	(LFOTJUNCN30 (483)	2	1745	" " " Jun-Dec

TABLE 6. CATCH AT AGE AND AVG WTS AT AGE FROM CANADIAN FISHERY.

AGE	AVERAGE WEIGHT	AVERAGE LENGTH	CATCH MEAN	CATCH STD. ERR.	CATCH C. V.
* 5	0.032	16.500	1	0.00	0.00
* 6	0.354	33.832	108	24.67	0.23
* 7	0.326	32.987	1106	102.94	0.09
* 8	0.347	33.798	5185	222.82	0.04
9	0.451	36.620	10559	311.13	0.03
10	0.595	39.733	11809	330.69	0.03
11	0.776	43.053	8036	268.43	0.03
*12	1.030	46.897	4976	167.96	0.03
*13	1.295	50.234	2134	93.74	0.04
14	1.650	54.050	921	46.76	0.05
15	2.167	58.712	473	27.96	0.06
*16	2.830	63.628	135	15.39	0.11
*17	3.270	66.487	20	7.65	0.38
*18	3.892	70.103	2	0.37	0.20

Table 7. Summary of catch (t) and effort (hrs) data used in the multiplicative model, Divisions 3LNO A. plaice CPUE calculations.

Year	Division 3L		Division 3N		Division 3Ø	
	Catch	Effort	Catch	Effort	Catch	Effort
1956	3863	3824	2115	2493	8	30
1957	3020	3385	2288	2668	20	36
1958	5096	5154	3099	4435	-	-
1959	5758	6780	3645	4738	31	59
1960	9792	11004	2584	3700	45	124
1961	6930	8790	2329	3615	51	70
1962	8278	12524	3419	6280	4	18
1963	11452	15543	6051	8410	222	509
1964	10279	14401	9081	10737	571	981
1965	11219	14487	18082	23677	962	1806
1966	8544	11560	20947	27769	2995	5220
1967	22104	30236	12261	15830	2193	3071
1968	24582	40128	6743	11389	357	790
1969	32196	59051	7053	14310	1244	2778
1970	19979	39158	3932	8147	3137	5273
1971	19998	41637	4441	9926	1625	3106
1972	17259	35232	5878	13452	875	2250
1973	12548	24730	7477	14354	6363	13137
1974	11276	26785	9609	21436	6721	16568
1975	10267	25395	11769	28294	2586	7929
1976	20133	45254	15569	38003	5152	17091
1977	18027	42580	14084	35295	2559	7738
1978	23685	48906	9961	24719	5067	13477
1979	20518	40603	10096	21629	3595	8536
1980	22638	37118	11929	22841	1446	3398
1981	28056	48719	6066	11741	1332	2917
1982	23502	40865	9541	18585	2930	6420
1983	12169	20677	6036	8662	2797	5990
1984	10307	15180	6313	10494	2186	4192
1985	14941	21598	10599	17048	1991	4611
1986	12644	26061	4965	11602	2164	5632
1987	14588	31878	1884	4921	1909	5355

TABLE 8. RESULTS FROM MODEL USED TO CALCULATE STANDARDIZED CPUE.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.789
MULTIPLE R SQUARED,..... 0.623

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.629E2	4.629E2	
REGRESSION	45	9.939E1	2.209E0	41.179
TYPE 1	2	1.911E1	9.554E0	178.130
TYPE 2	1	1.962E0	1.962E0	36.576
TYPE 3	11	2.929E0	2.663E-1	4.965
TYPE 4	31	9.082E1	2.930E0	54.620
RESIDUALS	1121	6.012E1	5.363E-2	
TOTAL	1167	6.224E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	0.383	0.073	1167
2	32				
3	7				
4	56				
1	3114	1	-0.396	0.021	384
	3124	2	-0.141	0.022	273
2	34	3	-0.085	0.014	576
3	1	4	0.097	0.040	52
	2	5	0.131	0.038	61
	3	6	0.007	0.038	64
	4	7	-0.078	0.034	84
	5	8	-0.071	0.030	106
	6	9	-0.012	0.028	121
	8	10	-0.022	0.029	125
	9	11	-0.061	0.030	122
	10	12	-0.075	0.030	109
	11	13	-0.036	0.030	106
	12	14	-0.010	0.032	88
4	57	15	-0.052	0.097	12
	58	16	-0.098	0.087	16
	59	17	-0.123	0.084	16
	60	18	-0.149	0.084	16
	61	19	-0.240	0.087	15
	62	20	-0.431	0.082	19
	63	21	-0.268	0.081	19
	64	22	-0.266	0.079	27
	65	23	-0.325	0.075	47
	66	24	-0.335	0.074	51
	67	25	-0.477	0.074	57
	68	26	-0.742	0.075	51
	69	27	-0.920	0.075	53
	70	28	-1.019	0.078	41
	71	29	-1.073	0.077	47
	72	30	-1.053	0.077	49
	73	31	-1.019	0.077	47
	74	32	-1.174	0.078	43
	75	33	-1.222	0.077	42
	76	34	-1.216	0.076	49
	77	35	-1.204	0.077	40
	78	36	-1.183	0.076	47
	79	37	-1.057	0.076	41
	80	38	-0.886	0.076	45
	81	39	-0.919	0.076	49
	82	40	-0.892	0.078	42
	83	41	-0.819	0.079	37
	84	42	-0.824	0.082	32

TABLE 9. A.PLAICE, DIV. 3LN, STANDARDIZED CPUE SERIES, 1956-88.

STANDARDS USED VARIABLE NUMBERS: 3125 32 7

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1956	0.3827	0.0053	1.502	0.109	10000	6657
1957	0.3308	0.0061	1.426	0.111	10000	7014
1958	0.2850	0.0041	1.363	0.088	10000	7336
1959	0.2600	0.0038	1.330	0.082	10000	7521
1960	0.2339	0.0037	1.296	0.078	23309	17992
1961	0.1431	0.0042	1.183	0.076	16896	14285
1962	-0.0487	0.0033	0.977	0.056	17507	17924
1963	0.1149	0.0032	1.150	0.065	23977	20842
1964	0.1166	0.0028	1.153	0.061	35978	31214
1965	0.0575	0.0018	1.087	0.046	51304	47196
1966	0.0475	0.0016	1.076	0.043	53270	49494
1967	-0.0944	0.0014	0.934	0.035	62879	67325
1968	-0.3595	0.0015	0.716	0.028	59164	82576
1969	-0.5373	0.0015	0.600	0.023	67322	112252
1970	-0.6368	0.0018	0.543	0.023	60379	111216
1971	-0.6901	0.0017	0.515	0.021	60724	117965
1972	-0.6701	0.0016	0.525	0.021	50717	96576
1973	-0.6367	0.0017	0.543	0.023	40986	75488
1974	-0.7910	0.0017	0.465	0.019	37736	81093
1975	-0.8389	0.0017	0.444	0.019	36479	82242
1976	-0.8336	0.0015	0.446	0.017	43745	98088
1977	-0.8210	0.0016	0.452	0.018	40306	89249
1978	-0.8001	0.0015	0.461	0.018	43588	94517
1979	-0.6742	0.0015	0.523	0.020	43420	83019
1980	-0.5030	0.0016	0.621	0.025	46836	75459
1981	-0.5367	0.0016	0.600	0.024	47897	79815
1982	-0.5093	0.0018	0.617	0.026	45862	74368
1983	-0.4363	0.0020	0.663	0.029	34071	51359
1984	-0.4418	0.0023	0.660	0.031	35432	53713
1985	-0.4389	0.0019	0.662	0.029	48967	74006
1986	-0.7518	0.0020	0.484	0.021	56152	116046
1987	-0.7717	0.0025	0.474	0.023	31749	66951

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.048

Table 10. Mean weight (kg) of American plaice per tow, by stratum, from R. V. surveys in Division 3L. Numbers in parentheses are the number of successful 30 minute tows in each stratum. The stratified mean weight per tow (kg/30 min.) and the biomass estimates (t x 10^{-1}), are given at the bottom of the table.

		Year - Trip								
		1971	1972	1973	1974	1975	1976	1977	1978	1979
Depth (fm)	Stratum	ATC 187	ATC 199	ATC 207, 208 209	ATC 222	ATC 233	ATC 246	ATC 262	ATC 276	ATC 289, 290, 291
51-100	328	-	-	-	-	-	-	26.9(3)	-	27.3(5)
51-100	341	-	-	48.4(3)	-	-	-	94.2(4)	43.8(4)	88.8(6)
51-100	342	-	-	-	-	-	-	75.4(2)	72.6(2)	59.5(4)
51-100	343	-	-	-	-	-	-	103.1(2)	112.6(3)	90.2(4))
101-150	344	-	-	-	-	-	92.3(4)	100.5(4)	62.4(4)	28.6(2)
151-200	345	-	-	-	-	-	22.8(4)	27.1(4)	56.3(2)	8.4(4)
151-200	346	-	-	-	-	45.9(2)	22.3(2)	8.4(3)	-	4.8(4)
101-150	347	28.8(2)	-	-	24.5(2)	61.9(2)	151.5(3)	91.1(3)	59.3(4)	58.3(4)
51-100	348*	214.4(3)	92.3(3)	-	73.6(6)	47.5(4)	83.7(6)	211.6(6)	232.8(6)	150.2(6)
51-100	349*	281.2(3)	46.8(4)	-	17.0(4)	23.6(2)	66.6(3)	124.3(6)	65.1(6)	105.7(7)
31-50	350*	77.9(3)	56.5(2)	33.5(4)	82.3(3)	78.1(3)	99.0(4)	40.5(4)	44.3(6)	45.5(9)
31-50	363*	56.3(3)	111.7(3)	50.1(4)	69.8(4)	21.5(3)	90.4(4)	103.1(5)	96.8(5)	88.0(8)
51-100	364*	155.7(4)	138.8(3)	-	92.3(4)	99.4(2)	164.6(3)	236.1(7)	172.4(6)	195.5(8)
51-100	365	192.0(3)	158.5(2)	-	43.1(3)	79.0(2)	62.4(3)	243.7(3)	243.3(2)	161.6(4)
101-150	366	34.4(3)	-	-	63.0(3)	37.6(4)	40.8(4)	76.7(4)	-	7.2(4)
151-200	368	0.0(2)	-	-	4.8(2)	1.1(2)	29.0(3)	0.0(3)	-	0.7(4)
101-150	369	31.8(3)	-	-	14.2(3)	23.8(3)	52.9(4)	51.0(3)	18.6(2)	16.8(4)
51-100	370*	44.0(2)	82.5(3)	-	90.5(3)	43.3(3)	93.1(3)	162.1(3)	70.7(3)	211.7(4)
31-50	371	95.8(3)	91.9(2)	-	63.1(3)	-	-	93.4(3)	114.1(3)	175.8(3)
31-50	372*	27.1(4)	36.3(3)	124.1(3)	50.4(3)	36.1(3)	47.5(3)	35.0(6)	24.5(7)	38.4(9)
31-50	384	87.9(3)	69.5(2)	12.4(3)	26.6(3)	-	-	54.0(2)	54.5(3)	79.0(4)
51-100	385*	139.5(4)	84.2(4)	34.5(3)	17.3(2)	72.1(4)	79.5(2)	168.0(6)	135.4(6)	102.2(7)
101-150	386	20.9(2)	-	-	24.1(3)	22.6(3)	51.7(2)	4.8(3)	19.5(3)	11.5(4)
151-200	387	1.2(3)	-	-	0.5(3)	0.0(2)	1.0(3)	2.5(2)	2.7(3)	1.0(4)
151-200	388	1.4(2)	-	12.2(2)	2.6(3)	0.2(2)	13.0(2)	0.7(2)	0.3(2)	0.6(3)
101-150	389*	17.4(3)	17.0(2)	13.4(2)	14.5(3)	22.7(2)	38.8(2)	7.0(3)	8.2(3)	2.3(4)
51-100	390	236.2(3)	30.1(3)	9.7(3)	1.6(3)	278.2(3)	-	68.1(2)	66.1(4)	93.8(5)
101-150	391	-	24.1(2)	12.2(2)	43.3(3)	16.8(2)	-	45.4(2)	15.4(2)	17.2(4)
151-200	392	-	-	291.9(3)	1.8(4)	2.4(2)	-	3.1(2)	1.9(3)	4.2(2)
201-300	729	-	-	-	-	-	-	-	-	-
301-400	730	-	-	-	-	-	-	-	-	-
201-300	731	-	-	-	-	-	-	-	-	-
301-400	732	-	-	-	-	-	-	-	-	-
201-300	733	-	-	-	-	-	-	-	-	-
301-400	734	-	-	-	-	-	-	-	-	-
201-300	735	-	-	-	-	-	-	-	-	-
301-400	736	-	-	-	-	-	-	-	-	-
Mean (#sets)		109.4(58)	79.0(38)	49.2(32)	47.1(70)	60.7(55)	76.8(64)	98.3(102)	87.1(94)	80.9(140)
Biomass		232.8	135.8	53.3	101.7	124.8	163.9	271.3	213.7	223.4

(cont'd next page)

Table 10. (Cont'd.)

Depth (fm)	Stratum	Year - Trip 1980 ATC 304, 305	1981 ATC 317 318, 319	1982 ATC 327 328, 329	1984 AN 28	1985 WT 28, 29, 30	1986 WT 48	1987 WT 58, 59, 60	1988[a] WT 70, 71
51-100	328	-	52.5(2)	72.8(3)	12.5(2)	51.6(4)	51.2(9)	85.9(7)	16.8(3)
51-100	341	47.0(6)	136.5(2)	146.6(5)	69.6(4)	40.3(9)	43.7(9)	82.5(6)	50.8(6)
51-100	342	77.0(4)	-	43.3(3)	60.1(4)	35.2(3)	53.5(3)	91.8(2)	94.0(2)
51-100	343	107.1(4)	177.5(2)	115.8(4)	-	12.7(3)	48.0(4)	111.5(3)	67.0(3)
101-150	344	105.5(3)	105.8(5)	58.0(4)	-	41.6(5)	80.3(8)	51.1(4)	73.0(7)
151-200	345	10.1(5)	32.5(4)	7.6(4)	-	23.3(5)	16.3(7)	11.0(4)	13.1(7)
151-200	346	2.8(3)	29.8(3)	5.3(3)	-	26.3(2)	33.1(5)	7.3(5)	8.8(4)
101-150	347	102.3(5)	86.1(4)	93.0(2)	-	42.1(5)	50.4(5)	43.5(3)	50.5(5)
51-100	348*	168.7(7)	89.5(7)	118.3(4)	-	65.1(18)	104.9(12)	130.1(8)	142.3(11)
51-100	349*	110.8(9)	72.8(4)	125.6(6)	89.5(6)	49.8(14)	58.3(14)	105.1(11)	137.8(8)
31-50	350*	96.8(10)	114.5(3)	76.6(7)	108.2(6)	98.5(12)	99.5(11)	68.7(11)	86.1(8)
31-50	363*	77.2(5)	62.3(3)	168.0(5)	92.2(5)	107.8(8)	138.4(10)	68.6(9)	124.9(7)
51-100	364*	166.9(6)	172.3(3)	195.5(6)	144.4(5)	102.3(17)	87.4(17)	164.0(15)	136.1(10)
51-100	365	156.1(4)	141.5(2)	88.7(3)	-	54.1(7)	68.5(5)	107.9(5)	82.4(4)
101-150	366	70.5(4)	20.2(3)	8.3(5)	-	37.6(6)	21.4(8)	14.5(7)	18.8(6)
151-200	368	0.8(2)	6.3(2)	0.5(2)	-	30.5(2)	16.5(2)	1.7(3)	2.0(2)
101-150	369	13.7(3)	39.8(2)	20.5(2)	-	71.7(5)	16.1(6)	8.4(5)	6.3(4)
51-100	370*	172.2(3)	54.0(2)	133.0(2)	-	56.6(8)	96.6(8)	69.8(7)	127.9(5)
31-50	371	147.0(3)	177.0(2)	102.9(4)	-	107.5(7)	68.0(6)	58.3(7)	135.8(5)
31-50	372*	39.7(6)	95.8(4)	50.8(6)	63.7(5)	109.9(12)	69.6(14)	30.1(13)	54.9(11)
31-50	384	48.8(2)	60.5(2)	32.3(2)	-	100.3(6)	114.0(6)	56.4(7)	51.9(5)
51-100	385*	224.4(4)	87.3(3)	70.8(3)	-	48.8(15)	62.8(13)	74.1(11)	46.1(10)
101-150	386	7.2(3)	20.8(2)	9.2(3)	-	26.0(5)	9.7(6)	7.5(5)	32.5(4)
151-200	387	0.7(2)	1.0(2)	1.3(3)	-	20.8(6)	3.0(4)	0.0(4)	1.2(4)
151-200	388	0.1(2)	0.1(2)	0.4(2)	-	25.5(2)	11.5(2)	1.4(2)	0.9(2)
101-150	389*	4.8(3)	23.9(2)	4.5(2)	-	27.2(5)	27.7(5)	10.6(6)	19.7(3)
51-100	390	99.0(3)	18.5(2)	35.8(4)	-	15.0(9)	14.5(8)	28.0(7)	10.7(5)
101-150	391	11.0(2)	4.3(2)	10.3(2)	-	9.5(2)	61.0(2)	12.5(2)	27.8(2)
151-200	392	1.5(2)	2.8(2)	0.8(2)	-	13.8(2)	9.5(2)	0.6(2)	0.9(2)
201-300	729	-	-	-	-	0.5(2)	-	-	-
301-400	730	-	-	-	-	0.3(2)	-	-	-
201-300	731	-	-	-	-	326.0(2)	-	-	-
301-400	732	-	-	-	-	0.3(2)	-	-	-
201-300	733	-	-	-	-	21.4(3)	-	-	-
301-400	734	-	-	-	-	1.5(3)	-	-	-
201-300	735	-	0.0(2)	-	-	57.0(2)	-	-	-
301-400	736	-	-	-	-	5.0(2)	-	-	-
Mean (#sets)		95.3(115)	80.7(80)	80.4(103)	87.4(37)	60.3(221)	63.1(211)	65.5(181)	-(155)
Biomass		252.1	221.0	222.0	97.9	175.1	174.1	180.9	193.1

[a]Preliminary analysis

Table 11. Mean weight (kg) of American plaice per tow, by stratum, from R. V. surveys in Division 3N. Numbers in parentheses are the number of successful 30 minute tows in each stratum. The stratified mean weight per tow (kg/30 min.) and the biomass estimates ($tx10^{-3}$) are given at the bottom of the table.

Depth (fm)	Stratum	1971 ATC 187	1972 ATC 199	1973 208 ATC 209	1974 ATC 222	1975 ATC 233	1976 ATC 245	1977 ATC 263	1978 278 ATC 277	1979 ATC 289
151-200	357	-	-	0.0(2)	-	-	-	5.5(2)	-	2.4(3)
101-150	358	-	2.4(4)	6.5(3)	-	-	-	20.0(2)	-	2.1(2)
51-100	359	-	46.3(3)	31.3(3)	-	-	66.3(3)	114.4(2)	-	60.3(4))
31-50	360	-	34.1(4)	-	-	23.5(4)	44.3(4)	58.8(4)	106.7(4)	60.4(9)
31-50	361*	17.3(2)	49.2(3)	25.2(4)	37.2(4)	46.3(4)	21.1(5)	22.1(3)	17.5(4)	20.3(8)
31-50	362*	89.0(2)	110.4(4)	58.0(5)	40.8(4)	18.6(3)	38.7(5)	27.4(5)	27.6(4)	37.3(12))
31-50	373*	93.1(4)	55.6(4)	27.6(4)	12.1(4)	-	75.5(5)	70.5(4)	70.3(5)	35.2(11)
31-50	374*	64.7(2)	66.7(2)	45.1(4)	30.4(2)	21.3(2)	-	68.1(3)	89.9(3)	46.3(4)
≤ 30	375*	17.3(3)	15.7(3)	41.5(3)	35.6(3)	14.6(3)	-	61.3(4)	39.1(5)	17.7(5)
≤ 30	376	-	16.3(2)	22.3(3)	-	23.6(2)	33.0(3)	59.0(3)	240.3(2)	25.4(4)
51-100	377	-	24.5(2)	52.2(2)	19.7(3)	165.3(2)	-	236.1(2)	28.6(2)	15.9(3)
101-150	378*	23.2(2)	22.3(2)	42.7(2)	21.0(3)	-	-	7.8(2)	10.0(2)	6.9(3)
151-200	379	-	-	0.5(2)	12.0(3)	-	-	0.2(2)	0.3(2)	4.7(3)
151-200	380	-	0.9(2)	15.7(3)	3.4(2)	-	-	2.3(2)	-	1.5(2)
101-150	381*	22.1(4)	3.6(4)	144.1(3)	19.5(4)	15.6(2)	-	15.3(2)	7.6(3)	19.1(3)
51-100	382*	23.5(3)	4.5(4)	15.4(3)	6.1(3)	-	45.6(2)	39.0(3)	32.4(3)	174.9(3)
31-50	383*	69.0(2)	59.9(2)	0.1(2)	51.8(2)	-	14.5(3)	62.7(3)	87.7(2)	25.6(3)
301-400	724	-	-	-	-	-	-	-	-	-
201-300	725	-	-	-	-	-	-	-	-	-
301-400	726	-	-	-	-	-	-	-	-	-
201-300	727	-	-	-	-	-	-	-	-	-
301-400	728	-	-	-	-	-	-	-	-	-
Mean (#sets)		58.5(24)	48.3(45)	34.2(48)	29.5(37)	25.8(22)	43.9(30)	51.7(48)	75.6(41)	40.4(82)
Biomass		48.6	59.5	35.1	25.2	22.6	43.1	64.5	89.4	50.6

Depth (fm)	Stratum	1980 ATC 304	1981 ATC 319	1982 ATC 328 329	1984 AN 27	1985 WT 29 AN 43	1986 WT 47	1987 WT 58,59, 60	1988[a] WT 70
151-200	357	0.5(3)	0.0(2)	0.8(2)	0.0(2)	22.3(2)	0.0(2)	-	0.0(2)
101-150	358	1.8(3)	0.0(3)	3.5(2)	3.5(2)	180.5(2)	2.8(2)	1.5(2)	1.9(2)
51-100	359	36.0(4)	25.4(3)	28.5(2)	51.8(2)	28.0(2)	27.0(2)	5.9(2)	3.9(2)
31-50	360	39.9(11)	43.3(6)	37.8(7)	47.3(7)	38.2(16)	32.5(13)	15.3(15)	10.4(12)
31-50	361*	33.7(7)	-	45.5(6)	39.0(5)	47.0(7)	22.7(10)	36.9(8)	26.5(7)
31-50	362*	46.5(11)	75.8(5)	46.8(8)	89.9(7)	66.9(11)	82.6(14)	55.4(13)	50.6(10)
31-50	373*	33.6(8)	83.4(5)	31.8(5)	66.1(7)	67.3(9)	26.4(14)	78.6(13)	44.1(10)
31-50	374*	54.7(3)	170.0(3)	12.4(4)	112.1(3)	49.5(4)	15.0(6)	36.5(5)	20.2(5)
≤ 30	375*	16.8(4)	10.5(4)	18.5(5)	46.2(5)	32.8(8)	45.6(8)	69.4(8)	36.8(6)
≤ 30	376	71.3(3)	22.0(4)	22.9(7)	10.6(4)	21.7(7)	22.4(9)	27.4(8)	6.0(6)
51-100	377	36.1(4)	215.3(3)	62.0(2)	319.5(2)	37.3(2)	34.0(2)	32.8(2)	26.8(2)
101-150	378*	10.0(2)	3.8(2)	6.5(2)	21.5(2)	36.5(2)	68.1(2)	7.0(2)	10.5(2)
151-200	379	9.7(3)	3.5(3)	2.0(2)	4.5(2)	5.8(2)	1.0(2)	7.8(2)	0.1(2)
151-200	380	2.7(3)	0.3(3)	-	1.3(2)	10.8(2)	3.6(3)	0.0(2)	0.0(2)
101-150	381*	13.1(4)	5.8(3)	5.6(2)	53.8(2)	26.3(2)	15.3(3)	2.4(2)	5.8(2)
51-100	382*	25.5(4)	103.5(2)	56.8(2)	2.8(3)	63.4(4)	6.5(4)	50.3(3)	5.5(2)
31-50	383*	33.0(4)	241.7(3)	19.8(2)	61.5(3)	22.2(3)	19.9(4)	36.3(3)	24.0(3)
201-300	723	-	-	-	-	-	-	-	-
301-400	724	-	-	-	-	-	-	-	-
201-300	725	-	-	-	-	-	-	-	-
301-400	726	-	-	-	-	-	-	-	-
201-300	727	-	-	-	-	-	-	-	-
301-400	728	-	-	-	-	-	-	-	-
Mean (#sets)		37.8(81)	67.6(54)	32.7(60)	54.7(60)	47.8(85)	35.0(101)	42.6(91)	25.9(77)
Biomass		47.4	75.3	40.7	68.4	59.9	43.8	52.8	32.4

[a]Preliminary analysis.

Table 12. Mean weight (kg) of American plaice per tow, by stratum, from R. V. surveys in Division 3Ø. Numbers in parentheses are the number of successful 30 minute tows in each stratum. The stratified mean weight per tow (kg/30 min.) and the biomass estimates ($tx10^{-3}$), are given at the bottom of the table.

		Year - Trip													
		1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987[a]	1988
		207					289			327				WT	
Depth		ATC 208				276	ATC 290		318	ATC 328				58,59	WT
(fm)	Stratum	209	ATC 233	ATC 245	ATC 263	ATC 277	291	ATC 303	ATC 319	329	AN 27	AN 43	WT 47	60	70
51–100	329	7.8(2)	–	91.7(2)	80.2(3)	16.6(5)	61.6(6)	45.8(2)	157.0(2)	54.9(6)	25.7(5)	30.5(8)	23.4(8)	49.3(9)	8.2(7)
31–50	330	47.6(6)	25.7(3)	26.9(3)	101.1(3)	40.0(6)	78.4(7)	22.0(2)	54.6(4)	24.2(7)	48.0(4)	118.4(10)	44.5(9)	56.1(11)	29.6(9)
31–50	331	28.6(2)	6.4(2)	41.2(2)	–	6.8(2)	28.9(3)	28.3(2)	–	24.0(4)	80.2(3)	98.8(3)	11.4(4)	46.8(2)	43.8(2)
51–100	332	–	23.6(2)	13.5(3)	10.3(3)	14.9(3)	12.9(4)	18.9(2)	–	16.3(4)	6.0(2)	24.3(5)	38.8(6)	59.4(5)	5.5(4)
101–150	333	–	5.7(2)	1.6(2)	4.3(2)	2.3(3)	5.3(2)	0.1(2)	–	1.3(4)	0.0(2)	0.0(2)	0.0(3)	0.4(2)	1.3(2)
151–200	334	–	–	0.0(2)	0.0(2)	0.0(3)	0.6(3)	0.0(2)	–	0.1(4)	0.0(2)	1.5(2)	0.4(2)	0.8(2)	0.1(2)
151–200	335	0.5(2)	–	13.3(3)	–	7.1(2)	4.1(2)	1.5(3)	–	0.7(2)	0.4(2)	0.7(2)	0.1(2)	0.4(2)	1.8(2)
101–150	336	4.8(3)	7.6(2)	30.9(2)	10.4(2)	6.8(2)	8.1(4)	0.3(2)	–	2.5(2)	0.0(2)	1.3(2)	0.3(2)	0.0(2)	1.8(2)
51–100	337	16.3(3)	3.0(3)	16.3(2)	21.8(2)	30.5(2)	1.3(4)	6.5(3)	–	22.3(3)	7.0(2)	15.8(5)	12.4(5)	14.3(6)	6.3(4)
31–50	338	38.8(5)	20.0(2)	62.7(3)	22.9(4)	7.6(5)	19.9(7)	30.2(5)	–	13.2(5)	60.1(5)	59.6(9)	28.5(9)	26.7(9)	50.3(8)
51–100	339	152.4(2)	47.2(2)	–	–	65.5(2)	262.4(3)	–	96.5(2)	27.0(4)	160.0(2)	13.9(3)	5.5(3)	68.5(3)	29.2(3)
31–50	340	–	20.0(3)	81.2(6)	52.1(3)	18.0(3)	59.2(7)	85.8(2)	97.3(3)	35.3(6)	49.5(4)	43.9(9)	35.9(7)	93.7(9)	56.1(7)
31–50	351	65.7(5)	73.5(4)	56.3(4)	62.7(5)	18.5(6)	46.8(11)	76.3(10)	180.0(4)	46.3(9)	92.9(6)	73.3(9)	80.3(14)	71.1(13)	76.9(10)
31–50	352	25.8(5)	77.9(4)	61.1(4)	17.1(5)	8.4(4)	25.5(12)	38.0(11)	–	36.6(7)	27.0(7)	56.5(11)	34.2(14)	63.5(13)	52.2(11)
31–50	353	42.0(3)	72.0(3)	46.3(2)	42.4(3)	41.5(3)	36.0(5)	75.9(4)	–	35.0(3)	48.5(2)	55.5(6)	29.2(7)	44.4(6)	21.0(5)
51–100	354	49.0(3)	–	32.4(3)	34.5(2)	–	17.7(4)	101.8(3)	10.8(2)	34.8(2)	11.8(2)	73.2(3)	9.8(3)	17.3(2)	6.0(2)
101–150	355	0.5(2)	3.6(2)	7.3(2)	–	–	16.8(4)	8.5(2)	28.5(2)	14.0(2)	4.8(2)	20.3(2)	1.0(2)	1.8(2)	0.4(2)
151–200	356	0.9(2)	–	–	–	–	11.6(2)	4.8(2)	30.5(2)	–	4.3(2)	7.0(2)	0.0(2)	1.2(2)	1.0(2)
201–300	717	–	–	–	–	–	–	–	–	–	–	–	–	–	–
301–400	718	–	–	–	–	–	–	–	–	–	–	–	–	–	–
201–300	719	–	–	–	–	–	–	–	–	–	–	–	–	–	–
301–400	720	–	–	–	–	–	–	–	–	–	–	–	–	–	–
201–300	721	–	–	–	–	–	–	–	–	–	–	–	–	–	–
301–400	722	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mean (#sets)		41.2(45)	42.9(34)	52.2(45)	47.4(39)	21.2(51)	46.5(90)	46.5(59)	115.1(21)	31.8(74)	48.0(56)	57.0(93)	35.9(102)	53.4(100)	37.7(84))
Biomass		46.1	49.1	67.6	59.2	27.5	62.5	60.1	79.2	42.4	64.5	76.6	48.2	71.7	50.7

Table 13. A. plaice, Division 3L, biomass estimates ('000 t) from r.v. surveys, 1983-88, summed by depth zone. Numbers in parenthesis in the column headings indicate the percentage of the stratified area of Division 3L found in each depth zone.

Year/survey	B = Biomass Pct. = Percentage	Depth zone (fath) 31-50 (22.1)	51-100 (45.0)	101-150 (17.9)	151-200 (10.0)	201-400 (5.0)	Total
1983 fall	B	88031	144706	33037	2210	-	267,984
	Pct.	32.9	54.0	12.3	0.8		
1984 summer/fall	B	69601	170923	59907	5664	51	306,146
	Pct.	22.7	55.8	19.6	1.9	<0.01	
1985 winter	B	37964	132564	32198	8842	605	212,173
	Pct.	17.9	62.4	15.2	4.2	0.3	
1985 spring	B	67297	73710	20262	6595	7263	175,125
	Pct.	38.4	42.1	11.6	3.8	4.1	
1985 summer	B	45835	128779	43046	3506	271	221,440
	Pct.	20.7	58.2	19.4	1.6	0.1	
1985 fall	B	50336	123344	48840	3611	231	226,362
	Pct.	22.2	54.5	21.6	1.6	0.1	
1986 winter	B	19328	19235	3400	5672	1713	49,348
	Pct.	39.1	39.0	6.9	11.5	3.5	
1986[a] spring	B	62064	87508	19214	4821	-	173,607
	Pct.	35.7	50.4	11.1	2.8	-	
1986 fall	B	24793	75079	26249	2588	486	129,195
	Pct.	19.2	58.1	20.3	2.0	0.4	
1987[a] spring	B	35034	13165	12531	1741	-	180,871
	Pct.	19.4	72.7	6.9	1.0	-	
1987[a] summer	B	52460	110674	34655	3672	-	201,461
	Pct.	26.0	55.0	17.2	1.8	-	
1987[a] fall	B	33687	112502	20391	2142	-	168,722
	Pct.	20.0	66.6	12.1	1.3	-	
1988[a] spring	B	55993	116424	18527	2119	-	193,063
	Pct.	29.0	60.0	9.6	1.1	-	
Average	B	49417	109755	28635	4091	1517	193,415
	Pct.	25.6	56.7	14.8	2.1	0.8	

[a]No sets in depths greater than 200 fath.

Table 14. Comparison of American plaice biomass from different strata in Div. 3N from surveys in 1984-88.

Stratum	% Area outside 200-mi. limit	Biomass ('000 t) 1984	1985	1986	1987	1988
357	100	0	0.3	0	-	0
358	100	0.06	3.0	0.05	0.03	0.03
359	100	1.6	0.9	0.9	0.2	0.1
360	93	10.6	8.6	7.3	3.4	2.3
376	89	1.2	2.4	2.6	3.1	0.7
377	100	2.4	0.3	0.3	0.2	0.2
378	100	0.2	0.4	0.7	0.07	0.1
379	100	0.04	0.05	0.01	0.06	0.01
380	83	0.01	0.09	0.03	0	0
381	79	0.7	0.4	0.2	0.03	0.08
Total	above strata	16.8	16.4	12.1	7.1	3.5
Total	all other strata	51.6	43.5	31.7	45.7	28.9
Total	3N	68.4	59.9	43.8	52.8	32.4

Table 15. Comparison of proportion at age of American plaice in the selected strata vs. all strata, Div. 3L, 3N, 1985-86.

	3L				3N			
	1985		1986		1985		1986	
Age	Sel. Strata	All Strata	Sel. Strata	All Strata	Sel. Strata	All Strata	Sel. Strata	All Strata
3								.01
4					.03	.02	.01	.04
5	.02	.02	.02	.02	.06	.09	.03	.12
6	.08	.07	.10	.10	.10	.09	.07	.15
7	.22	.22	.26	.26	.11	.12	.11	.14
8	.26	.26	.23	.24	.13	.11	.14	.11
9	.18	.18	.19	.19	.14	.12	.17	.11
10	.11	.12	.10	.09	.15	.11	.17	.11
11	.06	.06	.04	.04	.12	.12	.09	.06
12	.03	.03	.03	.03	.07	.09	.07	.05
13	.02	.02	.02	.02	.04	.05	.05	.03
14	.01	.01	.01	.01	.02	.03	.03	.02
15					.02	.02	.03	.02
16						.01	.02	.01
17							.01	.01

Table 16. American plaice population numbers ($x10^{-3}$) estimated from research vessel surveys in Division 3L (selected strata). Values for the trips by the A. T. CAMERON were adjusted by the appropriate conversion factors to make these estimates comparable with those from the W. TEMPLEMAN and the A. NEEDLER surveys.

Age (years)	1971	1972	1973[a]	1974	1975	1976	1977	1978	1979
1	0.0	28.9	0.0	0.0	0.0	0.0	0.0	0.0	120.5
2	0.0	36.1	0.0	0.0	273.4	243.0	177.7	282.2	269.2
3	978.9	175.6	332.4	98.6	1,075.6	4,122.5	1,532.2	6,669.2	619.4
4	6,064.3	6,584.5	2,694.7	2,190.6	1,688.3	7,822.2	6,710.1	9,896.0	8,515.0
5	24,901.2	13,799.5	12,918.8	3,394.7	4,498.9	8,305.7	21,758.5	37,990.9	27,779.6
6	37,562.4	31,252.0	14,949.1	12,843.3	12,418.4	9,088.3	44,584.0	44,155.2	47,015.9
7	75,394.5	46,174.5	20,463.4	21,174.2	22,881.5	28,866.0	82,778.4	69,573.7	69,693.6
8	40,057.4	48,148.5	12,589.6	30,218.1	42,217.9	64,397.0	130,367.3	106,241.8	111,200.9
9	74,642.7	30,979.4	9,916.7	33,593.2	45,709.4	75,925.8	95,242.1	85,721.8	92,502.0
10	33,851.3	33,397.6	13,214.6	35,230.2	40,065.0	79,930.3	98,128.5	65,847.8	81,838.0
11	30,712.0	20,106.1	11,345.0	19,827.0	20,490.7	50,978.1	42,849.3	22,636.1	41,442.9
12	28,714.7	21,231.9	9,758.0	17,509.3	15,023.2	29,911.8	28,873.5	15,744.8	17,834.3
13	21,587.1	9,937.1	5,324.8	10,371.2	7,254.3	14,215.0	11,969.1	6,995.6	6,539.5
14	15,020.5	7,966.1	3,691.4	5,609.8	4,073.9	4,055.2	4,530.9	4,498.5	3,483.6
15	7,508.8	6,559.7	1,392.6	3,309.2	1,835.7	3,119.6	3,389.3	1,878.1	2,189.3
16	5,202.9	4,490.9	832.4	1,179.6	1,535.0	1,452.4	1,947.0	950.5	1,030.4
17	2,938.9	1,499.7	167.3	185.6	411.2	1,062.5	913.6	514.9	437.2
18	1,678.4	414.3	445.7	0.0	135.7	335.8	586.8	109.4	116.7
19	290.7	154.7	–	50.6	–	120.2	102.3	–	22.5
20	230.5	130.5	–	–	–	–	–	–	–
21	145.3	–	–	–	–	–	–	–	–
22	115.2	–	–	–	–	–	–	–	–
Unknown	434.5	0.0	–	0.0	360.1	0.0	0.0	84.9	77.0
Total	408,032.2	283,067.6	120,036.5	196,785.2	221,948.2	383,951.4	576,440.6	479,791.4	512,727.5
2+	407,597.7	283,038.7	120,036.5	196,785.2	221,588.1	383,951.4	576,440.6	479,706.5	512,530.0
4+	406,618.8	282,827.0	119,704.1	196,686.6	220,239.1	379,585.9	574,730.7	472,755.1	511,641.4
6+	375,653.3	262,443.0	104,090.6	191,101.3	214,051.9	363,458.0	546,262.1	424,868.2	475,346.8
8+	262,696.4	185,016.5	68,678.1	157,083.8	178,752.0	325,503.7	418,899.7	311,139.3	358,637.3
12+	83,433.0	52,384.9	21,612.2	38,215.3	30,269.0	54,272.5	52,312.5	30,691.8	31,653.5

(cont'd)

Table 16 (Cont'd.)

Age (years)	1980	1981	1982	1984[a]	1985	1986	1987
1	94.4	119.8	0.0	0.0	0.0	0.0	0.0
2	891.4	214.1	67.0	0.0	0.0	48.4	230.5
3	2,710.6	2,290.2	1,785.0	0.0	321.9	108.1	515.5
4	4,895.7	2,450.2	6,473.1	205.1	1,053.2	881.1	1,969.7
5	26,647.7	8,859.6	7,196.7	744.6	5,816.0	4,338.7	9,108.4
6	51,690.9	25,555.5	20,362.2	8,126.6	18,697.9	25,749.3	32,515.3
7	67,331.5	37,153.4	38,260.8	31,823.9	52,741.1	63,184.2	72,051.3
8	133,955.9	100,240.2	81,576.0	48,117.4	61,648.2	58,121.4	78,448.7
9	115,494.3	97,163.3	126,390.0	53,177.3	42,174.2	46,566.7	42,926.4
10	75,532.3	59,910.6	103,503.1	29,775.0	26,633.3	23,634.7	24,402.7
11	33,534.4	32,366.5	61,278.2	13,620.1	14,496.5	9,926.2	8,428.1
12	21,425.5	12,983.9	26,945.2	8,527.3	7,368.5	6,582.5	7,275.4
13	11,087.1	5,911.9	14,552.3	3,177.5	4,219.8	4,435.4	3,263.0
14	4,193.5	2,070.7	7,005.4	1,921.5	2,079.7	1,844.2	1,343.2
15	2,446.1	1,641.4	2,224.1	778.3	1,123.9	1,115.8	658.2
16	1,927.8	1,106.3	1,683.7	404.7	805.4	747.5	260.1
17	550.6	610.7	851.9	195.3	187.9	210.2	71.0
18	287.1	87.9	72.1	89.6	15.4	113.7	7.4
19	62.6	32.9	–	36.9	15.4	–	–
20	–	–	–	–	–	–	–
21	–	–	–	–	–	–	–
22	–	–	–	–	–	–	–
Unknown	18.9	185.3	68.7	25.9	32.5	12.4	–
Total	554,778.3	390,954.4	500,295.5	200,747.0	239,430.8	247,620.5	283,474.9
2+	554,665.0	390,649.3	500,226.8	200,721.1	239,398.3	247,608.1	283,474.9
4+	551,063.0	388,145.0	498,374.8	200,721.1	239,076.4	247,451.6	282,728.9
6+	519,519.6	376,835.2	484,705.0	199,771.4	232,207.2	242,231.8	271,650.8
8+	400,497.2	314,126.3	426,082.0	159,820.9	160,768.2	153,298.3	167,084.2
12+	41,980.3	24,445.7	53,334.7	15,131.1	15,816.0	15,049.3	12,878.3

[a]Insufficient coverage of selected strata so estimates are from all surveyed strata.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.849
MULTIPLE R SQUARED,..... 0.721

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	9.158E3	9.158E3	
REGRESSION	43	3.501E2	8.142E0	19.628
TYPE 1	28	3.214E2	1.148E1	27.673
TYPE 2	15	2.788E1	1.858E0	4.480
RESIDUALS	327	1.357E2	4.148E-1	
TOTAL	371	9.644E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	350	INTERCEPT	4.847	0.176	371
2	85				
1	328	1	-0.054	0.251	8
	341	2	0.344	0.221	11
	342	3	0.173	0.349	9
	343	4	0.531	0.365	9
	344	5	0.207	0.233	10
	345	6	-1.177	0.236	10
	346	7	-1.514	0.284	10
	347	8	0.154	0.245	13
	348	9	0.959	0.188	14
	349	10	0.323	0.184	15
	363	11	0.152	0.189	16
	364	12	1.104	0.172	15
	365	13	0.883	0.233	14
	366	14	-0.609	0.223	12
	368	15	-2.996	0.392	12
	369	16	-0.667	0.247	13
	370	17	0.633	0.216	14
	371	18	0.391	0.240	12
	372	19	-0.512	0.175	16
	384	20	-0.175	0.234	13
	385	21	0.592	0.179	15
	386	22	-1.090	0.245	13
	387	23	-3.552	0.275	13
	388	24	-3.125	0.354	14
	389	25	-1.070	0.247	15
	390	26	-0.422	0.208	14
	391	27	-0.812	0.408	13
	392	28	-2.215	0.576	12
2	71	29	0.206	0.186	20
	72	30	0.010	0.199	14
	73	31	-0.208	0.234	11
	74	32	-0.387	0.185	22
	75	33	-0.000	0.188	21
	76	34	0.550	0.186	20
	77	35	0.524	0.173	29
	78	36	0.433	0.179	25
	79	37	0.285	0.173	29
	80	38	0.391	0.175	28
	81	39	0.401	0.173	28
	82	40	0.310	0.173	29
	84	41	-0.087	0.231	8
	86	42	-0.046	0.173	29
	87	43	-0.213	0.173	29

TABLE 18. MODEL USED TO CALCULATE ABUND. FROM SURVEYS IN DIV 3N.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.711
MULTIPLE R SQUARED..... 0.505

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.987E3	3.987E3	
REGRESSION	31	1.035E2	3.340E0	6.551
TYPE 1	16	7.646E1	4.779E0	9.373
TYPE 2	15	2.344E1	1.562E0	3.065
RESIDUALS	199	1.015E2	5.098E-1	
TOTAL	231	4.192E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	362	INTERCEPT	4.500	0.208	231
2	85				
1	357	1	-3.584	0.613	9
	358	2	-2.221	0.479	11
	359	3	0.337	0.346	12
	360	4	0.230	0.166	13
	361	5	-0.720	0.180	15
	373	6	-0.194	0.166	15
	374	7	-0.211	0.227	15
	375	8	-1.041	0.189	15
	376	9	-0.581	0.197	14
	377	10	0.680	0.627	14
	378	11	-0.986	0.536	14
	379	12	-2.814	0.658	12
	380	13	-2.812	0.657	11
	381	14	-0.936	0.456	15
	382	15	-0.272	0.261	15
	383	16	-0.340	0.257	15
2	71	17	-0.055	0.285	9
	72	18	-0.287	0.254	15
	73	19	-0.389	0.267	16
	74	20	-0.262	0.283	12
	75	21	-0.269	0.280	8
	76	22	0.058	0.270	8
	77	23	0.446	0.253	17
	78	24	0.729	0.257	13
	79	25	0.249	0.253	17
	80	26	0.207	0.253	17
	81	27	0.302	0.261	16
	82	28	-0.074	0.253	16
	84	29	-0.106	0.253	17
	86	30	-0.476	0.253	17
	87	31	-0.193	0.253	16

TABLE 19. UNCORRECTED ABUNDANCE FROM MODEL USED FOR SURVEYS, DIV 3L.

PREDICTED TOTALS FOR MISSING STRATA

YEAR	STRATUM	TOTAL
71	328	20119
71	341	31241
71	342	9436
71	343	12050
71	344	25803
71	345	6192
71	346	2638
71	391	1662
71	392	193
72	328	16499
72	341	25619
72	342	7738
72	343	9881
72	344	21159
72	345	5078
72	346	2163
72	347	13167
72	366	8748
72	368	183
72	369	5660
72	386	3793
72	387	234
72	388	176
72	392	159
73	328	13171
73	342	6177
73	343	7888
73	344	16891
73	345	4054
73	346	1727
73	347	10510
73	348	51342
73	349	27108
73	364	79051
73	365	23130
73	366	6983
73	368	146
73	369	4518
73	370	22933
73	371	15213
73	386	3028
73	387	187
74	328	11127
74	341	17278
74	342	5218
74	343	6664
74	344	14270
74	345	3425
74	346	1459
75	328	16366
75	341	25413
75	342	7675
75	343	9802
75	344	20990
75	345	5037
75	371	18904
75	384	10739
76	328	28380
76	341	44066
76	342	13309
76	343	16997
76	371	32779
76	384	18621
76	390	19341
76	391	2344
76	392	273
78	328	25274
78	346	3313
78	366	13400
78	368	280
80	328	24263
81	342	11495
84	343	8905
84	344	19067
84	345	4576
84	346	1949
84	347	11864
84	348	57955
84	365	26110
84	366	7883
84	368	165
84	369	5100
84	370	25887
84	371	17172
84	384	9755
84	385	44669
84	386	3418
84	387	211
84	388	159
84	389	2911
84	390	10132
84	391	1228
84	392	143

OVERALL TOTALS

YEAR	WEIGHTED AVERAGE
71	653213
72	477841
73	422976
74	333862
75	502808
76	730185
77	916185
78	777647
79	776183
80	833964
81	700234
82	740627
84	460567
85	379507
86	391601
87	445610

TABLE 20. UNCORRECTED ABUNDANCE FROM MODEL USED FOR SURVEYS,DIV 3N

PREDICTED TOTALS FOR MISSING STRATA

YEAR	STRATUM	TOTAL
71	357	31
71	358	176
71	359	4505
71	360	30101
71	376	6664
71	377	1313
71	379	41
71	380	46
72	357	24
72	379	33
73	360	21665
74	357	25
74	358	144
74	359	3665
74	360	24488
74	376	5421
75	357	25
75	358	143
75	359	3641
75	373	13414
75	378	294
75	379	34
75	380	37
75	382	3121
75	383	3040
76	357	34
76	358	198
76	374	6696
76	375	5040
76	377	1476
76	378	409
76	379	47
76	380	51
76	381	586
78	357	67
78	358	389
78	359	9940
78	380	100
81	361	10353
82	380	45
87	357	27

OVERALL TOTALS

YEAR	WEIGHTED AVERAGE
71	106327
72	80934
73	77577
74	77810
75	77280
76	101414
77	153885
78	288363
79	141326
80	111893
81	189670
82	95220
84	102164
85	91536
86	68121
87	78353

Table 21. Abundance (x 10^{-6}) of American plaice at age from Canadian spring surveys in Div. 3L. Results are from a multiplicative analysis to account for missing strata.

AGE (YEARS)	YEAR																
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.0		0.0	0.0	0.0	0.1
2	0.0	0.1	0.0	0.0	0.6	0.5	0.3	0.5	0.4	1.3	0.4	0.1		0.0	0.0	0.1	0.3
3	1.6	0.3	1.2	0.2	2.4	7.8	2.4	10.8	0.9	4.1	4.1	2.6		0.0	0.5	0.2	0.6
4	9.7	11.1	9.5	3.7	3.8	14.8	10.6	16.0	12.9	7.3	4.4	9.6		0.5	1.7	1.5	2.7
5	39.8	23.2	45.4	5.7	10.2	15.8	34.5	61.5	42.0	40.0	15.8	10.6		1.7	9.2	6.5	13.2
6	60.0	52.6	52.5	21.7	28.1	17.3	70.8	71.4	71.0	77.6	45.7	30.1		18.6	29.5	40.0	50.5
7	120.3	77.7	71.8	35.8	51.7	54.8	131.4	112.6	105.3	101.0	66.4	56.5		72.8	83.2	101.1	119.3
8	64.0	81.2	44.2	51.1	95.4	122.2	207.0	172.0	167.9	201.1	179.1	120.5		110.1	97.3	94.2	124.5
9	119.1	52.1	34.8	56.8	103.3	144.1	151.1	138.7	139.7	173.3	173.7	186.8		121.5	66.5	74.5	64.9
10	54.1	56.2	46.4	59.4	90.5	151.7	155.7	106.5	123.7	113.4	107.1	152.9		68.1	42.0	35.9	35.8
11	49.1	33.8	39.8	33.5	46.3	96.8	68.0	36.6	62.6	50.3	57.9	90.5		31.2	22.9	14.7	12.1
12	45.9	35.7	34.3	29.6	33.9	56.8	45.8	25.5	27.0	32.2	23.2	39.8		19.5	11.6	9.9	10.5
13	34.5	16.7	18.7	17.5	16.4	27.0	19.0	11.3	9.9	16.6	10.6	21.5		7.3	6.7	6.4	5.0
14	24.0	13.4	13.0	9.5	9.2	7.7	7.2	7.3	5.3	6.3	3.7	10.4		4.4	3.3	2.4	2.1
15	12.0	11.0	4.9	5.6	4.1	5.9	5.4	3.0	3.3	3.7	2.9	3.3		1.8	1.8	1.4	1.1
16	8.3	7.6	2.9	2.0	3.5	2.8	3.1	1.5	1.6	2.9	2.0	2.5		0.9	1.3	0.9	0.4
17	4.7	2.5	0.6	0.3	0.9	2.0	1.4	0.8	0.7	0.8	1.1	1.3		0.4	0.3	0.2	0.1
18	2.7	0.7	1.6	0.0	0.3	0.6	0.9	0.2	0.2	0.4	0.2	0.1		0.2	0.1	0.1	0.1
19	0.5	0.3	–	0.1	–	0.2	0.2	–	0.1	0.1	0.1	–		0.1	0.1	–	–
20	0.4	0.2	–	–	–	–	–	–	–	–	–	–		–	–	–	–
21	0.2	–	–	–	–	–	–	–	–	–	–	–		–	–	–	–
22	0.2	–	–	–	–	–	–	–	–	–	–	–		–	–	–	–
Unknown	0.7	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.1	0.1	0.3	0.1		0.1	0.1	0.1	–
Total	651.8	476.5	421.6	332.5	501.4	728.8	914.8	776.3	774.8	832.6	698.9	739.2		459.2	378.1	390.1	443.3
2+	651.1	476.4	421.6	332.5	500.6	728.8	914.8	776.2	774.5	832.4	698.4	739.1		459.1	378.0	390.0	443.2
4+	649.5	476.0	420.4	332.3	497.6	720.5	912.1	764.9	773.2	827.0	693.9	736.4		459.1	377.5	389.7	442.3
6+	600.0	441.7	365.5	322.9	483.6	689.9	867.0	687.4	718.3	779.7	673.7	716.2		456.9	366.6	381.7	426.4
8+	419.7	311.4	241.2	265.4	403.8	617.8	664.8	503.4	542.0	601.1	561.6	629.6		365.5	253.9	240.6	256.6
12+	133.4	88.1	76.0	64.6	68.3	103.0	83.0	49.6	48.1	63.0	43.8	78.9		34.6	25.2	21.3	19.3

Table 22. American plaice population numbers estimated from Canadian spring surveys in Div. 3N. Results are based on a multiplicative analysis which accounts for missing strata.

Age (Years)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0	0.1			0	0.1		0.1	0.1	0.1	0.1	0.3		0	0.1	-	0
2	0	0.2	0.1		1.0	0.2	0.1	0.4	0.4	0.1	1.0	0.6		0.1	0.1	0.1	0.9
3	3.0	0.4	0.4	1.0	5.3	3.2	1.6	5.2	1.2	0.7	5.0	1.8		1.0	1.8	0.7	3.9
4	3.1	2.3	1.0	2.9	10.5	5.8	9.5	14.0	2.8	2.1	7.6	6.6		2.5	8.2	2.9	7.2
5	5.2	5.6	5.6	5.9	9.0	12.4	14.4	43.3	11.0	6.1	5.3	7.5		5.7	8.6	7.8	7.0
6	3.4	8.6	9.9	11.2	8.2	12.4	28.7	61.6	18.5	13.0	12.3	7.9		11.2	11.3	10.2	10.5
7	12.5	5.0	11.5	12.4	14.7	12.3	25.3	70.2	29.4	26.4	41.6	8.8		13.8	9.6	9.6	10.4
8	8.6	8.4	8.5	11.7	10.1	15.4	22.3	38.6	33.2	22.2	42.3	15.8		13.1	10.7	7.6	8.7
9	14.7	10.2	5.6	7.7	5.7	10.0	18.3	17.6	18.0	17.1	31.1	17.7		14.7	10.3	7.6	8.6
10	14.7	13.6	8.2	8.0	3.2	9.2	11.8	18.0	13.7	9.5	20.5	11.4		16.5	11.0	7.2	6.2
11	13.4	8.9	9.5	5.6	2.9	4.9	9.1	7.8	5.7	4.8	9.0	6.4		7.8	8.4	4.0	3.8
12	10.0	6.5	6.6	3.6	1.6	5.2	5.2	5.2	3.0	3.4	5.4	3.7		5.1	5.0	3.3	2.9
13	4.8	4.3	4.7	3.5	2.0	3.5	2.9	2.5	1.2	1.7	3.0	1.2		3.2	2.6	2.3	2.4
14	3.2	3.2	1.4	1.3	0.9	1.8	2.1	1.3	1.0	1.2	1.0	1.7		1.8	1.6	1.2	1.8
15	2.1	1.2	1.2	1.4	0.8	2.3	1.0	1.1	0.9	0.9	1.9	0.9		1.5	1.3	1.2	1.6
16	2.1	0.9	1.0	0.5	0.5	1.3	0.7	0.3	0.4	0.7	0.9	0.9		1.4	0.4	0.7	0.9
17	0.8	0.2	1.0	0.2	0.1	0.7	0.2	0.2	0.1	0.8	0.5	0.8		0.7	0.1	0.5	0.4
18	1.7	0.2	0.3	0.1	0.1	0.1	0.1	0.1		0.2	0.4	0.4		0.3	-	0.1	0.2
19	0.7	0.2	0.3	0.1	0.1	-		0		0.1	-	0.1		0.1	-	0.1	0.1
20	0.3	0.2	0.1			-		0.1		0.1	-			0.1	-		0.1
21	0					-		-			-						-
22	0.2					-		-			-						-
Unknown	1.2	0.1	0.1	0.1	0	-		0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1
Total	105.7	80.3	77.0	77.2	76.7	100.8	153.3	287.7	140.7	111.3	189.0	94.6		100.7	91.2	67.2	77.7
2+	104.5	80.1	76.9	77.1	76.7	100.7	153.3	287.5	140.5	111.1	188.8	94.2		100.6	91.0	67.1	77.6
4+	101.5	79.5	76.4	76.1	70.4	97.3	151.6	281.9	138.9	110.3	182.8	91.8		99.5	89.1	66.3	72.8
6+	93.2	71.6	69.8	67.3	50.9	79.1	127.7	224.6	125.1	102.1	169.9	77.7		91.3	72.3	55.6	58.6
8+	77.3	58.0	48.4	43.7	28.0	54.4	73.7	92.8	77.2	62.7	116.0	61.0		66.3	51.4	35.8	37.7
12+	25.9	16.9	16.6	10.7	6.1	14.9	12.2	10.8	6.6	9.1	13.1	9.7		14.2	11.0	9.4	10.4

Table 23. American plaice abundance (x 10^{-3}) at age from Canadian spring surveys in Div. 3Ø from 1984-87.

Age (Years)	1984	1985	1986	1987
1	-	-	-	14
2	99	-	32	294
3	94	453	730	925
4	355	1316	2392	3142
5	2635	4250	3174	8230
6	7695	4719	5334	13024
7	15194	11159	9397	17135
8	23748	17695	11394	18823
9	18327	17308	10955	18635
10	15584	18886	9664	13112
11	6939	13254	6358	6933
12	4301	7598	5574	4986
13	2571	3048	3125	3456
14	1800	2764	1267	2095
15	2165	2192	1249	1651
16	1364	866	500	1001
17	681	172	394	528
18	203	17	98	252
19	-	-	27	107
Unknown	39	51	-	-
Total	103794	105748	71664	114343
2+	103755	105697	71664	114329
4+	103562	105244	70902	113110
6+	100572	99678	65336	101738
8+	77683	83800	50605	71579
12+	13085	16657	12234	14076

Table 24. Mean weight (kg) of American plaice per tow, by stratum, from R. V. surveys (fall) in Division 3L. Numbers in parentheses are the number of successful 30 minute tows in each stratum. The stratified mean weight per tow (kg/30 min.) and the biomass estimates ($tx10^{-3}$) are given at the bottom of the table. Strata marked with a plus sign were omitted from the calculations at the bottom of this table.

Stratum	1981 323 ATC 324 325	1982 333 ATC 334	1983 7 WT 8 9	1984 16 WT 17 18	1985 37 WT 38 39	1986 AN 72	1987 WT 65
328+	–	–	–	50.1(4)	99.5(8)	90.1(6)	15.5(4)
341	8.2(3)	18.2(4)	121.3(4)	110.8(5)	21.6(7)	16.7(7)	262.4(9)
342	109.7(3)	44.8(3)	19.5(4)	162.5(2)	84.7(3)	4.4(3)	30.6(3)
343+	50.9(4)	–	483.2(3)	53.3(4)	932.5(3)	17.2(3)	15.7(3)
344	227.3(4)	106.2(3)	70.7(6)	193.0(6)	93.8(9)	28.2(7)	46.3(4)
345	10.5(4)	17.4(6)	13.6(8)	48.4(7)	24.4(9)	12.5(4)	14.8(2)
346	13.0(3)	4.3(4)	10.8(5)	11.5(6)	6.5(5)	20.9(3)	4.3(4)
347	324.3(3)	235.9(4)	134.7(6)	216.5(6)	52.1(4)	30.7(4)	40.3(2)
348	114.1(6)	126.8(5)	112.3(11)	201.4(11)	43.4(14)	64.1(5)	46.7(9)
349	20.1(7)	27.5(5)	113.1(9)	81.7(14)	21.3(10)	16.8(9)	45.8(10)
350	8.3(6)	4.3(2)	72.1(8)	128.9(12)	57.7(9)	11.5(11)	15.0(9)
363	65.5(4)	34.3(3)	253.7(3)	54.9(8)	48.0(10)	44.3(7)	45.0(9)
364	254.2(9)	114.7(11)	95.2(11)	254.6(10)	114.4(18)	86.0(5)	104.1(14)
365	242.8(4)	284.0(4)	198.7(5)	67.9(4)	136.6(8)	123.5(5)	98.2(6)
366	318.3(3)	19.3(6)	50.8(4)	39.7(11)	62.4(9)	205.5(4)	10.1(7)
368	0.0(2)	1.5(2)	–	0.0(2)	1.4(2)	5.9(2)	2.8(2)
369	218.5(2)	27.9(4)	129.4(6)	76.4(7)	67.3(6)	19.4(3)	35.5(4)
370	121.0(4)	88.2(6)	121.0(6)	145.8(7)	34.3(9)	145.3(2)	61.4(6)
371	149.9(4)	97.3(5)	180.4(5)	110.7(7)	156.9(7)	26.3(3)	61.4(5)
372	20.3(5)	79.9(7)	102.5(4)	74.0(13)	68.3(17)	37.5(9)	58.4(13)
384	63.2(3)	176.9(4)	105.0(3)	210.8(6)	92.6(8)	100.0(5)	111.8(6)
385	78.5(8)	128.4(8)	107.1(5)	96.5(12)	30.0(12)	86.1(8)	127.9(9)
386	121.8(3)	123.0(4)	–	99.0(8)	123.6(5)	31.4(4)	41.3(4)
387	2.3(2)	0.3(3)	–	0.7(3)	0.7(4)	0.9(2)	0.7(3)
388+	–	0.0(3)	–	0.0(2)	14.0(2)	–	2.0(2)
389+	–	25.1(4)	–	103.1(6)	183.0(5)	3.9(4)	82.0(4)
390	38.5(3)	87.8(4)	72.7(3)	89.5(3)	97.2(7)	26.8(6)	42.0(8)
391+	–	37.0(2)	25.0(2)	233.8(2)	105.8(2)	37.3(2)	24.5(2)
392+	–	5.1(2)	4.7(2)	10.5(2)	6.8(2)	0.9(2)	11.0(2)
729+	–	–	–	3.3(2)	4.5(2)	0.0(2)	–
730+	–	–	–	0.0(2)	0.0(2)	–	–
731+	–	–	–	0.0(2)	1.0(2)	–	–
732+	–	–	–	0.0(2)	0.0(2)	–	–
733+	–	–	–	0.0(4)	0.7(3)	–	–
734+	–	–	–	0.0(3)	0.0(2)	–	–
735+	–	2.3(2)	–	0.0(3)	0.2(2)	20.6(2)	–
736+	–	–	0.0(2)	–	6.8(2)	2.1(2)	–
Mean (#sets)	108.2(99)	78.6(120)	110.8(125)	108.4(208)	75.7(231)	52.7(141)	61.1
Biomass (Total)	273.3	206.4	268.0	313.8	220.2	146.7	168.1
Biomass (selected strata)	271.3	204.0	248.4	294.5	157.9	134.2	160.0

Table 25. American plaice population numbers ($x10^{-5}$) estimated from research vessel surveys (fall) in NAFO Division 3L. Estimates in each year are for the same strata. Values for the trips by the A. T. Cameron were adjusted by the appropriate conversion factors to make these estimates comparable with those from the W. Templeman surveys.

	Survey-Year						
	ATC 323, 324, 325 Sept.-Nov.	ATC 333, 334 Oct.-Dec.	WT 7, 8, 9 Oct.-Nov.	WT 16, 17, 18 July-Sept.	WT 37, 38, 39 Oct. Nov.	AN 72 Nov.	WT 65 Oct.
Age	1981	1982	1983[a]	1984	1985	1986	1987
1	8.3	1.3	0.0	0.0	0.0	1.7	0.2
2	11.0	16.8	2.0	0.0	1.3	8.5	13.1
3	80.0	53.1	22.8	2.4	1.9	18.4	18.5
4	119.9	187.1	89.2	27.7	13.8	102.6	49.3
5	214.2	343.0	474.7	175.7	108.4	327.4	233.7
6	431.1	771.0	1,024.5	617.6	480.2	888.0	630.0
7	1,682.7	1,370.6	1,732.6	1,683.8	921.9	864.9	958.1
8	1,567.7	1,826.6	1,535.7	1,943.7	807.0	838.9	834.9
9	1,333.3	1,067.9	784.2	1,155.5	683.8	474.8	594.6
10	1,303.1	588.5	436.2	772.3	305.3	200.7	192.6
11	557.8	297.2	187.2	306.6	139.1	84.6	106.1
12	404.5	130.6	140.2	178.0	99.0	46.0	53.4
13	155.1	47.3	83.2	84.6	51.3	23.2	29.4
14	42.7	17.5	12.8	40.4	9.2	10.1	13.4
15	11.9	19.1	14.9	26.4	4.5	4.0	8.7
16	2.8	7.6	6.9	10.6	0.8	1.1	1.6
17	-	3.2	2.0	2.9	0.3	0.8	1.7
18	-	0.4	-	-	0.3	0.6	-
UNK	-	-	-	-	0.2	0.2	-
Totals							
2+	7,917.8	6,747.5	6,549.1	7,028.2	3,643.1	3,894.6	3,739.1
4+	7,826.8	6,677.6	6,524.3	7,025.8	3,639.9	3,867.7	3,707.5
6+	7,492.7	6,147.5	5,960.4	6,822.4	3,517.7	3,347.7	3,424.5
8+	5,378.9	4,005.9	3,203.3	4,521.0	2,115.6	1,684.8	1,836.4
12+	617.0	225.7	260.0	342.9	180.4	85.8	108.2

[a] 3 out of 23 strata not surveyed in 1983.

Table 26. American plaice abundance (x 10^{-6}) at age from Canadian surveys in Division 3L during 1987.

Age	WT 58-60 (Spring)	GA 142 (Summer)	WT 65 (Fall)
1	0.1	-	0.1
2	0.3	0.8	1.4
3	0.6	2.0	2.0
4	2.7	9.3	5.1
5	13.2	30.7	24.3
6	50.5	88.5	66.0
7	119.3	128.2	100.9
8	124.5	116.6	87.9
9	64.9	63.6	62.4
10	35.8	31.0	20.2
11	12.1	8.2	11.0
12	10.5	7.2	5.6
13	5.0	4.1	3.0
14	2.1	1.4	1.4
15	1.1	0.6	0.9
16	0.4	0.2	0.2
17	0.1	0.1	0.2
18	0.1	-	-
19	-	0.1	-
Total	443.3	492.6	392.6
2+	443.2	492.6	392.5
4+	442.3	489.8	389.1
6+	426.4	449.8	359.7
8+	256.6	233.1	192.8
12+	19.3	13.7	11.3

Table 27. American plaice population numbers (x10^{-3}) from seasonal R.V. surveys in 1985 in Division 3L.

Age (years)	1985 (Winter)	1985 (Spring)	1985 (Summer)	1985 (Fall)
1	-	-	-	-
2	-	-	31.2	148.7
3	133.8	433.5	506.0	257.0
4	808.0	1,405.7	3,573.5	1,672.1
5	5,470.7	8,570.0	14,768.6	14,268.3
6	16,637.5	28,497.3	62,699.4	69,233.4
7	68,038.1	84,508.3	159,409.8	170,545.4
8	99,895.8	102,402.7	147,995.8	134,131.3
9	97,996.9	71,465.8	87,625.5	93,886.1
10	100,671.0	45,078.4	33,890.6	37,312.8
11	40,345.2	24,369.1	13,758.4	16,226.3
12	17,711.3	12,066.6	10,344.3	11,257.8
13	10,008.7	6,716.9	5,654.5	5,931.1
14	2,785.0	3,250.2	1,955.2	1,889.6
15	1,549.2	1,632.7	925.0	1,180.6
16	741.5	1,040.0	446.5	537.1
17	292.1	213.4	269.8	104.5
18	73.1	15.4	39.6	37.6
19	16.8	15.4	-	-
Unknown	-	44.5	-	16.9
Total	463,174.7	391,725.9	543,893.7	558,636.6
2+	463,174.7	391,681.4	543,893.7	558,619.7
4+	463,040.9	391,247.9	543,356.5	558,214.0
6+	456,762.2	381,272.2	525,014.4	542,273.6
8+	372,086.6	268,266.6	302,905.2	302,494.8
12+	33,177.7	24,950.6	19,634.9	20,938.3

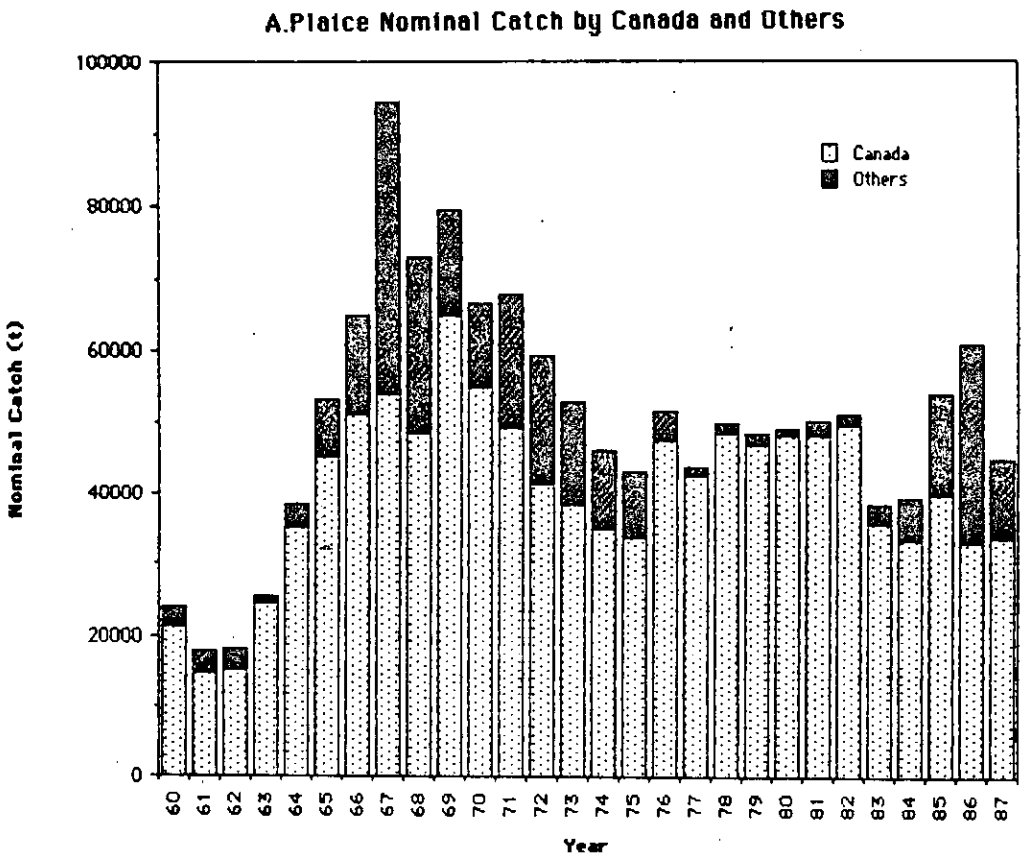


Fig.1 Nominal catches of A. plaice in Div. 3LNO by Canada and others.

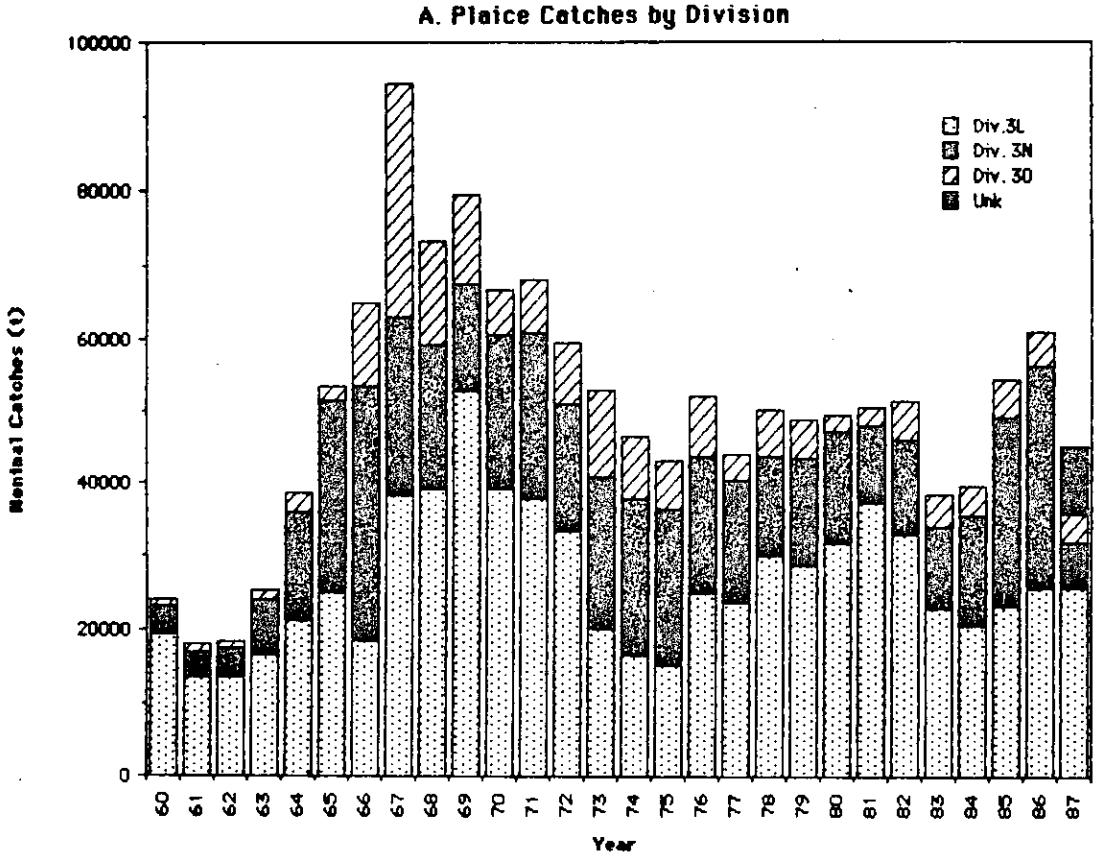


Fig.2 A. plaice nominal catches by division 1960-87.

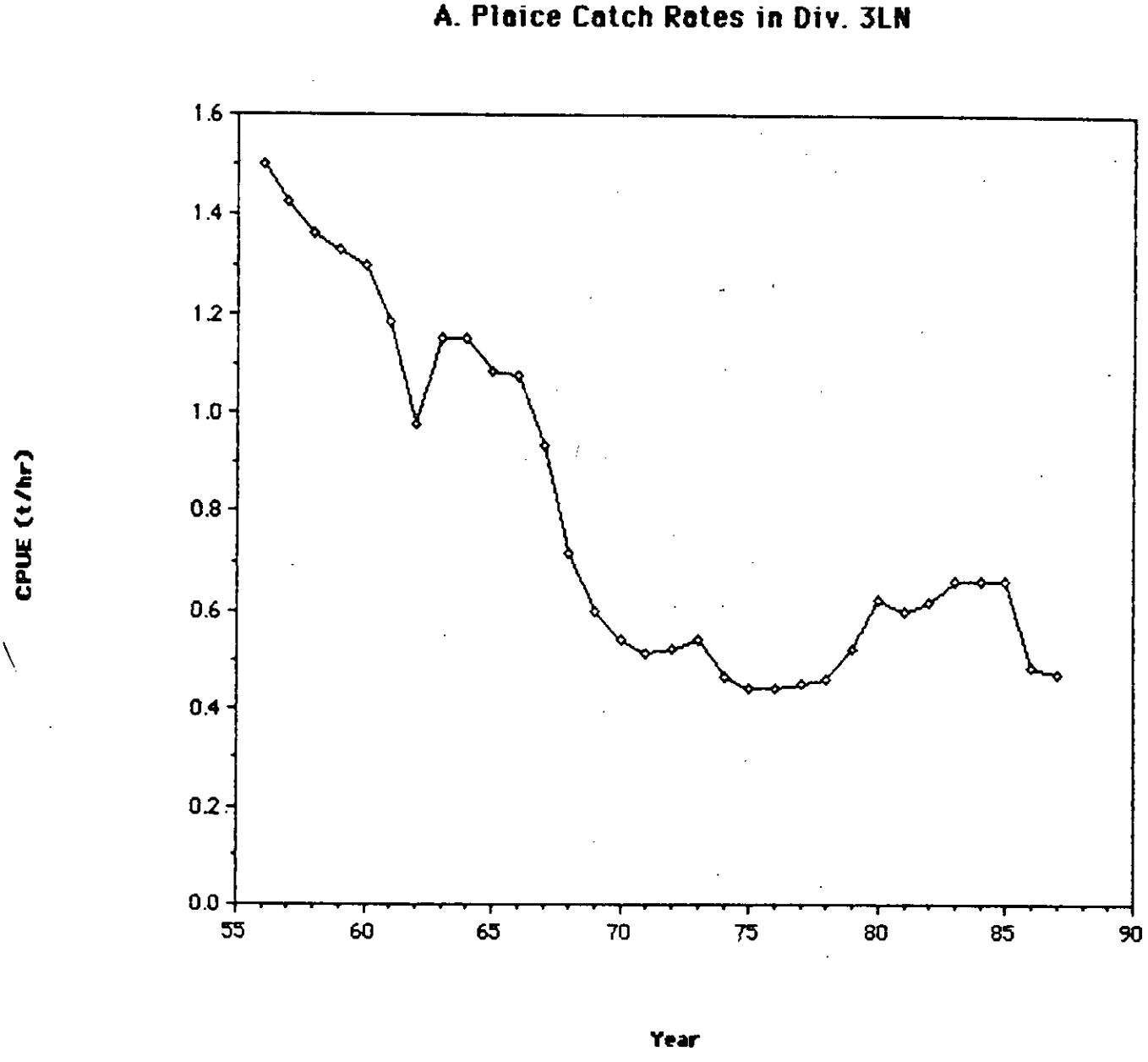
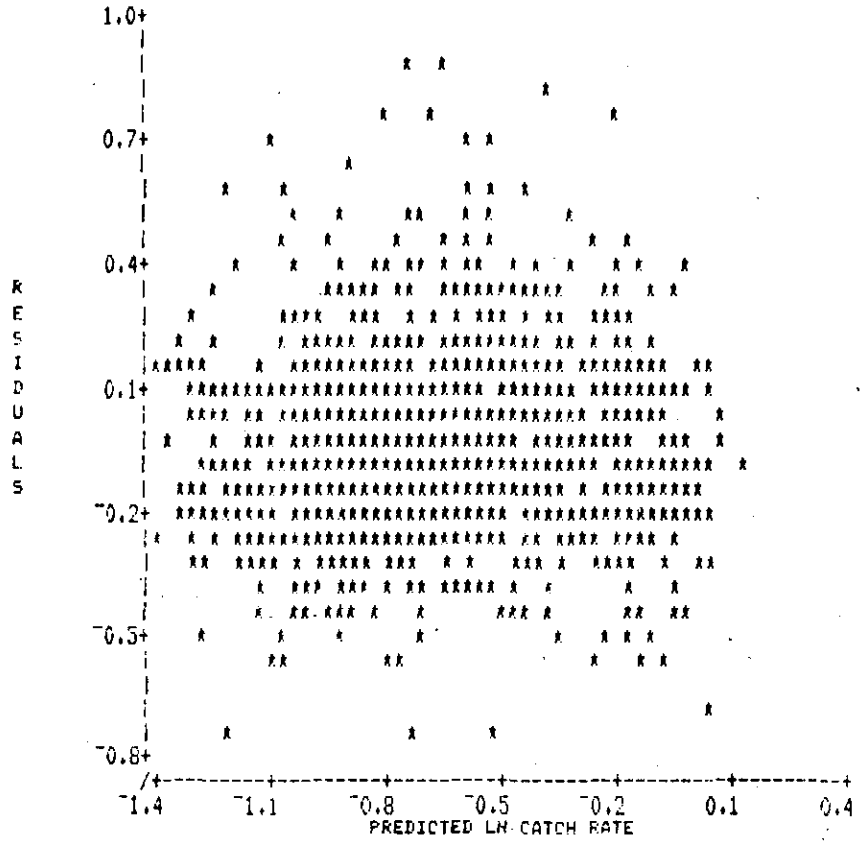
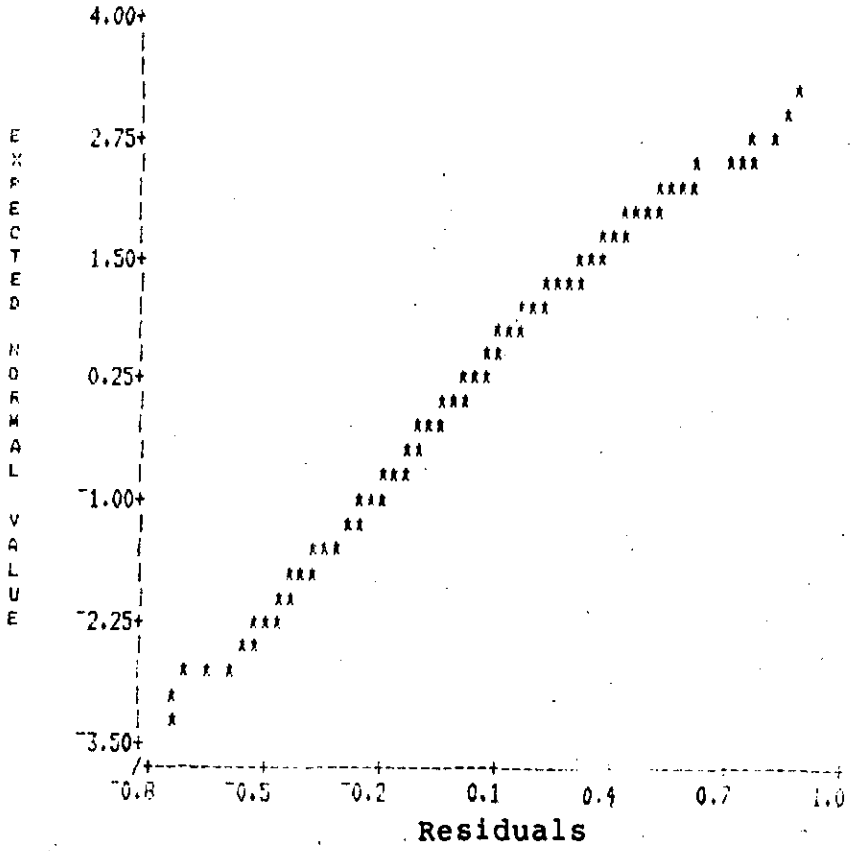


Fig.3 Catch rates of A. plaice in Divisions 3LN 1956-87.





FIGS 4,5. RESIDUAL PLOTS FROM THE MODEL USED TO STANDARDIZE CPUE.

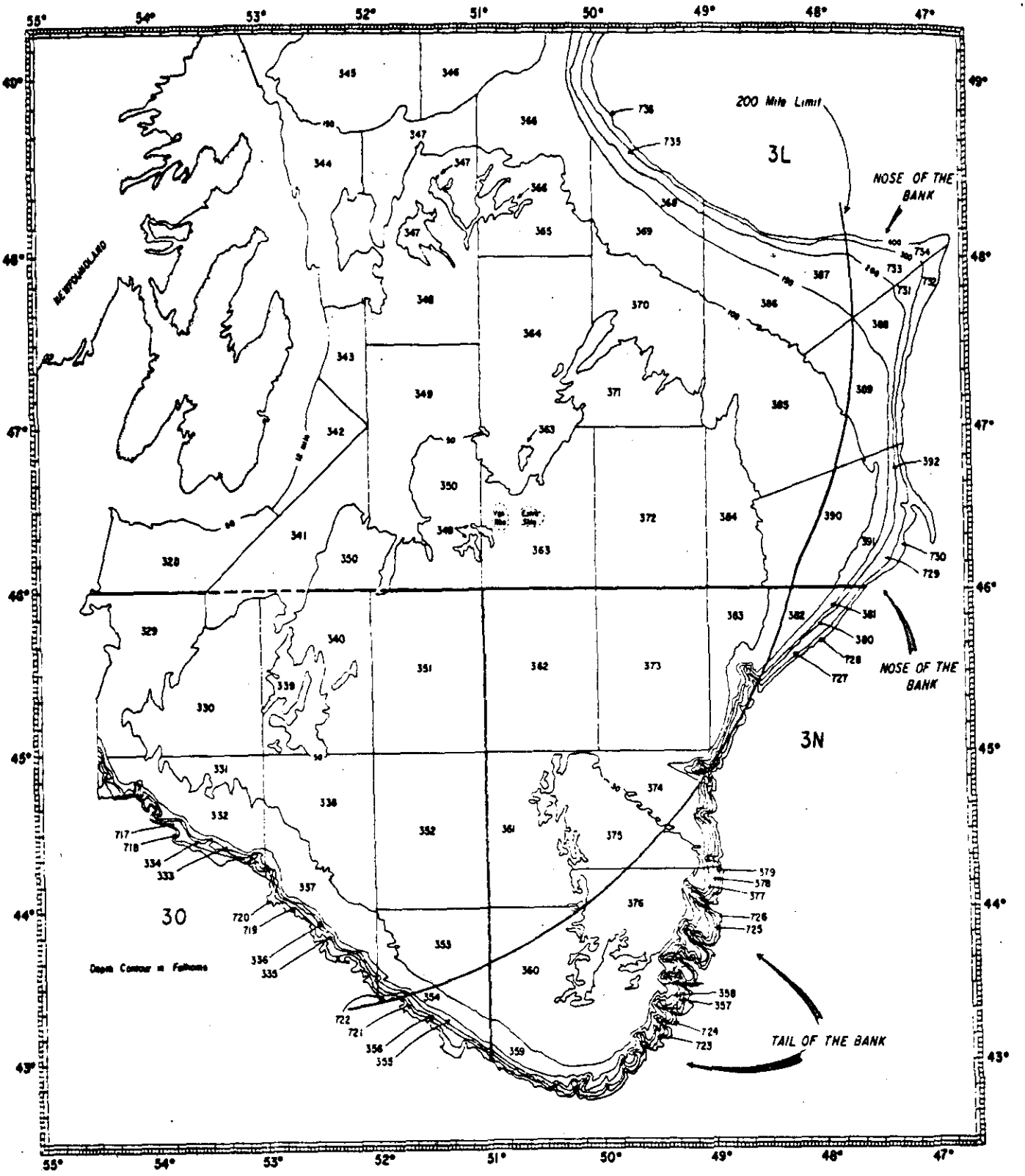


Fig.6 NAFO Div. 3LNO, showing the Canadian 200 mile limit in relation to the Nose and Tail of the Bank, as well as the stratification scheme used in Canadian groundfish surveys.

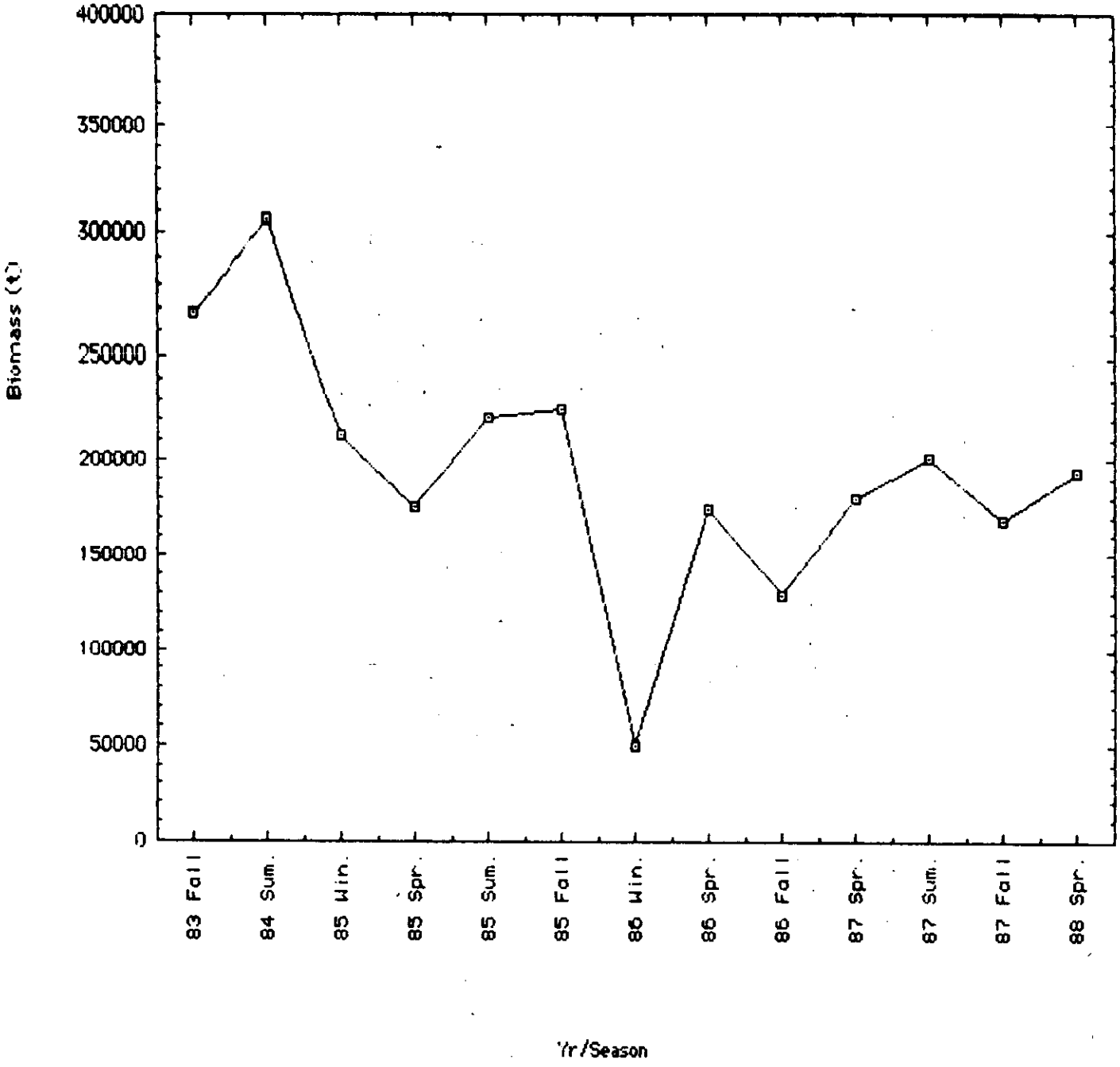
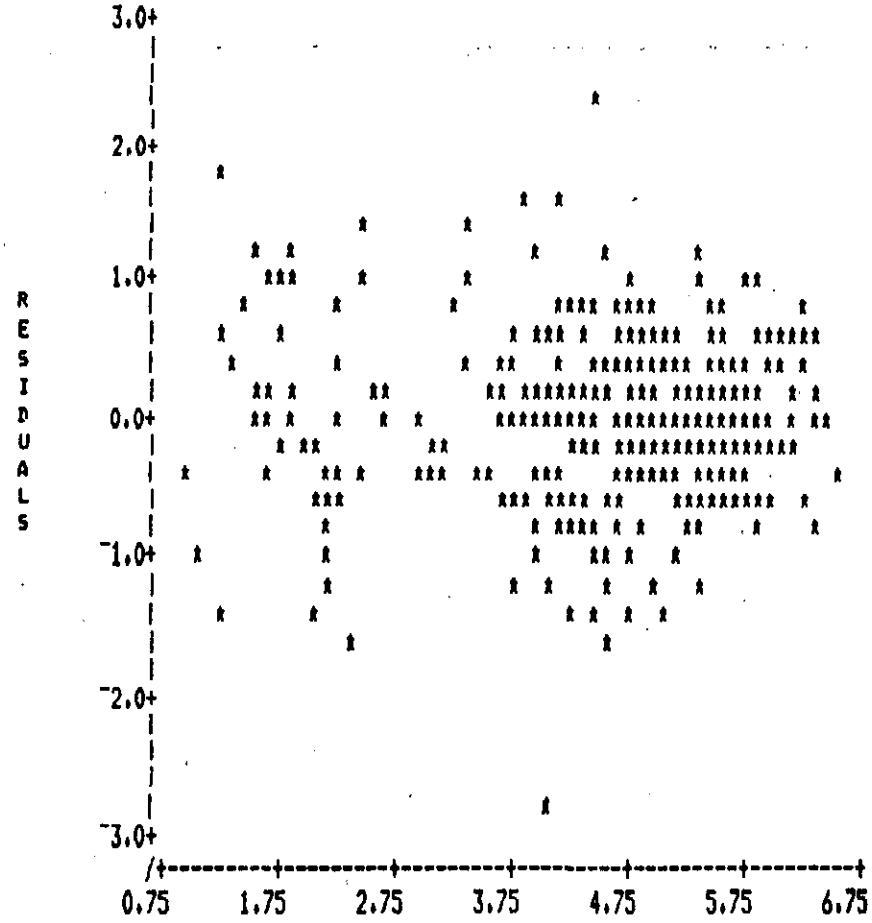
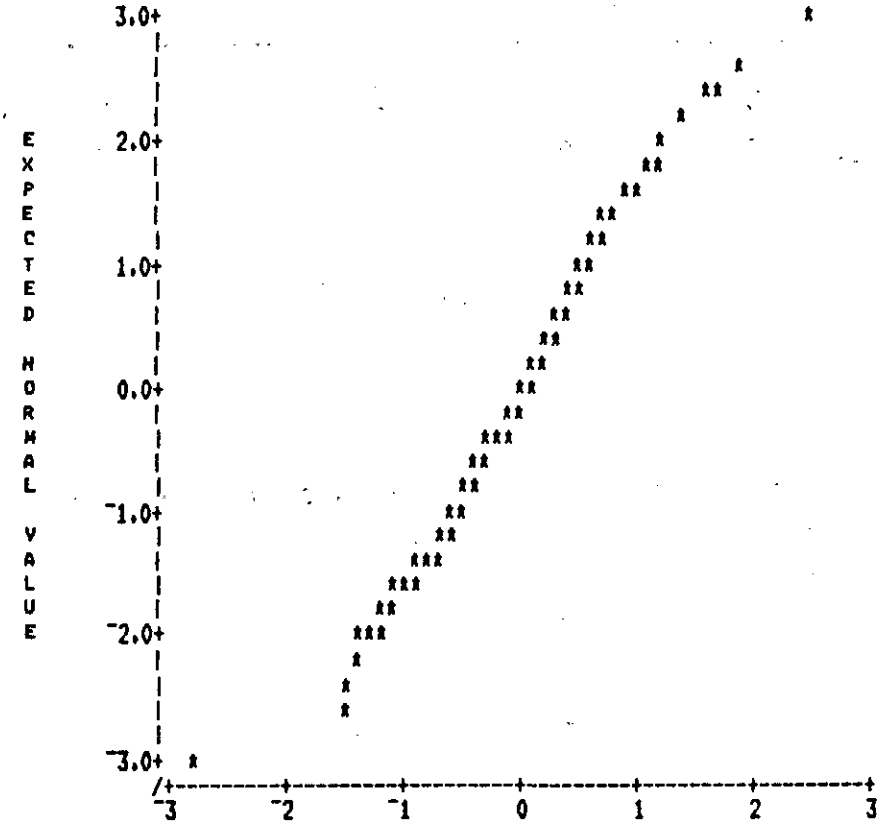
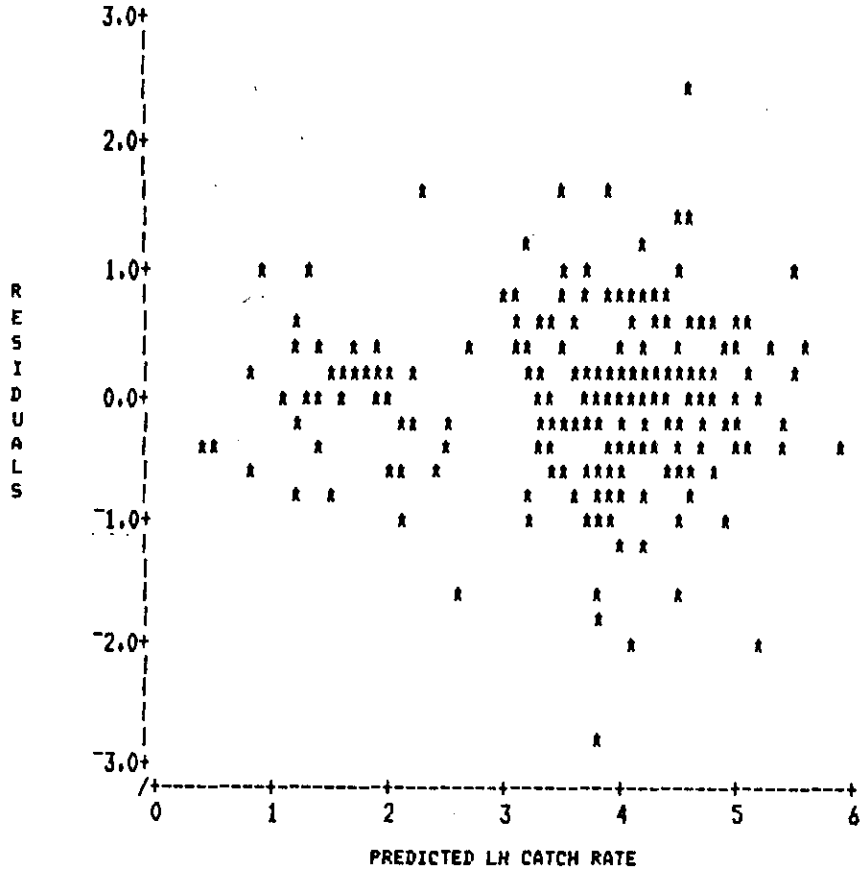


Fig.7 .Biomass estimates of A.plaice in Div. 3L from 1983-88.


RESIDUALS
3.0+
2.0+
1.0+
0.0+
-1.0+
-2.0+
-3.0+
0.75
1.75
2.75
3.75
4.75
5.75
6.75
PREDICTED LN CATCH RATE


EXPECTED NORMAL VALUE
3.0+
2.0+
1.0+
0.0+
-1.0+
-2.0+
-3.0+
-3
-2
-1
0
1
2
3



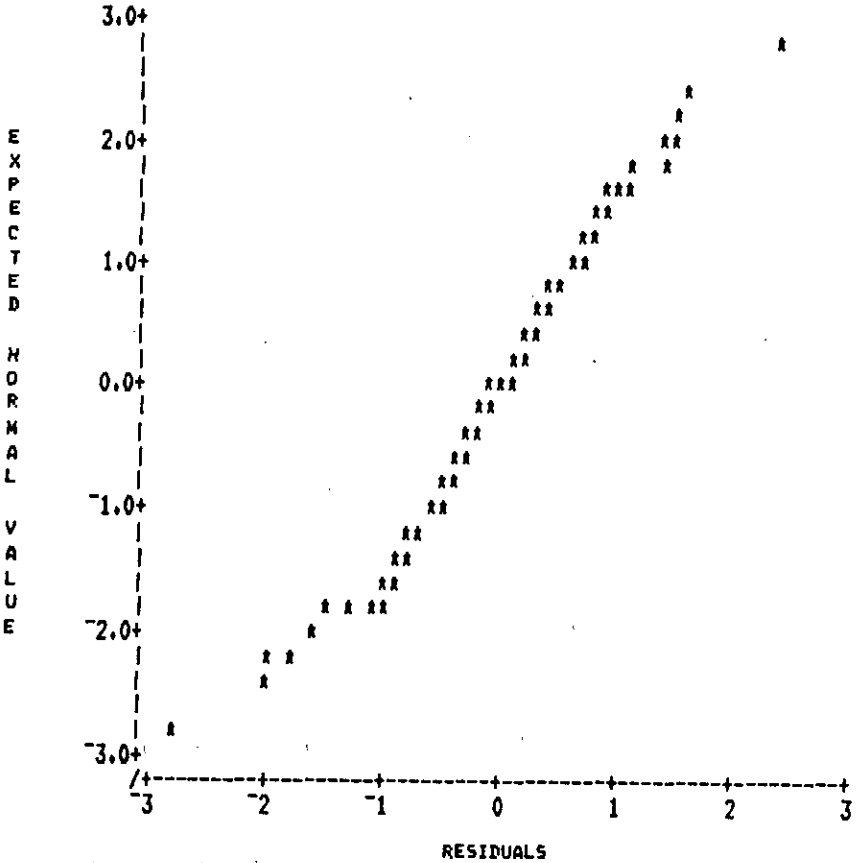


FIG.9. RESIDUAL PLOTS FROM THE MODEL USED FOR RV SURVEYS IN DIV 3N.

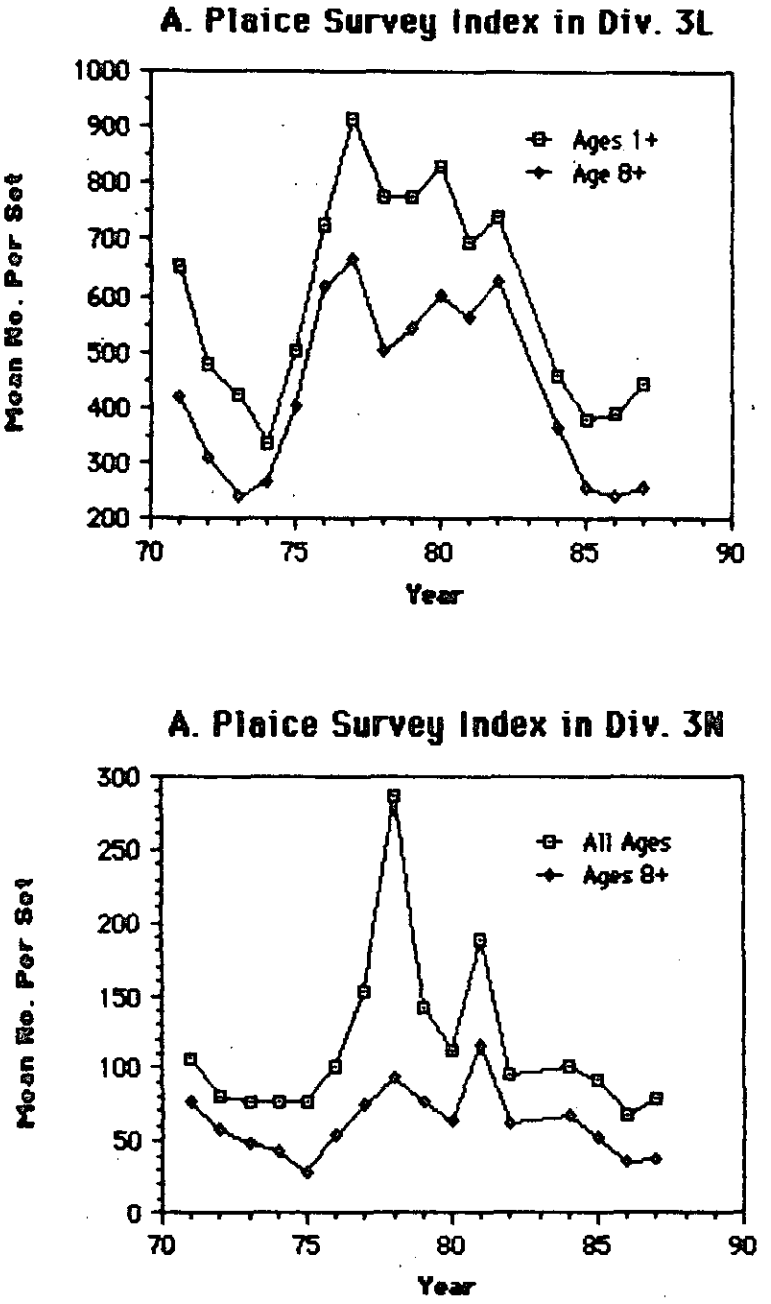


Fig.10 A. plaice survey abundance index in Division 3N and 3L 1971-87.

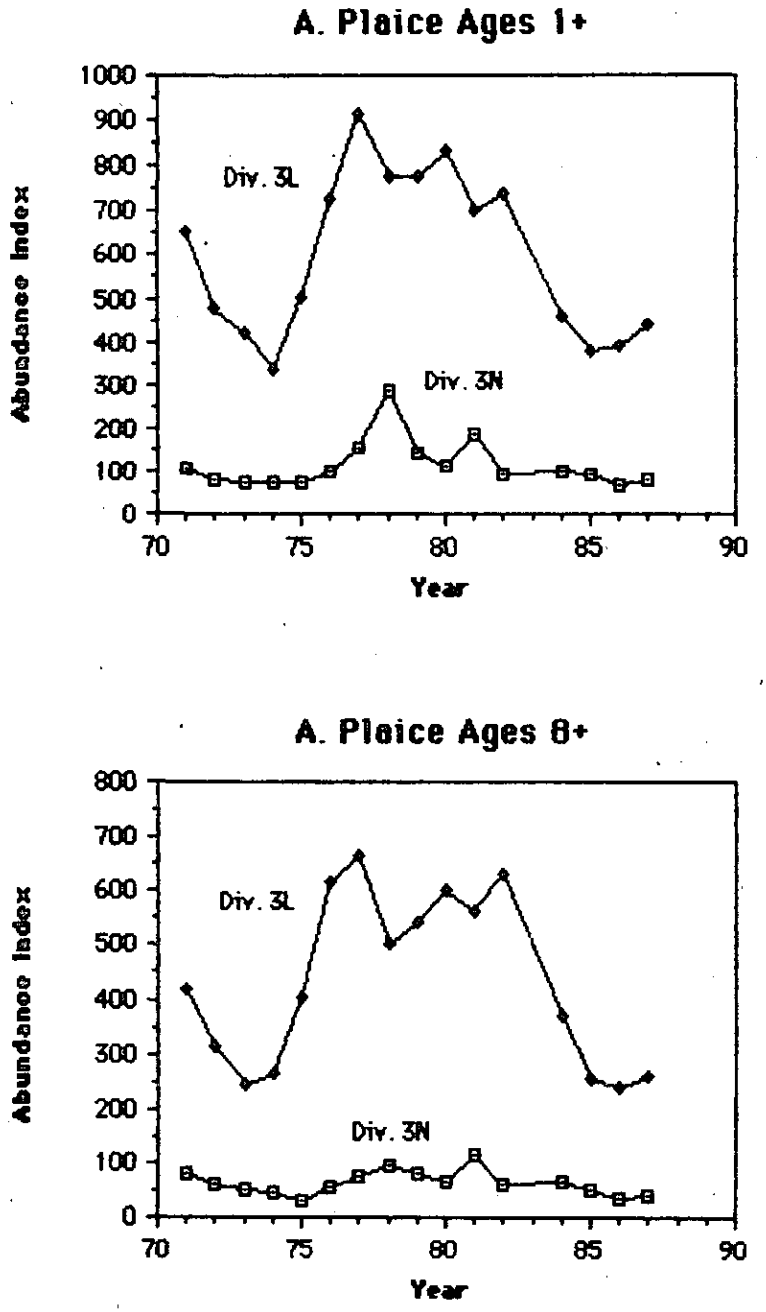


Fig.11 Abundance indices of A.plaice in Div. 3N and 3L 1971-87.

Appendix[1]

Catch at age and average weights at age

Table 28 contains the revised estimates of catch for 1987. Table 29 shows the length frequency data from the Spanish fisheries in 1985 and 1986 which were used to recalculate the catch-at-age. The 1985 data are unsexed, while those of 1986 are sexed. To examine the effects of using unsexed length frequencies to calculate catch-at-age, the analysis for 1986 was done using the sexed data and then redone using the data with sexes combined. Table 31 shows the results to be similar, and so the 1985 data were deemed acceptable. For both 1985 and 1986, age-length keys from the Canadian spring surveys were used to obtain age compositions, as the age-length keys from the Canadian commercial fishery did not contain fish as small as those found in the Spanish length frequencies. For both years, the Canadian catch-at-age was calculated separately using samples from the Canadian commercial fishery and was then added to the numbers-at-age from the non-Canadian portion of the fishery. For 1987, Div. 3N, the age composition from landings of the Spanish fishery was adjusted to the total non-Canadian landings and added to the Canadian catch-at-age (Table 30). The Canadian offshore catch-at-age for Div. 3L was adjusted to the total offshore catch in Div. 3L.

Table 32 shows a comparison between the catch-at-age for 1985 and 1986 from the 1987 and 1988 assessments. Age 5 is included in the 1988 version. The 1986 values are similar, because the 1987 assessment incorporated some Spanish length frequency information in the catch-at-age. In 1985, unlike 1986 and 1987, substantial numbers of smaller American plaice were not found in the Spanish length frequencies from Div. 3N, so no major differences are found in the old and new estimates of the 1985 catch-at-age.

Average weights-at-age were also recalculated for 1985-86 using the revised numbers-at-age to weight the averages. In addition, the average weights-at-age for 1982-84 were recalculated to correct for a minor error in the average lengths used in the length-weight relationship. A comparison of the original values for 1982-86 (from the 1987 assessment) and the recalculated values is shown in Table 33. Note that the recalculated weights include age 5, and estimates have been used at age 19 in 1985 and 1986.

Table 34 shows the catch numbers-at-age from 1965-87. For 1965-79, the numbers at age 5 were obtained from NAFO SCR Doc. 80/VI/110, and the numbers at age 5 for 1982-84 were taken from the 1983-85 assessments of this stock. For 1980 and 1981, the catch at age 5 was not available at present, so estimates were used. These were calculated using the average of the ratios of age 5 to age 6 in 1979 and 1982 applied to the catch at age 6 in 1980 and 1981. Table 35 shows the catch-at-age in percentages each year. As can be seen in this table, there has been a shift in the catch-at-age towards younger fish in 1986-87, with the pattern in these years resembling the percentages observed in many years prior to 1981. Table 36 contains the average weights-at-age for 1965-87, with the values at age 5 for 1965-81 representing an average from 1960-80 (NAFO SCR Doc. 82/VI/52). The average weights-at-age have been increasing at some ages in recent years; and this is partly attributable to the fact that higher proportions of the catch were taken in Div. 3N in 1984-86, where American plaice are larger at age than in Div. 3L. Although this does not explain the continuation of the trend in 1987, when the proportion of catch in Div. 3N declined, it should be noted that the catch in the Regulatory Area in Div. 3N in 1987 was still quite high compared to most other years in the series. Table 37 shows the catch biomass-at-age, with the 5+ total representing the sum of products (numbers x weights-at-age). The sums of products are close to the nominal catch in Div. 3LN in most years. Most of the catch in 1987 came from ages 9-12, with ages 13+ contributing less to the catch than in almost all previous years.

Sequential population analysis

Sequential population analysis (SPA) was carried out using the catch-at-age and weight-at-age matrices described previously. Partial-recruitment values were those calculated in last year's assessment as the average (1965-86) Fs from an SPA normalized to age 12. This is different from the PR actually used in last year's assessment but appears to be a more realistic estimate, given the decline in the proportion of catch from Div. 3N from 1986 to 1987. The following table shows the difference in the PR values used in the 1986-88 assessments:

Age	5	6	7	8	9	10	11	12	13+
1988 assessment	.011	.041	.116	.233	.374	.536	.745	1.00	1.00
1987 assessment	-	.050	.127	.284	.465	.665	.833	1.00	1.00
1986 assessment	-	.025	.100	.220	.300	.470	.560	.730	1.00

1. This section contains information and analyses presented at the June, 1988, meeting, after the initial research document had been tabled.

Table 38 shows the results of calibrations of SPA. Using average exploitable biomass (average population biomass in each year multiplied by the same average partial-recruitment vector) vs CPUE, Ft appears to be in the range of 0.50 to 0.55, and Fig. 12 shows the relationship at Ft = 0.55. It should be noted that no relationships were detected over a reasonable range of Ft for average exploitable biomass vs CPUE using only 1977-87 data (Fig. 13). Using 9+ average population numbers from SPA vs 9+ population numbers from the multiplicative analysis of survey data for 1971-87, shows Ft to be higher than 0.70, based on increasing r values and minimizing the sum of squares of the 1986 and 1987 residuals. The 1987 point is virtually on the regression line at Ft = 0.7 (Fig. 14). Using the 9+ population numbers from selected strata in Div. 3LN (last year's approach) with 9+ average population numbers from SPA, shows Ft to be between 0.65 and 0.70, based on minimizing the last 2 residual sum squares. This calibration was done simply as a comparison with the calibration using the recalculated 9+ survey numbers. Using 9+ SPA vs RV numbers for 1977-87, produced a significant relationship only after Ft reached 0.70; but it is noteworthy that the 1986 and 1987 residuals move further below the line as Ft increases from .60 to .70. Figure 15 shows the relationship at Ft = 0.70. The same situation exists for the relation of 12+ numbers from 1971-87, with r increasing with Ft, but the last 2 points moving further below the regression line (Fig. 16). Although the 12+ numbers from 1977-87 did not produce any significant regressions for the range of Ft used, it should be noted that the 1977 point was very influential in determining the relationship. Exclusion of this point resulted in a significant relationship with Ft being slightly lower than 0.7.

In addition to the relationship presented here, several others were examined. Exploitable biomass vs CPUE indicated Ft to be near the lower end of the range given in Table 38. Age 9+ population biomass vs CPUE showed a high r in most cases, with the relationships being very similar to those for average exploitable biomass vs CPUE. In both of these additional calibrations, there was no significant relationships using only the 1977-87 data.

Based on the calibrations presented, the value of Ft for 1987 was determined to be 0.60. The results of the SPA for this F are shown in Table 39. These results indicate that F has increased in recent years and that the 9+ population numbers in recent years have been relatively stable, below the levels observed from 1977-80 and similar to those found in the 1972-76 period. The population numbers at age 12+ (fully recruited) have declined in recent years, and are around the lowest levels observed for this stock in 1986 and 1987.

Catch projections and prognosis

The population size from the SPA with Ft in 1987 at 0.60 was used to project catches for 1988 and 1989. The population at age 5 and 6 was replaced with the geometric mean from 1974 to 1982 because these values in 1987 are very sensitive to even minor changes in the value of input PR. The average weights-at-age were averaged from 1984-87 and are similar to those used in the 1987 assessment, and the PR used to project was the same as that used in the input for SPA (Table 40). The catch projections (Table 41) represent Div. 3LN only, and a catch for Div. 3Ø, normally equal to the recent average value (about 5,000 tons) is usually added to give a projected catch for the whole stock.

It should be noted that the results from three Canadian surveys conducted in Div. 3L in 1987-88, a Canadian survey in Div. 3NØ in 1988, a USSR survey in Div. 3LNØ in 1987, and an additional year (1987) of commercial CPUE data from the Canadian fleet are now available since the last assessment. All of this stock have indicated the abundance to be similar to that estimated from previous results, and support the view of the stock size proposed in 1987; i.e., that it is considerably smaller than it was several years ago.

Therefore, the present assessment confirms the results of the 1987 assessment, and the recommended $F_{0.1}$ catches for the stock (Div. 3LNØ) in 1988 and 1989 are 28,000 and 32,000 tons respectively.

Table 28. Revised breakdown of 1987 nominal catch.

Country	Division				
	3L (Inshore)	3L (Offshore)	3N	3Ø	Total
Canada	3,892	21,673	4,483	3,875	33,923
Spain		5,202	8,347	927	14,476
Portugal		1,502	1,014		2,516
USA			1,249		1,249
So. Korea			501		501
USSR				28	28
Total	3,892	28,377	15,594	4,830	52,693

Table 29. Length-frequency data from Spanish catches in 1985-86 and corresponding nominal catches used to calculate catch at age.

1985 (3N)

Month	# Measurements	Catch (t)	(Cuba + Spain + USSR + USA + So. Korea)
March	3,014	214	
April	533	441	
May	3,409	849	
June	5,277	964	
July	3,740	1,888	
October	3,493	1,658	Nos at age subsequently adjusted to a catch of 12,320 t to include all catch in Div. 3N by non-Canadian vessels.
November	1,563	434	
December	1,091	370	
	22,120	6,818	

1986

Month	# Measurements 3L	# Measurements 3N	Catch (t) 3L	Catch (t) 3N	(3L = Spain + Portugal) (3N = Spain + Portugal + USA)
July	971	3,895	465	8,449	
August	10,768	5,218	2,219	1,950	
September	8,823	1,194	1,260	3,104	
October	870	185	308	1,446	
November	6,132	7,378	104	1,762	
December	370	4,890	3	1,355	3N catch numbers adjusted to 22,337 t; 3L catch numbers represent total non-Canadian catch
	27,934	22,760	4,359	18,066	

Spanish catches: 3L = 2,563 t
3N = 9,017 t

Table 30. Comparison of catch nos at age (x 10^{-3}), mean length (cm), and mean weight (kg) at age from the Spanish and Canadian fisheries in Div. 3N in 1987. Totals are the catch numbers at age from the Spanish fishery adjusted to the total non-Canadian catch in Div. 3N, plus the Canadian catch at age.

Age	Spain No.	Spain L	Spain W	Canada No.	Canada L	Canada W	Total No.	Total W
4	233	25	.146	-			279	.146
5	1750	29	.230	-			2097	.230
6	3694	31	.291	100	34.5	.368	4526	.293
7	4576	35	.416	409	35.9	.419	5891	.416
8	2671	39	.607	487	37.9	.505	3687	.594
9	1133	44	.865	722	41.2	.662	2079	.795
10	1143	47	1.087	795	45.3	.905	2164	1.020
11	560	51	1.461	669	47.6	1.068	1340	1.265
12	364	54	1.645	659	51.1	1.346	1095	1.465
13	256	55	1.776	322	54.5	1.667	629	1.720
14	60	57	1.974	185	58.5	2.147	257	2.099
15	58	57	1.999	106	63.4	2.765	175	2.463
16	*8	65	2.958	46	67.9	3.452	56	3.364
17	-			8	70.1	3.927	8	3.827
Total	16506			4508			24283	
Catch	9274			4483			15594	
Sum of Products	9389			4670			15921	

*16 plus

Table 31. Comparison of catch at age (x 10^{-3}) from Spanish fishery in Div. 3LN in 1986, using sexed data vs. unsexed data.

Age	3N		3L	
	Sexed analysis	Unsexed analysis	Sexed	Unsexed
2	7	4		
3	37	41		
4	357	368	9	9
5	1263	1262	57	55
6	2805	2812	382	389
7	3342	3339	1038	1047
8	2629	2692	1045	1039
9	1959	1849	863	850
10	1372	1374	519	537
11	852	899	286	305
12	825	815	221	201
13	586	577	157	148
14	248	248	73	72
15	182	182	40	40
16	61	61	19	19
17	21	21	4	4
18	1	1	1	1

Table 32. Comparison of catch at age for 1985 and 1986 as taken from the assessments in 1987 and 1988.

CATCH NOS AT AGE USED IN 1987 ASSESSMENT

AGE	1985	1986
6	254	8690
7	1748	9726
8	5081	9149
9	10279	10683
10	15086	12676
11	13590	14231
12	8622	10401
13	3759	5749
14	1564	2390
15	928	1227
16	269	446
17	91	116
18	7	12
19	1	1

CATCH NOS AT AGE USED IN 1988 ASSESSMENT

AGE	1985	1986
5	288	3807
6	725	8428
7	1969	10870
8	4825	10616
9	9562	11470
10	14580	12354
11	13645	13039
12	8935	9655
13	3889	5486
14	1710	2342
15	1033	1234
16	294	457
17	80	116
18	5	12
19	1	1

Table 33. Comparison of avg.wts. at age for 1982-86 as taken from the assessments in 1987 and 1988.

OLD WTS AT AGE 1982-86

AGE	1982	1983	1984	1985	1986
6	0.313	0.401	0.309	0.396	0.188
7	0.375	0.506	0.365	0.434	0.269
8	0.444	0.589	0.436	0.476	0.408
9	0.512	0.694	0.523	0.561	0.539
10	0.550	0.717	0.558	0.669	0.643
11	0.609	0.698	0.665	0.829	0.748
12	0.752	0.756	0.873	1.114	0.965
13	0.995	0.967	1.161	1.487	1.261
14	1.299	1.219	1.483	1.921	1.625
15	1.602	1.560	2.042	2.415	2.025
16	2.054	2.170	2.629	3.015	2.501
17	2.211	2.423	2.912	3.573	2.954
18	2.677	2.805	3.839	4.018	4.170
19	3.437	3.085	3.029	4.018	5.236

REVISED WTS AT AGE 1982-86

AGE	1982	1983	1984	1985	1986
5	0.270	0.301	0.205	0.213	0.121
6	0.298	0.383	0.294	0.330	0.193
7	0.357	0.484	0.348	0.431	0.274
8	0.424	0.565	0.416	0.462	0.406
9	0.490	0.667	0.501	0.537	0.539
10	0.527	0.689	0.535	0.642	0.650
11	0.584	0.671	0.639	0.804	0.752
12	0.723	0.727	0.841	1.091	0.967
13	0.960	0.933	1.122	1.459	1.269
14	1.257	1.179	1.437	1.892	1.632
15	1.553	1.512	1.984	2.357	2.021
16	1.996	2.110	2.560	2.984	2.469
17	2.150	2.358	2.838	3.464	2.907
18	2.607	2.733	3.749	3.859	4.006
19	3.354	3.008	2.953	4.500	4.500

Table 34.

CATCH NOS AT AGE, INCLUDING ALL REVISIONS

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
5	458	1442	289	223	585	105	1016	494	36	343	793	811	965	1225	1243	407	75	20
6	3041	5139	2228	1894	2079	1966	1565	2199	837	5222	2945	3400	6537	3538	6069	2924	538	271
7	6969	8224	7216	3347	6674	2314	7524	2023	4909	7305	6693	7388	8065	7874	12560	9110	2038	1576
8	8964	9122	5093	7913	12023	9066	9354	6576	8158	8070	8266	15943	10827	9238	16872	11601	4330	4303
9	6789	7798	6330	9065	15409	12264	13868	9656	10096	6675	7802	15166	12653	11583	13242	13571	7134	7878
10	7285	5954	9133	9405	10830	10225	12670	10907	7789	7741	6445	10772	19303	12370	11329	13735	10761	11345
11	5521	5823	9106	6255	10793	10128	9833	10866	7741	5901	4524	6867	5954	8859	8075	10796	13178	14704
12	5578	4644	9700	11193	8811	7473	8074	9147	5245	3839	3880	4273	3750	5825	3406	7696	11622	13687
13	5023	4696	6324	7098	5978	5034	4647	5796	5111	2940	3110	2415	2014	2977	1640	3385	8553	7418
14	4174	4105	4377	5126	4496	4223	3328	3720	2896	1642	2175	1984	1311	1738	594	1460	5527	3836
15	1773	2959	3615	2558	2955	3851	2920	2151	1560	866	1091	1176	872	1161	294	619	2903	1718
16	2054	1626	2501	2075	1586	2176	1753	1806	1828	595	595	448	308	469	148	244	1099	524
17	1270	1037	1314	1230	1051	1236	898	1239	802	187	393	193	161	152	57	79	383	146
18	556	933	1110	615	609	834	447	527	913	65	190	45	93	53	13	25	231	69
19	618	390	283	330	296	315	360	286	337	20	80	20	25	18	5	2	101	8

AGE	1983	1984	1985	1986	1987
5	116	8	288	3807	2098
6	937	99	725	8428	4536
7	2668	511	1969	10870	6803
8	4492	1907	4825	10616	9836
9	6698	4535	9562	11470	14889
10	6399	9141	14580	12354	16236
11	7757	12484	13645	13039	10533
12	7135	8650	8835	9655	6345
13	4428	4900	3889	5486	2763
14	2379	2406	1710	2342	1104
15	1170	1037	1033	1234	606
16	354	387	294	457	153
17	122	89	80	116	22
18	43	14	5	12	3
19	13	1	1	1	1

Table 35.

CATCH AT AGE AS PERCENTAGES OF YEARLY TOTALS

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
5	0.8	2.3	0.4	0.3	0.7	0.1	1.3	0.7	0.1	0.7	1.6	1.1	1.5	1.8	1.6	0.5	0.1	0.0	0.3	0.0
6	5.1	8.0	3.2	2.8	2.5	2.8	2.0	3.3	1.4	10.2	6.0	4.8	10.2	5.3	8.0	3.9	0.8	0.4	2.1	0.2
7	11.6	12.9	10.5	4.9	7.9	3.2	9.6	3.0	8.4	14.2	13.7	10.4	12.6	11.7	16.6	12.0	3.0	2.3	6.0	1.1
8	14.9	14.3	7.4	11.6	14.3	12.7	12.0	9.8	14.0	15.7	16.9	22.5	17.0	13.8	22.3	15.3	6.3	6.4	10.0	4.1
9	11.3	12.2	9.2	13.3	18.3	17.2	17.7	14.3	17.3	13.0	15.9	21.4	19.8	17.3	17.5	17.9	10.4	11.7	15.0	9.8
10	12.1	9.3	13.3	13.8	12.9	14.4	16.2	16.2	13.4	15.1	13.2	15.2	16.1	18.4	15.0	18.2	15.7	16.8	14.3	19.8
11	9.2	9.1	13.3	9.2	12.8	14.2	12.6	16.1	13.3	11.5	9.2	9.7	9.3	13.2	10.7	14.3	19.2	21.8	17.3	27.0
12	9.3	7.3	14.1	16.4	10.5	10.5	10.3	13.6	9.0	7.5	7.9	6.0	5.9	8.7	4.5	10.2	17.0	20.3	16.0	18.7
13	8.4	7.3	9.2	10.4	7.1	7.1	5.9	8.6	8.8	5.7	6.3	3.4	3.2	4.4	2.2	4.5	12.5	11.0	9.9	10.6
14	6.9	6.4	6.4	7.5	5.3	5.9	4.3	5.5	5.0	3.2	4.4	2.8	2.1	2.6	0.8	1.9	8.1	5.7	5.3	5.2
15	3.0	4.6	5.3	3.7	3.5	5.4	3.7	3.2	2.7	1.7	2.2	1.7	1.4	1.7	0.4	0.8	4.2	2.5	2.6	2.2
16	3.4	2.5	3.6	3.0	1.9	3.1	2.2	2.7	3.1	1.2	1.2	0.6	0.5	0.7	0.2	0.3	1.6	0.8	0.8	0.8
17	2.1	1.6	1.9	1.8	1.2	1.7	1.1	1.8	1.4	0.4	0.8	0.3	0.3	0.2	0.1	0.1	0.6	0.2	0.3	0.2
18	0.9	1.5	1.6	0.9	0.7	1.2	0.6	0.8	1.6	0.1	0.4	0.1	0.1	0.1	0.0	0.0	0.3	0.1	0.1	0.0
19	1.0	0.6	0.4	0.5	0.4	0.4	0.5	0.4	0.6	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

AGE	1985	1986	1987
5	0.5	4.2	2.8
6	1.2	9.4	6.0
7	3.2	12.1	9.0
8	7.9	11.8	13.0
9	15.6	12.8	19.6
10	23.7	13.7	21.4
11	22.2	14.5	13.9
12	14.4	10.7	8.4
13	6.3	6.1	3.6
14	2.8	2.6	1.5
15	1.7	1.4	0.8
16	0.5	0.5	0.2
17	0.1	0.1	0.0

Table 36. AVG WTS AT AGE, INCLUDING ALL REVISIONS

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
5	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209
6	0.289	0.277	0.287	0.276	0.290	0.275	0.259	0.278	0.244	0.252	0.248	0.261	0.264	0.266	0.320	0.328	0.381
7	0.365	0.369	0.383	0.348	0.332	0.330	0.331	0.372	0.292	0.339	0.347	0.345	0.359	0.363	0.374	0.410	0.408
8	0.498	0.499	0.469	0.450	0.412	0.397	0.404	0.484	0.380	0.416	0.418	0.403	0.431	0.414	0.448	0.483	0.453
9	0.625	0.640	0.610	0.602	0.564	0.536	0.494	0.527	0.519	0.568	0.578	0.548	0.623	0.515	0.546	0.537	0.480
10	0.703	0.788	0.788	0.697	0.670	0.680	0.612	0.629	0.629	0.694	0.706	0.658	0.676	0.618	0.594	0.570	0.523
11	0.827	0.976	0.847	0.851	0.785	0.795	0.772	0.753	0.816	0.917	0.922	0.841	0.884	0.773	0.683	0.653	0.542
12	0.869	0.988	1.030	0.991	0.982	0.841	0.909	0.867	1.041	1.108	1.099	1.029	1.013	0.928	0.906	0.742	0.670
13	0.932	0.984	1.064	1.075	1.050	1.043	1.034	0.935	1.243	1.360	1.339	1.152	1.199	1.199	1.188	0.989	0.786
14	1.258	1.287	1.369	1.397	1.401	1.166	1.132	1.175	1.334	1.567	1.536	1.327	1.389	1.389	1.659	1.352	1.000
15	1.377	1.413	1.631	1.597	1.602	1.311	1.279	1.380	1.524	1.922	1.813	1.658	1.768	1.768	1.886	1.739	1.300
16	1.614	1.656	1.890	1.881	1.870	1.673	1.600	1.654	1.816	2.387	2.319	2.137	2.196	2.196	2.118	1.770	1.762
17	1.905	1.922	2.166	2.197	2.240	1.854	1.911	1.854	1.939	2.458	2.578	2.318	2.324	2.324	2.302	2.140	2.099
18	1.943	1.917	2.305	2.297	2.348	2.073	2.117	1.915	2.104	2.871	2.880	2.716	2.546	2.546	3.199	2.700	2.368
19	1.957	2.025	2.527	2.488	2.595	2.283	2.285	2.129	2.294	3.004	2.942	2.864	3.072	3.072	3.243	3.000	2.558

AGE	1982	1983	1984	1985	1986	1987
5	0.270	0.301	0.205	0.213	0.121	0.230
6	0.298	0.383	0.294	0.330	0.193	0.292
7	0.357	0.484	0.348	0.431	0.274	0.396
8	0.424	0.565	0.416	0.462	0.406	0.428
9	0.490	0.667	0.501	0.537	0.539	0.483
10	0.527	0.689	0.535	0.642	0.650	0.633
11	0.584	0.671	0.639	0.804	0.752	0.820
12	0.723	0.727	0.841	1.091	0.967	1.075
13	0.960	0.933	1.122	1.459	1.269	1.354
14	1.257	1.179	1.437	1.892	1.632	1.674
15	1.553	1.512	1.984	2.357	2.021	2.140
16	1.996	2.110	2.560	2.984	2.469	2.826
17	2.150	2.358	2.838	3.464	2.907	3.304
18	2.607	2.733	3.749	3.859	4.006	4.035
19	3.354	3.008	2.953	4.500	4.500	4.500

Table 37. CATCH BIOMASS AT AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
5	96	301	60	47	122	22	212	103	8	72	166	169	202	256	260	85	16
6	879	1424	639	523	603	541	405	611	204	1316	730	887	1726	941	1942	959	205
7	2544	3035	2764	1165	2216	764	2490	753	1433	2476	2322	2549	2895	2858	4697	3735	832
8	4464	4552	2389	3561	4953	3599	3779	3183	3100	3357	3455	6433	4666	3825	7559	5603	1961
9	4243	4991	3861	5457	8691	6574	6851	5089	5240	3791	4510	8311	7883	5965	7230	7288	3424
10	5121	4692	7197	6555	7256	6953	7754	6861	4899	5372	4550	7088	6965	7645	6729	7829	5628
11	4566	5683	7713	5323	8473	8052	7591	8182	6317	5411	4171	5775	5263	6848	5515	7050	7142
12	4847	4588	9991	11092	8652	6285	7339	7930	5460	4254	4264	4397	3799	5406	3086	5710	7787
13	4681	4621	6729	7630	6277	5250	4805	5419	6353	3998	4164	2782	2415	3569	1948	3348	6723
14	5251	5283	5992	7161	6299	4924	3767	4371	3863	2573	3341	2633	1821	2414	985	1974	5527
15	2441	4181	5896	4085	4734	5049	3735	2968	2377	1664	1978	1950	1542	2053	554	1076	3774
16	3315	2693	4727	3903	2966	3640	2805	2987	3320	1420	1380	957	676	1030	313	432	1936
17	2419	1993	2846	2702	2354	2292	1716	2297	1555	460	1013	447	374	353	131	169	804
18	1080	1789	2559	1413	1430	1729	946	1009	1921	187	547	122	237	135	42	67	547
19	1209	790	715	821	768	719	823	609	773	60	235	57	77	55	16	6	258
5+	47158	50615	64078	61438	65794	56392	55019	52373	46823	36412	36827	44559	40541	43353	41009	45332	46564

AGE	1982	1983	1984	1985	1986	1987
5	5	35	2	61	461	482
6	81	358	29	239	1627	1326
7	563	1292	178	849	2978	2695
8	1825	2537	794	2228	4310	4208
9	3861	4467	2271	5133	6182	7198
10	5978	4410	4888	9359	8030	10279
11	8591	5203	7973	10972	9805	8639
12	9900	5188	7276	9636	9337	6819
13	7122	4130	5498	5675	6962	3741
14	4821	2804	3457	3235	3822	1848
15	2668	1769	2057	2436	2494	1298
16	1046	747	991	876	1129	434
17	314	288	253	279	338	71

Table 38. Calibration of SPA, American plaice in Div. 3LN.

	Parameter	Ft .50	.55	.60	.65	.70
Avg exploitable biomass vs CPUE 1965-87	r	.834	.832	.829	.825	.822
	intercept	-2927	-5097	-6904	-8433	
	slope	189189	191346	193155	194697	
	'87 resid	+7.3	+0.06	-6.0	-11.2	
	'86 resid	-0.6	-4.9	-8.4	-11.4	
	(87 res)²+(86 res²)	53.7	24.0	106.6	255.4	
Avg exploitable biomass vs CPUE 1977-87	r	.060NS	-	.032NS	-	-
9+ avg pop. nos from SPA vs 9+ pop nos. from mult. anal. of r.v. surveys, 1971-82, 1984-87	r	.065NS	-	.457NS	.524	.574
	intercept			127052	118820	111771
	slope			110.1	128.2	143.7
	'87 resid			+16.8	+7.0	+1.1
	'86 resid			+13.9	+13.2	+10.1
	(87)²+(86)²			475.5	223.2	103.2
9+ avg pop. nos from SPA vs 9+ r.v. pop. nos. from sel strata in Div. 3LN 1971-87, excluding 1973, 75, 76, 83, 84	r	.351NS	-	.581	.644	.687
	intercept			129222	119816	111761
	slope			194.6	231.3	258.4
	'87 resid			+6.5	+0.1	-5.5
	'86 resid			+10.3	+7.3	+4.7
	(87)²+(86)²			148.3	53.3	52.3
12+ avg pop. nos from SPA vs 12+ pop. nos from mult anal. of r.v. surveys 1971-82, 1984-87	r	.459NS	.484NS	.502	.516	.526
	intercept	20674		18968	18312	17749
	slope	122.7		139.6	146.1	151.6
	'87 resid	-2.3		-4.8	-5.7	-6.5
	'86 resid	-1.6		-2.4	-2.7	-2.9
	(87)²+(86)²	7.9		28.8	39.8	50.7
9+ avg pop. nos from SPA vs 9+ pop. nos from mult. anal. of r.v. surveys 1977-87 excl. 1983	r	.145NS	-	.531NS	.612NS	.662
	intercept			150863	138504	127922
	slope			86.3	112.4	134.8
	'87 resid			-6.0	-10.1	-13.6
	'86 resid			-2.9	-3.7	-4.5
	(87)²+(86)²			44.4	115.7	205.2
12+ avg pop. nos from SPA vs 12+ pop. nos from mult. anal. of r.v. surveys 1977-87 excl. 1983	r	.255NS	-	.336NS	.365NS	.386NS
	intercept					
	slope					
	'87 resid					
	'86 resid					
	(87²)+(86)²					

Table 39. Results of SPA at $F_T = 0.6$.

POPULATION NUMBERS

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
5	236421	211435	189939	149426	146251	138500	177331	220607	269745	261976	274795	259997	216563	203490	187753
6	183748	193151	171804	155248	122138	119211	113299	144267	180170	220816	214178	224266	212134	176434	165495
7	148771	147689	153489	138645	125392	98117	95821	91345	116126	146754	176063	172689	180537	167766	141250
8	119885	115498	113476	119137	110485	96624	78238	71644	72957	90634	113542	138093	134701	140514	130230
9	105073	90043	86308	88298	90381	79578	70905	55592	52707	52350	66903	85481	98617	100487	106684
10	86103	79883	66665	64935	64090	60055	54056	45504	36778	34017	36821	47716	56263	69292	71791
11	54824	63904	60016	46317	44654	42673	39917	32793	27387	23063	20847	24315	29320	36742	45538
12	36439	39890	47051	40897	32261	26794	25773	23784	17017	15418	13543	12974	13694	18618	22066
13	29674	24787	28457	29745	23356	18441	15175	13796	11196	9186	9149	7577	6756	7818	9972
14	18756	19750	16045	17577	17931	13713	10543	8220	6051	4542	4861	4677	4019	3709	3707
15	9689	11579	12455	9176	9752	10612	7406	5621	3364	2333	2233	2012	2034	2104	1464
16	7337	6329	6803	6927	5198	5311	5204	3422	2655	1342	1127	841	583	876	672
17	3763	4148	3710	3307	3793	2821	2379	2675	1167	520	561	384	283	199	293
18	2245	1932	2458	1849	1594	2155	1191	1135	1069	230	257	103	140	86	25
19	2108	1335	737	1008	957	754	1010	571	453	49	129	38	44	30	23
5+	1044838	1011353	959413	872490	798234	715359	698249	720974	798840	863232	935009	981164	955687	928164	886964
6+	808416	799917	769474	723064	651983	576859	520918	500368	529096	601255	660214	721166	739124	724674	699212
7+	624668	606766	597670	567816	529845	457648	407619	356100	348925	380440	446036	496900	526990	548240	533716
8+	475897	459077	444181	429171	404453	359531	311798	264755	232799	233686	269973	324211	346453	380474	392466
9+	356011	343580	330705	310035	293968	262907	233560	193111	159842	143052	156431	186119	211752	239961	262235
10+	250938	253537	244397	221737	203587	183329	162655	137520	107136	90701	89528	100638	113135	139474	155551
11+	164835	173653	177732	156802	139498	123274	108599	92015	70358	56684	52707	52922	56872	70182	83760
12+	110011	109750	117717	110485	94843	80601	68682	59222	42971	33621	31860	28607	27553	33440	38222

AGE	1980	1981	1982	1983	1984	1985	1986	1987
5	177919	175574	216181	206101	170123	178060	255644	386870
6	152594	145299	143680	176976	168636	139277	145523	205859
7	130005	122288	118474	117390	144048	137978	113375	111518
8	104281	98196	98277	95572	93696	117474	111185	82988
9	91357	74881	76478	76569	74183	74987	91814	81425
10	75364	62517	54853	55487	56628	56633	52742	64793
11	48527	49275	41448	34644	39638	38092	33175	32003
12	29977	29962	28419	20630	21345	21157	18841	15363
13	14984	17580	14015	10883	10434	9649	9327	6689
14	6680	9205	6654	4762	4903	4109	4382	2673
15	2498	4148	2535	1977	1746	1838	1817	1468
16	933	1485	770	521	560	491	569	371
17	416	543	221	156	106	108	137	52
18	188	269	98	49	17	7	16	7
19	9	132	12	18	1	2	1	2
5+	835732	791353	802112	801733	786068	779862	838547	992082
6+	657813	615779	585932	595633	615945	601802	582903	605212
7+	505219	470480	442252	418657	447309	462525	437380	399353
8+	375214	348192	323778	301267	303261	324547	324006	287835
9+	270933	249997	225501	205695	209565	207073	212821	204847
10+	179576	175115	149023	129126	135381	132086	121007	123422
11+	104212	112598	94171	73640	78753	75453	68265	58629
12+	55686	63323	52723	38996	39114	37361	35090	26627

Table 39. (continued)

POPULATION BIOMASS

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
5	44738	39905	35950	28283	27645	26225	33488	41739	51093	49590	51973	49168	40925	38422	35439
6	47703	47799	44380	38582	31810	29450	26399	36053	39745	49794	47787	52621	49918	42079	47052
7	47973	47908	51930	43163	36647	28975	27522	30432	30033	43880	54240	52754	57329	53799	45565
8	51918	49997	47069	46844	38805	32992	26774	29859	23592	32518	41319	47251	50323	50849	49122
9	57440	49772	45820	45480	41842	35374	28291	23999	22152	25067	32813	38281	51767	43948	49205
10	52340	54748	44029	37752	35281	33526	26036	22444	18486	18666	21276	24855	30968	34970	35285
11	38838	53727	42220	33075	27449	26645	24053	18109	16999	16398	15306	15558	20831	22249	25419
12	26278	33447	38871	31030	24265	17188	17421	14485	13223	13310	11290	9806	10619	12851	16577
13	22718	19778	24027	25092	19014	14733	11730	8786	9168	9242	8924	6464	6092	6606	9761
14	18719	20365	16828	18556	19548	11937	8858	6386	5204	5096	4961	4212	4110	3355	5081
15	10865	12689	15368	11178	11708	9950	6600	5457	3354	3186	2584	1913	2431	2218	2223
16	9025	8120	9159	9788	7272	6108	6080	3467	2378	2137	1601	1095	784	1169	1131
17	5232	6207	5788	5157	6490	3504	3213	3246	1119	917	697	561	385	195	545
18	3402	2377	3749	3111	2635	3131	1785	1422	695	502	330	189	183	121	50
19	3120	2046	1314	1849	1856	1181	1663	771	480	101	212	68	80	54	58
5+	440309	448886	426504	378941	332268	280919	249913	246655	237721	270405	295314	304795	326746	312885	322514
6+	395571	408981	390554	350658	304624	254694	216425	204916	186628	220814	243341	255627	285821	274463	287074
7+	347868	361181	346175	312076	272814	225244	190026	168863	146883	171020	195554	203006	235903	232384	240023
8+	299895	313273	294244	268913	236166	196270	162504	138431	116849	127141	141314	150253	178574	178585	194457
9+	247977	263276	247175	222069	197361	163278	135730	108572	93257	94622	99995	103001	128251	127737	145335
10+	190537	213504	201355	176589	155519	127904	107440	84573	71105	69556	67182	64720	76483	83788	96130
11+	138197	158756	157325	138837	120238	94378	81403	62129	52619	50889	45906	39864	45515	48818	60846
12+	99359	105029	115105	105762	92789	67733	57350	44020	35620	34491	30600	24307	24683	26569	35427

AGE	1980	1981	1982	1983	1984	1985	1986	1987
5	33661	33251	52900	56210	31608	34333	27812	80377
6	44897	50075	38704	61188	44868	41496	24659	53905
7	46477	44817	38104	50896	45313	53528	26686	38725
8	42877	39359	36892	47686	34978	48079	38787	30098
9	40827	30887	32063	44078	32556	33930	41783	32075
10	34997	26811	23174	32476	24998	28157	26983	31963
11	25141	20539	17433	18419	18801	21989	17399	19327
12	17236	14062	13214	10877	12391	15753	11348	11365
13	11730	8839	8229	6995	7616	9738	6757	6234
14	7185	5173	4843	3543	4488	5316	4349	3080
15	3387	2608	1978	1698	1963	2551	1840	2163
16	1275	1170	768	551	703	827	535	723
17	722	545	246	149	102	166	124	119
18	427	194	122	36	25	12	28	18
19	21	149	19	25	2	4	2	7
5+	310861	278477	268688	334829	260412	295880	229092	310178
6+	277199	245226	215788	278619	228804	261547	201280	229802
7+	232302	195151	177085	217431	183936	220050	176621	175896
8+	185826	150334	138981	166535	138623	166523	149936	137172
9+	142949	110975	102089	118848	103645	118444	111149	107073
10+	102122	80088	70026	74770	71088	84514	69366	74999
11+	67125	53278	46852	42294	46090	56357	42383	43036
12+	41984	32739	29419	23875	27290	34368	24983	23709

Table 39. (continued)

FISHING MORTALITY

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
5	0.002	0.008	0.002	0.002	0.004	0.001	0.006	0.002	0.000	0.001	0.003	0.003	0.005	0.007	0.007	0.003	0.000	0.000	0.001
6	0.018	0.030	0.014	0.014	0.019	0.018	0.015	0.017	0.005	0.026	0.015	0.017	0.035	0.022	0.041	0.021	0.004	0.002	0.006
7	0.053	0.064	0.053	0.027	0.061	0.026	0.091	0.025	0.048	0.057	0.043	0.048	0.051	0.053	0.103	0.081	0.019	0.015	0.025
8	0.086	0.091	0.051	0.076	0.128	0.109	0.142	0.107	0.132	0.104	0.084	0.137	0.093	0.075	0.155	0.131	0.050	0.050	0.053
9	0.074	0.101	0.085	0.120	0.209	0.187	0.244	0.213	0.238	0.152	0.138	0.218	0.153	0.136	0.148	0.179	0.111	0.121	0.102
10	0.098	0.086	0.164	0.174	0.207	0.208	0.300	0.308	0.267	0.290	0.215	0.287	0.226	0.220	0.192	0.225	0.211	0.260	0.136
11	0.118	0.106	0.184	0.162	0.311	0.304	0.318	0.456	0.375	0.332	0.274	0.374	0.254	0.310	0.218	0.282	0.350	0.498	0.284
12	0.185	0.138	0.259	0.360	0.359	0.369	0.425	0.553	0.416	0.322	0.381	0.453	0.360	0.424	0.187	0.334	0.560	0.760	0.482
13	0.207	0.235	0.282	0.306	0.332	0.359	0.413	0.624	0.702	0.436	0.471	0.434	0.400	0.546	0.201	0.287	0.772	0.879	0.597
14	0.282	0.261	0.359	0.389	0.325	0.416	0.429	0.693	0.753	0.510	0.682	0.633	0.447	0.730	0.195	0.276	1.089	1.014	0.803
15	0.226	0.332	0.387	0.368	0.408	0.513	0.572	0.550	0.719	0.528	0.777	1.039	0.642	0.941	0.251	0.320	1.484	1.382	1.062
16	0.370	0.334	0.521	0.402	0.411	0.603	0.466	0.875	1.430	0.673	0.876	0.889	0.877	0.895	0.279	0.341	1.703	1.396	1.388
17	0.467	0.323	0.497	0.530	0.366	0.662	0.540	0.717	1.424	0.507	1.490	0.810	0.990	1.869	0.242	0.235	1.513	1.305	1.995
18	0.320	0.763	0.691	0.458	0.548	0.558	0.536	0.719	2.886	0.375	1.706	0.655	1.326	1.139	0.850	0.159	2.953	1.509	3.390
19	0.388	0.386	0.544	0.444	0.414	0.609	0.495	0.789	1.612	0.593	1.108	0.845	0.961	1.026	0.279	0.288	1.738	1.386	1.558

AGE	1984	1985	1986	1987
5	0.000	0.002	0.017	0.006
6	0.001	0.006	0.066	0.025
7	0.004	0.016	0.112	0.070
8	0.023	0.046	0.112	0.140
9	0.070	0.152	0.149	0.224
10	0.196	0.335	0.300	0.322
11	0.428	0.504	0.570	0.447
12	0.594	0.619	0.836	0.600
13	0.732	0.589	1.050	0.600
14	0.782	0.616	0.893	0.600
15	1.068	0.972	1.388	0.600
16	1.444	1.080	2.188	0.600
17	2.576	1.727	2.840	0.600
18	2.207	1.519	1.672	0.600
19	1.576	1.175	2.273	0.600

Table 40. A. plaice in Div. 3LN: parameters used in projections of biomass and yield.

Age (yr)	1987 stock size (000)	Mean wt. (kg)	Partial recruitment
5	217,000	.192	.010
6	181,000	.277	.041
7	111,518	.362	.116
8	82,988	.428	.233
9	81,425	.515	.374
10	64,793	.615	.536
11	32,003	.754	.745
12	15,363	.993	1.0
13	6,689	1.301	1.0
14	2,673	1.659	1.0
15	1,468	2.125	1.0
16	371	2,710	1.0
17	52	3.128	1.0
18	7	3.912	1.0
19	2	4.113	1.0

Table 41. American plaice in Div. 3LNØ[a]. Results of catch projections for different levels of F in 1987 and 1988.

Catch in 1988	F in 1988	Catch at $F_{0.1}$ = 0.26 in 1989
27.4	0.26	32.4
33.0	0.33	30.5
40.0	0.43	29.3

[a]5,000 t has been added for Div. 3Ø to the Div. 3LN projections to give projected catches for the entire stock.

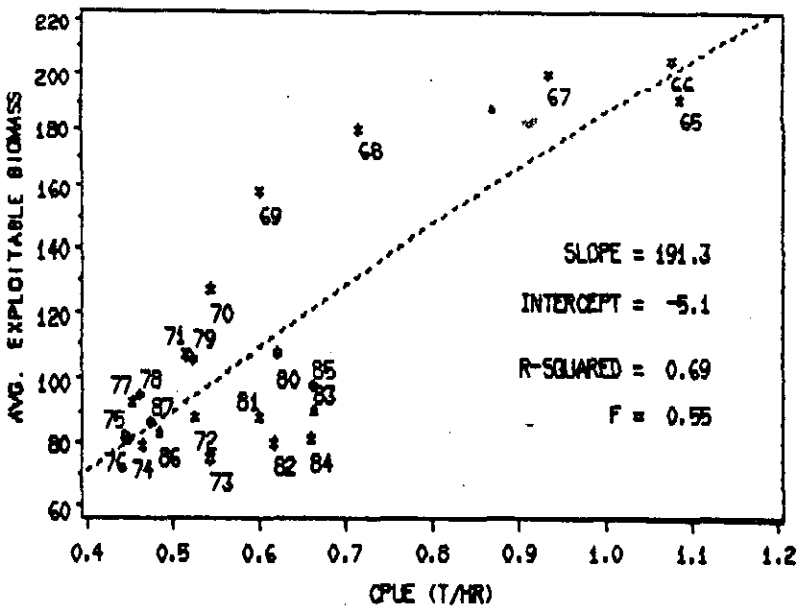


FIG 12. THE RELATIONSHIP OF AVERAGE EXPLOITABLE BIOMASS (X 1000 T) AND CPUE FOR AM. PLAICE IN DIV 3LN (1965-87).

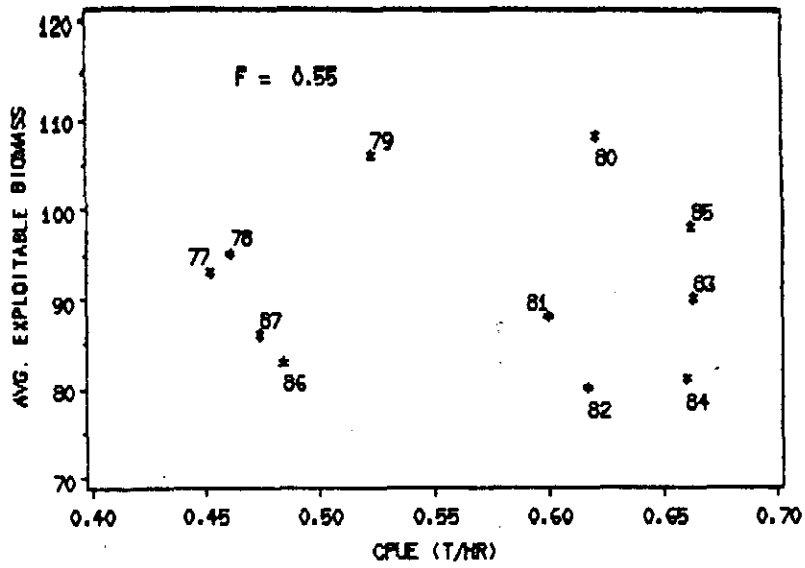


FIG 13. THE RELATIONSHIP OF AVERAGE EXPLOITABLE BIOMASS (X 1000 T) AND CPUE FOR AM. PLAICE IN DIV 3LN (1977-87).

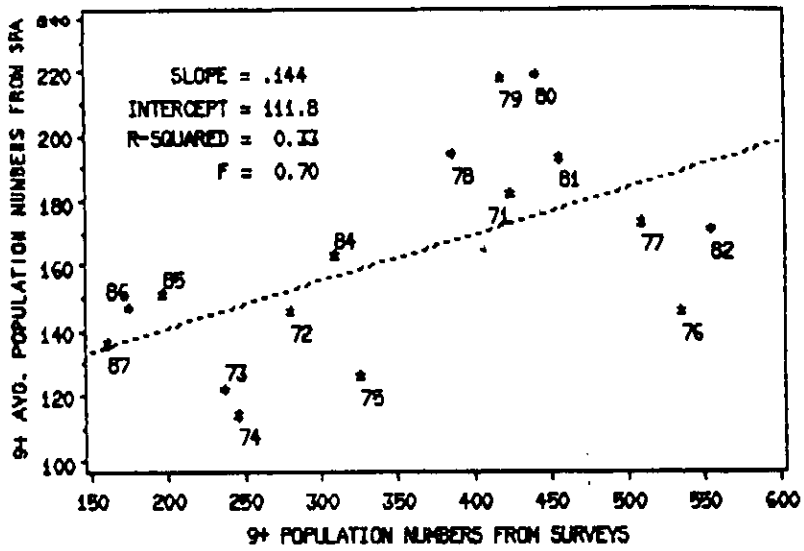


Fig. 14. THE RELATIONSHIP OF 9+ NOS FROM SPA (MILLIONS) AND 9+ NOS FROM SURVEYS (MILLIONS) (1971-87).

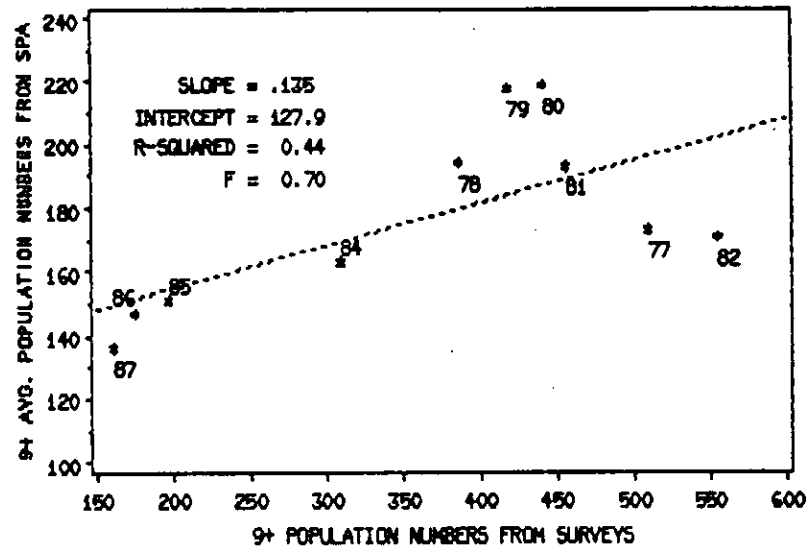


Fig. 15. THE RELATIONSHIP OF 9+ NOS FROM SPA (MILLIONS) AND 9+ NOS FROM SURVEYS (MILLIONS) (1977-87).

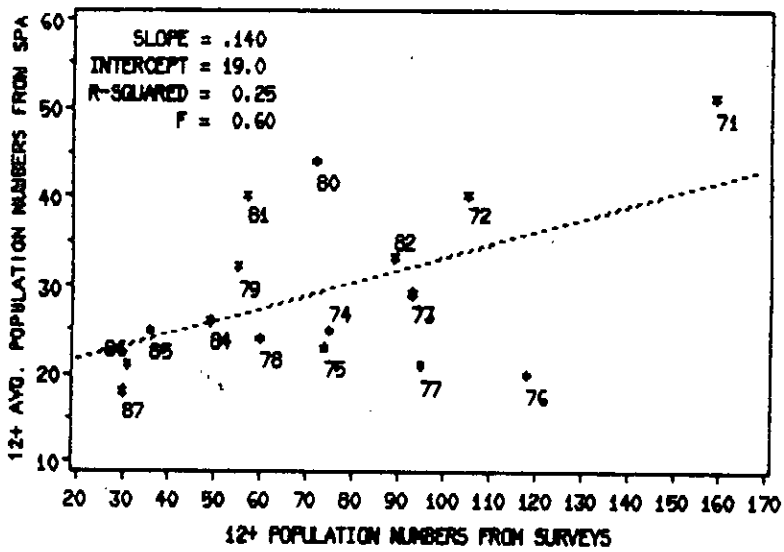


Fig. 16. THE RELATIONSHIP OF 12+ NOS FROM SPA (MILLIONS) AND 12+ NOS FROM SURVEYS (MILLIONS) (1971-87).