Northwest Atlantic Fisheries Organization

Serial No. N1478

NAFO SCR Doc. 88/38

SCIENTIFIC COUNCIL MEETING - JUNE 1988

An Update on the Status of the Yellowtail Flounder Stock in Division 3LNO[1]

by

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Introduction

TAC regulation

This stock has been under TAC regulation since 1973, when a precautionary level of 50,000 t was established. In 1976 the TAC was lowered to 9,000 t from 35,000 t, following a number of large catches and a decrease in stock biomass. After 1977, the TAC increased steadily to 23,000 t in 1982 and has been set at 15,000 t from 1985-88, based on average catches over several years preceding 1984.

Catch history

The nominal catch from this stock increased rapidly from a few hundred tons in 1963-64 to a high of about 37-39,000 t in 1971-72 (Table 1(a), Fig. 1). Vessels from Canada and the USSR took almost all of the catch up to and including 1975, with only Canada taking significant catches in 1976-81. With the entrance of South Korean vessels into the fishery in 1982, catches by non-Canadian vessels began to increase rapidly, approaching the Canadian catch in 1985 and 1986. For 1987, however, preliminary estimates indicate that catches by non-Canadian vessels were substantially lower (85%) than in 1986 (Table 1(b)). Overall, the preliminary estimate for the 1987 catch is 15,727 t, just over the TAC and about half the 1985 and 1986 values.

The fishery for this stock is conducted almost exclusively by large offshore otter trawlers, with the majority of the catch coming from Div. 3N (Table 2, Fig. 2). In 1985 and 1986, the catches from this division approached the highest on record and this can be attributed to the increased fishing effort on the tail of the bank, outside the Canadian 200 mile limit, much of which is excellent yellowtail habitat (Fig. 3). It should be noted that not all countries observed fishing in this area have reported catches to NAFO. For these countries, catches are estimated from Canadian surveillance reports (Table 1(b)).

In 1987 the decline in the yellowtail catch of many nations (Table 1(a)) was attributed (by Canadian surveillance personnel) to a shifting of effort to deeper water for redfish, after catch rates for flounder on the tail of the bank decreased substantially, from 1986 to 1987.

For South Korea, catches of unspecified flounder were reported to NAFO in 1982-84 and a ratio of 60%/40% yellowtail to A. plaice was used to estimate landings by species. In 1985, S. Korea reported a mixture of A. plaice, yellowtail, and unspecified flounder, and the ratio of yellowtail to A. plaice (63/37) was used to break down the unspecified flounder catch. For 1986 and 1987, surveillance estimates were used for the South Korean catch.

Given the offshore nature of the fishery and its concentration in Div. 3N, which is usually ice-free, catches occur in all months, often peaking in the fall (Table 3). It should be noted that monthly breakdowns are not available for substantial portions of the catch in 1984-86.

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

Assessment

Catch sampling (1987)

Length frequency information was available from the Canadian and USA fisheries in 1987. The level of sampling from the Canadian fishery remains high for this stock, as shown in Table 4, which indicates how the catch at age from this fishery was calculated. The standard weight-length relationship which has been used in recent assessments was used to convert the average lengths at age to average weights at age (Table 5).

Catch numbers and average weights at age

Following the recommendation of STACFIS in 1987, available sampling for the substantial portion of non-Canadian catch was incorporated into the catch at age calculations for 1985-1987. Previous assessments used only Canadian sampling data to estimate numbers and average weights in the catch. Length frequency data was available for USA 1986 and 1987, and Spain 1985 and 1986. Because of the incidence of fish in these data which were smaller than those found in the Canadian commercial age-length keys, otoliths from the Canadian spring surveys in 1985-87, Div. 3N were used to determine numbers at age from the length frequencies. All data except the Spanish length frequencies from 1985 was available in a sexed format, as is the norm for this species. However, the presence of unsexed data is not considered a major problem for yellowtail, unlike some other species of flatfish.

Sampling levels were generally acceptable, as indicated in the following table:

Year	Country	# Len. Frequencies	# months sampled	Total measurements	Catch (t)
1985	Spain	8	7	21,463	2425
1986	Spain	2	2	1,042	366
1986	USA	11	6	1,232	2563
1987	USA	17	9	2,003	1532

The American data was separated by size category; however, landings were available by month in these categories. Virtually all data was from Div. 3N, corresponding to the catches.

To determine the total numbers at age for 1985-87, the following procedures were used:

1) The Canadian catch at age was determined for each year as the fraction of the "old" catch at age represented by Canadian catch/Total catch used to calculate numbers at age. These values were 13,440/27,140 and 14,155/29,366 for 1985 and 1986 respectively.

2) For 1985, the Spanish catch at age was adjusted to the total non-Canadian catch of 15,334 t. For 1987, the USA catch at age was adjusted to the same category, which totaled 2313 t. For 1986, the catch at age for Spain and USA was added and then adjusted to the total non-Canadian catch of 16,326 t.

3) The results of 1) and 2) were added together.

A comparison of the re-analysis with the 'old' analysis is shown in Table 6.

Average weights at age were determined by weighting the average weights from each country by the adjusted catch numbers in each year. At this stage, the weights from these years (1985-87) as well as those from 1982-84 were corrected for an error used in their calculation. The error was caused by using lengths 0.5 cm too high in calculating the average length at age. Table 7 shows that the difference in the two sets of values is not substantial.

Tables 8(a),(b) show the revised catch at age and Table 8(c) contains the revised average weights at age, both for the period 1968-87. Table 8(d) shows the multiplication of the previous tables, and it can be seen that the sum of products agrees well with the nominal catch in most years, particularly the more recent ones when a generally higher level of sampling was available.

Commercial CPUE data

Table 9 contains a summary of catch and effort data from Canadian trawlers (mostly TC 4 and 5) in the main species yellowtail fishery in Div. 3LNO. The series is not standardized with respect to season, area, or country-gear-tonnage class, although a correction factor has been applied to equate side trawler effort with stern trawler effort. Such an analysis is planned for the 1989 assessment. In any case, an analysis conducted in 1987 for the Grand

Bank A. plaice catch rates for the same fleet showed the standardized series to be very similar to the values calculated with the method used here for yellowtail. Figure 4 shows the trends in CPUE from 1968 to 1987. After a decline from around 0.6 t/hr in the early 1970s to 0.33 t/hr in 1976, CPUE increased steadily to 0.64 t/hr in 1980, then remained at a level between .52 and .62 t/hr from 1981 to 1985. The values for 1986 and 1987 are 0.46 t/hr, down about 17% from the catch rate in 1983-85.

Research vessel survey results

A) Spring biomass surveys

Stratified-random trawl surveys have been carried out by Canadian research vessels on the Grand Bank each year from 1971 to 1982 and 1984 to 1988. Figure 3 shows the stratification scheme used in these surveys. Tables 10-12 show the mean weight per tow on a stratified basis, along with the total estimated biomass for Div. 3L, 3N, and 3Ø respectively, and as can be seen here, most of the biomass of this stock is found in Div. 3N. In this division the biomass has declined from about 60,000 t in 1985-86 to about 35,000 t in 1988. Overall, the stock biomass has decreased from about 94,000 t in 1985-86 to 82,000 t in 1987, and 53,000 t in 1988. A comparison of recent biomass estimates is shown in Table 13. In strata 360 and 376, which encompass virtually all the yellowtail habitat in the NAFO Regulatory Area, the biomass has declined steadily from almost 32,000 t in 1984 to 1,000 t in 1988, a drop of 97% (Fig. 5). For the remaining strata in Div. 3N, the biomass declined from 73,000 t in 1984 to 33,000 t in 1988, a decrease of 54%. However, in these strata, the 1988 value is only 22% lower than the average from 1985 to 1988, compared to a value of 93% for strata 360 and 376 over the same period. As a fraction of the total biomass in Div. 3N, strata 360 and 376 comprised about one-third in 1984-85, about one-fifth in 1986-87 and less than one-thirtieth in 1988. This decline in the estimated biomass in the regulatory area is consistent with the surveillance reports that many vessels ceased fishing for yellowtail in this area in 1987 because of very low catch rates.

Because of the incomplete survey coverage in many years for this stock, a series of strata common to most surveys was chosen previously from which abundance at age could be calculated. These results are shown in Table 14. However, concern had been expressed in previous assessments that these strata may not be representative of total stock abundance. Therefore, it was recommended by STACFIS in 1987 that other approaches be taken. To calculate total abundance, allowing for missing strata, a multiplicative model was used. The input to the model consisted simply of mean catch number per stratum, on a yearly basis, from 1971 to 1988. As can be seen from Tables 10-12, very few yellowtail have been taken in the surveys in strata deeper than 50 fath (91 m) (Fig. 3). Therefore, this analysis was limited to the average catches from strata less than 91 m. The average catches from 1971 to 1982 were multiplied by 1.4 to standardize them to the catches from 1984 to 1988, which were taken by a different vessel-gear combination (this approach has been used in the past several assessments of this stock). As well, average catches were increased by 0.5 to allow logarithms of catch to be used in the model. The regression of the multiplicative model was carried out using stratum areas as a weighting factor.

As can be seen in Table 15, the regression of the multiplicative model was highly significant and explained 78% of the variation, using year and stratum effects. The regression coefficients for stratum and year are also shown in this table and are relative to the standard values of 0.0. The standard chosen for stratum was 362 and for year was 1987, these being categories with no missing observations. The residual plots are shown in Fig. 6. Table 16 shows the abundance estimates obtained from the model for the missing strata, as well as total estimated abundance for each year, weighted by stratum area. It should be noted that these estimates have not been corrected for the transformation of the input data by +0.5. To correct the total abundance estimates, 1339 should be subtracted from the yearly totals. The correct values are plotted in Fig. 7 and have been used in the age by age estimates in Table 17. To arrive at these values, the age compositions from the selected strata analysis (Table 14) were used to adjust the total abundance in Table 16. A comparison of the percent at age from the selected strata with the percent at age from an analysis using all strata revealed very little difference, so the use of the selected strata results for this purpose was thought to be acceptable. As can be seen in Table 17, the abundance has decreased in recent years and the 1985-88 values are the lowest in the series. The 1988 value is 41% lower than the 1987 estimate and is less than half of the lowest estimate from 1971 to 1985. The relatively strong 1978 and 1979 year-classes have now passed through the fishery and the subsequent year-classes appear to be relatively weak. The 1981-83 year-classes, which should contribute significantly to the fishery in 1988-90, are among the worst in the time series, based on the 1987 and 1988 surveys, and to a lesser extent on the 1986 survey (Table 17). In 1987 and 1988, age 8 was the predominant age in the survey catches, compared to age 6 or 7 in all preceding years except 1981.
Analyses conducted by Walsh (1987) indicated that the catches of yellowtail in some surveys were significantly higher during darkness than those during daylight. Using the

set by set observations from the strata <50 fath surveyed from 1971 to 1987, the Mann-Whitney U test in Table 18 supports this finding. To attempt to account for the diurnal variability a multiplicative model was employed, using the same data base on which the Mann-Whitney test was run with the exception that the catch numbers from 1971 to 1982 were multiplied by 1.4. Sets were assigned to day or night, based on mean values for sunrise and sunset during the yearly surveys. The unweighted regression in the model was significant, although explained only 46% of the variation. A significant diurnal effect (night>day) was estimated. However, examination of residual plots revealed some trends and further analysis will be required before those results can be accepted. For comparison only, plots of the yearly estimates from this analysis and the estimates from the analysis described previously are shown in Fig. 8.

B) Juvenile yellowtail surveys

During November of 1987 a stratified-random survey was conducted aboard the WILFRED TEMPLEMAN. Because of bad weather and time restrictions the survey concentrated in the southern Grand Bank region of Div. 3NØ (Fig. 3). The survey is year 3 in a time series to develop indices of year-class strength of juvenile yellowtail, ages 1-4 years, as a predictive tool for incoming year-classes to the fisheries.

These surveys used a No. 41 Yankee (80/104) shrimp trawl with a mesh size of 38 mm throughout and a 12 mm stretched mesh codend liner. The towing speed was 2.5 knots and fishing hauls were of 30 minute duration covering a distance of 1.25 miles. Because of a limited distribution of juvenile yellowtail on the Grand Bank, selected strata used in these surveys are concentrated in the southern area (strata 352, 360, 361, 375, and 376) (Walsh 1987). The survey is designed so that fishing hauls are randomly assigned as day or night prior to the start of the survey.

Table 19 shows the average numbers and weights, along with biomass and abundance estimates from the juvenile surveys in 1985, 1986, and 1987. A decline is evident from 1986 to 1987 in biomass estimates in Div. 3NO as reported in the spring time regular groundfish surveys in the 1987 assessment (Brodie and Walsh, 1987). Table 20 shows the results of independent day and night biomass estimates compared to the combined surveys for 1985, 1986, and 1987. In 1987 abundance estimates for night fishing hauls were nine times higher than day catches, with biomass estimates being four times higher. In 1985 and 1986 abundance estimates at night were twice that of day estimates while biomass estimates were 1.91 (1985) and 1.68 (1986) higher at night than during the day. This strong diel variability has been statistically verified and was presented at last year's assessment (Walsh 1987). Tables 21 and 22 contain information on the age composition of the 1985, 1986, and 1987 juvenile surveys from selected strata. Mean catch per tow and abundance estimates for juveniles ages 1-4 years were higher in 1987 than in the other 2 years (Fig. 9) (1985 survey was incomplete). Estimates of commercial size yellowtail (age 4+) dropped from 1986 to 1987. The 1979 and 1980 year-classes make up the bulk of the commercial size samples in 1987. The 1981 and 1982 year-classes appear low but the 1983-86 year-classes are very high in the catches in the 1987 survey (Fig. 9). A comparison of average-per-tow catch of age 1-4 year olds in selected strata (352, 360, 361, 375, and 376) for the years 1986 and 1987 are given in Table 23. The 1985 survey had sparse coverage in the tail of the bank area and was considered not representative of the distribution of juveniles in the area. Stratum 352 was not sampled in 1987. Largest catches of 1 year old yellowtail were found in the Southeast Shoal Area (stratum 376) and just south and west of the shoal in the shallow waters (stratum 360) of the tail of the bank outside the Canadian 200 mile limit (Fig. 10 and 11). Similar distribution is seen for the ages 2-, 3-, and 4-year-old yellowtail in both years. This limited distribution of young yellowtail, which overlaps a large section of the southern Grand Bank juvenile plaice nursery, was documented at last year's assessment (Walsh 1987). Average catch rates of 1 year olds decreased from 1986 to 1987 in stratum 360, while they remained the same for stratum 361 but increased considerably in strata 375 and 376 in 1987. These fluctuations, also seen in ages 2-4 year olds, may reflect the patchy distribution of juveniles or fishing mortality on the older juveniles. It is also very common that large catches of 1 year olds usually contain large samples of 2, 3, and 4 year olds. Further surveys will concentrate in delineating the boundaries of distribution of 1 year old yellowtail.

Sequential population analysis (SPA)

Despite the fact that SPA has not been used in recent assessments as the basis for catch projections, the technique has been used and results presented for illustrative purposes. Table 24 contains the results of an SPA, calculated with the catch and weight matrices in Tables 8(a) and 8(c) respectively, an average partial recruitment vector from 1985-87, and terminal F in 1987 of 1.0.

Figure 12 shows the results of the regression of age 5+ population biomass from Table 24 on CPUE (Table 9). Figure 13 contains the results of the regression of population numbers (age 5-8) from Table 24 on population numbers (age 5-8) from R.V. surveys (Table 17). Figure 14 shows a similar regression, using only the age 6 population numbers from Tables 17 and 24.

References

Brodie, W. B., and S. J. Walsh. 1987. An assessment of yellowtail flounder stock in Div. 3LNO. NAFO SCR Doc. 87/44: 24 p.

Walsh, S. J. 1987. Diel variability in catches of yellowtail flounder on the Grand Bank Divisions 3LNO. NAFO SCR Doc. 87/48, Ser. No. N1335. 18 p.

Table 1(a). Nominal catches by country and TACs (tons) of yellowtail in NAFO Divisions 3LNO.

Year	Canada	France	USSR	South Korea[a]	Other	Total	TAC
1963	138	-	380	-	-	518	
1964	126	-	21	-	-	147	
1965	3,075	-	55	-	-	3,130	
1966	4,185	-	2,834	-	7	7,026	
1967	2,122	-	6,736	-	20	8,878	
1968	4,180	14	9,146	-	-	13,340	
1969	10,494	1	5,207	-	6	15,708	
1970	22,814	17	3,426	-	169	26,426	
1971	24,206	49	13,087	-	-	37,342	
1972	26,939	358	11,929	-	33	39,259	
1973	28,492	368	3,545	-	410	32,815	50,000
1974	17,053	60	6,952	-	248	24,313	40,000
1975	18,458	15	4,076	-	345	22,894	35,000
1976	7,910	31	57	-	59	8,057	9,000
1977	11,295	245	97	-	1	11,638	12,000
1978	15,091	375	-	-	-	15,466	15,000
1979	18,116	202	-	-	33	18,351	18,000
1980	12,011	366	-	-	-	12,377	18,000
1981	14,122	558	-	-	-	14,680	21,000
1982	11,479	110	-	1,073	657	13,319	23,000
1983	9,085	165	-	1,223	-	10,473	19,000
1984[b]	12,437	89	-	2,373	1,811	16,710	17,000
1985[b]	13,440	-	-	4,278	11,056	28,774	15,000
1986[b,c]	14,155	-	-	2,620	13,706	30,481	15,000
1987[b,c]	13,414	-	-	250	2,063	15,727	15,000
1988							15,000

[a]See text for explanation of South Korean catches.

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

[c]Provisional.

Table 1(b). Breakdown of provisional catches from Table 1(a) listed as "other" in 1984-87.

Year	Spain	Portugal	Panama[a]	U.S.A.	Cayman Islands[a]	Other	Total
1984	25	-	1,775	-	-	11	1,811
1985	2,425	-	4,067	3,797	755	12	11,056
1986	366	5,521	3,785	2,307	1,725	2	13,706
1987	-	-	-	1,534	-	529[b]	2,063

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

[b]EEC, country unknown.

Table 2. Breakdown of nominal catches (tons) of yellowtail by NAFO Div. 3L, 3N, and 30.

Year	3L	3N	30	UNK	Total
1965	117	2,958	55	-	3,130
1966	62	6,442	522	-	7,026
1967	453	6,117	2,308	-	8,878
1968	2,815	8,459	2,066	-	13,340
1969	5,287	7,215	3,206	-	15,708
1970	7,419	18,668	339	-	26,426
1971	6,632	25,174	5,536	-	37,342
1972	9,292	25,788	4,179	-	39,259
1973	4,856	23,693	4,266	-	32,815
1974	1,544	19,329	3,440	-	24,313
1975	2,638	16,156	4,100	-	22,894
1976	516	5,023	2,518	-	8,057
1977	2,651	7,381	1,606	-	11,638
1978	2,547	11,079	1,840	-	15,466
1979	2,595	14,556	1,200	-	18,351
1980	1,898	9,805	674	-	12,377
1981	2,345	11,733	602	-	14,680
1982[a]	2,305	9,327	1,687	-	13,319
1983[a]	2,552	6,966	925	-	10,473
1984[a,b]	5,264	10,777	669	-	16,710
1985[a,b]	3,478	23,742	1,554	-	28,774
1986[a,b,c]	3,049	25,571	1,861	-	30,481
1987[a,b,c]	1,599	12,015	1,584	-	15,727

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

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

[c]Provisional.

Table 3. Breakdown of yellowtail nominal catches (t) by Division and month, for the years 1977-87.

Month	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	-	1	-	-	1	-	-	5	-	3	-
Feb	21	2	-	-	-	-	2	-	-	3	-
Mar	13	-	165	-	2	-	-	13	382	7	-
Apr	9	5	195	-	101	3	31	367	434	134	32
May	113	184	621	715	1,024	24	100	2,163	484	674	191
June	668	1,230	778	864	309	918	568	1,155	591	584	193
July	731	473	452	233	503	711	533	1,211	595	531	571
Aug	790	423	256	65	153	154	611	289	484	426	213
Sept	127	175	79	11	134	96	253	21	209	567	211
Oct	163	50	43	9	65	255	227	6	81	99	70
Nov	15	-	3	-	9	51	165	26	191	13	106
Dec	-	4	3	1	44	93	62	8	27	8	12
Total	2,651	2,547	2,595	1,898	2,345	2,305	2,552	5,264	3,478	3,049	1,599
						3N					
Jan	-	219	11	-	66	70	364	366	-	295	48
Feb	14	55	27	-	16	400	349	120	1,285	216	60
Mar	66	106	109	180	30	144	4	316	878	206	114
Apr	52	519	1,007	17	189	16	423	2,507	1,441	446	666
May	876	384	1,044	431	614	371	556	1,897	1,440	2,283	937
June	853	788	1,557	896	765	402	369	709	1,568	1,430	1,194
July	1,270	750	917	594	2,351	1,202	584	680	1,186	2,518	2,136
Aug	1,099	1,047	1,229	325	3,582	1,965	1,074	183	1,921	2,536	2,064
Sept	520	1,265	2,203	374	1,765	1,346	718	16	1,961	3,381	2,250
Oct	320	3,136	4,417	2,675	1,972	1,464	521	18	1,975	1,547	1,552
Nov	1,730	2,259	1,828	3,389	372	739	447	54	2,486	1,967	708
Dec	581	551	207	924	11	180	486	76	780	1,428	62
Unknown	-	-	-	-	-	1,073	1,101	3,835	6,821	7,318	225
Total	7,381	11,079	14,556	9,805	11,733	9,327	6,996	10,777	23,742	25,571	12,015
						3O					
Jan	-	6	2	-	-	-	24	10	33	17	2
Feb	13	7	-	-	-	-	13	25	25	-	2
Mar	4	23	-	-	7	-	6	46	19	23	25
Apr	45	157	97	-	-	1	37	7	92	49	310
May	309	922	233	165	38	768	264	56	316	99	216
Jun	416	123	229	226	158	662	80	44	253	462	466
July	331	108	54	36	206	31	27	63	79	214	406
Aug	228	91	58	2	30	1	31	5	71	55	47
Sept	97	49	70	14	34	40	54	1	43	60	25
Oct	34	105	253	93	39	23	59	30	55	31	44
Nov	107	160	120	104	23	96	191	38	73	29	15
Dec	22	89	84	34	67	20	17	31	9	10	1
Unknown	-	-	-	-	-	45	122	313	486	812	25
Total	1,606	1,840	1,200	674	602	1,687	925	669	1,554	1,861	1,584

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

[b]Includes estimates of non-reported catch outside Canadian 200 mile limit. These catches are attributed 90%: 10% to Div. 3N:3O.

[c]Provisional.

Table 4. Commercial samples and catch used to calculate catch at age and average weights at age for yellowtail, Division 3LNO, 1987. Numbers in parentheses are the number of observations.

Age-Length Key	Length frequency	# Samples	Catch(t)	Description
ALKS03CN3L (75)	(LFOTAUGCN3L (387)	1	1199	Canada, 3L, all gears, Jan-Aug
+	(OCT (379)	1	281	" " " " Sep-Oct
ALKS04CN3L (142)	(NOV (490)	1	118	" " " " Nov-Dec
ALKS01CN3N (83)	(LFOTMARCN3N (401)	1	130	Canada, 3N, all gears, Jan-Mar
+	(APR (918)	2	541	" " " " Apr
ALKS02CN3N (406)	(MAY (1278)	3	885	" " " " May
	(JUN (1274)	3	1116	" " " " Jun
	(LFOTJULCN3N (2945)	7	1987	" " " " July
ALKS03CN3N (535)	(AUG (465)	1	1844	" " " " Aug
	(SEP (4371)	10	1952	" " " " Sept
ALKS04CN3N (483)	LFOTOCTCN3N (4073)	10	1802	" " " " Oct-Dec
	(LFOTAPRCN30 (393)	1	339	Canada, 30, all gears, Jan-Apr
ALKS02CN30 (99)	(MAY (355)	1	1220	" " " " May-Dec

Table 5. Catch at age and average weights at age for yellowtail in the Canadian fishery in 1987.

AGE	AVERAGE WEIGHT	AVERAGE LENGTH	CATCH MEAN	CATCH STD. ERR.	CATCH C.V.
* 4	0.150	26.993	3	1.87	0.62
* 5	0.217	30.120	471	44.69	0.09
* 6	0.326	33.859	5055	272.58	0.05
7	0.450	37.165	10935	381.54	0.03
* 8	0.605	40.522	8437	322.82	0.04
* 9	0.835	44.485	1609	113.00	0.07
*10	1.211	49.602	107	13.85	0.13
*11	1.668	54.500	1	0.01	0.01

TABLE 6. Comparison of old and new catch at age ('000s) for 1985 and 1986.

AGE	OLD CATCH 1985	NEW CATCH 1985
3	0	20
4	1	108
5	2113	2128
6	16810	15558
7	25497	26544
8	8653	11133
9	1305	1538
10	59	193

AGE	FOREIGN CATCH 1986	CANADIAN CATCH 1986	NEW TOTAL 1986	OLD TOTAL 1986
3	12	1	13	0
4	605	4	609	9
5	5552	813	6365	1686
6	9467	4210	13677	8734
7	14426	13007	27433	26984
8	5851	8088	13940	16780
9	1338	1650	2988	3423
10	86	186	272	386

TABLE 7, COMPARISON OF OLD AND NEW AVG WTS AT AGE FOR 1982-87.

OLD WEIGHTS AT AGE, 1982-87

AGE	1982	1983	1984	1985	1986	1987
4	0.238	0.210	0.206	0.127	0.099	0.144
5	0.292	0.338	0.303	0.261	0.199	0.206
6	0.346	0.420	0.386	0.374	0.317	0.323
7	0.486	0.530	0.511	0.515	0.477	0.465
8	0.675	0.680	0.702	0.728	0.643	0.633
9	0.933	0.944	1.040	1.041	0.896	0.877
10	1.304	1.303	1.207	1.353	1.106	1.253

NEW WEIGHTS AT AGE, 1982-87

AGE	1982	1983	1984	1985	1986	1987
4	0.225	0.198	0.194	0.118	0.092	0.135
5	0.277	0.321	0.288	0.247	0.188	0.194
6	0.329	0.401	0.368	0.356	0.301	0.307
7	0.464	0.507	0.489	0.493	0.456	0.444
8	0.648	0.652	0.674	0.699	0.616	0.607
9	0.899	0.909	1.003	1.004	0.863	0.844
10	1.260	1.259	1.166	1.308	1.067	1.210

Table 8(a), YELLOWTAIL, DIV 3LNO CATCH NUMBERS AT AGE (THOUSANDS),

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
4	573	80	141	169	1943	3734	1375	955	409	1391
5	6202	2993	2776	7534	10128	21280	19800	11240	2529	3211
6	12483	15035	19839	30365	22502	23709	18100	20931	7650	6851
7	9154	12076	20615	22117	19416	17053	11200	12737	5361	7331
8	1421	3150	4557	5869	10553	4713	2400	2536	953	4078
9	47	326	610	2152	4206	862	850	372	74	1433
10	1	40	68	245	1110	300	130	23	15	289

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
4	691	1061	1142	3245	111	25	116	108	609	5
5	3654	4783	5130	5077	1501	2081	1440	2127	6365	912
6	10979	13067	8383	8191	5244	6792	13160	15558	13677	6838
7	11028	14284	7199	9991	8901	7862	14341	26544	27433	12741
8	3870	4940	1519	4361	7591	3932	3932	11133	13940	9213
9	310	773	224	356	2184	546	281	1538	2988	1791
10	34	109	28	29	307	25	11	193	272	135

Table 8(b), CATCH AT AGE AS PERCENTAGES OF TOTAL,

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
4	1.9	0.2	0.3	0.2	2.8	5.2	2.6	2.0	2.4	5.7	2.3	2.7
5	20.8	8.9	5.7	11.0	14.5	29.7	36.8	23.0	14.9	13.1	12.0	12.3
6	41.8	44.6	40.8	44.4	32.2	33.1	33.6	42.9	45.0	27.9	35.9	33.5
7	30.6	35.8	42.4	32.3	27.8	23.8	20.8	26.1	31.6	29.8	36.1	36.6
8	4.8	9.3	9.4	8.6	15.1	6.6	4.5	5.2	5.6	16.6	12.7	12.7
9	0.2	1.0	1.3	3.1	6.0	1.2	1.6	0.8	0.4	5.8	1.0	2.0
10	0.0	0.1	0.1	0.4	1.6	0.4	0.2	0.0	0.1	1.2	0.1	0.3

AGE	1980	1981	1982	1983	1984	1985	1986	1987
4	4.8	10.4	0.4	0.1	0.3	0.2	0.9	0.0
5	21.7	16.2	5.8	9.8	4.3	3.7	9.7	2.9
6	35.5	26.2	20.3	31.9	39.5	27.2	21.0	21.6
7	30.5	32.0	34.4	37.0	43.1	46.4	42.0	40.3
8	6.4	14.0	29.4	18.5	11.8	19.5	21.4	29.1
9	0.9	1.1	8.5	2.6	0.8	2.7	4.6	5.7
10	0.1	0.1	1.2	0.1	0.0	0.3	0.4	0.4

Table 8(c). YELLOWTAIL DIV 3LNO AVG WTS AT AGE (KG).

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
4	0.247	0.247	0.247	0.247	0.247	0.247	0.200	0.184	0.200	0.214
5	0.305	0.305	0.305	0.305	0.305	0.305	0.300	0.298	0.322	0.324
6	0.456	0.456	0.456	0.456	0.456	0.456	0.452	0.450	0.486	0.409
7	0.610	0.610	0.610	0.610	0.610	0.610	0.600	0.569	0.615	0.532
8	0.725	0.725	0.725	0.725	0.725	0.725	0.725	0.743	0.814	0.648
9	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.953	1.029	0.809
10	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.111	1.201	0.905

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
4	0.249	0.178	0.271	0.228	0.225	0.198	0.194	0.118	0.092	0.135
5	0.315	0.278	0.274	0.308	0.277	0.321	0.288	0.247	0.188	0.194
6	0.430	0.378	0.493	0.349	0.329	0.401	0.368	0.356	0.301	0.307
7	0.557	0.504	0.635	0.496	0.464	0.507	0.489	0.493	0.456	0.444
8	0.740	0.668	0.750	0.661	0.648	0.652	0.674	0.699	0.616	0.607
9	0.981	0.787	0.927	0.909	0.899	0.909	1.003	1.004	0.863	0.844
10	1.235	0.756	1.221	1.186	1.260	1.259	1.166	1.308	1.067	1.210

Table 8(d). YELLOWTAIL DIV 3LNO CATCH BIOMASS (T).

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
4	142	20	35	42	480	922	275	176	82	298
5	1892	913	847	2298	3089	6490	5940	3350	814	1040
6	5692	6856	9047	13846	10261	10811	8181	9419	3718	2802
7	5584	7366	12575	13491	11844	10402	6720	7247	3297	3900
8	1030	2284	3304	4255	7651	3417	1740	1884	776	2643
9	40	274	514	1812	3541	726	716	355	76	1159
10	1	41	70	252	1143	309	134	26	18	262
4+	14380	17754	26391	35997	38009	33078	23706	22456	8781	12104

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
4	172	189	309	740	25	5	23	13	56	1
5	1151	1330	1406	1564	416	669	414	526	1194	177
6	4721	4939	4133	2859	1725	2720	4838	5534	4121	2097
7	6143	7199	4571	4956	4133	3986	7007	13074	12510	5658
8	2864	3300	1139	2883	4916	2566	2649	7785	8590	5591
9	304	608	208	324	1962	497	281	1544	2578	1512
10	42	82	34	34	387	31	13	252	290	164
4+	15397	17648	11800	13358	13565	10474	15225	28727	29338	15200

Table 9. Nominal catch and effort data for yellowtail in NAFO Division 3LNO. Column 2 refers to reported "directed" catch by Canada (N) otter trawlers, mostly TC 4 and 5.

Year	Directed catch (tons)	CPUE (tons/hr)	Total catch (tons)	Total calculated effort (hours)
1968	2,216	0.705	13,340	18,922
1969	3,165	0.610	15,708	25,751
1970	12,444	0.598	26,426	44,191
1971	14,094	0.600	37,342	62,237
1972	14,544	0.607	39,259	64,677
1973	21,225	0.645	32,815	50,876
1974	14,025	0.421	24,313	57,751
1975	13,345	0.402	22,894	56,950
1976	4,889	0.332	8,057	24,268
1977	5,029	0.423	11,638	27,513
1978	9,289	0.496	15,466	31,181
1979	13,273	0.517	18,351	35,495
1980	7,855	0.640	12,377	19,339
1981	10,400	0.614	14,680	23,909
1982	5,530	0.525	13,319	25,370
1983	4,605	0.556	10,473	18,836
1984	6,813	0.551	16,710	30,327
1985	6,841	0.566	28,774	50,837
1986[a]	8,894	0.461	30,481	66,119
1987[a]	8,968	0.457	15,727	34,414

[a]Provisional.

Table 10. Mean weight of yellowtail per 30 minute tow, by stratum, from research vessel surveys in Division 3L. Numbers in parentheses are the number of successful tows in each stratum.

		Year - Trip								
Depth (fm)	Stratum	1971 ATC 187	1972 ATC 199	1973 ATC 207-9	1974 ATC 222	1975 ATC 233	1976 ATC 245-6	1977 ATC 262-3	1978 ATC 276-7	1979 ATC 289-91
51-100	328	-	-	-	-	-	-	0.0(3)	-	0.0(5)
51-100	341	-	-	0.0(3)	-	-	-	0.1(4)	0.1(4)	0.0(6)
51-100	342	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(4)
51-100	343	-	-	-	-	-	-	0.0(2)	0.0(3)	0.0(4)
101-150	344	-	-	-	-	-	0.0(4)	0.0(4)	0.0(4)	0.0(2)
151-200	345	-	-	-	-	-	0.0(4)	0.0(4)	0.0(2)	0.0(4)
151-200	346	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(4)
101-150	347	0.0(2)	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(4)	0.0(4)
51-100	348	0.0(3)	0.0(3)	-	0.0(6)	0.0(4)	0.0(6)	0.0(6)	0.0(6)	0.0(6)
51-100	349	4.8(3)	0.0(4)	-	0.0(4)	0.0(2)	0.2(3)	0.0(6)	0.0(6)	0.0(7)
31-50	350	32.2(3)	2.3(2)	0.0(4)	0.2(3)	0.0(3)	0.2(4)	3.8(4)	1.5(6)	1.1(9)
31-50	363	119.8(3)	21.3(3)	12.5(4)	0.5(4)	1.0(3)	2.5(4)	27.4(5)	6.3(5)	22.3(8)
51-100	364	13.7(4)	0.0(3)	-	0.0(4)	0.0(2)	0.0(3)	0.2(7)	0.1(6)	0.1(8)
51-100	365	0.0(3)	0.0(2)	-	0.0(3)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	0.0(4)
101-150	366	0.0(3)	-	-	0.0(3)	0.0(4)	0.0(4)	0.0(4)	-	0.0(4)
151-200	368	0.0(2)	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	-	0.0(4)
101-150	369	0.0(3)	-	-	0.0(3)	0.0(3)	0.0(4)	0.0(3)	0.0(2)	0.0(4)
51-100	370	1.4(2)	0.3(3)	-	0.0(3)	0.0(3)	0.0(3)	0.5(3)	0.2(3)	0.0(4)
31-50	371	88.5(3)	6.4(2)	-	0.0(3)	-	-	1.4(3)	0.3(3)	0.5(3)
31-50	372	135.3(4)	28.1(3)	39.6(3)	7.1(3)	7.6(3)	44.2(3)	32.1(6)	20.5(7)	24.3(9)
31-50	384	86.0(3)	3.0(2)	2.3(3)	0.6(3)	-	-	7.0(2)	0.0(3)	1.5(4)
51-100	385	0.0(4)	0.0(4)	0.2(3)	0.0(2)	0.0(4)	0.0(2)	0.0(6)	0.0(6)	0.0(7)
101-150	386	0.0(2)	-	-	0.0(3)	0.0(3)	0.0(2)	0.0(3)	0.0(3)	0.0(4)
151-200	387	0.0(3)	-	-	0.0(3)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(4)
151-200	388	0.0(2)	-	0.0(2)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)
101-150	389	0.0(3)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(4)
51-100	390	0.3(3)	0.0(3)	0.0(3)	0.0(3)	0.0(3)	-	0.0(2)	0.0(4)	0.0(5)
101-150	391	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(4)
151-200	392	-	-	0.0(3)	0.0(4)	0.0(2)	-	0.0(2)	0.0(3)	0.0(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	-	-	-	-	-	-	-	-	-
Biomass ('000 t)		64.5	9.2	9.2	1.4	1.5	8.5	11.0	4.9	7.8

Table 10. (Cont'd.)

Depth (fm)	Stratum	Year- Trip 1980 ATC 303-5	1981 ATC 317-9	1982 ATC 327-9	1984 ATC 27-28	1985 AN 28-30	1986 WT 48	1987 WT 59,60	1988[a] WT 70,71
51-100	328	-	0.0(2)	0.0(3)	0.0(2)	0.0(4)	0.0(9)	0.0(7)	0.0(3)
51-100	341	0.0(6)	0.0(2)	0.0(5)	0.0(4)	0.01(9)	0.0(9)	0.1(6)	0.0(6)
51-100	342	0.0(4)	-	0.0(3)	0.0(4)	0.0(3)	0.0(3)	0.2(2)	0.0(2)
51-100	343	0.0(4)	0.0(2)	0.0(4)	-	0.0(3)	0.0(4)	0.0(3)	0.0(3)
101-150	344	0.0(3)	0.0(5)	0.0(4)	-	0.0(5)	0.0(8)	0.0(4)	0.0(7)
151-200	345	0.0(5)	0.0(4)	0.0(4)	-	0.0(5)	0.0(7)	0.0(4)	0.0(7)
151-200	346	0.0(3)	0.0(3)	0.0(3)	-	0.0(2)	0.0(5)	0.0(5)	0.0(4)
101-150	347	0.0(5)	0.0(4)	0.0(2)	-	0.0(5)	0.0(5)	0.0(3)	0.0(5)
51-100	348	0.0(7)	0.0(7)	0.0(4)	-	0.0(18)	0.0(12)	0.1(8)	0.0(11)
51-100	349	0.0(9)	0.0(4)	0.0(6)	0.1(6)	0.1(14)	1.3(14)	0.1(11)	0.1(8)
31-50	350	1.1(10)	0.3(3)	0.6(7)	1.5(6)	3.7(12)	2.3(11)	0.6(11)	1.6(8)
31-50	363	39.3(5)	3.0(3)	30.4(5)	28.2(5)	15.2(8)	8.3(10)	7.6(9)	4.9(7)
51-100	364	0.4(6)	0.0(3)	0.0(6)	0.6(5)	0.0(17)	0.0(17)	0.0(15)	0.0(10)
51-100	365	0.0(4)	0.0(2)	0.0(3)	-	0.0(7)	0.0(5)	0.0(5)	0.0(4)
101-150	366	0.0(4)	0.0(3)	0.0(5)	-	0.0(6)	0.0(8)	0.0(7)	0.0(6)
151-200	368	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)
101-150	369	0.0(3)	0.0(2)	0.0(2)	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)
51-100	370	0.0(3)	0.0(2)	0.0(2)	-	0.0(8)	0.0(8)	0.0(7)	0.0(5)
31-50	371	80.5(3)	0.0(2)	1.1(4)	-	0.4(7)	0.3(6)	0.0(7)	0.1(5)
31-50	372	25.0(6)	13.3(4)	19.8(6)	59.4(5)	56.5(12)	36.3(14)	13.9(13)	7.0(11)
31-50	384	0.0(2)	0.4(2)	10.3(2)	-	4.6(6)	1.6(6)	1.1(7)	0.2(5)
51-100	385	0.0(4)	0.0(3)	0.0(3)	-	0.0(15)	0.0(13)	0.0(11)	0.0(10)
101-150	386	0.0(3)	0.0(2)	0.0(3)	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)
151-200	387	0.0(2)	0.0(2)	0.0(3)	-	0.0(6)	0.0(4)	0.0(4)	0.0(4)
151-200	388	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)
101-150	389	0.0(3)	0.0(2)	0.0(2)	-	0.0(5)	0.0(5)	0.0(6)	0.0(3)
51-100	390	0.3(3)	0.0(2)	0.8(4)	-	0.3(9)	0.0(8)	0.0(7)	0.0(5)
101-150	391	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)
151-200	392	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.2(2)	0.0(2)
201-300	729	-	-	-	-	0.0(2)	-	-	-
301-400	730	-	-	-	-	0.0(2)	-	-	-
201-300	731	-	-	-	-	0.0(2)	-	-	-
301-400	732	-	-	-	-	0.0(2)	-	-	-
201-300	733	-	-	-	-	0.0(3)	-	-	-
301-400	734	-	-	-	-	0.0(2)	-	-	-
201-300	735	-	0.0(2)	-	-	0.0(2)	-	-	-
301-400	736	-	-	-	-	0.0(2)	-		-
Biomass ('000 t)		10.2	2.9	8.8	15.1	13.5	8.5	3.8	2.2

[a]Preliminary analysis.

Table 11. Mean weight of yellowtail per 30 minute tow, by stratum, from research vessel surveys in Division 3N. Numbers in parentheses are the number of successful sets in each stratum. The stratified mean weight per tow and the biomass estimates are given at the bottom of the table.

		Year-Trip								
Depth (fm)	Stratum	1971 ATC 187	1972 ATC 199	1973 ATC 207-9	1974 ATC 222	1975 ATC 233	1976 ATC 245-6	1977 ATC 262-3	1978 ATC 276-7	1979 ATC 289-91
151-200	357	-	-	0.0(2)	-	-	-	0.0(2)	-	0.0(3)
101-150	358	-	0.0(4)	0.0(3)	-	-	-	0.0(2)	-	0.0(2)
51-100	359	-	0.0(3)	0.0(3)	-	-	0.0(3)	0.0(2)	-	0.0(4)
31-50	360	-	58.3(4)	-	-	12.1(4)	128.6(4)	55.9(4)	43.5(4)	27.6(9)
31-50	361	45.8(2)	115.8(3)	93.4(4)	151.5(4)	105.3(4)	113.0(5)	141.5(3)	122.8(4)	92.3(8)
31-50	362	140.2(2)	132.8(4)	22.1(5)	38.9(4)	33.3(3)	44.1(5)	62.4(5)	28.8(4)	40.3(12)
31-50	373	73.6(4)	135.1(4)	26.7(4)	24.2(4)	-	23.3(5)	74.5(4)	50.5(5)	22.1(11)
31-50	374	67.8(2)	42.4(2)	115.4(4)	16.1(2)	62.1(2)	-	22.4(3)	22.0(3)	24.8(4)
30	375	60.0(3)	69.0(3)	121.9(3)	94.5(3)	80.3(3)	-	62.7(4)	30.6(5)	66.1(5)
30	376	-	45.4(2)	10.3(3)	-	82.1(2)	126.4(3)	78.3(3)	4.6(2)	86.4(4)
51-100	377	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(3)
101-150	378	0.0(2)	0.0(2)	0.0(2)	0.2(3)	-	-	0.0(2)	1.4(2)	0.0(3)
151-200	379	-	-	0.0(2)	0.0(3)	-	-	0.0(2)	0.3(2)	0.0(3)
151-200	380	-	0.0(2)	0.0(3)	0.0(2)	-	-	0.0(2)	-	0.0(2)
101-150	381	0.0(4)	0.5(4)	0.0(3)	0.0(4)	0.0(2)	-	0.0(2)	0.0(3)	0.0(3)
51-100	382	0.0(3)	0.0(4)	0.0(3)	0.0(3)	-	0.0(2)	0.0(3)	0.0(3)	0.0(3)
31-50	383	18.6(2)	7.3(2)	0.1(2)	0.0(2)	-	0.0(3)	2.7(3)	0.0(2)	0.0(3)
201-300	723	-	-	-	-	-	-	-	-	-
301-400	724	-	-	-	-	-	-	-	-	-
201-300	725	-	-	-	-	-	-	-	-	-
301-400	726	-	-	-	-	-	-	-	-	-
201-300	727	-	-	-	-	-	-	-	-	-
301-400	728	-	-	-	-	-	-	-	-	-
Mean (no. sets)		71.9(24)	78.4(45)	44.8(48)	53.2(37)	53.5(22)	72.7(30)	60.8(48)	40.2(41)	40.1(82)
Biomass ('000 t)		59.7	96.6	46.0	45.4	46.8	71.6	76.2	47.6	50.2

Table 11. (Cont'd.)

		Year-Trip							
Depth (fm)	Stratum	1980 ATC 303-5	1981 ATC 317-9	1982 ATC 327-9	1984 ATC 27-28	1985 AN 43 WT 29	1986 ATC 245-6	1987 WT 58-60	1988 WT 70
151-200	357	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)
101-150	358	0.0(3)	0.3(3)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
51-100	359	0.0(4)	0.0(3)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
31-50	360	83.8(11)	78.4(6)	36.7(7)	142.1(7)	54.0(16)	14.1(13)	9.2(15)	2.4(12)
31-50	361	128.4(7)	-	118.9(6)	139.9(5)	67.1(7)	44.1(10)	73.8(8)	88.7(7)
31-50	362	53.6(11)	104.2(5)	47.2(8)	95.1(7)	36.6(11)	73.2(14)	47.8(13)	43.8(10)
31-50	373	48.1(8)	58.4(5)	23.7(5)	63.5(7)	32.0(9)	17.9(4)	23.1(13)	23.8(10)
31-50	374	39.0(3)	71.7(3)	19.1(14)	35.5(3)	25.3(4)	11.6(6)	5.7(5)	2.3(5)
30	375	57.8(4)	69.3(4)	61.1(5)	176.1(5)	97.8(8)	231.7(8)	142.8(8)	68.1(6)
30	376	125.3(3)	74.3(4)	63.0(7)	32.5(4)	78.5(7)	88.2(90	59.4(8)	4.3(6)
51-100	377	0.0(4)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.5(2)
101-150	378	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
151-200	379	0.0(3)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)
151-200	380	0.0(3)	0.0(3)	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)
101-150	381	0.5(4)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)
51-100	382	0.0(4)	0.0(2)	0.0(2)	0.0(3)	0.0(4)	0.0(4)	0.0(3)	0.0(2)
31-50	383	0.5(4)	1.3(3)	10.0(2)	1.8(3)	0.0(3)	0.0(4)	0.1(3)	0.0(2)
201-300	723	-	-	-	-	-	-	-	-
301-400	724	-	-	-	-	-	-	-	-
201-300	725	-	-	-	-	-	-	-	-
301-400	726	-	-	-	-	-	-	-	-
201-300	727	-	-	-	-	-	-	-	-
301-400	728	-	-	-	-	-	-	-	-
Mean (no. sets)		63.6(81)	63.0(54)	43.8(60)	83.5(60)	45.3(85)	51.9(101)	40.2(91)	27.5(77)
Biomass ('000 t)		79.7	70.1	54.4	104.6	56.7	65.0	49.9	34.4

Table 12. Mean weight of yellowtail per 30 minute tow, by stratum, from research vessel surveys in Division 3O. Numbers in parentheses are the number of successful tows in each stratum. The stratified mean weight per tow and the biomass estimates are given at the bottom of the table.

		Year- Trip													
Depth (fm)	Stratum	1973 ATC 207, 208,209	1975 ATC 233	1976 ATC 245, 246	1977 ATC 262, 263	1978 ATC 276 277	1979 ATC 289, 290,291	1980 ATC 303, 304,305	1981 ATC 317, 318,319	1982 ATC 327, 328,329	1984 AN 27, 28	1985 AN 43	1986 WT 47	1987 WT 58-60	1988 WT 70
51-100	329	0.0(2)	-	0.0(2)	0.0(3)	0.2(5)	0.0(6)	0.0(2)	0.0(2)	0.0(6)	0.0(5)	0.0(8)	0.0(8)	0.0(9)	0.0(7)
31-50	330	0.1(6)	1.1(3)	0.2(3)	2.0(3)	5.6(6)	10.0(7)	0.0(2)	0.1(4)	1.9(7)	0.5(4)	7.8(10)	3.3(9)	0.7(11)	0.7(9)
31-50	331	33.6(2)	0.4(2)	9.2(2)	-	7.3(2)	6.0(3)	3.5(2)	-	4.0(4)	23.8(3)	36.7(3)	3.6(4)	16.0(2)	6.0(2)
51-100	332	-	3.2(2)	2.0(3)	11.5(3)	2.6(3)	2.0(4)	0.0(2)	-	0.3(4)	0.0(2)	0.3(5)	9.8(6)	5.9(5)	0.1(4)
101-150	333	-	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	-	0.0(4)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)
151-200	334	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	-	0.0(4)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
151-200	335	0.0(2)	-	0.0(3)	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
101-150	336	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(4)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
51-100	337	0.2(3)	1.3(3)	4.5(2)	6.6(2)	0.0(2)	0.6(4)	0.0(3)	-	0.3(3)	0.0(2)	0.0(5)	0.6(5)	0.7(6)	1.3(4)
31-50	338	33.7(5)	7.5(2)	9.1(3)	23.8(4)	2.3(5)	54.1(7)	23.0(5)	-	1.0(5)	15.8(5)	11.1(9)	6.8(9)	2.4(9)	23.0(8)
51-100	339	1.4(2)	0.0(2)	-	-	0.7(2)	0.4(3)	-	0.0(2)	0.1(4)	0.4(2)	0.1(3)	0.1(3)	0.1(3)	0.0(3)
31-50	340	-	0.6(3)	2.4(6)	22.2(3)	10.2(3)	32.8(7)	1.3(2)	15.0(3)	3.9(6)	3.0(4)	7.2(9)	8.3(7)	21.4(9)	5.8(7)
31-50	351	31.2(5)	29.3(4)	15.7(4)	80.6(5)	26.4(6)	78.5(11)	68.2(10)	51.0(4)	34.2(9)	40.5(6)	42.3(9)	39.1(14)	19.3(13)	36.5(10)
31-50	352	47.5(5)	55.5(4)	62.0(4)	76.6(5)	92.2(4)	79.7(12)	67.3(11)	-	40.3(7)	30.5(7)	29.7(11)	34.9(14)	51.4(13)	24.8(11)
31-50	353	0.5(3)	43.9(3)	9.1(2)	41.7(3)	8.5(3)	68.6(5)	0.4(4)	-	4.5(3)	1.0(2)	56.3(6)	21.8(7)	106.3(6)	2.2(5)
51-100	354	0.0(3)	-	4.8(3)	3.6(2)	-	0.0(4)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.5(3)	0.0(3)	0.0(2)	0.0(2)
101-150	355	0.0(2)	0.0(2)	0.0(2)	-	-	0.0(4)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
151-200	356	0.0(2)	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
201-300	717	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301-400	718	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201-300	719	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301-400	720	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201-300	721	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301-400	722	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean (no. sets)		19.0(45)	19.1(34)	14.2(45)	33.8(39)	20.6(51)	37.8(90)	22.7(59)	16.7(21)	11.8(74)	12.8(56)	18.0(93)	14.7(102)	20.9(100)	12.2(84)
Biomass ('000 t)		21.2	22.2	18.4	42.1	26.7	50.8	29.5	11.6	15.8	17.2	24.2	19.7	28.1	16.3

Table 13. Comparison of yellowtail biomass (000 t) from different strata in Division 3N from surveys in 1984-88.

	Stratum		Total	Total all other strata	
	360[a]	376[b]	360 + 376	in Div. 3N	Total 3N
1984	27.9	3.7	31.6	73.0	104.6
1985	12.1	8.8	20.9	35.8	56.7
1986	3.2	9.9	13.1	51.9	65.0
1987	2.1	6.7	8.8	41.1	49.9
1988	0.5	0.5	1.0	33.4	34.4

[a]93% of area outside 200-mile limit

[b]89% of area outside 200-mile limit

Table 14. Abundance (nos. x 10^{-3}) of yellowtail, by age, from Canadian research vessel surveys in Divisions 3LN (selected strata). Estimates from surveys conducted by the R.V. A. T. CAMERON (from 1971–82) have been adjusted upward by a factor of 1.4.

Age (yrs)	Year																	
	1971	1972	1973	1974	1975[a]	1976[a]	1977	1978	1979	1980	1981[a]	1982	1983	1984	1985	1986	1987	1988
1	–	–	–	–	–	–	–	–	–	–	–	16		–	–	–	–	–
2	–	–	–	124	–	–	–	106	34	22	–	752		–	–	–	–	40
3	2,239	5,551	369	1,252	243	1,697	130	1,651	402	2,135	439	2,926		169	355	68	26	53
4	26,316	41,658	5,381	11,153	4,221	7,188	1,936	5,755	2,645	4,697	778	9,962		2,087	1,259	1,137	242	781
5	59,225	82,045	35,573	35,794	21,145	32,089	11,737	22,103	5,540	16,087	3,460	20,460		15,901	6,443	7,512	3204	1057
6	111,386	94,332	45,905	61,410	30,512	43,882	28,595	40,834	22,032	41,536	14,874	29,704		56,668	26,396	19,260	10156	6409
7	100,907	50,878	46,958	30,988	35,261	40,250	76,267	42,361	56,825	59,436	38,033	46,246		79,224	45,470	59,625	28452	21256
8	13,568	16,179	17,925	3,728	8,643	8,154	62,561	22,100	27,068	19,303	40,029	30,028		34,093	21,018	29,019	38453	30698
9	4,326	1,711	6,098	547	963	168	17,411	2,297	3,165	1,330	7,668	7,375		2,647	1,628	4,164	3844	6086
10	58	99	504	–	64	–	2,645	24	377	42	2,072	1,083		32	137	294	307	287
11	–	–	–	–	–	23	200	–	–	–	0	141		–	–	–	–	–
12	–	–	–	–	–	–	30	–	–	–	48	–		–	–	–	–	–
Unknown	–	–	–	–	–	–	–	–	24	56	42	–		–	–	–	–	–
Totals																		
1+	318,025	292,453	158,713	144,996	101,052	133,451	201,512	137,231	118,112	144,644	107,443	148,693		190,821	102,706	121,079	84,687	66,686
4+	315,886	286,902	158,344	143,620	100,809	131,754	201,382	135,474	117,676	142,487	107,004	144,999		190,652	102,351	121,011	84,661	66,593
7+	118,959	68,867	71,485	35,263	44,931	48,595	159,114	66,782	87,459	80,167	87,892	84,873		115,996	68,253	93,102	71,059	58,346

[a]Survey coverage incomplete.

TABLE 15. MODEL USED TO CALCULATE ABUND, FOM SURVEYS IN DIV 3LNO,

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.881
MULTIPLE R SQUARED,.... 0.777

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.231E3	4.231E3	
REGRESSION	35	7.641E2	2.183E1	25.847
TYPE 1	19	6.734E2	3.544E1	41.959
TYPE 2	16	9.019E1	5.637E0	6.674
RESIDUALS	260	2.196E2	8.447E-1	
TOTAL	296	5.215E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	362	INTERCEPT	4.477	0.276	296
2	87				
1	330	1	-3.718	0.297	14
	331	2	-1.994	0.561	12
	338	3	-1.645	0.314	13
	340	4	-2.087	0.324	13
	350	5	-3.944	0.281	17
	351	6	-0.230	0.282	14
	352	7	0.026	0.287	13
	353	8	-1.918	0.358	13
	360	9	-0.487	0.270	14
	361	10	0.571	0.295	16
	363	11	-1.749	0.293	17
	371	12	-4.320	0.375	13
	372	13	-0.820	0.268	17
	373	14	-0.476	0.271	16
	374	15	-0.954	0.371	16
	375	16	0.245	0.309	16
	376	17	0.080	0.322	15
	383	18	-4.455	0.420	16
	384	19	-3.602	0.365	14
2	71	20	2.314	0.357	11
	72	21	1.352	0.332	13
	73	22	0.413	0.307	17
	74	23	-0.121	0.357	11
	75	24	0.131	0.306	16
	76	25	0.553	0.304	16
	77	26	1.260	0.293	19
	78	27	0.467	0.292	20
	79	28	1.005	0.292	20
	80	29	0.599	0.292	20
	81	30	0.526	0.314	15
	82	31	0.672	0.292	20
	84	32	0.595	0.297	18
	85	33	0.653	0.292	20
	86	34	0.237	0.292	20
	88	35	-0.465	0.292	20

TABLE 16. UNCORRECTED ABUNDANCE FROM MODEL USED FOR SURVEYS.

PREDICTED TOTALS FOR MISSING STRATA

YEAR	STRATUM	TOTAL
71	330	4821
71	331	5267
71	338	34652
71	340	20078
71	351	191255
71	352	252701
71	353	17554
71	360	176230
71	376	153152
72	330	1859
72	331	2031
72	338	13364
72	340	7744
72	351	73761
72	352	97459
72	353	6770
73	340	3051
73	360	26778
73	371	210
74	330	423
74	331	462
74	338	3037
74	340	1760
74	351	16765
74	352	22151
74	353	1539
74	360	15448
74	376	13425
75	371	158
75	373	17189
75	383	82
75	384	326
76	371	242
76	374	5818
76	375	33727
76	384	497
77	331	1875
81	331	894
81	338	5884
81	352	42907
81	353	2980
81	361	52999
84	371	252
84	384	519

OVERALL TOTALS

YEAR	WEIGHTED AVERAGE
71	1206081
72	506743
73	302099
74	208415
75	315254
76	324347
77	322807
78	238328
79	270431
80	341690
81	305105
82	282165
84	317884
85	206854
86	191799
87	169505
88	100671

Table 17. Estimates of yellowtail abundance (x 10^{-6}) at age from research vessel surveys in Div. 3LNO. The proportions at age from the selected strata analysis were used to break down the total abundance estimate from the multiplicative model.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	-	-	-	-	-	-	-	-	-	-	-	0.1		-	-	-	-	-
2	-	-	-	0.2	-	-	-	0.2	0.1	0.1	-	1.4		-	-	-	-	0.1
3	8.5	9.6	0.7	1.8	0.8	4.1	0.2	2.9	0.9	5.0	1.2	5.5		0.3	0.7	0.1	0.1	0.1
4	99.7	72.0	10.2	15.9	13.1	17.4	3.1	9.9	6.0	11.1	2.2	18.8		3.5	2.5	1.8	0.5	1.2
5	224.3	141.8	67.4	51.1	65.7	77.7	18.7	38.2	12.6	37.9	9.8	38.6		26.4	12.9	11.8	6.4	1.6
6	422.0	162.9	87.0	87.7	94.8	106.2	45.6	70.4	50.2	97.7	42.1	56.1		94.0	52.8	30.3	20.2	9.5
7	382.2	87.9	88.9	44.3	109.5	97.4	121.7	73.1	129.4	139.9	107.5	87.4		131.3	90.9	93.7	56.5	31.7
8	51.4	28.0	34.0	5.3	26.8	19.7	99.8	38.2	61.7	45.4	113.2	56.7		56.5	42.1	45.7	76.3	45.6
9	16.4	3.0	11.6	0.8	3.0	0.4	27.8	4.0	7.2	3.1	21.7	13.9		4.4	3.3	6.6	7.6	9.1
10	0.2	0.2	1.0	-	0.2	-	4.2	0.1	0.9	0.1	5.9	2.0		0.1	0.3	0.5	0.6	0.4
11	-	-	-	-	-	0.1	0.3	-	-	-	0	0.3		-	-	-	-	-
12	-	-	-	-	-	-	0.1	-	-	-	0.1	-		-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-	0.1	0.1	0.1	-		-	-	-	-	-
Totals																		
1+	1204.7	505.4	300.8	207.1	313.9	323.0	321.5	237.0	269.1	340.4	303.8	280.8		316.5	205.5	190.5	168.2	99.3
4+	1196.2	495.8	300.1	205.1	313.1	318.9	321.3	233.9	268.1	335.3	302.6	273.8		316.2	204.8	190.5	168.1	99.1
7+	450.2	119.1	135.5	50.4	139.5	117.6	253.9	115.4	199.3	188.6	248.5	160.3		192.3	136.6	146.5	141.0	86.8

Table 18. Statistical analysis of day and night catches of yellowtail from surveys during 1971-1987 using a Mann-Whitney U test, NAFO Division 3LNØ. Untransformed data, from strata less than 50 fm in depth.

Category	No. of Sets	Mean Score	z value	p value
Number	Day = 914	679.52	6.9987	.0000
	Night = 566	838.97		
Weight	Day = 914	682.32	6.6764	.0000
	Night = 566	834.44		

Table 19. Average numbers and weight of yellowtail per 30-minute tow for selected juvenile strata in Division 3NO (1985-87). Abundance and biomass are given at the bottom of table.

Stratum		1985[a]	1986	1987
352	No. of Sets	-	13	-
	Av. No./Set	-	210.77	-
	Av. Wt./Set	-	72.68	-
360	No. of Sets	3	14	19
	Av. No./Set	57.67	259.14	199.22
	Av. Wt./Set	26.83	19.96	12.75
361	No. of Sets	6	8	8
	Av. No./Set	99.83	188.50	399.94
	Av. Wt./Set	36.58	61.78	174.37
375	No. of Sets	7	5	7
	Av. No./Set	228.29	236.65	407.26
	Av. Wt./Set	104.14	115.19	43.22
376	No. of Sets	2	4	10
	Av. No./Set	148.50	325.76	1015.22
	Av. Wt./Set	47.75	150.46	58.22
Total	No. of Sets	18	44	44
	Av. No./Set	118.91	240.92	439.31
	Av. Wt./Set	49.04	73.53	65.24
Abundance (million Nos.)		100.3	269.3	370.9
Biomass (1000 t)		41.3	82.2	55.0

[a]Incomplete survey.

Table 20. A comparison of average numbers and weights of yellowtail per 30 minute set for Div. 3LNO from juvenile surveys in 1985, 1986 and 1987. These surveys are divided into independent day, night and combined categories.

			1985			1986			1987		
Div.	Stratum		Day	Night	Combined	Day	Night	Combined	Day	Night	Combined
3O	338	No. of sets	-	-	-	3	-	3			
		Av.No./sets	-	-	-	86.67	-	86.67			
		Av.Wt./set	-	-	-	41.17	-	41.17			
3L	350	No. sets	2	3	5	-	5	6			
		Av.No./set	8.00	93.00	59.00	-	9.40	7.83			
		Av.Wt/set	3.50	40.17	25.50		4.30	3.58			
3O	351	No. sets	2	-	3	5	5	9			
		Av.No./set	108.50	-	166.00	142.00	9.40	175.78			
		Av.Wt/set	44.00	-	63.67	47.70	4.30	66.00			
3O	352	No. sets	-	-	-	7	6	13		1[a]	1[a]
		Av.No./set	-	-	-	78.29	365.33	210.77		134	134
		Av.Wt./set	-	-	-	37.86	115.47	73.68		65.35	65.35
3O	353	No. sets	-	-	-	3	2	5			
		Av.No./set	-	-	-	97.69	148.50	118.00			
		Av.wt./set	-	-	-	60.17	81.63	68.75			
3N	360	No. sets	3	-	3	7	7	14	7	12	19
		Av.No./set	57.67	-	57.67	20.57	497.71	259.14	24.57	290.25	192.22
		Av.wt./set	26.83	-	26.83	5.50	34.43	19.96	19.02	18.61	12.75
3N	361	No. sets	4	2	6	4	4	8	4	4	8
		Av.No./set	58.50	182.50	99.83	160.00	217.00	188.50	146.75	653.75	399.94
		Av.wt./set	26.13	63.50	33.58	72.81	50.75	61.78	69.25	279.75	174.37
3N	362	No.sets	5	4	9	5	2	7		2	2
		Av.no/set	117.80	228.25	166.89	110.80	105.00	109.14		38.00	38.00
		Av.wt/set	45.00	77.63	59.50	43.56	42.00	43.14		16.75	16.75
3L	363	No.sets	3	2	5	3	2	5			
		Av.no/set	44.00	68.50	53.80	42.81	58.00	48.89			
		Av.wt/set	17.67	26.00	21.00	19.95	42.00	22.77			
3L	371	No. sets	2	2	4	-	-	-			
		Av.no/set	0.00	4.50	2.25	-	-	-			
		Av.wt/set	0.00	3.75	1.88	-	-	-			
3L	372	No. of sets	5	4	9	4	4	8			
		Av.No./sets	86.90	100.75	93.06	33.00	169.60	101.00			
		Av.Wt./set	35.08	45.00	39.49	17.13	79.13	48.13			
3N	373	No. sets	5	5	10	4	3	7			
		Av.No./set	34.80	286.80	160.80	160.50	49.50	112.93			
		Av.Wt/set	17.40	133.80	75.60	69.88	22.56	49.60			
3N	374	No. sets	2	2	4	-	3	4	1[a]		
		Av.No./set	10.50	21.50	16.00	-	14.67	12.00	2.00		
		Av.Wt/set	5.25	9.75	7.50	-	7.83	6.38	0.44		
3N	375	No. sets	4	3	7	2	3	5	3	4	7
		Av.No./set	60.50	452.00	228.29	4.10	391.69	236.65	29.33	691.25	407.26
		Av.Wt./set	36.50	194.33	104.14	1.40	191.05	115.19	14.75	64.63	43.22
3N	376	No. sets	-	-	2	3	-	4	3	7	10
		Av.No./set	-	-	148.50	69.97	-	325.75	109.67	1,404.43	1,015.22
		Av.wt./set	-	-	47.75	19.70	-	150.46	22.00	74.27	58.55

Table 20 (Cont'd.)

Div.	Stratum		1985 Day	1985 Night	1985 Combined	1986 Day	1986 Night	1986 Combined	1987 Day	1987 Night	1987 Combined
3N	383	No. sets	2	2	4	–	–	–			
		Av.No./set	0.00	0.00	0.00	–	–	–			
		Av.wt./set	0.00	0.00	0.00	–	–	–			
3N	384	No. sets	2	2	4	–	–	–			
		Av.No./set	69.50	1.00	35.25	–	–	–			
		Av.wt./set	44.75	1.00	22.88	–	–	–			
	Total	No.sets	41	31	75	50	45	98	17	29	46
		Av.no/set	59.27	157.95	104.92	84.70	204.72	147.90	70.12	514.68	342.59
		Av.wt/set	26.29	65.15	43.35	36.08	61.73	53.05	24.31	79.43	53.55
	Abundance (million nos.)		152.2	313.0	286.1	229.6	546.3	448.0	59.1	572.0	381.1
	3L Biomass		–	–	22.9	–	–	22.7			
	3N Biomass		–	–	78.2	–	–	85.4			59.6
	3Ø Biomass		–	–	17.1	–	–	52.5			
	Total Biomass('000t)		67.5	129.1	118.2	97.8	164.7	160.7	20.5	88.3	59.6

[a]Strata with less than two sets deleted from overall estimates.

Table 21. Average numbers per tow at age from selected strata in juvenile flatfish surveys of NAFO Division 3NO (strata 352, 360, 361, 375, and 376).

Age	1985[a]	1986	1987
1	4.72	21.48	30.48
2	2.76	16.95	113.11
3	1.43	27.29	88.50
4	7.29	10.05	80.17
5	9.98	18.99	20.09
6	14.67	41.41	19.05
7	35.32	53.87	37.65
8	35.45	41.66	46.10
9	7.10	8.07	4.40
10	0.36	0.62	0.12
11	0.00	0.08	
Av. No./Tow	119.08	240.46	440.51

[a]Incomplete survey.

Table 22. Abundance (nos x 10^{-3}) at age of yellowtail from selected strata in Division 3NO juvenile flatfish surveys (strata 352, 360, 361, 375, and 376).

Age	1985a	1986	1987
1	3,978	24,015	25,718
2	2,330	18,944	95,432
3	1,209	30,511	74,667
4	6,151	11,238	67,634
5	8,420	21,225	16,951
6	12,377	46,289	16,073
7	29,801	60,226	31,764
8	29,906	46,568	38,897
9	5,989	9,016	3,714
10	301	688	99
Unknown	0	88	698
Totals 1+	100,462	268,720	370,949
4+	92,945	195,250	175,132
7+	65,997	116,498	74,474
1 - 4	13,668	84,708	263,451

[a]Incomplete survey.

Table 23. A comparison of average catch (numbers) per tow of yellowtail from juvenile surveys in 1986 and 1987. Numbers of fishing sets in parentheses.

	Age 1		Age 2		Age 3		Age 4		Age >4	
Stratum	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
352	1.31(13)	No survey	1.54	-	2.08	-	6.54	-	199.23	-
360	71.80(14)	15.58(19)	47.71	72.21	71.57	49.31	13.94	30.68	52.36	24.53
361	2.00(8)	1.76(8)	5.88	6.00	8.38	5.50	10.13	9.12	160.63	302.30
375	0.40(5)	32.14(7)	4.20	166.43	5.60	81.57	6.80	59.71	220.40	67.71
376	2.25(4)	93.90(10)	9.25	270.60	28.50	276.60	12.00	288.80	273.75	90.40

TABLE 24. RESULTS FROM SPA USING FT IN 1987 = 1.0.

POPULATION NUMBERS

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
4	156799	147013	119893	110606	121785	113144	75637	71659	79483	83973	86856	70496	68298	121448	175222
5	109297	115666	108841	88697	81794	88548	80605	54850	52264	58530	61011	63750	51312	49614	87178
6	53827	75631	83112	78242	59224	51877	47282	42672	30960	36541	40597	42053	43110	33597	32385
7	18231	29132	43088	44495	31828	24507	18025	19449	13596	16351	21174	20625	19907	24722	17839
8	2460	5627	11187	14177	13926	6867	3477	3713	3445	5458	5803	6194	2985	8551	9715
9	149	599	1457	4366	5451	1234	1031	510	568	1732	534	968	337	904	2581
10	2	70	163	555	1382	418	172	32	58	357	50	128	52	57	363
4+	340763	373738	367742	341138	315389	286594	226230	192884	180374	202943	216024	204215	186001	238892	325284
5+	183965	226725	247849	230532	193605	173451	150592	121226	100891	118970	129168	133719	117703	117445	150062
6+	74668	111058	139008	141834	111811	84903	69987	66376	48627	60440	68157	69969	66391	67831	62884
7+	20841	35427	55896	63592	52587	33026	22705	23704	17667	23898	27560	27916	23281	34233	30499

AGE	1983	1984	1985	1986	1987
4	168279	88426	55605	12925	237
5	129712	124643	65408	41100	9051
6	63291	94302	91098	46625	24969
7	19478	41041	58534	54096	22768
8	5554	7662	18060	20516	16464
9	663	730	2292	3797	3201
10	33	21	299	374	241
4+	387011	356826	291297	179434	76931
5+	218731	268400	235692	166509	76694
6+	89019	143757	170284	125409	67643
7+	25728	49454	79186	78784	42674

POPULATION BIOMASS

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	33392	31362	25568	23583	25758	23701	12938	11307	13695	15383	18602	10751	15842	23568	34049	28783	14810
5	27887	30041	28274	22256	20040	20060	17892	12448	14147	15882	16048	14667	11462	12440	20664	35653	30815
6	18342	26376	28183	23531	17941	14602	14162	11440	11121	11518	12682	11194	16303	8688	8352	20597	27601
7	6540	11437	15865	16053	9928	6569	5435	5261	5484	5417	6788	4600	8534	7969	4885	6421	13690
8	955	2238	5256	6619	3797	2231	1121	1245	2028	1372	1998	1344	1307	3295	2185	1550	2999
9	88	282	787	2184	1650	454	242	198	468	383	279	247	146	539	525	169	485
10	1	39	109	361	529	192	74	16	51	118	29	32	36	40	150	17	14
4+	87205	101775	104041	94586	79644	67811	51864	41915	46993	50074	56426	42833	53629	56538	70811	93191	90414
5+	53813	70413	78473	71004	53885	44109	38926	30608	33299	34691	37824	32082	37787	32970	36762	64408	75604
6+	25926	40372	50199	48747	33846	24049	21034	18159	19152	18809	21776	17415	26325	20530	16098	28755	44789
7+	7584	13997	22016	25217	15904	9447	6872	6720	8030	7291	9094	6221	10022	11842	7746	8157	17188

AGE	1985	1986	1987
4	5663	1000	27
5	13705	6085	1431
6	25275	10018	5569
7	17878	14425	5657
8	6393	5741	5592
9	1063	1113	1512
10	197	175	163
4+	70173	38559	19952
5+	64510	37559	19925
6+	50805	31474	18494
7+	25530	21455	12924

Table 24. (continued)

FISHING MORTALITY

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
4	0.004	0.001	0.001	0.002	0.019	0.039	0.021	0.016	0.006	0.019	0.009	0.018	0.020	0.032	0.001	0.000	0.002	0.002
5	0.068	0.031	0.030	0.104	0.155	0.327	0.336	0.272	0.058	0.066	0.072	0.091	0.123	0.127	0.020	0.019	0.014	0.039
6	0.314	0.263	0.325	0.599	0.582	0.757	0.588	0.844	0.338	0.246	0.377	0.448	0.256	0.333	0.208	0.133	0.177	0.221
7	0.876	0.657	0.812	0.862	1.234	1.653	1.280	1.431	0.613	0.736	0.929	1.633	0.545	0.634	0.867	0.633	0.521	0.748
8	1.112	1.051	0.641	0.656	2.124	1.596	1.619	1.577	0.388	2.025	1.491	2.612	0.895	0.898	2.385	1.729	0.907	1.259
9	0.458	1.000	0.666	0.850	2.268	1.669	3.171	1.877	0.164	3.253	1.124	2.625	1.482	0.612	4.062	3.158	0.591	1.512
10	1.061	1.046	0.644	0.698	2.162	1.607	1.818	1.609	0.353	2.212	1.454	2.614	0.941	0.867	2.572	1.814	0.875	1.285

AGE	1986	1987
4	0.056	0.025
5	0.198	0.124
6	0.417	0.377
7	0.890	1.000
8	1.558	1.000
9	2.456	1.000
10	1.655	1.000

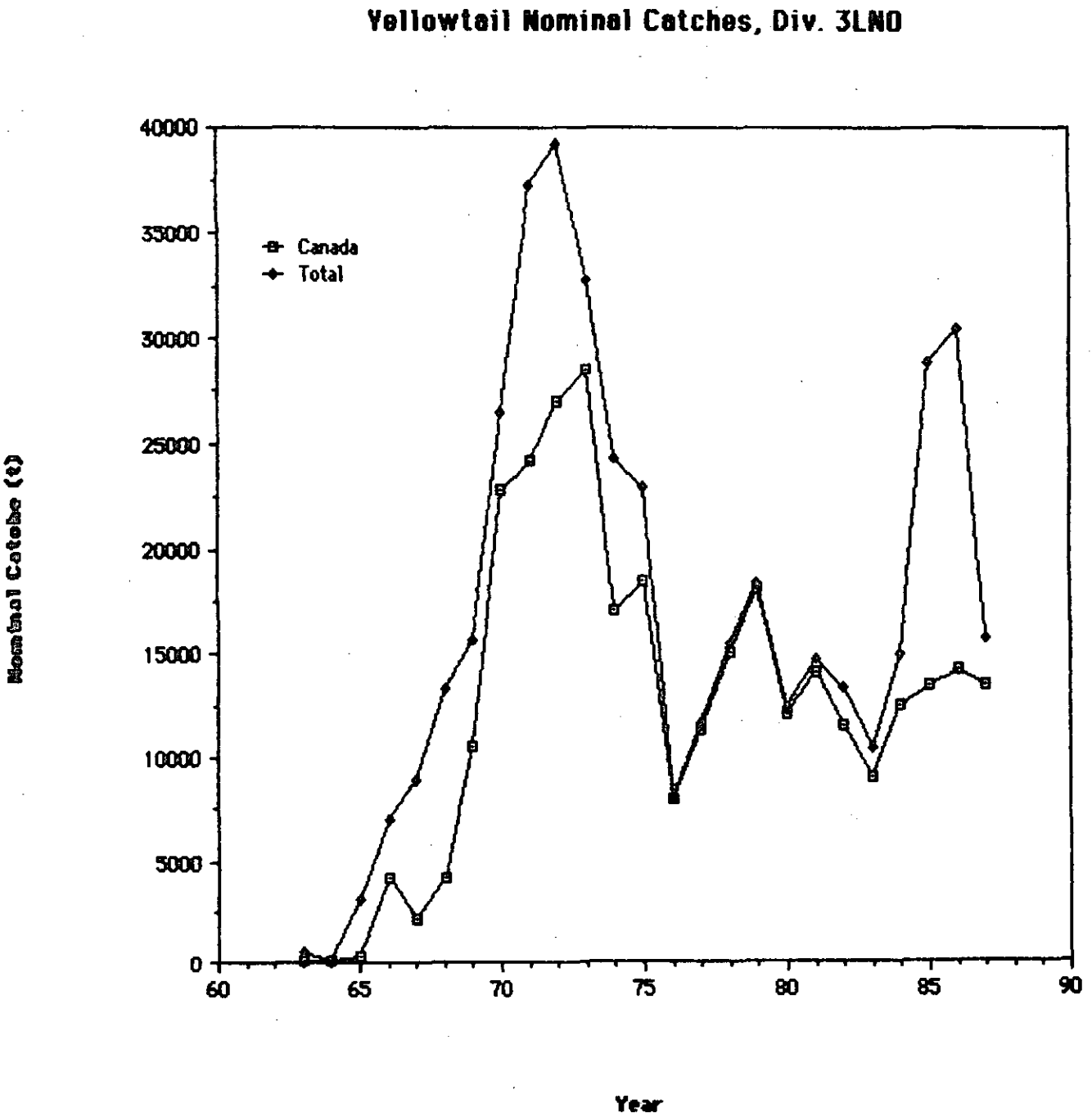


Fig.1 Nominal catches of Yellowtail in Div. 3LNO from 1963-1987.

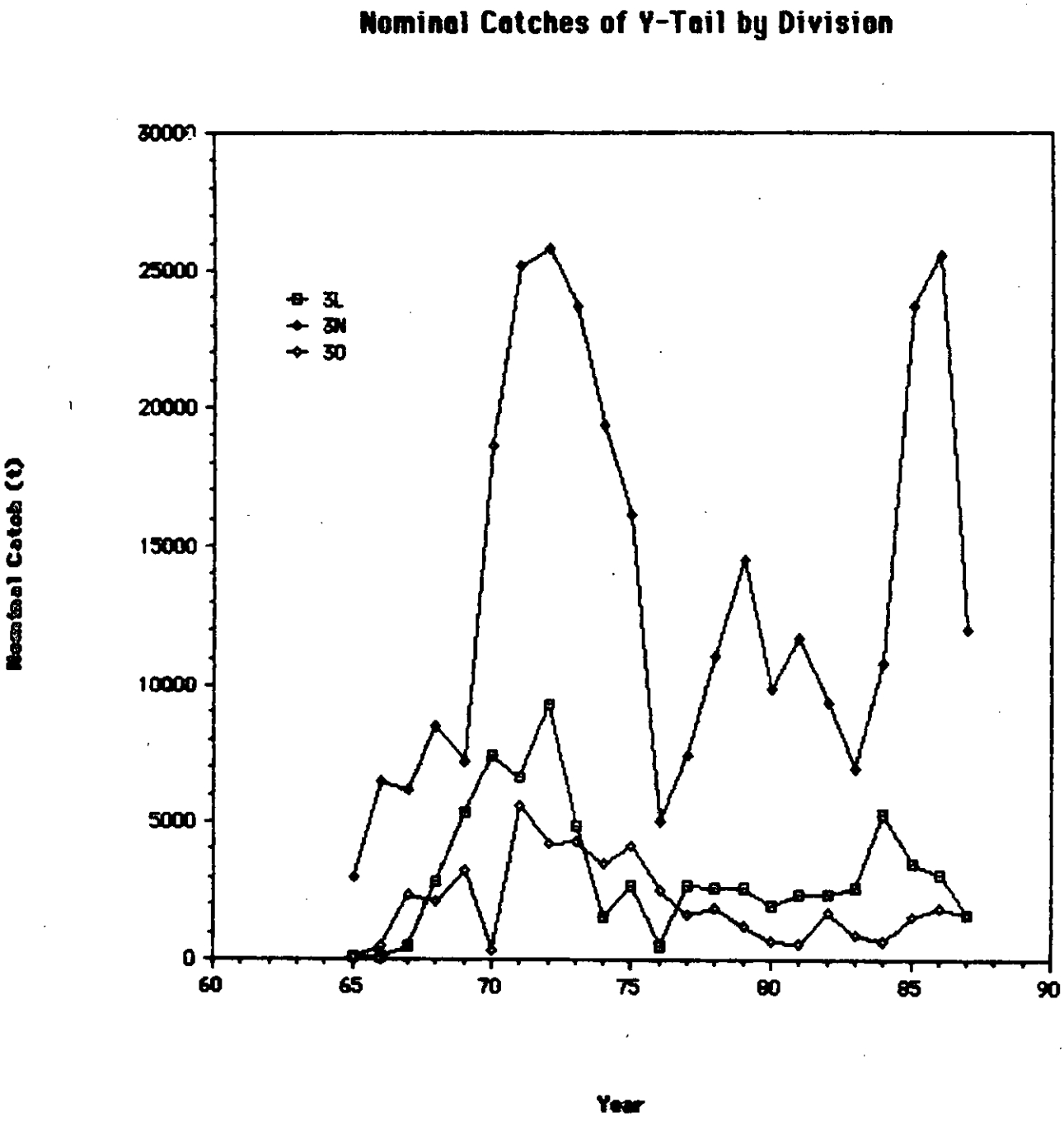


Fig.2 Nominal catches of yellowtail in Div. 3LNO by Division, 1965-87.

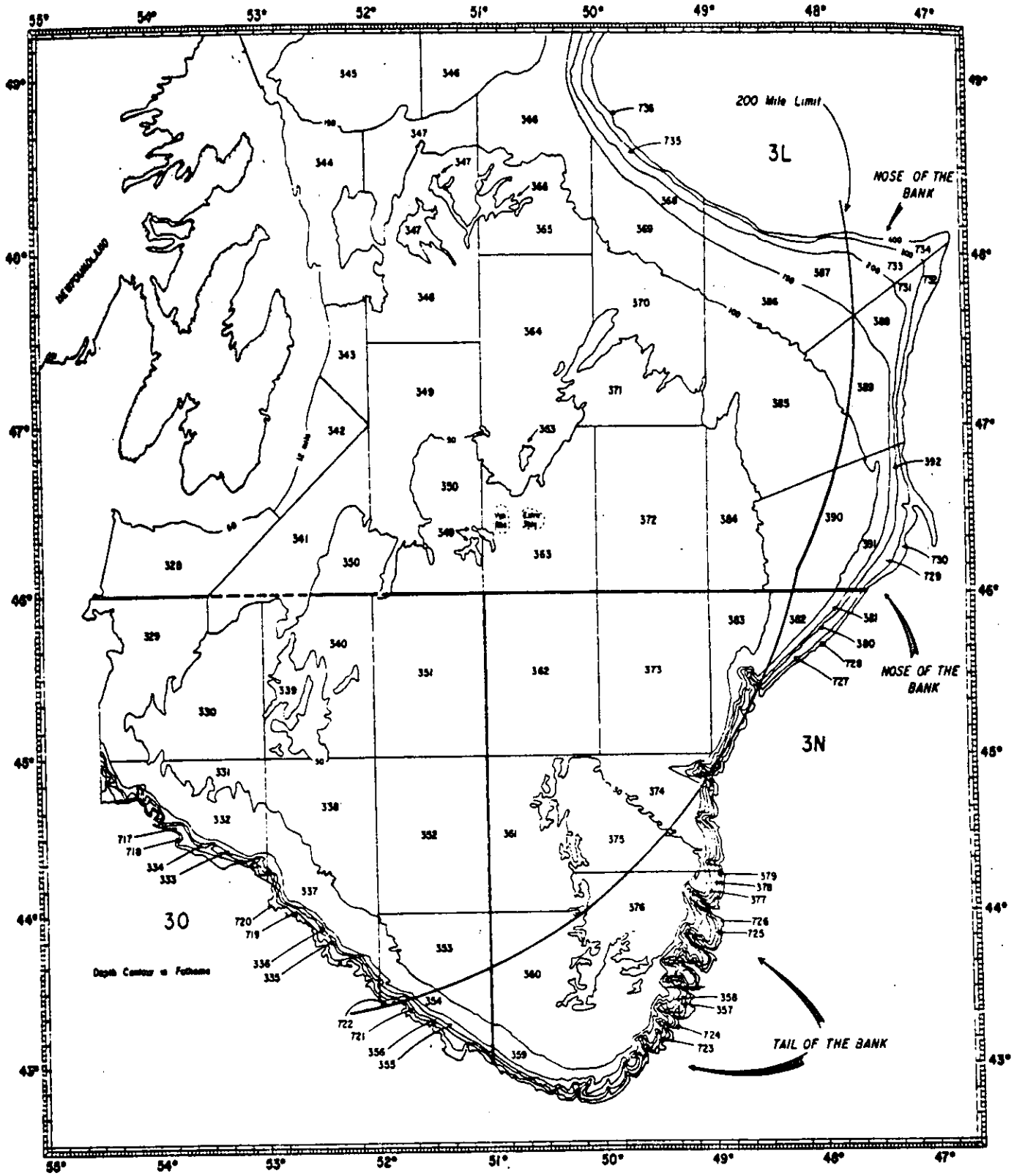


Fig.3 NAFO Div. 3LNO, showing the Canadian 200 mile limit in relation to the Nose and Tail of the Bank, as well as the stratification scheme used in Canadian groundfish surveys.

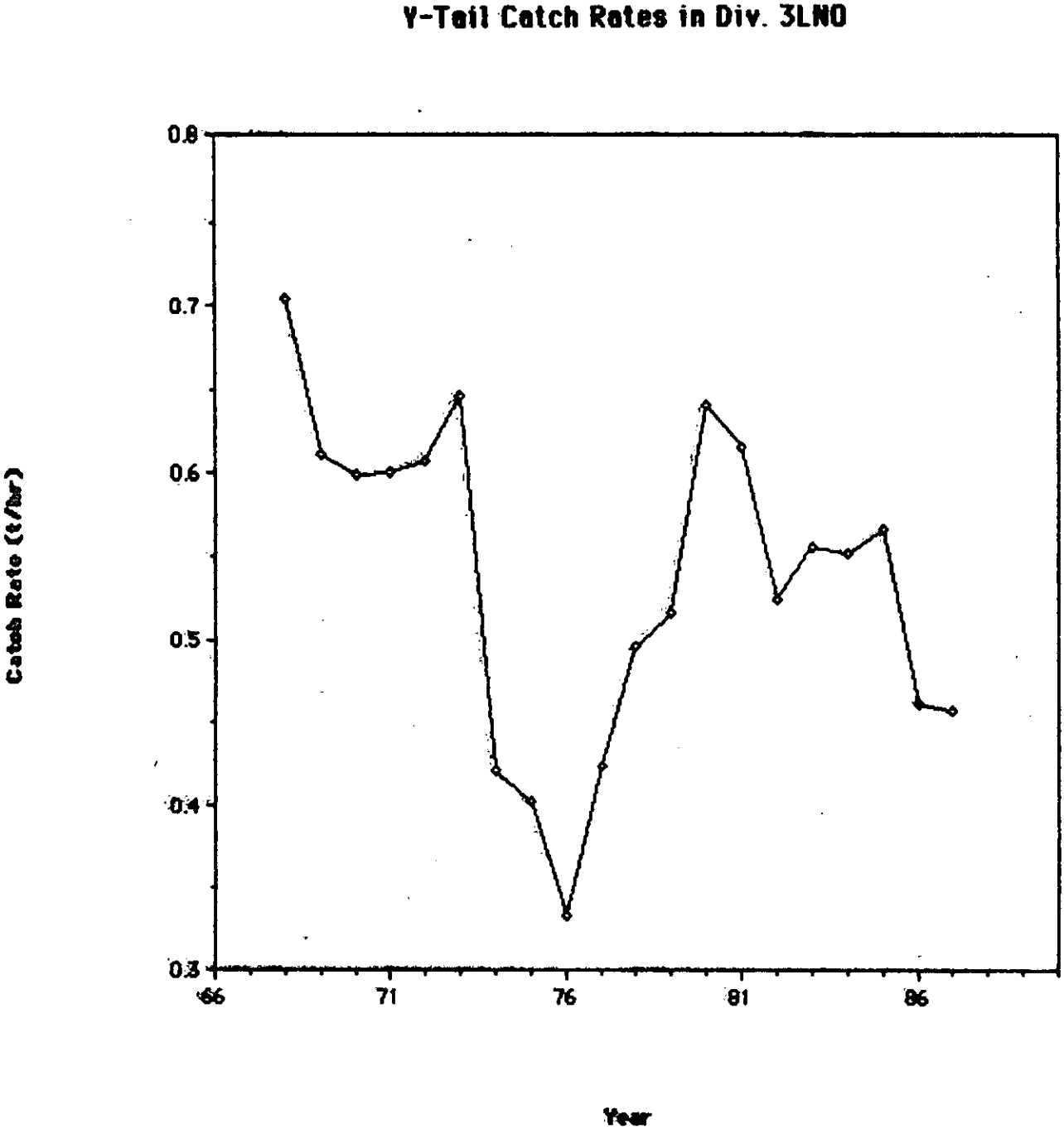


Fig. 4 Catch rates of Y-Tail in Div. 3LNO from 1968-87.

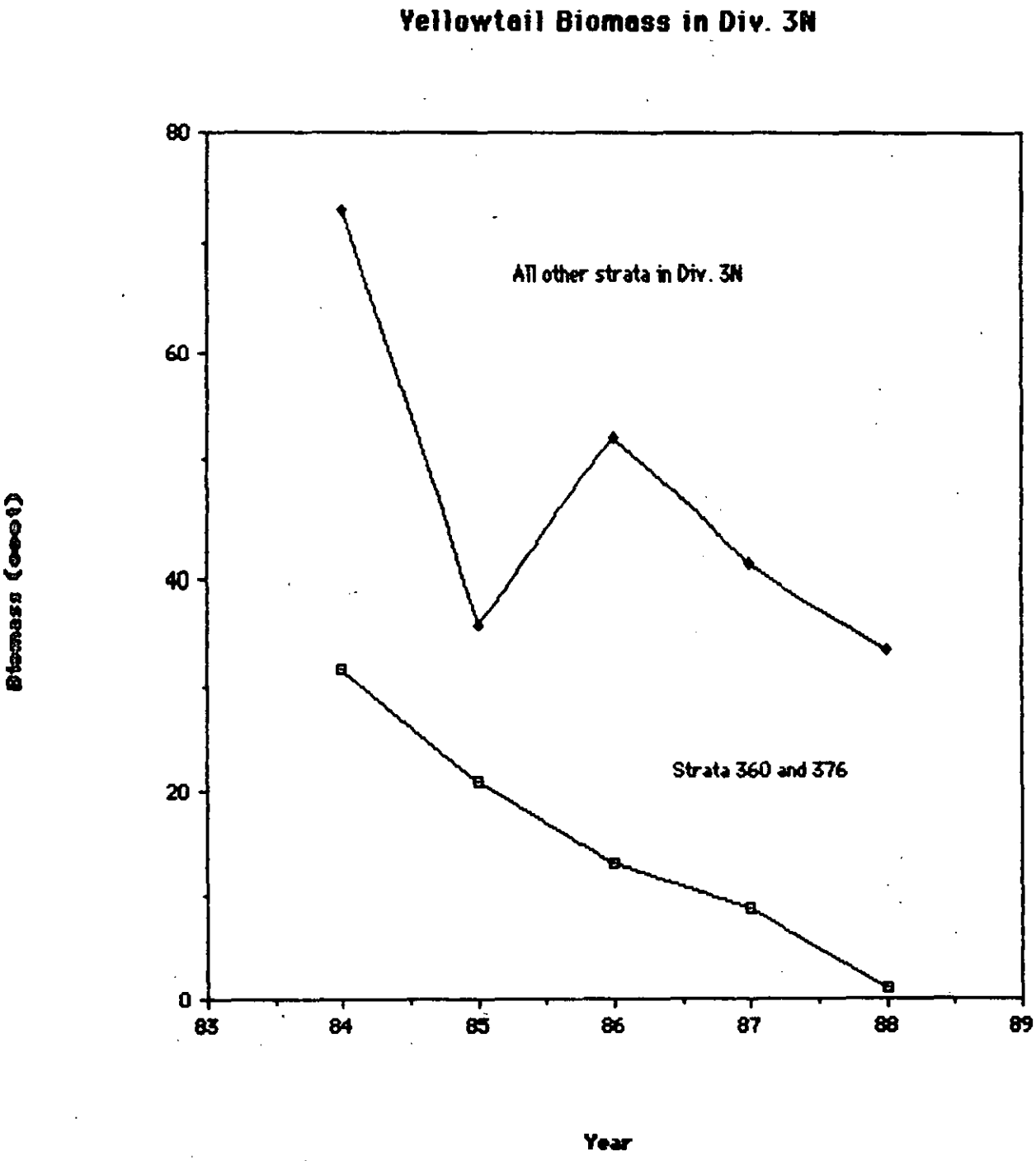
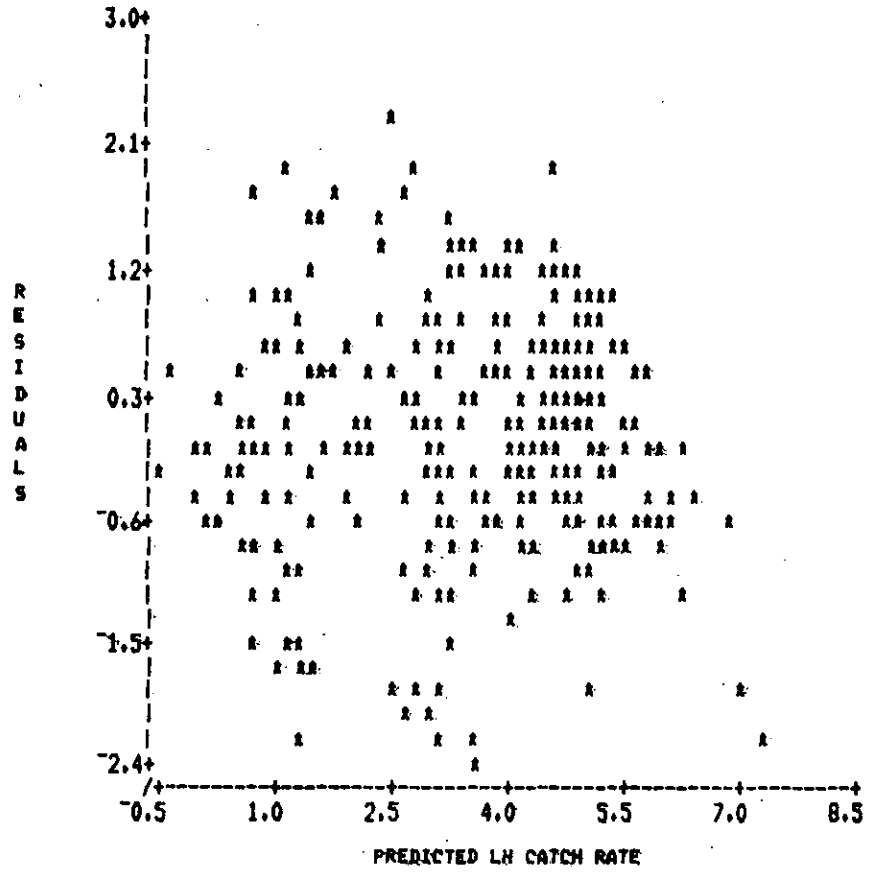


Fig.5 Estimated biomass of Yellowtail flounder in Div. 3N.



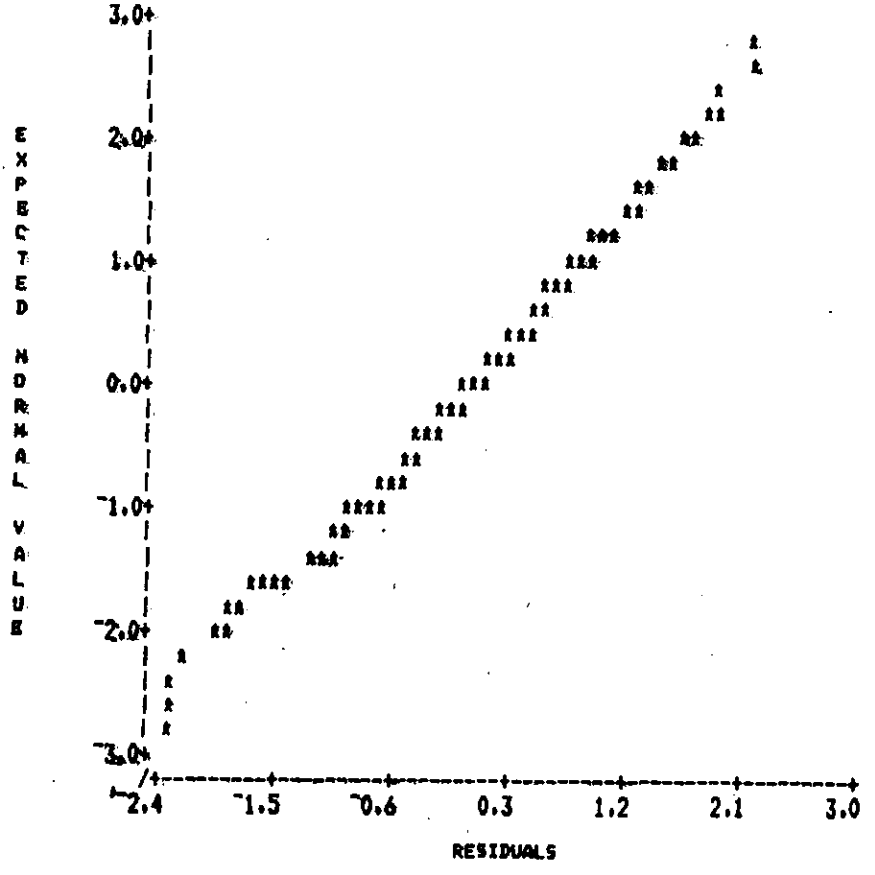


FIG.6. RESIDUAL PLOTS FROM MODEL USED FOR SURVEYS IN DIV 3LNO.

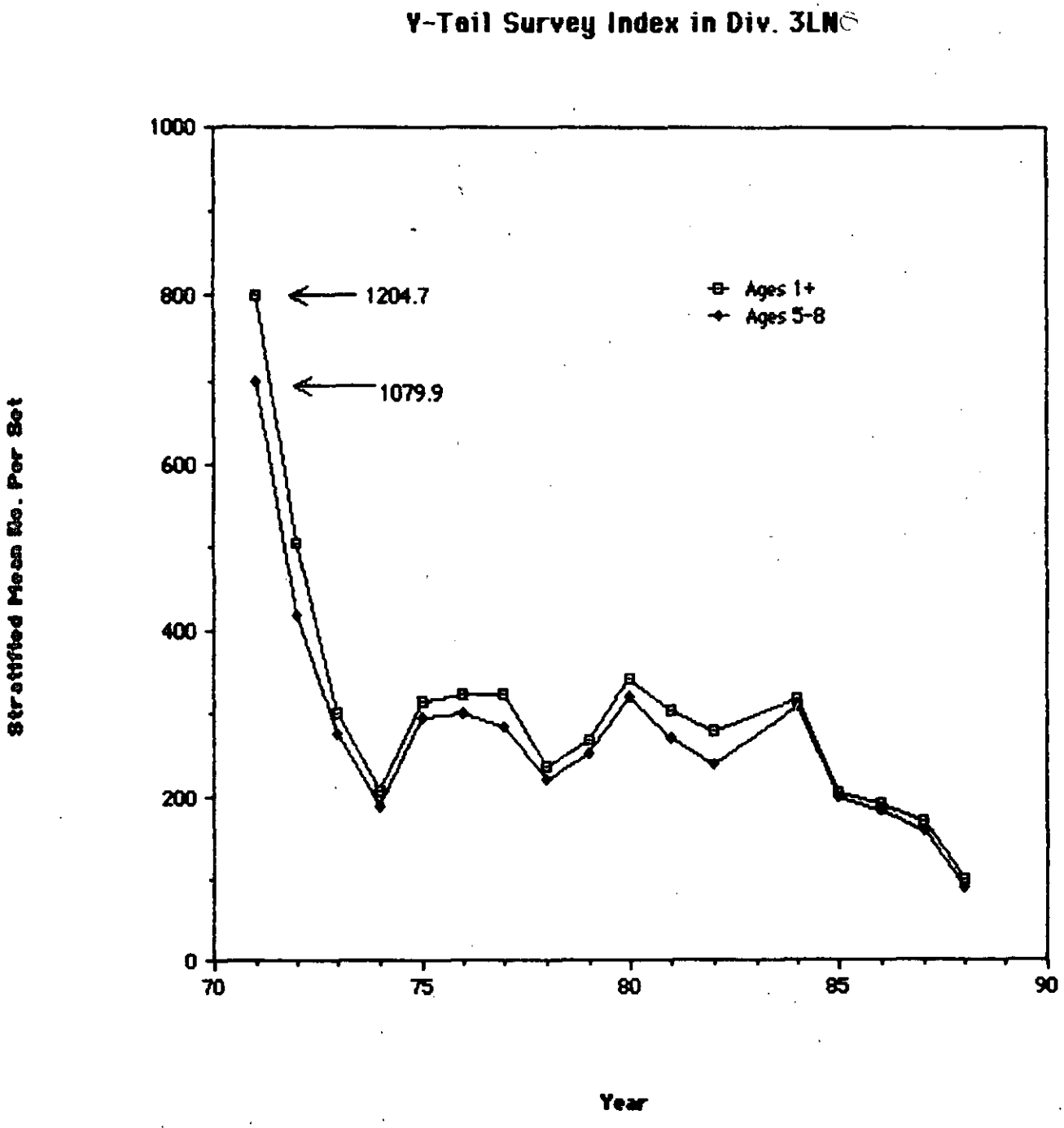


Fig.7 Research vessel survey abundance index for Y-Tail in Div. 3LN from 1971-88 (adjusted for different vessel and gear for 1971-82).

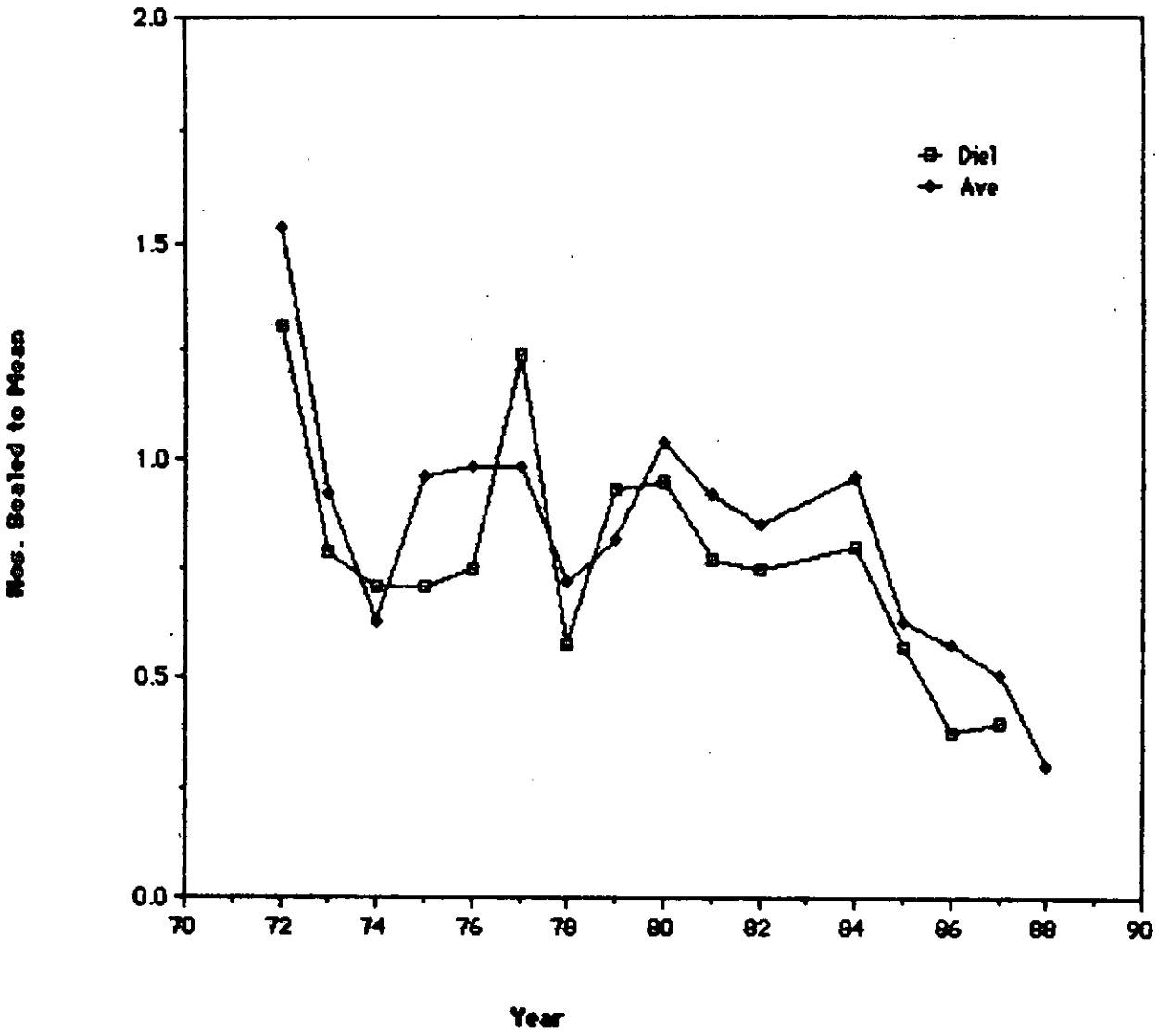
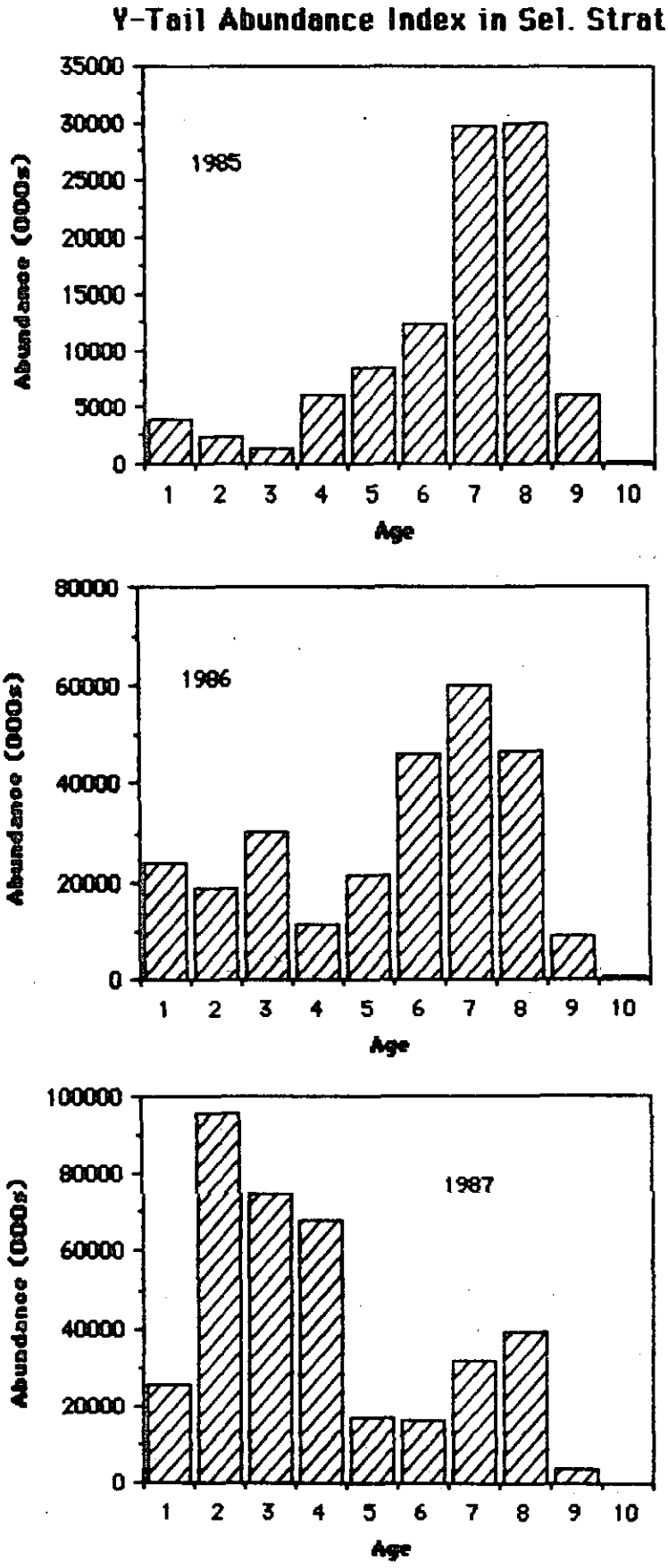


Fig.8 Comparison of Yellowtail survey results.



FIG,9, ABUNDANCE OF YELLOWTAIL IN SELECTED STRATA,FROM JUVENILE FLATFISH SURVEYS FROM 1985-87.

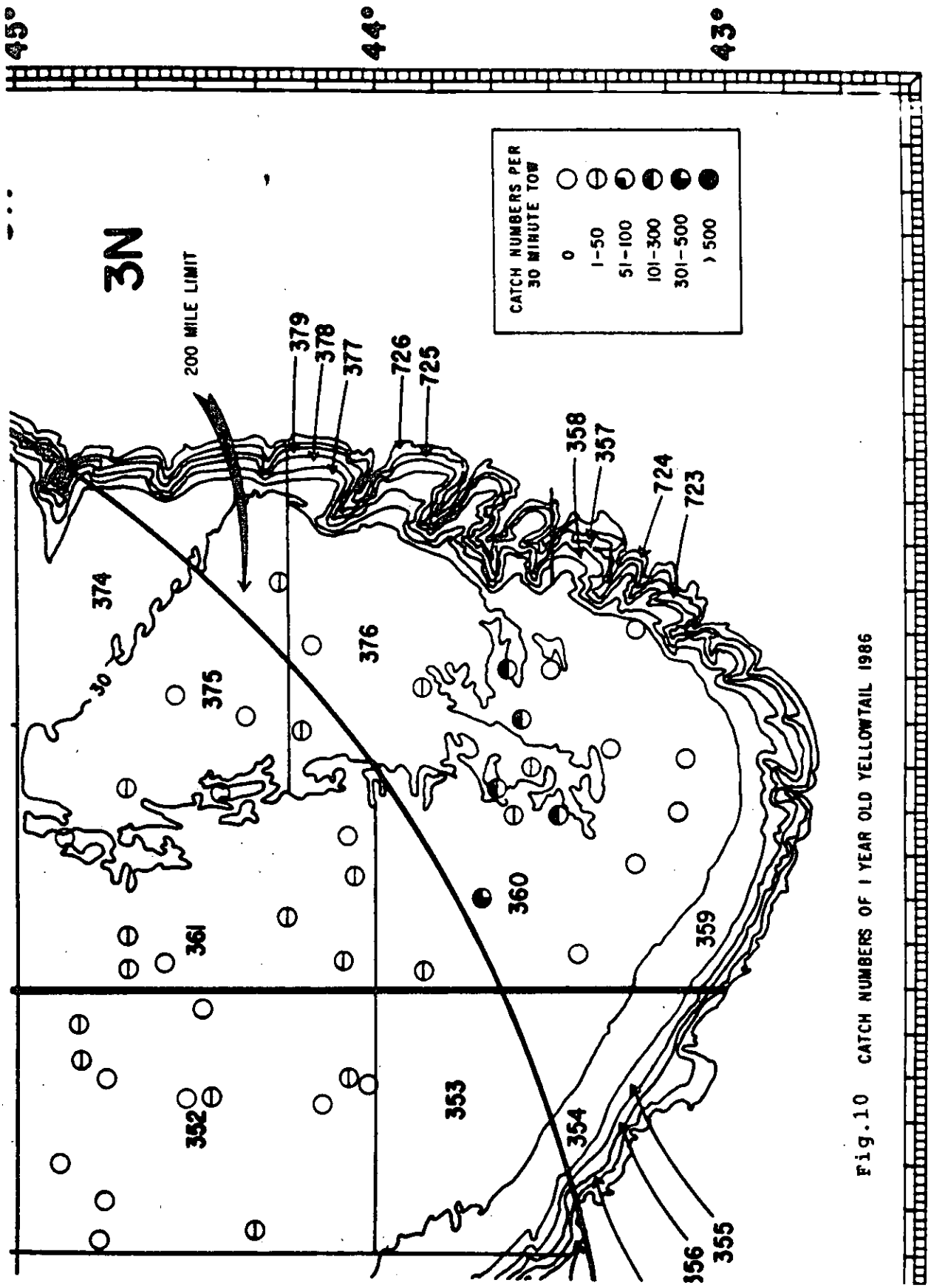


Fig.10 CATCH NUMBERS OF 1 YEAR OLD YELLOWTAIL 1986

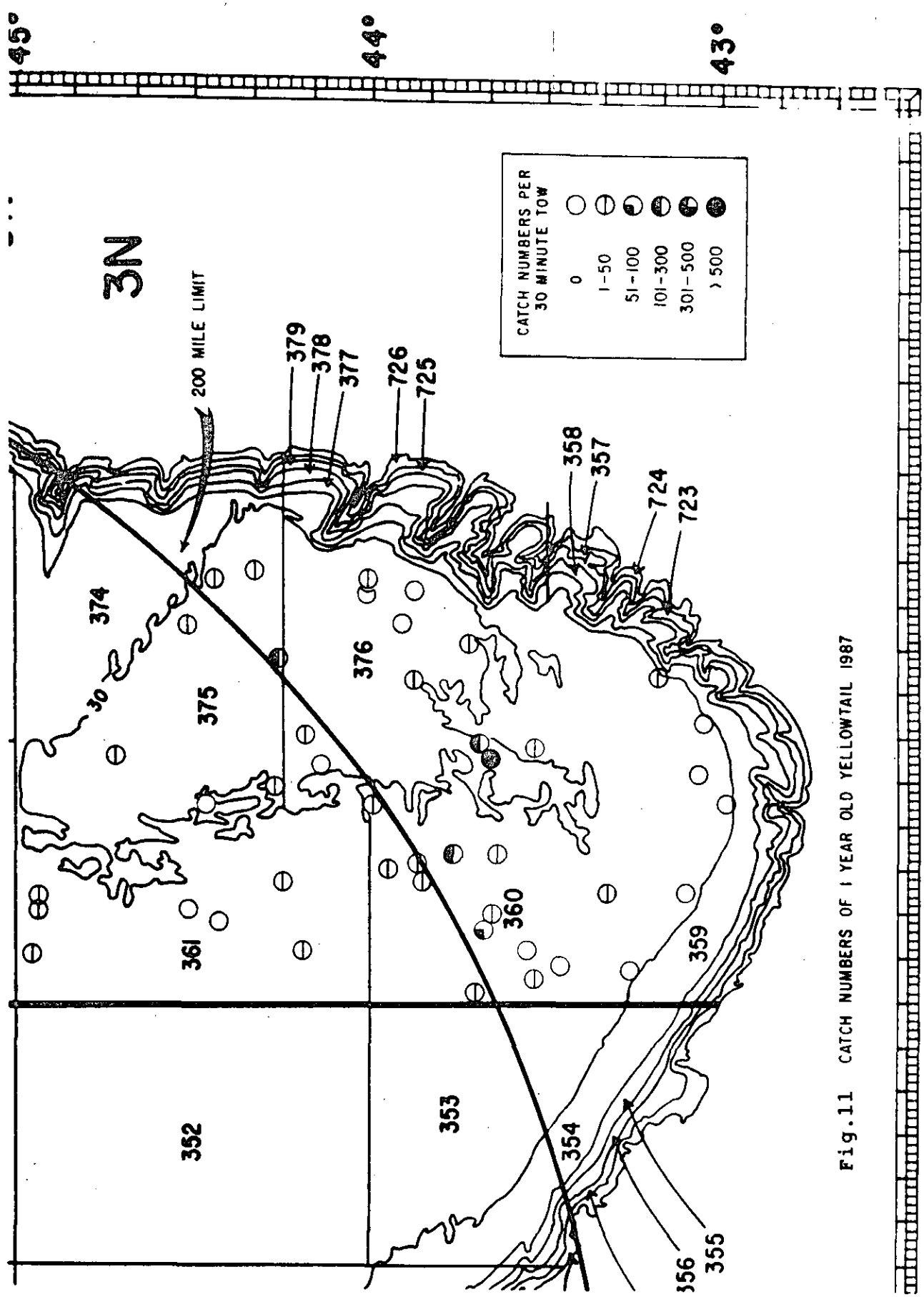


Fig.11 CATCH NUMBERS OF 1 YEAR OLD YELLOWTAIL 1987

Fig.12 ,RESULTS OF REGRESSION AND PLOT OF AGE 5+ POP, BIOMASS FROM SPA VS CPUE FOR 1968-87

MEAN OF DEPENDENT VARIABLE 47432.54274

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD, ERROR	T-VALUE
CONSTANT TERM		-3256.65602	19895.70156	-0.16369
1	0.53630	94516.49965	36540.67552	2.58661

COEFFICIENT OF DETERMINATION (R*2)..... 0.2709762767
CORRECTED R*2 (R*2)..... 0.2304749587
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 18) 6.6905545387
STANDARD ERROR OF THE ESTIMATE,..... 15366.0470552094
DURBIN-WATSON STATISTIC,..... 0.8196965197
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%) 32.3955794220

	OBSERVED Y	CALCULATED Y	RESIDUAL
1	53813.1096	63377.4762	-9564.3666
2	70413.0970	54398.4088	16014.6883
3	78473.3734	53264.2108	25209.1627
4	71003.7471	53453.2438	17550.5033
5	53885.3657	54114.8593	-229.4935
6	44109.4954	57706.4863	-13596.9909
7	38926.3677	36534.7903	2391.5774
8	30607.5674	34738.9768	-4131.4094
9	33298.5828	28122.8219	5175.7609
10	34690.9153	36723.8233	-2032.9081
11	37823.6715	43623.5278	-5799.8563
12	32081.8473	45608.3743	-13526.5270
13	37786.6281	57233.9038	-19447.2757
14	32969.7157	54776.4748	-21806.7590
15	36761.7145	46364.5063	-9602.7918
16	64407.5120	49294.5178	15112.9942
17	75603.8082	48821.9353	26781.8729
18	64510.4450	50239.6828	14270.7622
19	37558.8143	40315.4503	-2756.6360
20	19925.0767	39937.3843	-20012.3076

GRAPH TO BE PLOTTED?(YES/NO)

YES
SUPERPLOT OR PLOT?(S/P)

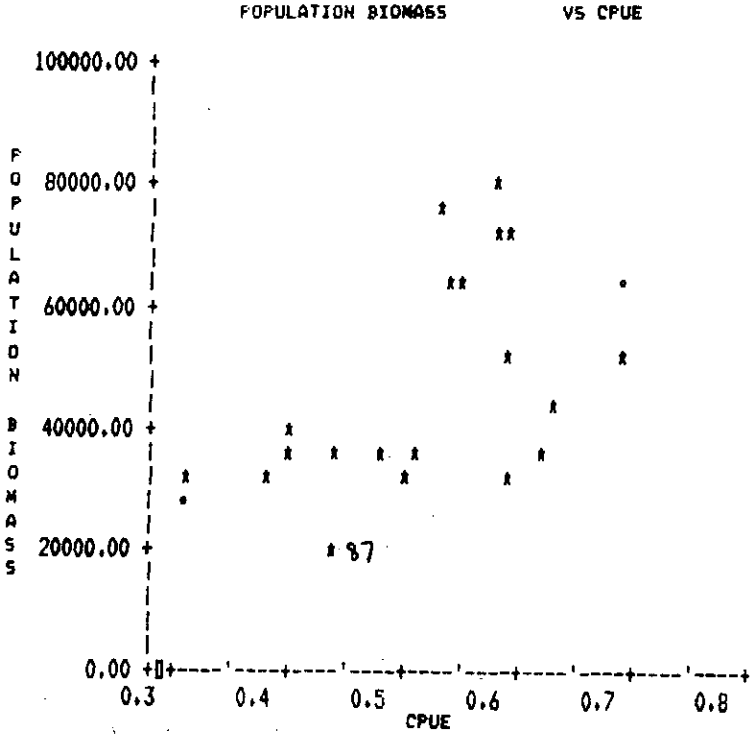


Fig.13 ,RESULTS OF REGRESSION AND PLOT OF AGE 5-8 POP,NOS, FROM SPA VS AGE 5-8 POP,NOS, FROM SURVEYS,1972-87,

MEAN OF DEPENDENT VARIABLE 148283.34874

VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD, ERROR	T-VALUE
CONSTANT TERM		113781.04071	55516.76776	2.04949
1	261.58667	131.89628	205.98334	0.64032

COEFFICIENT OF DETERMINATION (R*2).....	0.0305753610
CORRECTED R*2 (R*2).....	-0.0439957651
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 13)	0.4100160828
STANDARD ERROR OF THE ESTIMATE,.....	51786.3165313185
DURBIN-WATSON STATISTIC,.....	0.8591378541
COEFFICIENT OF VARIATION (AT THE MEAN OF Y),,(%)	34.9238919758

	OBSERVED Y	CALCULATED Y	RESIDUAL
1	186772.0969	169256.6157	17515.4811
2	171798.6406	150355.8789	21442.7617
3	149389.2105	138630.2997	10758.9107
4	120683.5235	152927.8564	-32244.3329
5	100265.0370	153481.8208	-53216.7838
6	116880.8551	151476.9973	-34596.1422
7	128584.8870	142785.0325	-14200.1455
8	132622.2238	147269.5060	-14647.2822
9	117314.1237	156106.5567	-38792.4330
10	116483.9124	149735.9664	-33252.0540
11	147117.0204	145277.8722	1839.1482
12	267648.5837	154431.4740	113217.1097
13	233100.3221	139988.8314	93111.4907
14	162337.3255	137720.2154	24617.1102
15	73252.4688	134805.3076	-61552.8389

GRAPH TO BE PLOTTED?(YES/NO)
YES
SUPERPLOT OR PLOT?(S/P)
P

POPULATION NUMBERS VS SUR NOS 5-8

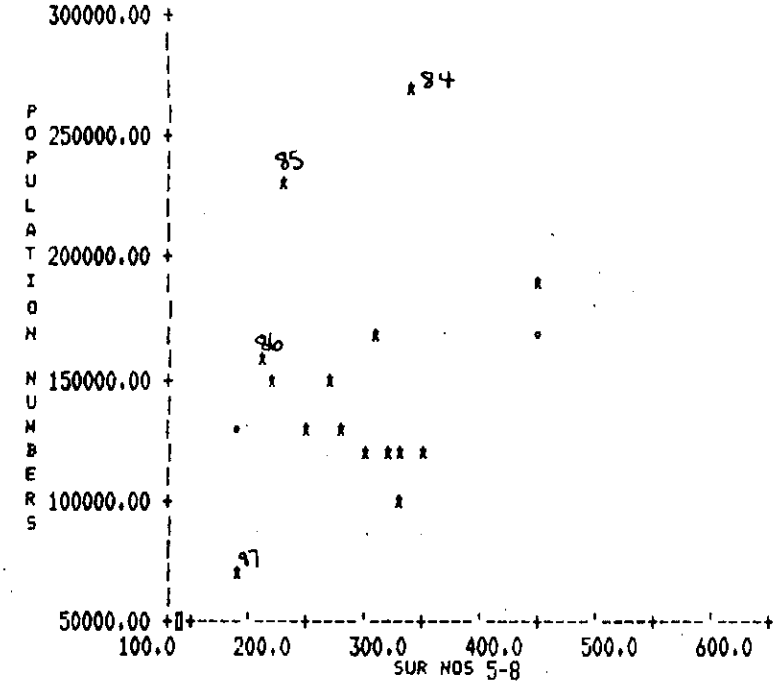


Fig.14 ,RESULTS OF REGRESSION AND PLOT OF AGE 6 POP,NOS, FROM SPA VS AGE 6 POP,NOS, FROM SURVEYS,1972-87.

MEAN OF DEPENDENT VARIABLE 47819.51352

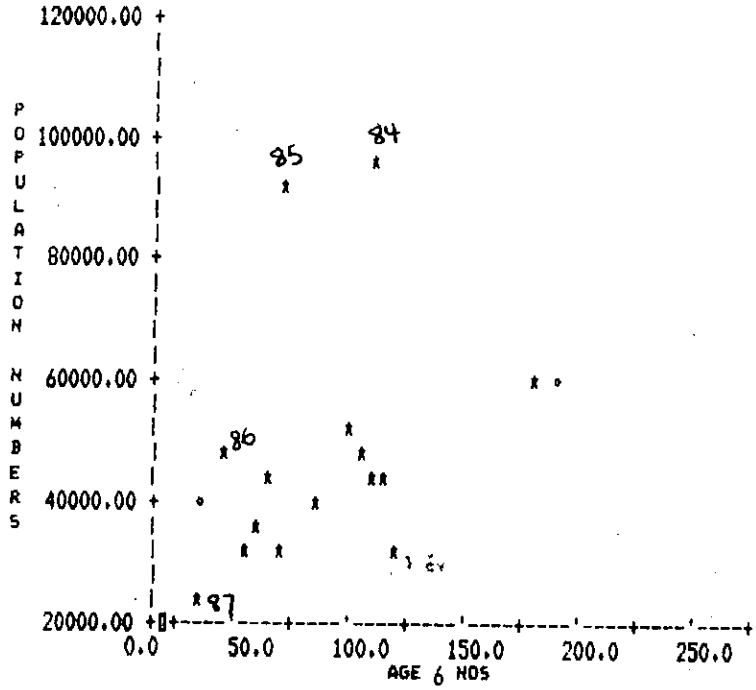
VARIABLE	MEAN	ESTIMATED COEFFICIENT	STD. ERROR	T-VALUE
CONSTANT TERM		36815.83621	11974.87233	3.07442
1	73.20000	150.32346	147.37621	1.02000

COEFFICIENT OF DETERMINATION (R*2).....	0.0741002021
CORRECTED R*2 (R*2).....	0.0028771407
F-STATISTIC FOR SIGNIFICANCE OF REGRESSION(1, 13)	1.0403961949
STANDARD ERROR OF THE ESTIMATE.....	20131.2991386549
DURBIN-WATSON STATISTIC.....	1.1009231753
COEFFICIENT OF VARIATION (AT THE MEAN OF Y)..(%)	42.0985025936

	OBSERVED Y	CALCULATED Y	RESIDUAL
1	59224.0513	61303.5279	-2079.4766
2	51877.0388	49893.9773	1983.0616
3	47281.9824	49999.2037	-2717.2213
4	42671.6430	51066.5003	-8394.8572
5	30959.5762	52780.1877	-21820.6116
6	36541.4032	43670.5860	-7129.1828
7	40596.5097	47398.6078	-6802.0981
8	42053.2412	44362.0739	-2308.8328
9	43110.3896	51502.4383	-8392.0487
10	33597.3091	43144.4539	-9547.1448
11	32384.9718	45248.9823	-12864.0106
12	94302.3971	50946.2415	43356.1556
13	91098.3472	44752.9149	46345.4323
14	46624.5561	41370.6371	5253.9190
15	24969.2861	39852.3701	-14883.0840

GRAPH TO BE PLOTTED?(YES/NO)
YES
SUPERPLOT OR PLOT?(S/P)
P

POPULATION NUMBERS VS AGE 6 NOS



Appendix[1]

Nominal catch

Revisions to the nominal catch for 1986 and 1987 are as follows:

1986 - USA 2562 t. Total 1986 catch = 30,736 t
1987 - Spain 1183 t. Total 1987 catch = 16,381 t

These figures are still preliminary and were not considered substantial enough to warrant major recalculations of the assessment parameters.

Assessment

Table 25 shows a comparison between population estimates from R. V. Surveys and catches for 1971-87. The abundance at ages 5-7 was relatively stable from 1973-82, with average catches in 1974-83 of about 15,200 t. From 1984-86, the average abundance was about 16% lower, but the catch from 1985-87 averaged 25,300 t. In 1987 and 1988, the average abundance was about one-third of the long-term average at ages 5-7.

Given the magnitude of the decline in stock size (particularly that indicated by Canadian and USSR surveys) and the very low levels of incoming recruitment, a TAC of 5,000 t for the entire stock is recommended for 1989. Of major concern in establishing this figure is the presence of large numbers of juvenile yellowtail in the Regulatory Area, where fishing pressure on yellowtail has been high in recent years.

Table 25. Population sizes from Canadian R.V. surveys and nominal catches, 1971-87.

Year	Pop. size (nos. x 10^{-6}) at ages 5-7	Catch (t) in Subsequent year
1971	1029	39,259
1972	393	32,815
1973	243	24,313
1974	183	22,894
1975	270	8,057
1976	281	11,638
1977	186	15,466
1978	182	18,351
1979	192	12,377
1980	276	14,680
1981	159	13,319
1982	182	10,473
1983	-	16,710
1984	252	28,774
1985	156	30,736
1986	136	16,381
1987	83	
1988	43	
Avg (73-82)	216	15,157
Avg (84-86)	181	25,297
Avg (87-88)	63	?

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