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Yellowtail flounder in NAFO Div. 3LNO - An Assessment of Stock Status

by

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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 reduced to 9,000 t from 35,000 t, following a number of large catches (Table 1) and a decrease in stock abundance. After 1977, the TAC increased steadily to 23,000 t in 1982 and was set at 15,000 t from 1985 to 1988, based on average catches over a number of years preceding 1984. In 1989, the TAC was reduced to 5,000 t, following a sharp decline in biomass after the large catches in 1985-86. The level of 5,000 t was also maintained in 1990.

Catch trends

The nominal catch increased rapidly from a few hundred tons in 1963-64 to a peak of over 39,000 t in 1972 (Fig. 1). Vessels from Canada and the USSR took virtually all the catch up to 1975, with only Canada taking significant catches in 1976-81 (Table 1). Catches by other nations began to increase in 1982, as several freezer trawler fleets began directing for flounder on the Tail of the Bank in the NAFO Regulatory Area. As a result, catches by other nations exceeded those of Canada in 1985-86, and the total catch in these years was about 30,000 t, double the TAC. Catches by many fleets declined in 1987-89 (Tables 1 and 2) as effort in the Regulatory Area was directed primarily at redfish. In 1989, the catch was about 7,600 t, compared to 16,000 t in the previous 2 years. With the TAC of 5,000 t restricting the Canadian catch, the catch by this country in 1989 was the lowest since 1968. Except for 248 t taken by Scottish seines, the catch by Canada was taken by otter trawls.

With the recent release of final catch statistics for 1986 and 1987 and the revision by surveillance personnel of estimated catches taken by non-member countries, some changes to the nominal catches for 1984-88 were necessary. By year, these changes were (t): +25, +189, -560, -67, +1582. The larger changes (1986, 1988) were a result of a revised breakdown of the South Korean unspecified flounder catches. From 1982 to 1984, S. Korea reported catches of all flounder as unspecified flatfish and a ratio of 60% yellowtail to 40% American plaice was used to estimate the species composition. From 1985 to 1988, these catches included a species breakdown for a portion of the catch which was then used to adjust the unspecified flatfish totals. For 1989, the value of 1000 t was simply an estimate based on recent catch levels and developments in the fishery.

Table 3 shows the catch by division. After approaching record levels in 1985-86, the catch in Div. 3N declined to only 5000 t in 1989, the lowest value since 1965. The catch in Div. 3L was also at a low level in 1989, while the catch in Div. 3O has remained constant at around 1700 t from 1985 to 1989.

Commercial CPUE data

A multiplicative analysis was carried out in the catch and effort data for this stock, using the same model as in the 1989 assessment. As can be seen from Table 1, Canada took virtually all the catch from 1976 to 1983, so only the data from this fishery can be used as a CPUE index. Table 4 shows a summary of the C/E data from 1965 to 1989 which were used in the analysis. Although there have been substantial catches by other nations in recent years, some of these catches are only estimates (eg. Panama) while some other catches (eg. Spain, S. Korea) are reported as coming from a mixed fishery, and cannot, therefore, be used to generate a CPUE series. Table 5 shows the results of the multiplicative analysis and the CPUE series for 1965-89. Figure 2 shows that the CPUE declined steadily from 1965 to 1975, increased slightly to the 1983-85 period, then declined to a low but stable level in 1986-89. The CPUE observed in these recent years is similar to the previous low values in 1974-76.

Catch sampling (1989)

Canada:

Length frequencies and otoliths were available from the Canadian fishery for yellowtail in 1989. As indicated in Table 6, the level of sampling from this fishery was again high in 1989. These data were used, along with the standard length-weight relationship, to produce the catch at age and mean weights at age in Table 7.

USA:

Numbers at length were available from the USA catch in Div. 3NØ for all months combined. To derive the numbers at age, age-length keys from the Canadian fishery in Div. 3NØ in Quarter 3 were used. The results are shown in Table 8a.

Spain:

Length frequencies from the catch by Spanish freezer trawlers in Div. 3NØ in 1988 were available. To determine the numbers caught at length, the mean weight (from the length-weight relationship) in each sample was divided into the appropriate catch and the length frequencies were then adjusted to this total number of fish caught. As in previous years, age-length keys from Canadian surveys in Div. 3N (spring and fall) were used to determine numbers at age because the Canadian commercial fishery did not have fish at the smaller lengths observed in the Spanish fishery. Table 8a shows the resulting catch at age for this fleet.

Portugal:

Length frequency information was available but was not used at this time, as the Portuguese catch amounted to only 6 t.

Catch at age and mean weights at age (1989).

The Canadian catch in 1989 consisted mainly of fish aged 7 and 8 (Table 8a), as has been the case in recent years (Table 9a). The USA catch consisted mainly of ages 6 and 7, while the Spanish fishery caught yellowtail aged 3-5 (Table 8a). These patterns were the same as those observed in 1988.

The mean weights at ages 5-7 were similar in the USA and Canadian fisheries (Table 8a), with the mean weights in the USA catches being somewhat higher at ages 8 and 9. The mean weights at age in the Spanish catch were similar at age 7, lower at younger ages and higher at older ages compared to the other fisheries. It should be noted that the sum-of-products check for the Spanish catch at age was about 13% higher than the nominal catch, which is a larger discrepancy than usual.

Table 9b shows that there has been little change in the mean weights at age in the Canadian fishery over the period 1986-89.

To produce the total catch at age for 1989, the Spanish catch at age from Table 8a was adjusted up to a catch of 2226 t, accounting for the catches by all countries except Canada and U.S.A. The catch at age for these two countries was then added to the revised Spanish total to give the catch at age for the stock in 1989 (Table 10). In addition, it is estimated that approximately 0.3 million age 2 and 2.5 million age 3 yellowtail were landed in 1989.

The mean weights at age for 1989 were calculated from the values in Table 8b (weighted by the appropriate catch at age) and can be seen in Table 12.

Revisions to the 1988 catch at age and mean weights at age

In the 1989 assessment of this stock, the catch at age for countries other than Spain, Canada, and U.S.A. was calculated as being in the same proportion as the catch at age from these three countries combined. However, it is more likely that these other catches resemble the Spanish catch at age. Therefore, the Spanish catch at age was adjusted to represent a catch of 4,688 t in 1988 compared to the actual Spanish catch of 3,205 t in this year. The resulting catch at age for 1988 had substantially more young fish, as seen in the table below (nos. of fish in millions):

	4	5	6	7	8	9
Old estimate	10.9	7.3	5.5	9.2	8.3	1.4
New estimate	15.9	10.3	6.5	9.7	8.5	1.3

As well about 3.9 million yellowtail were caught at age 3 in 1988.

The mean weights at age were also adjusted according to the new proportions of catch at age in the 1988 fisheries.

Catch at age and mean weights at age, 1968-89

The catch matrix for this stock is shown in Table 10 in numbers and in Table 11 in percentages. As can be seen here, and as was noted above, there are many more young fish in the catch in 1988-89 than in previous years. It must be stated, however, that the calculation of the catch at age in earlier years was based on fewer samples, and that in recent years, there are substantial segments of the fishery which have not been sampled at all, eg. the catch by some non-member countries. In 1986, this catch amounted to some 13,400 t, or about 45% of the nominal catch. As can be seen from the above text table, the calculation of removals at age is very sensitive to the amount of catch applied to the sampling from the various fleets, given the vastly different age compositions of the catches by different countries. Therefore, the confidence which can be placed in the calculation of catch at age from large amounts of non-sampled catch must be very low. A second important point to note is that the Spanish catch at age has been estimated from age-length keys from Canadian surveys in Div. 3N. This was necessary because the keys from the Canadian commercial fishery did not cover the lengths of fish taken in the Spanish fishery. It is likely that there would be some selectivity differences in the trawls used in the fishery compared to those used in the surveys, which would therefore introduce biases in the estimated size at age. Given these uncertainties with the catch at age, these data cannot be used in any assessment model based on sequential population analysis.

The mean weights at age for 1968-89 are shown in Table 12. The weights at ages 7+ have been relatively stable in recent years, but have been declining at the younger ages. This is likely to be a result of the shift in the exploitation pattern to younger ages, and the same caveats which were expressed about the catch at age in recent years obviously apply to these data as well. Table 13 shows the calculated catch biomass at age, which compare reasonably well to the nominal catches in most years, although the discrepancies are larger than those observed for many other stocks.

Research vessel surveys

A) Spring groundfish 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 1990. Figure 3 shows the stratification scheme used in the surveys. Tables 14-16 show the mean weight-per-tow on a stratified basis, along with the total estimated biomass for Div. 3L, 3N, 3N, and 3Ø respectively. Most of the biomass of this stock is found in Div. 3N, and has declined from about 60,000 t in 1985-86 to about 33,000 t in 1988-1989, with a 17% increase in 1990 to 42,000 t. Overall, the stock biomass (Div. 3LNØ) has decreased from 94,000 t in 1985-86 to 82,000 t in 1987, and to about 50,000 t in 1988-89. The value for the 1990 survey is higher at 59,000 t. Table 17 shows the trends in strata 360 and 376, which are located mainly outside the 200 mile limit, compared to the rest of Div. 3N. After declining to negligible levels from 1984 to 1988, the biomass in these strata in 1989 was estimated to comprise over 40% of the total biomass in Div. 3N. The 1990 survey showed that only 14% of the total biomass was found in these two strata while over 70% of the biomass was found in strata 361 and 375, which are located mainly inside the 200 mile limit.

As was done in the 1989 assessment, a multiplicative model was employed to obtain estimates of abundance which accounted for strata not surveyed in some years. Using the same dataset, with the addition of the 1990 values, produced the abundance estimates shown in Table 18. As was done in 1989, the age by age estimates for the current year were calculated from the population structure in strata surveyed in Div. 3NØ. The estimates from 1971 to 82 have been adjusted upward by a factor of 1.4 to account for the different vessel-gear used in these surveys. After the decline from very high levels in the early 1970s the abundance remained relatively stable between 240 and 340 million from 1975 to 1984, after which time it declined steadily to about 100 million in 1988.

In 1989 the estimate increased by 30% to 132 million and the recent survey shows a further 12% increase in numbers, but is still the 3rd lowest value in the 19 year series. The decline from the mid-to late 1980s is also present in the groundfish surveys conducted by the USSR, as is the increase in abundance from 1988 to 1989.

On an age by age basis, the 1982 year-class, which was reported in the 1989 assessment as being poor at age 7, improved slightly at age 8 in 1990. The 1983 year-class also appeared slightly stronger at age 7 in 1990 but is still relatively poor and appears as the third lowest estimate at age 7 in the time series.

The 1984 and 1985 year-classes, which appeared strong in the 1989 survey, do not show to be as strong in the 1990 survey at ages 6 and 5 years, respectively. In the 1989 survey, about 90% of the total population abundance of these year-classes was found in strata largely outside the 200 mile limit. These two year-classes also comprised 80% of the catch-at-age in the 1989 Spanish fishery on the "Tail of the Bank" (Fig. 4). In the 1990 survey the population size of these two year-classes at ages 5 and 6 years was approximately the same as in the 1989 survey but only 50% of the population was found in the two strata (360 and 376) outside the 200 mile limit (Table 19).

B) Juvenile yellowtail surveys

During August-September of 1989, a stratified-random survey of the Grand Bank (Fig. 3) was conducted by the research vessel WILFRED TEMPLEMAN, consisting of two hundred and fifteen (215) successful 30-minute fishing hauls. In addition to the survey, 18 tagging sets were made and a total of 505 American plaice and 1213 yellowtail in the size range 14-30 cm were tagged in stratum 360, in areas inside and outside the 200 mile zone. This survey constituted year 5 in a time series for juvenile flatfish. The majority of fishing hauls were made inside the 91 m depth zone to the 183 m zone.

The standard juvenile flatfish trawl, a Yankee 41 shrimp trawl, was used in the survey. This trawl has a mesh size of 38 mm throughout, uses a 12 mm stretched mesh codend liner, and is rigged with rubber bobbin footgear. The standard towing speed used was 2.5 knots and each haul was 30 minutes duration, covering a distance of 1.25 miles.

The WEBBER[1] sampling design, formulated in 1985 to give independent day and night biomass estimates of yellowtail flounder using randomly assigned day and night hauls within strata to track diel variability in trawl catches, was modified in 1988 (see Walsh, 1986, for a detailed description of this method). In 1985-87, an attempt was made to sample all strata inside the 91 m contour using this day/night split survey, but in 1988 it was decided to only use this design in the selected strata 352, 360, 361, 375, and 376, which are used to monitor juvenile yellowtail abundance. All of the other strata were surveyed in the regular way. This scheme was again followed for the 1989 survey and the areal coverage extended into the slope waters to a depth of 183 m.

Table 20 shows the average numbers and weights, along with biomass and abundance estimates from the juvenile surveys in 1985-89. All depth strata to the 183 m contour were sampled in 1989. Largest catches (in numbers) of yellowtail were made in stratum 360 (dominated by the 1985 year-class) strata 361, 362, 375, and 376 in Div. 3N, and stratum 352 in Div. 3Ø. Catches in Div. 3L were smaller in comparison.

Table 21 shows a comparison of average numbers and weights of yellowtail flounder derived from independent day and night estimates, and the sum of the two, for juvenile yellowtail from the selected strata in the 1985-89 surveys. Again in 1989, the abundance estimates of yellowtail derived from night catches were larger than those derived from day catches, with biomass estimates being about twice as high. Biomass estimates showed a large increase from 1988 due to large numbers of 7 year old fish (1982 year-class) showing up in catches in Stratum 352 in Div. 3Ø and stratum 361 of Div. 3N. About 66% of catches of this age group were found in these two strata when compared to the other selected strata (Table 22). Examination of catches on a set by set basis revealed that in Stratum 352, one set contributed 19% of the overall numbers caught in that stratum and one set in stratum 361 contributed 37% of the overall numbers caught in that stratum. These large catches may have inflated the overall estimates of this year-class which previously has shown to be weak in the time series of both the regular spring groundfish surveys and the fall juvenile surveys (Brodie et al 1989).

Tables 23 and 24 contain information on the age compositions of the 1985-89 juvenile surveys from selected strata. In 1989 the overall average number per tow was twice that of the 1988 estimate in selected strata, being greatly inflated by the 1985 year-class showing up strongly at age 4 in the catches (Table 23). Estimates of ages 1 to 4 year old contributed 50% of the total abundance. Age 7+ yellowtail showed an increase from 1988 with the 1982 year-class contributing 23% of the estimate (Table 24). In 1989, the 1984 and 1985 year-classes were dominant, as was seen in the 1989 spring surveys (Table 24, Fig. 5). As well, the 1989 juvenile survey indicated that the 1986 year-class at age 3 also appears to be strong.

Assessment

The two Canadian and one USSR survey in 1989 showed an increase in abundance from 1988, with the 1990 Canadian groundfish survey showing a further slight increase, although the population size is still at a relatively low level. The Canadian CPUE has been relatively stable from 1986 to 1989, at a level similar to the lowest observed previously. The fact that the 1989 CPUE did not decline was viewed as a positive indication, given that in the 1988

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[1]An acronym based on the names of researchers at DFO's Newfoundland Region who designed a double (day and night) biomass stratified-random survey.

assessment it was noted that "the prospects for the 1989 and 1990 fisheries, which should be comprised mainly of the 1981-83 year-classes, are very poor." (NAFO Sci. Coun. Rep. 1988, p. 65). This is consistent with the data in the Canadian surveys, which showed the relative strengths of the 1982-83 year-classes to be greater in both 1989 and 1990 than had been estimated in 1987-88. The 1984 and 1985 year-classes still appeared to be stronger than the three preceding poor ones, but did not appear to be as strong in 1990 compared to 1989. However, substantial numbers of yellowtail from these year-classes were taken in fisheries in the Regulatory Area in 1988 and 1989.

The information from 1989 to 1990 in the RV survey and CPUE indices points to a slightly more optimistic view of this stock in 1990 compared to the previous two assessments. Although the stock is still at a relatively low level, there is improved recruitment from the 1984-85 year-classes, and the size of the 1982-83 year-classes appeared to be larger in 1989-90 compared to 1987-88. In 1988, a decrease in the TAC from 15,000 t to 5,000 t was advised, based mainly on the mean estimate of abundance of age 5-7 yellowtail in the Canadian spring surveys in 1987-88, which were estimated to be about 30% of the mean at these ages from the historic data. Although the mean estimate of abundance at these ages increased by about 50% in the 1989-90 surveys, this is not sufficient on its own to recommend a change in the current TAC, given the variability inherent in surveys.

In retrospect, the rationale used in 1988 to derive the 5,000 t TAC may have lead to a somewhat pessimistic view of the resource, given that CPUE data were not considered directly in the calculation and that the 1988 survey produced the lowest estimates of the 1981-83 year-classes. Therefore, it was decided to use a modified approach in analyzing the indices of abundance, in which the current levels of these indices were compared to the levels during a period of relative stability in the stock.

From 1977 to 1984, the Canadian surveys showed a relatively stable index of abundance at ages 5-7, averaging about 200 million fish. The CPUE index during these years also showed little trend, and had a mean value of about 0.64. Catches were also relatively stable with a mean of about 14,100 t. In the 1987-90 surveys, the mean abundance at ages 5-7 was only 78 million, or 38% of the mean in the earlier period. However, the CPUE, which was stable from 1986 to 1989, had a mean value of about .51, which was abut 80% of the mean from 1977 to 1984. It was considered that the CPUE, which was calculated only from the Canadian fleet, was likely to represent an overestimate of total stock biomass in recent years because the smaller portion of the stock outside 200 miles was not covered by this fishery. However, this alone does not account for the difference in the ratios of the indices between the earlier and later periods (38% in the surveys, 80% in the CPUE) and the reduction in stock abundance is more likely to be somewhere between these values. Therefore, it was concluded that the abundance of the stock was currently about 50% of the abundance in 1977-84, when an exploitation rate which produced an average catch of 14,100 t did not result in trends in the indices of abundance. Applying this level of exploitation to the current stock size implies that a catch of about 7,000 t for 1991 would not be harmful to the stock in its present condition. This corresponds to an exploitation rate of less than 15% of the mean biomass from the Canadian RV surveys in 1988-90.

The reduction of the TAC to 5,000 t in 1989 succeeded in restricting the catch, which was less than half the value in 1987-88. If the current TAC of 5,000 t for 1990 has a similar effect, there will have been a substantial reduction in catch from the level of about 30,000 t in 1985-86.

This stock is no longer declining, although it is still at a relatively low level compared to earlier years. The 1984-85 year-class sizes appeared to be larger than those of the preceding 3 year-classes, and these 2 stronger year-classes will contribute to the spawning stock in 1990-91. The estimated increase in population size at ages 5-7 in 1989-90 over 1987-88 will not translate into any long-term increases in population size or catch beyond 1991, as yellowtail at ages 9+ usually comprise less than 5% on average of the commercial and RV survey catches, i.e. have essentially disappeared from the fishery and possibly the population.

The rationale for increasing the TAC to 7,000 t assumes an exploitation pattern at age similar to that observed in the earlier period (1977-84) when ages 5-8 dominated the catch. It was concluded that the population size at these ages is now higher than previously estimated, and the fishery could sustain an increase in catch from these ages before they virtually disappeared from the fishery after age 8. This does not account for the recent shift in exploitation toward younger yellowtail in the Regulatory Area. This fishery will continue to be difficult to manage if unregulated catches by non-member countries increase from the low levels of 1988-89 to the levels estimated in 1985-86. The situation is compounded by the fact that the effective mesh size being used by some fisheries in the Regulatory Area appears to be much lower than the NAFO-regulated minimum.

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Table 1. 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	12,437	89	-	2,373	1,836[b]	16,735	17,000
1985	13,440	-	-	4,278	11,245[b]	28,963	15,000
1986	14,168	77	-	2,049	13,882[b]	30,176	15,000
1987	13,420	51	-	125	2,718[b]	16,314	15,000
1988[c]	10,614	-	-	1,383	4,166[b]	16,263	15,000
1989[c]	5,007			1,000[d]	1,551[b]	7,558	5,000
1990							5,000

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

[b]Includes some catches estimated from surveillance reports. See Table 2.

[c]Provisional.

[d]Estimate.

Table 2. Breakdown of 1984-89 catches from Table 1 listed as "other".

Year	Spain	Portugal	Panama[a]	USA	Cayman Islands[a]	Other	Total
1984	25	-	1,800	-	-	11	1,836
1985	2,425	-	4,208	3,797	803	12	11,245
1986	366	5,521	4,044	2,221	1,728	2	13,882
1987	1,183	-	-	1,535	-	-	2,718
1988[b]	3,205	-	-	861	-	100[c]	4,166
1989[b]	1,126	6	-	319	-	100[d]	1,551

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

[b]Provisional.

[c]Includes some estimated catches.

[d]Assumed catch.

Table 3. 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	10,799	672	-	16,735
1985[a,b]	3,478	23,912	1,573	-	28,963
1986[a,b]	3,053	25,475	1,648	-	30,176
1987[a]	1,600	12,791	1,923	-	16,314
1988[a,b,c]	2,126	12,421	1,716	-	16,263
1989[b,c]	861	4,977	1,720	-	7,558

[a]Includes estimated 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 4. Summary of actual Canadian catch (t) and effort (hrs) data used in the multiplicative analysis of CPUE.

Year	Div. 3L		Div. 3N		Div. 30	
	Catch	Effort	Catch	Effort	Catch	Effort
1965	-	-	1374	1732	-	-
1966	-	-	1282	1699	104	160
1967	190	351	705	998	52	132
1968	1585	2428	524	648	104	183
1969	1103	1863	2110	3393	19	40
1970	4138	8295	8208	12875	72	166
1971	3030	6291	11066	17885	60	154
1972	3031	7040	11218	17063	297	652
1973	1617	3206	18338	28083	1272	2226
1974	399	1329	13002	30222	624	2224
1975	1312	4385	10303	23882	1730	5274
1976	107	491	3673	10749	1106	3589
1977	847	2420	3563	7696	646	2324
1978	599	1917	7830	14769	865	2719
1979	873	2606	11872	22214	526	1567
1980	568	1579	6878	10150	414	1020
1981	682	1725	9566	15120	174	345
1982	699	1802	4794	9013	92	321
1983	477	1247	4071	6925	54	88
1984	1890	4247	4861	10064	107	217
1985	830	1928	5804	9771	235	727
1986	624	1976	7819	16472	450	1567
1987	209	707	8157	17857	608	1933
1988	252	856	5254	11831	600	2148
1989	64	260	1386	3797	594	2057

Table 5. Results of multiplicative analysis of Canadian CPUE data.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R............. 0.766
MULTIPLE R SQUARED..... 0.587

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.143E1	2.143E1	
REGRESSION	39	2.846E0	7.298E¯2	25.309
TYPE 1	2	4.061E¯1	2.031E¯1	70.418
TYPE 2	2	2.383E¯1	1.192E¯1	41.322
TYPE 3	11	4.488E¯1	4.080E¯2	14.147
TYPE 4	24	1.099E0	4.577E¯2	15.872
RESIDUALS	694	2.001E0	2.884E¯3	
TOTAL	734	2.627E1		

TYPE 1 = COUNTRY-GEAR-TC
3114=CAN(N),OTB1,TC4
3124=CAN(N),OTB2,TC4
3125=CAN(N),OTB2,TC5

TYPE 2 = DIVISION
32=3L,34=3N,35=3O

TYPE 3 = MONTH

TYPE 4 = YEAR

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	0.154	0.099	734
2	34				
3	10				
4	65				
1	3114	1	¯0.293	0.028	156
	3124	2	¯0.227	0.031	127
2	32	3	¯0.189	0.025	176
	35	4	¯0.189	0.029	139
3	1	5	¯0.217	0.076	19
	2	6	¯0.298	0.072	20
	3	7	¯0.246	0.055	33
	4	8	¯0.277	0.046	54
	5	9	¯0.302	0.040	104
	6	10	¯0.374	0.041	94
	7	11	¯0.334	0.042	93
	8	12	¯0.228	0.042	88
	9	13	¯0.040	0.043	77
	11	14	¯0.097	0.047	50
	12	15	¯0.208	0.056	36
4	66	16	0.039	0.126	11
	67	17	¯0.070	0.128	12
	68	18	¯0.266	0.121	14
	69	19	¯0.380	0.114	20
	70	20	¯0.373	0.102	41
	71	21	¯0.403	0.100	41
	72	22	¯0.527	0.101	44
	73	23	¯0.404	0.100	50
	74	24	¯0.803	0.103	36
	75	25	¯0.828	0.103	35
	76	26	¯0.887	0.110	26
	77	27	¯0.703	0.104	36
	78	28	¯0.689	0.101	51
	79	29	¯0.653	0.101	46
	80	30	¯0.553	0.105	30
	81	31	¯0.555	0.106	30
	82	32	¯0.649	0.109	23
	83	33	¯0.488	0.108	23
	84	34	¯0.528	0.108	27
	85	35	¯0.510	0.105	29
	86	36	¯0.805	0.106	30
	87	37	¯0.780	0.106	29
	88	38	¯0.862	0.108	26
	89	39	¯0.852	0.118	16

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1965	0.1543	0.0097	1.163	0.114	3130	2692
1966	0.1930	0.0089	1.209	0.114	7026	5810
1967	0.0839	0.0097	1.084	0.106	8878	8191
1968	-0.1113	0.0068	0.893	0.074	13340	14940
1969	-0.2257	0.0053	0.797	0.058	15708	19709
1970	-0.2190	0.0026	0.803	0.041	26426	32890
1971	-0.2486	0.0024	0.780	0.038	37342	47869
1972	-0.3724	0.0023	0.689	0.033	29259	42448
1973	-0.2494	0.0022	0.780	0.036	32815	42095
1974	-0.6482	0.0026	0.523	0.027	24313	46484
1975	-0.6739	0.0025	0.510	0.026	22894	44907
1976	-0.7330	0.0040	0.480	0.030	8057	16778
1977	-0.5485	0.0031	0.578	0.032	11638	20144
1978	-0.5345	0.0025	0.586	0.029	15466	26390
1979	-0.4983	0.0024	0.608	0.030	18351	30197
1980	-0.3990	0.0034	0.671	0.039	12377	18450
1981	-0.4006	0.0033	0.670	0.039	14680	21919
1982	-0.4942	0.0039	0.610	0.038	13319	21844
1983	-0.3333	0.0034	0.716	0.042	10473	14620
1984	-0.3736	0.0037	0.688	0.042	16735	24326
1985	-0.3553	0.0030	0.701	0.038	28963	41319
1986	-0.6509	0.0031	0.522	0.029	30176	57863
1987	-0.6252	0.0031	0.535	0.030	16314	30488
1988	-0.7074	0.0035	0.493	0.029	16263	33002
1989	-0.6977	0.0058	0.497	0.038	7558	15207

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.062

Table 6. Samples used to calculate catch at age and average weights at age for yellowtail in the Canadian fishery in Division 3LNO in 1989. Numbers in parentheses are the number of observations, and n is the number of samples.

Age-length key	Length frequency	n	Catch (t)	Description
ALKOF2CN3L (31)	LFOTAPRCN3L (427)	1	340	OT + Sc.S., 3L, Jan-Jun
+	JUL (724)	2	280	" " Jul
ALKOF3CN3L (164)	AUG (679)	2	133	" " Aug
	SEP (628)	1	108	" " Sep-Dec
			861	
	LFOTAPRCN3N (301)	1	9	" 3N, Jan-Apr
ALKOF2CN3N (227)	MAY (1347)	3	717	" " May
	JUN (457)	1	347	" " Jun
			1073	
ALKOF3CN3N (255)	JUL (1514)	3	883	" " Jul-Aug
	SEP (730)	2	168	" " Sep
			1051	
ALKOF3CN3N (255) + ALKOF4CN3N (88)	OCT (1096)	3	331	" " Oct-Dec
	LFSCAPRCN3Ø (460)	1	156	Sc.S., 3Ø, Jan-Jun
ALKOF2CN3Ø (163)	OTAPRCN3Ø (360)	1	7	OT, " Jan-Apr
	MAY (312)	1	335	" " May
	JUN (842)	2	503	" " Jun
			1001	
ALKOF3CN3Ø (156)	JUL (1120)	3	487	Sc.S + OT, " Jul
	AUG (406)	1	203	" " Aug-Dec
			690	

Total Canadian catch = 5007 t

Table 7. Catch at age (000) and mean weights at age (kg) of yellowtail in the Canadian fishery in 1989 in Div. 3LNO.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
* 5	0.218	30.083	131	16.75	0.13
* 6	0.318	33.582	986	62.85	0.06
7	0.439	36.871	3978	140.98	0.04
8	0.586	40.088	4150	135.91	0.03
* 9	0.867	44.947	541	42.22	0.08
*10	1.370	51.356	16	4.53	0.28

Table 8a. Comparison of yellowtail catch at age ('000) from the Canadian, Spanish, and USA fisheries in Div. 3LNO in 1989.

Age	Canada		USA		Spain	
	Catch	%	Catch	%	Catch	%
1					1	0.01
2					198	1.6
3					1,448	11.7
4					6,635	53.4
5	131	1.3	29	4.0	3,163	25.5
6	986	10.1	273	37.7	850	6.8
7	3,978	40.6	290	40.0	95	0.8
8	4,150	42.3	113	15.6	27	0.2
9	541	5.5	19	2.6	7	0.06
10	16	0.2	1	0.1		
Total	9,802		725		12,424	
Catch (t)	5,007		319		1,126	

Table 8b. Comparison of yellowtail mean weights at age (kg) from the Canadian, Spanish, and USA fisheries in Div. 3LNO in 1989. The bottom row (S.O.P.) indicates the sum of the catch numbers at age times mean weights at age.

Age	Canada	USA	Spain
1			.006
2			.015
3			.034
4			.073
5	.218	.236	.151
6	.318	.311	.229
7	.439	.447	.404
8	.586	.679	.726
9	.867	.965	1.033
10	1.370	1.282	
Catch (t)	5007	319	1126
S.O.P. (t)	5011	316	1274

Table 9a. Comparison of yellowtail catch at age ('000) from the Canadian fishery in Div. 3LNO from 1986 to 1989 (1986-88 from last year's assessment).

Age	1986 Catch	%	1987 Catch	%	1988 Catch	%	1989 Catch	%
3	1				1	0.01		
4	4	0.01	3	0.01	85	0.4		
5	813	2.9	471	1.8	546	2.8	131	1.3
6	4,210	15.1	5,055	19.0	2,877	14.8	986	10.1
7	13,007	46.5	10,935	41.0	7,365	37.8	3,978	40.6
8	8,088	28.9	8,437	31.7	7,322	37.6	4,150	42.3
9	1,650	5.9	1,609	6.0	1,226	6.3	541	5.5
10	186	0.7	107	0.4	66	0.3	16	0.2
11			1		1	0.01		
Total	27,959		26,618		19,489		9,802	
Catch (t)	14,155		13,144		10,544		5,007	

Table 9b. Comparison of yellowtail average weights at age (kg) from the Canadian fishery in Div. 3LNO from 1986 to 1988.

Age	1986	1987	1988	1989
3	-	-	.11	-
4	.09	.15	.18	-
5	.26	.22	.25	.22
6	.36	.33	.33	.32
7	.47	.45	.45	.44
8	.62	.61	.62	.59
9	.84	.84	.92	.87
10	1.03	1.21	1.28	1.37
11	1.26	1.67	1.50	-

TABLE 10. CATCH (000) OF YELLOWTAIL AT AGES 4-10 FROM 1968-89.

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
4	573	80	141	169	1943	3734	1375	955	409	1391	691	1061	1142	3245	111	25	116	108	609	5	15893	11593
5	6202	2993	2776	7534	10128	21280	19800	11240	2529	3211	3654	4783	5130	5077	1501	2081	1440	2127	6365	912	10389	5687
6	12483	15035	19839	30365	22502	23709	18100	20931	7650	6851	10979	13067	8383	8191	5244	6792	13160	15558	13677	6838	6454	2744
7	9154	12076	20615	22117	19416	17053	11200	12737	5361	7331	11028	14284	7139	9991	8901	7862	14341	26544	27433	12741	9773	4434
8	1421	3150	4557	5869	10553	4713	2400	2536	953	4078	3870	4940	1519	4361	7591	3932	3932	11133	13940	9213	8506	4310
9	47	326	610	2152	4206	862	850	372	74	1433	310	773	224	356	2184	546	281	1538	2988	1791	1342	572
10	1	40	68	245	1110	300	130	23	15	289	34	109	28	29	307	25	11	193	272	135	78	17
4+	29881	33700	48606	68451	69858	71651	53855	48794	16991	24584	30566	39017	23625	31250	25839	21264	33280	57201	65284	31635	52435	29357
5+	29308	33620	48465	68282	67915	67917	52480	47839	16582	23193	29875	37956	22483	28005	25728	21239	33165	57093	64675	31630	36542	17764
6+	23106	30627	45689	60748	57787	46637	32680	36599	14053	19982	26221	33173	17353	22928	24227	19158	31725	54966	58310	30718	26153	12077
7+	10623	15592	25850	30383	35285	22928	14580	15668	6403	13131	15242	20106	8970	14737	18983	12366	18564	39408	44633	23880	19699	9333

TABLE 11. CATCH (PCT) OF YELLOWTAIL AT AGES 4-10 FROM 1968-89.

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	1988	1989
4	4.8	10.4	0.4	0.1	0.3	0.2	0.9	0.0	30.3	39.5
5	21.7	16.2	5.8	9.8	4.3	3.7	9.7	2.9	19.8	19.4
6	35.5	26.2	20.3	31.9	39.5	27.2	21.0	21.6	12.3	9.3
7	30.5	32.0	34.4	37.0	43.1	46.4	42.0	40.3	18.6	15.1
8	6.4	14.0	29.4	18.5	11.8	19.5	21.4	29.1	16.2	14.7
9	0.9	1.1	8.5	2.6	0.8	2.7	4.6	5.7	2.6	1.9
10	0.1	0.1	1.2	0.1	0.0	0.3	0.4	0.4	0.1	0.1

TABLE 12. MEAN WEIGHTS (KG) OF YELLOWTAIL AT AGES 4-10 FROM 1968-89.

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
4	0.247	0.247	0.247	0.247	0.247	0.247	0.200	0.184	0.200	0.214	0.249	0.178	0.271
5	0.305	0.305	0.305	0.305	0.305	0.305	0.300	0.298	0.322	0.324	0.315	0.278	0.274
6	0.456	0.456	0.456	0.456	0.456	0.456	0.452	0.450	0.486	0.409	0.430	0.378	0.493
7	0.610	0.610	0.610	0.610	0.610	0.610	0.600	0.569	0.615	0.532	0.557	0.504	0.635
8	0.725	0.725	0.725	0.725	0.725	0.725	0.725	0.743	0.814	0.648	0.740	0.668	0.750
9	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.953	1.030	0.809	0.981	0.787	0.927
10	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.110	1.200	0.905	1.240	0.756	1.220

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989
4	0.228	0.225	0.198	0.194	0.118	0.092	0.135	0.087	0.073
5	0.308	0.277	0.321	0.288	0.247	0.189	0.194	0.123	0.153
6	0.349	0.329	0.401	0.368	0.356	0.301	0.307	0.273	0.266
7	0.496	0.464	0.507	0.489	0.493	0.456	0.444	0.436	0.438
8	0.661	0.648	0.652	0.674	0.699	0.616	0.607	0.618	0.590
9	0.909	0.899	0.909	1.000	1.000	0.863	0.844	0.918	0.874
10	1.190	1.260	1.260	1.170	1.310	1.070	1.210	1.270	1.365

TABLE 13. CATCH BIOMASS (T) OF YELLOWTAIL AT AGES 4-10 FROM 1968-89.

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
4	142	20	35	42	480	922	275	176	82	298	172	189	309
5	1892	913	847	2298	3089	6430	5940	3350	814	1040	1151	1330	1406
6	5692	6856	9047	13846	10261	10811	8181	9419	3718	2802	4721	4939	4133
7	5584	7366	12575	13491	11844	10402	6720	7247	3297	3900	6143	7199	4571
8	1030	2284	3304	4255	7651	3417	1740	1884	776	2643	2864	3300	1139
9	40	274	514	1812	3541	726	716	355	76	1159	304	608	208
10	1	41	70	252	1143	309	134	26	18	262	42	82	34
4+	14380	17754	26391	35937	38009	33078	23706	22456	8781	12104	15397	17648	11800

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989
4	740	25	5	22	13	56	1	1383	846
5	1564	416	668	415	525	1197	177	1278	870
6	2859	1725	2724	4843	5539	4117	2099	1762	730
7	4956	4130	3986	7013	13086	12509	5657	4261	1942
8	2883	4919	2564	2650	7782	8587	5592	5257	2543
9	324	1963	497	281	1538	2579	1512	1232	500
10	35	387	31	13	253	291	163	99	23
4+	13359	13565	10475	15236	28736	29336	15201	15271	7454

Table 14. Mean weight of yellowtail per 30 minute tow, by stratum, from research vessel surve in Division 3L. Numbers in parentheses are the number of successful tows in each stratum.

Depth (fm)	Stratum	No. of trawlable units	Year-Trip 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	114,023	-	-	-	-	-	-	0.0(3)	-	0.0(5)
51-100	341	118,151	-	-	0.0(3)	-	-	-	0.1(4)	0.1(4)	0.0(6)
51-100	342	43,913	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(4)
51-100	343	39,409	-	-	-	-	-	-	0.0(2)	0.0(3)	0.0(4)
101-150	344	112,146	-	-	-	-	-	0.0(4)	0.0(4)	0.0(4)	0.0(2)
151-200	345	107,492	-	-	-	-	-	0.0(4)	0.0(4)	0.0(2)	0.0(4)
151-200	346	64,931	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(4)
101-150	347	73,788	0.0(2)	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(4)	0.0(4)
51-100	348	159,136	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	158,686	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	155,458	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	133,614	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	211,456	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	78,142	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	104,639	0.0(3)	-	-	0.0(3)	0.0(4)	0.0(4)	0.0(4)	-	0.0(4)
151-200	368	25,071	0.0(2)	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	-	0.0(4)
101-150	369	72,137	0.0(3)	-	-	0.0(3)	0.0(3)	0.0(4)	0.0(3)	0.0(2)	0.0(4)
51-100	370	99,085	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	84,147	88.5(3)	6.4(2)	-	0.0(3)	-	-	1.4(3)	0.3(3)	0.5(3)
31-50	372	184,658	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	84,072	86.0(3)	3.0(2)	2.3(3)	0.6(3)	-	-	7.0(2)	0.0(3)	1.5(4)
51-100	385	176,851	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	73,788	0.0(2)	-	-	0.0(3)	0.0(3)	0.0(2)	0.0(3)	0.0(3)	0.0(4)
151-200	387	53,896	0.0(3)	-	-	0.0(3)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(4)
151-200	388	27,098	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	61,628	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	111,170	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	21,168	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(4)
151-200	392	10,884	-	-	0.0(3)	0.0(4)	0.0(2)	-	0.0(2)	0.0(3)	0.0(2)
201-300	729	13,962	-	-	-	-	-	-	-	-	-
301-400	730	12,761	-	-	-	-	-	-	-	-	-
201-300	731	16,214	-	-	-	-	-	-	-	-	-
301-400	732	17,340	-	-	-	-	-	-	-	-	-
201-300	733	35,130	-	-	-	-	-	-	-	-	-
301-400	734	17,115	-	-	-	-	-	-	-	-	-
201-300	735	20,417	-	-	-	-	-	-	-	-	-
301-400	736	13,136	-	-	-	-	-	-	-	-	-
Biomass ('000 t)			64.5	9.2	9.2	1.4	1.5	8.5	11.0	4.9	7.8

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 WT 70,71	1989 WT 82,83	1990[a] WT 96
51-100	328	-	0.0(2)	0.0(3)	0.0(2)	0.0(4)	0.0(9)	0.0(7)	0.0(2)	0.0(8)	
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)	0.0(8)	
51-100	342	0.0(4)	-	0.0(3)	0.0(4)	0.0(3)	0.0(3)	0.2(2)	0.0(2)	0.1(3)	
51-100	343	0.0(4)	0.0(2)	0.0(4)	-	0.0(3)	0.0(4)	0.0(3)	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(6)	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(8)	0.0(9)	
151-200	346	0.0(3)	0.0(3)	0.0(3)	-	0.0(2)	0.0(5)	0.0(5)	0.0(4)	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)	0.0(6)	
51-100	348	0.0(7)	0.0(7)	0.0(4)	-	0.0(18)	0.0(12)	0.1(8)	0.0(11)	0.0(9)	
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)	0.0(11)	
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)	0.6(11)	
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)	1.5(9)	
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)	0.0(16)	
51-100	365	0.0(4)	0.0(2)	0.0(3)	-	0.0(7)	0.0(5)	0.0(5)	0.0(4)	0.0(6)	
101-150	366	0.0(4)	0.0(3)	0.0(5)	-	0.0(6)	0.0(8)	0.0(7)	0.0(6)	0.0(8)	
151-200	368	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	
101-150	369	0.0(3)	0.0(2)	0.0(2)	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	
51-100	370	0.0(3)	0.0(2)	0.0(2)	-	0.0(8)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	
31-50	371	80.5(3)	0.0(2)	1.1(4)	-	0.4(7)	0.3(6)	0.0(7)	0.1(5)	0.1(6)	
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)	12.7(13)	
31-50	384	0.0(2)	0.4(2)	10.3(2)	-	4.6(6)	1.6(6)	1.1(7)	0.2(5)	0.1(6)	
51-100	385	0.0(4)	0.0(3)	0.0(3)	-	0.0(15)	0.0(13)	0.0(11)	0.0(10)	0.0(12)	
101-150	386	0.0(3)	0.0(2)	0.0(3)	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	
151-200	387	0.0(2)	0.0(2)	0.0(3)	-	0.0(6)	0.0(4)	0.0(4)	0.0(4)	0.0(5)	
151-200	388	0.0(2)	0.0(2)	0.0(2)	-	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(5)	0.0(5)	0.0(6)	0.0(3)	0.0(5)	
51-100	390	0.3(3)	0.0(2)	0.8(4)	-	0.3(9)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	
101-150	391	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	
151-200	392	0.0(2)	0.0(2)	0.0(2)	-	0.0(2)	0.0(2)	0.2(2)	0.0(2)	0.0(3)	
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	2.7	1.4

[a]Preliminary analysis.

Table 15. 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.

Depth (fm)	Stratum	No. of trawlable units	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
			Year-Trip								
151-200	357	12,317	-	-	0.0(2)	-	-	-	0.0(2)	-	0.0(3)
101-150	358	16,899	-	0.0(4)	0.0(3)	-	-	-	0.0(2)	-	0.0(2)
51-100	359	31,620	-	0.0(3)	0.0(3)	-	-	0.0(3)	0.0(2)	-	0.0(4)
31-50	360	224,717	-	58.3(4)	-	-	12.1(4)	128.6(4)	55.9(4)	43.5(4)	27.6(9)
31-50	361	139,171	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	189,267	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	189,267	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	69,924	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	119,644	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	112,584	-	45.4(2)	10.3(3)	-	82.1(2)	126.4(3)	78.3(3)	4.6(2)	86.4(4)
51-100	377	7,511	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(3)
101-150	378	10,440	0.0(2)	0.0(2)	0.0(2)	0.2(3)	-	-	0.0(2)	1.4(2)	0.0(3)
151-200	379	7,961	-	-	0.0(2)	0.0(3)	-	-	0.0(2)	0.3(2)	0.0(3)
151-200	380	8,712	-	0.0(2)	0.0(3)	0.0(2)	-	-	0.0(2)	-	0.0(2)
101-150	381	13,669	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	48,594	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	50,621	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

Depth (fm)	Stratum	1980 ATC 303-5	1981 ATC 317-9	1982 ATC 327-9	1984 ATC 27-28	1985 WT 29	1986 ATC 245-6	1987 WT 58-60	1988 WT 70	1989 WT 82	1990[a] WT 95-96
		Year-Trip									
151-200	357	0.0(3)	0.0(2)	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)	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)	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)	30.9(15)	
31-50	361	128.4(7)	-	118.9(6)	139.9(5)	67.1(7)	44.1(10)	73.8(8)	88.7(7)	48.6(10)	
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)	30.5(13)	
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)	14.8(13)	
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)	0.1(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)	23.2(8)	
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)	72.6(8)	
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)	0.0(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)	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)	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)	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)	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)	0.0(3)	
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)	0.0(3)	
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)	26.5(94)	-(85)
Biomass ('000 t)		79.7	70.1	54.4	104.6	56.7	65.0	49.9	34.4	33.3	42.6

[a]Preliminary analysis

Table 16. 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	No. of trawlable units	1973 ATC 207, 208,209	1975 ATC 233	1976 ATC 245,246	1977 ATC 262,263	1978 ATC 276,277	1979 ATC 289, 290,191	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	1989 WT 82	1990[a] WT 94-95
51-100	329	129,257	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)	0.0(9)	-
31-50	330	156,896	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)	1.2(11)	-
31-50	331	34,248	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)	18.7(2)	-
51-100	332	78,636	-	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)	12.7(5)	-
101-150	333	11,341	-	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)	0.0(2)	-
151-200	334	6,910	-	-	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)	0.0(2)	-
151-200	335	4,356	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)	0.0(2)	-
101-150	336	9,088	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)	0.0(2)	-
51-100	337	71,200	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)	1.7(5)	-
31-50	338	142,551	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)	7.2(10)	-
51-100	339	43,937	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)	0.0(3)	-
31-50	340	128,882	-	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)	3.4(9)	-
31-50	351	189,267	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)	21.9(13)	-
31-50	352	193,773	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)	27.0(13)	-
31-50	353	96,286	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)	6.0(7)	-
51-100	354	35,600	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)	0.1(2)	-
101-150	355	7,736	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)	0.0(2)	-
151-200	356	4,581	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)	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)	9.9(101)	11.9(92)
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	13.4	15.6

[a]Preliminary analysis.

Table 17. Comparison of yellowtail biomass (000 t) from different strata in Division 3N from surveys in 1984-90.

	Stratum 360[a]	Stratum 376[b]	Total 360+376	Total all other strata 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
1989	6.9	8.2	15.1	18.2	33.3
1990	1.5	4.5	6.0	36.6	42.6

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

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

TABLE 18.ABUNDANCE AT AGE(MILLIONS), ADJUSTED TO MULT.MODEL TOTALS.

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.1	0.1
3	6.9	8.4	0.7	1.6	0.8	3.9	0.2	2.9	0.9	5.0
4	81.1	62.9	9.9	14.4	12.7	16.6	3.1	9.9	6.0	11.1
5	182.2	124.0	65.5	46.2	63.9	74.2	18.6	38.2	12.6	37.9
6	343.2	142.4	84.6	79.3	92.1	101.3	45.4	70.4	50.3	97.7
7	310.7	76.8	86.4	40.1	106.9	93.1	121.4	73.1	129.2	140.0
8	41.8	24.5	33.1	4.8	26.0	18.8	99.3	38.2	61.8	45.4
9	13.3	2.6	11.3	0.7	2.9	0.4	27.7	4.0	7.2	3.1
10	0.2	0.2	1.0	0.0	0.2	0.0	4.2	0.1	0.9	0.1
11	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0
1+	979.3	441.7	292.4	187.3	305.6	308.4	320.1	237.0	269.0	340.4
2+	979.3	441.7	292.4	187.3	305.6	308.4	320.1	237.0	269.0	340.4
3+	979.3	441.7	292.4	187.1	305.6	308.4	320.1	236.8	268.9	340.3
4+	972.4	433.3	291.7	185.5	304.8	304.5	319.9	233.9	268.0	335.3
5+	891.3	370.4	281.8	171.1	292.1	287.9	316.8	224.0	262.0	324.2
6+	709.1	246.4	216.3	124.9	228.2	213.6	298.2	185.8	249.4	286.3
7+	366.0	104.0	131.7	45.6	136.1	112.4	252.8	115.4	199.1	188.6
8+	55.3	27.3	45.3	5.5	29.2	19.3	131.4	42.3	69.9	48.6
9+	13.5	2.8	12.2	0.7	3.1	0.5	32.1	4.1	8.1	3.2
10+	0.2	0.2	1.0	0.0	0.2	0.1	4.5	0.1	0.9	0.1

AGE	1981	1982	1984	1985	1986	1987	1988	1989	1990
1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	1.4	0.0	0.0	0.0	0.0	0.1	0.2	0.0
3	1.1	5.5	0.3	0.7	0.1	0.1	0.1	2.4	0.8
4	2.0	18.8	3.5	2.5	1.8	0.5	1.2	23.8	7.9
5	8.7	38.6	26.4	12.9	11.8	6.4	1.6	25.9	22.1
6	37.4	56.1	94.0	52.8	30.3	20.2	9.5	27.3	29.3
7	96.0	87.4	131.0	90.9	93.7	56.5	31.8	33.5	45.6
8	100.5	56.7	56.5	42.1	45.7	76.3	45.8	17.2	38.6
9	19.3	13.9	4.4	3.3	6.6	7.6	9.1	1.7	4.9
10	5.2	2.0	0.1	0.3	0.5	0.6	0.4	0.1	0.4
11	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1+	270.2	280.8	316.2	205.5	190.5	168.2	99.7	132.2	149.5
2+	270.2	280.7	316.2	205.5	190.5	168.2	99.7	132.2	149.5
3+	270.2	279.3	316.2	205.5	190.5	168.2	99.6	132.0	149.5
4+	269.1	273.8	315.9	204.8	190.4	168.1	99.5	129.6	148.7
5+	267.2	255.0	312.4	202.3	188.6	167.6	98.3	105.8	140.9
6+	258.5	216.4	286.0	189.4	176.8	161.2	96.7	79.9	118.8
7+	221.0	160.3	192.0	136.6	146.5	141.0	87.1	52.5	89.5
8+	125.0	72.9	61.0	45.7	52.8	84.5	55.3	19.0	43.9
9+	24.5	16.2	4.5	3.6	7.1	8.2	9.5	1.8	5.3
10+	5.2	2.3	0.1	0.3	0.5	0.6	0.4	0.1	0.4

Table 19a. Age composition of yellowtail flounder in Division 3N inside and outside (strata 360 and 376) 200-mile limit, expressed as a percent of total abundance (millions) from research vessel surveys in 1989 and 1990.

	Juvenile-1989					Spring 1990				
	Total	Outside		Inside		Total	Outside		Inside	
Age	abundance	Abundance	%	Abundance	%	abundance	Abundance	%	Abundance	%
1	4.1	2.6	63.4	1.5	36.6	0	0	0	0	0
2	18.2	11.5	63.3	6.7	36.7	0	0	0	0	0
3	42.1	33.5	79.6	8.4	20.4	0.7	0.4	57.1	0.3	42.9
4	135.3	118.8	87.8	16.5	12.2	7.0	4.9	70.0	2.1	30.0
5	65.9	53.9	81.8	12.0	18.2	19.2	13.0	67.7	6.1	32.3
6	38.2	24.9	65.2	13.3	34.8	24.1	8.8	36.5	15.3	63.5
7	40.6	12.8	31.5	27.8	68.5	27.5	1.8	15.3	25.7	84.7
8	20.8	4.5	21.6	16.2	78.4	23.2	0.4	1.7	22.8	98.3
9	2.7	0.5	18.5	2.2	81.5	3.6	0	0	3.6	100
10	0	0	-	0		0.3	0	0	0.3	100
Total	367.9	263.0		104.6		105.7	29.2		76.2	

Table 19b. Comparison of age composition of yellowtail flounder in NAFO Division 3N inside and outside (strata 360 and 376) the 200-mile limit derived from research surveys in 1989-90, and the Canadian and Spanish fisheries in 1989 (abundance and catch are in millions of fish).

	Juvenile Survey - 1989				Spring - 1990				Canadian fishery - 1989		Spanish fishery - 1989	
	Outside		Inside		Outside		Inside					
Age	Abundance	%	Abundance	%	Abundance	%	Abundance	%	Catch	%	Catch	%
1	2.6	1.0	1.5	1.4	0	0	0	0	0	0	0	0
2	11.5	4.4	6.7	6.4	0	0	0	0	0	0	0.1	0.8
3	33.5	12.7	8.4	8.0	0.4	1.4	0.3	0.4	0	0	1.5	12.2
4	118.8	45.2	16.5	15.8	4.9	16.8	2.1	2.8	0	0	6.6	53.7
5	53.9	20.5	12.0	11.5	13.0	44.5	6.1	8.0	0.1	1.0	3.2	26.0
6	24.9	9.5	13.3	12.7	8.8	30.1	15.3	20.1	1.0	10.3	0.9	7.3
7	12.8	4.9	27.8	26.6	1.8	6.2	25.7	33.7	3.9	40.2	0	0
8	4.5	1.7	16.2	15.5	0.4	1.4	22.8	29.9	4.2	43.3	0	0
9	0.5	0.2	2.2	2.1	0	0	3.6	4.7	0.5	5.2	0	0
10	0	0	0	0	0	0	0.3	0.4	0	0		0
Total	263.0		104.6		29.2		76.2		9.7		12.3	

Table 20. A comparison of average numbers and weights of yellowtail per 30-minute set for Div. 3LNO from juvenile surveys in 1985-89.

Div.	Stratum	Category	1985	1986	1987	1988	1989
3Ø	330	No. of sets	-	-	-	2	7
		Av. no./set				10.99	6.87
		Av. wt./set				5.50	3.54
3Ø	331	No. of sets	-	-	-	2	2
		Av. no./set				0.50	12.50
		Av. wt./set				0.25	7.75
3Ø	340	No. of sets	-	-	-	3	6
		Av. no./set				7.59	33.50
		Av. wt./set	-			2.85	15.33
3Ø	338	No. of sets	-	3	-	6	6
		Av. no./set		86.67		18.99	48.50
		Av. wt./set		41.17		9.58	20.12

Table 20 (Cont'd.).

Div.	Stratum	Category	1985	1986	1987	1988	1989
3L	350	No. of sets	5	6	-	5	8
		Av. no./set	59.00	7.83		37.97	0.88
		Av. wt./set	25.50	3.58		3.70	0.49
3Ø	351	No. of sets	3	9	-	7	8
		Av. no./set	166.00	175.78		85.93	69.38
		Av. wt./set	63.67	66.00		28.68	29.31
3Ø	352	No. of sets	-	13	1[a]	11	14
		Av. no./set		210.77	134	164.78	206.93
		Av. wt./set		73.68	65.35	58.81	77.43
3Ø	353	No. of sets	-	5	-	4	3
		Av. no./set		118.00		19.24	21.67
		Av. wt./set		68.75		9.19	10.33
3N	360	No. of sets	3	14	19	20	19
		Av. no./set	57.67	259.14	192.22	112.51	373.03
		Av. wt./set	26.83	19.96	12.75	22.73	46.28
3N	361	No. of sets	6	8	8	6	9
		Av. no./set	99.83	188.50	399.94	162.38	286.33
		Av. wt./set	33.58	61.78	174.37	62.29	107.86
3N	362	No. of sets	9	7	2	6	8
		Av. no./set	166.89	109.14	38.00	129.29	103.13
		Av. wt./set	59.50	43.14	16.75	57.64	45.31
3L	363	No. of sets	5	5	-	6	7
		Av. no./set	53.80	48.89		42.47	13.71
		Av. wt./set	21.00	22.77		19.65	7.54
3L	371	No. of sets	4	-	-	5	4
		Av. no./set	2.25			1.20	6.50
		Av. wt./set	1.88			0.70	3.70
3L	372	No. of sets	9	8	-	8	8
		Av. no./set	93.06	101.00		64.83	41.00
		Av. wt./set	39.49	48.13		34.31	20.21
3N	373	No. of sets	10	7	-	8	8
		Av. no./set	160.80	112.93		29.85	32.25
		Av. wt./set	75.60	49.60		15.74	15.38
3N	374	No. of sets	4	4	-	4	3
		Av. no./set	16.00	12.00		5.25	0.33
		Av. wt./set	7.50	6.38		3.63	0.17
3N	375	No. of sets	7	5	7	9	8
		Av. no./set	228.29	236.65	407.26	146.44	284.88
		Av. wt./set	104.14	115.19	43.22	25.67	88.88
3N	376	No. of sets	2	4	10	12	9
		Av. no./set	148.50	325.75	1015.22	363.72	916.22
		Av. wt./set	47.75	150.46	58.55	38.79	160.04
3N	383	No. of sets	4	-	-	4	3
		Av. no./set	0.00			2.00	0.00
		Av. wt./set	0.00			0.32	0.00
3L	384	No. of sets	4	-	-	5	4
		Av. no./set	35.25			1.00	0.25
		Av. wt./set	22.88			0.18	0.13
3L	328	No. of sets	3				
		Av. no./set	0.00				
		Av. wt./set	0.00				
3Ø	329	No. of sets	4				
		Av. no./set	0.00				
		Av. wt./set	0.00				

Table 20 (Cont'd.).

Div.	Stratum	Category	1985	1986	1987	1988	1989
3Ø	332	No. of sets	4				
		Av. no./set	6.50				
		Av. wt./set	0.00				
3Ø	337	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3Ø	339	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3L	341	No. of sets					4
		Av. no./set					0.00
		Av. wt./set					0.00
3L	342	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3L	343	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3L	348	No. of sets					7
		Av. no./set					0.00
		Av. wt./set					0.00
3L	349	No. of sets					5
		Av. no./set					0.00
		Av. wt./set					0.00
3Ø	354	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3N	359	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3L	364	No. of sets					11
		Av. no./set					0.00
		Av. wt./set					0.00
3L	365	No. of sets					4
		Av. no./set					0.00
		Av. wt./set					0.00
3L	370	No. of sets					6
		Av. no.set					0.00
		Av. wt./set					0.00
3L	382	No. of sets					2
		Av. no./set					0.00
		Av. wt./set					0.00
3L	385	No. of sets					5
		Av. no./set					0.00
		Av. wt./set					0.00
3L	390	No. of sets					4
		Av. no./set					0.00
		Av. wt./set					0.00
Total		No. of sets	75	98	46	134	215
		Av. no./set	104.92	147.90	342.59	78.77	82.46
		Av. wt./set	43.35	53.05	53.55	24.37	22.17
Abundance (million nos.)			286.1	448.0	318.0	298.9	516.9
3L Biomass			22.9	22.7	-	13.6	7.2
3N Biomass			78.2	85.4	59.6	56.10	92.7
3Ø Biomass			17.1	52.5	-	28.8	38.9
Total biomass (000 t)			118.2	160.7	59.6	92.5	138.9

Table 21. A comparison of average numbers and weights of yellowtail flounder per 30-minute tows from day and night and combined surveys. Selected strata in Div. 3NØ used. Abundance and biomass are given at the bottom of the table.

Stratum	Category	1985 Day	1985 Night	1985 Combined	1986 Day	1986 Night	1986 Combined	1987 Day	1987 Night	1987 Combined	1988 Day	1988 Night	1988 Combined	1989 Day	1989 Night	1989 Combined
352	No. of sets	-	-	-	7	6	13	-	-	-	6	5	11	4	10	14
	Av. no./set				78.29	365.33	210.77				60.67	290.00	164.91	115.25	243.6	206.93
	Av. wt./set				37.86	115.47	72.68				26.75	97.37	58.85	48.88	88.85	77.43
360	No. of sets	3	-	3	7	7	14	7	12	19	11	8	20	12	7	19
	Av. no./set	57.67		57.67	20.57	497.71	259.14	24.57	290.25	192.22	39.18	227.63	112.60	540.72	85.55	373.03
	Av. wt./set	26.83		26.83	5.50	34.43	19.96	2.72	18.61	12.75	10.89	41.89	22.75	61.42	20.31	46.28
361	No. of sets	4	2	6	4	4	8	4	4	8	2	4	6	6	3	9
	Av. no./set	58.50	182.50	99.83	160.00	217.00	188.50	146.75	653.75	399.94	137.00	175.25	162.50	197.33	464.33	286.33
	Av. wt./set	26.13	63.50	36.58	72.81	50.75	61.78	69.25	279.75	174.37	77.00	55.00	62.33	93.25	137.07	107.86
375	No. of sets	4	3	7	2	3	5	3	4	7	6	3	9	5	3	8
	Av. no./set	60.50	452.00	228.29	4.10	391.69	236.65	29.33	691.25	407.26	19.33	401.00	146.56	161.20	491.00	284.88
	Av. wt./set	36.50	194.33	104.14	1.40	191.05	115.19	14.75	64.63	43.22	9.69	57.70	25.69	70.10	120.17	88.88
376	No. of sets	-	-	2	3	1	4	3	7	10	7	5	12	5	4	9
	Av. no./set	-		148.50	69.67	-	325.76	109.67	1404.23	1015.22	148.57	665.60	364.00	456.20	1491.25	916.22
	Av. wt./set	-		47.75	19.70	-	150.46	22.00	74.27	58.22	16.13	50.59	38.82	69.50	273.22	160.04
Total	No. of sets	11	5	18	23	20	44	17	27	44	32	25	58	32	27	59
	Av. no./set	59.00	344.20	118.91	67.36	385.95	240.92	70.12	692.37	439.31	74.24	322.28	175.20	306.31	452.83	381.08
	Av. wt./set	30.09	142.00	49.04	28.55	85.50	73.53	24.31	78.55	65.24	26.99	64.30	41.32	66.42	108.87	87.44
Abundance (000s)		40.0	112.4	100.3	71.1	367.3	269.3	59.1	561.9	370.9	83.0	360.4	195.8	342.4	506.2	426.0
Biomass (000s t)		19.7	45.5	41.3	57.8	84.7	82.2	20.5	83.8	55.0	30.2	71.9	46.1	74.2	121.7	97.7

Table 22. Comparison of catches of age 7 year old yellowtail flounder from selected strata in the 1989 juvenile survey.

Stratum	Division	Average catch per tow	Abundance (1000's)	% Catch
352	3Ø	89.47	24,536	38
360	3N	7.27	2,313	4
361	3N	91.58	18,037	28
375	3N	54.17	9,680	15
376	3N	66.03	10,521	16
Total			65,089	

Table 23. Average numbers per tow at age from selected strata in juvenile flatfish surveys of NAFO Division 3NØ (strata 352, 360, 361, 375, and 376) 1985-89.

Age	1985[a]	1986	1987[a]	1988	1989
1	4.72	21.48	30.48	5.67	3.68
2	2.76	16.95	113.11	15.01	17.88
3	1.43	27.29	88.50	40.07	40.20
4	7.29	10.05	80.17	27.81	125.86
5	9.98	18.99	20.09	17.27	62.01
6	14.67	41.41	19.05	18.19	43.82
7	35.32	53.87	37.65	31.45	58.22
8	35.45	41.66	46.10	17.47	24.57
9	7.10	8.07	4.40	2.37	2.87
10	0.36	0.62	0.12	0.02	0.09
11	0.00	0.08	0.00	0.00	0.01
Av. no./tow	119.08	240.47	439.67	175.33	379.21

[a]Incomplete survey, stratum 352 not surveyed.

Table 24. 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	1985[a]	1986	1987[a]	1988	1989
1	3,978	24,015	25,718	6,343	4,113
2	2,330	18,944	95,432	16,781	19,992
3	1,209	30,511	74,667	44,793	44,941
4	6,151	11,238	67,634	31,092	140,700
5	8,420	21,225	16,951	19,309	69,326
6	12,377	46,289	16,073	20,337	49,002
7	29,801	60,226	31,764	35,159	65,089
8	29,906	46,568	38,897	19,528	27,468
9	5,989	9,016	3,714	2,654	3,212
10	301	688	99	18	96
Unknown	0	88	698	70	432
Totals 1+	100,462	268,720	370,949	196,014	423,939
4+	92,945	195,250	175,132	128,174	354,893
7+	65,997	116,498	74,474	57,429	95,865
1 - 4	13,668	84,708	263,451	99,009	209,746

[a]Incomplete survey; Stratum 352 not surveyed.

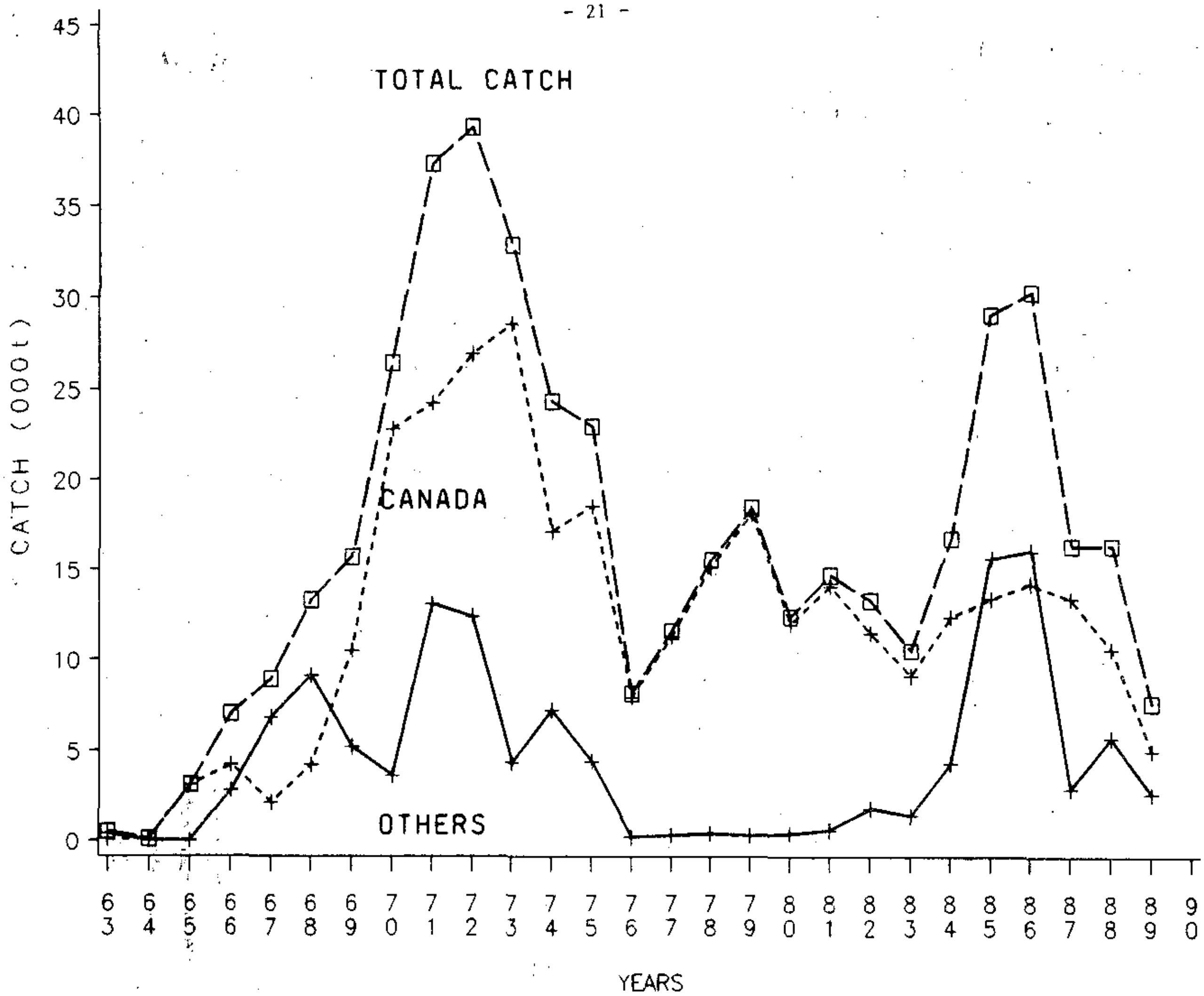

FIG. 1 . YELLOWTAIL CATCHES IN DIV.3LNO.

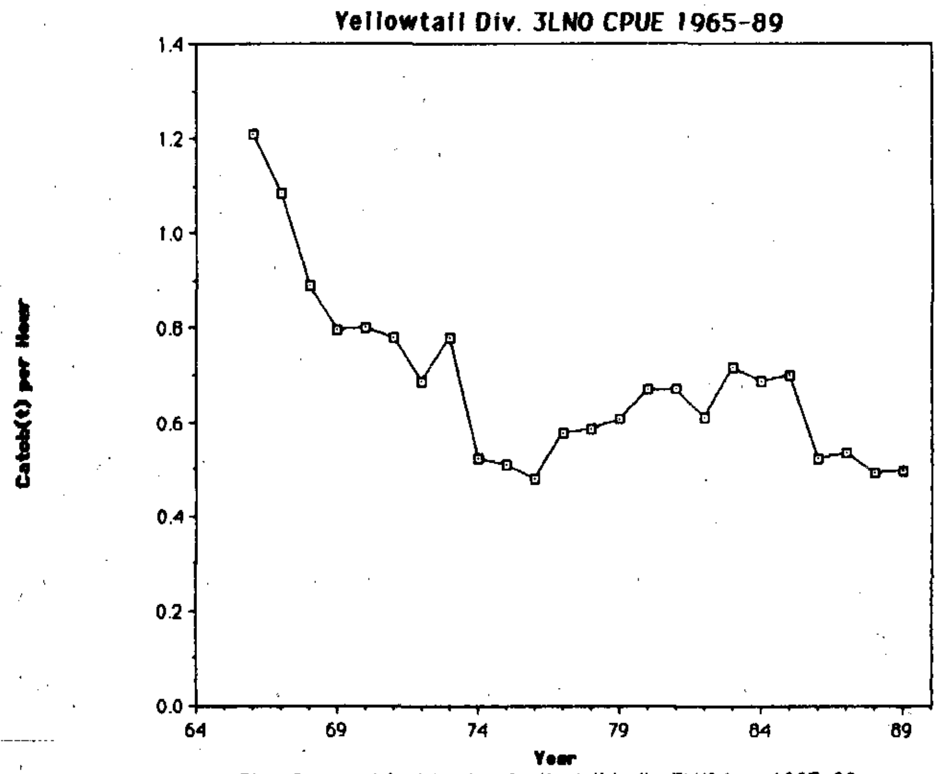

Fig 2 Commercial catch rates of yellowtail in div. 3LNO from 1965-89.

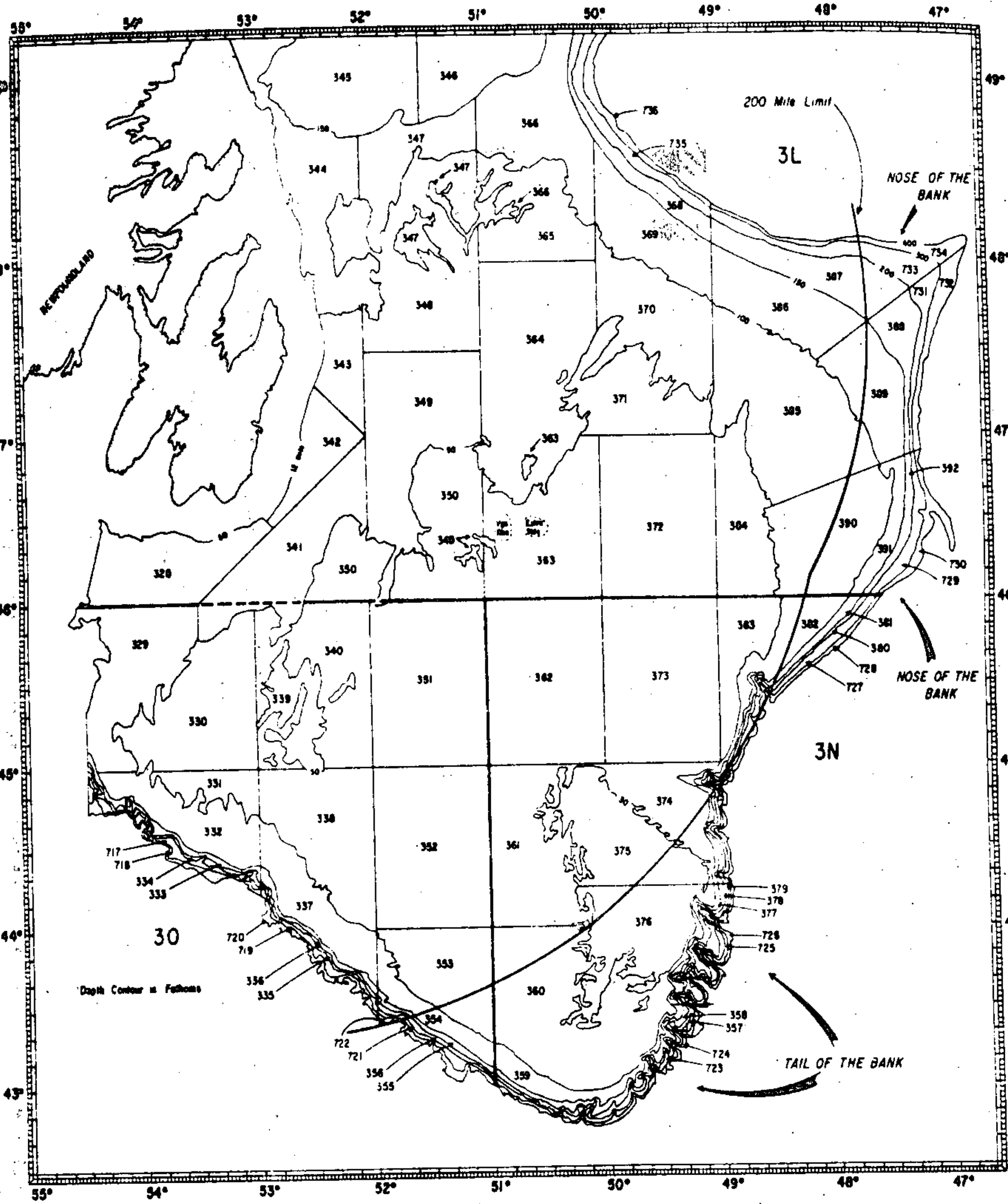

Fig. 3 NAFO Div. 3LNO, showing the Canadian 200 mile limit in relation to the Nose and Tail of the Bank, as well as the stratification scheme used in Canadian groundfish surveys.

Figure 4: Comparison of percent catch-at-age for juvenile yellowtail flounder (ages 1-10) from 1989 research survey and Canadian and Spanish catches inside and outside the 200 mile line.

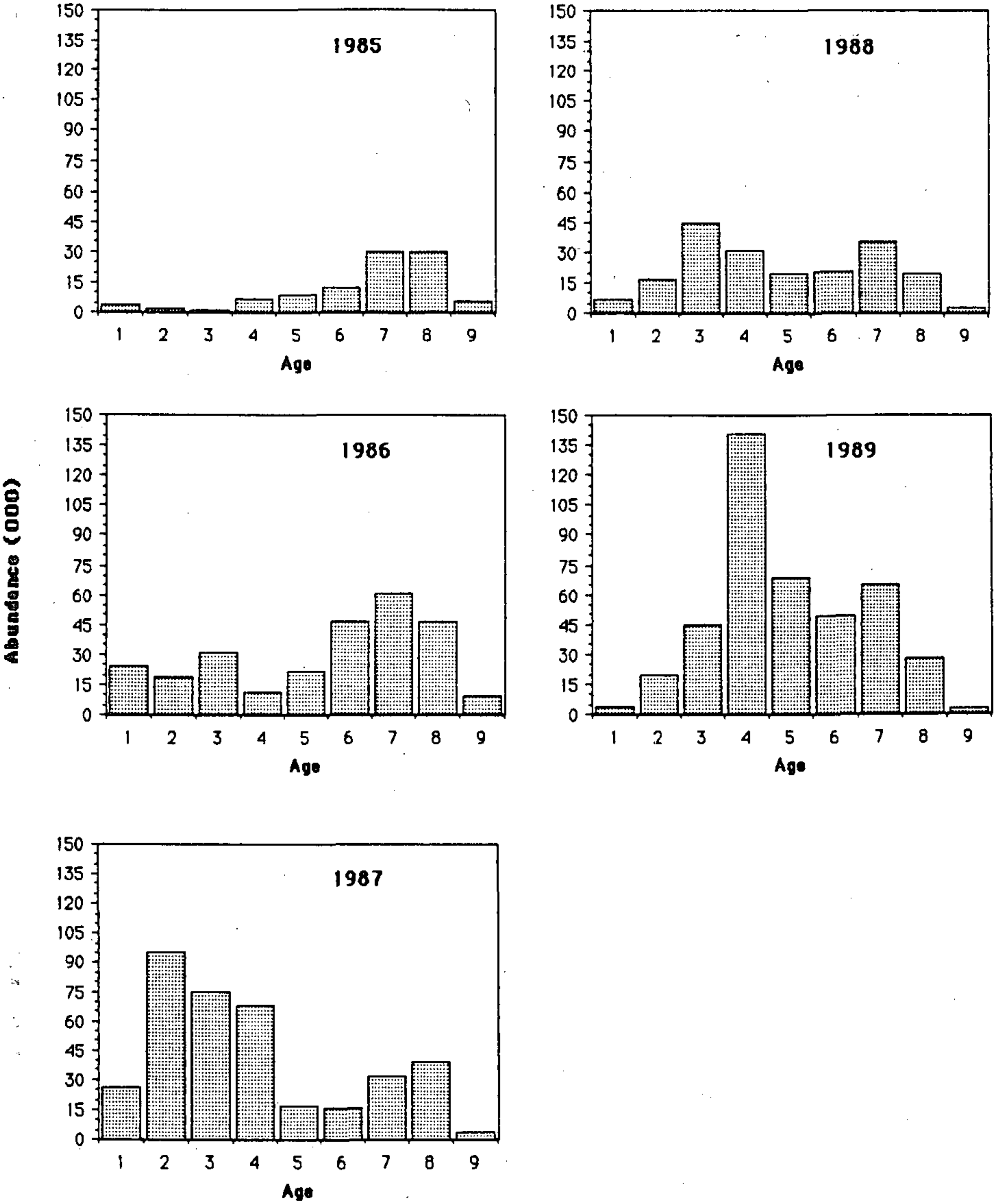

Fig.5 Abundance of yellowtail flounder from selected strata injuvenile flatfish surveys on the Grand Bank from 1985-89.