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An Assessment of the Yellowtail Flounder Stock in Divisions 3LNO

by

W. B. Brodie, and S. J. Walsh

Science Branch, Dept. of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland Canada A1C 5X1

TAC regulation

TACs have been in place since 1973, when a precautionary level of 50,000 t was established. In 1976, the TAC was set at 9000 t, following a series of high catches (Fig.1, Table 1) and a reduction in stock size. From 1977-88, the TAC varied between 12,000 t and 23,000 t and was unchanged at 15,000 t for the last 4 years of that period. The TAC was set at 5000 t in 1989 and maintained at that level for 1990, following sharp declines in stock size after the large catches in 1985 and 1986. For 1991 and 1992, the TAC was set at 7000 t as there appeared to be some improved recruitment to the fishable stock.

Catch trends

The nominal catch *increased from* negligible levels in the early 1960s to a peak of over 39,000 t in 1972 (Fig. 1). Canada and the USSR were the major participants in the fishery up to 1975, with Canada taking virtually all the catch from 1976-81 (Table 1). Catches by other nations began to increase in 1982 as freezer trawlers started to fish in the NAFO Regulatory Area on the Tail of the Bank (Fig.2). In 1985 and 1986, catches for all other nations exceeded those of Canada and total removals from the stock were about 30,000 t in each year. Catches by most fleets declined in subsequent years as some of the fishing effort was diverted to redfish in the deeper waters of the Regulatory Area, although catches in 1989 to 1991 were still well above the TAC.

The following text table shows the catches for 1990 and 1991:

	1990	1991
Canada	4,969	6,642
USA	6	
S. Korea	5,903	3,000
Others	3,111	5,458
Total	13,989	15,100

The catches for S. Korea in many years include a substantial amount of yellowtail determined from breakdowns of catches reported as unspecified flounder. The Korean catch in 1990 is the highest value for this country (Table 1). The 1991 Korean catch was obtained from Canadian surveillance estimates as S.Korea has not yet reported its 1991 catches to NAFO. USA catches have declined steadily in recent years (Table 2), with the small catches in 1990-91 likely to be the result of improved yellowtail flounder catches off New England.

As in most years, catches of yellowtail flounder in 1990 and 1991 were mainly from Div. 3N. Table 3 shows the trends by division from 1965 to 1988. However in 1991 the Canadian fleet caught 2500 t of yellowtail in Div. 3O (Table 4), which is the highest Canadian catch in this Division since 1976 (Table 5). This increase can be attributed to the shift in effort of the Canadian flounder fishery (for both A. plaice and yellowtail) to Div. 3O in 1991 (Table 6), resulting in a higher by-catch of yellowtail. As usual, most of the directed yellowtail fishery by Canada in 1991 took place in Div. 3N (Table 7).

Overall, the catches in 1989 to 1991 were lower than the preceding few years. However, there is still considerable doubt about the precise catch levels from this stock in recent years. About 25% of the catch from this stock in 1984-86 was determined from Canadian surveillance reports and estimates of the proportion of yellowtail flounder in catches of unspecified flounder by S. Korea. Based on the above text table, the estimated portion of the catch in 1991 could be higher than 50%. Given that Panama and Cayman islands continue to fish in the Regulatory Area along with vessels from several other nations who are not Contracting Parties of NAFO, it is possible that some yellowtail flounder has been taken in recent years, probably as a by-catch, which is not included in the catch estimates. Data from surveillance for these nations is not always adequate to allow a breakdown of flounder catches by species.

Determination of catch-at-age and mean weights-at-age from the commercial fishery

Length frequency samples are available from the Portuguese catch , the Spanish catch, and the Canadian catch in 1991. Most of the Portuguese gillnet catch was between 30 cm and 35 cm, resulting in a peak in the age distribution at age 6, however the fish were generally smaller than this in the otter trawl catches. The Spanish length frequency data were summed over all months and adjusted to represent a catch of 3600 t. As in recent assessments, an age-length key from the Canadian juvenile survey in Div. 3N in the same year was used to determine numbers-at-age. Ages 5 and 6 made up over 86% of these catch numbers, with the dominant year-class being that of 1985. This year-class has was also dominant in the 1989 and 1990 Spanish fishery catch, when it accounted for 53 and 40% respectively of the catch numbers (Fig.3).

Data from the Canadian fishery is shown in Table 8 and the resulting age composition is given in Table 9. To comply with a recommendation of STACFIS in 1991, catch at age and mean weights at age from the Canadian fishery were calculated for years prior to 1986. Tables 10 to 13 show these results. In most years ages 6 to 8 comprise over 85% of the catch numbers (Tables 10 and 11), although prior to 1982 more young fish were present in the catches. The reason for this is a change in mesh size from 120 mm to 130 mm by the Canadian fleet in late 1981. The mean weights at age have shown little in the way of trends in recent years (Table 12).

In the 1990 assessment of this stock, it was demonstrated that large changes in the age composition of the catch could be generated by slight changes in how samples were applied to catches, given the large differences in the age composition of catches by different fleets. It was also stated that large portions of catch in some years (e.g., 40%-45% in 1986) had no sampling whatsoever. These same caveats apply to the 1990 and 1991 data, where the S. Korean catch is estimated to be over 25% of the total catch, and for which no sampling data are available. Thus, at present, there is no reliable catch-at-age calculated for the total removals from this stock for many of the years since 1984.

Commercial C/E data

A multiplicative analysis was carried out on the catch and effort data for this stock, using the same model as in the recent assessments. Canada took almost all the catch from this stock from 1976 to 1983, so only data from this fishery is available as a C/E index. Canadian data from 1965 to 1991 were input to the model. Table 14 gives the results of the analysis, including the C/E index, which is also shown in Figure 4. Catch per unit of effort declined fairly steadily from 1965 to 1976, then rose gradually to a relatively stable level in 1983-85. The index declined sharply in 1986 and remained at this relatively low level through 1989, followed by an increase in 1990 of about 15%. In 1991 the CPUE declined 45% from 1990 to the lowest level in the time series. Further examination of the data showed that this decline was greatest in Div. 3O and that the CPUE in Div. 3N, while lower than in 1990, was still at the level observed in 1988 and 1989. Thus the decline in the overall index in 1991 was due to the switch in effort of the fleet to Div. 3O. Some of the effort labelled 'directed yellowtail' in this Division was undoubtedly effort directed at a mixed fishery of A.plaice and yellowtail. The 1991 value for CPUE does not translate into a similar decline in stock size, although it does indicate that the stock continues to remain at a relatively low level.

Table 15 shows the catch rate at age in number of fish per hour from the Canadian fishery from 1977-1991. The effort values used were those derived from the multiplicative analysis described above and shown in Table 14. These data show the C/E at most ages in 1991 to be relatively low, which is not unexpected given the results of the C/E analysis discussed previously. There is generally very little catch at ages other than 6-8 from this fishery in recent years, although C/E at the younger ages was higher before 1982, due undoubtedly to the smaller mesh size in use at that time.

Research vessel surveys

A) Spring groundfish surveys - Canada

Stratified-random trawl surveys have been conducted by Canada in Div. 3LNO since 1971 with the exception of 1983. Stratification is based on depth and the survey strata are presented in Fig.2. Tables 16 to 18 give the mean weight per tow by stratum as well as the total biomass for Div. 3L, 3N, and 3Ø respectively. Most of the biomass for this stock occurs in Div. 3N (about 60%-70% in recent years) and has declined from 65,000 t in 1986 to between 33 and 40 thousand tons in 1989-91. In 1992 the biomass estimate was approximately 28,000 t. The total stock biomass has been variable and in the range of 80,000-140,000 t during the early 1980s; however, during the 1988-91 period the biomass has been fairly stable but lower, averaging about 55,000 t. Preliminary results from the 1992 survey suggest a reduction of about 30%. Trends in biomass for strata located wholly or partly outside the 200-mile limit are shown in Table 19 for the 1984-92 period. Biomass estimated from these strata declined steadily from 1984 to 1988 but has been at a higher level since then due mainly to the strength of the 1984-86 year-classes.

Survey abundance at age for all three divisions combined is presented in Table 20. To account for incomplete survey coverage during some years, estimates for non-sampled strata, derived using a multiplicative model, were included in the calculation of total abundance. It was assumed that the age composition in these non-sampled strata was the same as those strata where sampling occurred. The estimates for 1971-82 were also increased by a factor of 1.4 to account for a different vessel-gear combination used during this period. The estimates for 1971-1974 are not presented as it was felt that these were not as reliable due to the large numbers of missing strata in these years. Total survey abundance for the 1975-84 period was fairly stable, averaging just under 300 million fish; however, during 1985-88, a steady decline occurred and the 1988 abundance was estimated to be only about 100 million fish (Fig. 5). The 1989-91 values are about 30 to 50% higher than the 1988 estimate but are still among the lowest in the 16-year research vessel time series for this stock. Age by age estimates of abundance from the 1992 survey are not available at this time.

The Canadian surveys are usually dominated by yellowtail of ages 5-8 years (Table 20). The 1985 and 1986 year-classes, age 6 and 5 years respectively in 1991, appear to be larger than any year-classes at these ages in the most recent 5 or 6 years. The 1985 year-class also appeared to be quite large at age 4 in the 1989 survey. The 1984 year-class (age 7 in 1991) appears to be on a par with recent year-classes at that same age. The 1983 year-class, which appeared relatively strong at ages 6 and 7 in 1989 and 1990 respectively was estimated to be one of the lowest in the time series at age 8. Fig.6 shows the size of year-classes as measured at age 5 in the surveys, and indicates that the 1984-86 year-classes appear to be larger than their immediate predecessors. However, it should be noted that all year-class strengths observed from surveys in the most recent period are considerably lower than those observed during the 1970s and early 1980s.

B) Spring groundfish surveys - USSR

USSR/Russia has conducted stratified random surveys for groundfish in Div. 3LNO since 1983, and before then, fixed station surveys which were post-stratified for purposes of comparison. Abundance and biomass estimates for yellowtail from these surveys are presented in Figs 7 and 8. These data show a higher stock size in the 1970's and early 1980's, followed by a decline to lower levels in the late 1980's and early 1990's. The 1991 results (in total) were similar to those of 1990. No age by age information was available from the 1991 survey.

C) Fall groundfish surveys

Stratified-random bottom trawl surveys have been conducted by Canada during the fall in Div. 3L since 1981. In 1990 and 1991, this survey was extended to cover Div. 3N and 3Ø. In both years, the abundance and biomass were lower in the fall than in spring, with the fall 1991 results being higher than fall 1990 (Fig.9). Age 7 was dominant in the catches in both fall surveys, although age 6 in 1991 (1985 year-class) was almost as abundant. In the 4 surveys conducted in 1990 and 1991 (2 spring and 2 fall), the total abundance estimate (age 1+) has fluctuated between 90 and 150 million fish.

C) Juvenile yellowtail surveys

During August-September of 1991, a stratified-random survey of the Grand Bank (Fig.2) was conducted by the research vessel WILFRED TEMPLEMAN, consisting of 206 successful 30-minute fishing hauls. This survey constituted year 7 in a time series for juvenile flatfish. From 1985-88, the survey covered strata inside the 91-m (50 fm.) isobath; and since 1989 the coverage has been extended out to the 183-m (100 fm) isobath.

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 30-cm rubber bobbin footgear. The standard towing speed used was 2.5 knots and each haul was 30 minutes duration, covering an average 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 selected strata which are used to monitor juvenile yellowtail abundance, these being strata 352, 360, 361, 375, and 376. All of the other strata were surveyed in the regular manner. This scheme was again followed in the 1989, 1990, and 1991 surveys.

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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.

Tables 21-23 show the average numbers and weights, along with biomass and abundance estimates of all three divisions from the juvenile surveys in 1985-91. In 1991, as in most years, largest catches (in numbers) of yellowtail were made in strata 360, 361, 362, and 375, and 376 in Div. 3N; and stratum 352 in Div. 3Ø. Since the extended coverage in 1989, the biomass of Div. 3L has showed some small fluctuations, with Div. 3Ø showing some stability. For the period 1989-91 the biomass of Div. 3N has showed a steady increase, which is reflected in an increase in the total stock abundance and biomass.

Table 24 shows a comparison of average numbers and weights of yellowtail flounder derived from independent day and night estimates, and the combined estimate of these two, from the selected strata in the 1985-91 surveys. In 1991, as in other years, the abundance and biomass estimates of yellowtail derived from night catches were larger than those derived from day catches. Biomass estimates have shown an increasing trend since 1988, with the 1991 estimate of stock biomass being about 2.8 times the size of the 1988 estimate, when the stock had declined to probably its lowest point (Fig. 10). The 1985 estimate is not considered valid due to poor coverage of the selected strata.

Tables 25 and 26 contain information on the age composition of the 1985-1991 juvenile surveys taken from selected strata in Div. 3NO. Table 25 shows that, in 1991, the overall average number per tow at age increased by 20% due mainly to high catch rates of age 3 (1988 year-class), age 5 (1986 year-class), and age 6 (1985 year-class). Table 26 shows the estimated abundance at age. In 1991, the estimate of age 1 fish is the lowest in the time series, even lower than 1985 when survey coverage was the poorest. The estimate for age 3 (1988 year-class) is the largest in the time series at that age, accounting for 31% of the entire abundance estimate, and it is the single highest estimate of any age class in the 7-year time series (Fig.11). At age 2 in the 1990 survey, it was the second largest estimate in that time series, next to the 1985 year-class estimate in the 1987 survey. The 1985 and 1986 year-classes, at ages 5 and 6 years in the 1991 survey, are still contributing strongly to the overall abundance increase. These two year-classes have been consistently strong in the time series, except for the 1988 estimate, since they first appeared as age 1 in the 1986 and 1987 surveys. Age 7+ (adult) yellowtail also showed an increase in numbers due to the contribution of a moderately strong 1984 year-class at age 7. Fig.12 compares the estimates of year-class strength at age 5 from the spring RV and juvenile surveys, and both indicate that the 1984-86 year classes are larger than the preceeding 3. Table 28 describes the distribution of the 1985-90 year-classes present in the 1991 survey of selected strata in Div. 3NO along with average size at age. The majority of the 1986 to 1990 year-classes were found in stratum 376, on the southern portion of the Southeast Shoal in Div. 3N. The 1985 year-class at age 6 was spread evenly throughout most of the selected strata.

Table 27 outlines a comparison of distribution of the age composition of yellowtail flounder in Div. 3N as derived from juvenile and spring surveys since 1989. The vast majority of the abundance estimates of ages 1 to 6 juvenile yellowtail were consistently found in the two strata (376 and 360) on the Tail of the Bank, which are located mainly outside the 200-mile limit. Age 7+ yellowtail were less concentrated in this area, mainly being found in strata 362 and 375 in Div. 3N and in stratum 352 in Div. 3Ø.

Assessment

Sequential population analysis (SPA) has been used in the past to assess this stock but has not been used since 1984 as the basis of advice. Since then, it was concluded that the very high value of fishing mortality at the older ages could not be fully explained and that the SPA models attempted were not appropriate. In 1990, the previously noted difficulties with the catch at age were raised, with the conclusion being that catch at age based models, such as SPA, were not suitable for this stock. If anything, the confidence in the catch figures for this stock is now lower. Thus, evaluation of stock status relies heavily on the interpretation of the independent indices of abundance.

There are 5 indices used to evaluate this stock (Canadian spring and fall groundfish surveys, USSR groundfish surveys, Canadian juvenile flatfish surveys, and C/E from the Canadian commercial fleet) and most indicate that the stock is still at a low level compared to historic values. The decline in stock size in the mid- to late-1980s was caused by poor recruitment from the year-classes of the early 1980s and a rapid increase in catches to about 30,000 t in 1985-86 from 10,000-15,000 t in 1980-83. The year-classes of 1984-86, and possibly 1988, are stronger than their immediate predecessors. Although the 1984-86 year-classes do not appear to be as strong as most of the 1970's year-classes at ages 4 and 5, comparisons are somewhat difficult, given that large numbers of the recent year-classes were caught at younger ages relative to the earlier cohorts; i.e., there is likely to be more of an influence from fishing mortality on the recent estimates of year-classes at ages 4 and 5 compared to the years prior to the mid-1980s. This would be caused by the exploitation of younger fish in the Regulatory Area; e.g., the Spanish catches in 1989 to 1991 were dominated by the 1985 year-class. Given the inadequacies with the catch and sampling data is not possible to estimate reliably the level of fishing mortality in recent years on this stock.

Prognoses

In the 1990 assessment of this stock, the recent C/E and Canadian R.V. survey abundance at ages 5-7 were compared to historically stable levels to determine stock status. Both these indices showed a slight increase (1990 for C/E; 1991 for R.V.; Fig.4 and 5) and a subsequent decrease, remaining at relatively low levels. The increase in catch from 1989 to 1990-91 is likely a measure of strong recruitment, particularly the 1985 and 1986 year-classes, although the age composition of large percentages of the catch in 1990 and 1991 is unknown. Juvenile flatfish surveys continue to show an increase in the abundance of yellowtail, particularly at the younger ages. Thus, the prognosis is that the stock remains at a low level, although improved recruitment appears likely. The stock has remained at a low level in recent years with catches around 13,000 t (versus TAC's of 5000-7000 t) so it is apparent that further reductions in the total catch will be needed to allow some growth in stock size. While a catch of 7000 t (current TAC) in 1993 should not be detrimental to the stock, continued catches on each side of the 200 mile limit , each approaching the TAC, will reduce the chances for this stock to rebuild to former levels, when catches averaged over 14,000 t for an extended period of time with no adverse effects on stock size. Thus measures are needed to ensure that the total catch from this stock in 1993 does not exceed the TAC, as it has in each of the past 7 years.

References

Walsh, S. J. 1986. Juvenile yellowtail surveys on the Grand Banks (NAFO Division 3LNO). NAFO SCR Doc. 86/39, Ser. No. N1153.

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	16,314	15,000
1988	10,607	-	-	1,383	4,166[b]	16,158	15,000
1989[c]	5,009	139	-	3,515	1,563	10,226	5,000
1990[c]	4,969	-	-	5,903	3,117	13,989	5,000
1991[c,d]							7,000
1992							7,000

[a]See text for explanation of South Korean catches.
[b]Includes some catches estimated from surveillance reports. See Table 2.
[c]Provisional
[d]See text for details of 1991 catches.

Table 2. Breakdown of 1984-90 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	3,205	-	-	863	-	100[b]	4,163
1989	1,139	5	-	319	-	100[b]	1,563
1990	119	11	-	6	-	2,981[c]	3,117

[a]Not reported to NAFO. Catches estimated from surveillance reports.
[b]Includes some estimated catches.
[c]Includes 2881 t estimated for NAFO member countries.

Table 3. Breakdown of nominal catches (tons) of yellowtail by NAFO Div. 3L, 3N, and 3Ø for 1965-88.

Year	3L	3N	3Ø	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]	2,127	12,331	1,700	16,158

[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:3Ø.

Table 4. Breakdown of Canadian (N+SF) catches by division, month, and gear of yellowtail in Div. 3LNO in 1991.

	3L		3N		3Ø		
	OT	SS	OT	SS	OT	SS	Total
Jan						1	1
Feb							
Mar			2				2
Apr			412	8	1		421
May	42		822	85	231	61	1241
Jun	195		889	79	530	33	1726
Jul	230		213	16	977	48	1484
Aug	154	11	307	29	352	31	884
Sep	146	4	252	34	120	19	575
Oct	46	4	46	19	57	20	192
Nov	2		14	16	12	7	51
Dec			23	29	3	10	65
Total	815	19	2980	315	2283	230	6642

	3L	3N	3Ø
Div. Totals	834	3295	2513

Canada (Nfld)	6244
Canada (S.Fundy)	398
Otter Trawl	6078
Scottish Seine	564[a]

[a]Includes 4 t from misc. gears.

Table 5. Canadian catches of yellowtail (otter trawl only), by division, from 1973-91.

Year	3L	3N	3Ø	3LNO
1973	4188	21470	2827	28475
1974	1107	14757	1119	16983
1975	2315	13289	2852	18456
1976	448	4978	2478	7904
1977	2546	7166	1583	11295
1978	2537	10705	1793	15035
1979	2575	14359	1100	18034
1980	1892	9501	578	11971
1981	2345	11245	515	14105
1982	2305	7554	1607	11466
1983	2552	5737	770	9059
1984	5264	6847	318	12429
1985	3404	9098	829	13331
1986	2933	10196	1004	14133
1987	1584	10248	1529	13361
1988	1813	7146	1475	10434
1989	844	2407	1506	4757
1990	1263	2725	664	4652
1991	815	2980	2283	6078

Table 6. Catches and by-catches (t) of A. plaice and yellowtail, by division, from 1985-91 for Can(N) TC 5 stern trawlers. Figures in square brackets represent the percentage of directed catch taken by division each year, and the figures in parentheses represent the by-catch rates of one species in the directed fishery for the other.

		Directed plaice fishery		Directed yellowtail fishery	
		Plaice	Yellowtail	Yellowtail	Plaice
1985	3L	14617 [55]	995 (6)	793 [12]	328 (29)
	3N	9978 [38]	1764 (15)	5385 [84]	1439 (21)
	3Ø	1917 [7]	317 (14)	222 [4]	148 (40)
1986	3L	12410 [64]	890 (7)	619 [7]	319 (34)
	3N	4767 [25]	934 (16)	7632 [88]	1666 (18)
	3Ø	2128 [11]	375 (15)	450 [5]	241 (35)
1987	3L	14089 [80]	216 (2)	198 [2]	98 (33)
	3N	1774 [10]	357 (17)	7672 [91]	1492 (16)
	3Ø	1767 [10]	358 (17)	587 [7]	296 (34)
1988	3L	8262 [58]	165 (2)	220 [4]	95 (30)
	3N	3279 [23]	392 (11)	5096 [86]	912 (15)
	3Ø	2709 [19]	430 (14)	571 [10]	310 (35)
1989	3L	11046 [66]	149 (1)	65 [4]	40 (38)
	3N	3131 [19]	428 (12)	1321 [68]	515 (28)
	3Ø	2483 [15]	438 (15)	548 [28]	322 (37)
1990	3L	7388 [57]	176 (2)	194 [9]	92 (32)
	3N	2759 [21]	427 (13)	1753 [80]	626 (26)
	3Ø	2919 [22]	238 (8)	237 [11]	131 (36)
1991	3L	6107 [43]	328 (5)	93 [3]	56 (38)
	3N	2202 [15]	295 (12)	2212 [72]	440 (17)
	3Ø	6089 [42]	1067 (15)	758 [25]	411 (35)

Table 7. Catches of yellowtail by Canada(N) otter trawlers in the directed (main species yellowtail) fishery and their percentage of the total otter trawl catch of yellowtail by Canada.

	3L		3N		3Ø		3LNO	
Year	Directed	%	Directed	%	Directed	%	Directed	%
1973	1617	39	18338	85	1272	45	21227	75
1974	399	36	13002	88	624	56	14025	83
1975	1312	57	10303	78	1730	61	13345	72
1976	107	24	3673	74	1106	45	4886	62
1977	847	33	3563	50	646	41	5056	45
1978	599	24	7830	73	865	48	9294	62
1979	873	34	11872	83	526	48	13271	74
1980	568	30	6878	72	414	72	7860	66
1981	682	29	9566	85	174	34	10422	74
1982	699	30	4794	63	92	6	5585	49
1983	477	19	4071	71	54	7	4602	51
1984	1890	36	4861	71	107	34	6858	55
1985	830	24	5804	64	235	28	6869	52
1986	624	21	7819	77	450	45	8893	63
1987	198	13	8144	79	607	40	8949	67
1988	243	13	5254	74	598	41	6095	58
1989	64	8	1386	58	594	39	2044	43
1990	95	8	1860	68	245	37	2200	47
1991	95	12	2254	76	895	39	3244	53

Table 8. Samples used to calculate catch at age and mean weights at age for yellowtail in the Canadian fishery in Div. 3LNO in 1991. Numbers in parentheses are the number of observations and 'n' is the number of samples.

Age-length key	Length frequency	n	Catch (t)	Description
Q2, 3N (502)	OT, Apr, 3N (711)	2	424	3LNO, Jan-Apr
3Ø (25)	May, (1299)	4	949	3LN, May
	Jun, (749)	2	1163	3LN, Jun
	Jun, 3Ø (316)	1	855	3Ø, May-Jun
Q3, 3L (111)	OT, Sep, 3L (624)	2	831	3L, Jul-Sep, 3N Sep
3Ø (117)	Jul, 3Ø (969)	3	1254	3NO, Jul
	Aug, 3Ø (673)	2	858	3NO, Aug, 3Ø Sep
Q4, 3L (47)	OT, Oct, 3L (445)	1	199	3LN, Oct-Dec
3Ø (46)	3Ø (381)	1	109	3Ø, Oct-Dec
Q3, 3Ø (177)				
	Total Can. catch = 6642 t			

Table 9. Catch at age and mean weights at age from the Canadian fishery for yellowtail in 1991.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
* 5	0.203	29.512	203	28.17	0.14
6	0.324	33.771	2700	148.76	0.06
7	0.480	37.891	6644	196.01	0.03
8	0.709	42.435	3081	137.70	0.04
* 9	1.021	47.186	334	36.06	0.11

TABLE 10. CATCH AT AGE (000) FROM CANADIAN FISHERY IN DIV. 3LNO.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
4	1414	671	44	1229	3180	113	23	107	0	4
5	3723	3553	2003	4937	5193	1513	1748	1374	1162	813
6	7918	10758	11116	7792	8173	4623	5587	11958	8701	4210
7	7116	10594	17838	7217	9513	7441	6744	11552	12201	13007
8	3503	3795	6315	2201	4098	6538	3456	2662	4172	8088
9	933	259	605	275	330	2121	505	196	664	1650
10	173	16	24	31	31	325	33	6	26	186
4+	24780	29646	37945	23682	30518	22674	18096	27855	26926	27958

AGE	1987	1988	1989	1990	1991
4	3	85	0	4	0
5	471	546	131	259	203
6	5055	2877	986	1762	2700
7	10935	7365	3978	4912	6644
8	8437	7322	4150	2968	3081
9	1609	1226	541	330	334
10	107	66	16	2	0
4+	26617	19487	9802	10237	12962

TABLE 11. CATCH AT AGE (PERCENTAGE) FROM CANADIAN FISHERY IN 3LNO.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
4	5.7	2.3	0.1	5.2	10.4	0.5	0.1	0.4	0.0	0.0	0.0	0.4
5	15.0	12.0	5.3	20.8	17.0	6.7	9.7	4.9	4.3	2.9	1.8	2.8
6	32.0	36.3	29.3	32.9	26.8	20.4	30.9	42.9	32.3	15.1	19.0	14.8
7	28.7	35.7	47.0	30.5	31.2	32.8	37.3	41.5	45.3	46.5	41.1	37.8
8	14.1	12.8	16.6	9.3	13.4	28.8	19.1	9.6	15.5	28.9	31.7	37.6
9	3.8	0.9	1.6	1.2	1.1	9.4	2.8	0.7	2.5	5.9	6.0	6.3
10	0.7	0.1	0.1	0.1	0.1	1.4	0.2	0.0	0.1	0.7	0.4	0.3

AGE	1989	1990	1991
4	0.0	0.0	0.0
5	1.3	2.5	1.6
6	10.1	17.2	20.8
7	40.6	48.0	51.3
8	42.3	29.0	23.8
9	5.5	3.2	2.6
10	0.2	0.0	0.0

TABLE 12. MEAN WEIGHTS AT AGE (KG) FROM CANADIAN FISHERY IN 3LNO.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
4	0.251	0.267	0.145	0.256	0.232	0.222	0.198	0.194	0.000	0.090	0.150
5	0.309	0.315	0.242	0.363	0.322	0.306	0.322	0.289	0.289	0.260	0.220
6	0.405	0.409	0.344	0.460	0.423	0.367	0.401	0.371	0.382	0.360	0.330
7	0.477	0.553	0.476	0.549	0.509	0.467	0.507	0.492	0.501	0.470	0.450
8	0.508	0.725	0.652	0.719	0.648	0.594	0.657	0.683	0.686	0.620	0.610
9	0.634	0.800	0.790	0.912	0.929	0.734	0.911	1.025	0.972	0.840	0.840
10	0.793	1.217	0.829	1.132	1.194	0.880	1.267	1.142	1.362	1.030	1.210

AGE	1988	1989	1990	1991
4	0.180	0.000	0.140	0.000
5	0.250	0.220	0.210	0.203
6	0.330	0.320	0.320	0.324
7	0.450	0.440	0.450	0.480
8	0.620	0.590	0.630	0.709
9	0.920	0.870	0.890	1.021
10	1.280	1.370	1.370	0.000

TABLE 13. CATCH BIOMASS (T) FROM CANADIAN FISHERY IN 3LNO.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
4	355	179	6	315	738	25	5	21	0	0
5	1150	1119	485	1792	1672	463	563	397	336	211
6	3207	4400	3824	3584	3457	1697	2240	4436	3324	1516
7	3394	5858	8491	3962	4842	3475	3419	5684	6113	6113
8	1780	2751	4117	1583	2656	3884	2271	1818	2862	5015
9	592	207	478	251	307	1557	460	201	645	1386
10	137	19	20	35	37	286	42	7	35	192
4+	10615	14535	17421	11522	13708	11386	8999	12564	13315	14433

AGE	1987	1988	1989	1990	1991
4	0	15	0	1	0
5	104	137	29	54	41
6	1668	949	316	564	875
7	4921	3314	1750	2210	3189
8	5147	4540	2449	1870	2184
9	1352	1128	471	294	341
10	129	84	22	3	0
4+	13321	10168	5036	4995	6631

Table 14. Results of a multiplicative analysis of catch and effort data from the Canadian directed fishery for yellowtail in Div. 3LNO.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R............	0.741
MULTIPLE R SQUARED.....	0.550

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.190E1	3.190E1	
REGRESSION	41	4.166E0	1.016E¯1	21.765
TYPE 1	2	5.239E¯1	2.619E¯1	56.111
TYPE 2	2	4.479E¯1	2.240E¯1	47.977
TYPE 3	11	5.021E¯1	4.565E¯2	9.778
TYPE 4	26	1.929E0	7.419E¯2	15.892
RESIDUALS	731	3.413E0	4.668E¯3	
TOTAL	773	3.948E1		

Type 1 : Country-Gear-Tonnage class
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	0.150	0.115	773
2	34				
3	10				
4	65				
1	3114	1	¯0.287	0.030	157
	3124	2	¯0.211	0.033	135
2	32	3	¯0.215	0.027	186
	35	4	¯0.226	0.031	150
3	1	5	¯0.233	0.081	19
	2	6	¯0.307	0.080	20
	3	7	¯0.227	0.062	33
	4	8	¯0.226	0.051	55
	5	9	¯0.282	0.044	110
	6	10	¯0.353	0.045	102
	7	11	¯0.324	0.045	101
	8	12	¯0.244	0.046	95
	9	13	¯0.069	0.047	82
	11	14	¯0.109	0.052	51
	12	15	¯0.173	0.061	38
4	66	16	¯0.033	0.143	11
	67	17	¯0.058	0.144	12
	68	18	¯0.219	0.138	14
	69	19	¯0.353	0.129	20
	70	20	¯0.373	0.118	41
	71	21	¯0.407	0.117	41
	72	22	¯0.521	0.117	44
	73	23	¯0.393	0.116	50
	74	24	¯0.800	0.119	36
	75	25	¯0.804	0.119	36
	76	26	¯0.904	0.126	26
	77	27	¯0.705	0.120	36
	78	28	¯0.699	0.117	51
	79	29	¯0.655	0.117	46
	80	30	¯0.550	0.122	30
	81	31	¯0.547	0.122	30
	82	32	¯0.635	0.125	23
	83	33	¯0.511	0.124	24
	84	34	¯0.545	0.125	27
	85	35	¯0.499	0.122	29
	86	36	¯0.811	0.123	30
	87	37	¯0.781	0.123	29
	88	38	¯0.856	0.125	26
	89	39	¯0.842	0.135	16
	90	40	¯0.704	0.132	16
	91	41	¯1.298	0.129	21

Table 14. Continued.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1965	0.1500	0.0131	1.157	0.132	3075	2658
1966	0.1173	0.0103	1.121	0.113	4185	3732
1967	0.0916	0.0111	1.092	0.115	2122	1943
1968	¯0.0691	0.0083	0.932	0.085	4180	4487
1969	¯0.2035	0.0060	0.815	0.063	10494	12870
1970	¯0.2225	0.0032	0.801	0.045	22814	28478
1971	¯0.2570	0.0029	0.774	0.042	24206	31271
1972	¯0.3707	0.0028	0.691	0.037	26939	38992
1973	¯0.2431	0.0026	0.785	0.040	28492	36296
1974	¯0.6504	0.0033	0.522	0.030	17053	32658
1975	¯0.6535	0.0030	0.521	0.028	18458	35452
1976	¯0.7544	0.0047	0.470	0.032	7910	16819
1977	¯0.5554	0.0038	0.574	0.035	11295	19674
1978	¯0.5487	0.0029	0.578	0.031	15091	26099
1979	¯0.5054	0.0030	0.604	0.033	18116	30004
1980	¯0.4001	0.0043	0.670	0.044	12011	17917
1981	¯0.3965	0.0040	0.673	0.043	14122	20987
1982	¯0.4846	0.0046	0.616	0.042	11479	18636
1983	¯0.3607	0.0041	0.697	0.045	9085	13028
1984	¯0.3950	0.0046	0.674	0.046	12437	18461
1985	¯0.3488	0.0038	0.706	0.043	13440	19040
1986	¯0.6612	0.0039	0.516	0.032	14168	27435
1987	¯0.6311	0.0039	0.532	0.033	13420	25215
1988	¯0.7058	0.0044	0.494	0.033	10614	21496
1989	¯0.6924	0.0069	0.500	0.041	5009	10021
1990	¯0.5542	0.0060	0.574	0.045	4969	8655
1991	¯1.1477	0.0055	0.317	0.024	6643	20940

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.069

TABLE 15. CPUE AT AGE (# FISH/HR) FROM CANADIAN FISHERY IN 3LNO.

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
4	71.8	25.7	1.5	68.7	151.4	6.1	1.8	5.8	0.0	0.1
5	189.0	136.1	66.8	275.8	247.3	81.3	134.5	74.3	61.2	29.7
6	401.9	412.2	370.5	435.3	389.2	248.5	429.8	646.4	457.9	153.6
7	361.2	405.9	594.6	403.2	453.0	400.1	518.8	624.4	642.2	474.7
8	177.8	145.4	210.5	123.0	195.1	351.5	265.8	143.9	219.6	295.2
9	47.4	9.9	20.2	15.4	15.7	114.0	38.8	10.6	34.9	60.2
10	8.8	0.6	0.8	1.7	1.5	17.5	2.5	0.3	1.4	6.8

AGE	1987	1988	1989	1990	1991
4	0.1	4.0	0.0	0.5	0.0
5	18.7	25.4	13.1	29.8	9.7
6	200.6	133.8	98.6	202.5	129.2
7	433.9	342.6	397.8	564.6	317.9
8	334.8	340.6	415.0	341.1	147.4
9	63.8	57.0	54.1	37.9	16.0
10	4.2	3.1	1.6	0.2	0.0

Table 16. 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.

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	1980 ATC 303-5	1981 ATC 317-9	1982 ATC 327-9	1984 AN 27-28
51-100	328	114,023	-	-	-	-	-	-	0.0(3)	-	0.0(5)	-	0.0(2)	0.0(3)	0.0(2)
51-100	341	118,151	-	-	0.0(3)	-	-	-	0.1(4)	0.1(4)	0.0(6)	0.0(6)	0.0(2)	0.0(5)	0.0(4)
51-100	342	43,913	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(4)	0.0(4)	-	0.0(3)	0.0(4)
51-100	343	39,409	-	-	-	-	-	-	0.0(2)	0.0(3)	0.0(4)	0.0(4)	0.0(2)	0.0(4)	-
101-150	344	112,146	-	-	-	-	-	0.0(4)	0.0(4)	0.0(4)	0.0(2)	0.0(3)	0.0(5)	0.0(4)	-
151-200	345	107,492	-	-	-	-	-	0.0(4)	0.0(4)	0.0(2)	0.0(4)	0.0(5)	0.0(4)	0.0(4)	-
151-200	346	64,931	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(4)	0.0(3)	0.0(3)	0.0(3)	-
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)	0.0(5)	0.0(4)	0.0(2)	-
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)	0.0(7)	0.0(7)	0.0(4)	-
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)	0.0(9)	0.0(4)	0.0(6)	0.1(6)
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)	1.1(10)	0.3(3)	0.6(7)	1.5(6)
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)	39.3(5)	3.0(3)	30.4(5)	28.2(5)
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)	0.4(6)	0.0(3)	0.0(6)	0.6(5)
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)	0.0(4)	0.0(2)	0.0(3)	-
101-150	366	104,639	0.0(3)	-	-	0.0(3)	0.0(4)	0.0(4)	0.0(4)	-	0.0(4)	0.0(4)	0.0(3)	0.0(5)	-
151-200	368	25,071	0.0(2)	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	-	0.0(4)	0.0(2)	0.0(2)	0.0(2)	-
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)	0.0(3)	0.0(2)	0.0(2)	-
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)	0.0(3)	0.0(2)	0.0(2)	-
31-50	371	84,147	88.5(3)	6.4(2)	-	0.0(3)	-	-	1.4(3)	0.3(3)	0.5(3)	80.5(3)	0.0(2)	1.1(4)	-
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)	25.0(6)	13.3(4)	19.8(6)	59.4(5)
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)	0.0(2)	0.4(2)	10.3(2)	-
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)	0.0(4)	0.0(3)	0.0(3)	-
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)	0.0(3)	0.0(2)	0.0(3)	-
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)	0.0(2)	0.0(2)	0.0(3)	-
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)	0.0(2)	0.0(2)	0.0(2)	-
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)	0.0(3)	0.0(2)	0.0(2)	-
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)	0.3(3)	0.0(2)	0.8(4)	-
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)	0.0(2)	0.0(2)	0.0(2)	-
151-200	392	10,884	-	-	0.0(3)	0.0(4)	0.0(2)	-	0.0(2)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	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	-	-	-	-	-	-	-	-	-	-	0.0(2)	-	-
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	10.2	2.9	8.8	15.1

Depth (fm)	Stratum	Year-Trip 1985 AN 28-30	1986 WT 48	1987 WT 59, 60	1988 WT 70, 71	1989 WT 82, 83	1990 WT 95-96	1991 WT 106, 107	1992[a] WT 120, 121
51-100	328	0.0(4)	0.0(9)	0.0(7)	0.0(2)	0.0(8)	0.1(7)	0.2(6)	
51-100	341	0.01(9)	0.0(9)	0.1(6)	0.0(6)	0.0(8)	0.0(4)	0.0(6)	
51-100	342	0.0(3)	0.0(3)	0.2(2)	0.0(2)	0.1(3)	0.0(2)	0.0(2)	
51-100	343	0.0(3)	0.0(4)	0.0(3)	0.0(3)	0.0(3)	0.2(3)	0.0(2)	
101-150	344	0.0(5)	0.0(8)	0.0(4)	0.0(6)	0.0(7)	0.0(6)	0.0(5)	
151-200	345	0.0(5)	0.0(7)	0.0(4)	0.0(8)	0.0(9)	0.0(4)	0.0(3)	
151-200	346	0.0(2)	0.0(5)	0.0(5)	0.0(4)	0.0(4)	0.0(4)	-	
101-150	347	0.0(5)	0.0(5)	0.0(3)	0.0(5)	0.0(6)	0.0(4)	0.0(4)	
51-100	348	0.0(18)	0.0(12)	0.1(8)	0.0(11)	0.0(9)	0.0(11)	0.0(8)	
51-100	349	0.1(14)	1.3(14)	0.1(11)	0.1(8)	0.0(11)	0.0(9)	0.0(9)	
31-50	350	3.7(12)	2.3(11)	0.6(11)	1.6(8)	0.6(11)	0.2(7)	1.0(8)	
31-50	363	15.2(8)	8.3(10)	7.6(9)	4.9(7)	1.5(9)	3.4(7)	0.6(7)	
51-100	364	0.0(17)	0.0(17)	0.0(15)	0.0(10)	0.0(16)	0.0(12)	0.0(11)	
51-100	365	0.0(7)	0.0(5)	0.0(5)	0.0(4)	0.0(6)	0.0(4)	0.0(4)	
101-150	366	0.0(6)	0.0(8)	0.0(7)	0.0(6)	0.0(8)	0.0(6)	-	
151-200	368	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(2)	-	
101-150	369	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	0.0(5)	0.0(2)	
51-100	370	0.0(8)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	0.0(7)	0.0(6)	
31-50	371	0.4(7)	0.3(6)	0.0(7)	0.1(5)	0.1(6)	0.0(6)	0.1(5)	
31-50	372	56.5(12)	36.3(14)	13.9(13)	7.0(11)	12.7(13)	4.7(7)	2.2(10)	
31-50	384	4.6(6)	1.6(6)	1.1(7)	0.2(5)	0.1(6)	0.0(4)	0.0(4)	
51-100	385	0.0(15)	0.0(13)	0.0(11)	0.0(10)	0.0(12)	0.0(11)	0.0(8)	
101-150	386	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	0.0(5)	0.0(3)	
151-200	387	0.0(6)	0.0(4)	0.0(4)	0.0(4)	0.0(5)	0.0(4)	0.0(3)	
151-200	388	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	
101-150	389	0.0(5)	0.0(5)	0.0(6)	0.0(3)	0.0(5)	0.0(4)	0.0(3)	
51-100	390	0.3(9)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	0.0(5)	0.0(5)	
101-150	391	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	
151-200	392	0.0(2)	0.0(2)	0.2(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	
201-300	729	0.0(2)	-	-	-	-	-	0.0(2)	
301-400	730	0.0(2)	-	-	-	-	-	0.0(2)	
201-300	731	0.0(2)	-	-	-	-	-	0.0(2)	
301-400	732	0.0(2)	-	-	-	-	-	0.0(2)	
201-300	733	0.0(3)	-	-	-	-	-	0.0(2)	
301-400	734	0.0(2)	-	-	-	-	-	0.0(2)	
201-300	735	0.0(2)	-	-	-	-	-	-	
301-400	736	0.0(2)	-	-	-	-	-	-	
Biomass ('000 t)		13.5	8.5	3.8	2.2	2.7	1.4	0.7	

[a] Preliminary analysis.

Table 17. 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	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	1980 ATC 303-5
151-200	357	12,311	-	-	0.0(2)	-	-	-	0.0(2)	-	0.0(3)	0.0(3)
101-150	358	16,889	-	0.0(4)	0.0(3)	-	-	-	0.0(2)	-	0.0(2)	0.0(3)
51-100	359	31,602	-	0.0(3)	0.0(3)	-	-	0.0(3)	0.0(2)	-	0.0(4)	0.0(4)
31-50	360	224,592	-	58.3(4)	-	-	12.1(4)	128.6(4)	55.9(4)	43.5(4)	27.6(9)	83.8(11)
31-50	361	139,094	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)	128.4(7)
31-50	362	189,162	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)	53.6(11)
31-50	373	189,162	73.6(4)	135.1(4)	26.7(4)	24.2(4)	-	23.3(5)	74.5(4)	50.5(5)	22.1(11)	48.1(8)
31-50	374	69,885	67.8(2)	42.4(2)	115.4(4)	16.1(2)	62.1(2)	-	22.4(3)	22.0(3)	24.8(4)	39.0(3)
<30	375	119,577	60.0(3)	69.0(3)	121.9(3)	94.5(3)	80.3(3)	-	62.7(4)	30.6(5)	66.1(5)	57.8(4)
≤30	376	112,521	-	45.4(2)	10.3(3)	-	82.1(2)	126.4(3)	78.3(3)	4.6(2)	86.4(4)	125.3(3)
51-100	377	7,506	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(3)	0.0(4)
101-150	378	10,434	0.0(2)	0.0(2)	0.0(2)	0.2(3)	-	-	0.0(2)	1.4(2)	0.0(3)	0.0(2)
151-200	379	7,957	-	-	0.0(2)	0.0(3)	-	-	0.0(2)	0.3(2)	0.0(3)	0.0(3)
151-200	380	8,707	-	0.0(2)	0.0(3)	0.0(2)	-	-	0.0(2)	-	0.0(2)	0.0(3)
101-150	381	13,662	0.0(4)	0.5(4)	0.0(3)	0.0(4)	0.0(2)	-	0.0(2)	0.0(3)	0.0(3)	0.5(4)
51-100	382	48,567	0.0(3)	0.0(4)	0.0(3)	0.0(3)	-	0.0(2)	0.0(3)	0.0(3)	0.0(3)	0.0(4)
31-50	383	50,593	18.6(2)	7.3(2)	0.1(2)	0.0(2)	-	0.0(3)	2.7(3)	0.0(2)	0.0(3)	0.5(4)
201-300	723	11,635	-	-	-	-	-	-	-	-	-	-
301-400	724	9,308	-	-	-	-	-	-	-	-	-	-
201-300	725	7,882	-	-	-	-	-	-	-	-	-	-
301-400	726	5,405	-	-	-	-	-	-	-	-	-	-
201-300	727	12,010	-	-	-	-	-	-	-	-	-	-
301-400	728	11,710	-	-	-	-	-	-	-	-	-	-
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)	63.6(81)
Biomass ('000 t)			59.7	96.6	46.0	45.4	46.8	71.6	76.2	47.6	50.2	79.7

Depth (fm)	Stratum	Year-Trip 1981 ATC 317-9	1982 ATC 327-9	1984 AN 27-28	1985 WT 29	1986 ATC 245-6	1987 WT 58-60	1988 WT 70	1989 WT 82	1990 WT 95-96	1991 WT 106	1992 WT 119-120
151-200	357	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)
101-150	358	0.3(3)	0.0(3)	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)
51-100	359	0.0(3)	0.0(3)	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)
31-50	360	78.4(6)	36.7(7)	142.1(7)	54.0(16)	14.1(13)	9.2(15)	2.4(12)	30.9(15)	6.6(15)	10.4(12)	19.6(14)
31-50	361	-	118.9(6)	139.9(5)	67.1(7)	44.1(10)	73.8(8)	88.7(7)	48.6(10)	125.2(9)	92.3(8)	38.9(8)
31-50	362	104.2(5)	47.2(8)	95.1(7)	36.6(11)	73.2(14)	47.8(13)	43.8(10)	30.5(13)	35.3(10)	30.5(10)	3.0(12)
31-50	373	58.4(5)	23.7(5)	63.5(7)	32.0(9)	17.9(4)	23.1(13)	23.8(10)	14.8(13)	0.9(10)	8.9(11)	0.1(10)
31-50	374	71.7(3)	19.1(14)	35.5(3)	25.3(4)	11.6(6)	5.7(5)	2.3(5)	0.1(5)	0.9(5)	0.2(5)	0.8(5)
<30	375	69.3(4)	61.1(5)	176.1(5)	97.8(8)	231.7(8)	142.8(8)	68.1(6)	23.2(8)	102.7(8)	14.9(6)	141.1(6)
≤30	376	74.3(4)	63.0(7)	32.5(4)	78.5(7)	88.2(90	59.4(8)	4.3(6)	72.6(8)	40.3(7)	113.8(7)	10.7(7)
51-100	377	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.5(2)	0.0(2)	0.0(2)	0.0(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)	0.0(3)	0.0(2)
151-200	379	0.0(3)	0.0(2)	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)
151-200	380	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	381	0.0(3)	0.0(2)	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)
51-100	382	0.0(2)	0.0(2)	0.0(3)	0.0(4)	0.0(4)	0.0(3)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	0.0(3)
31-50	383	1.3(3)	10.0(2)	1.8(3)	0.0(3)	0.0(4)	0.1(3)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(2)
201-300	723	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(2)
301-400	724	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(2)
201-300	725	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(1)
301-400	726	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(2)
201-300	727	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(2)
301-400	728	-	-	-	-	-	-	-	-	-	0.0(2)	0.0(2)
Mean (No. sets)		63.0(54)	43.8(60)	83.5(60)	45.3(85)	51.9(101)	40.2(91)	27.5(77)	26.5(94)	34.1(85)	28.4(93)	- (94)
Biomass ('000 t)		70.1	54.4	104.6	56.7	65.0	49.9	34.4	33.3	42.6	37.2	28.5

Table 18. 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.

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
			Year-Trip										
51-100	329	129,185	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)
31-50	330	156,809	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)
31-50	331	34,229	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)
51-100	332	78,592	–	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)
101-150	333	11,335	–	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)
151-200	334	6,906	–	–	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	–	0.0(4)	0.0(2)	0.0(2)
151-200	335	4,354	0.0(2)	–	0.0(3)	–	0.0(2)	0.0(2)	0.0(3)	–	0.0(2)	0.0(2)	0.0(2)
101-150	336	9,083	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)
51-100	337	71,161	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)
31-50	338	142,472	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)
51-100	339	43,913	1.4(2)	0.0(2)	–	–	0.7(2)	0.4(3)	–	0.0(2)	0.1(4)	0.4(2)	0.1(3)
31-50	340	128,810	–	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)
31-50	351	189,162	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)
31-50	352	193,666	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)
31-50	353	96,232	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)
51-100	354	35,580	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)
101-150	355	7,732	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)
151-200	356	4,579	0.0(2)	–	–	–	–	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
201-300	717	6,981	–	–	–	–	–	–	–	–	–	–	–
301-400	718	8,332	–	–	–	–	–	–	–	–	–	–	–
201-300	719	5,705	–	–	–	–	–	–	–	–	–	–	–
301-400	720	7,882	–	–	–	–	–	–	–	–	–	–	–
201-300	721	5,705	–	–	–	–	–	–	–	–	–	–	–
301-400	722	6,981	–	–	–	–	–	–	–	–	–	–	–
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)
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

Depth (fm)	Stratum	1986 WT 47	1987 WT 58-60	1988 WT 70	1989 WT 82	1990 WT 94-95	1991 WT 105, 106	1992[a] WT 119, 120
		Year - Trip						
51-100	329	0.0(8)	0.0(9)	0.0(7)	0.0(9)	0.0(7)	0.2(9)	0.0(8)
31-50	330	3.3(9)	0.7(11)	0.7(9)	1.2(11)	0.6(10)	4.8(11)	0.0(10)
31-50	331	3.6(4)	16.0(2)	6.0(2)	18.7(2)	–	0.7(2)	0.0(2)
51-100	332	9.8(6)	5.9(5)	0.1(4)	12.7(5)	0.8(5)	0.8(6)	0.5(5)
101-150	333	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
151-200	334	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.2(2)
151-200	335	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(3)
101-150	336	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
51-100	337	0.6(5)	0.7(6)	1.3(4)	1.7(5)	0.0(2)	0.0(5)	0.4(4)
31-50	338	6.8(9)	2.4(9)	23.0(8)	7.2(10)	6.1(8)	5.4(10)	11.5(5)
51-100	339	0.1(3)	0.1(3)	0.0(3)	0.0(3)	0.4(3)	0.0(3)	0.0(2)
31-50	340	8.3(7)	21.4(9)	5.8(7)	3.4(9)	9.7(9)	2.7(9)	1.8(5)
31-50	351	39.1(14)	19.3(13)	36.5(10)	21.9(13)	27.3(12)	13.2(12)	3.3(10)
31-50	352	34.9(14)	51.4(13)	24.8(11)	27.0(13)	36.0(13)	49.4(14)	22.8(8)
31-50	353	21.8(7)	106.3(6)	2.2(5)	6.0(7)	12.0(6)	17.6(7)	5.6(4)
51-100	354	0.0(3)	0.0(2)	0.0(2)	0.1(2)	0.0(2)	1.8(3)	0.0(2)
101-150	355	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)
201-300	717	–	–	–	–	–	0.0(2)	0.0(2)
301-400	718	–	–	–	–	–	0.0(2)	0.0(2)
201-300	719	–	–	–	–	–	0.0(2)	0.0(2)
301-400	720	–	–	–	–	–	0.0(2)	0.0(2)
201-300	721	–	–	–	–	–	0.0(2)	0.0(2)
301-400	722	–	–	–	–	–	0.0(2)	0.0(2)
Mean (No. sets)		14.7(102)	20.9(100)	12.2(84)	9.9(101)	11.9(93)	11.4(116)	– (91)
Biomass ('000 t)		19.7	28.1	16.3	13.4	15.6	15.8	7.5

[a]Preliminary analysis.

Table 19. Biomass of yellowtail outside 200 miles in NAFO Div. 3NO as estimated from Canadian r.v. surveys from 1984-92.

Strata	% Outside 200 miles	1984	1985	1986	1987	1988	1989	1990	1991	1992
						3N				
357	100	0	0	0	-	0	0	0	0	0
358	100	0	0	0	0	0	0	0	0	0
359	100	0	0	0	0	0	0	0	0	0
360	93	25.9	11.3	3.0	2.0	0.5	6.4	1.4	2.1	4.1
374	23	0.6	0.4	0.2	0.1	+	+	+	+	+
375	17	3.6	2.0	4.7	2.9	1.4	0.5	2.1	0.3	2.9
376	89	3.3	7.8	8.8	6.0	0.4	7.3	4.0	11.4	1.1
377	100	0	0	0	0	0	0	0	0	0
378	100	0	0	0	0	0	0	0	0	0
379	100	0	0	0	0	0	0	0	0	0
380	83	0	0	0	0	0	0	0	0	0
381	79	0	0	0	0	0	0	0	0	0
382	53	0	0	0	0	0	0	0	0	0
Biomass outside		33.4	21.5	16.7	11.0	2.3	14.2	7.5	13.8	8.1
Total biomass		104.6	56.7	65.0	49.9	34.4	33.3	42.6	37.2	28.5
% Biomass outside		31.9	37.9	25.7	22.0	6.7	42.6	17.6	37.1	28.4
						3Ø				
353	21	+	1.1	0.4	2.1	+	0.1	0.3	0.4	0.1
354	52	0	+	0	0	0	+	0	+	0
355	72	0	0	0	0	0	0	0	0	0
356	77	0	0	0	0	0	0	0	0	0
Biomass outside		+	1.1	0.4	2.1	+	0.1	0.3	0.4	0.1
Total biomass		17.2	24.2	19.7	28.1	16.3	13.4	15.6	15.8	7.5
% Biomass outside		+	4.6	2.0	7.5	+	0.8	1.9	2.5	1.3
3LNO biomass outside		33.4	22.6	17.1	13.1	2.3	14.3	7.8	14.2	8.2
Total 3LNO biomass		136.9	94.4	93.2	81.8	52.9	49.4	59.6	53.7	
% Biomass outside		24.4	23.9	18.3	6.2	4.3	28.9	13.1	26.4	

TABLE 20. ABUNDANCE (MILLIONS) OF YELLOWTAIL, FROM CANADIAN SPRING RV SURVEYS IN DIV. 3LNO

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2	0.0	0.0	0.0	0.2	0.1	0.1	0.0	1.4	0.0	0.0
3	0.8	3.9	0.2	2.9	0.9	5.0	1.1	5.5	0.3	0.7
4	12.7	16.5	3.1	9.9	6.0	11.1	2.0	18.8	3.5	2.5
5	63.8	73.8	18.6	38.2	12.6	37.9	8.8	38.6	26.4	12.9
6	92.1	100.7	45.5	70.4	50.3	97.7	37.9	56.1	94.0	52.8
7	106.8	92.5	121.7	73.1	129.2	140.0	97.3	87.4	131.0	90.9
8	26.0	18.7	99.5	38.2	61.8	45.4	101.8	56.7	56.5	42.1
9	2.9	0.4	27.7	4.0	7.2	3.1	19.6	13.9	4.4	3.3
10	0.2	0.0	4.2	0.1	0.9	0.1	5.3	2.0	0.1	0.3
11	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0
1+	305.3	306.6	320.8	237.0	269.1	340.3	273.9	280.8	316.2	205.5
2+	305.3	306.6	320.8	237.0	269.1	340.3	273.9	280.7	316.2	205.5
3+	305.3	306.6	320.8	236.8	269.0	340.2	273.9	279.3	316.2	205.5
4+	304.5	302.7	320.6	233.9	268.1	335.2	272.8	273.8	315.9	204.8
5+	291.8	286.2	317.5	224.0	262.1	324.1	270.8	255.0	312.4	202.3
6+	228.0	212.4	298.9	185.8	249.5	286.2	262.0	216.4	286.0	189.4
7+	135.9	111.7	253.4	115.4	199.2	188.5	224.1	160.3	192.0	136.6
8+	29.1	19.2	131.7	42.3	69.9	48.6	126.7	72.9	61.0	45.7
9+	3.1	0.5	32.2	4.1	8.1	3.2	24.9	16.2	4.5	3.6

AGE	1986	1987	1988	1989	1990	1991
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.1	0.2	0.0	0.1
3	0.1	0.1	0.1	2.4	0.8	0.4
4	1.8	0.5	1.2	23.8	7.9	5.6
5	11.8	6.4	1.6	25.9	22.1	27.0
6	30.3	20.2	9.5	27.3	29.3	39.3
7	93.7	56.5	31.8	33.5	45.6	39.3
8	45.7	76.3	45.8	17.2	38.6	19.6
9	6.6	7.6	9.1	1.7	4.9	2.8
10	0.5	0.6	0.4	0.1	0.4	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
1+	190.5	168.2	99.7	132.2	149.5	134.2
2+	190.5	168.2	99.7	132.2	149.5	134.2
3+	190.5	168.2	99.6	132.0	149.5	134.1
4+	190.4	168.1	99.5	129.6	148.7	133.7
5+	188.6	167.6	98.3	105.8	140.9	128.1
6+	176.8	161.2	96.7	79.9	118.8	101.0
7+	146.5	141.0	87.1	52.5	89.5	61.7
8+	52.8	84.5	55.3	19.0	43.9	22.4
9+	7.1	8.2	9.5	1.8	5.3	2.8

Table 21. Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. surveys in Division 3L. Numbers in parentheses are the number of successful 30-minute tows in each stratum. The stratified mean number and weight per tow (kg/30 min.), abundance (millions), and biomass (t x 10^{-3}).

Depth (fm)	Stratum	Category	1985	1986	1987	1988	1989	1990	1991
51-100	328	Av.No./set	-	-	-	-	0.00(3)	-	0.00(5)
		Av.wt./set					0.00		0.00
51-100	341	Av.No./set	-	-	-	-	0.00(4)	0.00(5)	0.00(4)
		Av.wt./set					0.00	0.00	0.00
51-100	342	Av.No./set	-	-	-	-	0.00(2)	-	-
		Av.wt./set					0.00		
51-100	343	Av.No./set	-	-	-	-	0.00(2)	-	0.00(2)
		Av.wt./set					0.00		0.00
51-100	348	Av.No./set	-	-	-	-	0.00(7)	0.00(4)	0.00(7)
		Av.wt./set					0.00	0.00	0.00
51-100	349	Av.No./set	-	-	-	-	0.00(5)	0.00(7)	0.00(7)
		Av.wt./set					0.00	0.00	0.00
31-50	350	Av.No./set	59.00(5)	7.83(6)	-	37.97(5)	0.88(8)	0.00(4)	1.37(8)
		Av.wt./set	25.50	3.58		3.70	0.49	0.00	0.58
31-50	363	Av.No./set	53.80(5)	48.89(5)	-	42.47(6)	13.71(7)	7.25(4)	15.99(4)
		Av.wt./set	21.00	22.77		19.65	7.54	3.39	8.06
51-100	364	Av.No./set	-	-	-	-	0.00(11)	0.00(5)	0.00(6)
		Av.wt./set					0.00	0.00	0.00
51-100	365	Av.No./set	-	-	-	-	0.00(4)	0.00(3)	0.00(4)
		Av.wt./set					0.00	0.00	0.00
51-100	370	Av.No./set	-	-	-	-	0.00(6)	0.00(3)	24.98(3)
		Av.wt./set					0.00	0.00	0.48
31-50	371	Av.No./set	2.25(4)	-	-	1.20(5)	6.50(4)	4.00(3)	-
		Av.wt./set	1.88			0.70	3.70	1.95	
31-50	372	Av.No./set	93.06(9)	101.00(8)	-	64.83(8)	41.00(8)	78.75(4)	58.21(4)
		Av.wt./set	39.49	48.13		34.31	20.21	40.21	27.57
31-50	384	Av.No./set	35.25(4)	-	-	1.00(5)	0.25(4)	0.50(2)	0.00(3)
		Av.wt./set	22.88			0.18	0.13	0.47	0.00
51-100	385	Av.No./set	-	-	-	-	0.00(5)	0.00(4)	0.00(6)
		Av.wt./set					0.00	0.00	0.00
51-100	390	Av.No./set	-	-	-	-	0.00(4)	0.00(3)	0.00(4)
		Av.wt./set					0.00	0.00	0.00
Mean No./set (# sets)			57.16(27)	55.73(19)	(0)	29.53(29)	5.18(84)	9.06(51)	7.64(67)
Abundance (Nos x 10^{-6})			52.0	37.4		26.9	14.3	22.5	19.7
Mean wt./set			25.15	26.36		14.98	2.63	4.61	3.44
Biomass (t)			22.9	17.7		13.6	7.3	11.4	8.9

Table 22. Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. surveys in Division 3N. Numbers in parentheses are the number of successful 30-minute tows in each stratum. The stratified mean number and weight per tow (kg/30 min.), abundance (millions), and biomass (t x 10^{-3}).

Depth (fm)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991
51-100	359	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(4)
		Av.wt./set					0.00	0.00	0.00
31-50	360	Av.No./set	57.67(3)	259.14(14)	192.22(19)	112.51(20)	373.03(19)	392.00(21)	456.87(18)
		Av.wt./set	26.83	19.96	12.75	22.73	46.28	58.37	75.37
31-50	361	Av.No./set	99.83(6)	188.50(8)	399.94(8)	162.38(6)	286.33(9)	379.63(10)	521.72(8)
		Av.wt./set	33.58	61.78	174.37	62.29	107.86	133.26	172.86
31-50	362	Av.No./set	166.89(9)	109.14(7)	38.00(2)	129.29(6)	103.13(8)	79.40(9)	292.89(7)
		Av.wt./set	59.50	43.14	16.75	57.64	45.31	40.37	126.99
31-50	373	Av.No./set	160.80(10)	112.93(7)	-	29.85(8)	32.25(8)	14.78(9)	1.13(7)
		Av.wt./set	75.60	49.60		15.74	15.38	8.67	0.78
31-50	374	Av.No./set	16.00(4)	12.00(4)	-	5.25(4)	0.33(3)	0.75(4)	0.00(2)
		Av.wt./set	7.50	6.38		3.63	0.17	0.15	0.00
≤30	375	Av.No./set	228.29(7)	236.65(5)	407.26(7)	146.44(9)	284.88(8)	266.65(11)	450.51(7)
		Av.wt./set	104.14	115.19	43.22	25.67	88.88	73.25	144.79
≤30	376	Av.No./set	148.50(2)	325.75(4)	1015.22(10)	363.72(12)	916.22(9)	1505.36(11)	1658.82(10)
		Av.wt./set	47.75	150.46	58.55	38.79	160.04	206.24	160.03
51-100	382	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(3)
		Av.wt./set					0.00	0.00	0.00
31-50	383	Av.No./set	0.00(4)	-	-	2.00(4)	0.00(3)	0.00(3)	0.00(4)
		Av.wt./set	0.00			0.32	0.00	0.00	0.00
Mean No./set (# sets)			122.37(45)	184.12(49)	342.85(46)	125.06(69)	243.79(71)	306.43(84)	401.52(70)
Abundance (Nos x 10^{-6})			189.9	272.2	381.1	193.9	405.6	509.8	667.7
Mean wt./set			50.52	59.17	53.60	32.32	55.78	62.05	85.58
Biomass (t)			78.2	85.4	59.6	56.1	92.7	103.2	142.4

Table 23. Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. surveys in Division 3Ø. Numbers in parentheses are the number of successful 30-minute tows in each stratum. The stratified mean number and weight per tow (kg/30 min.), abundance (millions), and biomass (t x 10^{-3}).

Depth (fm)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991
51-100	329	Av.No./set	-	-	-	-	0.00(4)	-	0.00(6)
		Av.wt./set					0.00		0.00
31-50	330	Av.No./set	-	-	-	10.99(2)	6.87(7)	37.14(7)	4.00(6)
		Av.wt./set				5.50	3.54	18.20	1.65
31-50	331	Av.No./set	-	-	-	0.50(2)	12.50(2)	19.00(2)	8.99(3)
		Av.wt./set				0.25	7.75	10.56	4.91
51-100	332	Av.No./set	-	-	-	-	6.50(4)	7.00(2)	27.98(4)
		Av.wt./set					3.75	1.88	12.48
51-100	337	Av.No./set	-	-	-	-	0.00(2)	10.67(3)	1.25(4)
		Av.wt./set					0.00	2.82	0.39
31-50	338	Av.No./set	-	86.67(3)	-	18.99(6)	48.50(6)	9.25(4)	9.83(6)
		Av.wt./set		41.17		9.58	20.12	3.89	4.21
51-100	339	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	4.50(4)
		Av.wt./set					0.00	0.00	8.17
31-50	340	Av.No./set	-	-	-	7.59(3)	33.50(6)	6.71(7)	29.18(5)
		Av.wt./set				2.85	15.33	3.16	11.82
31-50	351	Av.No./set	166.00(3)	175.78(9)	-	85.93(7)	69.38(8)	99.42(9)	41.40(7)
		Av.wt./set	63.67	66.00		28.68	29.31	43.95	18.90
31-50	352	Av.No./set	-	210.77(13)	134.00(1)	164.78(11)	206.93(14)	158.95(16)	231.96(16)
		Av.wt./set		73.68	65.35	58.81	77.43	66.01	80.02
31-50	353	Av.No./set	-	118.00(5)	-	19.24(4)	21.67(3)	0.00(4)	86.73(5)
		Av.wt./set		68.75		9.19	10.33	0.00	37.86
51-100	354	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(3)
		Av.wt./set					0.00	0.00	0.00
Mean No./set (# sets)			166.00(3)	157.31(30)	(1)	58.68(35)	57.72(60)	50.88(60)	53.09(69)
Abundance (Nos x 10^{-6})			44.5	138.5		78.2	97.0	84.3	97.7
Mean wt./set			63.67	63.13		21.58	21.15	21.88	20.05
Biomass (t)			17.1	52.5		28.8	38.9	36.3	36.9

Table 24. A comparison of average numbers and weights of yellowtail flounder per 30-minute tows from day, night, and combined juvenile surveys from 1985 to 1991. Selected strata in Div. 3NO used. Abundance and biomass are given at the bottom of the table.

Selected strata	Category	1985			1986			1987			1988			1989			1990			1991		
		Day	Night	Combined	Day	Night	Combined	Day	Night	Combined	Day	Night	Combined	Day	Night	Combined	Day	Night	Combined	Day	Night	Combined
352	No. of sets	-	-	-	7	6	13	-	-	-	6	5	11	4	10	14	11	5	16	7	9	16
	Av. no./set				78.29	365.33	210.77				60.67	290.00	164.91	115.25	243.6	206.93	184.47	102.80	158.95	133.19	309.09	232.14
	Av. wt./set				37.86	115.47	72.68				26.75	97.37	58.85	48.88	88.85	77.43	81.04	32.95	66.01	59.69	95.93	80.08
360	No. of sets	3	-	3	7	7	14	7	12	19	11	8	20	12	7	19	11	10	21	10	8	18
	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	152.00	656.00	392.00	371.10	564.88	457.22
	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	25.80	94.20	58.37	66.33	86.79	75.43
361	No. of sets	4	2	6	4	4	8	4	4	8	2	4	6	6	3	9	3	7	10	5	3	8
	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	404.75	368.86	379.63	306.0	882.33	522.13
	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	177.94	114.12	133.26	113.10	272.49	172.99
375	No. of sets	4	3	7	2	3	5	3	4	7	6	3	9	5	3	8	4	7	11	4	3	7
	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	47.50	391.89	266.65	320.5	624.67	450.86
	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	14.69	106.70	73.25	134.10	159.31	144.90
376	No. of sets	-	-	2	3	1	4	3	7	10	7	5	12	5	4	9	5	6	11	7	3	10
	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	1076.20	1863.0	1505.36	1241.86	2636.0	1660.10
	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	154.47	249.38	206.24	143.7	198.54	160.16
Total	No. of sets	11	5	18	23	20	44	17	27	44	32	25	58	32	27	59	34	35	69	33	26	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	320.4	601.73	472.35	417.71	862.32	583.92
	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	82.8	106.70	96.77	94.27	148.66	116.36
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	358.2	672.7	528.1	467.0	964.0	652.8
Biomass (000s t)		19.7	45.50	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	92.6	119.3	108.2	105.4	166.2	130.1

Table 25. Average numbers per tow at age from selected strata in juvenile flatfish surveys of NAFO Division 3NØ (strata 352, 360, 361, 375, and 376) 1985-91.

Age	1985[a]	1986	1987[a]	1988	1989	1990	1991
1	4.72	21.48	30.48	5.67	3.68	4.33	0.30
2	2.76	16.95	113.11	15.01	17.88	42.22	30.80
3	1.43	27.29	88.50	40.07	40.20	76.71	184.53
4	7.29	10.05	80.17	27.81	125.86	90.74	75.49
5	9.98	18.99	20.09	17.27	62.01	139.22	107.27
6	14.67	41.41	19.05	18.19	43.82	54.33	90.41
7	35.32	53.87	37.65	31.45	58.22	38.43	53.05
8	35.45	41.66	46.10	17.47	24.57	22.25	35.73
9	7.10	8.07	4.40	2.37	2.87	2.71	9.12
10	0.36	0.62	0.12	0.02	0.09	0.15	0.00
11	0.00	0.08	0.00	0.00	0.01	0.04	0.00
Av. no./tow	119.08	240.47	439.67	175.33	379.21	471.12	586.7

[a]Incomplete survey, stratum 352 not surveyed.

Table [illegible]. Abundance (Nos x 10^{-6}) at age of yellowtail from selected strata in Div. 3NO estimated from juvenile surveys (strata 352, 360, 361, 375, and 376) from 1985-91.

Age	1985[a]	1986	1987[a]	1988	1989	1990	1991
1	4.0	24.0	25.7	6.3	4.1	4.8	0.3
2	2.3	18.9	95.4	16.8	20.0	47.2	34.4
3	1.2	30.5	74.7	44.8	44.9	85.8	206.3
4	6.2	11.2	67.6	31.1	140.7	101.4	84.4
5	8.4	21.2	17.0	19.3	69.3	155.6	119.9
6	12.4	46.3	16.1	20.3	49.0	60.7	101.1
7	29.8	60.3	31.8	35.2	65.1	43.0	59.3
8	29.9	46.6	38.9	19.5	27.5	24.9	39.9
9	6.0	9.0	3.7	2.7	3.2	3.0	10.2
10	0.3	0.7	0	0	0	0.2	0
Total 1+	100.5	268.7	370.9	196.0	423.8	526.6	655.8
5+	86.8	184.1	107.5	97.1	214.1	287.4	330.4
7+	66.0	116.5	74.4	57.4	95.9	71.1	109.4
1 to 4	13.7	84.6	263.4	99.0	209.7	239.2	325.4

[a]Incomplete survey; stratum 352 not surveyed.

Table 27. Age composition of yellowtail flounder in Division 3N outside the 200-mile limit (strata 360[a] and 376[b]), expressed as a percent of total abundance (millions) from research vessel surveys in 1989, 1990, and 1991.

	Juvenile - 1989		Spring - 1990		Juvenile - 1990		Spring - 1991		Juvenile - 1991	
Age	Total abundance	Outside %	Total abundance	Outside %	Total abundance	Outside %	Total abundance	Outside %	Total abundance	Outside %
1	4.1	63	0	-	4.6	65	0.0	-	0.4	0
2	18.2	63	0	-	50.2	77	0.1	100	37.2	75
3	42.1	80	0.7	57	83.5	86	0.4	100	201.5	85
4	135.3	88	7.0	70	106.6	94	5.4	89	84.1	78
5	65.9	82	19.2	68	147.5	83	25.8	76	115.8	73
6	38.2	65	24.1	37	48.5	59	34.9	61	105.4	46
7	40.6	32	27.5	15	24.1	16	24.2	33	71.7	10
8	20.8	22	23.2	2	15.6	7	10.6	10	45.5	7
9	2.7	19	3.6	0	2.2	9	1.9	11	10.2	10
10	0	-	0.3	0	0.2	0	0.0	-	0	
Total	367.9		105.7		483.0		103.5		671.8	

[a] 93% of area survey outside 200-mile limit.
[b] 89% of area survey outside 200-mile limit.

Table 28. Percent abundance of the 1985 to 1990 year-classes in the various selected strata from the 1991 juvenile survey.

Year-class	Age	$\bar{x}$ len. (cm)	Abundance (10^{-6})	Selected strata - Percentage 352	360[a]	361	375	376[b]
1990	1	7.5	0.3	0	0	33	0	0
1989	2	10.5	34.4	6	6	12	10	66
1988	3	17.0	206.3	3	17	7	5	67
1987	4	22.6	84.4	6	33	9	8	44
1986	5	27.1	120.0	7	38	9	13	34
1985	6	32.1	101.1	10	26	22	22	21

[a] 93% outside 200-mile limit.

[b] 89% outside 200-mile limit.

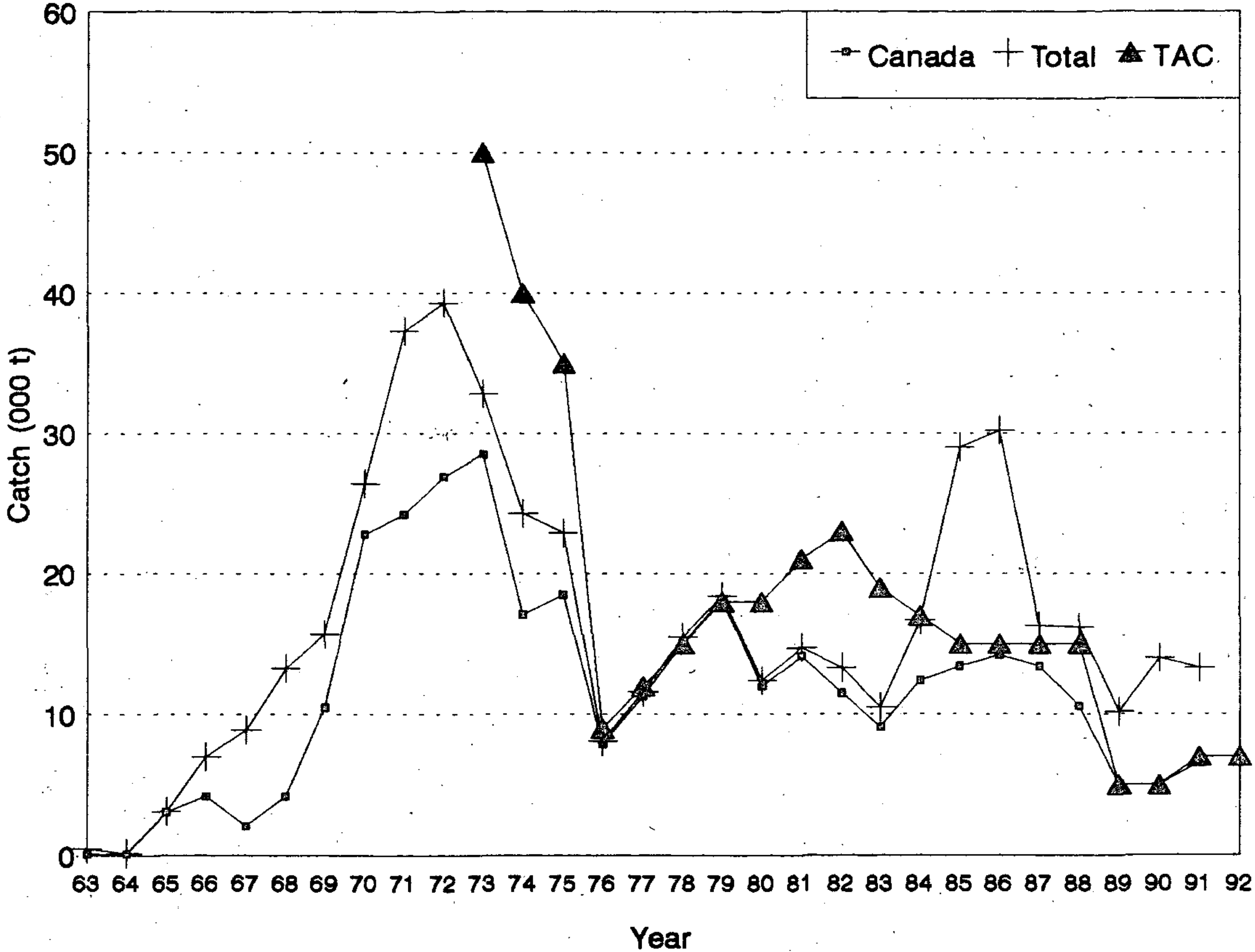

Fig.1. Catches and TAC's of yellowtail in Div. 3LNO.

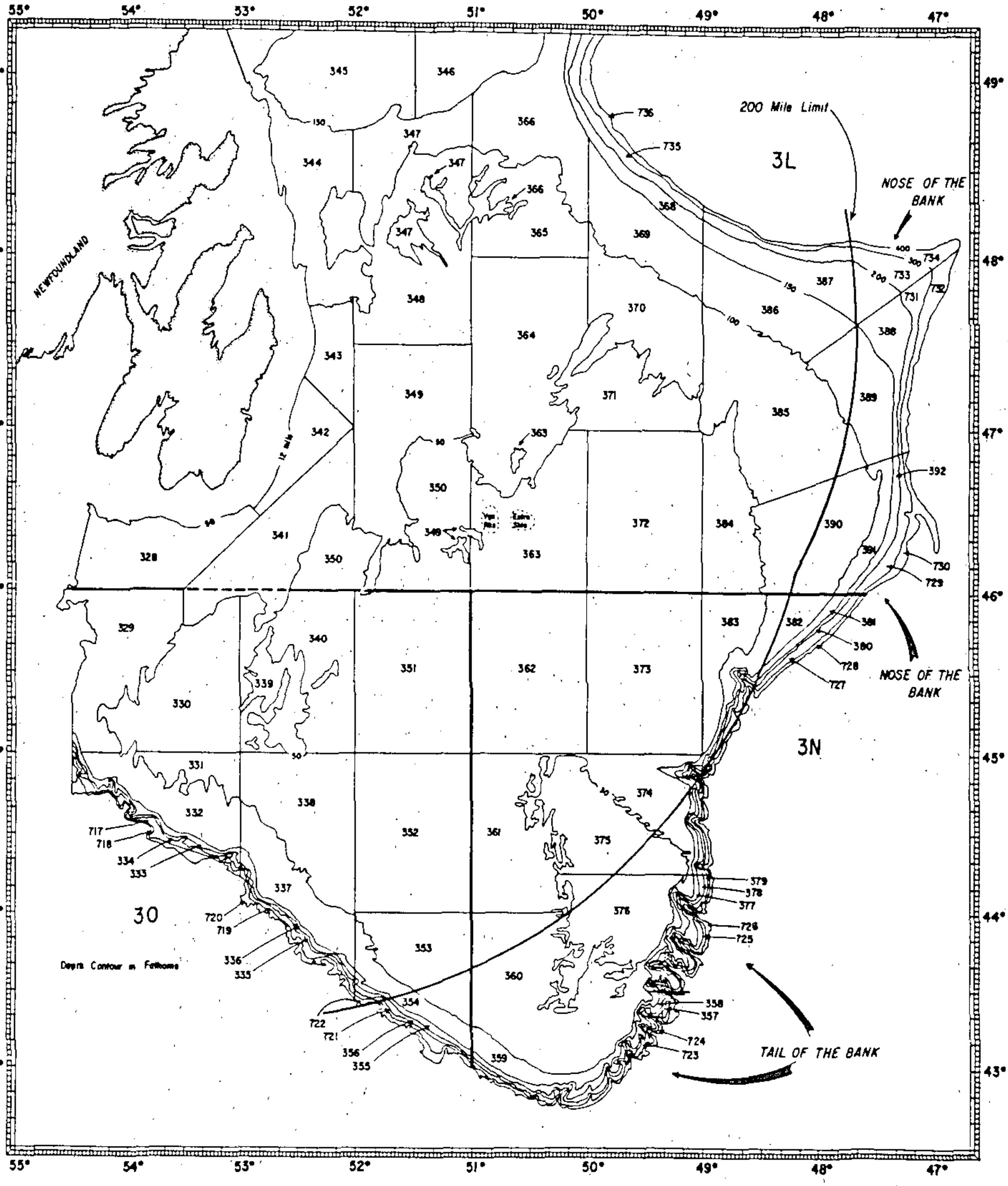

Fig. 2. Depth stratification chart of the Grand Bank, NAFO Div. 3LNO

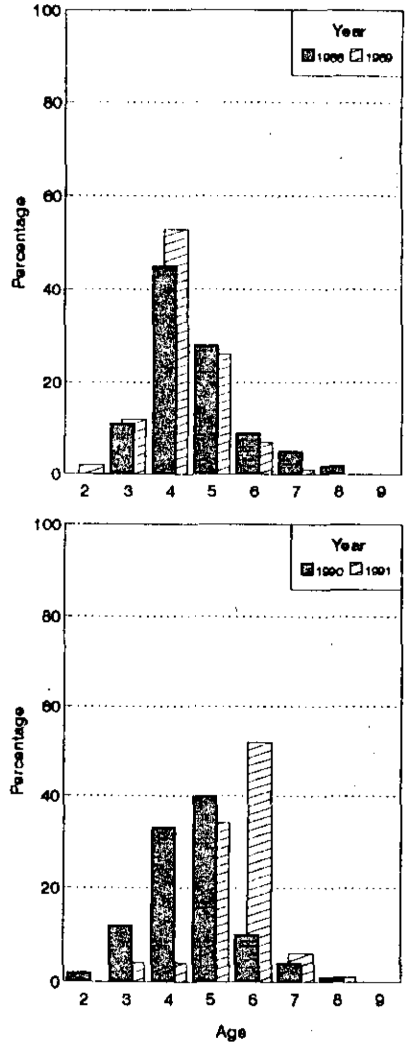

Fig 3 Percent age composition of yellowtail in the Spanish fishery 1988-91

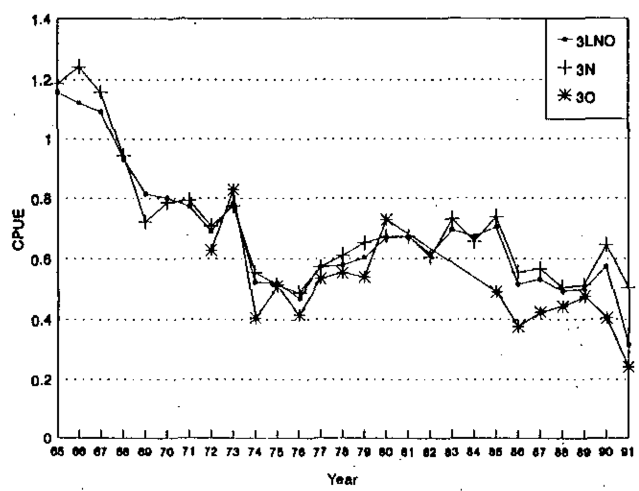

Fig. 4. CPUE indices for yellowtail from the Canadian fishery in Div. 3LNO.

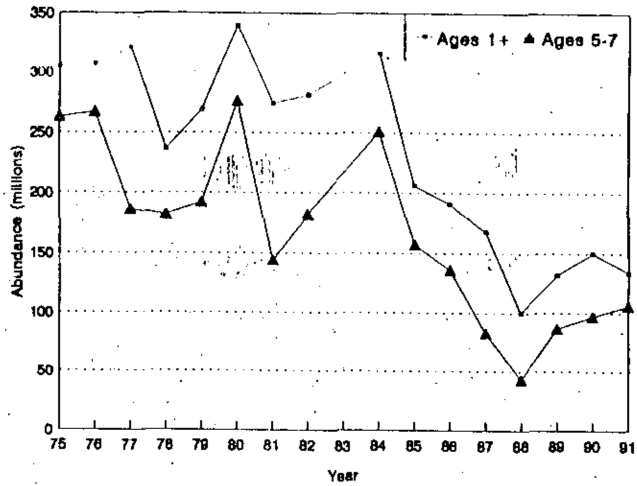

Fig. 5 . Abundance of yellowtail in Div. 3LNO as measured by Canadian spring RV surveys.

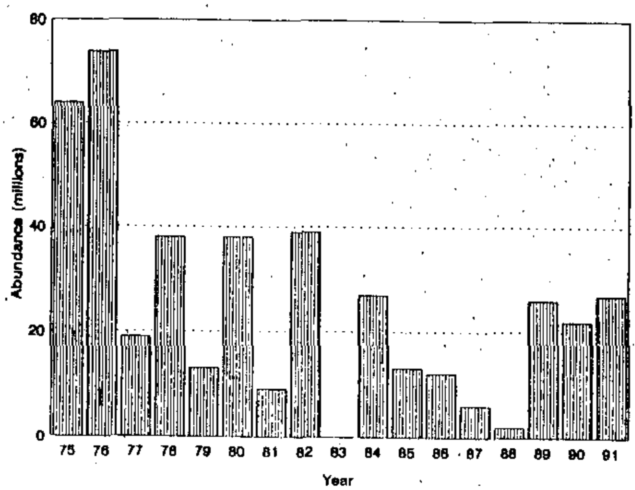

Fig. 6 . Abundance at age 5 from Canadian spring RV surveys in Div 3LNO.

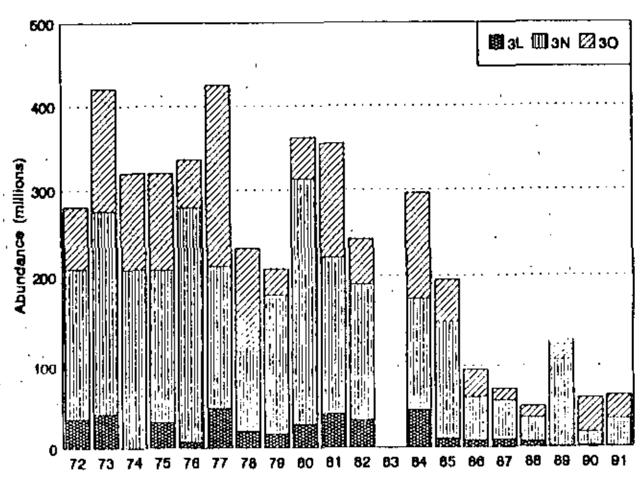

Fig. 7 . Abundance of yellowtail flounder from USSR RV surveys conducted in Div. 3LNO

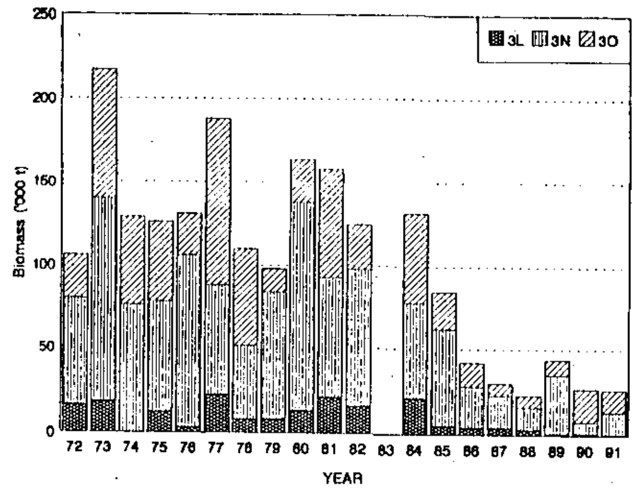

Fig.8 . Biomass of yellowtail flounder from USSR RV surveys conducted in Div. 3LNO

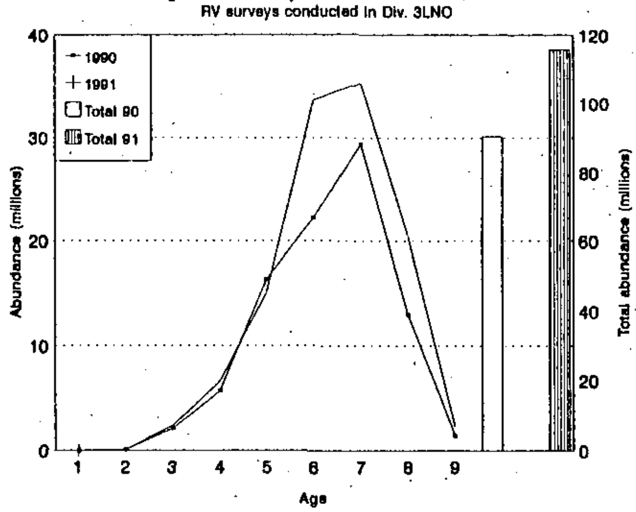

Fig.9 . Abundance of yellowtail from fall RV surveys in Div. 3NO in 1990 and 1991.

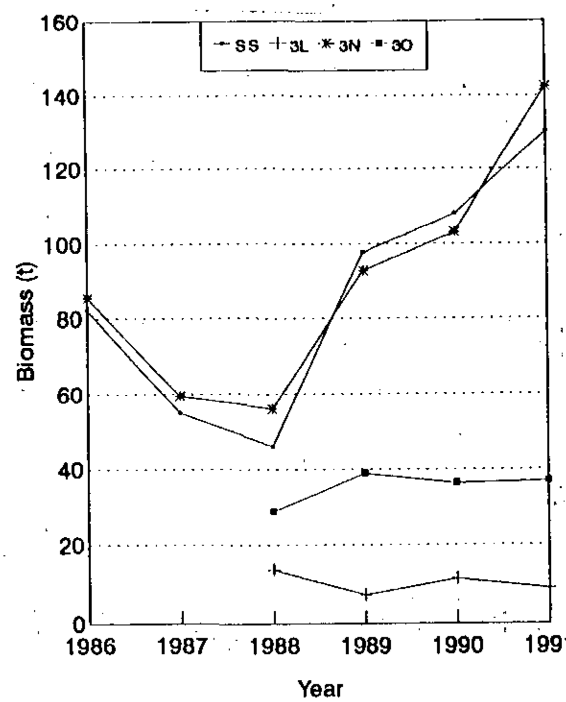

Fig. 10. Biomass (T) of yellowtail flounder derived from juvenile flatfish surveys,1986-91
SS = selected strata

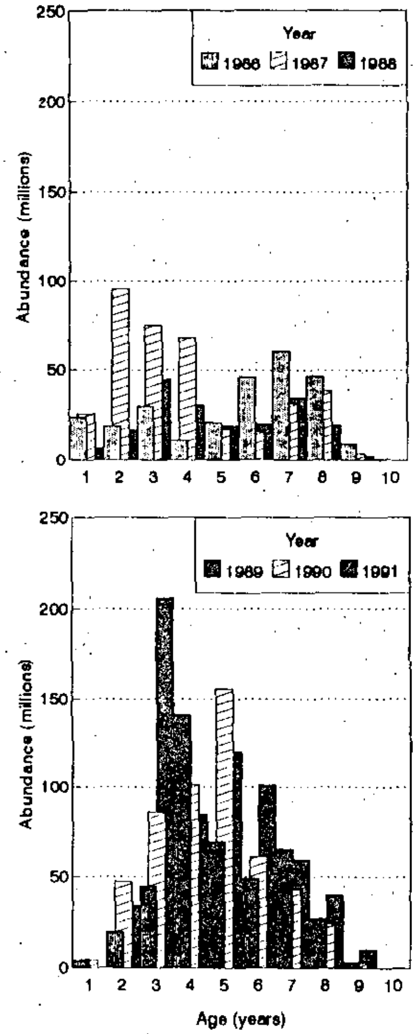

Fig. 11. 1986-91 abundance of yellowtail flounder from selected strata (352,360,361,375,376) in Div. 3NO, juvenile flatfish survey.

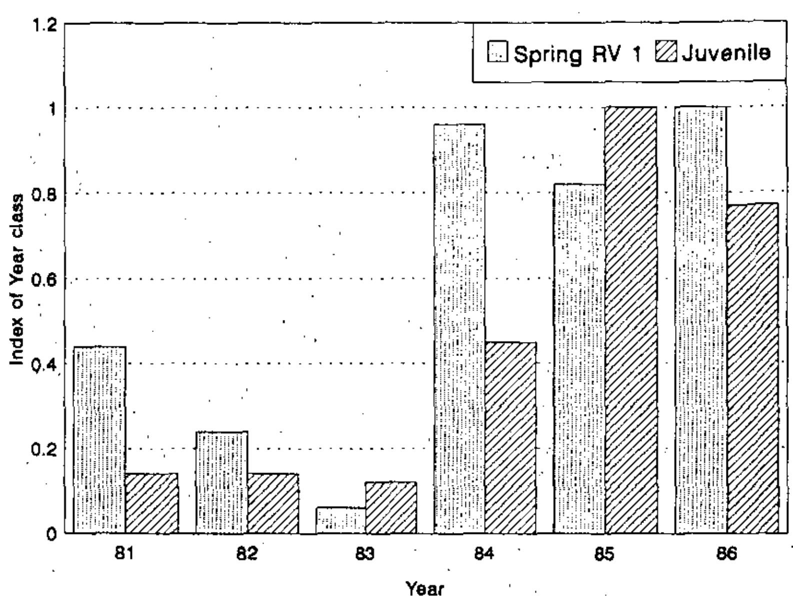

Fig. 12. Indices of year class strength (at age 5) as measured by Spring RV and Juvenile flatfish surveys. Values are scaled to the highest in each series.