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The Status of Yellowtail Flounder Resource in the NAFO Fisheries Management Area of Divisions 3LNO

by

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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 to 1988, 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 1991-1993, the TAC was set at 7000 t since there appeared to be a slight improvement in recruitment to the fishable stock. In 1994, the TAC was maintained at 7000 t, although it was decided by the NAFO Fisheries Commission that no directed fisheries would be permitted for this stock and the 2 other flatfish fisheries on the Grand Bank (A. plaice and witch). In 1995 and 1996, the TAC was set at zero and a fishery moratorium is in place.

Catch trends

The nominal catch increased from negligible levels in the early 1960's to a peak of over 39,000 t in 1972 (Fig. 1). With the exception of 1985 and 1986, when they were around 30,000 t, catches have been in the range of 10,000 to 18,000 t from 1976-93. 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). Canadian catches were consistently around the TAC in the mid to late 1970's, but were under the TAC's in the early 1980's as much of the fishery for flounders was directed toward American plaice in Div. 3L. 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, as well as in 1989-1994, catches for all other nations combined exceeded those of Canada. Canadian catches were stable around 6700 t from 1991-93, but declined to 0 in 1994. USA catches declined steadily from 3,800 t in 1985 to zero in 1991 and 1992 (Table 2), and were estimated to be 700 t in 1994. Catches by Spain and Portugal have also decreased to relatively low levels in 1992-95. South Korea, which has been involved in this fishery since 1982, and caught between 3500 and 5900 t per year from 1989 to 1992, has had no vessels in this fishery since early 1993. It should be noted that the catches for S. Korea in many years include a substantial amount of yellowtail determined from breakdowns of catches reported as unspecified flounder.

Overall, the catches from this stock exceeded the TAC in each year from 1985-95, often by a factor of two (Fig. 1). However, there is still considerable doubt about the precise catch levels from this stock in recent years, with up to one-third of the catch in some years (almost two-thirds in 1994) being determined from Canadian surveillance reports and estimates of the proportion of yellowtail flounder in catches of unspecified flounder by S. Korea (Brodie et al. 1994). In 1995, the catch of yellowtail was 67 t of which EU(Spain) took 65 t in the Regulatory Area, mainly in Div. 3N (Tables 1 and 2).

Commercial fishery data

There were no available length frequencies, age samples or catch data from the 1995 by-catch fisheries. Noteworthy is that the catch rate analysis of Canadian data from 1965 to 1993, presented in 1994 showed that the CPUE in 1991 was the lowest in the series (Brodie et al 1994). Also there was a slight increase in the 2 subsequent years, although the values in 1992 and 93 were the second and third lowest values in the time series.

Research vessel surveys

Canadian Survey gears: From 1971 to 1982 the surveys of the Grand Bank were conducted by the FRV A. T. Cameron (ATC) using a two bridle Yankee 41.5 otter trawl rigged with rubber disk footgear. In 1983, this trawl was replaced by the three bridle Engel 145 Hi-Lift otter trawl rigged with steel bobbin gear aboard the FRV W. Templeman (WT) or its sister ship, the FRV A. Needler (AN). In 1995, the old standard trawl was replaced by the three bridle Campelen 1800 shrimp trawl rigged with rockhopper footgear. The Yankee and the Engel trawls were towed at 3.5 kts and the Campelen was towed at 3.0 kts (see McCallum and Walsh 1996 for details). Surveys began with the new standard trawl in the fall of 1995 aboard the W. Templeman.

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. Strata deeper than 731 m were fished for the first time in this time series in 1994, however, mechanical problems with the survey vessel did not permit these strata to be fished in 1995. In virtually all years, few yellowtail were caught deeper than 100 m on the Grand Bank.

Tables 3 to 5 give the mean weight per tow by stratum as well as the total biomass for Div. 3L, 3N, and 3O respectively for the time period 1971 to 1995 (see also Fig. 3). In 1996, the survey coverage of Div. 3N and 3O has been completed with the Campelen survey trawl and the catch is presented in Fig. 3 and Tables 6 to 8.. Although comparative fishing experiments between the Engel 145 otter trawl and the Campelen shrimp trawl have been completed, conversion factors needed to convert the Engel indices to the Campelen indices have not been derived. ***Therefore, it must be noted that the estimates of the Campelen trawl can not be directly compared with the Engel time series.***

Biomass trends: In Div. 3L, the biomass index has declined steadily from about 15,000 t in 1984-85 to less than 300 t in 1992-94 and to 0 t in 1995 (Table 3). The decline in Div. 3L can also be seen in Fig. 5. The 1996 survey data are not available. Div. 3N Most of the biomass for this stock occurs in this division (about 60% to 80% in recent years) and the index of trawlable biomass has declined from 65,000 t in 1986 to around 30 thousand tons in 1992-94 (Table 4; Fig. 3). The survey estimate from the 1995 survey showed a 17% increase to 36,000 t. Analysis of the 1995 data showed that approximately 49% of the biomass estimate for Div. 3N came from stratum 361, the area west of the Southeast Shoal. The 1996 survey with the Campelen trawl yielded a biomass of 102,800 t of which 33% (34.1 t) was found in stratum 361 and 38% on the Southeast Shoal in strata 375 and 376.. In Div. 3O, the biomass index fluctuated widely from 1992-95, after a period of relative stability from 1988 to 1991 at around 15,000 t (Table 5). The survey estimate from the 1995 survey was 8,000 t . Of concern are the estimates for 1992, 1994 and 1995 of less than 8,500 t, which are the lowest in the time series (Table 5). In 1996, the Campelen trawl survey yielded a biomass of 70,500 t of which 65% was found in stratum 352, inside the Regulatory Area. Figure 4 shows the cumulative biomass of the 3LNO stock for the time period 1971 to 1995. The overall stock has been steadily declining since 1984 especially in Div 3L and to a lesser extent Div. 3O.

Abundance trends: Figs. 5-7 show the abundance trends by Division up to 1994, with approximate 95% confidence intervals. There has been a continuous decline in Div. 3L to "0" abundance. Abundance in Div. 3N was stable from 1992-94 and increased to 17.5 million fish in 1995. The high degree of variability around the 1993 estimate in Div. 3O was generated by the high catch rates in stratum 352, however there was an increase in abundance from 1994 to 1995.. The spring survey abundance at age index for all three divisions combined is presented in Table 9, and total abundance of the mature stock, at ages 5+ and ages 7+, are shown in Fig. 8.

Age composition: The spring surveys are usually dominated by yellowtail of ages 5-8 years, but in recent years it is dominated by ages 6 and 7 (Table 9). Abundance of ages 1+ in 1995 was the third lowest in the time series at 96 million fish, up from the 1994 estimate of 81 million fish (Table 9). In 1995 the survey abundance was dominated by the 1988 and 1989 year classes. All year-class strengths observed from surveys in the most recent period are considerably lower than those observed during the 1970's and early 1980's. Some caution must also be used in interpreting the population sizes at ages 6 and 7 in 1993, as about 50% of the totals at these ages came from Div. 3O, where the 1993 estimate of abundance was shown to have a very wide confidence interval (Fig. 7).

A first attempt was made to investigate a stock-recruit relationship using the fully mature stock size at age 7+ and subsequent recruitment, i.e. a proxy for SSB in year n and recruitment at age 5 in year n+5 (Table 9). There is some indication of a stock-recruit relationship (Fig. 9). If such is the case then this would imply that with the current low SSB the probability of getting good year-classes during the 1990's is very low. However, caution is noted in this interpretation because survey estimates are used and that varying levels of fishing mortality have been exerted on recruiting year-classes before they reach age 5. Nevertheless, the age 7+ population values (SSB) from the 1992-95 spring surveys are all at the low end of this time series. Further investigations of a stock-recruit relationship is warranted.

B) Spring groundfish surveys - USSR/Russia

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. However, there was no survey in 1992 and 1995 and the results from the 1993 to 1994 surveys were not available for inclusion in the 1994 or 1995 assessments. Abundance and biomass estimates for yellowtail from these surveys were presented in previous assessments of this stock, and like the Canadian surveys, 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.

C) Spring groundfish surveys -EU/Spain

In 1995 and 1996, EU-Spain conducted stratified-random surveys for groundfish in the NAFO Regulatory Area of Div. 3NO. Most of the biomass was found in stratum 376 (Southeast Shoals) and stratum 360 (southwest of the shoals). The biomass increased almost 5 times from 1995 to 1996. Modal length of the 1995 and 1996 catches was 24 cm.

D) Fall groundfish surveys-Canada

Stratified-random bottom trawl surveys using an Engel otter trawl have been conducted by Canada during the fall in Div. 3L since 1981. From 1990 onward, this survey has been extended to cover Div. 3N and 3O. In 1995, the fall survey was conducted using the Campelen 1800 shrimp trawl (Tables 6-8 and 10).The biomass index from these surveys ranged from 38,000 t to 48,000 t in 1990-92, increasing to 67,000 t in 1993 and 1994 (Table 10, Fig. 10). It should be noted that the low value in 1992 may be explained by the omission of stratum 375 and part of stratum 362 from the survey coverage due to time constraints. The higher values in 1993-94 were found in Div. 3N, unlike the increase in spring 1993 which was attributable to Div. 3O. The 1995 survey with the Campelen shrimp trawl yielded a biomass estimate of 102,000 t in Div. 3N and 26,000 t in Div. 3O. *These estimates are not directly comparable since conversion factors have not been derived.* Abundance estimates and their approximate 95% confidence intervals are shown, by division, in Fig. 11.

Age Composition: Age 7 was dominant in the catches in 4 out of 5 fall surveys (Table 11), but age 6 was the most abundant age-group in the 1993 survey. Some caution should be exercised in evaluating these age compositions given the problems with the 1992 survey. Age 5+ and age 7+ have shown a general increasing trend and their abundance in 1994 was considerably higher than the estimates from 1990-93. With the exception of 1994, the spring and fall survey estimates of biomass show essentially the same picture of stock size (Fig. 10). Noteworthy, here, is the severe decline and disappearance of yellowtail in Div. 3L (Fig. 12) which was shown in last years assessment to be related to range contraction, possibly due to decreasing stock size (Walsh et. al 1995).

E) Juvenile groundfish surveys-Canada

During September-October, annual stratified-random surveys of the Grand Bank (Fig. 2) were conducted by the FRV W. Templeman using a Yankee 41 shrimp trawl rigged with rubber disk/rubber bunts footgear. The 1994 survey constituted year 10 in a time series for juvenile flatfish and since 1989 coverage has increased beyond 91 m out to 274 m depth (see Walsh 1986 for details). In 1995, the Campelen 1800 shrimp trawl replaced the Yankee shrimp trawl as the standard gear in the fall Grand Bank surveys (Brodie 1996). Allocation of sets and the 50:50 proportionality of day and night sets were incorporated into the new trawl survey for strata 352, 360, 361,375 and 376. Fig. 13 shows a preliminary analysis of a comparison of the relative efficiencies of the three sampling trawls used in the Canadian yellowtail surveys. Both shrimp trawls show similar selectivity in contrast to the otter trawl.

Biomass trends: Tables 12-14 show the average numbers and weights in each stratum, along with biomass and abundance estimates from Divisions 3L, 3N and 3O respectively from the juvenile surveys in 1985-94 .Table 15 shows a comparison of average numbers and weights , abundance and biomass of yellowtail flounder derived from the estimates (see Walsh 1988), from selected strata in the 1986-94 surveys (Fig 14) with the Yankee and shows the results of the fall 1995 survey by the Campelen trawl. The 1985 survey was dropped due to poor coverage. In 1994, the abundance (1022.5 million) and biomass (262,000 tons) estimates showed an increase of 46% and 40%, respectively, over 1993 (Figs. 14). In 1994 and 1995, most of the biomass was found in strata 361,375 and 376 in and around the Southeast Shoal, and a large portion of this distribution was found straddling the 200 mile limit. STACFIS, in the 1995 review of this stock, *expressed caution about these estimates and noted that this increase may be a 'year effect'* (NAFO 1995). The 1995 estimate from the Campelen is not directly comparable because the Yankee indices cannot be converted.

Age Composition: Table 16 contains information on the age composition of yellowtail in the selected strata in Div. 3NO from 1986-94. No age data are available for the fall 1995 or spring Campelen trawl surveys. Since 1989 the total abundance has remained relatively stable up to 1994 similar to age 5+ fish, With the exception of 1991 and 1994, estimate the recruitment has been declining since 1989. In 1994, estimates of the age composition indicate that most year classes have become more abundant compared to the previous year. This is a typical pattern of a "year effect" and probably reflects a change in availability or catchability to the survey gear. More than 60% of juvenile yellowtail, ages 1 to 4, were taken in catches in the NAFO Regulatory Area, consistent with other years (Walsh et al. 1995).

Fig. 15 shows the trends in a standardized abundance index of age 5 yellowtail from the three Canadian surveys: spring, fall and juvenile. The strong year-classes during the 1980's have usually been detected in both the spring and juvenile surveys, in particular the 1985 and 1986 year classes. This was generally not the case for the fall groundfish surveys, which are approximately a month later than the juvenile surveys (see also Walsh et al 1995).

Mean weights-at-age from surveys

From 1990 onward, yellowtail sampled for otoliths during the Canadian surveys were weighed at sea. The mean weights at age from the spring and fall surveys in Div. 3N and 3O are shown in Fig. 16. Overall, there do not appear to be any significant trends in the average weights at age during the period 1990-94, although there is some inter-annual variability. Similar conclusions about the mean weight-at-age of yellowtail were drawn from the juvenile surveys (Walsh et al. 1995).

Distribution Analyses

Yellowtail flounder inhabits the continental shelf of the Northwestern Atlantic Ocean from Labrador to Chesapeake Bay at depths of 10-100 m, (Bigelow and Schroeder 1953). This species has reached its northern limit in commercial concentrations on the Grand Bank off the coast of Newfoundland. Walsh et al. (1995) showed that in the three 1994 Canadian surveys, the stock was almost exclusively found in Div. 3NO, concentrated on the Southeast Shoal and the adjacent area to the west, below 45^0 N. Analyses were performed to look at the relationship of stock abundance and occupied range using a variety of techniques and the conclusion was that the stock had contracted in range from marginal habitats possibly due to a decrease in stock size rather than a response to some environmental signal. The consequence of this contraction is that this change in availability could strongly influence survey catch rates and may explain the "year effect" seen in the 1993-94 surveys (Walsh et al. 1995).

Figures 17 and 18 show the distribution of standard numbers and weight per tow of yellowtail flounder in the fall juvenile survey in 1994 (Yankee shrimp trawl); the spring 1994, the fall 1994 and the 1995 spring survey (Engel otter trawl); the 1995 fall survey and the 1996 spring survey (Campelen shrimp trawl; Div. 3L data not available for 1996). As previously mentioned above, the majority of the stock is distributed in Div, 3N and 3O during all surveys in particular the area of the Southeast Shoal (see Fig. 2 for location) and the area south and west of the Shoals in strata 360, and 361 in Div 3N and stratum 352 in Div 3O. In the 1996 survey with the Campelen, the catches are more widely distributed than in the fall of 1995 and include some expansion into stratum 353 in Div 30 and smaller amounts in stratum 362 in Div 3N and the eastern edge of stratum 351 in Div. 3O (see Table 8). Noteworthy is the near total absent of catches in NAFO Div. 3L which is consistent with the range contraction hypothesis (Walsh et al. 1995). Contraction of the stock in recent years could strongly influence surveys catch rates and contributed to the high variances seen in recent surveys. Such a contraction in the stock could also make it vulnerable to over-exploitation, should a fishery re-open..

Assessment

Sequential population analysis (SPA) has been employed 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 values of 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. Confidence in the catch and catch-at-age data for this stock remains at a low level, especially with the lack of sampling from fisheries in the Regulatory Area from 1992-95. Thus, evaluation of stock status continues to rely heavily on the interpretation of fishery-independent indices of abundance.

In the recent assessments, there were 5 indices used to evaluate this stock (Canadian spring and fall groundfish surveys, USSR/Russian groundfish surveys, Canadian juvenile groundfish surveys, and CPUE from the Canadian commercial fleet) and most indicated that the stock was still at a low level compared to historic values. In the current assessment, there are no new data for 3 of these indices (Russian surveys, Canadian juvenile surveys and the Canadian CPUE series). New data is available on stock size in the Regulatory Area of Div. 3NO from the 1995-96 EU-Spanish surveys. The decline in stock size in the mid- to late-1980's was caused by poor recruitment from the year-classes of the early 1980's 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 were stronger than their immediate predecessors and likely were responsible for the increased catches from 1989 to 1991.

Given the continuing inadequacies with the catch and sampling data, and still-unresolved questions about the natural mortality at age for this stock, it remains impossible to estimate the level of fishing mortality in recent years. However, available data suggest that there has likely been increased fishing mortality at ages 5 and younger in the late 1980's and early 1990's than in earlier years (Myers 1994). Examination of the catch to spring RV biomass ratio (Fig. 19), which is assumed to reflect the exploitation rate on the stock, shows some interesting patterns. During the two periods of highest catches from this stock (early 1970's and mid 1980's), the catch/biomass ratio was above 0.25. In the years between these periods, when the catches were stable at a lower level, the catch/biomass ratio was usually below 0.12 when the stock of biomass was at its highest levels. A similar index based on the juvenile surveys and presented at last year's assessment (Walsh et al. 1995) showed that, during the same period, catch/biomass ratio remained stable as biomass increased up to 1993. A decline in the 1994 ratio was difficult to interpret due to the uncertainty about the high 1994 biomass estimate. STACFIS expressed caution about the inclusion of juvenile age classes in the calculation of the catch/biomass ratios to reflect what is really happening in this stock, since the size composition of the commercial catch has changed several times over the history of the fishery (NAFO 1995).

Summary

- The total stock biomass in the spring surveys up to 1995 show a systematic decline in size since 1984 in particular Div 3L. From 1989 to 1995 the biomass of Div 3N remained somewhat stable compared to Div. 30 which shows no obvious pattern and may reflect some movement back and forth between the two NAFO Divisions in the spring surveys. The biomass estimates in the spring of 1996 is not directly comparable due to change in survey gears. Surveys prior to 1996 suggested that the 1987 and 1988 year-classes were average at best and well below estimates in the early 1970's and mid-1980's based on the spring surveys.

- The fall time series with the old standard Engel trawl also shows a disappearance of yellowtail from Div 3L. The fall 1993 and 1994 estimates are higher than the corresponding spring estimates, although this is not a consistent pattern in the fall time series. There was little difference in stock size between 1993 and 1994, however, both are higher than in 1992. In the 1996 spring survey, with the new trawl, the biomass of Div. 3N is close to the fall 1995 biomass with the same trawl, however, the fall Div 3O biomass showed a 64% increase during the same time period. The overall abundance and that of the mature stock at age 5 + has generally increased since the start of the surveys in 1990.

- The juvenile surveys from 1985 to 1994, using the Yankee shrimp trawl, has also shown the systematic decline in Div. 3L as seen in the other surveys. The biomass in Div. 3O has remained relatively stable over the time series, showing a small increase from during 1992 and 1993 corresponding to a decrease in Div. 3N. Overall the stock has shown a systematic increase in size during recent years, however, the large increase in stock size in Div 3N in 1994 is probably an anomalously high estimate. The abundance of adult fish (age 5+) has generally increased since 1989, however, with the exception of the 1994 estimate, recruitment (ages 1-4) has decrease since 1992. The 1993 juvenile survey indicated that the 1989 to 1992 year-classes may be average to well below average. Because of the obvious year effect in the 1994 juvenile survey, it is difficult to say anything about recruitment in this survey.

Conclusions: It is important to note that stock size is still well below that observed for most of the 1970's and early to mid 1980's. With the exception of the spring surveys, the fall and juvenile survey indices (and EU-Spain spring survey from 1995-96) have shown improvement since the Fisheries Commission closed directed fisheries of yellowtail in 1994. There are some concerns that the distribution of the stock has contracted to the southern Grand Bank and the high catch rates may play havoc with assessment and management of this species. Due to the unavailability of the age data from the fall 1995 survey and the spring 1996 surveys with the new survey gear, we are unable to comment on the strength of year-classes. However, the 1996 assessment of the resource status is optimistic compared to recent years.

References

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildlife Serv. Fish. Bull. 74: 577 p.

Brodie, W.B., S.J. Walsh, D. Power and M.J. Morgan. 1994. An assessment of the yellowtail flounder stock in Divisions 3LNO. NAFO SCR Doc. 94/44:40p

Brodie, W.B. 1996. A description of the 1995 fall groundfish survey in Divisions 2J3KLNO. NAFO SCR Doc. 96/27:7p NAFO 1995.

NAFO Scientific Council Reports 1995

MaCallum and Walsh 1996. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971-present. NAFO SCR Doc. 96/50:18p

Myers, 1994 Analysis of mortality from research vessel surveys for cod and flatfish in the Northwest Atlantic. NAFO SCR Doc 94/58: 33p.

Walsh, S.J. 1992. Factors influencing distribution of juvenile yellowtail flounder (Limanda ferruginea) on the GrandBank of Newfoundland Neth. J. Sea Res.29:193-203

Walsh, S.J, W.B. Brodie, DB. Atkinson and D. Power. 1995. An assessment of the yellowatil flounder s tock in Divisions 3LNO. NAFO SCR Doc. 95/74:44p.

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

Year	Canada	France	USSR/ Russia	South Korea[a]	Other[b]	Total	TAC
1960	7	-	-	-	-	7	
1961	100	-	-	-	-	100	
1962	67	-	-	-	-	67	
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	5,009	139	-	3,508	1,551	10,207	5,000
1990	4,966	-	-	5,903	3,117	13,986	5,000
1991	6,589	-	-	4,156	5,458	16,203	7,000
1992	6,814	-	-	3,825	123	10,762	7,000
1993[c]	6,697	-	-	-	6,868	13,565	7,000
1994[c]	-	-	-	-	2069	2069	7,000[d]
1995[c]	2	-	-	-	65	67	0
1996	-	-	-	-	-	-	0

[a]See text for explanation of South Korean catches.
[b]Includes catches estimated from surveillance reports in some years. See Table 2.
[c]Provisional
[d]No directed fishery permitted.

Table 2. Breakdown of 1984-95 catches from Table 1 listed as "other."

Year	Spain	Portugal	Panama[a]	USA	Cayman Islands[a]	Misc.	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	1,126	5	-	319	-	101[b]	1,551
1990	119	11	-	6	-	2,981[b]	3,117
1991	246	-	-	-	-	5,212[b]	5,458
1992	122	1	-	-	-	-	123
1993	-	-	-	68	-	6,800[a]	6,868
1994	719	-	-	700[a]	-	650[a]	2,069
1995	65	-	-	-	-	-	65

[a]Not reported to NAFO.Catches estimated from surveillance reports.
[b]Includes some estimated catches.

Table 3. 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 (m)	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
9/-183	328	114,023	-	-	-	-	-	-	0.0(3)	-	0.0(5)	-	0.0(2)	0.0(3)
93-183	341	118,151	-	-	0.0(3)	-	-	-	0.1(4)	0.1(4)	0.0(6)	0.0(6)	0.0(2)	0.0(5)
93-183	342	43,913	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(4)	0.0(4)	-	0.0(3)
93-183	343	39,409	-	-	-	-	-	-	0.0(2)	0.0(3)	0.0(4)	0.0(4)	0.0(2)	0.0(4)
184-274	344	112,146	-	-	-	-	-	0.0(4)	0.0(4)	0.0(4)	0.0(2)	0.0(3)	0.0(5)	0.0(4)
275-366	345	107,492	-	-	-	-	-	0.0(4)	0.0(4)	0.0(2)	0.0(4)	0.0(5)	0.0(4)	0.0(4)
275-366	346	64,931	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(4)	0.0(3)	0.0(3)	0.0(3)
184-274	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)
93-183	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)
93-183	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)
57-91	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)
57-91	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)
93-183	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)
93-183	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)
184-274	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)
275-366	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)
184-274	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)
93-183	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)
57-91	371	84,147	88.5(3)	6.4(2)	-	0.0(3)	-	-	1.4(3)	0.3(3)	0.5(3)	0.5(3)	0.0(2)	1.1(4)
57-91	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)
57-91	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)
93-183	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)
184-274	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)
275-366	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)
275-366	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)
184-274	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)
93-183	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)
184-274	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)
275-366	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)
367-549	729	13,962	-	-	-	-	-	-	-	-	-	-	-	-
550-731	730	12,761	-	-	-	-	-	-	-	-	-	-	-	-
367-549	731	16,214	-	-	-	-	-	-	-	-	-	-	-	-
550-731	732	17,340	-	-	-	-	-	-	-	-	-	-	-	-
367-549	733	35,130	-	-	-	-	-	-	-	-	-	-	-	-
550-731	734	17,115	-	-	-	-	-	-	-	-	-	-	-	-
367-549	735	20,417	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
550-731	736	13,136	-	-	-	-	-	-	-	-	-	-	-	-
732-914	737	17,040	-	-	-	-	-	-	-	-	-	-	-	-
732-914	741	16,789	-	-	-	-	-	-	-	-	-	-	-	-
732-914	745	26,122	-	-	-	-	-	-	-	-	-	-	-	-
732-914	748	11,935	-	-	-	-	-	-	-	-	-	-	-	-
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

Table 3. (Cont'd.)

Depth (m)	Stratum	Year-Trip 1984 WT 27-28	1985 AN 43 WT 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 WT 120-122	1993 WT 136-138	1994 WT 152-154	1995 WT 168-170
93-183	328	0.0(2)	0.0(4)	0.0(9)	0.0(7)	0.0(2)	0.0(8)	0.1(7)	0.2(6)	0.0(4)	0.0(6)	0.0(4)	0.0 (6)
93-183	341	0.0(4)	0.01(9)	0.0(9)	0.1(6)	0.0(6)	0.0(8)	0.0(4)	0.0(6)	0.0(8)	0.0(6)	0.0(5)	0.0 (6)
93-183	342	0.0(4)	0.0(3)	0.0(3)	0.2(2)	0.0(2)	0.1(3)	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(3)	0.0 (2)
93-183	343	-	0.0(3)	0.0(4)	0.0(3)	0.0(3)	0.0(3)	0.2(3)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	0.0 (2)
184-274	344	-	0.0(5)	0.0(8)	0.0(4)	0.0(6)	0.0(7)	0.0(6)	0.0(5)	0.0(6)	0.0(6)	0.0(5)	0.0 (5)
275-366	345	-	0.0(5)	0.0(7)	0.0(4)	0.0(8)	0.0(9)	0.0(4)	0.0(3)	0.0(6)	0.0(6)	0.0(5)	0.0 (5)
275-366	346	-	0.0(2)	0.0(5)	0.0(5)	0.0(4)	0.0(4)	0.0(4)	-	0.0(4)	0.0(4)	0.0(3)	0.0 (3)
184-274	347	-	0.0(5)	0.0(5)	0.0(3)	0.0(5)	0.0(6)	0.0(4)	0.0(4)	0.0(4)	0.0(4)	0.0(4)	0.0 (4)
93-183	348	-	0.0(18)	0.0(12)	0.1(8)	0.0(11)	0.0(9)	0.0(11)	0.0(8)	0.0(9)	0.0(8)	0.2(8)	0.0 (8)
93-183	349	0.1(6)	0.1(14)	1.3(14)	0.1(11)	0.1(8)	0.0(11)	0.0(9)	0.0(9)	0.0(9)	0.0(9)	0.5(8)	0.0 (2)
57-91	350	1.5(6)	3.7(12)	2.3(11)	0.6(11)	1.6(8)	0.6(11)	0.2(7)	1.0(8)	0.1(11)	0.0(9)	0.0(7)	0.0 (5)
57-91	363	28.2(5)	15.2(8)	8.3(10)	7.6(9)	4.9(7)	1.5(9)	3.4(7)	0.6(7)	0.1(9)	0.0(8)	0.0(6)	0.0 (7)
93-183	364	0.6(5)	0.0(17)	0.0(17)	0.0(15)	0.0(10)	0.0(16)	0.0(12)	0.0(11)	0.0(12)	0.0(12)	0.0(10)	0.0 (8)
93-183	365	-	0.0(7)	0.0(5)	0.0(5)	0.0(4)	0.0(6)	0.0(4)	0.0(4)	0.0(4)	0.0(5)	0.0(4)	0.0 (4)
184-274	366	-	0.0(6)	0.0(8)	0.0(7)	0.0(6)	0.0(8)	0.0(6)	-	0.0(6)	0.0(7)	0.0(5)	0.0 (5)
275-366	368	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(2)	-	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
184-274	369	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	0.0(5)	0.0(2)	0.0(4)	0.0(5)	0.0(3)	0.0 (3)
93-183	370	-	0.0(8)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	0.0(7)	0.0(6)	0.0(6)	0.0(6)	0.0(5)	0.0 (5)
57-91	371	-	0.4(7)	0.3(6)	0.0(7)	0.1(5)	0.1(6)	0.0(6)	0.1(5)	0.0(5)	0.0(5)	0.0(4)	0.0 (5)
57-91	372	59.4(5)	56.5(12)	36.3(14)	13.9(13)	7.0(11)	12.7(13)	4.7(7)	2.2(10)	0.3(10)	0.4(11)	0.5(8)	0.0 (10)
57-91	384	-	4.6(6)	1.6(6)	1.1(7)	0.2(5)	0.1(6)	0.0(4)	0.0(4)	0.0(5)	0.0(5)	0.0(4)	0.0 (5)
93-183	385	-	0.0(15)	0.0(13)	0.0(11)	0.0(10)	0.0(12)	0.0(11)	0.0(8)	0.0(10)	0.0(11)	0.0(8)	0.0 (9)
184-274	386	-	0.0(5)	0.0(6)	0.0(5)	0.0(4)	0.0(6)	0.0(5)	0.0(3)	0.0(4)	0.0(5)	0.0(4)	0.0 (4)
275-366	387	-	0.0(6)	0.0(4)	0.0(4)	0.0(4)	0.0(5)	0.0(4)	0.0(3)	0.0(3)	0.0(3)	0.0(3)	0.0 (3)
275-366	388	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
184-274	389	-	0.0(5)	0.0(5)	0.0(6)	0.0(3)	0.0(5)	0.0(4)	0.0(3)	0.0(3)	0.0(4)	0.0(3)	0.0 (4)
93-183	390	-	0.3(9)	0.0(8)	0.0(7)	0.0(5)	0.0(8)	0.0(5)	0.0(5)	0.0(6)	0.0(6)	0.0(5)	0.0 (7)
184-274	391	-	0.0(2)	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)
275-366	392	-	0.0(2)	0.0(2)	0.2(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)
367-549	729	-	0.0(2)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
550-731	730	-	0.0(2)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
367-549	731	-	0.0(2)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
550-731	732	-	0.0(2)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
367-549	733	-	0.0(3)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0 (2)
550-731	734	-	0.0(2)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
367-549	735	-	0.0(2)	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0 (2)
550-731	736	-	0.0(2)	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	-
732-914	737	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	741	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	745	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	748	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
Biomass ('000)		15.1	13.5	8.5	3.8	2.2	2.7	1.4	0.7	0.1	0.1	0.3	0.0

Table 4. Mean weight of yellowtail per 30 minute tow, by stratum, from research vessel surveys in Division 3N. Numbers in parentheses are the number of successful sets in each stratum. The stratified mean weight per tow and the biomass estimates are given at the bottom of the table.

			Year-Trip											
Depth (m)	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	1980 ATC 303-5	1981 ATC 317-9	1982 ATC 327-9
275-366	357	12,311	-	-	0.0(2)	-	-	-	0.0(2)	-	0.0(3)	0.0(3)	0.0(2)	0.0(2)
185-274	358	16,889	-	0.0(4)	0.0(3)	-	-	-	0.0(2)	-	0.0(2)	0.0(3)	0.3(3)	0.0(3)
93-183	359	31,602	-	0.0(3)	0.0(3)	-	-	0.0(3)	0.0(2)	-	0.0(4)	0.0(4)	0.0(3)	0.0(3)
57-91	360	224,592	-	58.3(4)	-	-	12.1(4)	128.6(4)	55.9(4)	43.5(4)	27.6(9)	83.8(11)	78.4(6)	36.7(7)
57-91	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)	-	118.9(6)
57-91	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)	104.2(5)	47.2(8)
57-91	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)	58.4(5)	23.7(5)
57-91	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)	71.7(3)	19.1(4)
<56	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)	69.3(4)	61.1(5)
<56	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)	74.3(4)	63.0(7)
93-183	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)	0.0(3)	0.0(2)
185-274	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)	0.0(2)	0.0(2)
275-366	379	7,957	-	-	0.0(2)	0.0(3)	-	-	0.0(2)	0.3(2)	0.0(3)	0.0(3)	0.0(3)	0.0(2)
275-366	380	8,707	-	0.0(2)	0.0(3)	0.0(2)	-	-	0.0(2)	-	0.0(2)	0.0(3)	0.0(3)	-
185-274	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)	0.0(3)	0.0(2)
93-183	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)	0.0(2)	0.0(2)
57-91	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)	1.3(3)	10.0(2)
367-549	723	11,635	-	-	-	-	-	-	-	-	-	-	-	-
350-731	724	9,308	-	-	-	-	-	-	-	-	-	-	-	-
367-549	725	7,882	-	-	-	-	-	-	-	-	-	-	-	-
550-731	726	5,405	-	-	-	-	-	-	-	-	-	-	-	-
367-549	727	12,010	-	-	-	-	-	-	-	-	-	-	-	-
550-731	728	11,710	-	-	-	-	-	-	-	-	-	-	-	-
732-914	752	10,059	-	-	-	-	-	-	-	-	-	-	-	-
732-914	756	7,957	-	-	-	-	-	-	-	-	-	-	-	-
732-914	760	11,560	-	-	-	-	-	-	-	-	-	-	-	-
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)	63.0(54)	43.8(60)
Biomass ('000 t)			59.7	96.6	46.0	45.4	46.8	71.6	76.2	47.6	50.2	79.7	70.1	54.4

Table 4. - (Cont'd.)

Depth (m)	Stratum	1984 AN 27-28	1985 AN 43 WT 29	1986 WT 47	1987 WT 58-60	1988 WT 70	Year-Trip 1989 WT 82	1990 WT 95-96	1991 WT 106	1992 WT 119-120	1993 WT 136-137	1994 WT 152-154	1995 WT 168-170
275-366	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)	0.0 (2)
185-274	358	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)	0.0 (2)
93-183	359	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)	0.4(2)	0.0(2)	0.0 (2)
57-91	360	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)	7.5(11)	2.6(8)	42.2(12)
57-91	361	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)	95.1(8)	197.8(5)	129.3(7)
57-91	362	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)	52.5(9)	1.5(6)	0.3 (10)
57-91	373	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)	0.1(9)	0.8(7)	0.0(10)
57-91	374	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)	0.0(3)	0.0(3)	1.1(4)
<56	375	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)	60.0(6)	13.9(4)	72.8(6)
<56	376	32.5(4)	78.5(7)	88.2(9)	59.4(8)	4.3(6)	72.6(8)	40.3(7)	113.8(7)	11.2(7)	3.3(6)	2.2(4)	2.5(6)
93-183	377	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)	0.0(2)	0.0(2)	0.0(2)
185-274	378	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)	0.0(2)	0.0(2)	0.0(2)
275-366	379	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)	0.0(2)	0.0(2)
275-366	380	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)	0.0(2)	0.0(2)
185-274	381	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)	0.0(2)	0.0(2)
93-183	382	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)	0.0(2)	0.0(2)	0.0(2)
57-91	383	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)	0.0(3)	0.0(2)	0.0(3)
367-549	723	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(3)
350-731	724	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
367-549	725	-	-	-	-	-	-	-	0.0(2)	0.0(1)	0.0(2)	0.0(2)	0.0(2)
550-731	726	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
367-549	727	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
550-731	728	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)
732-914	752	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	756	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	760	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
Mean (No. sets)		83.5(60)	45.3(85)	51.9(101)	40.2(91)	27.5(77)	26.5(94)	34.1(85)	28.4(93)	22.0(94)	24.7(85)	22.6(76)	84.3(89)
Biomass ('000 t)		104.6	56.7	65	49.9	34.4	33.3	42.6	37.2	28.6	32.4	30.3	36.6

Table 5. Mean weight of yellowtail per 30-minute tow, by stratum, from research vessel surveys in Division 3O. Numbers in parenthesis are the number of sucessful 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
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)
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)
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)
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)
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)
151-200	334	6,906	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	-	0.0(4)
151-200	335	4,354	0.0(2)	-	0.0(3)	-	0.0(2)	0.0(2)	0.0(3)	-	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)
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)
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)
51-100	339	43,913	1.4(2)	0.0(2)	-	-	0.7(2)	0.4(3)	-	0.0(2)	0.1(4)
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)
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)
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)
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)
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)
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)
151-200	356	4,579	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)
Biomass ('000 t)			*21.2*	*22.2*	*18.4*	*42.1*	*26.7*	*50.8*	*29.5*	*11.6*	*15.8*

						Year - Trip						
Depth (m)	Stratum	1984 AN 27, 28	1985 AN 43	1986 WT 47	1987 WT 58-60	1988 WT 70	1989 WT 82	1990 WT 94-95	1991 WT 105, 106	1992 WT 119, 120	1993 WT 136-138	1994 WT 152-154	1995 WT 168-170
93-183	329	0.0(5)	0.0(8)	0.0(8)	0.0(9)	0.0(7)	0.0(9)	0.0(7)	0.2(9)	0.0(8)	0.1(6)	0.0(5)	0.0(5)
57-91	330	0.5(4)	7.8(10)	3.3(9)	0.7(11)	0.7(9)	1.2(11)	0.6(10)	4.8(11)	0.0(10)	0.1(7)	0.0(5)	0.0(7)
57-91	331	23.8(3)	36.7(3)	3.6(4)	16.0(2)	6.0(2)	18.7(2)	-	0.7(2)	0.0(2)	1.3(2)	2.8(2)	0.3(2)
93-183	332	0.0(2)	0.3(5)	9.8(6)	5.9(5)	0.1(4)	12.7(5)	0.8(5)	0.8(6)	0.5(5)	6.6(4)	0.2(4)	0.9(4)
185-274	333	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)	0.0(2)	0.0(2)
275-366	334	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.2(2)	0.0(2)	0.0(2)	0.8(2)
275-366	335	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(3)	0.0(2)	0.0(2)	0.2(2)
185-274	336	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)	0.4(2)	0.0(2)
93-183	337	0.0(2)	0.0(5)	0.6(5)	0.7(6)	1.3(4)	1.7(5)	0.0(2)	0.0(5)	0.4(4)	4.8(2)	0.2(3)	0.2(4)
57-91	338	15.8(5)	11.1(9)	6.8(9)	2.4(9)	23.0(8)	7.2(10)	6.1(8)	5.4(10)	9.6(6)	5.7(6)	3.2(6)	5.3(6)
93-183	339	0.4(2)	0.1(3)	0.1(3)	0.1(3)	0.0(3)	0.0(3)	0.4(3)	0.0(3)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
57-91	340	3.0(4)	7.2(9)	8.3(7)	21.4(9)	5.8(7)	3.4(9)	9.7(9)	2.7(9)	1.8(5)	1.5(6)	0.0(2)	0.0(5)
57-91	351	40.5(6)	42.3(9)	39.1(14)	19.3(13)	36.5(10)	21.9(13)	27.3(12)	13.2(12)	3.3(10)	2.2(9)	0.1(7)	0.3(8)
57-91	352	30.5(7)	29.7(11)	34.9(14)	51.4(13)	24.8(11)	27.0(13)	36.0(13)	49.4(14)	22.8(8)	109.4(7)	26.9(8)	17.5(10)
57-91	353	1.0(2)	56.3(6)	21.8(7)	106.3(6)	2.2(5)	6.0(7)	12.0(6)	17.6(7)	5.6(4)	36.4(4)	1.1(4)	40.4(5)
93-183	354	0.0(2)	0.5(3)	0.0(3)	0.0(2)	0.0(2)	0.1(2)	0.0(2)	1.8(3)	0.0(2)	0.0(2)	0.0(2)	0.2(3)
185-274	355	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)	0.2(2)
275-366	356	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.3(2)
367-549	717	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
350-731	718	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
367-549	719	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
550-731	720	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
367-549	721	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	0.0(2)
550-731	722	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	4.5(2)
732-914	764	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
732-914	772	-	-	-	-	-	-	-	-	-	-	0.0(2)	-
Mean (No. sets)		12.8(56)	18.0(93)	14.7(102)	20.9(100)	12.2(84)	9.9(101)	11.9(93)	11.4(116)	5.2(91)	19.5(81)	4.2(81)	17.4(85)
Biomass ('000 t)		17.2	24.2	19.7	28.1	16.3	13.4	15.6	15.8	7.3	27.0	5.9	8.2

Table 6 Biomass of yellowtail by stratum from research vessel surveys in Division 3L. Numbers in parentheses are the number of successful tows in each stratum.

		Year-Gear	
Depth (m)	Stratum	1995 Fall Campelen 15 min. tow	1996 Spring Campelen 15 min. tow
93-183	328	0(6)	No Survey
93-183	341	0(6)	data
93-183	342	0(2)	available
93-183	343	0(2)	
184-274	344	0(5)	
275-366	345	0(7)	
275-366	346	0(3)	
184-274	347	0(4)	
93-183	348	0(7)	
93-183	349	0(9)	
57-91	350	0(8)	
57-91	363	0.6(7)	
93-183	364	0(9)	
93-183	365	0(4)	
184-274	366	0(5)	
275-366	368	0(2)	
184-274	369	0(3)	
93-183	370	0(5)	
57-91	371	0(5)	
57-91	372	0.6(10)	
57-91	384	0(5)	
93-183	385	0(9)	
184-274	386	0(4)	
275-366	387	0(3)	
275-366	388	0(2)	
184-274	389	0(3)	
93-183	390	0(6)	
184-274	391	0(2)	
275-366	392	0(2)	
367-549	729	0(2)	
550-731	730	0(2)	
367-549	731	0(2)	
550-731	732	0(2)	
367-549	733	0(3)	
550-731	734	0(2)	
367-549	735	0(2)	
550-731	736	0(2)	
732-914	737	0(2)	
732-914	738	0(2)	
732-914	741	-	
732-914	745	-	
732-914	748	-	
Mean No/set (# sets)		0.66(166)	-
Abundance (Millions)		3.6	-
Mean wgt/set		0.23	-
Biomass ('000t)		1.2	-

Table 7 Biomass of yellowtail by stratum, from research vessel surveys in Division 3N. Numbers in parentheses are the number of successful tows in each stratum.

		Year-Gear	
Depth (m)	Stratum	1995 Fall Campelen 15 min. tow	1996 Spring Campelen 15 min. tow
275-366	357	0(2)	0(2)
185-274	358	0(2)	0(2)
93-183	359	0(2)	0(2)
57-91	360	1.6(17)	28.2(11)
57-91	361	34.1(11)	26.1(7)
57-91	362	12.1(5)	28.9(9)
57-91	373	1.0(5)	0.7(9)
57-91	374	0(2)	0.9(3)
<56	375	14.8(9)	17.3(6)
<56	376	24.5(9)	1.1(5)
93-183	377	0(2)	0(2)
185-274	378	0(2)	0(2)
275-366	379	0(2)	0(2)
275-366	380	0(2)	0(2)
185-274	381	0(2)	0(2)
93-183	382	0(2)	0(2)
57-91	383	0(2)	0(2)
367-549	723	0(2)	0(2)
350-731	724	0(2)	0(2)
367-549	725	0(2)	0(2)
550-731	726	0(2)	0(2)
367-549	727	0(2)	0(2)
550-731	728	0(2)	0(2)
732-914	752	-	-
732-914	756	-	-
732-914	760	-	-
Mean No/set (# sets		294.2(90)	196.5(82)
Abundance (Millions		509	471.7
Mean wgt/set		42.8	43.0
Biomass ('000t)		102.8	103.1

Table 8 Biomass of yellowtail by stratum, from research vessel surveys in Division 3O. Numbers in parentheses are the number of successful tows in each stratum.

Depth (fm)	Stratum	1995 Fall Campelen 15 min. tow	1996 Spring Campelen 15 min. tow
51-100	329	0(5)	0(6)
31- 50	330	1.1(5)	0.3(8)
31- 50	331	0(2)	0(2)
51-100	332	0.1(3)	0.5(4)
101-150	333	0(2)	0(2)
151-200	334	0(2)	0(2)
151-200	335	0(2)	0(2)
101-150	336	0(2)	0(2)
51-100	337	0(2)	0.3(3)
31- 50	338	7.2(5)	8.0(7)
51-100	339	0(2)	0(2)
31- 50	340	0.5(4)	0(6)
31- 50	351	2.2(7)	4.7(8)
31- 50	352	13.7(17)	46.0(9)
31- 50	353	0.8(3)	10.7(5)
51-100	354	0(2)	0(2)
101-150	355	0(2)	0(2)
151-200	356	0(2)	0(2)
201-300	717	0(2)	0(2)
301-400	718	0(2)	0(2)
201-300	719	0(2)	0(2)
301-400	720	0(2)	0(2)
201-300	721	0(2)	0(2)
301-400	722	0(2)	0(2)
Mean No/set (# sets		31.2(81)	87.3(86)
Abundance (Millions)		79.7	161.6
Mean wgt/set		10.1	27.6
Biomass ('000t)		25.7	70.5

Table 9 . Abundance index (millions) of yellowtail from Canadian spring groundfish surveys in Div. 3LNO.

Age	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	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	0.1	0.1	0.0	1.4	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.0	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	0.1	0.1	0.1	2.4	0.8	0.4	1.0	0.5	0.3	0.1
4	12.7	16.5	3.1	9.9	6.0	11.1	2.0	18.8	3.5	2.5	1.8	0.5	1.2	23.8	7.9	5.6	5.2	7.6	2.0	2.8
5	63.8	73.8	18.6	38.2	12.6	37.9	8.8	38.6	26.4	12.9	11.8	6.4	1.6	25.9	22.1	27.0	11.0	18.4	9.2	3.3
6	92.1	100.7	45.5	70.4	50.3	97.7	37.9	56.1	94.0	52.8	30.3	20.2	9.5	27.3	29.3	39.3	26.3	39.2	24.0	32.4
7	106.8	92.5	121.7	73.1	129.2	140.0	97.3	87.4	131.0	90.9	93.7	56.5	31.8	33.5	45.6	39.3	26.1	41.7	30.5	38.8
8	26.0	18.7	99.5	38.2	61.8	45.4	101.8	56.7	56.5	42.1	45.7	76.3	45.8	17.2	38.6	19.6	12.0	15.0	14.1	19.1
9	2.9	0.4	27.7	4.0	7.2	3.1	19.6	13.9	4.4	3.3	6.6	7.6	9.1	1.7	4.9	2.8	2.7	1.5	1.0	0.1
10	0.2	0.0	4.2	0.1	0.9	0.1	5.3	2.0	0.1	0.3	0.5	0.6	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.0
11	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1+	305.3	306.6	320.8	237.0	269.0	340.4	273.8	280.8	316.2	205.5	190.5	168.2	99.6	132.1	149.6	134.1	84.4	123.9	81.1	96.6
5+	291.8	286.2	317.5	224.0	262.0	324.2	270.7	255.0	312.4	202.3	188.6	167.6	98.2	105.7	140.9	128.0	78.1	115.8	78.8	93.7
7+	135.9	111.7	253.4	115.4	199.1	188.6	224.0	160.3	192.0	136.6	146.5	141.0	87.1	52.5	89.5	61.7	40.8	58.2	45.6	58.0

Table 10 Biomass estimates ('000 t) of yellowtail, by stratum, from fall R.V. surveys in Div. 3LNO from 1990 to 1994 using the Engel 145 survey trawl and in 1995 using the Campelen 1800 shrimp trawl.

	1990 Engel	1991 Engel	1992 Engel	1993 Engel	1994 Engel	1995 Campelen
Div. 3L	1.3	0.6	0.6	0.7	0.0	1.3*
Div. 3N						
360	2.9	4.3	5.3	14.0	6.6	16.3
361	6.4	11.1	15.6	19.3	26.7	34.1
362	4.4	4.1	0.6	0.2	0.6	12.1
375	1.7	3.3	-	5.4	21.0	14.8
376	12.5	4.5	4.1	15.7	5.2	24.5
Other	0.1	0.4	0.0	0.0	0.3	1.0
Total	28.1	27.7	25.7	54.6	60.5	102.8*
Div. 3Ø						
329-332	0.4	0.6	0.3	1.2	0.0	1.2
337-340	1.0	4.0	0.2	0.9	0.1	7.7
351	3.5	1.4	0.1	3.2	0.5	2.2
352	4.6	13.3	10.9	5.5	5.7	13.7
353	1.6	0.0	0.0	0.4	0.0	0.8
Other	-	-	-	-	0.2	0.0
Total	11.2	19.3	11.6	11.2	6.3	25.7*
Div. 3LNØ	40.6	47.6	37.9	66.5	66.8	129.9*

*1995 estimates can not be directly compared to the 1990-94 estimates because conversion factors have not been derived!

Table 11. Abundance index (millions) of yellowtail from Canadian fall groundfish surveys in Div. 3LNO using the Engel 145 otter trawl from 1990-94.

Age	1990	1991	1992	1993	1994	1995
1	0.0	0.0	0.0	0.0	0.0	no age data
2	0.1	0.1	0.1	0.0	0.1	
3	2.2	2.4	1.2	0.7	0.4	
4	5.9	6.6	5.9	22.3	4.6	
5	16.9	15.1	10.0	35.6	15.4	
6	22.9	33.8	18.5	46.2	39.8	
7	30.3	36.0	31.1	40.6	48.2	
8	13.4	20.9	17.6	13.8	35.5	
9	1.4	2.2	2.8	0.8	1.0	
10	0.0	0.0	0.0	0.0	0.0	
1+	93.1	117.1	87.2	160.0	145.0	
5+	84.9	108.0	80.0	137.0	139.9	
7+	45.1	59.1	51.5	55.2	84.7	

Table 12. Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. juvenile 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}) are shown at the bottom of the table. Gear used is a Yankee 41 shrimp trawl.

Depth (m)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
93-183	328	Av.No./set	-	-	-	-	0.00(3)	-	0.00(5)	0.00(3)	0.00(3)	0.00(3)
		Av.wt./set										
93-183	341	Av.No./set	-	-	-	-	0.00(4)	0.00(5)	0.00(4)	0.00(5)	0.00(5)	0.00(4)
		Av.wt./set										
93-183	342	Av.No./set	-	-	-	-	0.00(2)	-	-	0.00(2)	0.00(2)	0.00(2)
		Av.wt./set										
93-183	343	Av.No./set	-	-	-	-	0.00(2)	-	0.00(2)	0.00(2)	0.00(2)	0.00(2)
		Av.wt./set										
187-274	344	Av.No./set	-	-	-	-	-	-	-	0.00(2)	0.00(3)	0.00(4)
		Av.wt./set										
187-274	347	Av.No./set	-	-	-	-	-	-	-	0.00(2)	0.00(3)	0.00(3)
		Av.wet./set										
93-183	348	Av.No./set	-	-	-	-	0.00(7)	0.00(4)	0.00(7)	0.00(12)	0.00(11)	0.00(7)
		Av.wt./set										
93-183	349	Av.No./set	-	-	-	-	0.00(5)	0.00(7)	0.00(7)	0.00(8)	0.00(7)	0.00(5)
		Av.wt./set										
57-91	350	Av.No./set	59.00(5)	7.83(6)	-	37.97(5)	0.88(8)	0.00(4)	1.37(8)	0.50(6)	0.43(7)	0.54(4)
		Av.wt./set	25.50	3.58		3.70	0.49		0.58	0.24	0.20	0.23
57-91	363	Av.No./set	53.80(5)	48.89(5)	-	42.47(6)	13.71(7)	7.25(4)	15.99(4)	13.60(5)	17.40(5)	14.90(4)
		Av.wt./set	21.00	22.77		19.65	7.54	3.39	8.06	6.67	8.84	7.15

Table 12. (Cont'd).

Depth (m)	Stratum	Category	Year									
			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
93-183	364	Av.No./set	-	-	-	-	0.00(11)	0.00(5)	0.00(6)	0.00(17)	0.13(16)	0.20(11)
		Av.wt./set									0.03	0.06
93-183	365	Av.No./set	-	-	-	-	0.00(4)	0.00(3)	0.00(4)	0.00(6)	0.00(6)	0.00(4)
		Av.wt./set										
184-274	366	Av.No./set	-	-	-	-	-	-	-	0.00(3)	0.00(2)	0.00(3)
		Av.wt./set										
184-274	369	Av.No./set	-	-	-	-	-	-	-	0.00(3)	0.00(3)	0.00(3)
		Av.wt./set										
93-183	370	Av.No./set	-	-	-	-	0.00(6)	0.00(3)	24.98(3)	0.00(8)	0.00(7)	0.00(5)
		Av.wt./set							0.48			
57-91	371	Av.No./set	2.25(4)	-	-	1.20(5)	6.50(4)	4.00(3)	-	1.08(3)	0.33(3)	1.44(3)
		Av.wt./set	1.88			0.70	3.70	1.95		0.65	0.08	0.71
57-91	372	Av.No./set	93.06(9)	101.00(8)	-	64.83(8)	41.00(8)	78.75(4)	58.21(4)	34.67(6)	5.60(10)	7.37(5)
		Av.wt./set	39.49	48.13		34.31	20.21	40.21	27.57	9.25	2.72	3.80
57-91	384	Av.No./set	35.25(4)	-	-	1.00(5)	0.25(4)	0.50(2)	0.00(3)	0.00(4)	0.75(4)	0.00(4)
		Av.wt./set	22.88			0.18	0.13	0.47			0.45	
93-183	385	Av.No./set	-	-	-	-	0.00(5)	0.00(4)	0.00(6)	0.00(13)	0.00(12)	0.00(6)
		Av.wt./set										
187-274	386	Av.No./set	-	-	-	-	-	-	-	0.00(3)	0.00(3)	0.00(3)
		Av.wt./set										

Table 12 (Cont'd).

Depth (m)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
185-274	389	Av.No./set Av.wt./set	-	-	-	-	-	-	-	0.00(3)	0.00(3)	0.00(3)
93-183	390	Av.No./set Av.wt./set	-	-	-	-	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(3)
185-274	391	Av.No./set Av.wt./set	-	-	-	-	-	-	-	0.00(2)	0.00(2)	0.00(2)
Mean No./set (# sets)			57.16(27)	55.73(19)	(0)	29.53(29)	5.18(84)	9.06(51)	7.64(67)	3.39(122)	1.43(123)	1.46(93)
Abundance (Nos x 10^{-6})			52.0	37.4		26.9	14.3	22.5	19.7	11.9	5.02	5.10
Mean wt./set			25.15	26.36		14.98	2.63	4.61	3.44	1.09	0.71	0.71
Biomass ('000t)			22.9	17.7		13.6	7.3	11.4	8.9	3.8	2.5	2.50

Table 13 Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. juvenile surveys in Division 3N. Numbers in parentheses are the number of successful 30-mi... tows in each stratum. The stratified mean number and weight per tow (kg/30 min.), abundance (millions), and biomass (t x 10^{-3}) are shown at the bottom of the table. Gear used was a Yankee 41 shrimp trawl.

Depth (m)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
185-274	358	Av.No./set	-	-	-	-	-	-	-	0.00(2)	-	-
		Av.Wt./set										
98-183	359	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(2)
		Av.wt./set										
57-91	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)	332.50(16)	457.92(14)	323.65(13)
		Av.wt./set	26.83	19.96	12.75	22.73	46.28	58.37	75.37	59.95	89.25	62.19
57-91	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)	431.63(8)	714.92(8)	1140.56(8)
		Av.wt./set	33.58	61.78	174.37	62.29	107.86	133.26	172.86	156.88	266.33	418.23
57-91	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)	40.17(6)	71.18(8)	192.47(3)
		Av.wt./set	59.50	43.14	16.75	57.64	45.31	40.37	126.99	18.09	33.93	79.77
57-91	373	Av.No./set	160.80(10)	112.93(7)	-	29.85(8)	32.25(8)	14.78(9)	1.13(7)	1.00(5)	7.63(8)	11.92(4)
		Av.wt./set	75.60	49.60		15.74	15.38	8.67	0.78	0.43	3.68	5.40
57-91	374	Av.No./set	16.00(4)	12.00(4)	-	5.25(4)	0.33(3)	0.75(4)	0.00(2)	7.00(3)	0.25(4)	0.00(3)
		Av.wt./set	7.50	6.38		3.63	0.17	0.15	0.00	3.67	0.19	
<56	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)	458.33(11)	157.01(10)	951.71(7)
		Av.wt./set	104.14	115.19	43.22	25.67	88.88	73.25	144.79	169.22	84.80	257.47
<56	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)	475.13(8)	701.78(9)	2557.52(7)
		Av.wt./set	47.75	150.46	58.55	38.79	160.04	206.24	160.03	58.53	127.06	452.64
93-183	377[a]	Av.No./set	-	-	-	-	-	-	-	-	0.00(2)	0.00(2)
		Av.wt./set										
185-274	378[b]	Av.wt./set	-	-	-	-	-	-	-	-	-	0.00(3)
		Av.wt./set										
185-274	381[a]	Av.No./set	-	-	-	-	-	-	-	-	0.00(2)	0.00(2)
		Av.wt./set										
93-183	382	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(3)	0.00(2)	0.00(2)	0.00(2)
		Av.wt./set										
57-91	383	Av.No./set	0.00(4)	-	-	2.00(4)	0.00(3)	0.00(3)	0.00(4)	0.00(2)	0.00(2)	0.00(2)
		Av.wt./set				0.32						
Mean No./set (# sets)			122.37(45)	184.1(49)	342.9(46)	125.1(69)	243.8(71)	306.4(84)	401.52(70)	210.85(66)	263.35(72)	556.70(58)
Abundance (Nos x 10^{-6})			189.9	272.2	381.1	193.9	405.6	509.8	667.7	355.8	446.0	951.0
Mean wt./set			50.5	59.2	53.6	32.3	55.8	62.05	85.58	55.27	74.13	140.90
Biomass ('000t)			78.2	85.4	59.6	56.1	92.7	103.2	142.4	93.3	125.5	240.7

[a]New strata in 1993.
[b]New strata in 1994.

Table 14 Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. juvenile 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}) are shown at the bottom of the table. Gear used was a Yankee 41 shrimp trawl.

Depth (m)	Stratum	Category	Year 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
93-183	329	Av.No./set	-	-	-	-	0.00(4)	-	0.00(6)	2.50(6)	0.00(5)	0.00(3)
		Av.Wt./set								1.02		
57-91	330	Av.No./set	-	-	-	10.99(2)	6.87(7)	37.14(7)	4.00(6)	53.40(5)	3.40(5)	16.52(4)
		Av.wt./set				5.50	3.54	18.20	1.65	29.16	1.32	8.42
57-91	331	Av.No./set	-	-	-	0.50(2)	12.50(2)	19.00(2)	8.99(3)	4.00(2)	1.51(2)	5.42(2)
		Av.wt./set				0.25	7.75	10.56	4.91	1.48	1.80	2.11
93-183	332	Av.No./set	-	-	-	-	6.50(4)	7.00(2)	27.98(4)	0.00(4)	3.50(4)	4.33(3)
		Av.wt./set					3.75	1.88	12.48		1.43	1.90
185-274	333[a]	Av.No./set	-	-	-	-	-	-	-	-	0.00(2)	-
		Av.wt./set										
93-183	336[a]	Av.No./set	-	-	-	-	-	-	-	-	0.00(2)	-
		Av.wt./set										
57-91	337	Av.No./set	-	-	-	-	0.00(2)	10.67(3)	1.25(4)	1.25(4)	15.00(4)	1.00(3)
		Av.wt./set						2.82	0.39	0.17	5.91	0.28
93-183	338	Av.No./set	-	86.67(3)	-	18.99(6)	48.50(6)	9.25(4)	9.83(6)	33.75(4)	81.00(4)	27.98(4)
		Av.wt./set		41.17		9.58	20.12	3.89	4.21	17.96	35.55	5.97
57-91	339	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	4.50(4)	4.50(4)	0.75(4)	0.00(3)
		Av.wt./set							8.17	0.34	0.25	
57-91	340	Av.No./set	-	-	-	7.59(3)	33.50(6)	6.71(7)	29.18(5)	9.75(4)	4.33(3)	39.72(3)
		Av.wt./set				2.85	15.33	3.16	11.82	3.88	1.79	17.77
57-91	351	Av.No./set	166.00(3)	175.78(9)	-	85.93(7)	69.38(8)	99.42(9)	41.40(7)	63.66(7)	72.38(8)	57.15(4)
		Av.wt./set	63.67	66.00		28.68	29.31	43.95	18.90	27.60	32.89	24.16
57-91	352	Av.No./set	-	210.77(13)	134.00(1)	167.78(11)	206.93(14)	158.95(16)	231.96(16)	352.08(13)	457.85(13)	460.38(9)
		Av.wt./set		73.68	65.35	58.81	77.43	66.01	80.02	97.62	155.71	160.64
57-91	353	Av.No./set	-	118.00(5)	-	19.24(4)	21.67(3)	0.00(4)	86.73(5)	6.25(4)	7.25(4)	1.00(3)
		Av.wt./set		68.75		9.19	10.33		37.86	2.84	3.80	0.53
93-183	354	Av.No./set	-	-	-	-	0.00(2)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(3)
		Av.wt./set										
185-274	355	Av.wt./set	-	-	-	-	-	-	-	-	-	0.00(2)
		Av.wt./set										
Mean No./set (# sets)			166.0(3)	157.3(30)	. (1)	58.7(35)	57.7(60)	50.9(60)	53.1(69)	59.1(61)	88.7(63)	85.9(44)
Abundance (Nos x 10^{-6})			44.5	138.5		78.2	97.0	84.3	97.7	108.8	165.8	159.1
Mean wt./set			63.8	63.2		21.6	21.2	21.9	20.1	24.8	32.4	30.9
Biomass ('000t)			17.1	52.4		28.8	38.9	36.3	36.9	60.4	60.6	57.4

[a]New strata in 1993.
[b]New strata in 1993.

Table 15. A comparison of average numbers and weights of yellowtail flounder per 30-minute tows from juvenile surveys from 1986 to 1994 with the Yankee shrimp trawl and the 1995 average numbers and weight per 15 minute tow with the Campelen shrimp trawl.

Selected strata	Category	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995(Campelen) unadjusted)
352	No. of sets	13	-	11	14	16	16	13	13	9	17
	Av. no./set	210.77		164.9	206.9	159.0	232.1	254.1	457.9	460.6	121.9
	Av. wt./set	72.68		58.8	77.4	66.0	80.1	97.6	155.7	160.6	38.6
360	No. of sets	14	19	20	19.0	21.0	18.0	16.0	14.0	13.0	17
	Av. no./set	259.14	192.2	112.6	373.0	392.0	457.2	332.5	458.0	323.7	171.3
	Av. wt./set	19.96	12.8	22.7	46.3	58.4	75.4	60.0	89.3	62.2	39.63
361	No. of sets	8	8	6	9.0	10.0	8.0	8.0	8.0	8.0	11
	Av. no./set	188.5	399.9	162.5	286.3	379.6	522.1	431.6	714.9	1140.6	450.0
	Av. wt./set	61.8	174.4	62.3	107.9	133.3	173.0	156.9	266.3	418.2	133.7
375	No. of sets	5	7	9	8.0	11.0	7.0	11.0	10.0	7.0	9
	Av. no./set	236.7	407.3	146.6	284.9	266.7	450.9	458.3	157.0	951.7	398.5
	Av. wt./set	115.2	43.2	25.7	88.9	73.3	144.9	169.2	84.8	257.5	67.8
376	No. of sets	4	10	12	9.0	11.0	10.0	8.0	9.0	7.0	9
	Av. no./set	325.8	1015.2	364.0	916.2	1505.4	1660.1	475.1	701.8	2557.5	711.6
	Av. wt./set	150.5	58.2	38.8	160.0	206.2	160.2	58.5	127.1	452.6	118.6
Total	No. of sets	44	44	58	59.0	69.0	59.0	56.0	54.0	44.0	63
	Av. no./set	240.9	439.3	175.2	381.1	472.4	583.9	370.1	492.4	914.7	319.7
	Av. wt./set	73.5	65.2	41.32	87.4	96.8	116.4	102.6	141.5	234.3	71.5
Abundance (millions)		269.3	370.9	195.8	426.0	528.1	652.8	413.8	550.4	1022.5	462.5
Biomass (000s t)		82.2	55.0	46.1	97.7	108.2	130.1	114.7	158.1	261.9	103.4

Table 16 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 1986-94.

Age	1986	1987[a]	1988	1989	1990	1991	1992	1993	1994
1	24.0	25.7	6.3	4.1	4.8	0.3	2.9	3.9	19.9
2	18.9	95.4	16.8	20.0	47.2	34.4	5.3	31.9	100.6
3	30.5	74.7	44.8	44.9	85.8	206.3	69.2	39.6	157.9
4	11.2	67.6	31.1	140.7	101.4	84.4	75.5	81.5	131.9
5	21.2	17.0	19.3	69.3	155.6	119.9	71.5	105.6	120.1
6	46.3	16.1	20.3	49.0	60.7	101.1	78.9	92.7	195.4
7	60.3	31.8	35.2	65.1	43.0	59.3	66.7	88.6	164.3
8	46.6	38.9	19.5	27.5	24.9	39.9	33.8	47.3	101.2
9	9.0	3.7	2.7	3.2	3.0	10.2	6.4	10.1	7.0
10	0.7	0	0	0	0.2	0	0	0	0
Total 1+	268.7	370.9	196.0	423.8	526.6	655.8	410.6	501.9	998.3
5+	184.1	107.5	97.1	214.1	287.4	330.4	257.3	344.3	588.0
7+	116.5	74.4	57.4	95.9	71.1	109.4	106.9	146.0	272.5
1 to 4	84.6	263.4	99.0	209.7	239.2	325.4	152.9	156.9	410.3

[a]Incomplete survey; stratum 352 not surveyed.

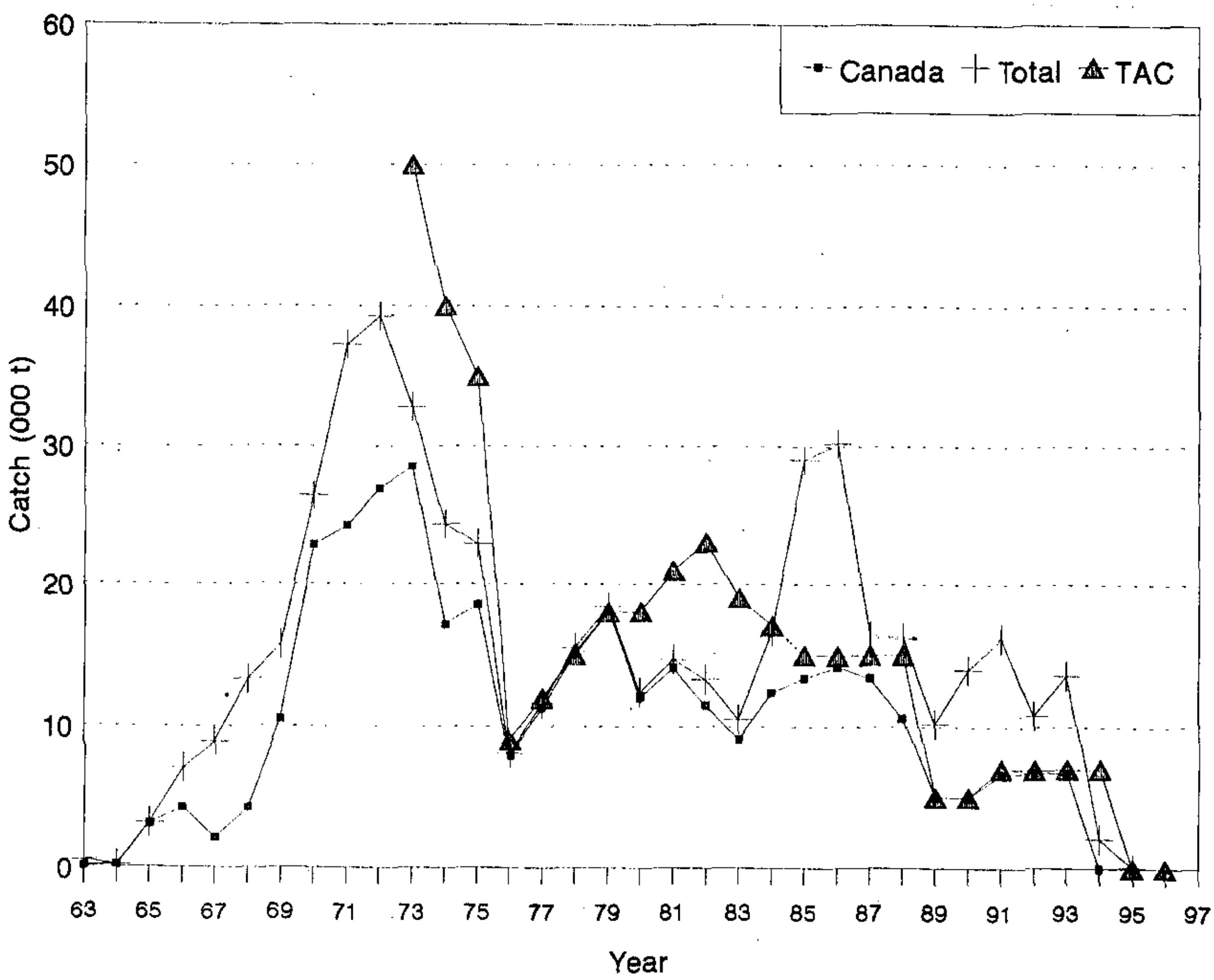


Fig. 1. Catches and TAC's of yellowtail in Div. 3LNO.

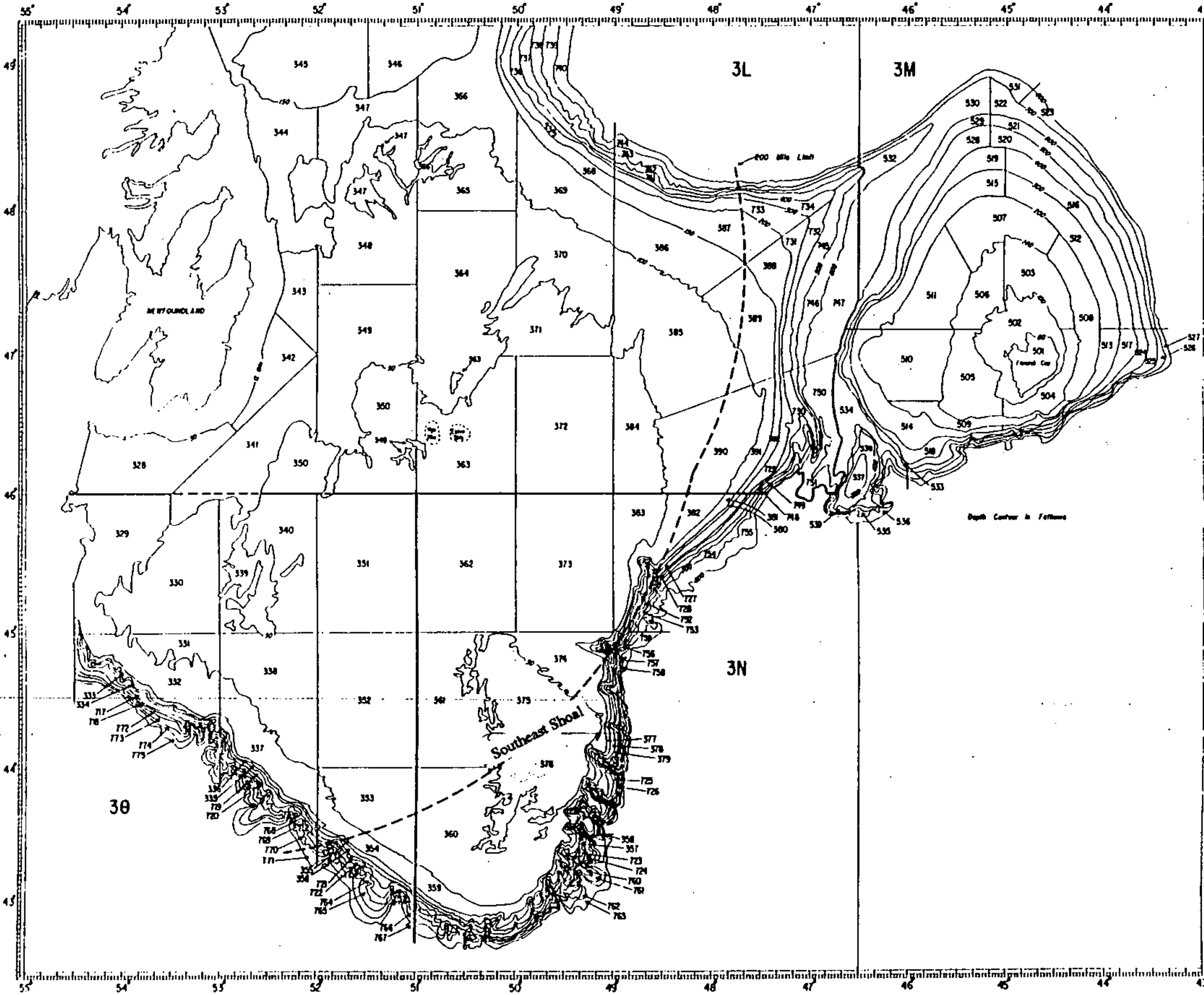


Figure 2. NAFO Div. 3LMNO, showing the Canadian 200 mile limit as well as the stratification scheme used in Canadian groundfish surveys.

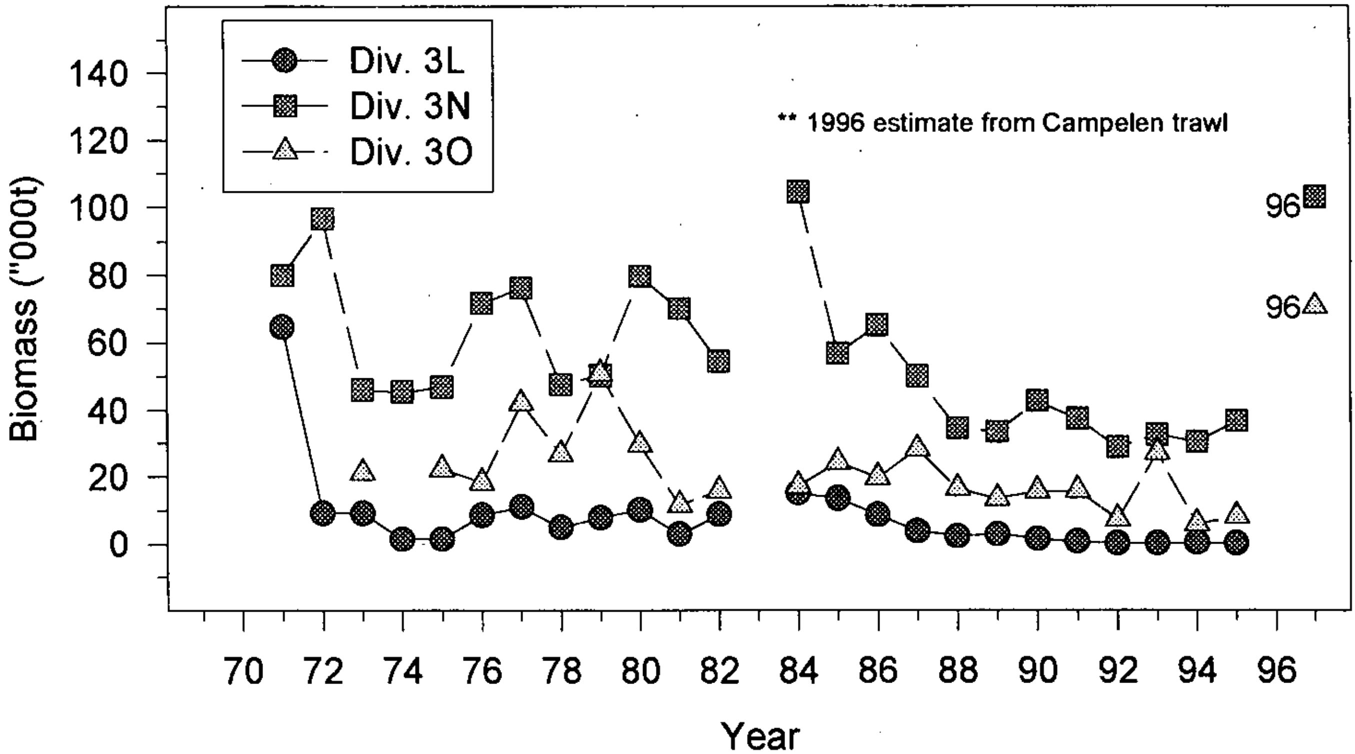


Fig. 3. Biomass estimates of yellowtail by NAFO Division from the Canadain spring surveys using the Engel 145 otter trawl from 1971-95 and the Campelen 1800 shrimp trawl in 1996. The 1996 estimate is not directly comparable to previous years.

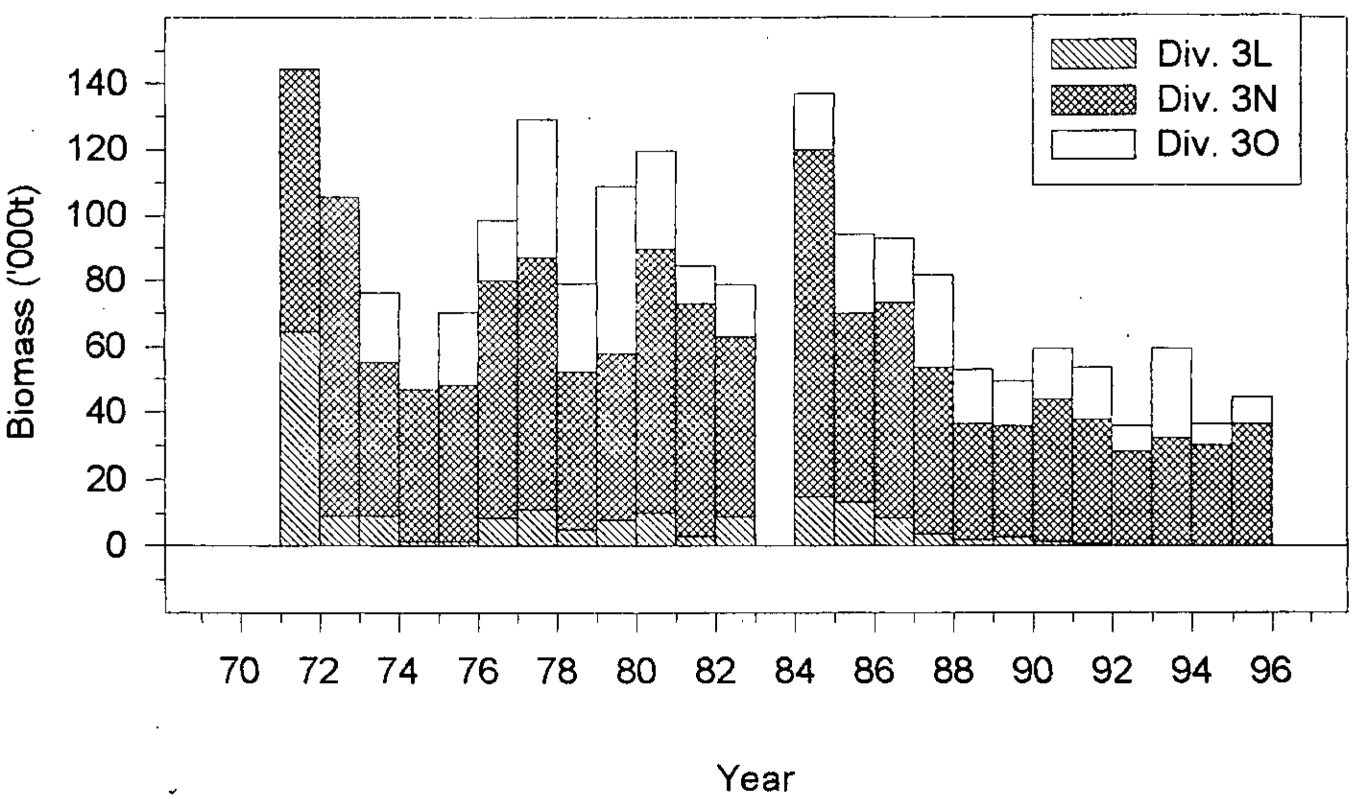


Fig. 4 Cumulative biomass estimates of yellowtail from Divisions 3L, 3N, & 3O from the Canadian spring surveys with the Engel 145 otter trawl. The 1996 estimate is not included because of the use of a different survey trawl.

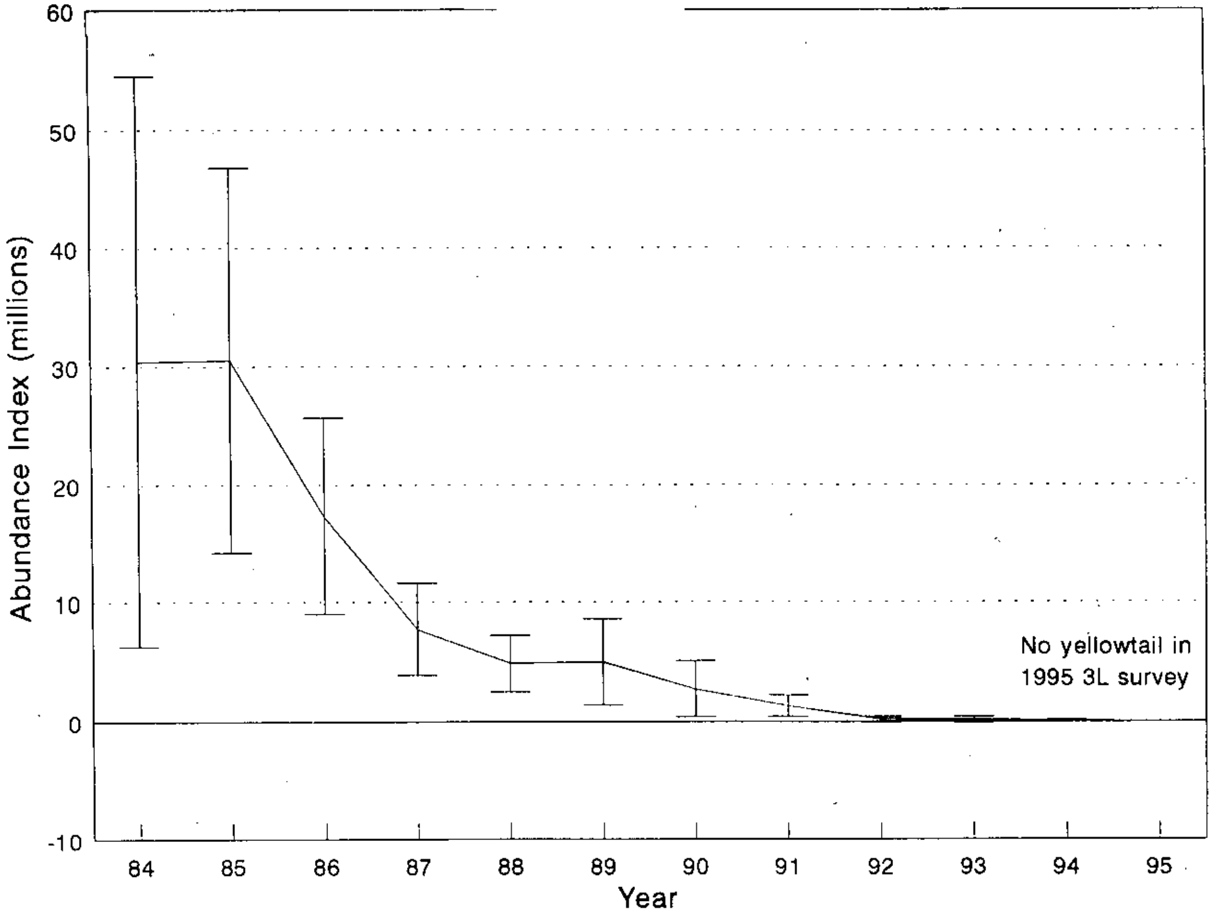


Fig. 5 . Abundance estimates of yellowtail (with approx. 95% C.I)
from Canadian spring surveys in Div.3L.

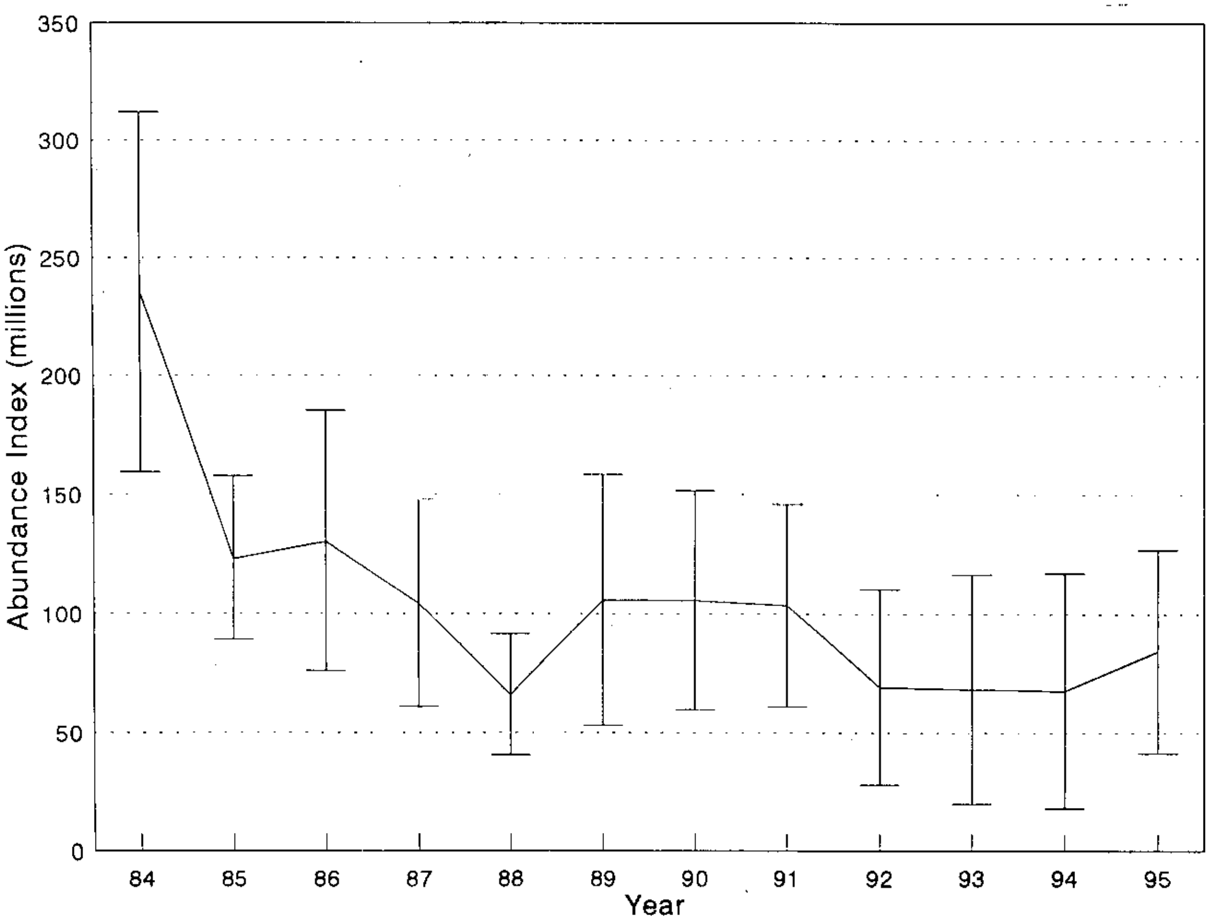


Fig. 6 . Abundance estimates of yellowtail (with approx. 95% C.I.)
from Canadian spring surveys in Div.3N.

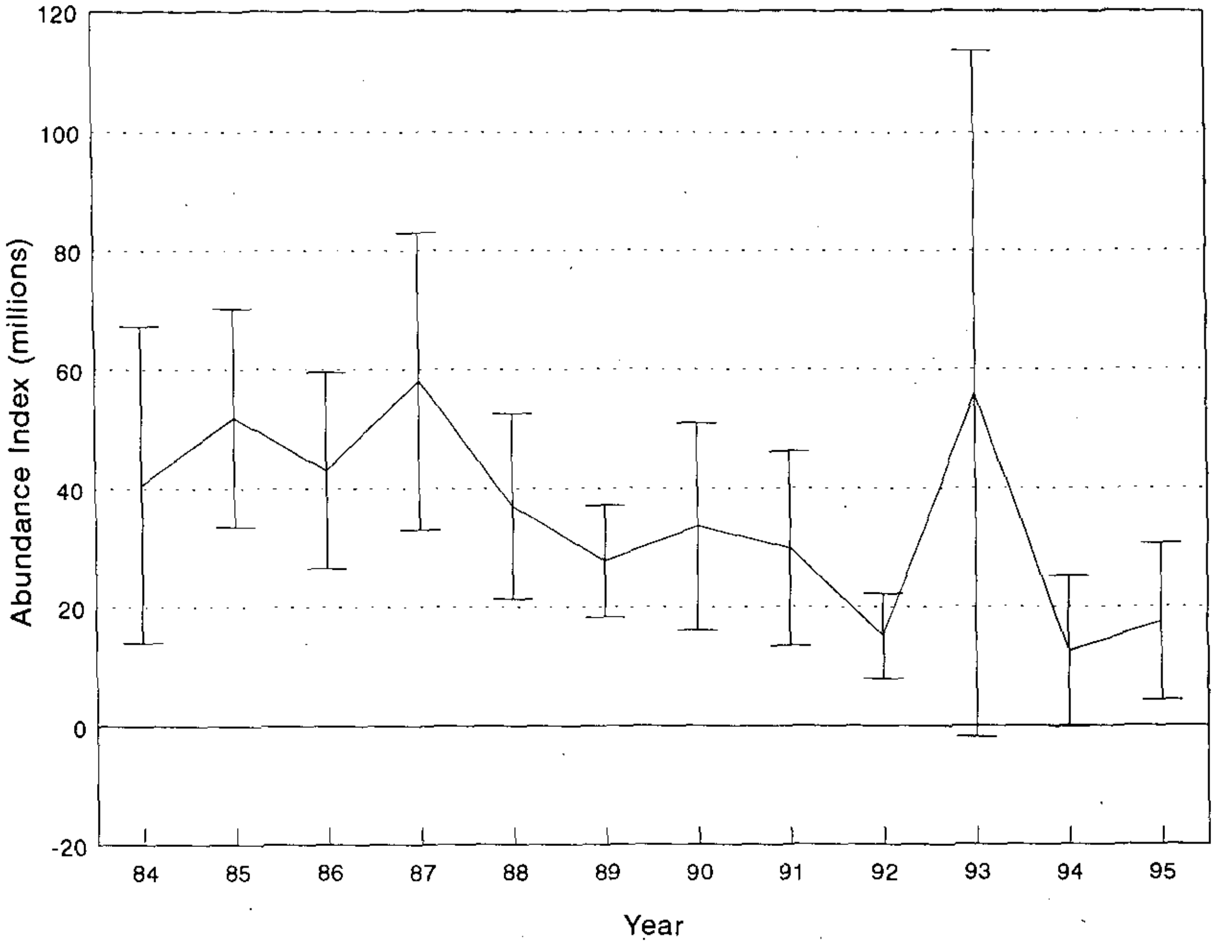


Fig. 7 Abundance estimates of yellowtail (with approx. 95% C.I.) from Canadian spring surveys in Div.3O.

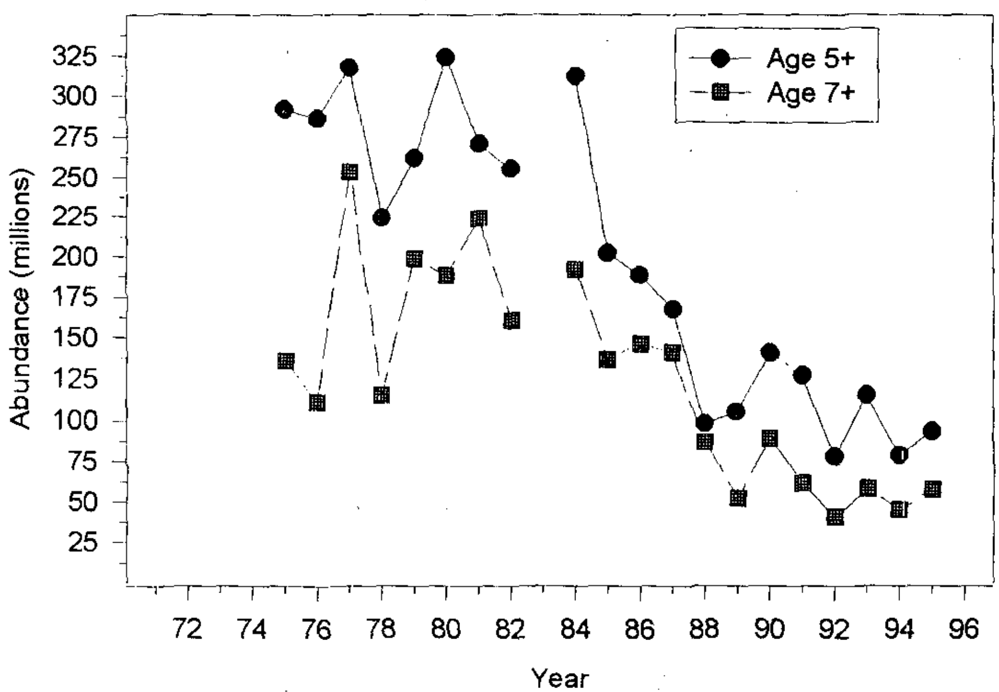


Fig. 8 Index of abundance of adult yellowtail flounder from the Canadian spring surveys, 1975-95, using the Engel 145 otter trawl.

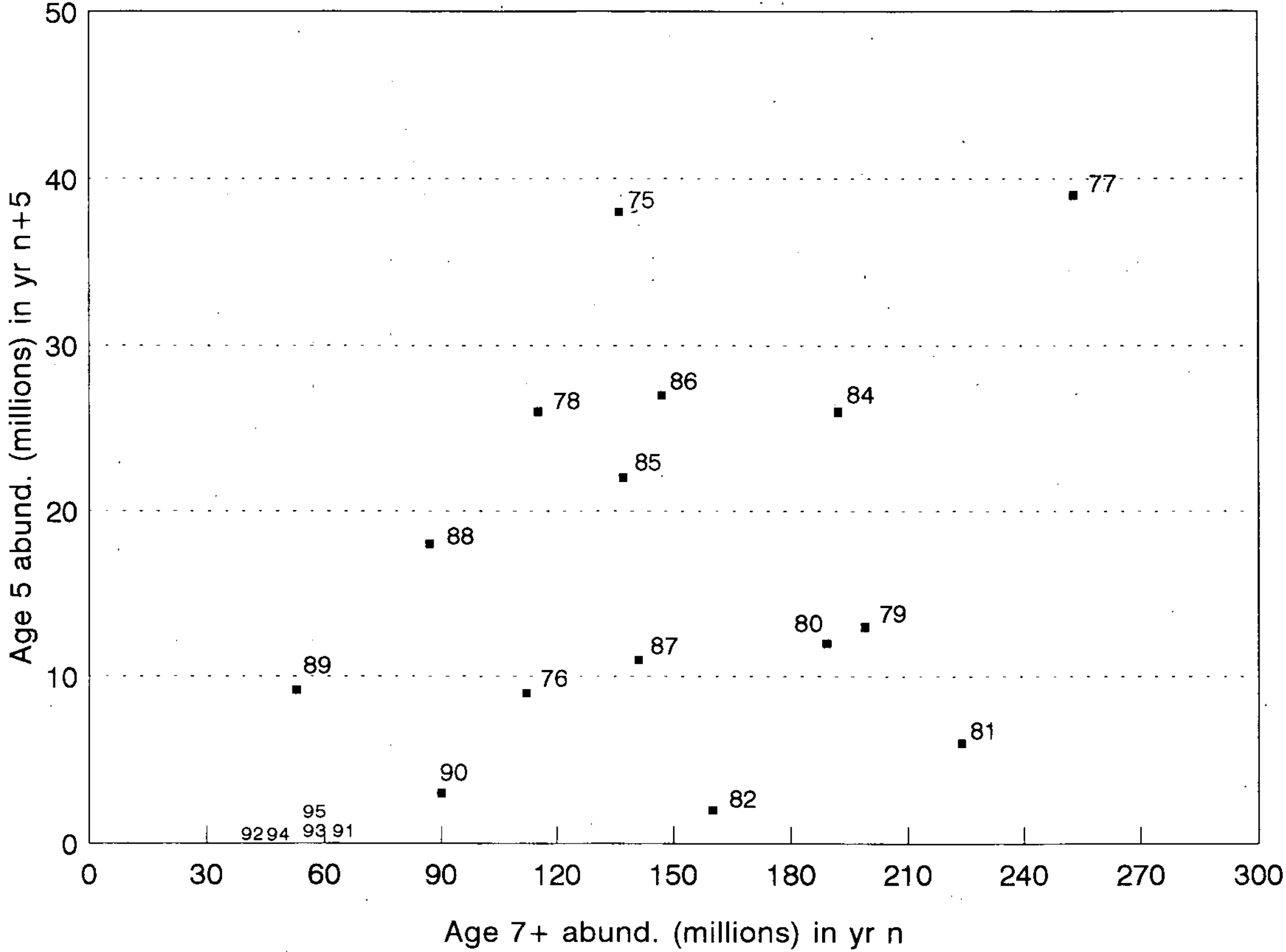


Fig. 9 . Regression of age 5 abundance (yr n+5) from spring surveys against age 7+ abundance (yr n, 1975-90) from spring surveys, Div. 3LNO.

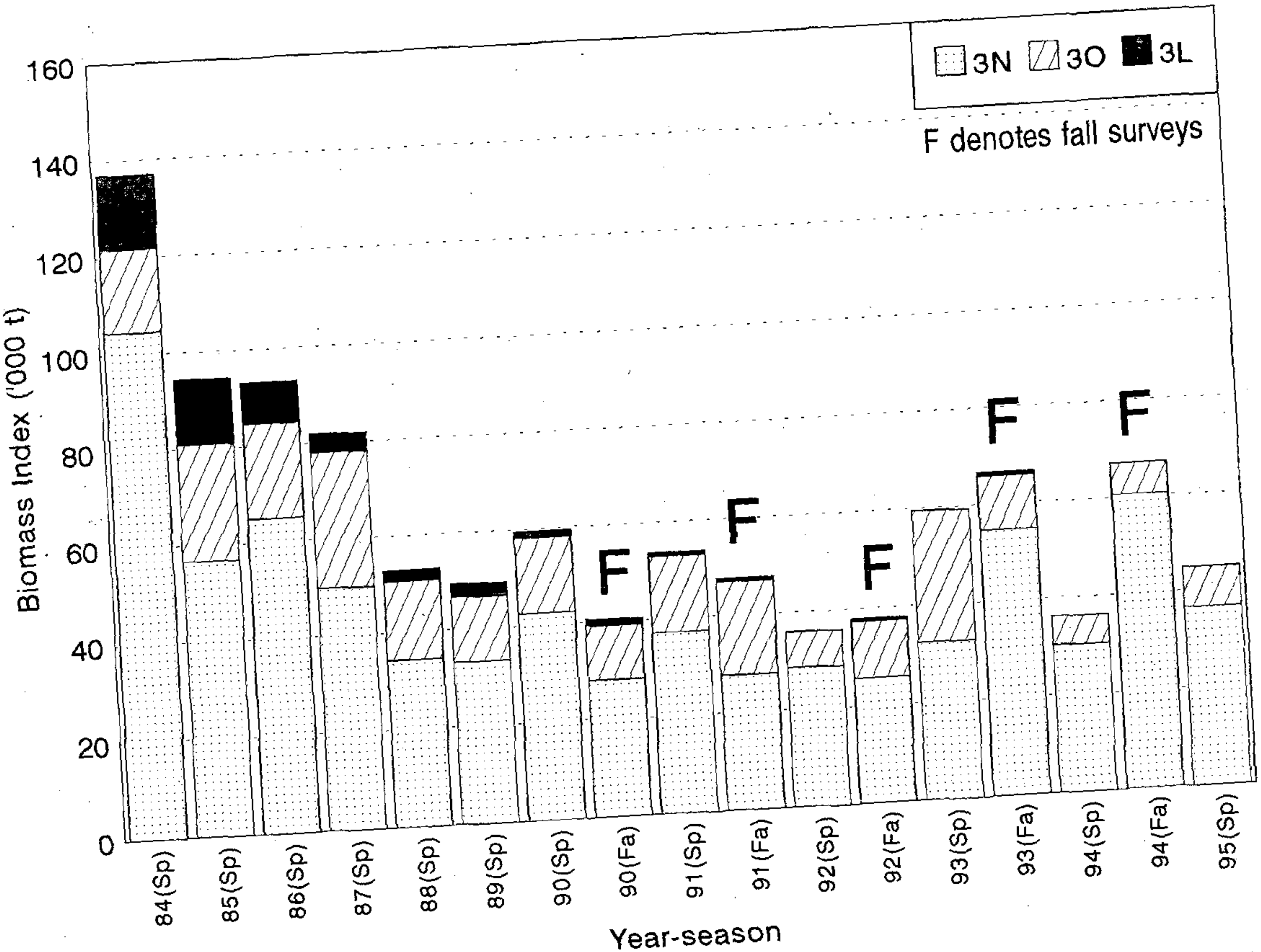


Fig. 10. Biomass of yellowtail flounder from Canadian RV surveys conducted in spring and fall in Div. 3LNO.

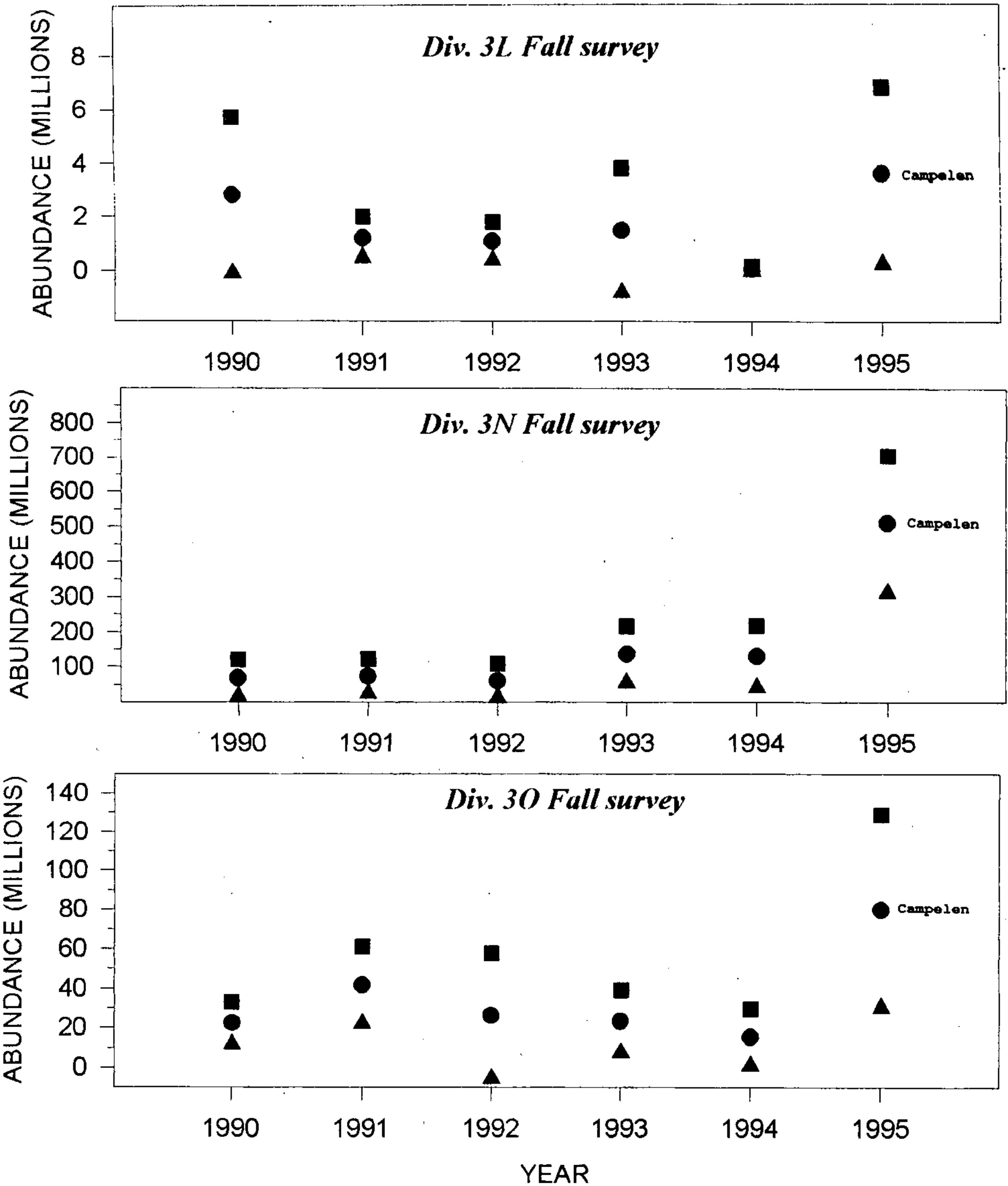


Fig 11 Abundance estimates of yellowtail (with 95% C.I.) from Canadian fall surveys in Div. 3L, 3N & 3O using a Engel 145 otter trawl from 1990-94 and the 1995 survey using aCampelen shrimp trawl.

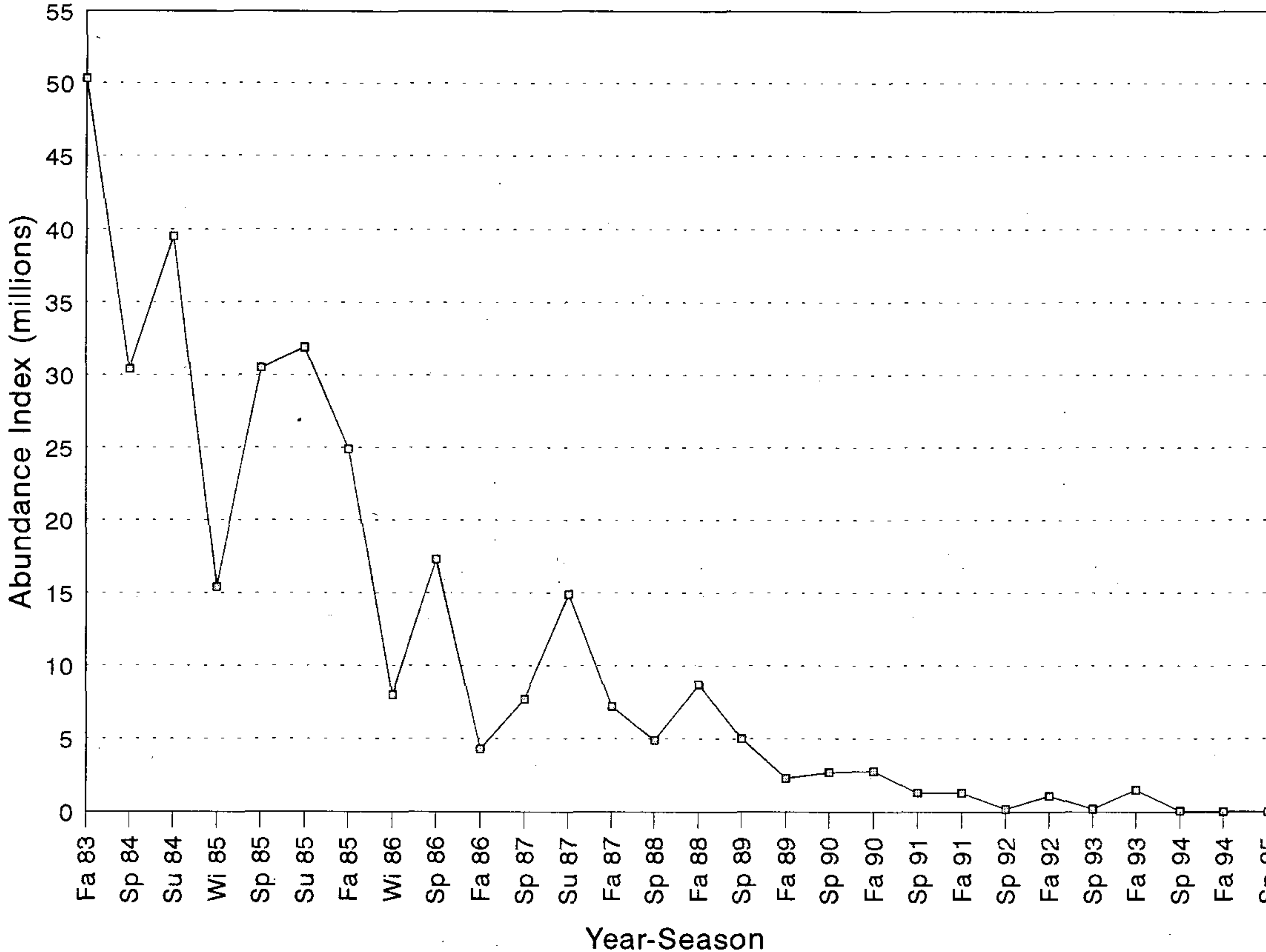
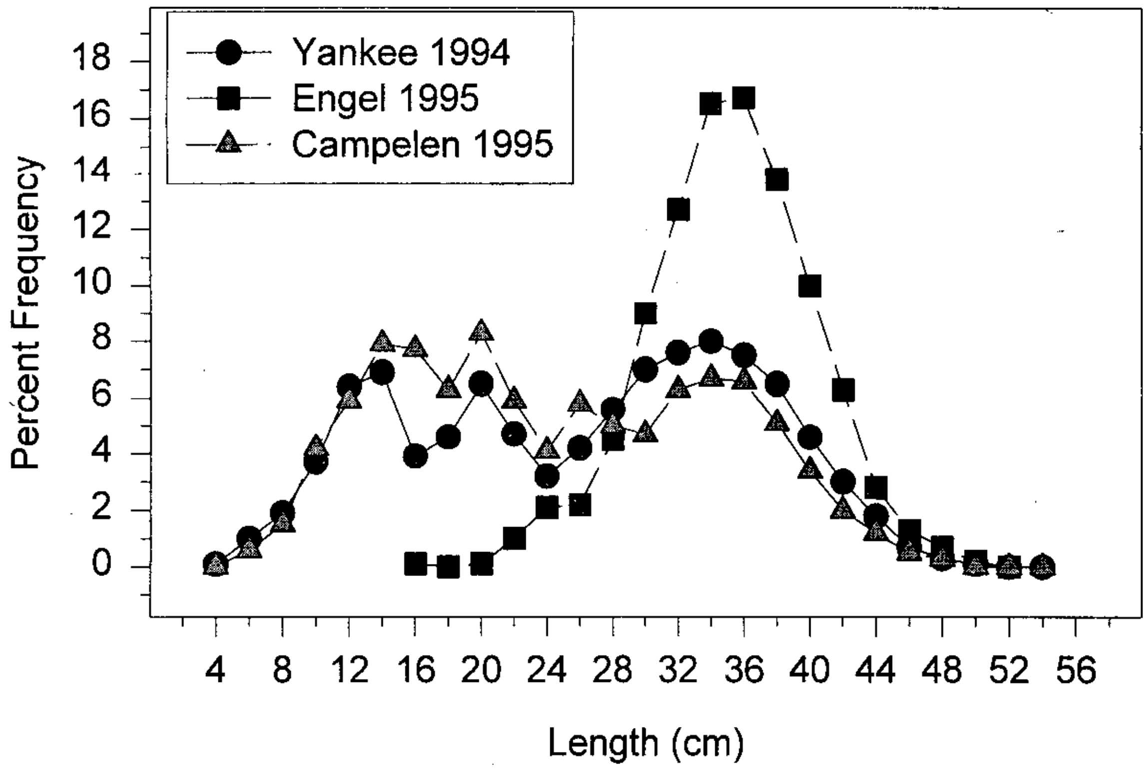


Fig. 12 Abundance of Yellowtail from surveys conducted at various times in Div. 3L.

Yellowtail flounder, Div. 3LNO



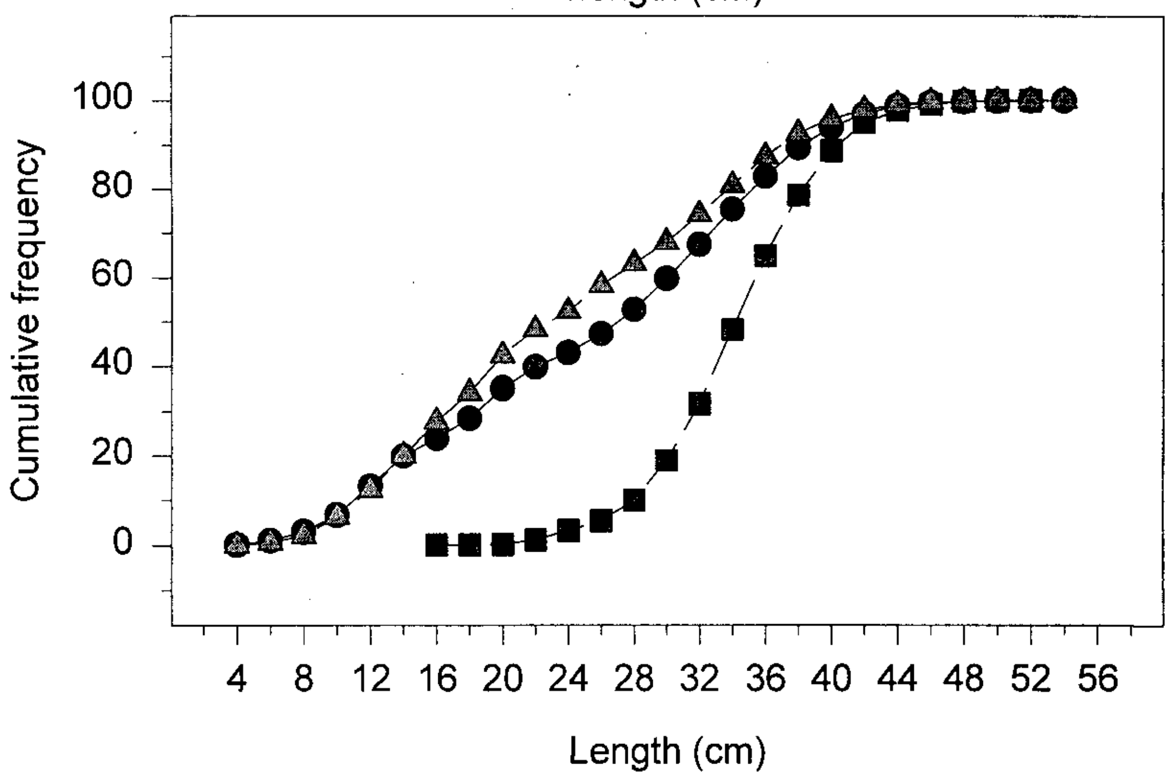


Fig. 13 Relative efficiency of survey trawls in catching yellowtail flounder. Yankee 41 shrimp trawl used in the 1994 fall juvenile groundfish survey, Engel 145 otter trawl used in the 1995 spring groundfish survey and the Campelen 1800 shrimp trawl used in the 1995 fall groundfish survey

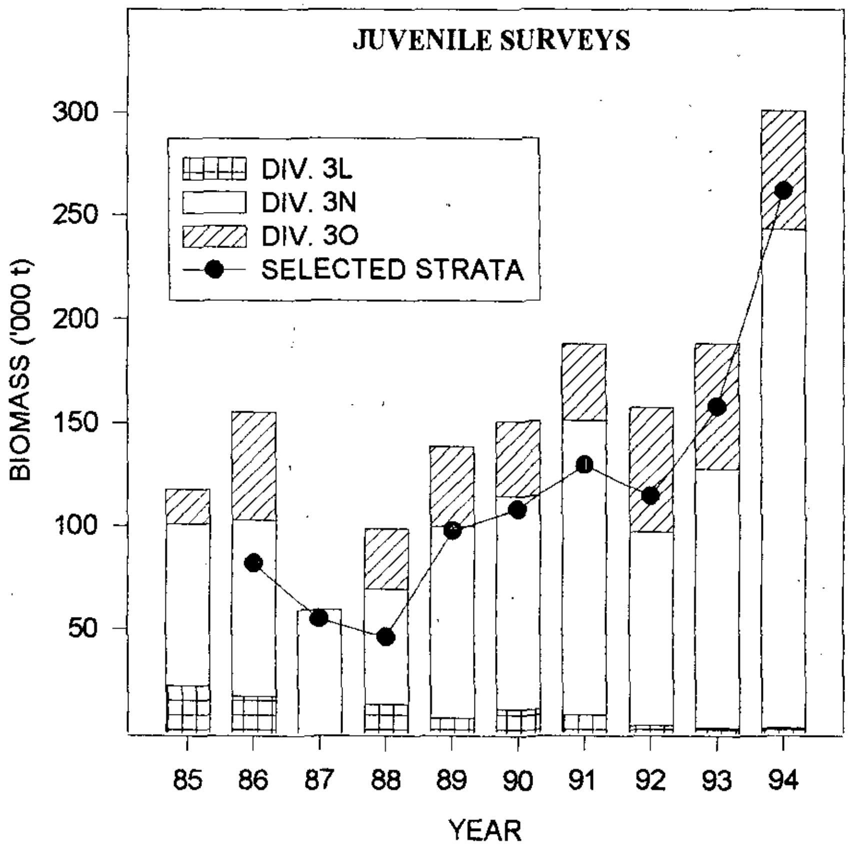


Fig 14 Trends in biomass of yellowtail from the Canadian juvenile groundfish surveys of the Grand Bank (Selected strata are 352 in Div. 3O; 360, 361, 375 &376 in Div. 3N) No survey in Div. 3L and 3O in 1987.

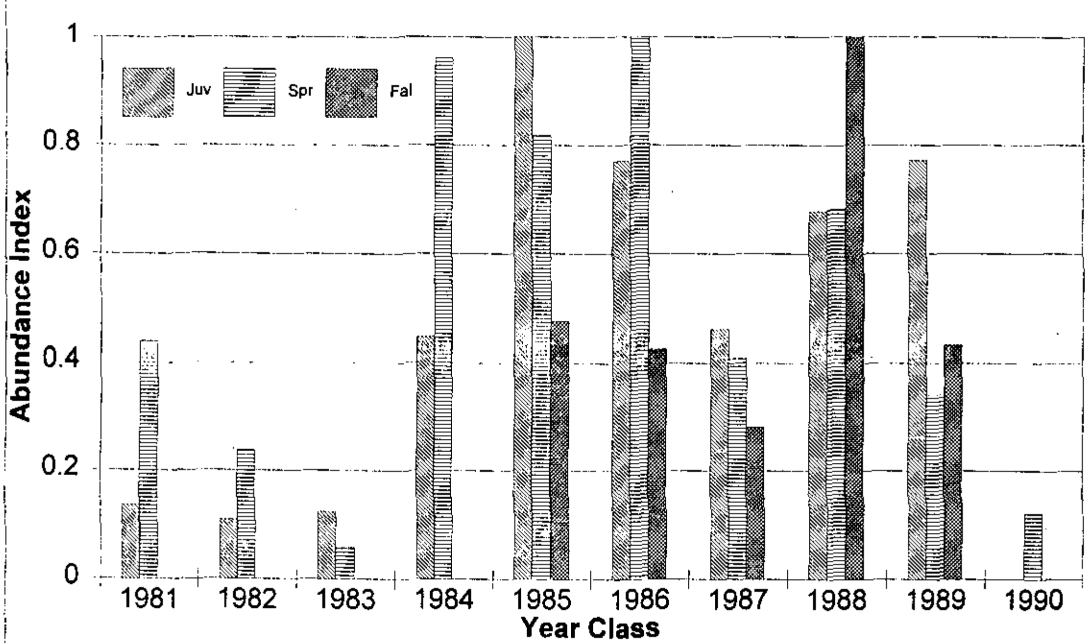


Fig 15. Standardized abundance indices of yellowtail at age 5 from the three research vessel surveys.

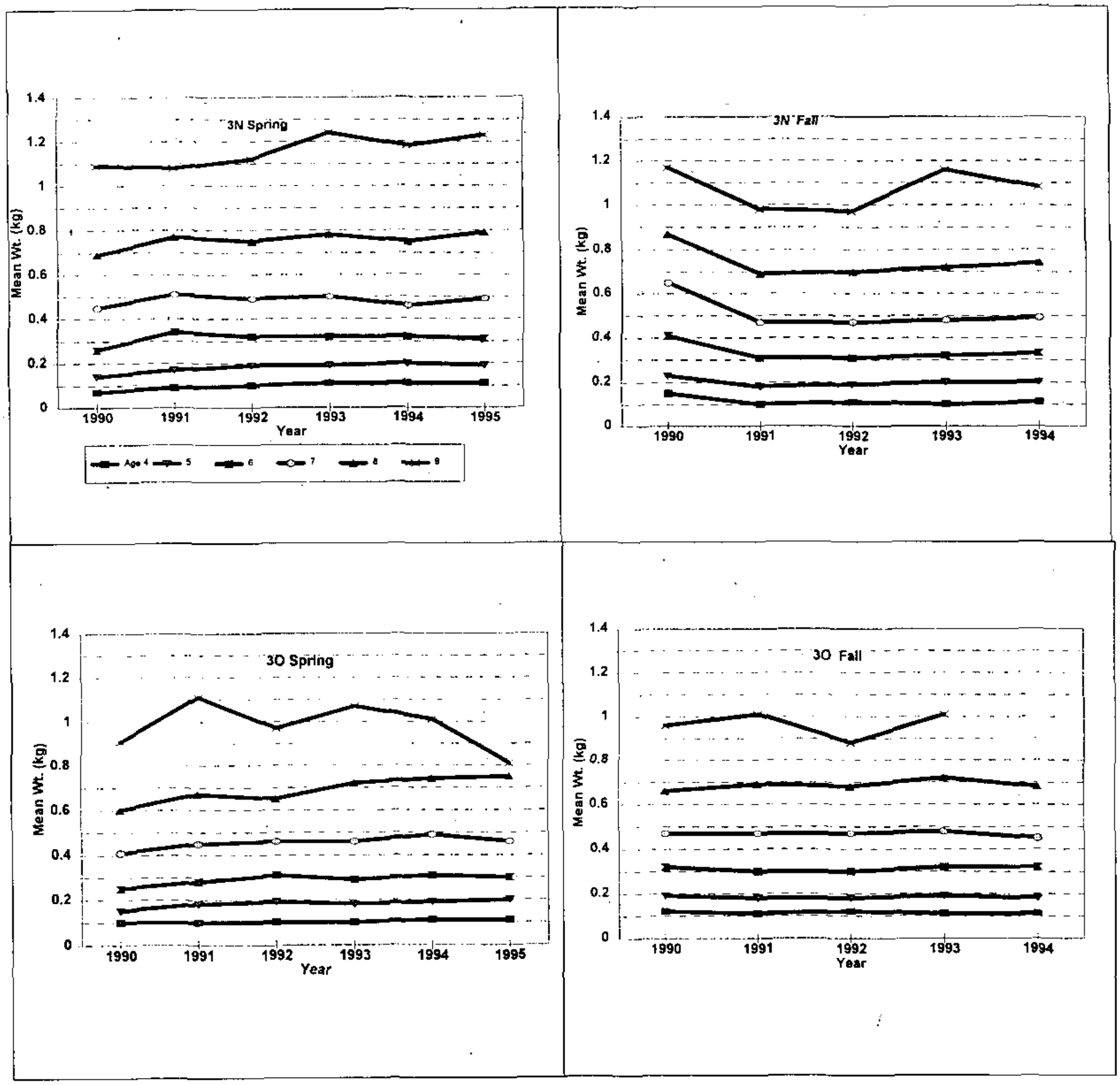


Fig 16. Trends in the mean weight- at- age derived from regular spring and fall groundfish surveys with the Engel 145 otter trawl, 1990-95.

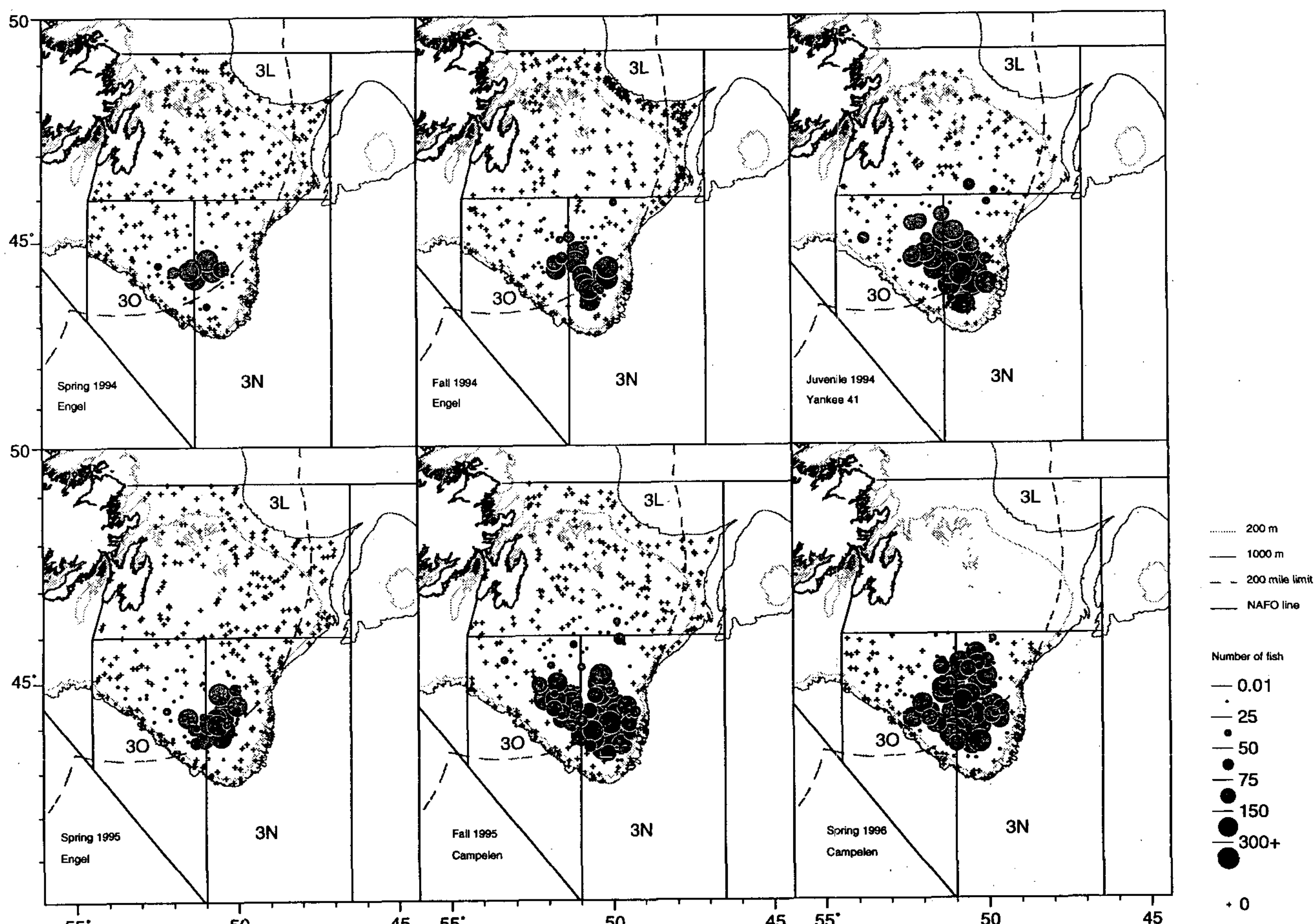


Fig.17 Distribution of yellowtail flounder on the Grand Banks using standard numbers per tow based upon catches from Engel 145 Hi-Lift trawl; Yankee 41 shrimp trawl and Campelen 1800 shrimp trawl
3L data not available

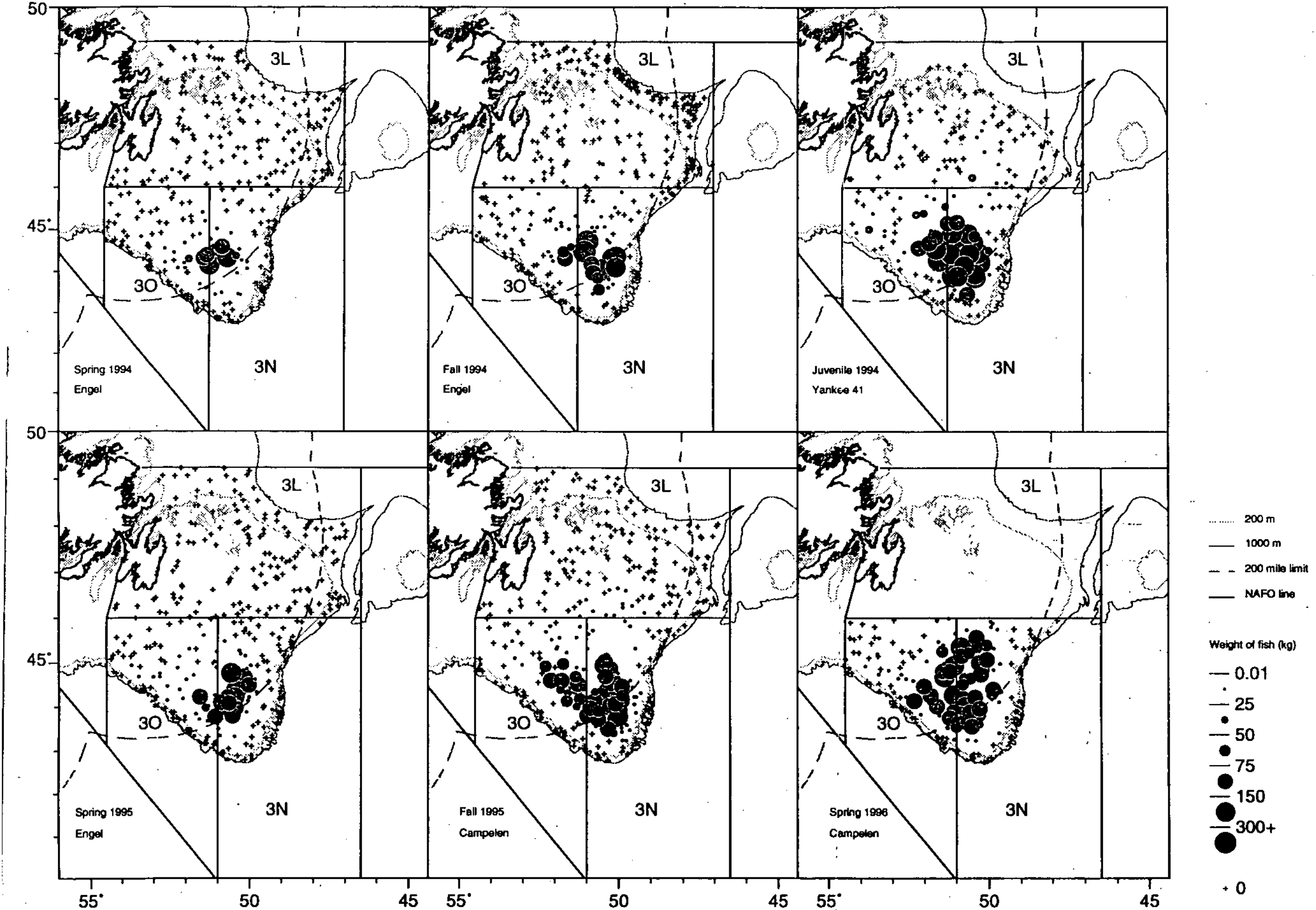


Fig.18 Distribution of yellowtail flounder on the Grand Banks using standard weight (kg) per tow based upon catches from Engel 145 Hi-Lift trawl; Yankee 41 shrimp trawl and Campelen 1800 shrimp trawl
3L data not available

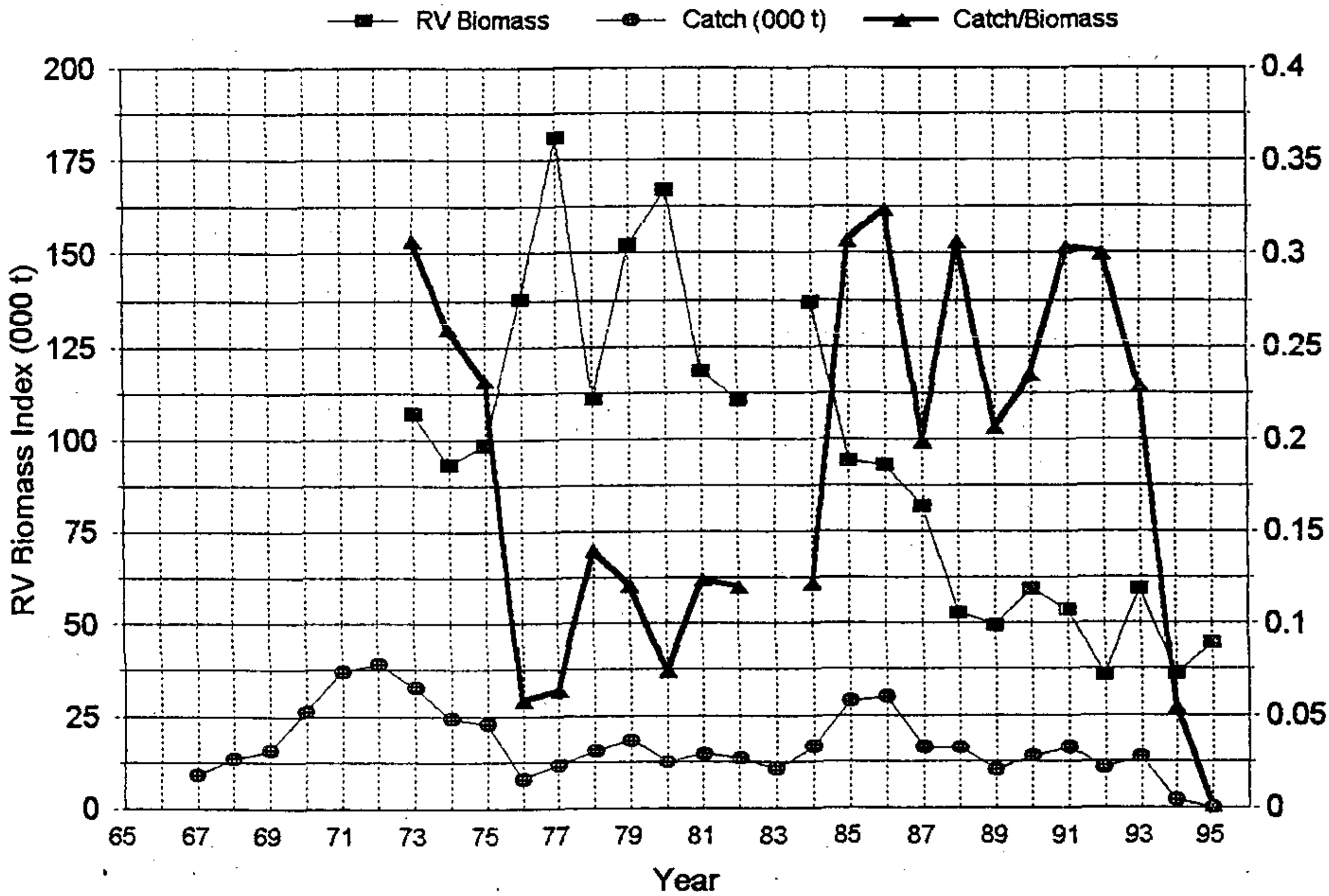


Fig. 19. Comparison of catch and RV biomass index for yellowtail in Division 3LNO derived from Spring groundfish surveys.