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An Assessment of the Yellowtail Flounder Stock in 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, the TAC was set at zero.

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 1992-94. 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.

The following table shows the catches for 1993 and 1994:

	1993	1994
Canada	6,697	0
Others	6,868	2,069
Total	13,565	2,069

The 6,868 t for others in 1993 is made up of 3,900 t from European-crewed vessels flying flags of non-contracting parties [NCP(E)] and 2,900 t from Korean-crewed vessels flying similar flags of convenience [NCP(K)], with both estimates coming from Canadian surveillance. The remaining 68 t was reported by USA vessels. For 1994, estimates of 550 t, 100 t, and 700 t were provided by Canadian surveillance for NCP(E), NCP(K), and USA respectively. The remaining 719 t was caught by EU(Spain). In total, the catch in 1994 of 2069 t was the lowest since 1964, when this fishery was just beginning.

As in most years, catches of yellowtail flounder in 1994 were mainly from Div. 3N, including virtually all of the catch in the Regulatory Area. Overall, the catches from this stock exceeded the TAC in each year from 1985-93, 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). Based on information from other sources, it was acknowledged that the 1994 catch may have been as low as 1600 t or as high as 2250 t.

Commercial fishery data

There were no length frequencies or age samples from the 1994 fisheries available. As well, there were no data for Canada in 1994 to update the catch rate analysis presented last year (Brodie et al 1994). That analysis of Canadian data from 1965 to 1993 showed that the CPUE in 1991 was the lowest in the series, and that 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

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. In virtually all years, very few yellowtail are 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. Most of the biomass for this stock occurs in Div. 3N (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 (Fig. 3). The preliminary estimate from the 1995 survey is 36,000 t. Analysis of the 1994 data showed that approximately 90% of the biomass estimate for Div. 3N came from stratum 361. 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 (the 3L results for 1995 were not available for inclusion in this paper). The decline in Div. 3L can also be seen in Fig. 4, which shows the results of seasonal surveys in that division from 1983 to 1994. In Div. 3O, the biomass index fluctuated widely in 1992-94, after a period of relative stability from 1988 to 1991 around 15,000 t. The preliminary estimate from the 1995 survey is 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). Figs. 5-7 show the abundance trends by Division up to 1994, with approximate 95% confidence intervals. The high degree of variability around the 1993 estimate in Div. 3O was generated by the high catch rates in stratum 352.

The spring survey abundance at age index for all three divisions combined is presented in Table 6, and total abundance at ages 1+ and ages 5-7 are shown in Fig. 8. These surveys are usually dominated by yellowtail of ages 5-8 years, which was the case in 1994. Abundance of ages 1+ in 1994 was the lowest in the time series, similar to the level in 1992. Fig. 9 shows the size of year-classes as measured at age 5 in the surveys, indicating that the 1984-86 year-classes appear to be larger than those of the early 1980's as well as those of 1987-89. However, it must be stressed again that 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 further examination of the survey population estimates in Table 6 did not reveal any significant relationship between age 7+ stock size and subsequent recruitment, i.e. a proxy for SSB in year n and recruitment at age 5 in year n+5 (Fig. 10). This was expected given that survey estimates were used and that varying levels of fishing mortality may have been exerted on recruiting year-classes before the age of 5. As well, a positive relationship for many years in the 1980's appears unlikely, given the 1985 and 1986 year-classes were clearly larger than their immediate predecessors, despite a decline in stock size in the mid-1980's. Nonetheless, the age 7+ population values from the 1992-94 spring surveys are all at the low end of this time series, which may be a warning sign for future recruitment.

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. However, there was no survey in 1992 and the results from the 1993 and 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) Fall groundfish surveys-Canada

Stratified-random bottom trawl surveys 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. 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 7, Fig. 3). 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 caused by the estimate for Div. 3N, unlike the increase in spring 1993 which was attributable to Div. 3O. Abundance estimates and their approximate 95% confidence intervals are shown, by division, in Fig. 11.

Age 7 was dominant in the catches in 4 out of 5 fall surveys (Table 8), 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 and the possibility that the increase in 1993 may be due to a 'year effect' rather than an actual increase in abundance. Age 7+ abundance in 1994 was considerably higher than the estimates from 1990-93. With the exception of 1994, the spring and fall surveys show essentially the same picture of stock size (Fig. 3).

D) Juvenile groundfish surveys-Canada

During September-October of 1994, a stratified-random survey of the Grand Bank (Fig. 2) was conducted by the research vessel WILFRED TEMPLEMAN. This survey constituted year 10 in a time series for juvenile flatfish and since 1989 has increased coverage beyond 91 m out to 274 m depth (see Walsh 1986 for details).

Tables 9-11 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 (Fig. 12). Div. 3L: In 1994, yellowtail were found almost exclusively in strata 363 and 372 (Fig. 2), at a mean depth of 76 m (cv=.15) and a mean temperature of -0.5°C (cv= 1.3). In all surveys, since 1985, these two strata have consistently been the areas of highest abundance in Div. 3L and almost no yellowtail have been found beyond the 91 m depth contour. Both abundance and biomass has been decreasing since 1985 (Figs. 12 & 13). The 1994 estimates (5.1 million fish; 2500 tons) were comparable to the 1993 estimates, both being the lowest in the time series. A similar trend was noted above in both the spring and fall regular groundfish surveys. Div.3N: Most of the biomass of this stock has been found in this division. In 1994 yellowtail were concentrated mainly in 4 strata (360, 361, 375 and 376; see Fig. 2), consistent with other years. Yellowtail were caught at a mean depth of 58 m (cv=.15) and a mean temperature of 2.1°C (cv=.86). In 1994, the abundance (951 million) and biomass (241,000 tons) estimates were approximately twice the 1993 estimates (Fig. 12), due to large catches in strata 361, 375 and 376. These large catches accounted for the high variability estimated for the 1994 abundance estimtate (Fig.14). Prior to the 1994 survey, the stock in Div. 3N had shown some modest increase from 1992-93, similar to the regular fall groundfish survey (Fig. 11). Div. 3O: In 1994, concentrations were mostly located in stratum 352 which is consistent with other years. Fish were located in a mean depth of 77 m (cv=.12)and a mean temperature of 0.9°C (cv=.98). The abundance (159.1 million) and biomass (57,000 tons) estimates were very close to the estimates from the 1992-93 (Figs. 12 &15) and are the highest in the time series. Noteworthy, are the large confidence intervals around the 1993 & 1994 estimates

Selected strata: Table 12 shows a comparison of average numbers and weights of yellowtail flounder derived from independent day, night and combined estimates (see Walsh 1988), from selected strata in the 1986-94 surveys. The 1985 survey was dropped due to poor coverage. Fig. 18 shows that estimates from day and night sets track very well the combined estimates for the time series and a significant predictive relationship exists with these indices. In 1994, similar to other years, 87% of the biomass of yellowtail on the Grand Bank is found in these 5 strata. The 1994 abundance estimates of yellowtail derived from night catches were substantially larger than those derived from day catches. The combined abundance (1022.5 million) and biomass (262,000 tons) estimates showed an increase of 46% and 40%, respectively, over 1993 (Figs. 12 & 16). 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 (Fig. 17). However, the large confidence intervals around the 1994 estimate, as seen in Fig. 16, is not typical of other estimates in this time series and caution is stressed in accepting this large increase in stock size due to a possible "year effect".

Tables 13 and 14 contain information on the age composition of yellowtail in the selected strata in Div. 3NO from 1986-94. Estimates 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 (Table 15).

Figs. 19-21 show the relationships between the abundance of yellowtail from the juvenile surveys and the abundance from the spring surveys at ages 4, 5, and 6 respectively for the years 1986-1994. Although the 3 regressions are all significant in the 1994 assessment (r= .84,.76 & .86), the addition of the 1994 points weakened the relationships. Some caution must be exercised in interpreting the results due to the low number of points (9) in each fit and the nature of some of the relationships, i.e. '2-point regressions'. The surveys generally agreed in estimating abundance at these ages, eg. both series show the 1985 year-class to be about the largest in the short time series and the 1982 year-class to be about the smallest.

One advantage of the juvenile surveys is that it measures population abundance at ages 1-3, which are not captured by the standard fishing gear used in the spring surveys, thereby giving an earlier estimate of the strength of recruiting year-classes. Figs. 22-24 show the relationship between abundance at age in year n+2 in the spring surveys and abundance of the same year-class in year n in the juvenile surveys, for ages 2, 3, and 4 respectively. The regressions were significant for ages 2/4 and 4/6, but not for ages 3/5. The same caveats which applied to the previous set of figures also apply here, given that only 7 points were available for each relationship. Figs. 22 and 24 also indicate the point estimates from the 1993 and 1994 juvenile surveys at ages 2 and 4 respectively.

Figs. 25-27 show the relationships between the abundance of yellowtail from the juvenile surveys and the abundance from the fall surveys at ages 4, 5, and 6 respectively for the years 1990-1994. There appears to be little or no predictive relationship between the estimates from both surveys ,which are approximately a month apart. Although there are only five points in these regressions, they indicate that the 1993 fall survey estimates may be anomalously high

Fig. 28 shows the trends in catch rates for the three surveys: spring, fall and juvenile, 1986-94. In Div. 3L from 1989 onward the catch rates track the trends in the population quite well. In Div. 3N, there is a wide divergence in the catch rates between the juvenile and spring surveys and consequently they do not show the same trends. However, the fall survey estimates show a similar trend with the juvenile surveys from 1992 onward. In Div. 3O, only the juvenile catch rates track closely the spring survey trends. Of course the fall time series is relatively short by comparison to the other two series.

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. 29 and the results from the juvenile survey for Divs. 3LNO are contained in Fig. 30 . 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 interannual variability.

Distributional 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. The abundance of yellowtail declined sharply in the mid to late 1980's following a period of increased catches (Fig. 8). In particular, the annual late summer/fall juvenile fish surveys, 1986-1994, all showed a systematic decline in abundance in Div. 3L (Figs. 4, 13 &31). In the three 1994 surveys, the stock was almost exclusively found in Div. 3NO, concentrated on the Southeast Shoal and the adjacent area to the west, below the 45°N (Fig. 17). Analyses were performed to look at the relationship of stock abundance and occupied range using a variety of techniques.

Bottom temperatures and spatial distribution

Yearly biomass estimates were used from the spring surveys from 1975-94 (no survey in 1983). Changes in spatial distribution were expressed as the biomass ratio of yellowtail in Div. 3L to that of Div. 3NO (Fig. 32). The relative biomass has been declining steadily since 1985.Weighted linear regressions were used to test whether temperature (derived from survey data) may have affected spatial distribution of yellowtail on the Grand Bank. Using temperature data and biomass estimates for the same year we found the decline was uncorrelated with temperature ($F_{1,19}$ = 2.18; r = .34; p=.1578) (Fig. 33A). Lagging the temperature by one year improved the correlation ($F_{1,18}$ = 4.70; r = .48; p = .0464), however there is a lack of a linear relationship (Fig. 33B). Yellowtail flounder is a eurythermal species and the stock on the Grand Bank is associated with wide fluctuations in bottom temperature (Fig. 34) (Walsh 1992). Yellowtail on the Scotian Shelf have been shown to tolerate wide fluctuations in temperature and salinity without changing their distribution (Perry et al. 1988). Certainly, Grand Bank yellowtail may inhabit a wide range of temperatures, but, it doesn't rule out that they may have a preferred shorter temperature range under ideal conditions.

Stock size and spatial distribution

A statistical ellipse technique was used to describe the central tendency of the survey catch data to allow quantification and visualization of distributional data. Contour ellipses provide a flexible and easily interpreted method of data examination (Warren *et al.* 1992). Statistical ellipses are centered on the sample means of the X and Y variables. Their major axes are determined by the unbiased sample standard deviations of X and Y, and their orientation will result from the covariation between the X and Y variables. Hence ellipses provide information on the central tendency as well as orientation of the data (SYSTAT 1984). It becomes possible to overlay the results of a number of years of data on a single figure facilitating easier visual examination. The method was applied to the Divisions 3LNO spring fishing station positional data at 50% probability (SYSTAT 1984). For this analysis, each position was weighted by the log transform of the yellowtail catch (kilograms). Thus the resulting ellipses indicated the central tendency of the distribution of yellowtail within the survey area. Besides examining the location of the distribution of the fish, we also examined the geographic area of that distribution. The area contained within each ellipse was determined using image analysis (NIH image analysis system, Vivino 1993).

Fig. 35 shows the ellipses for select years over the time series. When the stock size was high in the late 1970's and mid-80's the area of distribution was very wide. As the stock size decreased there was a reduction in the size of the ellipses and area distribution . This southward shift and aerial contraction occurred predominately in the 1990's when the stock was at its lowest. Area distribution estimated from the ellipses and trawlable biomass from the surveys show that both indices tracked each other fairly well up to the mid-80's, however, there was a difference in the timing of the decline in both indices in the late 80's. The southward contraction began after the biomass declined (Fig 36). Area distribution and trawlable biomass were significantly correlated (r = .75) although the fit in latter years is not particularly good. (Fig. 37).

Further evidence for this range contraction was demonstrated by Myers et al. (1995) who used the Gini concentration/area distribution index to show that there was an increase in the concentration of yellowtail, as stock area decreased. on the Grand Bank from the early-mid 1980's to 1994 (Fig. 38).

Juvenile and sub-adult yellowtail flounder are consistently found concentrated on the Southern Grand Bank, mainly in the Regulatory Area, and as they mature their distribution radiates in a west and northerly direction (Walsh, 1992). This movement may be a function of density and it may be assumed that intraspecific competition for prey items may be the stimulus. However, historically the major portion of the biomass has always been located in the Southern Grand Bank area thus one can assumed that this area , which also acts as a nursery area (Walsh, 1992), is the most preferred habitat. The extensive sand sediments on the Southeast Shoal and the central part of the southern Grand Bank appears to be the preferred substrate for age 1-group, older juvenile and adult yellowtail flounder (Walsh, 1992). These areas are mainly composed of sand and to a lesser degree gravely sand, i.e. 10-50% of sand is gravel. This type of substrate is also found in certain areas of the northern section of the Bank in Div. 3L. Sediments also indirectly influence distribution by the composition of benthic food items preferred by yellowtail flounder which feed exclusively on surficial and interstitial macrofauna. Sandy substrate could also provide places for the newly settled to hide and avoid predators. On the southern Grand Bank there is a southeast to northwest change in bottom type with an accompanying change in concentrations of juveniles.

Although the severity of the range contraction (1990 onward) is coincident with the period of intense cooling of waters on the Newfoundland and Labrador shelves (Colbourne and Narayanan 1994) , it is tempting to say that this contraction is solely due to temperature. However, the wide tolerance to changes in temperature and salinity, exhibited by this species, casts some doubt on this relationship. The underlying assumption is that distribution patterns define preferred substrates in this species and that when stock size was high then yellowtail dispersed, in significant amounts, further north into Div. 3L (Brodie and Walsh 1994). We hypothesize that the contraction of the range of this species on the Grand Bank to the preferred habitat in the southern area is a function of low stock size. The consequence of this contraction is that this change in availability could strongly influence catch rates and may explain the "year effect" seen in the 1993-94 surveys.

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 1992-94. Thus, evaluation of stock status continues to rely heavily on the interpretation of the 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 is still at a low level compared to historic values. In the current assessment, there are no new data for 2 of these indices (Russian surveys, Canadian CPUE). 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. 39), 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, and the stock biomass was at its highest levels. A similar index based on the juvenile surveys (Fig. 40) 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. Caution is stressed here about 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

Summary

Surveys prior to 1994 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. In 1993, the juvenile survey also indicate that the 1989 to 1992 year-classes may be average to well below average. Because of the year effect in the 1994 juvenile survey, it is difficult to say anything about recruitment in this survey. The biomass estimates in 1994 (spring and fall) and 1995(spring), although slightly higher, are similar to recent average biomass in recent years. The juvenile survey showed a large increase in stock size in 1994, however, it should be treated with caution since this is probably an anomalously high estimate.

It is important to note that stock size is well below that observed for most of the 1970's and early to mid 1980's, and that recent stability at this level should not be viewed as a sign that recent catch levels and exploitation patterns have been appropriate. There are also concerns that the stock distribution has contracted to a relatively small area west of the Southeast Shoal and the high catch rates may play havoc with assessment of this species.. It is also difficult to ignore the fact that many groundfish fisheries on the Grand Bank have either collapsed or been reduced to very low levels, which leads to the question as whether yellowtail can maintain stability at its current low level.

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

Year	Canada	France	USSR	South Korea[a]	Other[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[c]	6,809	-	-	3,825	123	10,757	7,000
1993[c,d]	6,697	-	-	-	6,868	13,565	7,000
1994	-	-	-	-	-	-	7,000[e]
1995	-	-	-	-	-	-	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]See text for details of 1993 catches.
[e]No directed fishery permitted.

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
93-183	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	16,739	-	-	-	-	-	-	-	-	-	-	-	-
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 AN 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
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
367-549	729	-	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)
367-549	731	-	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)
367-549	733	-	0.0(3)	-	-	-	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(2)
550-731	734	-	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)
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 t)		15.1	13.5	8.5	3.8	2.2	2.7	1.4	0.7	0.1	0.1	0.3

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.

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
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	Year-Trip 1984 AN 27-28	1985 AN 43 WT 29	1986 WT 47	1987 WT 58-60	1988 WT 70	1989 WT 82	1990 WT 95-96	1991 WT 106	1992 WT 119-120	1993 WT 136-137	1994 WT 152-154	1995
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
<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)	
<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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
367-549	723	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)	
350-731	724	-	-	-	-	-	-	-	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)	
550-731	726	-	-	-	-	-	-	-	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)	
550-731	728	-	-	-	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(3)	
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)	
Biomass ('000 t)		104.6	56.7	65.0	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 parentheses are the number of successful tows in each stratum. The stratified mean weight per tow and the biomass estimates are given at the bottom of the table.

			Year-Trip								
Depth (m)	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
93-183	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)
57-91	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)
57-91	331	34,229	33.6(2)	0.4(2)	9.2(2)	-	7.3(2)	6.0(3)	3.5(2)	-	4.0(4)
93-183	332	78,592	-	3.2(2)	2.0(3)	11.5(3)	2.6(3)	2.0(4)	0.0(2)	-	0.3(4)
185-274	333	11,335	-	0.0(2)	0.0(2)	0.0(2)	0.0(3)	0.0(2)	0.0(2)	-	0.0(4)
275-366	334	6,906	-	-	0.0(2)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	-	0.0(4)
275-366	335	4,354	0.0(2)	-	0.0(3)	-	0.0(2)	0.0(2)	0.0(3)	-	0.0(2)
185-274	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)
93-183	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)
57-91	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)
93-183	339	43,913	1.4(2)	0.0(2)	-	-	0.7(2)	0.4(3)	-	0.0(2)	0.1(4)
57-91	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)
57-91	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)
57-91	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)
57-91	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)
93-183	354	35,580	0.0(3)	-	4.8(3)	3.6(2)	-	0.0(4)	0.0(3)	0.0(2)	0.0(2)
185-274	355	7,732	0.0(2)	0.0(2)	0.0(2)	-	-	0.0(4)	0.0(2)	0.0(2)	0.0(2)
275-366	356	4,579	0.0(2)	-	-	-	-	0.0(2)	0.0(2)	0.0(2)	0.0(2)
367-549	717	6,981	-	-	-	-	-	-	-	-	-
550-731	718	8,332	-	-	-	-	-	-	-	-	-
367-549	719	5,705	-	-	-	-	-	-	-	-	-
550-731	720	7,882	-	-	-	-	-	-	-	-	-
367-549	721	5,705	-	-	-	-	-	-	-	-	-
550-731	722	6,981	-	-	-	-	-	-	-	-	-
732-914	764	7,882	-	-	-	-	-	-	-	-	-
732-914	772	10,134	-	-	-	-	-	-	-	-	-
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

Table 5. - (Cont'd.)

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
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
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)	
367-549	717	-	-	-	-	-	-	-	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)	
367-549	719	-	-	-	-	-	-	-	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)	
367-549	721	-	-	-	-	-	-	-	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)	
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)	
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 . 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
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
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
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
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
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
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
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
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
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
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
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
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
4+	304.5	302.7	320.6	233.9	268.0	335.3	272.7	273.8	315.9	204.8	190.4	168.1	99.4	129.5	148.8	133.6	83.3	123.4	80.8
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

Table 7 . Abundance index (millions) of yellowtail from Canadian fall groundfish surveys in Div. 3LNO.

Age	1990	1991	1992	1993	1994
1	0.0	0.0	0.0	0.0	0.0
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
4+	90.8	114.6	85.9	159.3	144.5
7+	45.1	59.1	51.5	55.2	84.7

Table 8. Biomass estimates ('000 t) of yellowtail, by stratum, from fall R.V. surveys in Div. 3LNO from 1990 to 1994.

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

Table 9. 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.

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 9 . (Cont'd).

Depth (m)	Stratum	Category	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										
185-274	389	Av.No./set	-	-	-	-	-	-	-	0.00(3)	0.00(3)	0.00(3)
		Av.wt./set										
93-183	390	Av.No./set	-	-	-	-	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(3)
		Av.wt./set										
185-274	391	Av.No./set	-	-	-	-	-	-	-	0.00(2)	0.00(2)	0.00(2)
		Av.wt./set										
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	2.5

Table 10. 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-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.

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)	184.12(49)	342.85(46)	125.06(69)	243.79(71)	306.43(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			50.52	59.17	53.60	32.32	55.78	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 11. Mean numbers and weight (kg) of yellowtail per tow, by stratum from r.v. juvrnile 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.

Depth (m)	Stratum	Category	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[b]	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 12. A comparison of average numbers and weights of yellowtail flounder per 30-minute tows from day, night, and combined juvenile surveys from 1986 to 1994. Selected strata in Div. 3NØ used. Abundance and biomass are given at the bottom of the table.

Selected strata	Category	1986 Day	1986 Night	1986 Combined	1987 Day	1987 Night	1987 Combined	1988 Day	1988 Night	1988 Combined	1989 Day	1989 Night	1989 Combined	1990 Day	1990 Night	1990 Combined
352	No. of sets	7	6	13	-	-	-	6	5	11	4	10	14	11	5	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
	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
360	No. of sets	7	7	14	7	12	19	11	8	20	12	7	19	11	10	21
	Av. no./set	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
	Av. wt./set	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
361	No. of sets	4	4	8	4	4	8	2	4	6	6	3	9	3	7	10
	Av. no./set	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
	Av. wt./set	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
375	No. of sets	2	3	5	3	4	7	6	3	9	5	3	8	4	7	11
	Av. no./set	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
	Av. wt./set	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
376	No. of sets	3	1	4	3	7	10	7	5	12	5	4	9	5	6	11
	Av. no./set	69.67	-	325.76	109.67	1404.23	1015.22	148.57	665.60	364.00	456.20	1491.25	916.22	1076.2	1863.0	1505.36
	Av. wt./set	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
Total	No. of sets	23	20	44	17	27	44	32	25	58	32	27	59	34	35	69
	Av. no./set	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
	Av. wt./set	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
Abundance (millions)		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
Biomass (000s t)		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

Table 12. (Cont'd.)

Selected strata	Category	1991 Day	1991 Night	1991 Combined	1992 Day	1992 Night	1992 Combined	1993 Day	1993 Night	1993 Combined	1994 Day	1994 Night	1994 Combined
352	No. of sets	7	9	16	7	6	13	8	5	13	4	5	9
	Av. no./set	133.19	309.09	232.14	257.43	250.17	254.08	250.50	786.60	457.85	207.10	663.00	460.38
	Av. wt./set	59.69	95.93	80.08	90.39	106.05	97.62	118.09	215.90	155.71	73.66	230.22	160.64
360	No. of sets	10	8	18	10	6	16	9	5	14	6	7	13
	Av. no./set	371.10	564.88	457.22	220.20	503.00	332.50	89.88	1120.40	457.97	42.33	564.79	323.65
	Av. wt./set	66.33	86.79	75.43	49.72	76.98	59.95	28.15	199.23	89.25	10.51	106.49	62.19
361	No. of sets	5	3	8	6	2	8	4	4	8	5	3	8
	Av. no./set	306.0	882.33	522.13	249.00	979.50	431.63	549.00	880.84	714.92	1070.00	1258.17	1140.56
	Av. wt./set	113.10	272.49	172.99	103.75	316.73	156.88	236.55	296.12	266.33	451.28	363.16	418.23
375	No. of sets	4	3	7	6	5	11	6	4	10	3	4	7
	Av. no./set	320.5	624.67	450.86	113.93	871.60	458.33	176.68	127.50	157.01	1053.00	875.75	951.71
	Av. wt./set	134.10	159.31	144.90	57.97	302.73	169.22	96.84	66.75	84.80	356.49	183.20	257.47
376	No. of sets	7	3	10	4	4	8	6	3	9	4	3	7
	Av. no./set	1241.86	2636.0	1660.10	117.00	833.45	475.13	198.00	1709.33	701.78	1101.50	4498.89	2557.52
	Av. wt./set	143.7	198.54	160.16	21.83	95.24	58.53	40.76	299.71	127.06	246.68	727.25	452.64
Total	No. of sets	33	26	59	33	23	56	33	21	54	22	22	44
	Av. no./set	417.71	862.32	583.92	206.45	627.83	370.11	238.73	930.59	492.36	567.87	1318.88	914.65
	Av. wt./set	94.27	148.66	116.36	66.49	163.07	102.62	99.13	214.65	141.47	189.73	282.16	234.30
Abundance (millions)		467.0	964.0	652.8	230.8	701.9	413.8	266.9	1040.3	550.4	634.84	1474.41	1022.5
Biomass (000s t)		105.4	166.2	130.1	74.3	182.3	114.7	110.8	240.00	158.1	212.10	315.44	261.9

Table 13. Average numbers per tow at age of yellowtail from selected strata in juvenile surveys of NAFO Division 3NO (strata 352, 360, 361, 375, and 376) 1986-94.

Age	1986	1987[a]	1988	1989	1990	1991	1992	1993	1994
1	21.48	30.48	5.67	3.68	4.33	0.30	2.66	3.51	17.78
2	16.95	113.11	15.01	17.88	42.22	30.80	4.77	28.57	89.98
3	27.29	88.50	40.07	40.20	76.71	184.53	61.94	35.44	141.25
4	10.05	80.17	27.81	125.86	90.74	75.49	67.50	72.88	117.97
5	18.99	20.09	17.27	62.01	139.22	107.27	63.95	94.45	107.40
6	41.41	19.05	18.19	43.82	54.33	90.41	70.65	82.93	174.80
7	53.87	37.65	31.45	58.22	38.43	53.05	59.63	79.21	146.99
8	41.66	46.10	17.47	24.57	22.25	35.73	30.24	42.37	90.55
9	8.07	4.40	2.37	2.87	2.71	9.12	5.73	9.11	6.30
10	0.62	0.12	0.02	0.09	0.15	0.00	0.00	0.00	0.00
11	0.08	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00
Av. no./tow	240.47	439.67	175.33	379.21	471.12	586.70	367.27	448.97	893.02

[a]Incomplete survey, stratum 352 not surveyed.

Table 14. 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.

Table 15. Percent abundance of the 1985-93 year-classes in the various selected strata from the 1994 juvenile survey.

Year-class	Age	Mean len.(cm)	Abundance millions	Selected strata - Percentage 352	360[a]	361	375	376[b]
1993	1	6.7	19.9	3	32	11	5	50
1992	2	10.5	100.6	3	19	9	7	61
1991	3	16.6	157.9	7	13	13	15	52
1990	4	22.1	131.9	4	9	10	27	50
1989	5	27.1	120.1	14	8	19	14	45
1988	6	32.2	195.4	16	9	27	17	31
1987	7	37.4	164.3	23	6	36	15	20
1986	8	43.3	101.2	19	6	43	15	17
1985	9	49.8	7.0	19	4	36	27	16

[a]93% outside 200-mile limit.

[b]89% outside 200-mile limit.

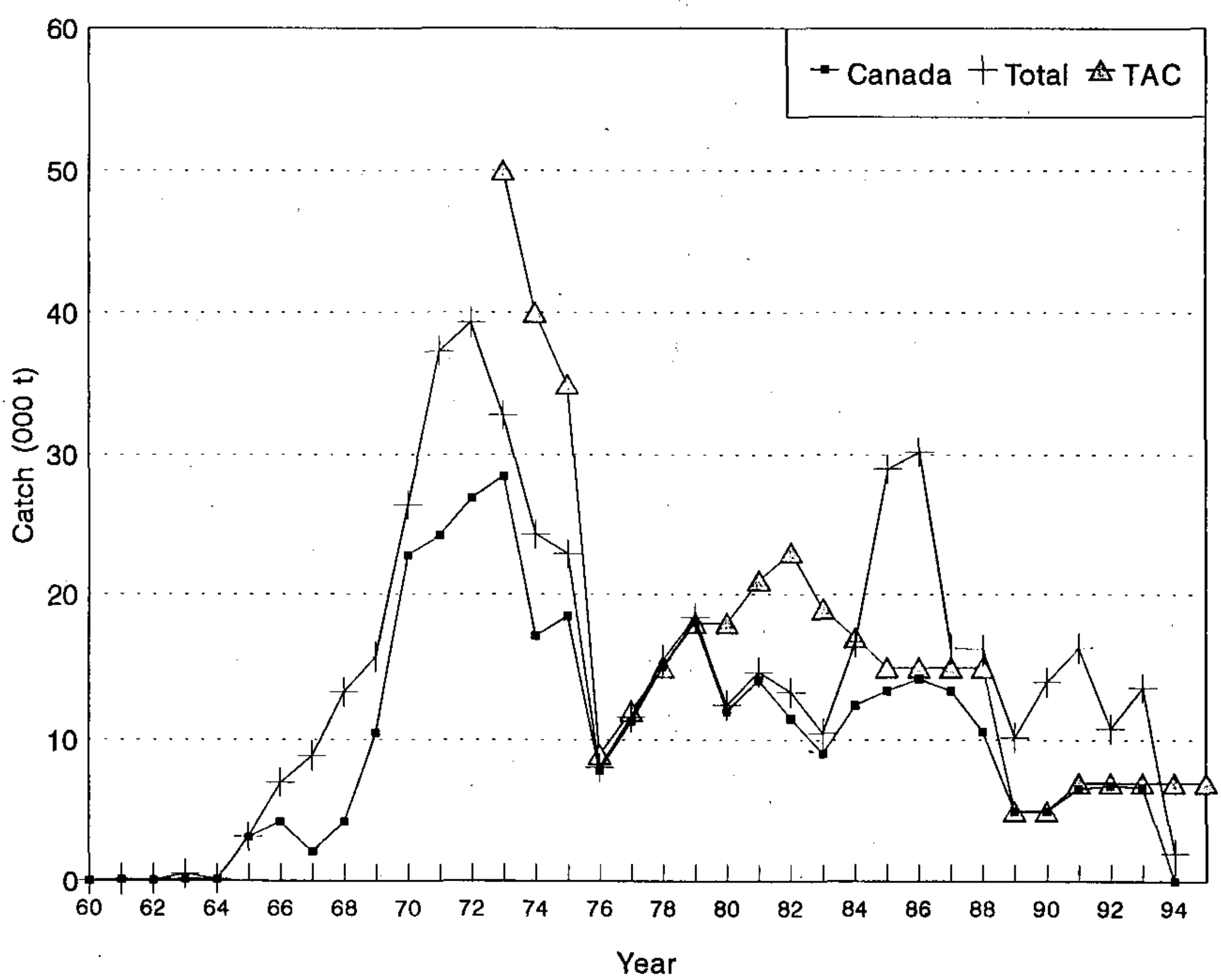

Fig. 1. Catches and TAC's of yellowtail in Div. 3LNO.

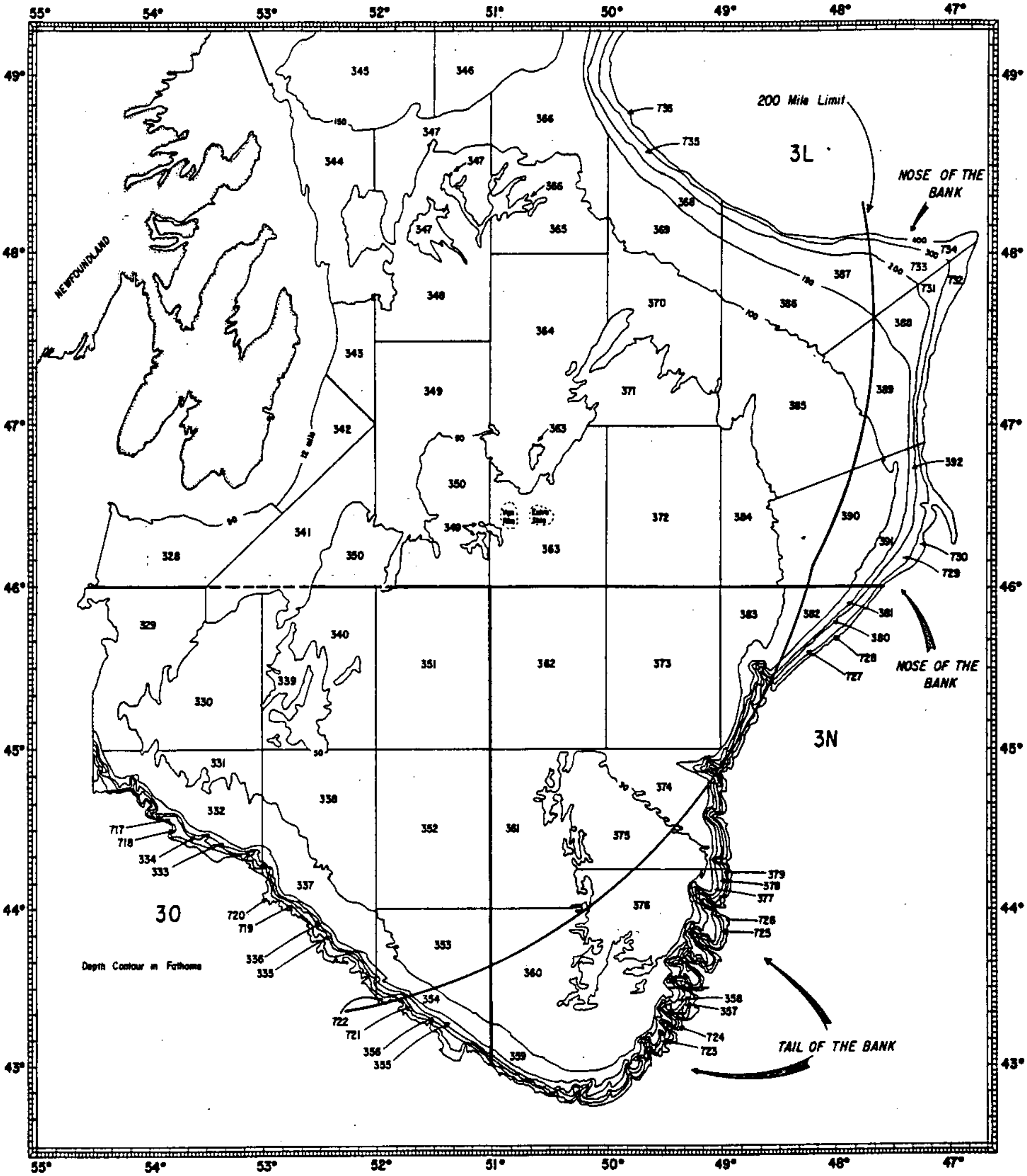

Fig. 2 Grand Banks, NAFO Div. 3LNO, showing the Canadian 200 mile limit in relation to the Nose and Tail of the Bank as well as the stratification scheme used in Canadian groundfish surveys.

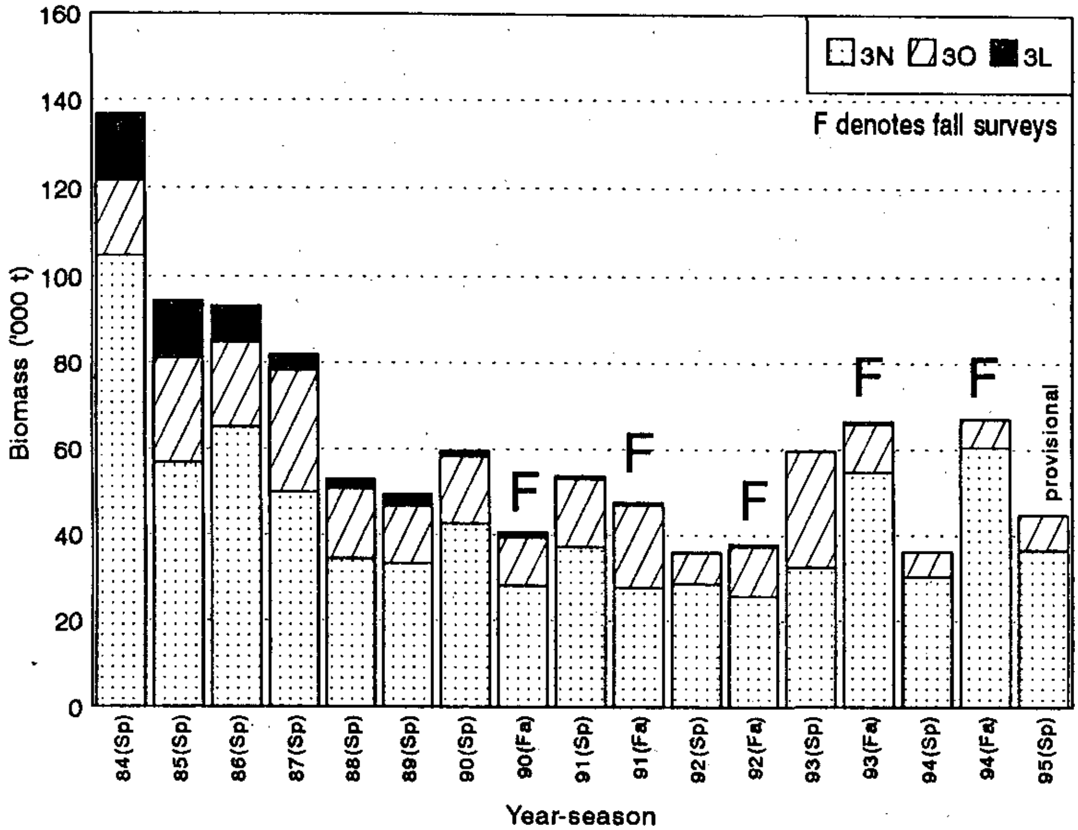

Fig. 3 Biomass of yellowtail flounder from Canadian RV surveys conducted in spring and fall in Div. 3LNO.

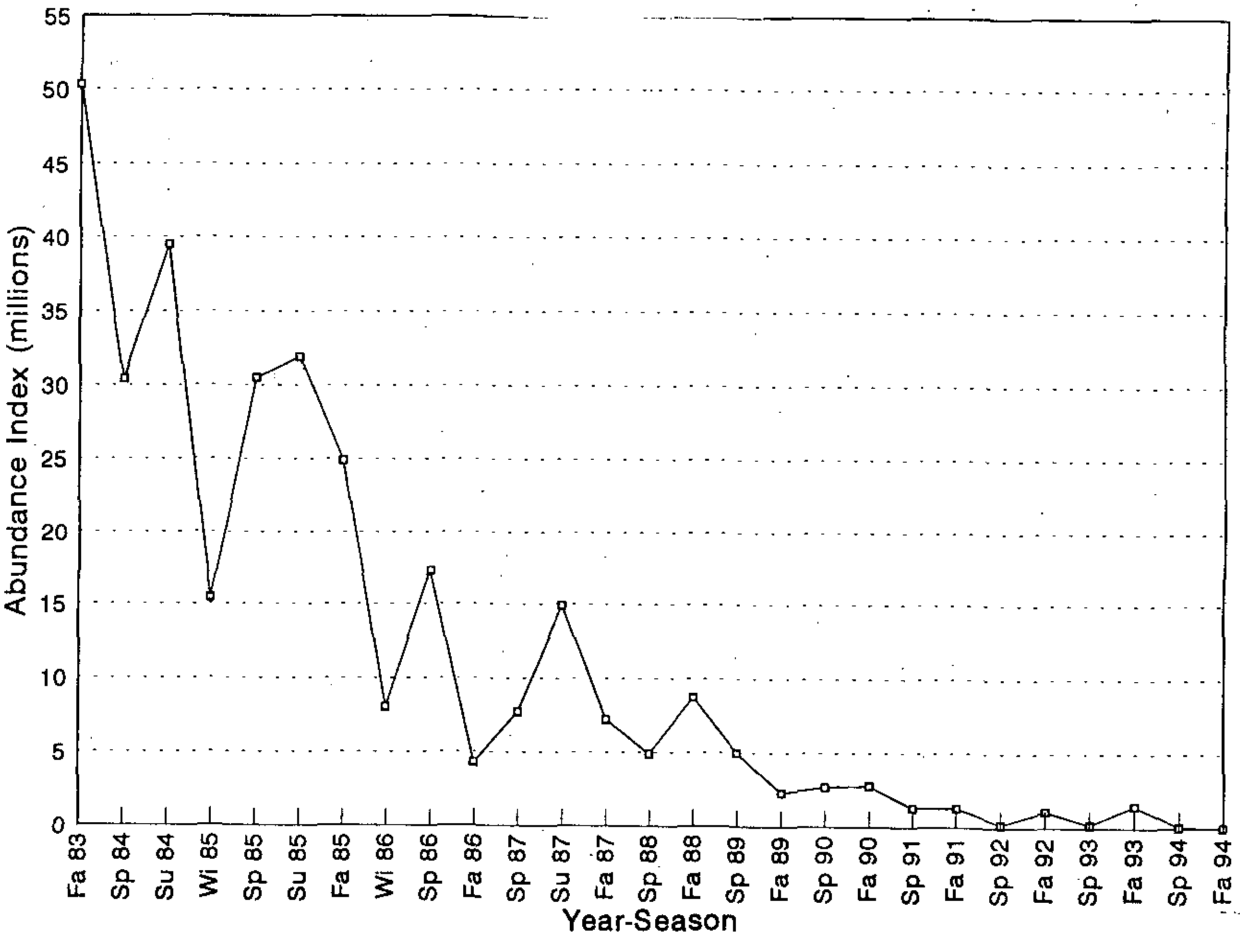

Fig. 4 Abundance of Yellowtail from surveys conducted at various times in Div. 3L.

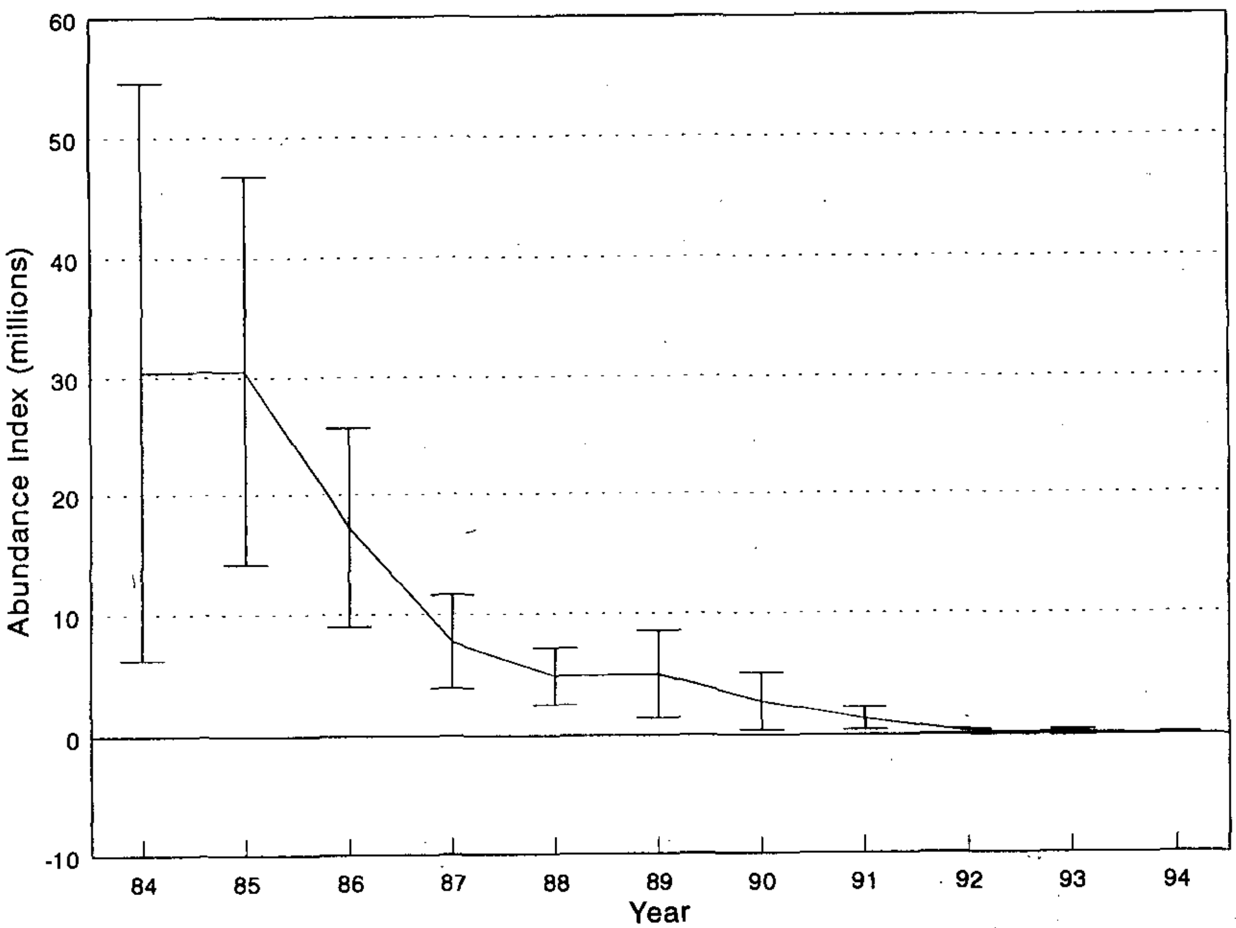

Fig. 5 Abundance estimates of yellowtail (with approx. 95% C.I) from Canadian spring surveys in Div.3L.

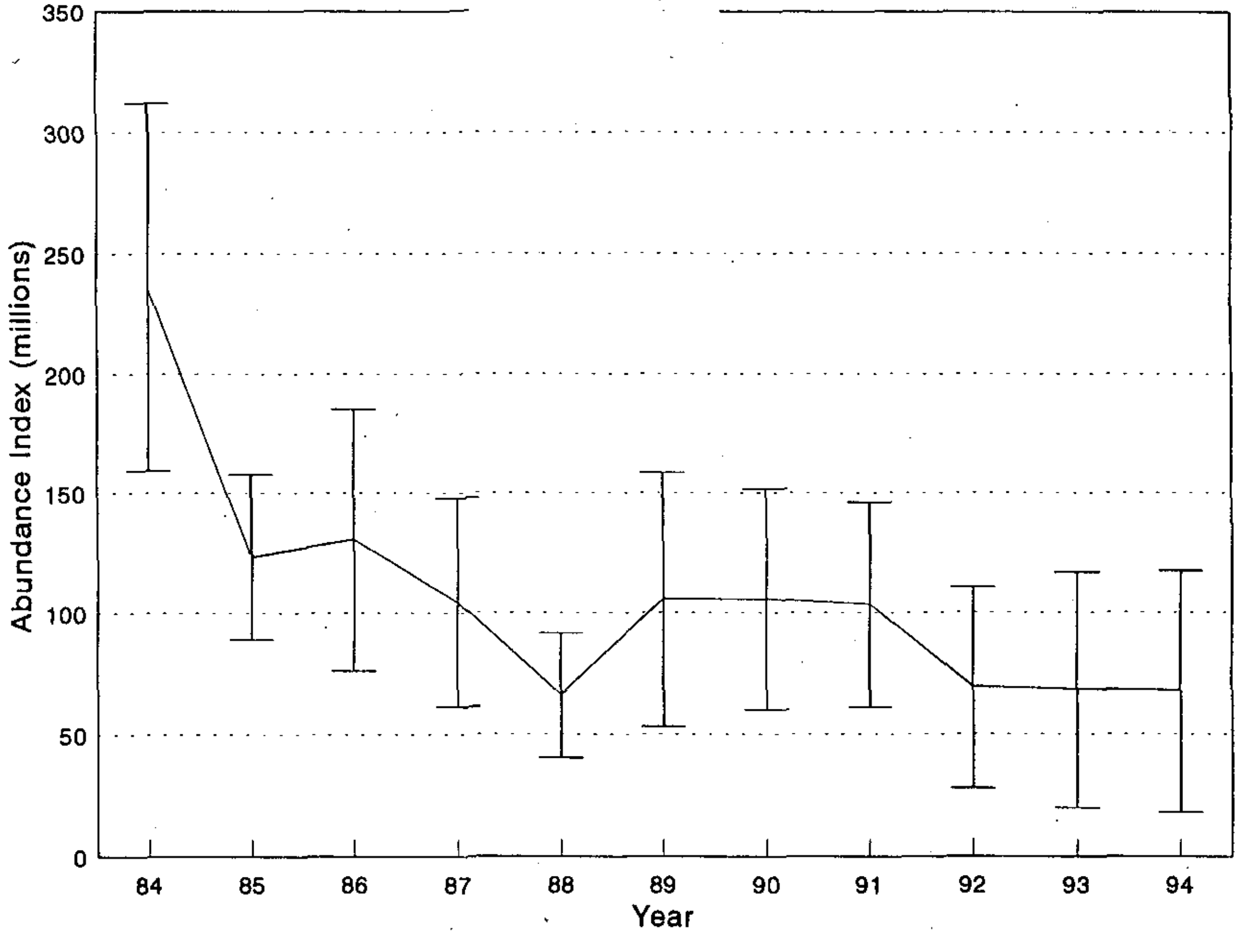

Fig. 6 Abundance estimates of yellowtail (with approx. 95% C.I.) from Canadian spring surveys in Div.3N.

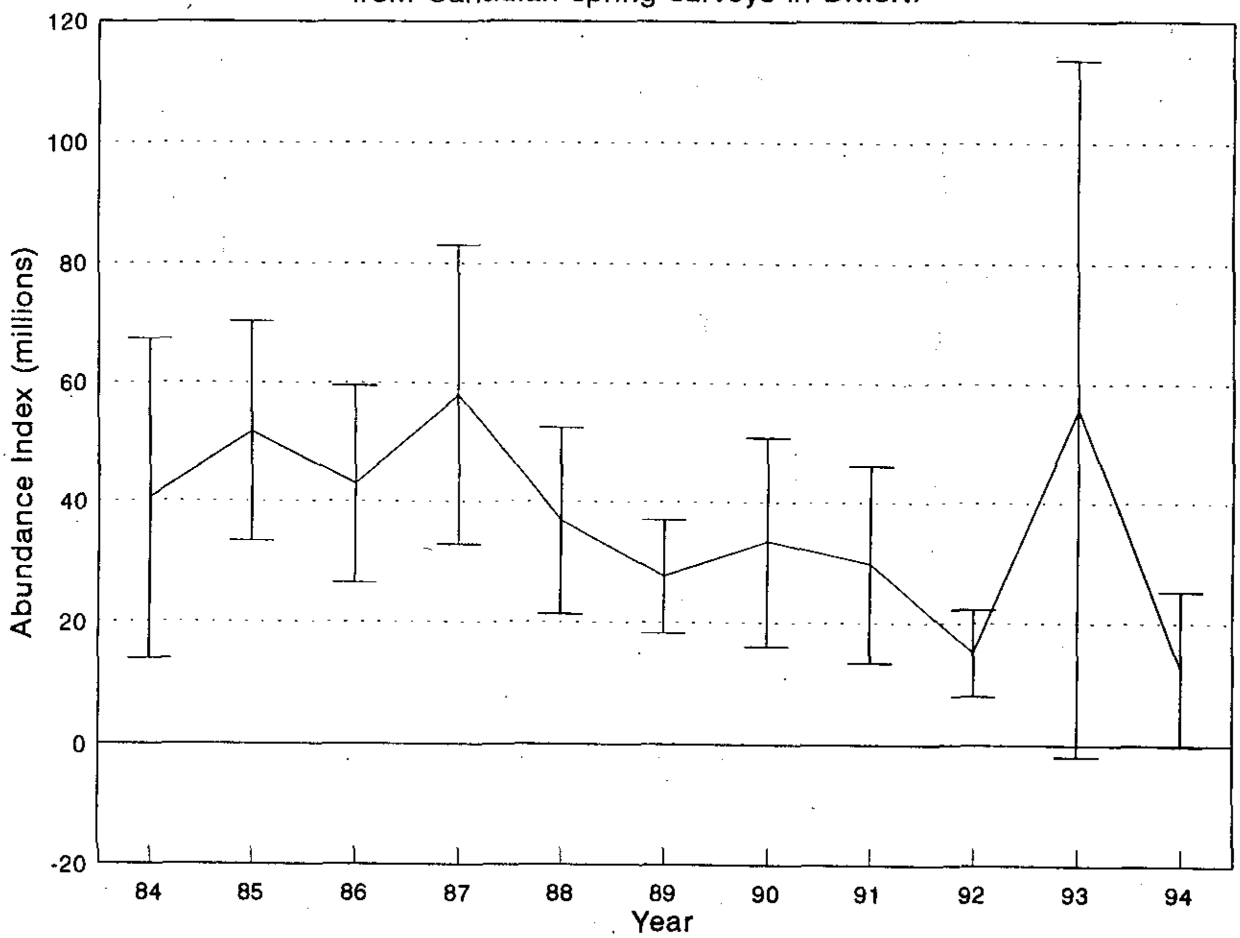

Fig. 7 . Abundance estimates of yellowtail (with approx. 95% C.I.) from Canadian spring surveys in Div.3O.

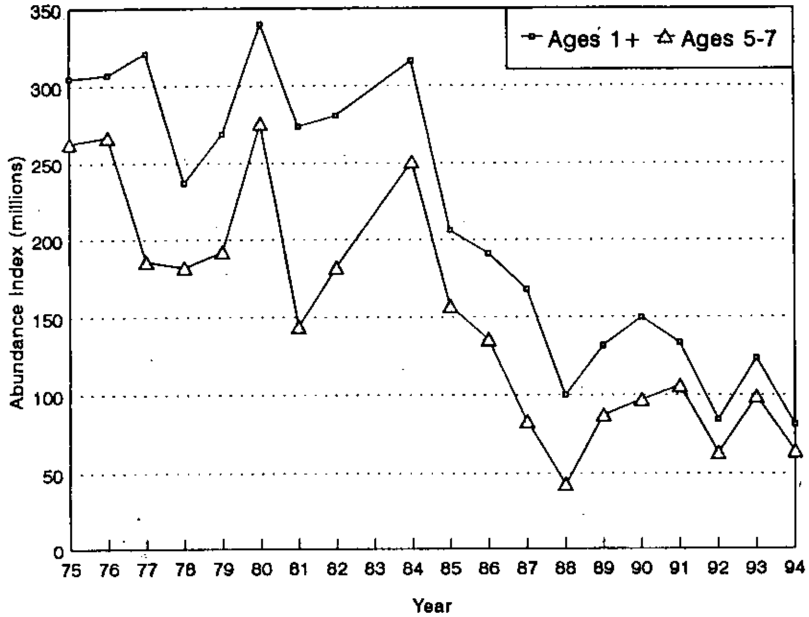

Fig. 8 Index of abundance of yellowtail in Div. 3LNO, as measured by Canadian spring RV surveys.

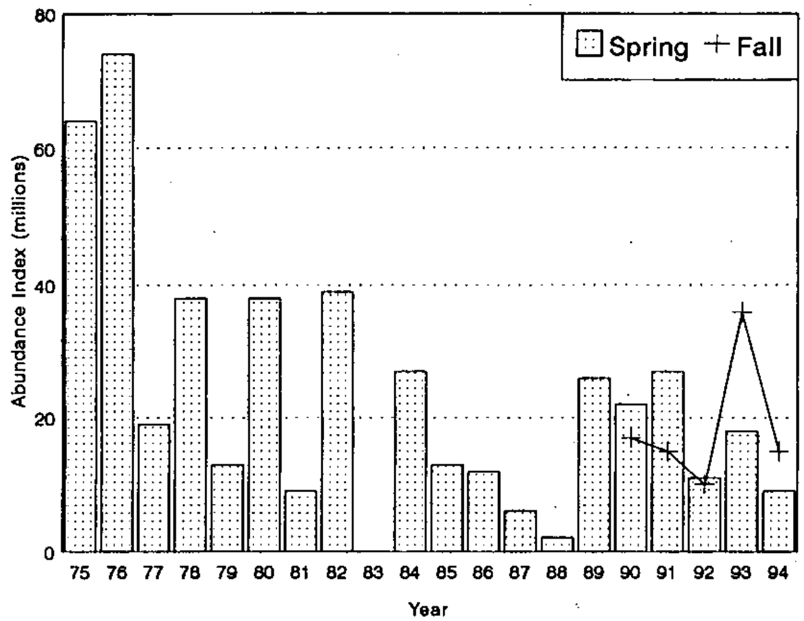

Fig. 9 Abundance at age 5 from Canadian spring and fall groundfish RV surveys in Div 3LNO.

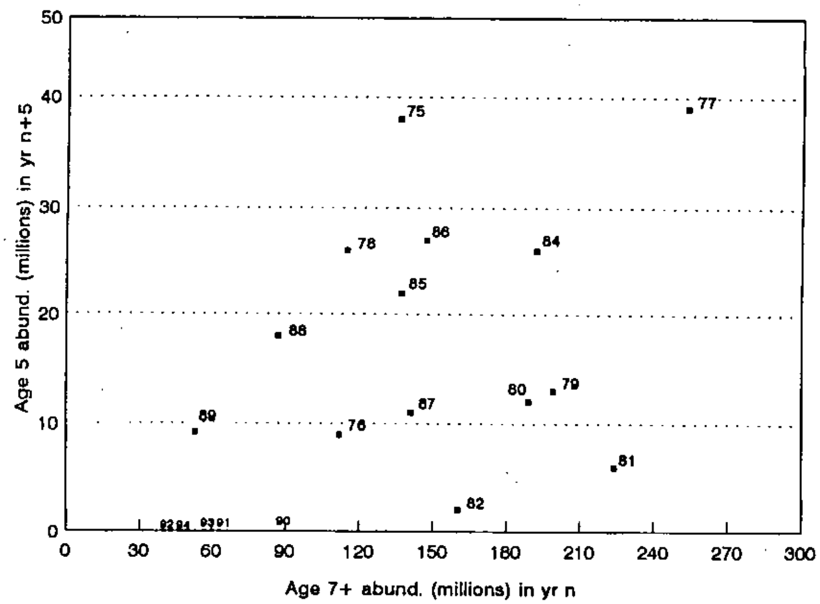

Fig. 10 Regression of age 5 abundance (yr n+5) from spring surveys against age 7+ abundance (yr n, 1975-89) from spring surveys, Div. 3LNO.

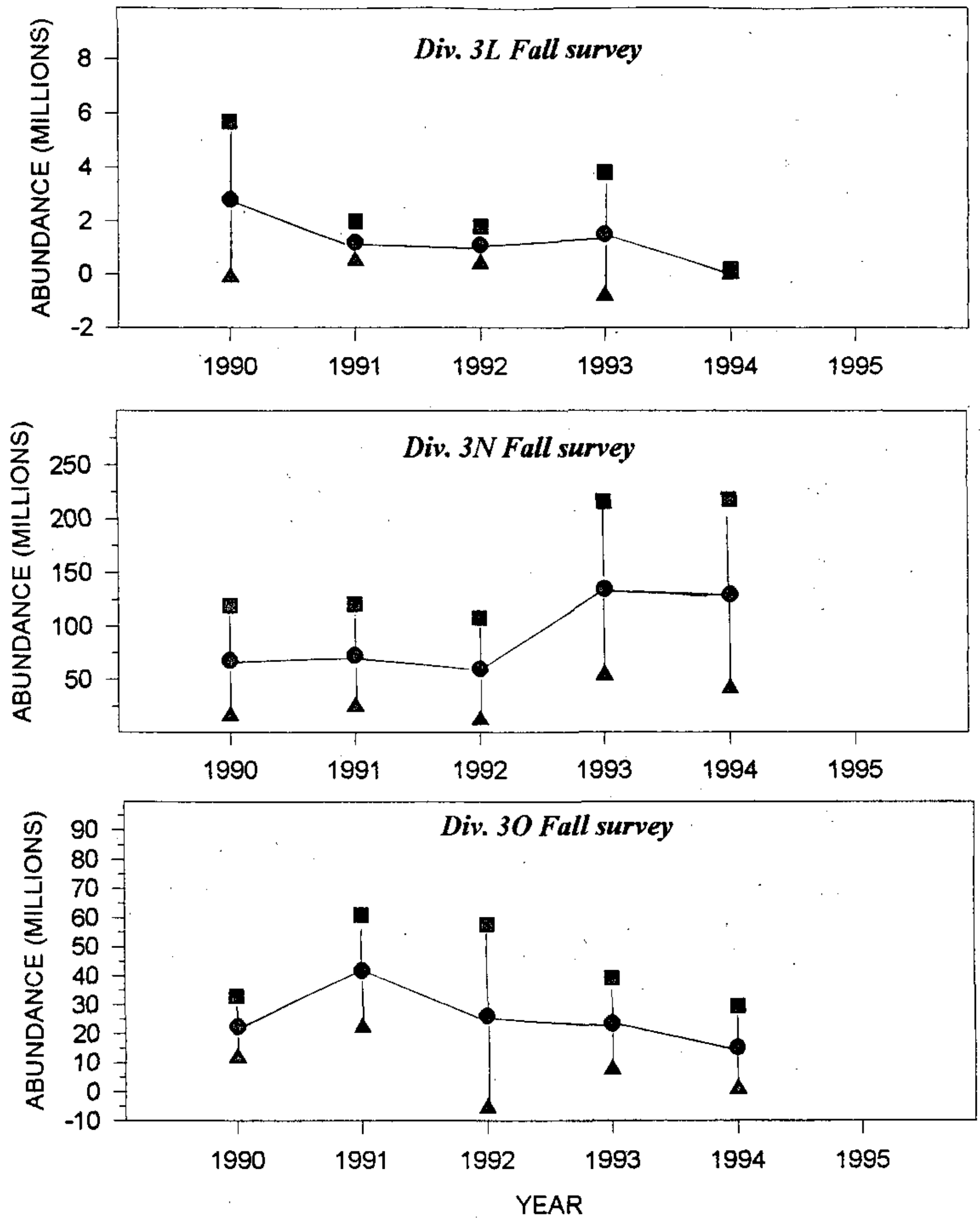

Fig 11 Abundance estimates of yellowtail (with 95% C.I.) from Canadian fall surveys in Div. 3L, 3N & 3O.

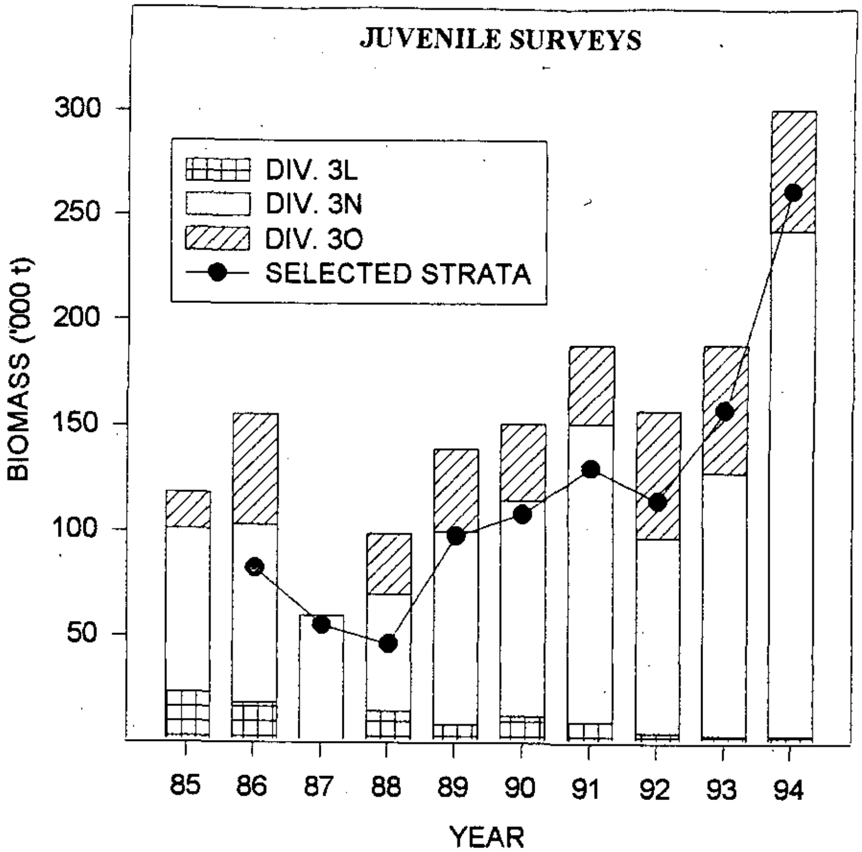

Fig 12 Trends in biomass of yellowtail from the Canadian juvenile groundfish surveys of the Grand Bank (Selected strata are 352 in Div. 3O; 360, 361, 375 &376 in Div. 3N) No survey in Div. 3L and 3O in 1987.

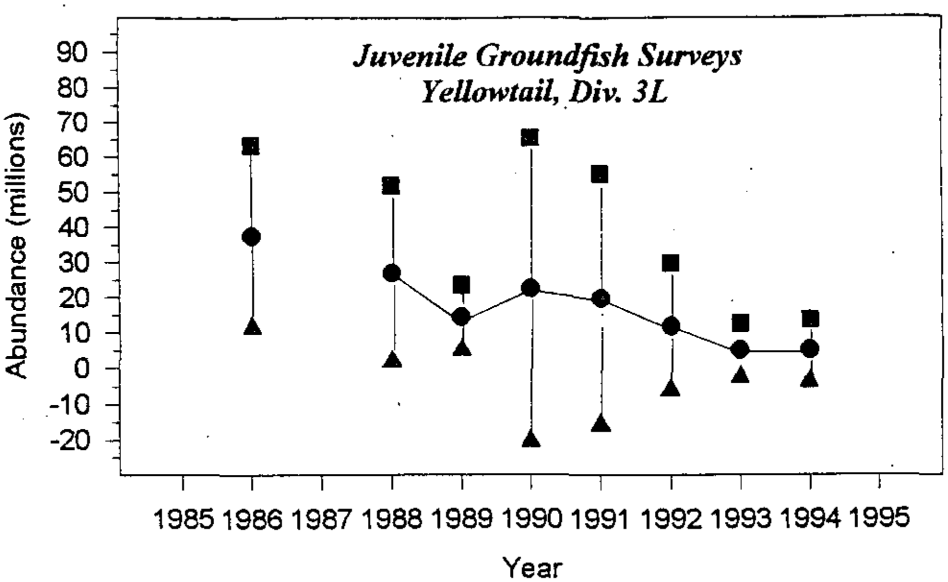

Fig.13 Abundance estimates of yellowtail (with 95% C.I.) from the Canadian fall juvenile groundfish surveys in NAFO Div. 3L, 1986-94. Note: no survey in 1987.

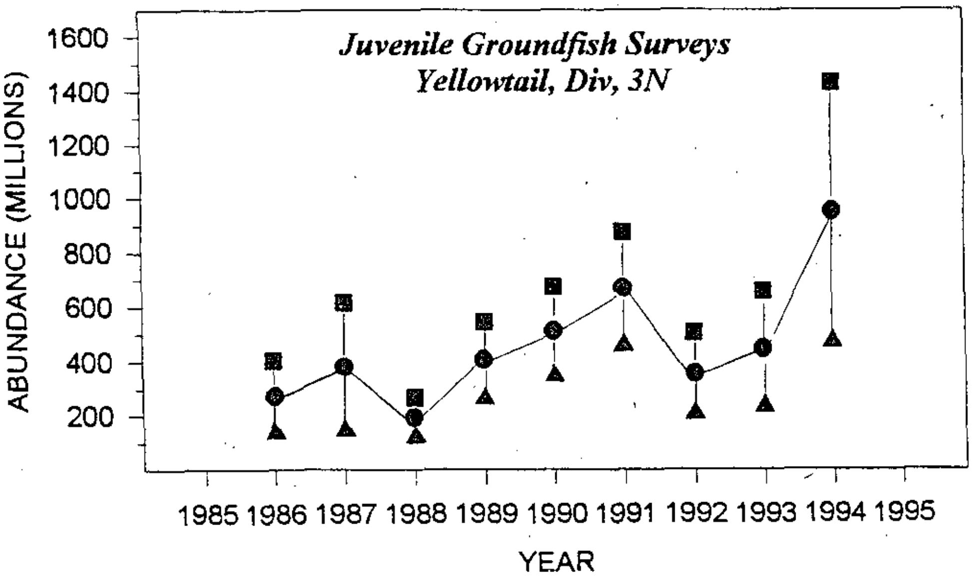

Fig 14 Abundance estimates of yellowtail (with 95% C.I.) from the Canadian fall juvenile groundfish surveys of Div. NAFO 3N, 1986-94.

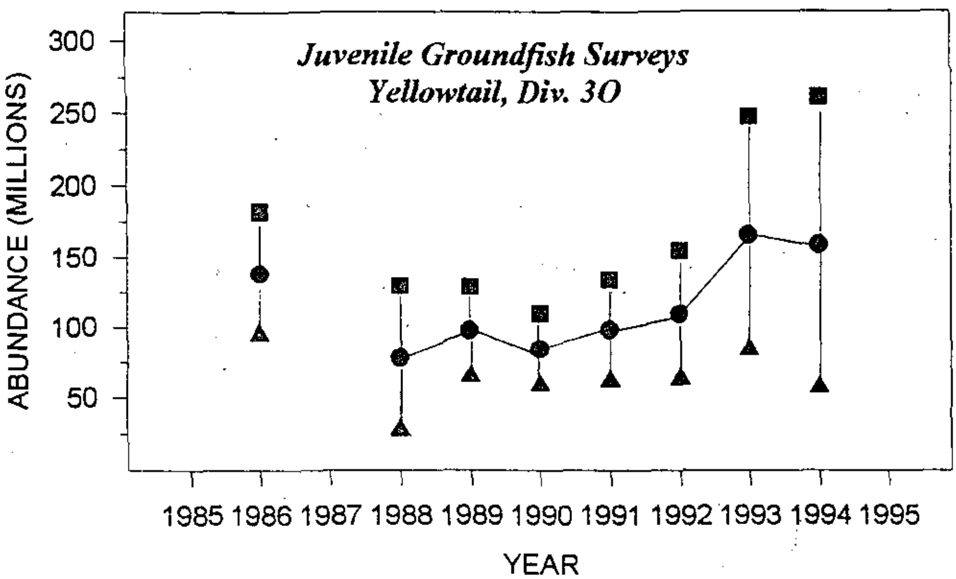

Fig. 15 Abundance estimates of yellowtail (with 95% C.I.) from the Canadian fall juvenile groundfish surveys of Div. NAFO 3O, 1986-94.

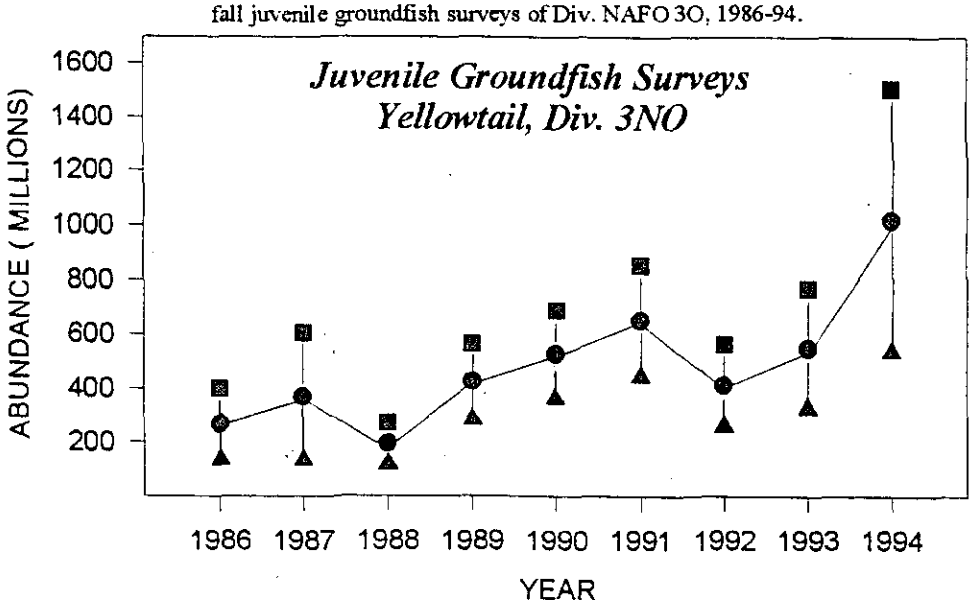

Fig 16 Abundance estimates of yellowtail (with 95% C.I.) from the Canadian fall juvenile groundfish surveys in selected strata

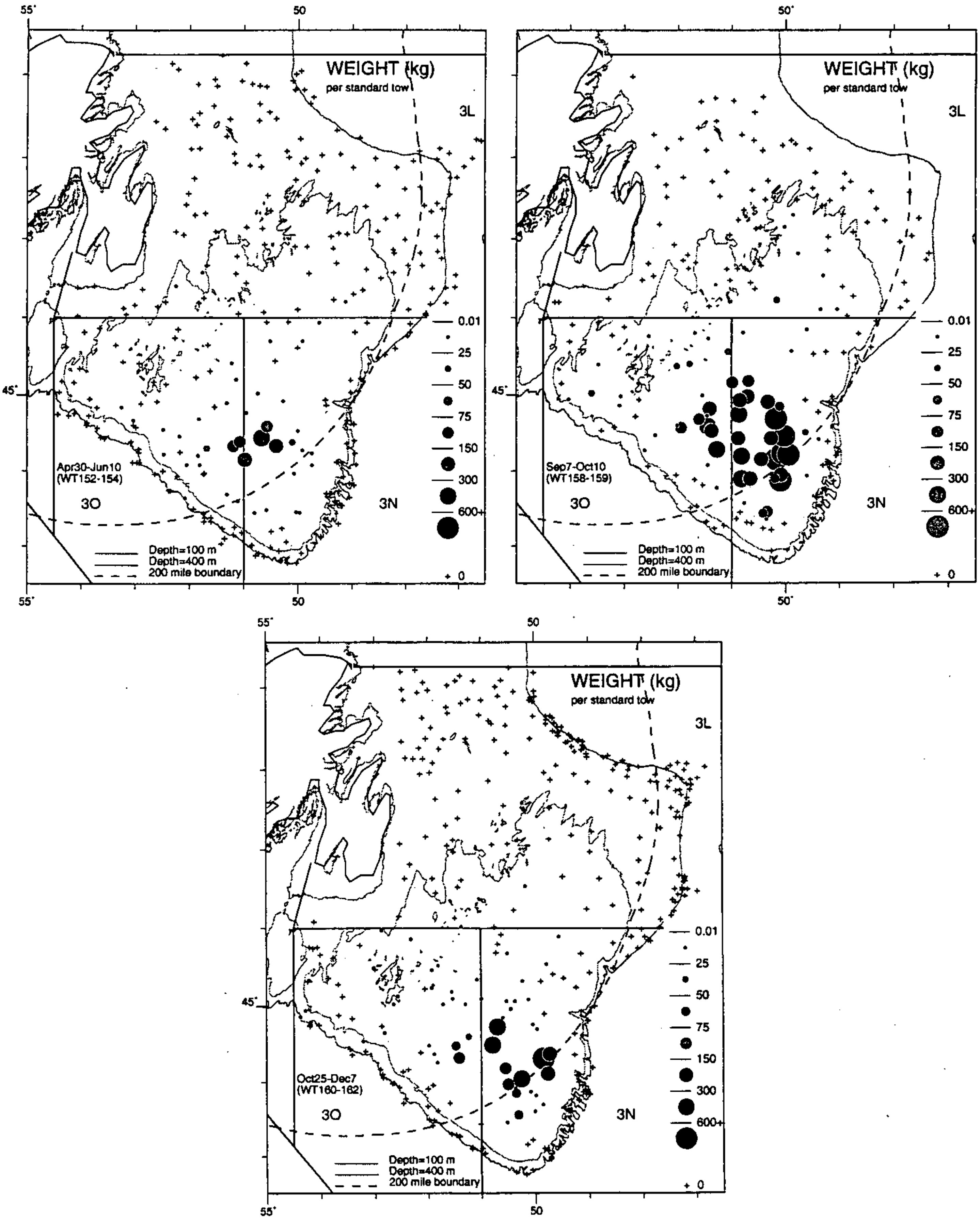

Fig 17 Distribution of yellowtail flounder catches from 1994 Canadian surveys of NAFO Divisions 3LNO by the FRV Wiltred Templeman (WT). The spring (WT152-154) and autumn (WT160-162) surveys utilized an Engels 145 trawl and the juvenile survey (WT158-159) utilized a Yankee 36 shrimp trawl. Circles represent catch weight (kg) per standard tow (1.75 nautical miles for spring and fall surveys, 1.25 nautical miles for juvenile survey).

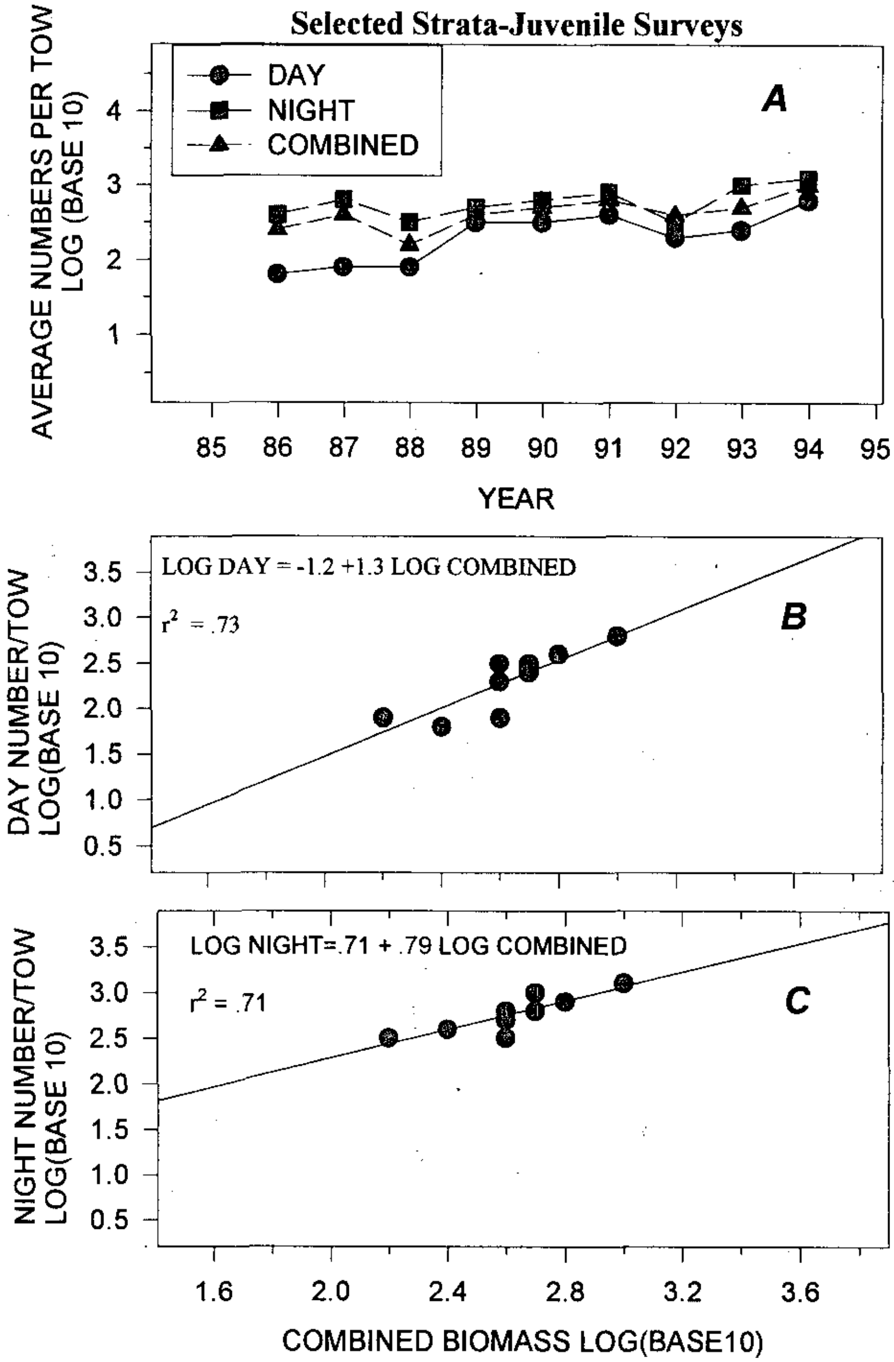

Fig. 18. **(A)** Trends in juvenile survey catch rates of yellowtail derived from day and night and combined estimates. Regression of day **(B)** and night estimates **(C)** withcombined estimates

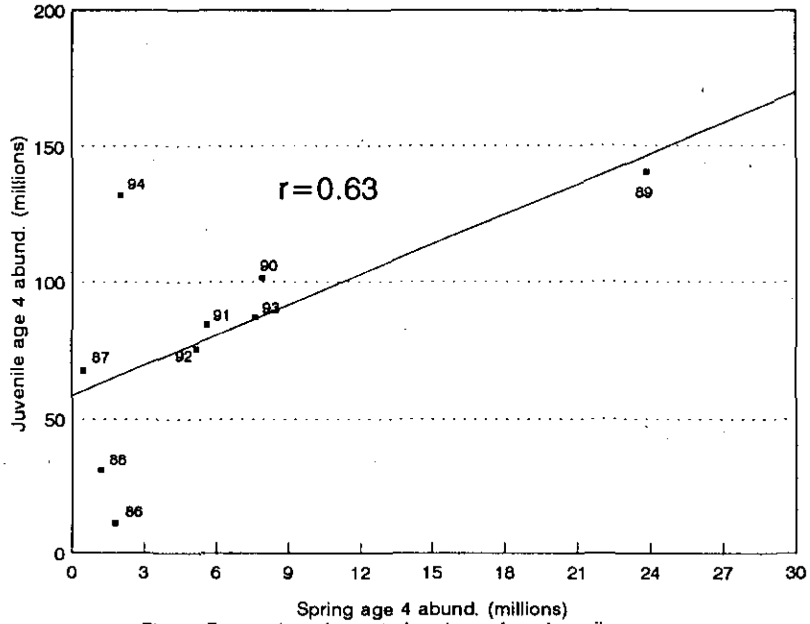

Fig.19 Regression of age 4 abundance from juvenile surveys against age 4 abundance from spring surveys, Div. 3LNO.

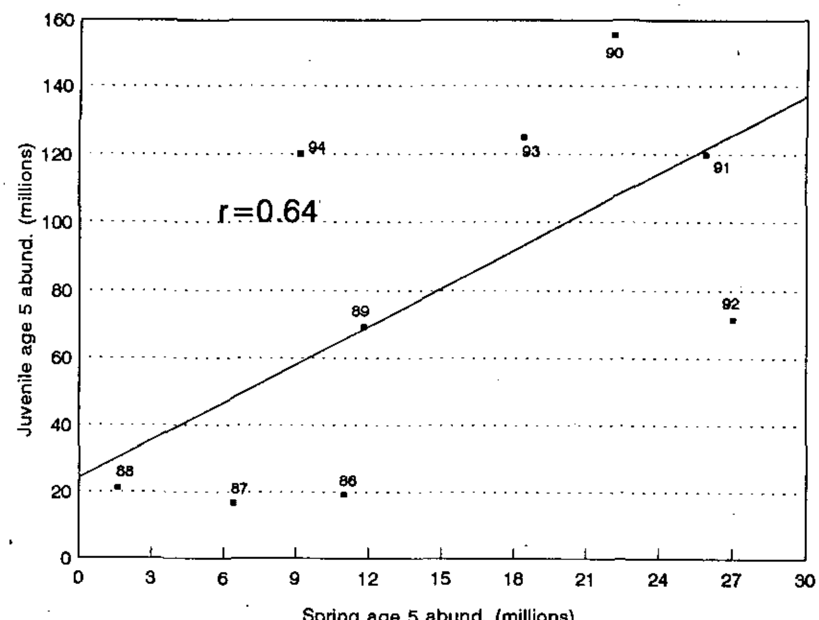

Fig 20 Regression of age 5 abundance from juvenile surveys against age 5 abundance from spring surveys, Div. 3LNO.

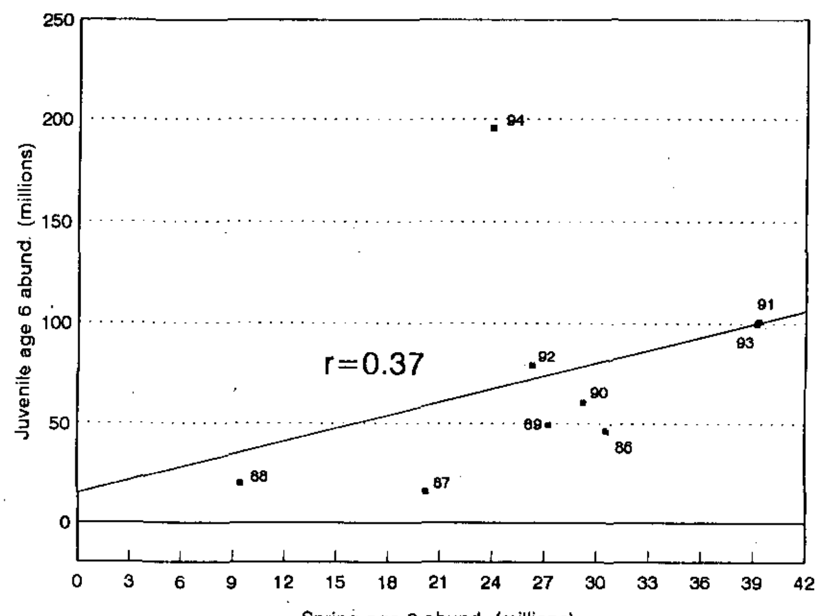

Fig.21 Regression of age 6 abundance from juvenile surveys against age 6 abundance from spring surveys, Div. 3LNO.

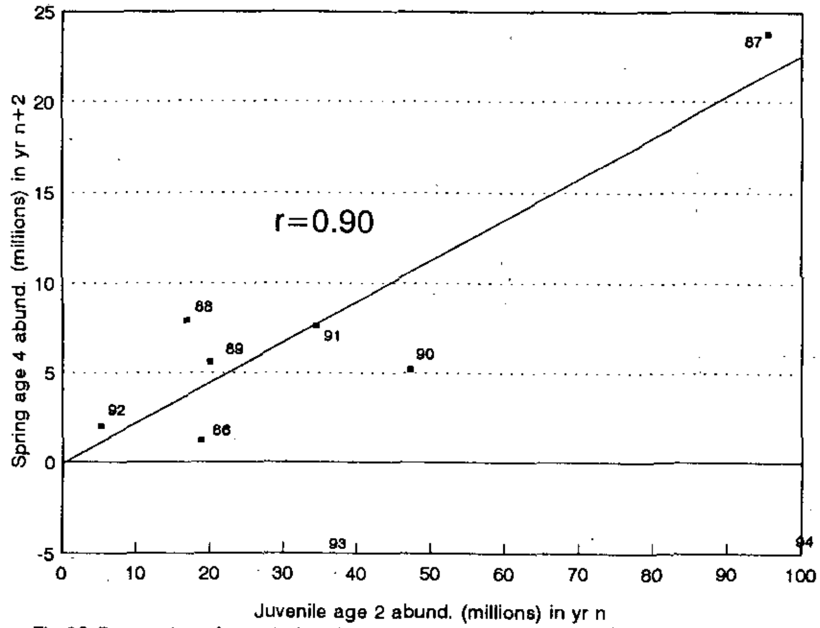

Fig.22 Regression of age 4 abundance (yr n+2) from spring surveys against age 2 abundance (yr n) from juvenile surveys, Div. 3LNO.

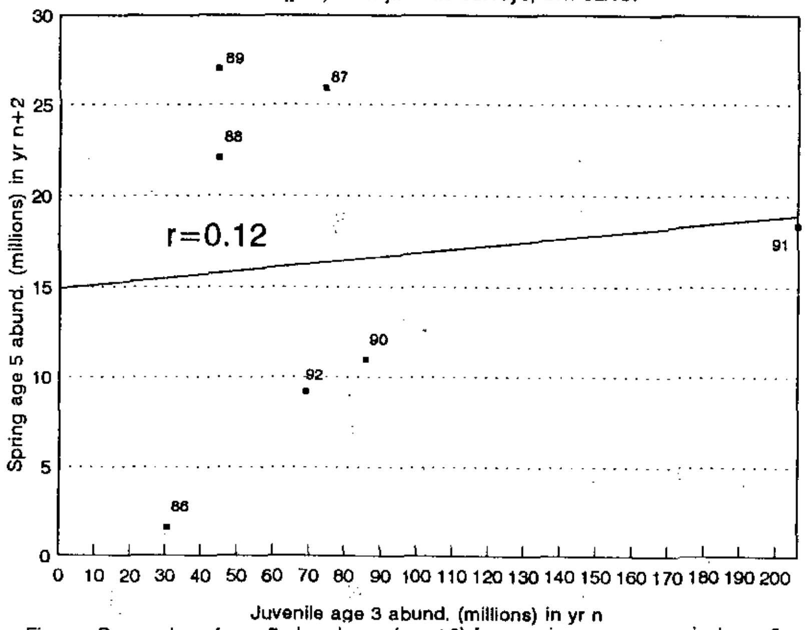

Fig.23. Regression of age 5 abundance (yr n+2) from spring surveys against age 3 abundance (yr n) from juvenile surveys, Div. 3LNO.

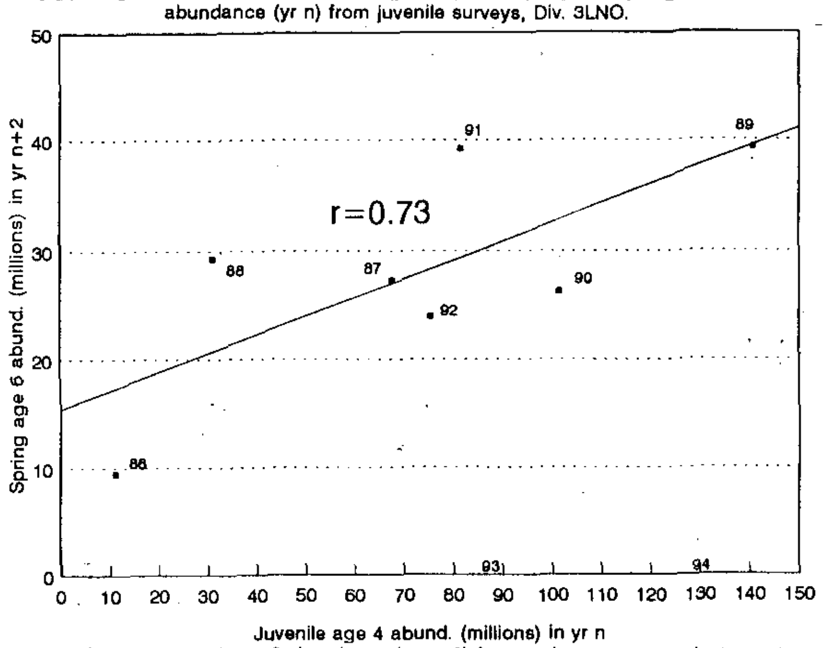

Fig. 24 Regression of age 6 abundance (yr n+2) from spring surveys against age 4 abundance (yr n) from juvenile surveys, Div. 3LNO.

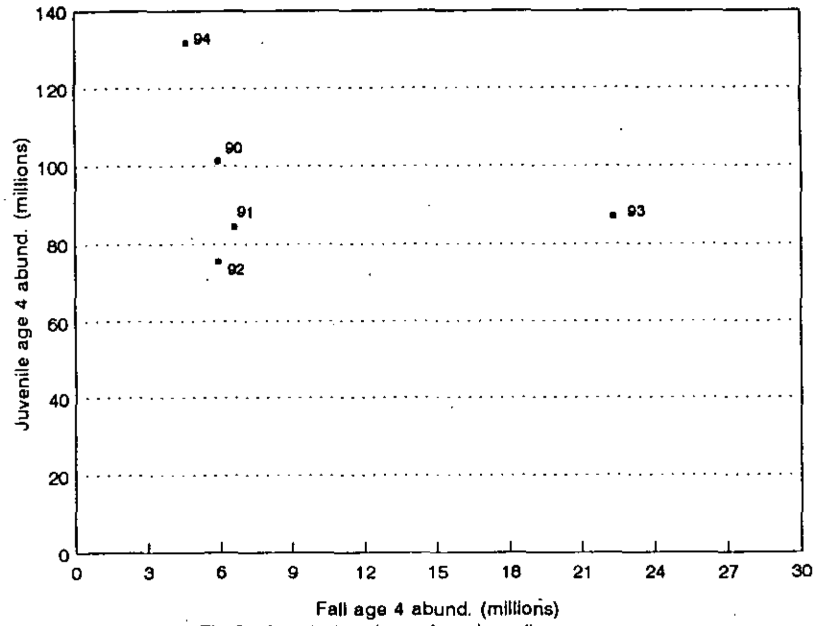

Fig 25 Age 4 abundance from juvenile surveys versus age 4 abundance from fall surveys, Div. 3LNO.

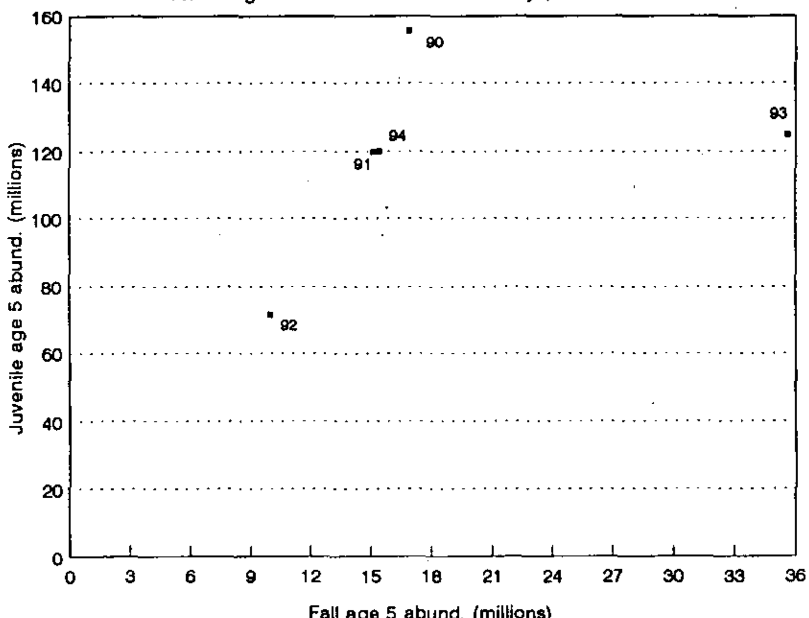

Fig 26 Age 5 abundance from juvenile surveys versus age 5 abundance from fall surveys, Div. 3LNO.

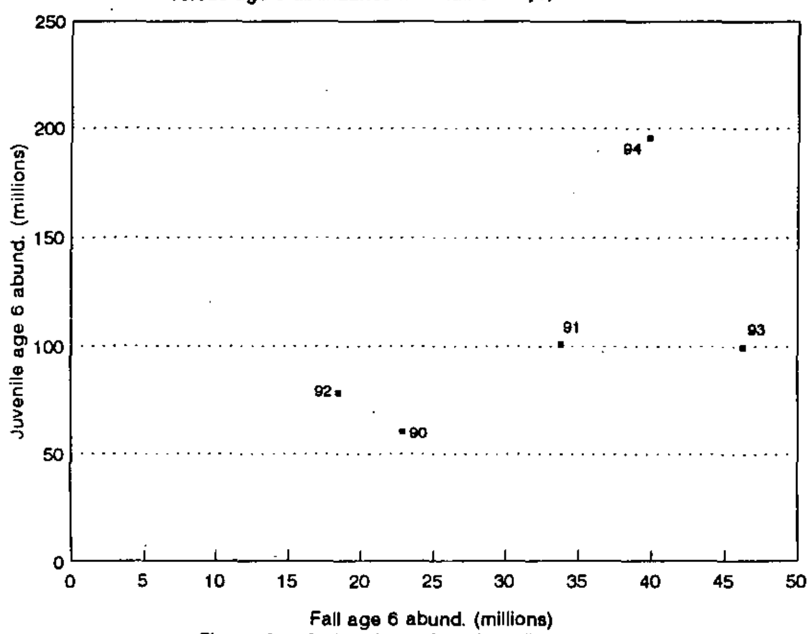

Fig 27 Age 6 abundance from juvenile surveys versus age 6 abundance from fall surveys, Div. 3LNO.

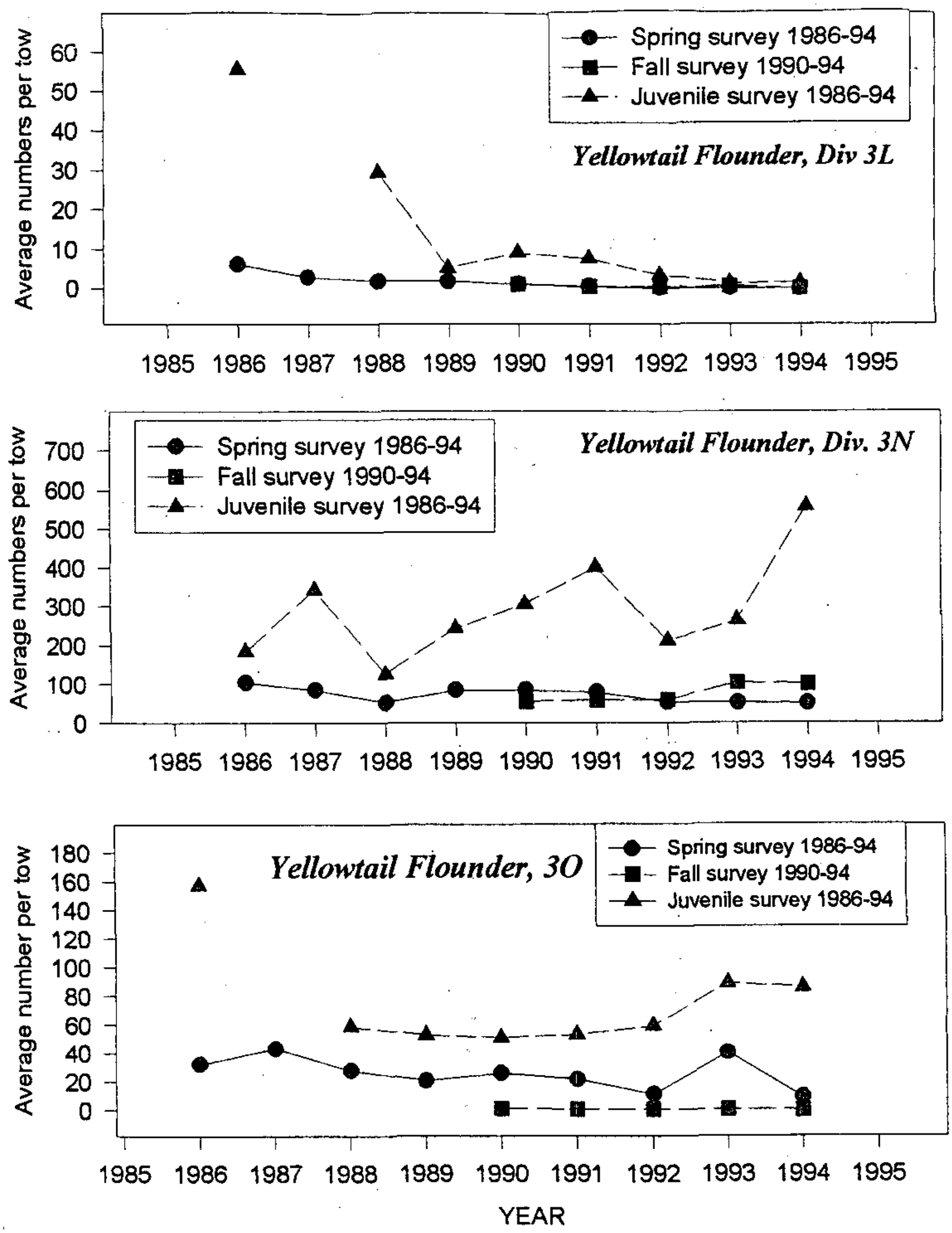

Fig. 28 Trends in average number per tow of yellowtail from the spring , fall and juvenile surveys on the Grand Bank, 1986-94.

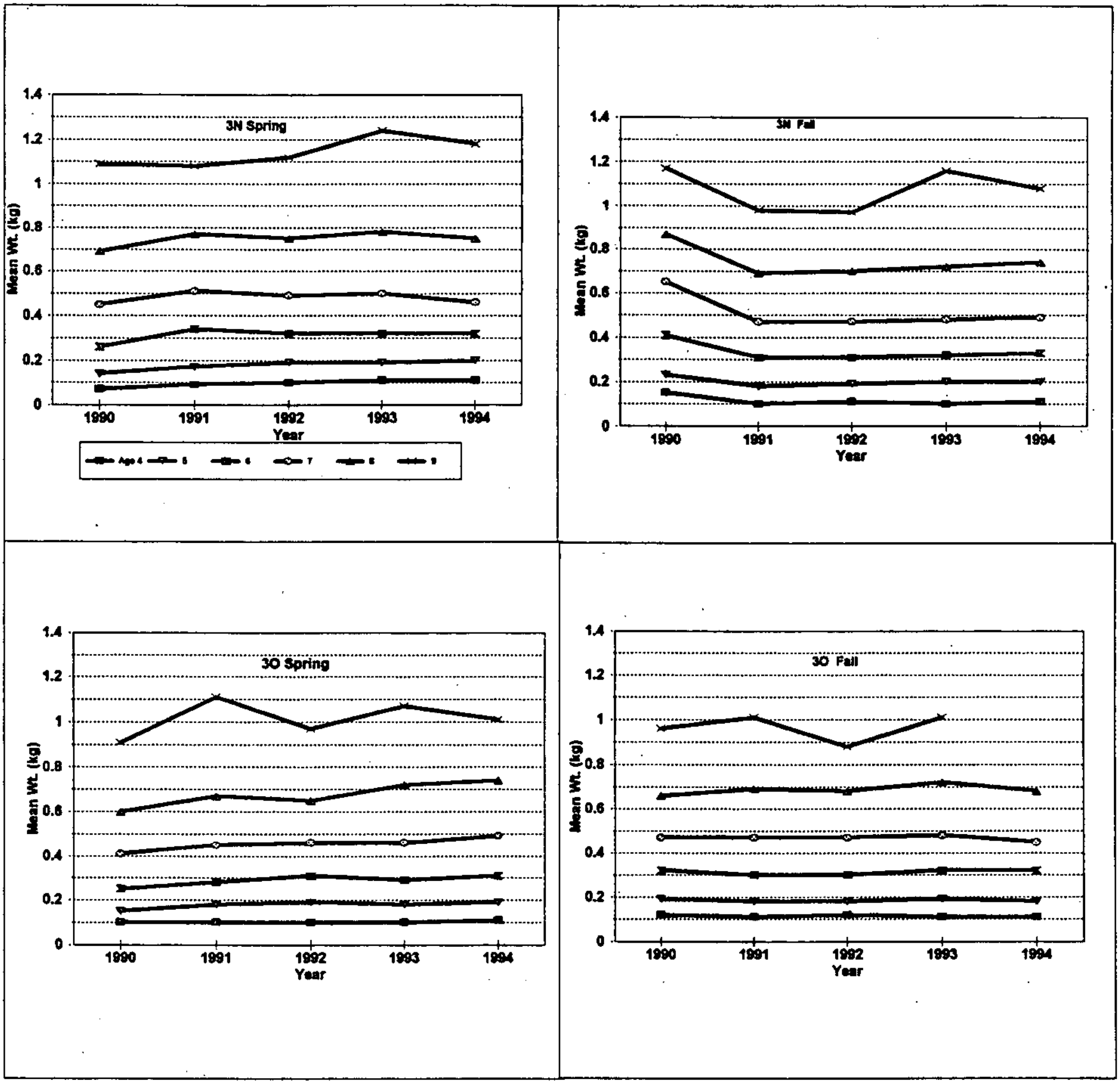

Fig.29 Trends in mean weight at age derived from the regular spring and fall groundfish surveys in Div. 3LNO, 1990-94.

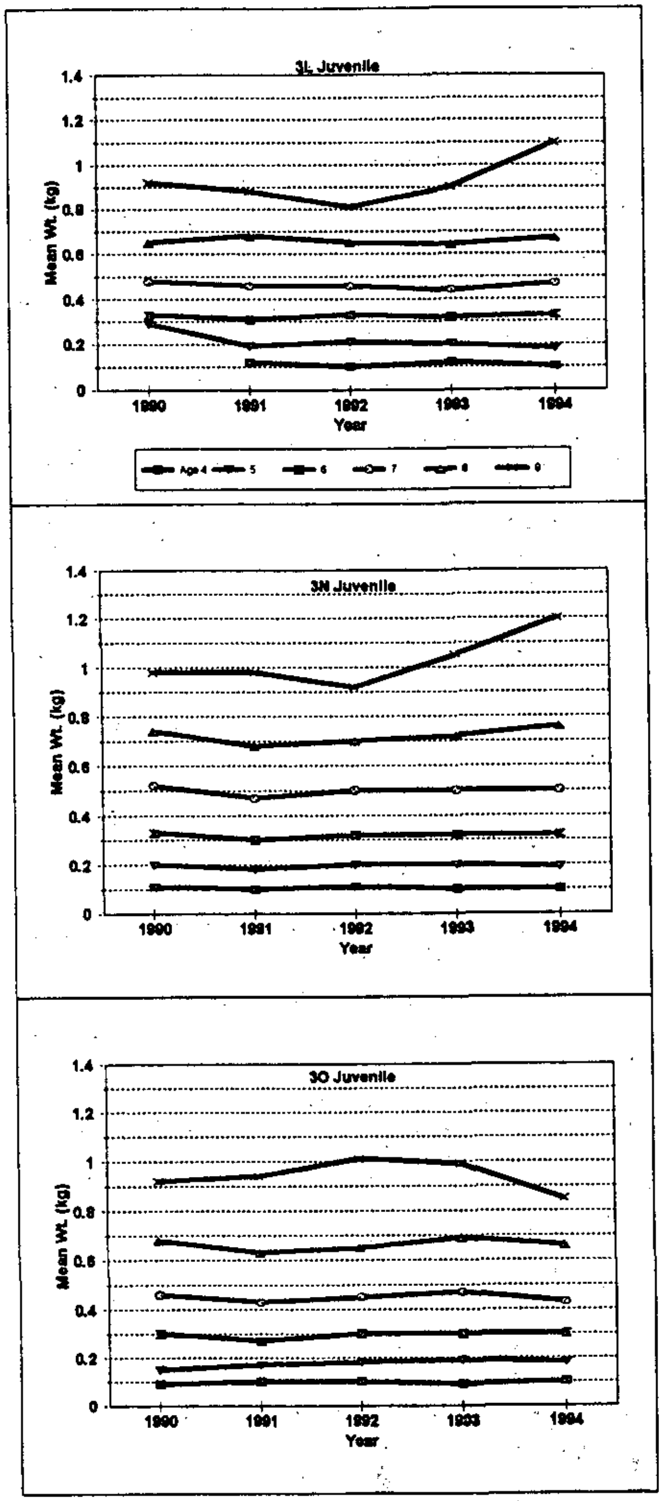

Fig.30 Trends in mean weight at age derived from the fall juvenile groundfish surveys in Div. 3LNO, 1990-94.

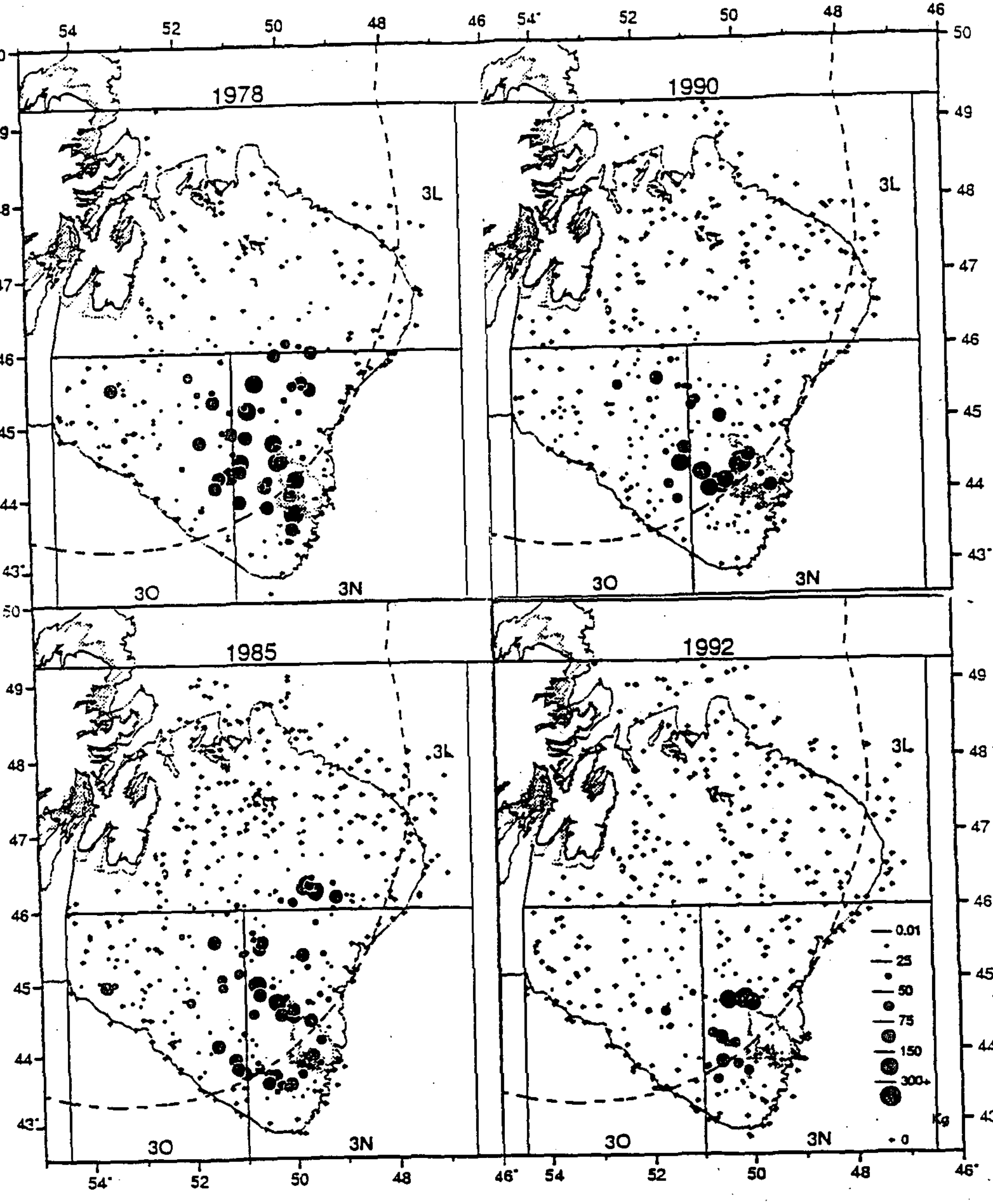

Fig.31. Yellowtail distribution on the Grand Bank from spring groundfish surveys in 1978, 1985, 1990, and 1992.

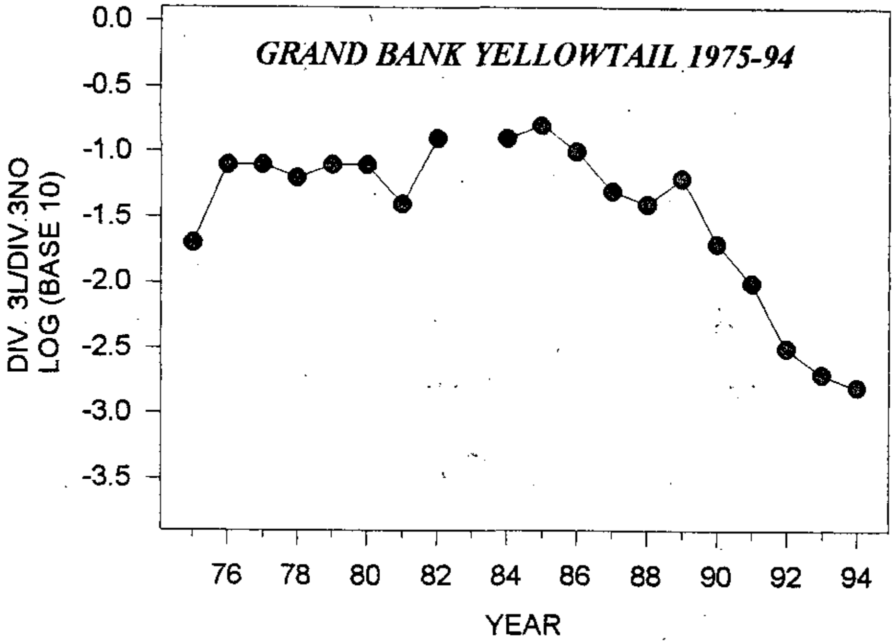

Fig.32 Interannual variation in the ratio of biomass of yellowtail in Div. 3L to biomass in Div. 3NO from spring surveys, 1975-1994.

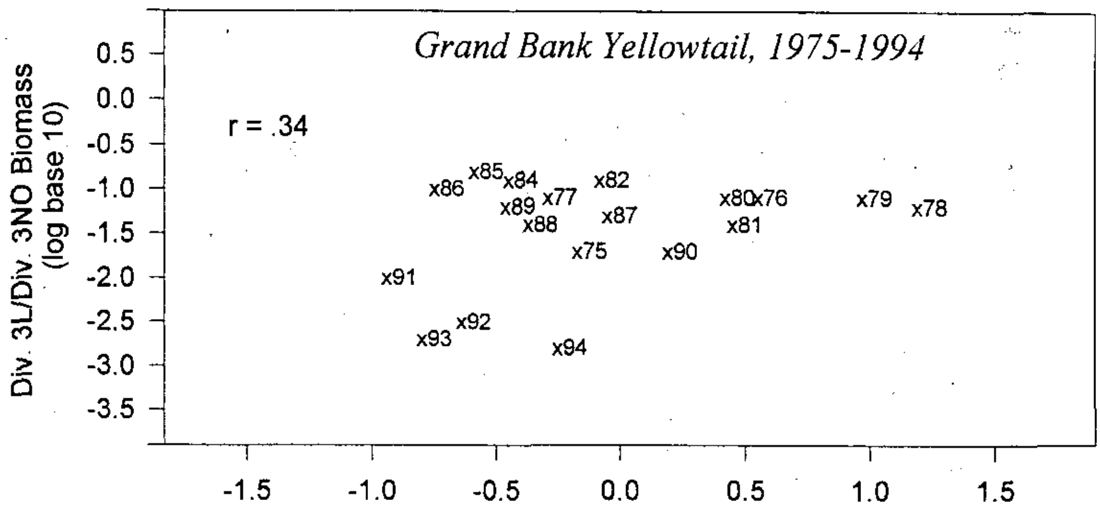

Fig.33A Relationship between the ratio of biomass of yellowtail in Div. 3L to that in Div. 3NO and mean groundfish survey bottom temperature of Div. 3L , 1975-1994

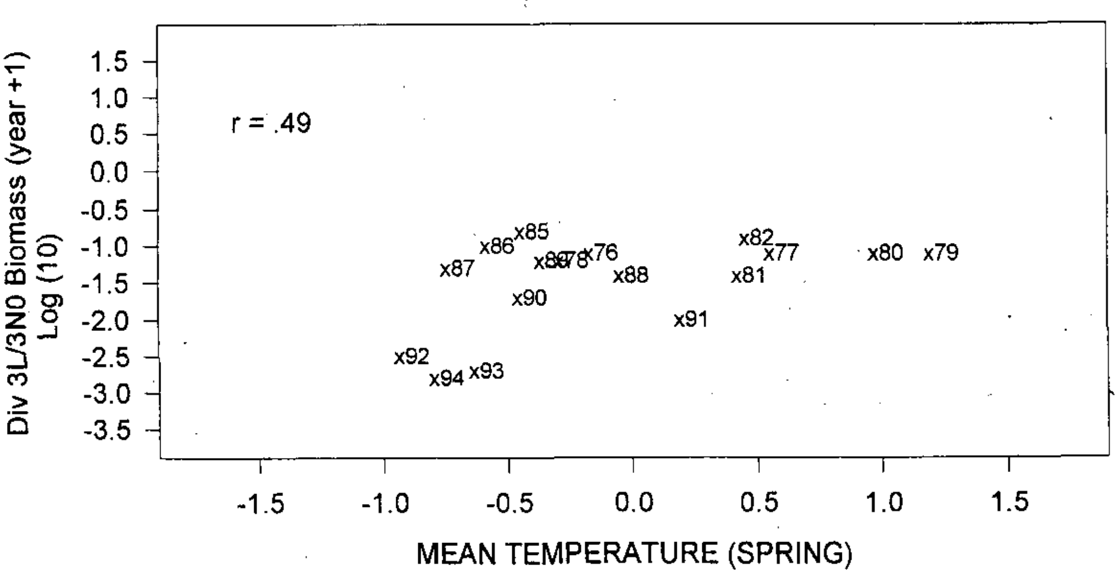

Fig. 33B Relationship between the ratio of biomass of yellowtail (year+1) in Div. 3L to that in Div. 3NO and mean groundfish survey bottom temperature of Div. 3L , 1975-1994

Grand Bank Yellowtail

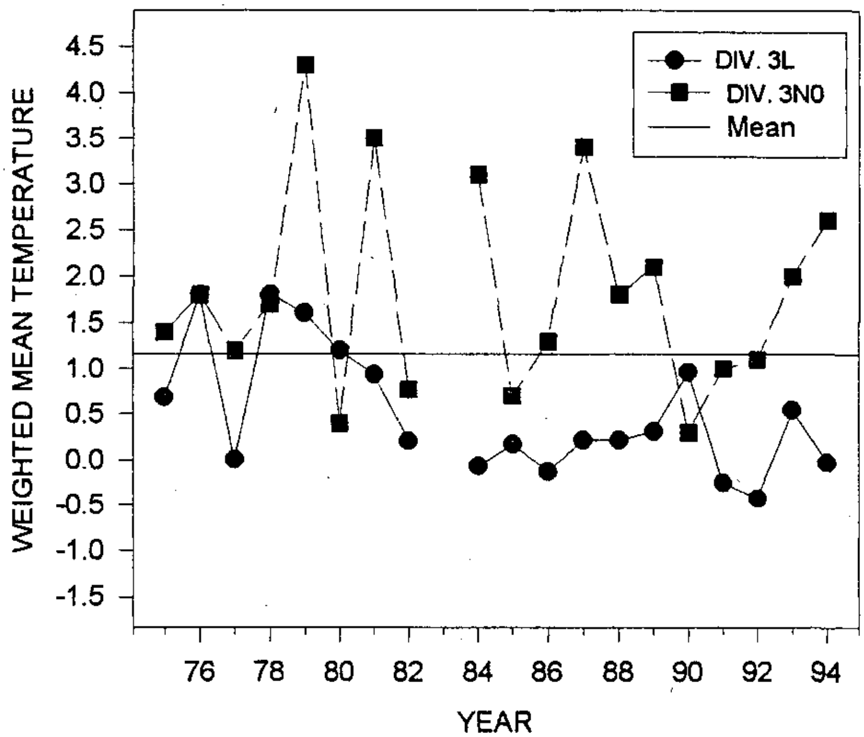

Fig 34. Mean temperature (weighted by catch numbers) distribution associated with yellowtail flounder in Div. 3L and Div. 3NO for the period 1975-94.

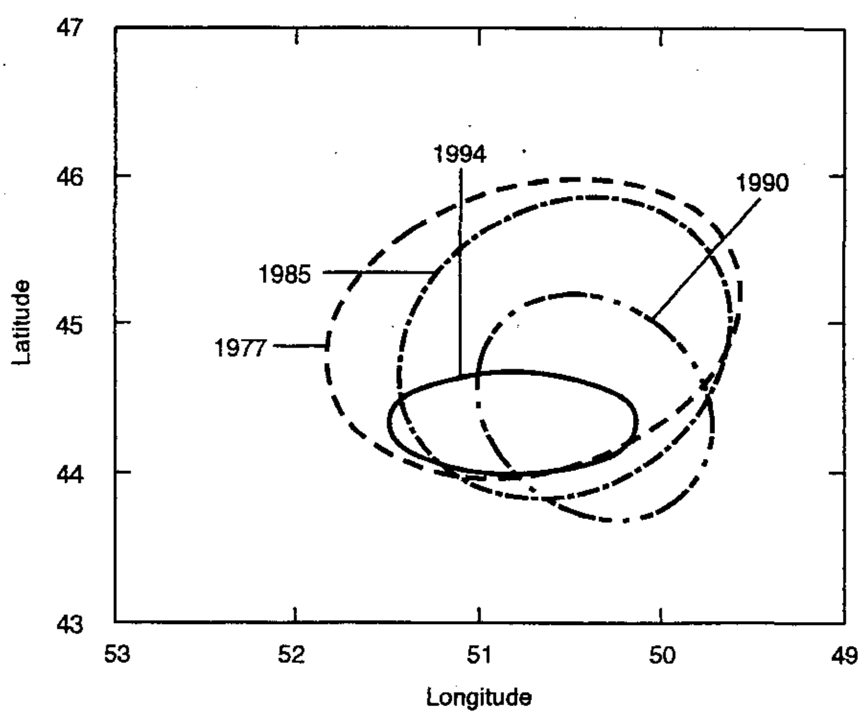

Fig. 35 Bivariate ellipses showing the distribution of yellowtail on the Grand Bank as derived from the spring surveys, 1975-94. Selected years shown.

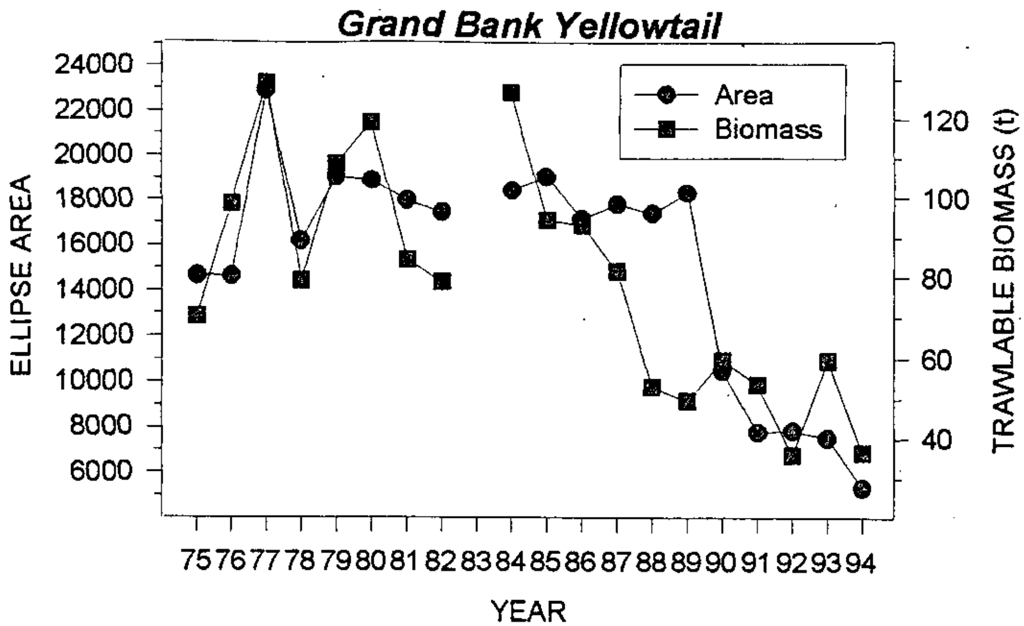

Fig.36 Trends in trawlable biomass of yellowtail from spring surveys and relative areas of distribution as determined from ellipses, NAFO Div. 3LNO.

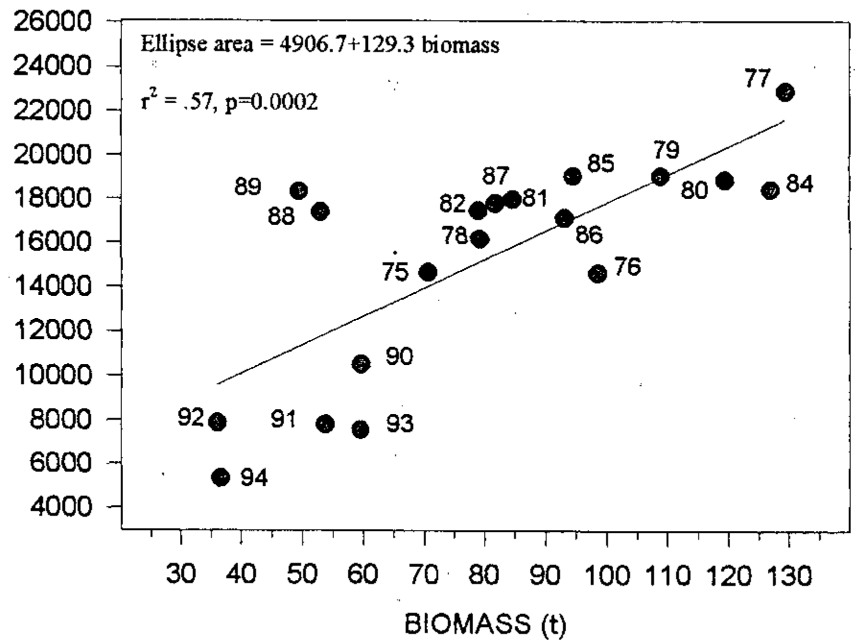

Fig. 37 Regression of ellipse area (square units) on population biomass of yellowtail derived from survey estimates

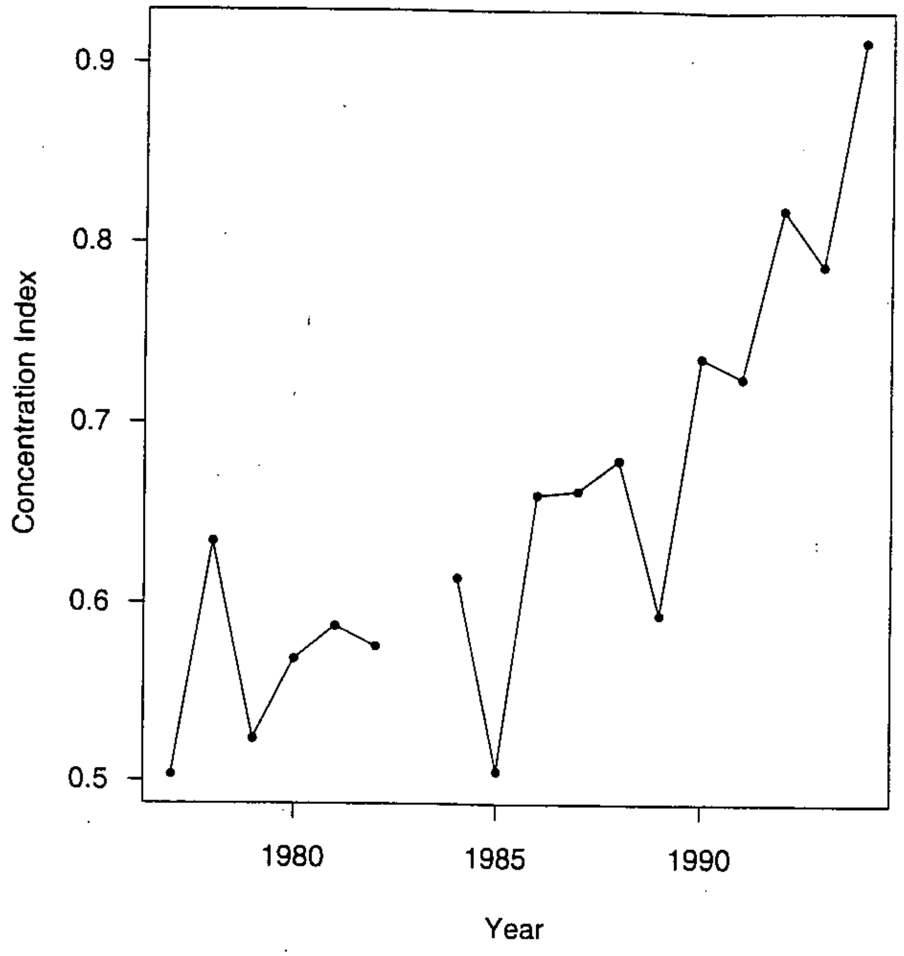

Fig. 38. Gini concentration/area distribution index for yellowtail flounder in Division 3LNO derived from the spring surveys, 1976-94 (reprinted from Myers et al. 1995).

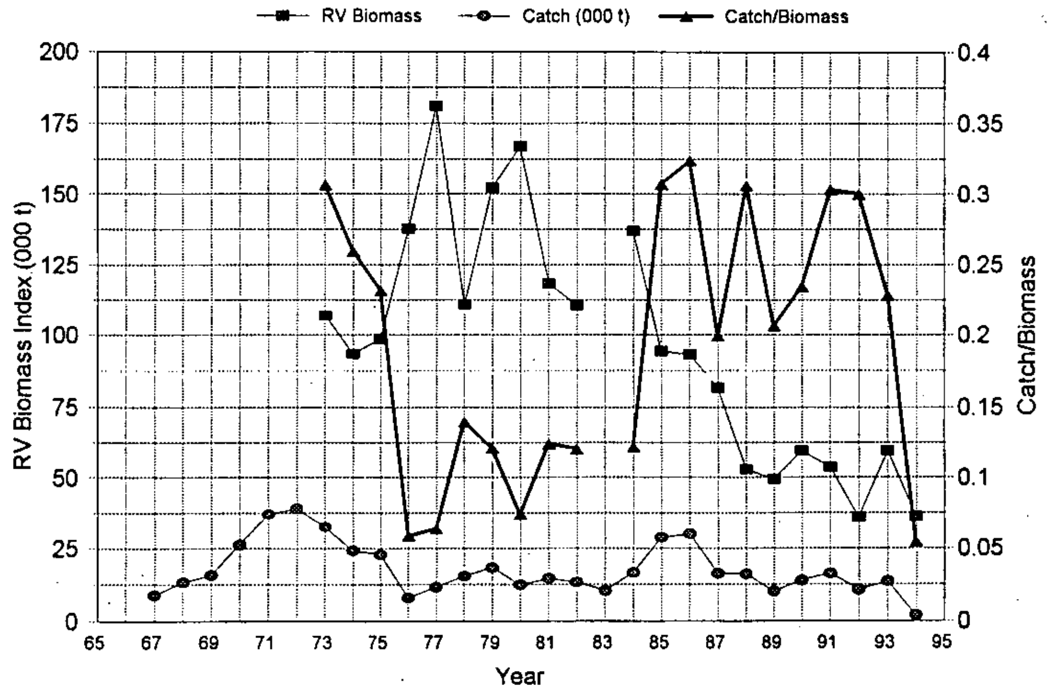

Fig 39 Comparison of catch and RV biomass index, 3LNO Yellowtail

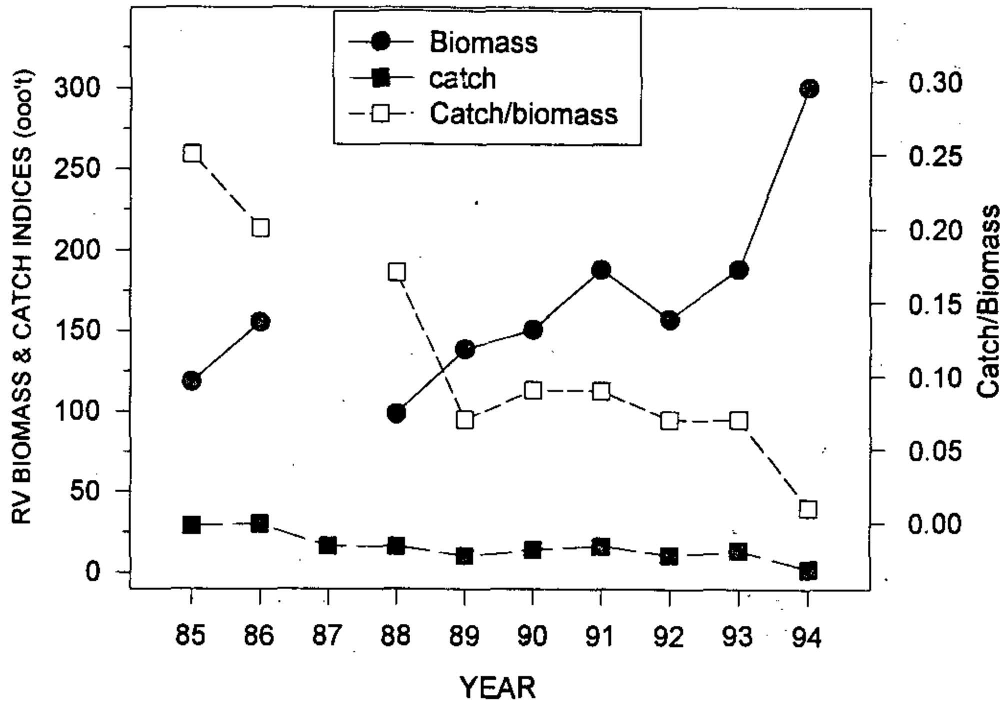

Fig. 40. Comparison of catch and R.V. biomass indices for yellowtail in Division 3LNO derived from the juvenile surveys, 1985-94.