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Managing Transboundary Flatfish Stocks - Sources and Consequences of Uncertainity

by

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Introduction

When Canada declared a 200 mile limit around its coastline in 1977, a boundary was created which divided the continental shelf on the Nose and Tail of the Grand Bank, NAFO Div. 3LNO (Fig. 1). This boundary meant that about 9, 41, and 4% of the area (down to 732 m) in Div. 3L, 3N, and 3Ø respectively lay outside Canadian jurisdiction. Among the more important fish stocks affected were the flatfish, American plaice (Hippoglossoides platessoides) and yellowtail flounder (Limanda ferruginea). Prior to 1977, fleets of various countries fished these stocks over most of the Grand Bank, restricted only by the total allowable catches (TAC's), which were introduced in 1973. After January 1, 1977, access to the large portion of fishing grounds inside the 200 mile limit was denied to many non-Canadian vessels, as allocations of fish to these vessels were reduced. In the early 1980's, fleets of some nations began fishing outside the 200 mile limit, in the area referred to as the "NAFO Regulatory Area". Catches of American plaice and yellowtail increased rapidly, leading to overruns of the TAC's in some years.

This paper will examine some of the difficulties encountered in the recent management of these transboundary flatfish stocks. It will focus on the sources of uncertainty which have arisen in the assessment of these resources caused by the separate fisheries which have developed on either side of the 200 mile limit.

Distribution of American plaice and yellowtail on the Grand Bank

American plaice is distributed widely over the Grand Bank, with the largest concentrations being found where the slope of the bank is in contact with the cold Labrador current (Pitt 1967). Most of these areas occur in the north (Div. 3L), in depths from 80 to 250 m, where bottom temperatures are often between -1.5 and +1.0C (Wells et al. 1988). Between one-half and two-thirds of the American plaice population on the Grand Bank is found in Div. 3L (Brodie et al. 1990a). Research vessel surveys conducted on the Grand Bank indicated that the proportion of American plaice outside 200 miles in each division was generally equivalent to the proportion of the area outside 200 miles, eg. about 4% in Div. 3Ø. However, Brodie et al. (1990a) showed that the percentage of American plaice biomass outside 200 miles has declined since the mid 1980's, and was in the range of 11-22% from 1987 to 1990, compared to 26-46% from 1979 to 1986 (Fig. 2).

Yellowtail flounder is a shallow-water species, occurring principally in 35-85 m (Pitt 1970), with a concentration on the Grand Bank around the Southeast Shoal (strata 375 and 376 in Fig. 1). Yellowtail are found mainly in warmer water, eg. 1-4°C, but do occur in colder water, when lower temperatures are prevalent in the Tail of the Bank area (Wells et al. 1988). Research vessel surveys showed that about 70% of the yellowtail population is usually found in Div. 3N, with most of the remainder being in Div. 3Ø (Brodie et al. 1990b). There is virtually no yellowtail outside 200 miles in Div. 3L, and the percentage is generally less than 5% in Div. 3Ø. In Div. 3N, the percentage of biomass outside 200 miles ranged from 28 to 41% from 1979 to 1985, but exceeded 20% only once from 1986 to 1990 (Fig. 3).

A feature common to both flatfish stocks is the presence on the Grand Bank of nursery areas, which contain high concentrations of juveniles. Research vessel surveys, directed at juvenile flatfish, have been conducted in Div. 3LNO since 1985, using a modified shrimp trawl as a standard sampling gear and employing a stratified-random survey design (Walsh 1990a,b).

These surveys concentrated on estimating abundance and biomass of American plaice and yellowtail and have identified areas of high juvenile abundance. There are two main nursery areas for American plaice on the Grand Bank, one located on the northern slope of Div. 3L in depths of 93-183 m and the other in the southern transboundary area (Fig. 4). The southern area contains a larger concentration of juveniles in the age range of 1 to 4 years than the northern sector and any possible linking mechanism between the two areas is unknown. The yellowtail flounder nursery area also incorporates the transboundary area in Div. 3N, with most of the concentrations of juveniles (ages 1 to 4 years) in stratum 376 on the Southeast Shoals, mainly outside the 200 mile limit (Fig. 5).

An examination of the distribution of catch at age (numbers) from the combined 1986 to 1989 juvenile surveys, separated into catch outside and inside the 200 mile limit in Div. 3N, showed remarkable similarities in the areas of concentration of both species. For American plaice, 70 to 94% of the catches of fish aged 1-6 years are located outside the 200 mile limit, while age 7+ fish are located mainly inside the boundary (Fig. 6). Similarly yellowtail flounder aged 1 to 5 years are also located mainly (71-85%) outside the boundary with older fish being more abundant inside (Fig. 7).

One obvious management tool to control the exploitation of young flatfish would be the introduction of closed areas and/or seasons. However, at present, information on seasonal distribution of juveniles is lacking, as is the appropriate data on precise location of catches from commercial fisheries in the area (NAFO Sci. Coun. Rep. 1990, p. 27). In addition, more information on the mixing rates of the juvenile and adult populations is required before nursery areas can be delineated precisely.

Fisheries for American plaice and yellowtail

The largest commercial fishery for American plaice in the Northwest Atlantic occurs on the Grand Bank (Pitt 1967). The fishery began in the 1940's, after the introduction of the otter trawler to the Canadian fleet, and Canada took all or most all of the landings from this stock until the mid 1960's (Pitt 1970b). At this time, catches by other nations, mainly USSR, increased rapidly, with the total catch peaking at 94,000 t in 1967 (Brodie et al. 1990a). Catches declined subsequently, and remained stable around 45-50,000 t from 1973 to 1982 (Fig. 8), as Canada once again became virtually the only nation involved in the fishery, particularly after the declaration of the 200 mile limit in 1977. However after 1982, other nations, notably Spain, Portugal, Panama, South Korea, and the USA began fishing for flounders on the Nose and/or Tail of the Bank. This resulted in an increase in the catch up to 1986, after which time catches decreased due to a decline in stock abundance (Brodie et al. 1990a). From 1971 to 1987, the Canadian catch from the stock ranged from 33,000 t to 50,000 t, with about 5-10% of this total coming from the inshore sector.

The fishery for yellowtail flounder on the Grand Bank essentially began in 1965, with a catch of about 3000 t. Prior to this, catches were generally quite low (Pitt 1970a), but after the demise of the Grand Bank haddock fishery in the early 1960's, catches of yellowtail by the Canadian otter trawl fleet quickly increased (Pitt 1975). Catches by USSR vessels also rose throughout the late 1960's and early 1970's, resulting in a peak catch from the stock of just over 39,000 t in 1972 (Brodie et al. 1990b). Catches averaged around 14,000 t in the late 1970's and early 1980's, as foreign catches dwindled to negligible levels following the declaration of the 200 mile limit (Fig. 9). With the arrival of the foreign fleets on the Tail of the Bank in 1982, catches once again increased rapidly, reaching 30,000 t in 1986, before decreasing in recent years as the stock declined. After peaking at over 28,000 t in 1973, the Canadian catch from this stock ranged from 8,000 t to 18,000 t in the period 1974-88.

In recent years, the Canadian fleet has directed very little effort towards flounders in the NAFO Regulatory Area, and has concentrated on the fishery inside 200 miles where catch rates of flatfish are usually much higher (Brodie 1989). Foreign fleets remain restricted to the NAFO Regulatory Area, creating two distinct fisheries on the stocks which straddle the 200 mile limit. The situation is further complicated by the participation in the fishery of vessels registered to countries which are not members of NAFO, and are therefore not obliged to observe the NAFO regulations governing fisheries in the area.

Uncertainties (related to the 200 mile limit) in the assessments of American plaice and yellowtail

With the heavy involvement in the fishery in the mid 1980's of non-NAFO countries, some of which did not report their catches (eg. Panama, Cayman Islands), it became difficult to get accurate figures for total catches from the Grand Bank flatfish stocks. The problem was compounded by the fact that South Korea, a non-NAFO country which did report catches, did not submit its substantial flatfish catch on a species by species breakdown. To arrive at total landings figures, it was necessary to use estimates of catch obtained from Canadian surveillance personnel, which were based on vessel sightings and some estimates of catch per day and species composition (NAFO Sci. Coun. Rep. 1988, p. 53). These catches, combined with the estimated breakdown of the South Korean landings, comprised a substantial portion of the

flatfish catches from the Regulatory Area, and from the stocks as a whole, for the years 1984-86 (Fig. 10). Thus the catches from this period are considered to be less reliable than other years (Brodie et al. 1990a, b).

The absence of sampling data, i.e. length frequencies and otoliths, from large portions of the American plaice and yellowtail catches has also caused difficulties in the assessments of these stocks. Obviously, there are no such data available for the unreported catch, but even for some of the reported catches in the Regulatory Area the sampling information has been less than adequate. This problem could have been overcome if the available data showed that the different fisheries were taking catches with similar age compositions. However, it has been documented (Brodie et al. 1990a, b) that at least one major fleet (EEC-Spain) has recently shifted its catch of flatfish toward much smaller animals compared with earlier years. For example, the Spanish catch of yellowtail in 1989 was estimated to contain 12.4 million individuals for a weight of 1,126 t, compared to the Canadian catch of 9.8 million fish for a weight of 5,007 t (NAFO Sci. Coun. Rep 1990, p. 98). Thus the age compositions in the Spanish flatfish catches are considerably different than those in the Canadian catches (Fig. 11). These differences are very important when the total catch at age for the two stocks are calculated, given that these data must be applied to the non-sampled catches. In the recent assessment of the yellowtail stock (Brodie et al. 1990b) a major revision to the catch at age for 1988 was proposed (Fig. 12), based on the re-assignment of a portion of the catch in the Regulatory Area to different sampling data and a revised estimate of the 1988 nominal catch. As can be seen from Fig. 13, there is little similarity in the catch at age for 1987 and 1988, despite the fact that the nominal catch was almost identical in these years. Brodie et al. (1990b) concluded that the uncertainties in the catch at age for this stock precluded its use in any assessment models which were based on sequential population analysis. Although the same problems exist to some degree in the American plaice database, they are not as limiting, given the better level of catch sampling in that stock compared with yellowtail.

The development of separate fisheries on either side of the 200 mile limit has meant that additional sources of catch per unit effort (CPUE) data should now be available. Prior to the onset of the fisheries in the Regulatory Area in 1982, only data from Canadian offshore trawlers were available from the Grand Bank flatfish fisheries. These data continue to be used as the only index of abundance from the commercial fisheries, despite the fact that these vessels no longer fish in the Regulatory Area, as they once did. Lack of appropriate data precludes the calculation of CPUE for most of the fleets fishing outside 200 miles, as these fisheries are often reported as directing for a mixture of species. Effort data, if present, is often reported to NAFO in days rather than hours. Thus, at present, there is no reliable CPUE index for the portion of the American plaice and yellowtail stocks in the Regulatory Area.

Perhaps the greatest uncertainties in the assessment of the Grand Bank flatfish stocks have come simply from the dynamic nature of the fisheries in the Regulatory Area. What were once relatively stable fisheries have become quite unpredictable, as exploitation patterns fluctuate between years and between fleets. Apart from the previously noted difficulties with assessment parameters such as catch at age and CPUE, this variability in the fishery makes catch forecasting extremely difficult. In preparing catch forecasts from analytical assessments, parameters such as mean weights at age, partial recruitment to the fishery, reference fishing mortality levels from yield per recruit analysis and the catch in the current (assessment) year must be used. With the exception of the latter, these values are usually derived from averaging recent (or sometimes long-term) values. Catches in the current year are usually assigned the value of the TAC. In the case of the 1990 assessment of American plaice in Div. 3LNO, problems were noted in all these areas, but particularly with yield per recruit parameters and the catch for 1990 (NAFO Sci. Coun. Rep. 1990, p. 70-73). To assist managers in evaluating the effects of a TAC overrun in 1990 on the stock, catch and yield projections were provided using two values for catch in 1990 - one equal to the TAC and the other roughly equal to the recent catch levels from the stock. For yellowtail, there is more difficulty in trying to quantify the levels of uncertainty, as no analytical assessment has been possible in recent years.

At present, the consequences of many of the uncertainties in the assessments are largely unknown. NAFO has stated that these fisheries will be impossible to manage if catches by non-member countries increase from the low levels observed in 1988-89 to the levels observed in 1985-86 (NAFO Sci. Coun. Rep. 1990, p. 71, 81). Perhaps the most immediate concern is the removal of large numbers of juveniles by some fleets in the Regulatory Area. However, the effects of these fisheries on yield per recruit, recruitment to the fisheries inside 200 miles, and future spawning stock size are not yet quantified. Until a longer time series of more complete data becomes available, it is likely that managers (and assessment biologists) will continue to experience problems with the transboundary flatfish stocks on the Grand Bank.

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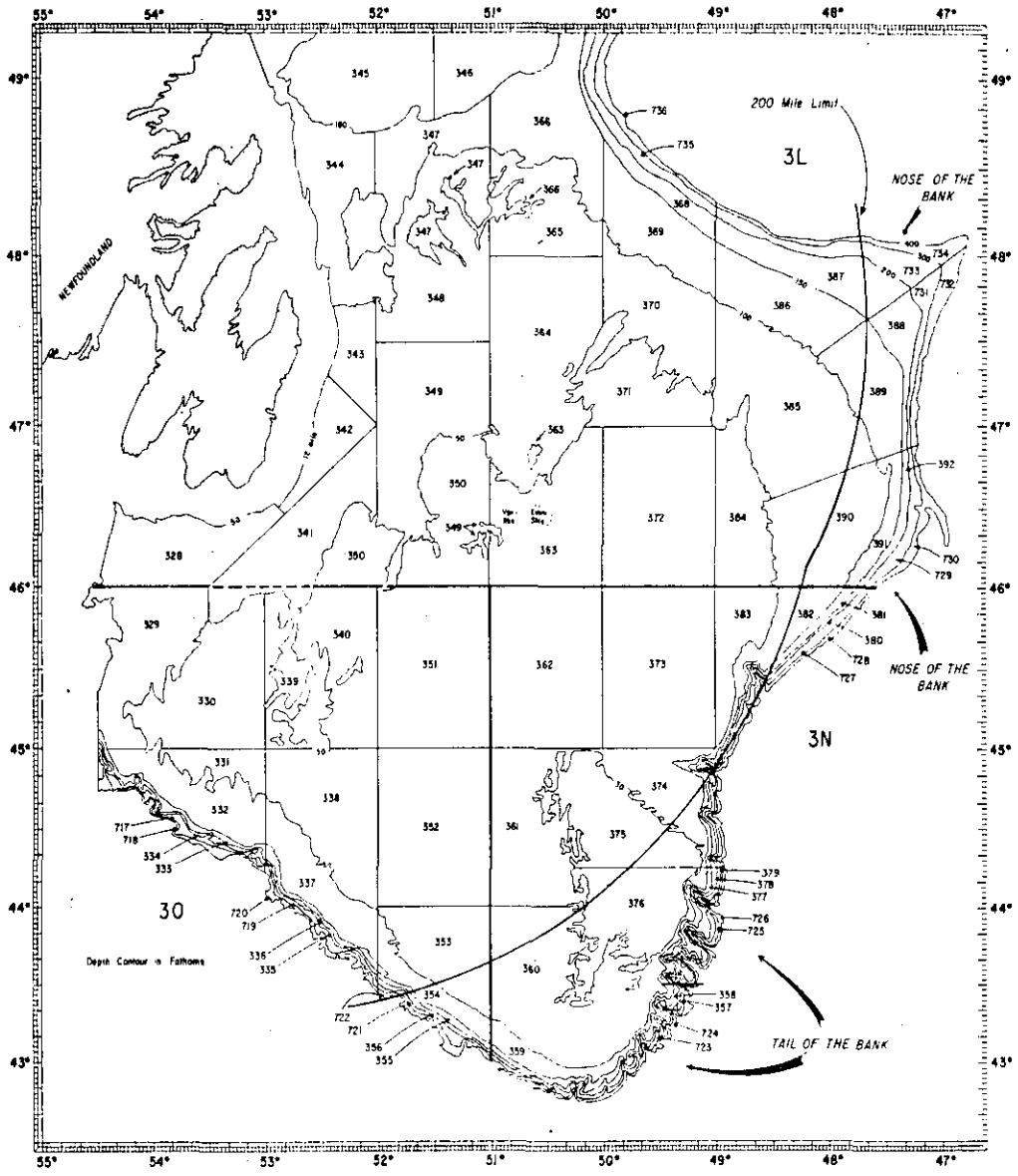

FIG.1. MAP OF THE GRAND BANK, NAFO DIV.3LNO, WITH THE CANADIAN 200-MILE LIMIT AND THE STRATIFICATION SCHEME USED IN CANADIAN RESEARCH VESSEL SURVEYS.

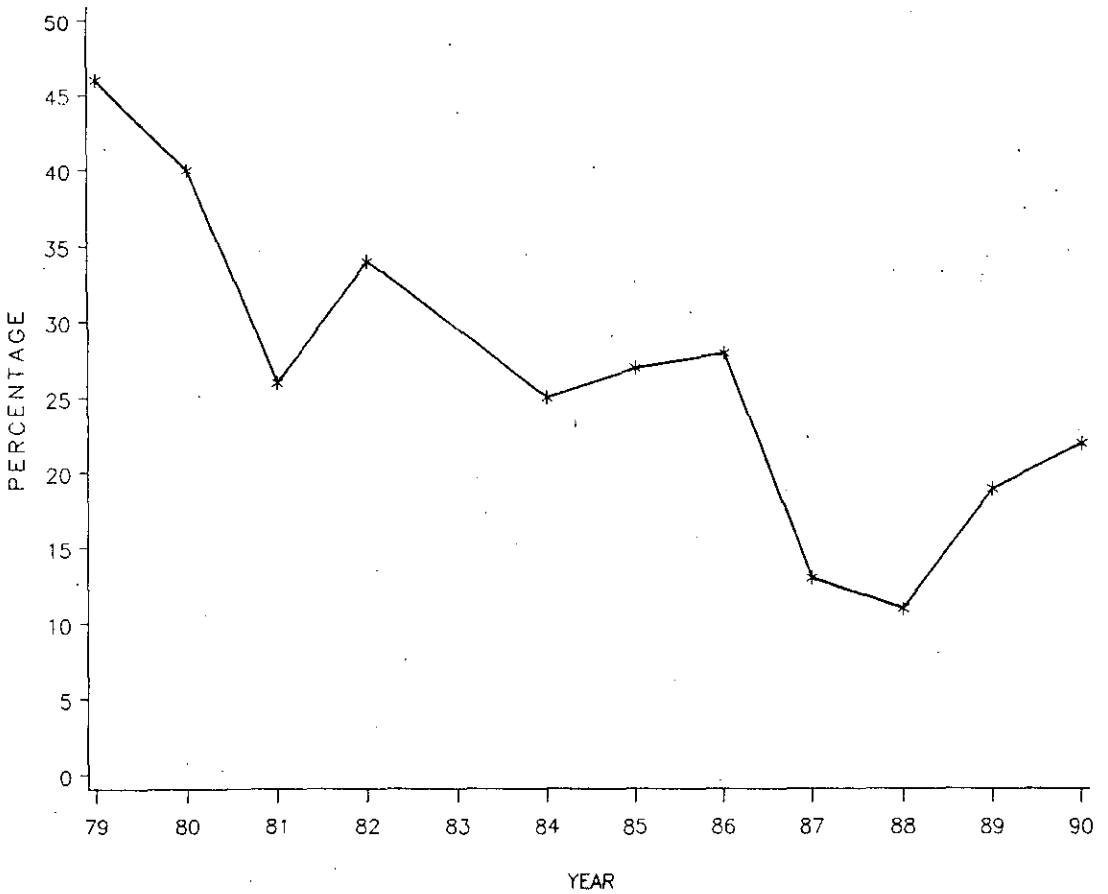

FIG.2. A.PLAICE IN DIV.3N, PERCENT OF BIOMASS OUTSIDE 200 MILES.

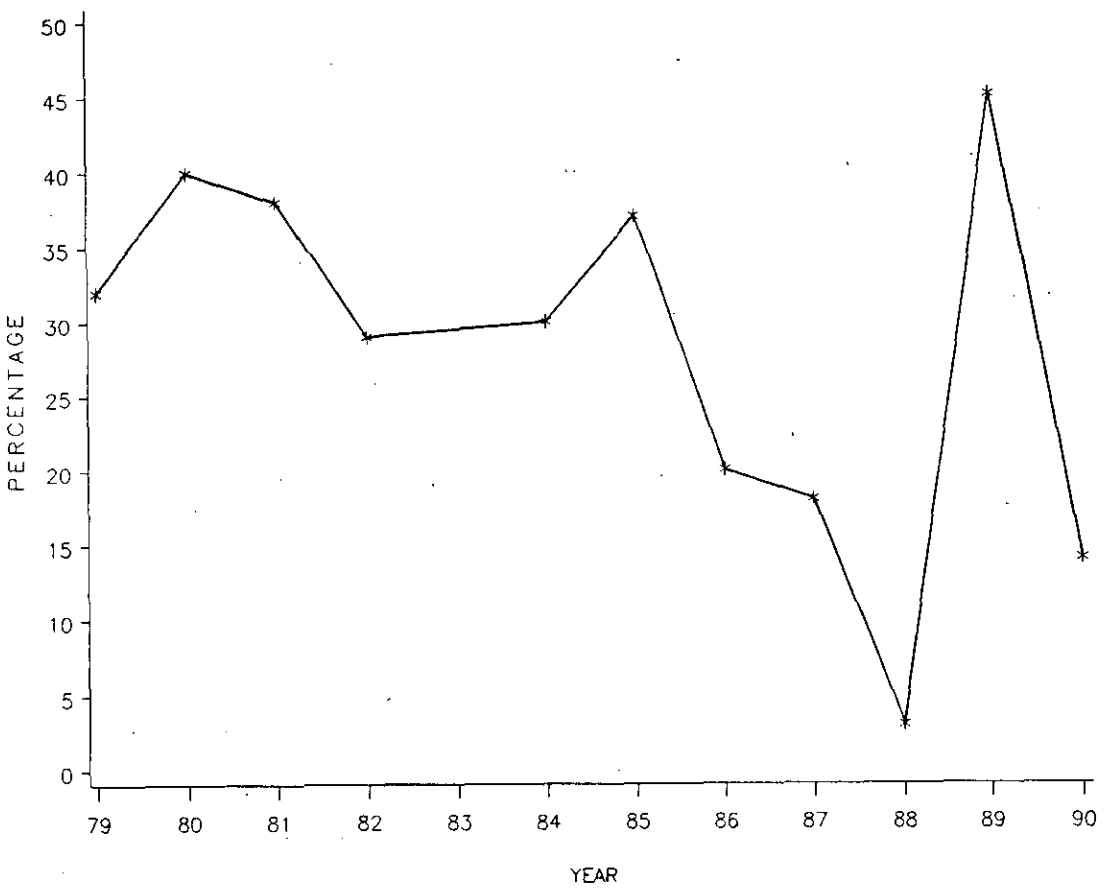

FIG.3. YELLOWTAIL IN DIV.3N, PERCENT OF BIOMASS OUTSIDE 200 MILES.

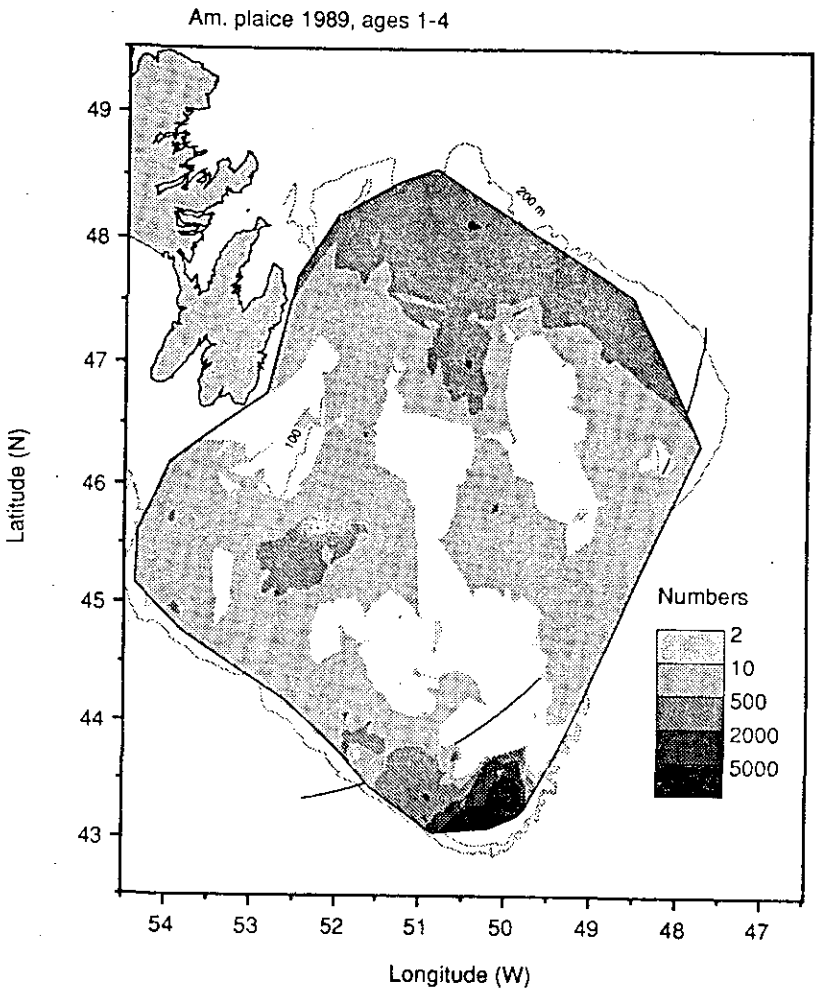

Fig. 4. Distribution of A. plaice aged 1-4 years from juvenile flatfish surveys in Div. 3LNO from 1986-89.

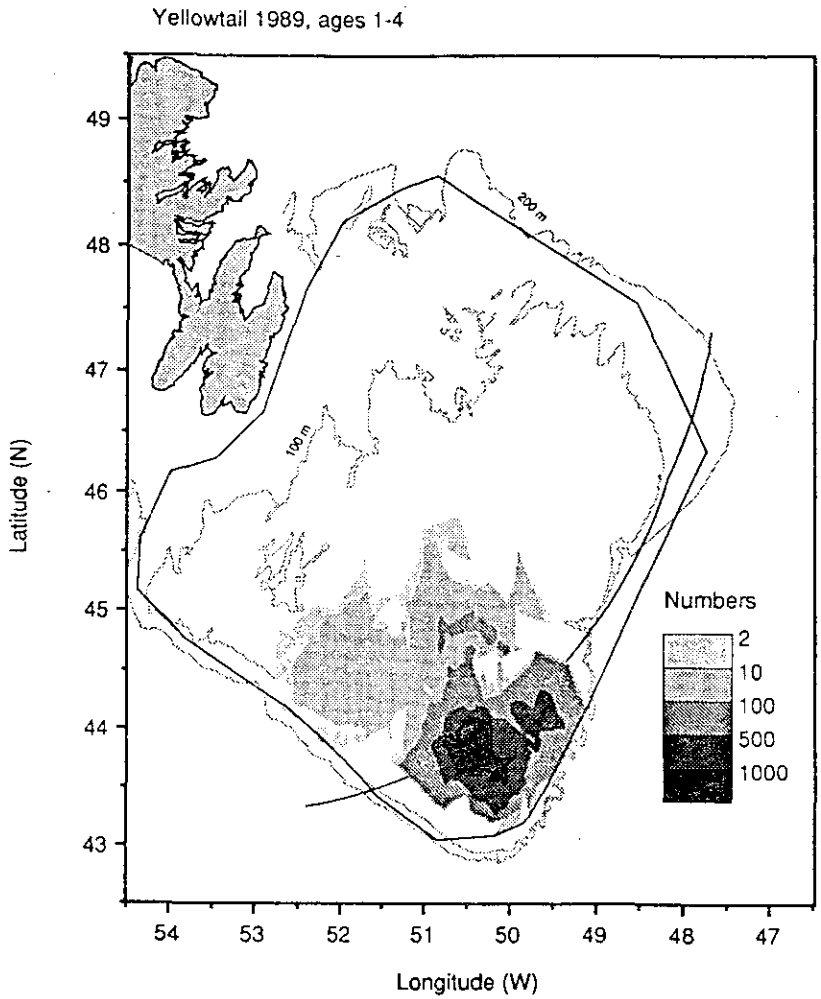

Fig. 5. Distribution of yellowtail aged 1-4 years from juvenile flatfish surveys in Div. 3LNO from 1986-89.

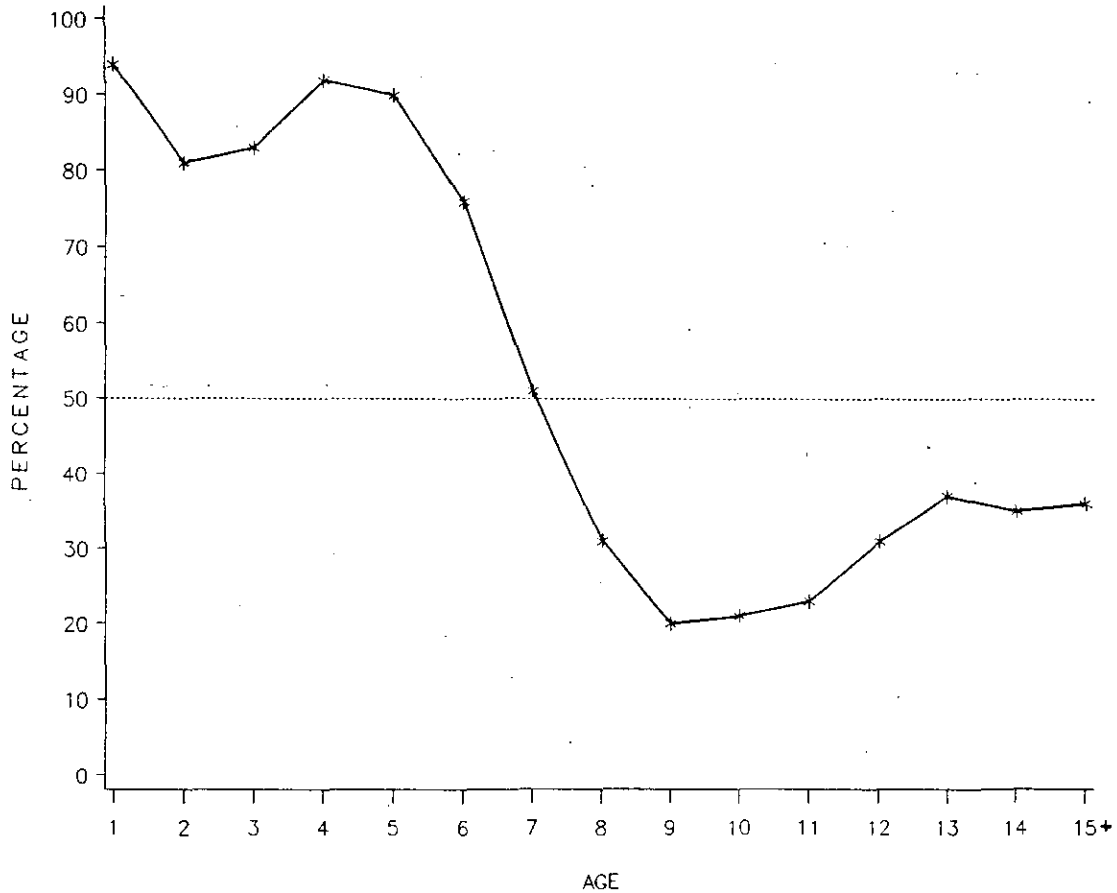

FIG.6. A.PLAICE IN DIV.3N, PERCENT AT AGE OUTSIDE 200 MILES.

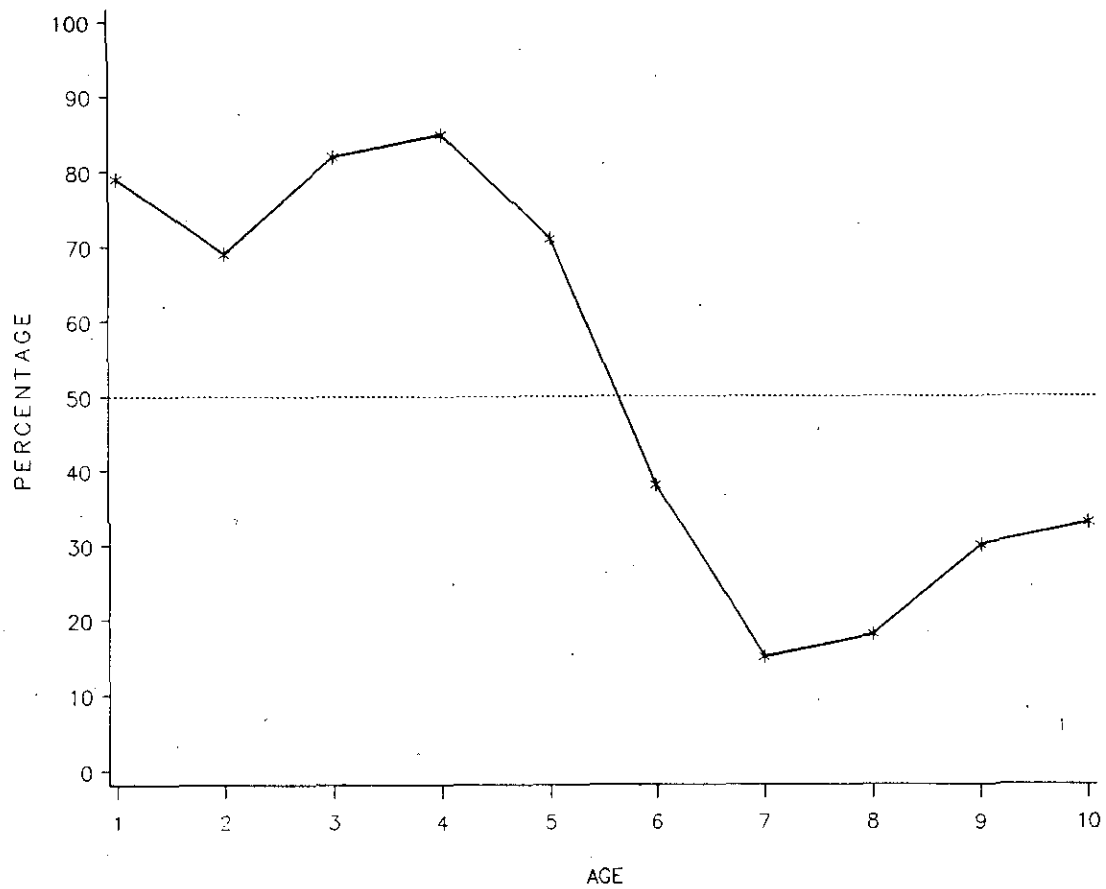

FIG.7. YELLOWTAIL IN DIV.3N, PERCENT AT AGE OUTSIDE 200 MILES.

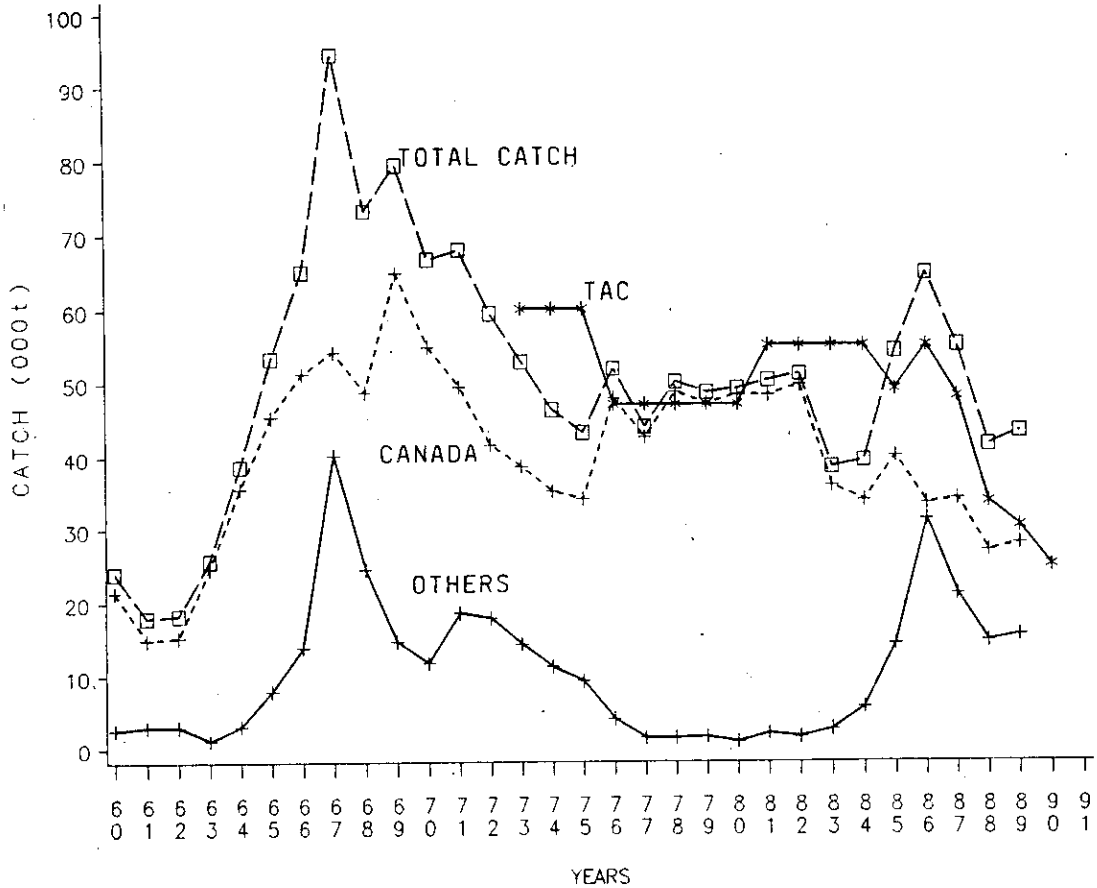

FIG.8. A.PLAICE CATCHES AND TACs IN DIV.3LNO.

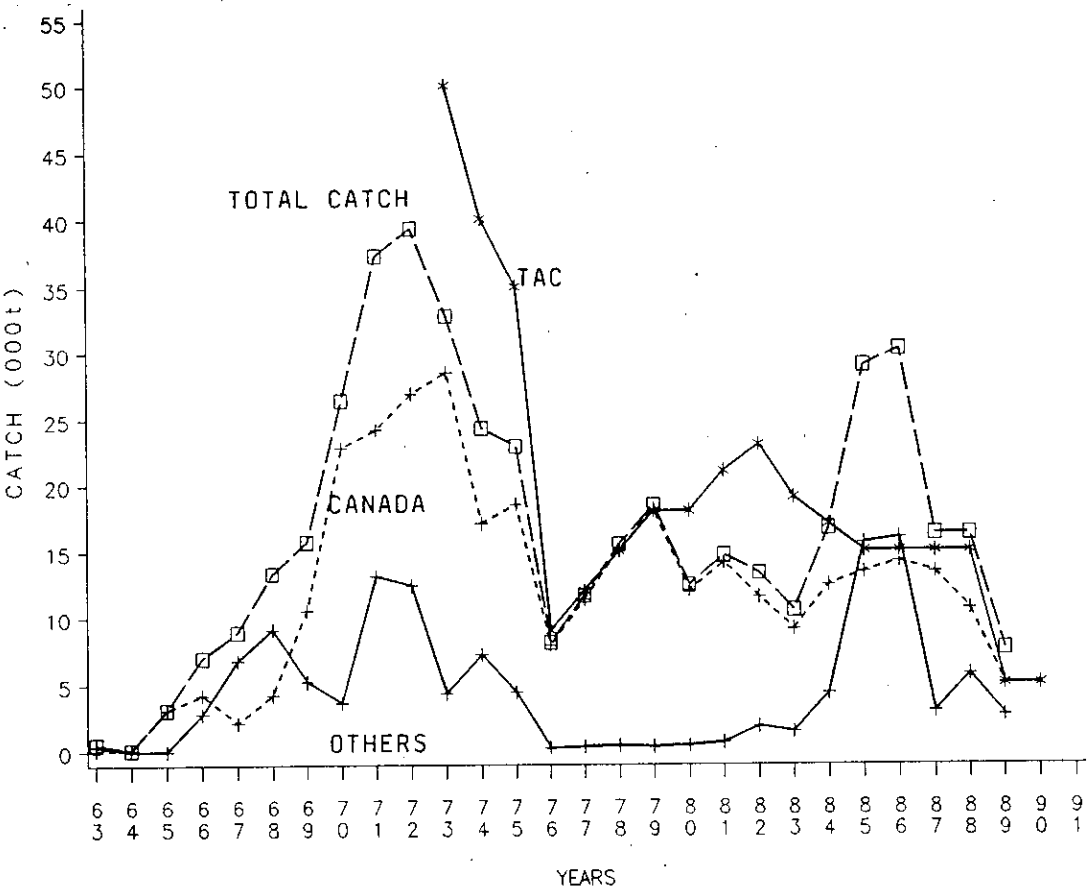

FIG.9. YELLOWTAIL CATCHES AND TACs IN DIV.3LNO.

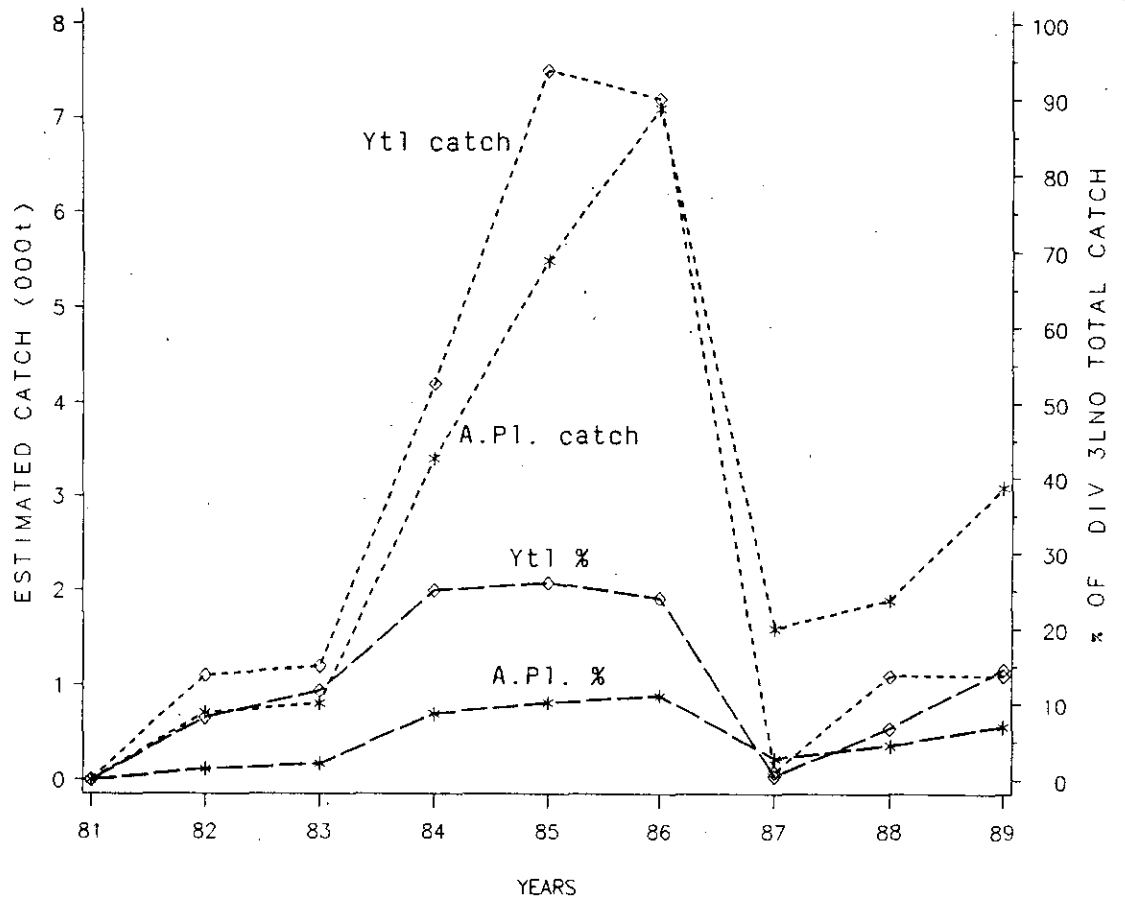

FIG.10. CATCHES OF A.PLAICE AND YTAIL IN DIV 3LNO WHICH ARE ESTIMATED.

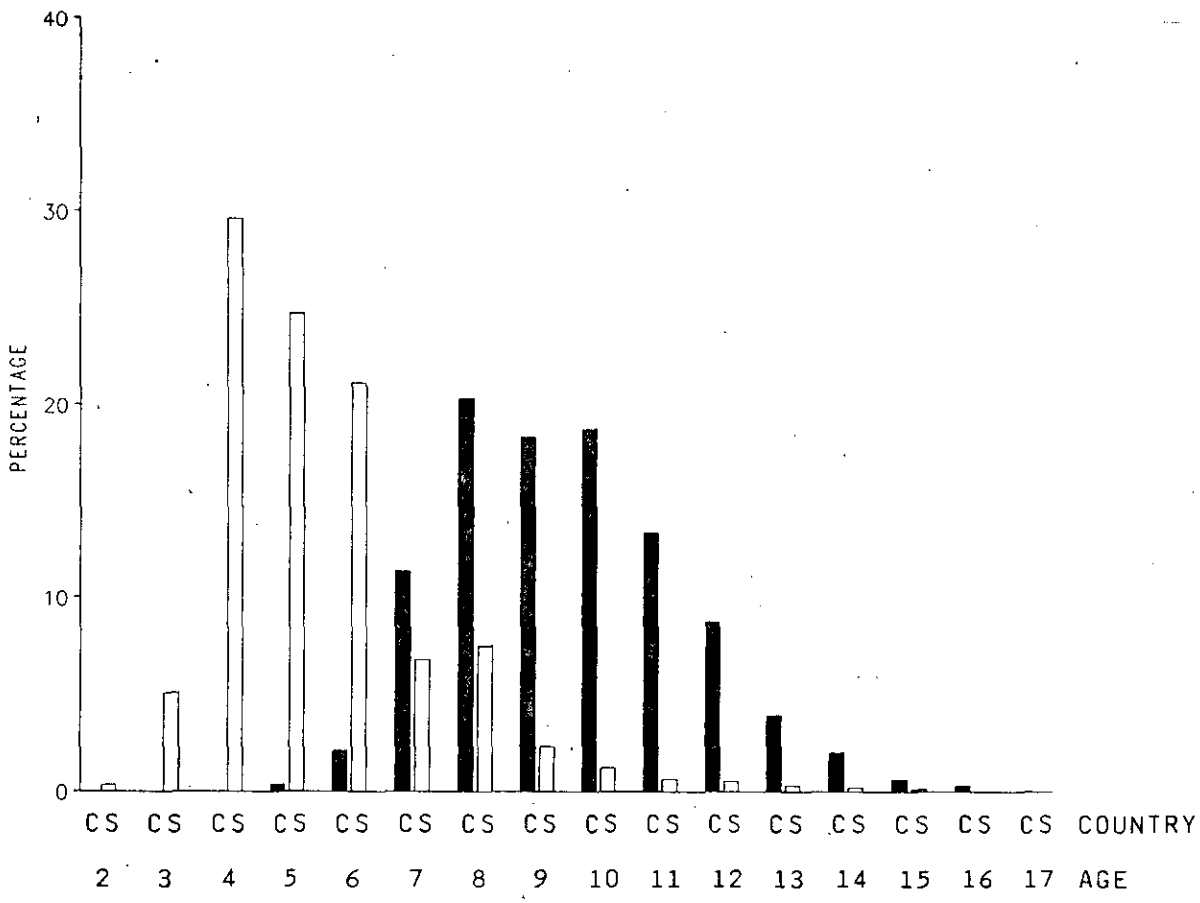

FIG. 11A. A.PLAICE CATCH AT AGE IN PERCENT BY SPAIN (S) AND CANADA (C) IN DIV. 3N IN 1989

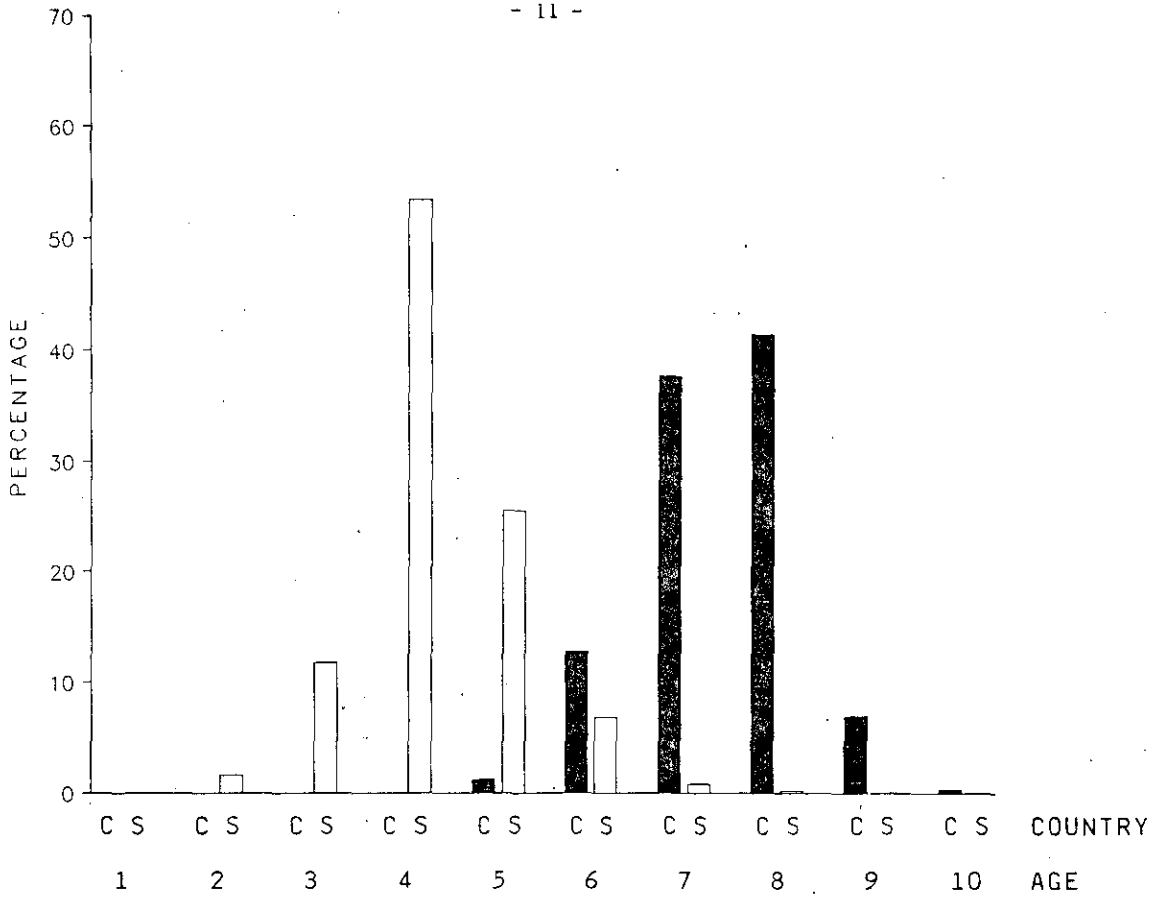

FIG. 11B. YELLOWTAIL CATCH AT AGE IN PERCENT BY SPAIN (S) AND CANADA (C) IN DIV. 3N IN 1989

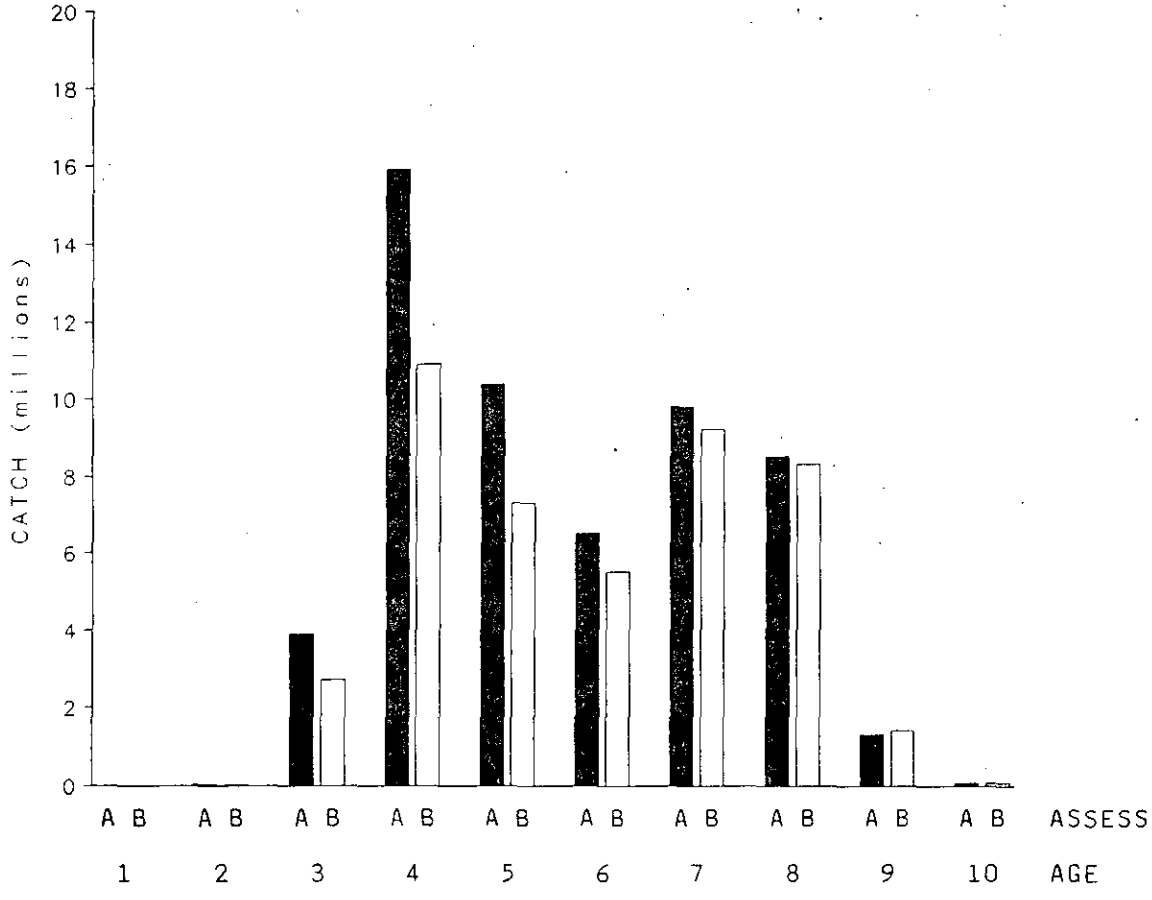

FIG. 12. YELLOWTAIL CATCH AT AGE IN DIV 3LNO FOR 1988 FROM THE 1989(B) AND 1990(A) ASSESSMENTS.

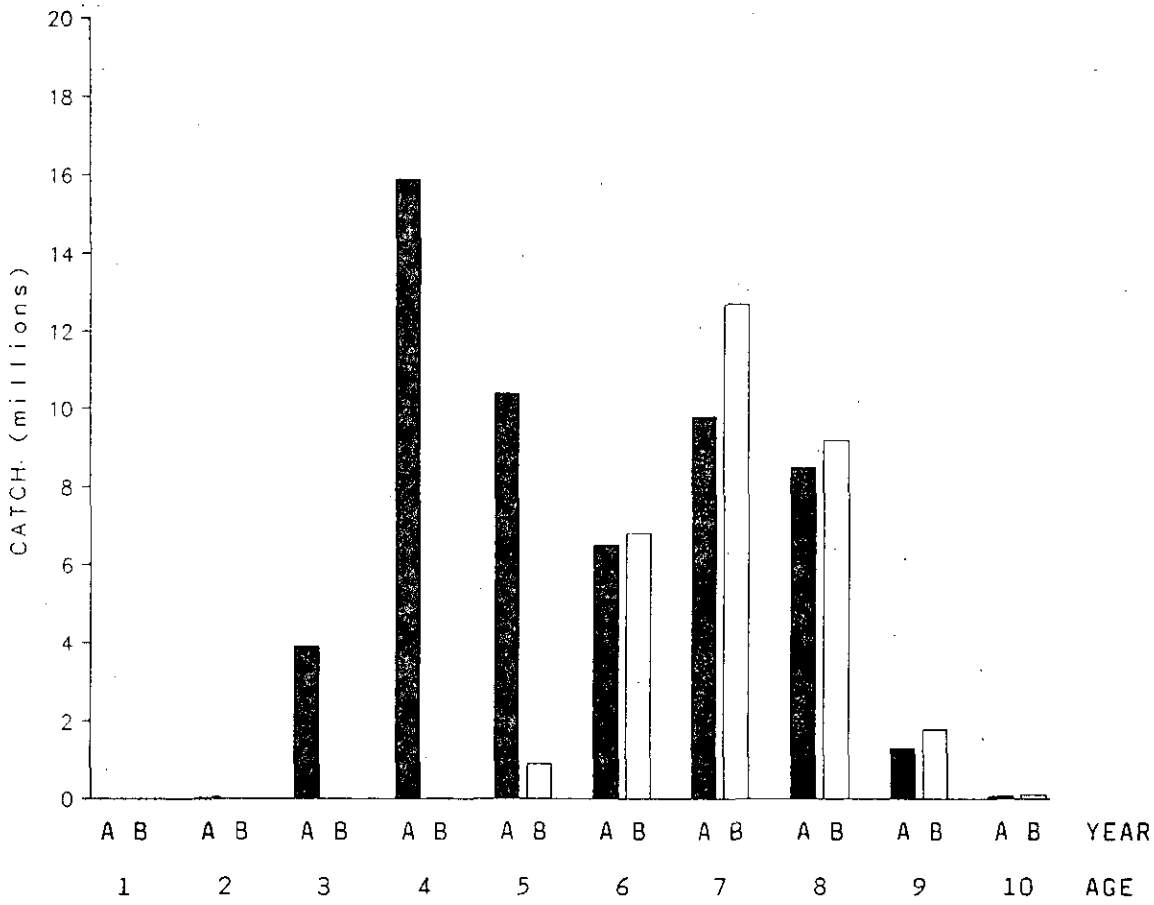

FIG. 13. YELLOWTAIL CATCH AT AGE IN DIV 3LNO FOR 1987(B) AND 1988(A) FROM THE 1990 ASSESSMENT.