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Assessment Status of Yellowtail Flounder (*Limanda ferruginea*) Stocks Off the Northeast United States, 1983

by

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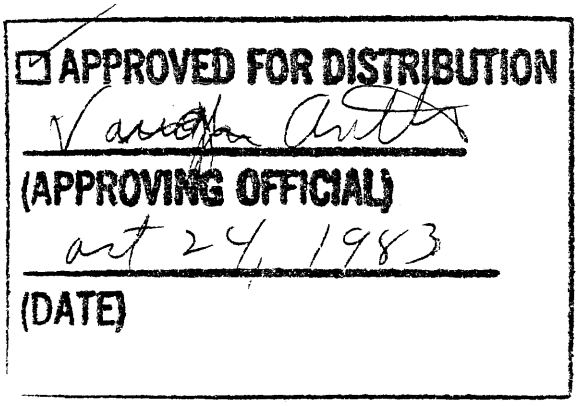

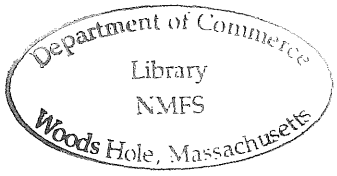

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SUMMARY

Nominal catches (landings) of yellowtail flounder have fluctuated considerably. In the last two decades, landings peaked at 57,500 metric tons (MT) in 1969 and subsequently declined steadily to 11,300 tons in 1978. Landings have since increased steadily to approximately 25,000 MT in 1982, and landings through June of 1983 substantially exceed corresponding levels for 1981 and 1982. The upward trend has been most evident for the southern New England fishery, although landings for Georges Bank have also increased considerably.

Increased landings for 1982 appear attributable to improved recruitment (primarily from the 1980 year class) which dominated southern New England and Georges Bank landings and to removal of quotas under the Interim Management Plan for Atlantic Groundfish (effective March 31, 1982). Biweekly landings totals indicate that 1981 and 1982 landings were equal through mid-April, but subsequent 1982 landings significantly exceeded corresponding totals for 1981, suggesting that relaxation of quota management under provisions of the Interim Plan was a factor influencing the observed increase.

All data sources point to a marked increase in abundance and recruitment for southern New England. Total landings in 1982 more than double the 1981 value. The 1982 catch per unit effort (CPUE), estimate fo 3.6 MT/day fished is the highest observed since 1968. Northeast Fisheries Center (NEFC) research vessel survey indices for 1982 were the highest since the early 1970's. Results of cooperative surveys and industry sources also suggest a substantial improvement in recruitment and biomass in recent years. Commercial and research vessel survey catch-at-age data indicate that the 1982 fishery was supported primarily by the 1979 and 1980 year classes. Discard levels appear to have increased substantially in 1982, particularly in southern New England. Reported trip discard rates ranged from 25-80% (by weight). Instantaneous total mortality (Z) estimates derived from NEFC survey data indicate that fishing mortality (F) has exceeded levels providing maximum yield per recruit (F_{max}) in recent years.

Commercial catch-effort data also suggest some increase in abundance for Georges Bank, although improvement appears to have been more moderate than for southern New England and the supporting evidence is less consistent. Total 1982 landings in this area increased 66% over 1981 while CPUE increased by 38%. Research survey indices show little if any improvement in abundance and/or biomass for 1982. Commercial data indicate that the 1979 and 1980 year classes were also dominant in this fishery. Reported trip discard rates for Georges Bank ranged from 0-30% (by weight). Again, NEFC survey data suggest that F has exceeded F_{max} in recent years.

Landings for the Cape Cod grounds have declined somewhat since 1980, but remained above the 1960-1980 average during 1981 and 1982. Survey indices for Cape Cod have fluctuated without a definite trend, although recent (1982-1983) spring indices are among the highest observed in the time series. Massachusetts inshore survey indices generally reflect a more constant level of abundance; commercial catch per unit effort indices have also remained constant in recent years.

Landings in the Mid-Atlantic have decreased since the early 1970's and 1982 landings declined 50% from 1981 levels. However, NEFC survey indices have increased in recent years. Survey catch-at-age data indicate that the 1979 and 1980 year classes are again dominant in the population. Abundance appears to have increased in this area, but is is not reflected in 1982 landings. Gulf of Maine landings have been relatively constant since 1980.

INTRODUCTION

The yellowtail flounder (Limanda ferruginea) represents an important component of the New England groundfish resource. In the last two decades, nominal catch (live weight equivalent of landings exclusive of discard, hereafter referred to as 'landings') has fluctuated considerably, peaking at 57,500 metric tons (MT) in 1969 (the peak year of exploitation by distant-water fleets) before declining to only 11,300 MT in 1978 (Table 1). Since that year, landings increased to an annual average of 16,600 MT for 1979-1981; the preliminary 1982 total is 24,900 MT (Table 1).

Yellowtail flounder concentrate primarily on three fishing grounds along the east coast of the USA: southern New England, Georges Bank, and east and north of Cape Cod (Figure 1). Since 1960, approximately 80% of total landings have come from the southern New England and Georges Bank grounds. Yellowtail have also been fished in the Mid-Atlantic and Gulf of Maine areas (Figure 1), although landings from these areas have been minor in recent years. Definitions of yellowtail flounder fishing grounds in terms of USA statistical areas for reporting purposes are given in Figure 2.

Two yellowtail management units have been recognized; the Georges Bank (east of 69° longitude) unit and a second unit which includes the Cape Cod, southern New England, and Mid-Atlantic groups (west of 69° longitude). The Gulf of Maine area is bisected by the division line, and was managed as part of both units, with the major portion of its landings coming from the areas west of 69°W, i.e., statistical area 513 (Figure 2). Some intermixing of stocks among these grounds has been documented (Royce et al. 1959; Lux 1963) and appears seasonal in nature, but the extent to which this occurs is underdetermined.

This document presents an update of Northeast Fisheries Center (NEFC), Woods Hole Laboratory Reference Number 81-10, Yellowtail Flounder Stock Status, 1981 (Clark et al. MS 1981). It provides an assessment of the current status of yellowtail flounder on the southern New England, Georges Bank, Cape Cod, Mid-Atlantic, and Gulf of Maine fishing grounds. The assessment is based on analysis of commercial landings and interview data, Northeast Fisheries Center (NEFC) and Massachusetts Division of Marine Fisheries (DMF) survey results, and results of co-operative surveys on the southern New England grounds. The assessment primarily examines 1981 and 1982 trends in the fishery; available 1983 bottom trawl survey and commercial data are also considered.

MANAGEMENT

The New England yellowtail flounder fishery was managed by the International Commission for the Northwest Atlantic Fisheries (ICNAF) from 1971 through 1976. It was then managed by the New England Fishery Management Council (NEFMC) under the Fishery Management Plan (FMP) for Atlantic Groundfish (as amended) from March 15, 1977, until March 30, 1982. Management was by calendar year until October, 1978, and subsequently by fishing year (October 1-September 30) until early 1982. Management provisions of the FMP included the establishment of optimum yield (OY) levels, minimum codend mesh size regulations, trip limits, spawning area closures and data reporting requirements. Optimum yield levels for both of the yellowtail management units (east and west of 69° longitude) were set at 5,000 MT each for 1980 and 1981. A summary of calendar and fishing year OY's implemented under the FMP during 1977-1981 is given in Clark et al. (MS 1981).

Attempts to restrict harvest to these OY levels in New England's mixed groundfish fishery led to a complex series of regulations which were reportedly ignored or circumvented by harvesters in many cases, which seriously impaired the reliability of the commercial data base. In response to these and other problems, the NEFMC decided to develop a new management plan, the Atlantic Demersal Finfish Plan (ADF) for the cod-haddock-yellowtail groundfish complex (NEFMC 1981), which would better address mixed species management problems encountered in New England groundfish fisheries. To allow time to develop, the ADF, the NEFMC developed the Interim Plan which was implemented on March 31, 1982.

The Interim Plan redefined OY as the amount of cod, haddock, and yellowtail flounder actually harvested by USA fisheries in accordance with other plan

provisions, which include mesh regulations by area, a minimum possession size of 28 cm (11 inches) for yellowtail and 43 cm (17 inches) for cod and haddock, and a voluntary data reporting system. A large mesh area was established, including shoreward portions of the Gulf of Maine west of Penobscot Bay and Georges Bank (Figure 1), where vessels employing trawl gear were required to use codend with stretched mesh sizes measuring at least 130 mm (5 1/8 inches) during the first year of the Interim Plan and 140 mm (5 1/2 inches) one year after initial implementation; thus the fishery is currently subject to the 140 mm regulation.

Under the Interim Plan's Optional Settlement Program, the NMFS Regional Director may sanction legitimate small mesh fisheries within the large mesh area. Of these fisheries, those for silver hake, red hake, and dogfish could affect yellowtail, although such impacts do not appear to be significant at present. Of the 3,710 current groundfish permit holders, 159 (4.3%) have been licensed to participate in the Optional Settlement Program.[1] Of greater concern is the fact that the large mesh area delineated in the Interim Plan does not encompass a substantial portion of the southern New England fishing grounds (Figure 1). Directed effort with small mesh gear in this area or failure to adhere to regulations within the large mesh area could result in significant mortality on small yellowtail.

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[1]Peter D. Colosi, NMFS, Gloucester, MA, personal communication, 7/19/83.

COMMERCIAL FISHERY

Recent commercial fishery trends are herein evaluated primarily from commercial weighout and interview data, biological sampling of commercial landings, and information collected in special industry surveys during the summer and autumn of 1982. Domestic and foreign landings and discard estimates prior to 1981 are as reported by Clark et al. (1981), based on commercial interview data and results of intermittent sea sampling programs (Brown and Hennemuth MS 1971). Landings and discard data from 1979 through the first quarter of 1982 are not considered reliable due to alleged misreporting (or non-reporting) to circumvent landings restrictions imposed under the FMP.

Preliminary estimates of combined 1982 landings for all areas (east and west of 69°W) showed a marked increase compared to 1981. Plots of biweekly landings totals from NEFC quota reports (Figure 3) indicate that 1981 and 1982 landings were equal through mid-April, after which 1982 landings substantially exceeded those for 1981. This suggest that the relaxation of quota restrictions under the Interim Plan was a significant factor contributing to the observed 1982 increase. Preliminary 1983 landings (January-June) also reflect a substantial increase over the 1981-1982 levels for this period (Figure 3).

Industrial catches have been taken almost exclusively off southern New England and were applicable only in the mid-to-late 1960's; landings for Calendar Years 1981 and 1982 have not been significant. Reported foreign landings have generally been minor, with the exception of 1969 when 20,700 MT were landed. Reported Canadian landings for 1981 and 1982 totalled less than 100 MT (Table 1). Recreational catches of yellowtail appear to be consistently negligible; only 15 MT were reported in 1979, and no catches were reported in recreational surveys conducted during 1960's and 1970's (Clark et al. 1981).

Commercial catch per unit effort (CPUE) indices for 1981 were calculated for domestic trawlers using trip data for vessels of 50-104 GT for which at least 50% of the total catch consisted of yellowtail flounder (Lux 1964). These calculations involved standardization of fishing effort by applying fishing power coefficients (originally obtained by Lux) to summarized effort data (days fished) by vessel class using 26-50 GT vessels as standard. Adjusted effort data were then summarized over vessel classes and divided into food landings and discard data (MT) for these vessel classes to obtain values (MT/day fished, Table 2, Figure 4).

Age compositions for southern New England and Georges Bank yellowtail landings for 1962-1982 were estimated using USA reported landings, length frequencies and age samples derived from biological sampling at dockside by NMFS port agents. Age-length keys were prepared for each quarter and applied to corresponding length frequency expansions. Results were summarized by year to provide annual age compositions which are reported in terms of percent landed at age (Tables 3 and 4).

Discard estimates for 1981-1982 (Table 1) were extracted from Northeast Fisheries Center (NEFC) spring and autumn bottom trawl survey length frequencies assuming a minumum retention length of 29 cm and an average cull length of 32 cm, as reflected by 1981-1982 commercial length samples. The 29 cm minimum retention length represents the mean selection length for 130 mm (5.1 inch) mesh size trawls based on selectivity data provided by Mayo et al. (MS 1981). Results of these analyses are summarized by area in the following sections.

Southern New England

Distinct peaks in total catch (landings plus discard) are evident for the southern New England fishery in the 1940's and 1960's (Figure 5). Landings

declined more or less continually from 1969 through 1976, but have since gradually increased (Table 1). The preliminary 1982 landings value of 10,300 MT is the highest observed since 1970 and exceeds the 1981 figure of 4,900 MT by 110% (Table 1). The southern New England CPUE index has increased since the mid-1970's (Figure 4). The 1982 value (3.6 MT/day fished) is the highest observed since the late 1960's (Table 2).

Age compositions, derived from biological sampling of southern New England landings, indicate that during 1981,the fishery was primarily supported by the 1978 year class (47% by number), with the 1977 and 1979 year classes represented equally at 22% (Table 3). Biological sampling of 1982 landings,as well as reports from industry,suggest strong recruitment from the 1980 year class, which comprised 54% of the total number landed. This represents a substantially higher percentage of age 2 fish compared to all other years except 1978. The 1979 year class accounted for 39% of the 1982 total (Table 3).

Estimated 1982 discard rates for southern New England ranged from 15-42% (by weight) of the total quantity landed; industry sources reported even higher rates ranging from 25-80%. This suggests that 1982 discard for this area was under-estimated, although the special industry surveys which provided this information were conducted during the third quarter of 1982 when highest discard rates would be anticipated.

Georges Bank

Total catches on Georges Bank peaked at over 20,000 MT in 1969-1970, and then subsequently declined to approximately 5,000 tons in 1978 (Figure 5). Landings increased gradually during 1979-1981 and then more sharply in 1982; reported 1982 landings (10,600 MT) were up 66% over the 1981 value of 6,400 MT (Table 1). The 1982 CPUE index for Georges Bank (2.2 MT/day fished)

increased over 40% from 1981, but remains comparable to the relatively low values observed during the early 1970's (Table 2). Industry sources however, were generally of the opinion that abundance on Georges Bank in 1982 was comparable to or less than 1981 levels.

Age compositions derived from biological sampling of commercial landings in 1981 indicated a predominance of the 1978 (48% by numbers) and 1977 (42%) year classes (Table 4). The age structure of the 1982 landings from Georges Bank was similar to southern New England in that the 1980 year class recruited strongly and dominated landings by number (53%), while the 1979 year class was of secondary importance (29%). Thus, the Georges Bank fishery also experienced improved recruitment in 1982.

Estimated discard rates were not as high as for southern New England, ranging from 8-32% (industry sources reported rates which ranged from 0-30%). The difference in reported discard rates between these two areas (both of which appear to have experienced relatively strong recruitment in 1982) may result,at least in part,from different mesh regulations under the Interim Plan as noted above, i.e., all of Georges Bank lies within the large mesh area, whereas a substantial portion of southern New England does not.

Cape Cod and the Gulf of Maine

Landings for the Cape Cod and Gulf of Maine areas increased during the 1970's; landings from the Cape Cod grounds declined in 1981 from 1980, but remained above the 1960-1980 average (Table 1). Preliminary landings data for 1982 showed no appreciable change from 1981. Landings for the Gulf of Maine have been relatively constant since 1980. The CPUE index for Cape Cod have been stable at around 1.8 MT/day fished since 1979, a level which is below the long-term (1960-1981) average of 2.3 MT/day fished (Table 2).

Biological sampling has been inadequate in recent years for monitoring trends in age composition. Estimated discard for Cape Cod in 1982 was below levels estimated for 1979-1981 (Table 1).

Mid-Atlantic

Recent Mid-Atlantic landings have been quite low relative to peak levels of the early 1970's although landings increased from 300 MT in 1980 to 700 MT in 1981. Preliminary 1982 landings of 400 MT represented a 43% decrease from 1981 and were well below the 2,710 MT long-term (1964-1981) average (Table 1).

RESEARCH VESSEL SURVEYS

The Northeast Fisheries Center (NEFC) has conducted a stratified random bottom trawl survey in offshore waters (>27 m) in autumn from Hudson Canyon to the Scotian Shelf since 1963; the Mid-Atlantic area was added in 1967 (Figure 6). A spring survey covering this area was initiated in 1968, and a summer survey has also been run intermittently (1963-1965, 1969, and 1977-1981). Similar surveys have also been conducted in inshore areas (<27 m) since 1972 (Figure 7).

The R/V Albatross IV, the Delaware II and the Atlantic Twin have been used in these surveys. A "36 Yankee" trawl equipped with 41 cm (16 inch) rollers has been used in all autumn surveys and in all spring surveys except during 1973-1981 when a modified high opening "41 Yankee" trawl equipped with 30-46 cm (12-18 inch) rollers was used. Both trawls are equipped with 1.25 cm (0.5 inch) codend liners. Further information on survey design and procedures is provided by Grosslein (1969) and Azarovitz (1981).

Indices of abundance and biomass (stratified mean catch-per-tow in numbers and weight) have been calculated for southern New England (Tables 5

and 6, Figure 8), Georges Bank (Tables 7 and 8, Figure 8), Cape Cod (Tables 9 and 10), and the Mid-Atlantic (Tables 11 and 12) regions. It should be noted that spatial and/or temporal coverage in NEFC inshore and summer surveys has been sporadic, and yellowtail catches in these surveys have often been negligible or display widely fluctuating patterns which are difficult to interpret. Consequently, inshore survey indices have not been derived for all area/season combinations represented in the NEFC survey data base.

The Massachusetts Division of Marine Fisheries (DMF) has conducted a stratified random bottom trawl survey during spring and autumn since 1978 to monitor relative abundance of fish stocks in Massachusetts territorial waters. These surveys have been conducted using a 3/4-sized "North Atlantic" trawl equipped with 0.64 cm (0.25 inch) mesh codend liner and a chain sweep fitted with 7.6 cm (3 inch) rubber discs. Sampling strata have been arranged into five regions (Figure 9). Areal coverage, sampling procedures and other information including catch-per-tow data for 1978-1980 are given in annual completion reports (Howe et al. MS 1979, MS 1980, MS 1981) and preliminary data are available for 1981 and 1982.[2] Yellowtail catches in these surveys have generally been minor in Regions 1 and 2 (representing the southern New England grounds) but have been much higher in Regions 3-5 (representing the Cape Cod Grounds, Figure 9). Accordingly, indices of relative abundance have been developed for Cape Cod yellowtail using Massachusetts DMF survey data for Regions 3-5 (Table 13). Information from all of the above surveys is summarized by area in the following sections.

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[2]Arnold B. Howe, DMF, Sandwich, MA, personal communication, June 1983.

Southern New England

The late 1960's marked the beginning of a pronounced decline in survey abundance and biomass indices for southern New England yellowtail flounder which continued to very low levels in the mid-1970's. Improvement has been evident in recent years however (Table 5, Figure 8). The offshore spring biomass index rose from 2.2 kg in 1979 to 10.4 kg in 1982; autumn indices increased from 2.0 kg in 1980 to 8.1 kg in 1982. Abundance indices for both surveys more than tripled during the same period. Survey index values for 1982 were substantially above those observed during the mid-1970's but remain below the peak levels observed in the mid-to-late 1960's.

Stratified mean catch-per-tow-at-age values for 1981-1982 show the 1979 and 1980 year classes to be the strongest in recent years (Table 6), with the 1980 year class the stronger of the two. Pre-recruit indices (stratified mean number per tow of age 1 yellowtail caught in autumn surveys) have been rather low since the early 1970's, although the 1981 value (3.2) increased substantially over the 1979-1980 average of 1.6 (Table 6, Figure 10). The 1980 year class is comparable at age 2 to many of the strong year classes appearing in the mid-1960's (Table 6). The recent increase in numbers and biomass for the southern New England population is therefore attributable primarily to strong recruitment from the 1980 year class. This trend is reflected in increased landings in 1982 (Table 1, Figure 5), reports from industry of improved abundance, and the large percentage (54%) of age 2 yellowtail in the 1982 landings (Table 3). The 1980 year class appears to dominate the southern New England population in 1983 as evidenced by the large proportion of 30-36 cm (presumably age 3) fish in the spring 1983 survey length frequencies (Figure 11). The 1982 pre-recruit index value

(2.18) was also substantially higher than the 1979-1980 average, suggesting that the 1981 year class may also be stronger than those produced in the late 1970's.

Estimates of instantaneous total mortality (Z) for recent years were obtained for both spring and autumn by pooling survey catch-per-tow-at-age data (Table 6) over fully recruited age groups (age 3+) e.g.,

$$Z = \ln\left(\frac{\Sigma \text{ age } 3+ \text{ } 1978\text{-}1981}{\Sigma \text{ age } 4+ \text{ } 1979\text{-}1982}\right)$$

Resulting estimates of Z were 0.70 for spring and 0.88 for autumn. Assuming that instantaneous natural morality (M)=0.2 for yellowtail (Lux 1969), then instantaneous fishing mortality (F) averaged 0.50 and 0.68 respectively, at or above F_{max} (=0.5) (Sissenwine et al. 1978). Apparently, high mortality has been the general rule for southern New England yellowtail over the last two decades. Lux (1969) reported that Z averaged 1.02 during 1960-1965 based on analysis of commercial catch-effort data, while Penttila and Brown (1973) obtained an estimate of Z = 1.25 from analysis of research vessel survey data from 1963-1969.

Georges Bank

Spring and autumn survey indices of abundance and biomass declined throughout the 1970's (Table 7 and 8, Figure 8). Both spring and autumn indices increased substantially in 1980, a result which appears attributable at least in part to changes in availability as noted by Clark et al. (MS 1981). Subsequent data have been conflicting; the spring 1980-1983 data suggest increases in abundance and biomass compared to the late 1970's, but autumn data indicate little, or no, improvement (Table 7). Survey indices for 1981-1982 remain substantially below values observed in the late 1960's and early 1970's. Stratified mean catch-per-tow-at-age data again suggest that

the 1979 and 1980 year classes are dominant in the current population (Table 8), with the 1980 year class again being stronger.

Pre-recruit indices for Georges Bank are consistent with southern New England in indicating some improvement since 1980 (based on the 1980 year class), and in suggesting some potential for further increase (from the 1981 year class) (Table 8, Figure 10). Spring survey length frequencies in 1983 also indicate a substantial proportion of <30 cm yellowtail, which are probably age 2 (1981 year class) fish (Figure 11).

Mortality rates for Georges Bank appear to have been relatively high in recent years. Estimates for Z of 1.05 and 1.33 were obtained from spring and autumn survey data for 1978-1982. This implies that F substantially exceeded F_{max} during this period. The above estimates exceed values of Z = 1.02 and 1.00 obtained by Lux (1969) and Penttila and Brown (1973), respectively.

Cape Cod

No clear, consistent historical trends are evident for the Cape Cod area from survey data (Tables 9 and 10). Indices of abundance and biomass from NEFC surveys have fluctuated considerably, although some improvement is evident compared to the mid-1970's (Table 9). The NEFC 1982 spring index values were the largest observed in the time series, whereas autumn indices increased in 1982 but remained slightly below the long-term average (Table 9). Stratified mean catch-per-tow-at-age values (Table 10) suggest that the 1978 and 1979 year classes dominated the Cape Cod population until autumn 1982 when the 1980 year class became apparent. Massachusetts survey indices have likewise fluctuated without a definite trend; survey catch-at-age data also show the 1978 and 1979 year classes to be relatively strong (Table 13). Spring 1983 NEFC survey length frequency data for Cape Cod indicate a more balanced age structure than for other areas (Figure 11).

Mid-Atlantic

Spring and autumn survey indices for the Mid-Atlantic area underwent dramatic decreases in the early to mid-1970's; abundance and biomass indices have increased markedly since 1979-1980. The spring survey biomass index declined from 29.4 kg in 1968 to only 0.6 kg in 1979, but subsequently increased to 9.9 kg in 1982. The autumn survey biomass index averaged 0.2 kg during 1977-1979, then increased to 2.4 kg in 1981. Indices subsequently declined somewhat but remained above levels observed in the mid-to-late 1970's. Similar trends are evident for inshore survey indices (Table 11). Stratified mean catch-per-tow-at-age data indicate that the 1979 and 1980 year classes are the strongest to appear since the mid-1970's (Table 12). Spring 1983 survey length frequencies are dominated by 1979 and 1980 year class fish with a secondary mode comprised of 1981 year class (22-29 cm) fish (Figure 11).

In summary, recent NEFC survey indices show substantial increases in abundance and biomass through 1982 for the southern New England and Mid-Atlantic areas. Age data suggest dominance of the 1979 and 1980 year classes. Georges Bank indices have not shown the same degree of improvement, although a relatively strong 1980 year class is again apparent. Some evidence of a recruiting 1981 year class is also apparent in the Georges Bank and Mid-Atlantic areas. Instantaneous fishing mortality rates for both southern New England and Georges Bank continue to exceed F_{max}.

COOPERATIVE SURVEYS

During January and February of 1980, 1981, and 1983, cooperative bottom-trawl surveys were conducted for yellowtail flounder on the southern New England grounds. These surveys were jointly sponsored by the Point Judith

Fishermen's Cooperative, the New Bedford Seafood Council, Inc., and NEFMC. The project was coordinated and staffed by the Rhode Island Division of Fish and Wildlife; NEFC provided technical assistance and participated in field sampling and data analysis.

The stern trawlers M/V FRIESLAND [87 ft total length (TL), 117 gross tons (GT)], M/V FORAGER (78 ft TL, 141 GT), and M/V SHIRLEY S. (72 ft TL, 98 GT) were used in the 1980, 1981, and 1983 surveys, respectively. Gear consisted of a 310x5 in Shuman bottom trawl with a wire sweep fitted with 5.1 cm (2 in) rubber discs, a 1.25 cm (0.5 in) codend liner and 2.13 m (7 ft) V-doors each weighing 544.31 kg (1200 lbs[3]) (Borden and Fogarty 1980). A stratified random sampling design was used, with the area encompassing the southern New England grounds divided into strata primarily on the basis of depth contours (Figure 12). Stations were allocated to strata roughly in proportion to area and randomly assigned to specific locations within strata. Tow duration at each station was 20 minutes at a speed of 3.0 knots. Further information concerning gear, sampling design, and related topics is given in Borden and Fogarty (MS 1980).

Stratified mean catch-per-tow of yellowtail flounder in numbers and weights (kg) from the Rhode Island coopearive surveys remained approximately constant in 1980-1981 and then increased sharply in 1983 (Table 14). Highest catches occurred consistently in inshore strata (1, 2, 4, and 5, Figure 12) at depths of 20-35 fathoms. Application of age-length keys constructed from cooperative survey and/or NEFC survey samples (e.g., samples obtained in NEFC winter bottom trawl surveys) to stratified mean catch-per-tow at length data reveals that (1) the 1979 and 1980 year classes were the strongest in recent

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[3]In 1983, 2.29 m (7.5 ft) V-door each weighing 635 kg (1400 lbs) were used.

years, and (2) the sharp increase in 1983 was primarily attributable to high survey catches of 1980 year class fish at age 3 (Table 15, Figure 13). The 1980 year class appears predominant at present (68% of the total catch by number of age 2 and older fish, Table 15, Figure 13). Subsequent year classes appear to be somewhat weaker (Table 15). These results are generally consistent with those from NEFC surveys indicating increased abundance and biomass in recent years. Total instantaneous mortality (Z) for age 3 and older fish was estimated at 0.75 annually for 1981-1983, again indicating that F has exceeded F_{max} in recent years.

DISCUSSION

Three major events have taken place in the yellowtail flounder fishery since the 1981 assessment: (1) the Interim Management Plan for Atlantic Groundfish was implemented, effectively eliminating quota management for yellowtail, (2) a strong 1980 year class was recruited to the fishery and apparently accounted for more than 50% of 1982 landings, and (3) 1982 landings rose dramatically showing a 60% increase over 1981 and were only slightly below the long-term average (28,090 MT). Events 1 and 2 have almost certainly influenced Event 3 in all fishing areas, although their relative impacts cannot be determined.

The positive effect of the 1980 year class was most evident on the southern New England grounds where 1982 landings rose 110% from those in 1981, with the 1980 year class contributing 54% (by number). Commercial and NEFC survey indices suggest substantial increases in abundance and biomass since the late 1970's, however current levels remain below those of the highly productive period during the 1960's. Cooperative survey data also corroborate the observed increase in abundance indicating a strong 1980 year class.

Instantaneous fishing mortality remains at or above F_{max}, thus impacting negatively upon yield per recruit and effecting a high dependence on recruiting year classes. Surveys of harvesters in 1982 consistently indicated improved abundance and increased numbers of recruiting yellowtail in 1982, as well as high discard rates ranging from 25-80% (by weight) in that area.

The high reported discard rates were unexpected given the minimum size restriction of 28 cm under the Interim Plan, which corresponds approximately to the 50% selection point for 130 mm mesh trawls (Mayo et al. MS 1980). While it is true that a substantial portion of the southern New England grounds is not included in the large mesh area, 1982 trip interview data indicate that almost all vessels used trawls with at least 130 mm mesh.

This high discard rate and its potential for effecting significant losses in yield per recruit is cause for concern. Commercial age composition data for 1982 (Table 3) coupled with high discard levels, suggest that for the 1982 southern New England fishery mean age at first capture (t_c) was about two years or less. Yield per recruit analyses employing the Beverton-Holt model indicate that at recent F levels of 0.6 or higher (see RESEARCH VESSEL SURVEYS and COOPERATIVE SURVEYS) yield is maximized at $t_c \geq 4$ years. Thus, the recent increase in minimum mesh size from 130 mm (5 1/8 inches) to 140 mm (5 1/2 inches) (implying an increase in t_c of from 2.3 to 2.6 years) is expected to be of some value; benefits would obviously be higher if this regulation were applicable to the entire southern New England grounds rather than to the large mesh area.

Data for the Georges Bank fishery are not as easily interpreted, but overall results suggest no substantial improvement in abundance over recent years. Landings in 1982 increased 66% over 1981, with evidence of the 1980 year class constituting 53% (by number). The 1982 CPUE index rose 38%

over 1981. However, NEFC survey data do not consistently support such improvements: the 1982 spring indices show only a modest increase, whereas the autumn indices declined further to low levels typical of the 1970's. Surveys of harvesters in 1982 suggested some recruitment from the 1980 year class, but were unclear whether or not abundance had actually increased. Thus, the extent to which either improved abundance or greater effort effected increased landings cannot be determined. Reported discard levels for Georges Bank ranged from 0-30% (by weight), and were not as high as for southern New England. This observation is consistent with the fact that all of Georges Bank is now subject to large mesh area regulation under the Interim Plan.

Preliminary 1983 (January-June) landings data from all areas indicated a continued increase over the same period in 1981-1982. NEFC 1983 spring survey biomass and abundance indices generally showed a decrease from the corresponding 1982 values. Length frequency data suggest continued strong support from the 1980 year class in the 1983 fishery.

Landings for Cape Cod and the Gulf of Maine areas have increased since the 1970's and appear stable at a level above the long-term average. Commercial CPUE indices for Cape Cod have stabilized at a level above that of the mid-1970's. No clear trends are evident throughout the time series of NEFC survey data for Cape Cod. Recent landings in the Mid-Atlantic area have been low relative to peak levels of the early 1970's, although survey indices suggest a dramatic increase in abundance and biomass resulting from recruitment of the 1980 year class.

In conclusion, a strong 1980 year class has revived the New England yellowtail flounder fishery. Having made a dramatic impact on 1982 landings, there is evidence of its continued strength in the fishery thus far in 1983. Available information does suggest, however, that this year class was subjected

to very high fishing mortality, as reflected by high discard rates during 1982, particularly in the southern New England area. Recent levels of fishing mortality have exceeded F_{max}, thus implying a continued potential for losses in yield per recruit and a continued heavy dependence on recruiting year classes.

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Table 1. Commercial catch[1] of yellowtail flounder (000's of metric tons) from the Southern New England, Georges Bank, Cape Cod, Mid-Atlantic, and Gulf of Maine areas[2], 1960-1982.

	Southern New England					Georges Bank					Cape Cod				
Year	Food landings	Estimated Discard	Indust.	Foreign	Total	Food landings	Estimated Discard	Indust.	Foreign	Total	Food landings	Discard	Indust.	Foreign	Total
1960	7.8	3.2	0.5	-	11.5	4.4	1.5	-	-	5.9	1.5	0.5	-	-	2.0
1961	11.6	4.7	0.7	-	17.0	4.2	1.5	-	-	5.7	1.8	0.6	-	-	2.4
1962	13.1	5.3	0.2	-	18.6	7.7	2.7	-	-	10.3	1.9	0.6	-	-	2.5
1963	22.0	5.4	0.3	0.2	27.9	11.0	5.6	-	0.1	16.7	3.6	1.0	-	-	4.6
1964	19.0	9.5	0.5	-	29.0	14.9	4.9	-	-	19.8	1.8	0.6	-	-	2.4
1965	18.4	7.0	1.0	1.4	27.8	14.2	4.4	-	0.8	19.2	1.5	0.5	-	-	2.0
1966	14.9	5.3	2.7	0.7	23.6	11.3	2.1	-	0.3	13.7	1.8	0.3	-	-	2.1
1967	10.8	7.7	4.5	2.8	25.8	8.4	5.5	-	1.4	15.3	1.5	0.8	-	-	2.3
1968	14.3	6.3	3.9	3.5	28.0	12.8	3.6	-	1.8	18.2	1.6	0.6	-	-	2.2
1969	11.4	2.4	4.2	17.6	35.6	15.9	2.6	-	2.4	20.9	1.3	0.3	-	-	1.6
1970	13.1	4.7	2.1	2.5	22.4	15.5	5.5	-	0.3	21.3	1.2	0.4	-	-	1.6
1971	8.2	3.3	0.4	0.3	12.2	11.9	3.1	-	0.5	15.5	1.7	0.7	-	-	2.3
1972	8.2	1.7	0.3	3.0	13.2	14.2	1.2	-	2.2	17.6	1.4	0.3	-	-	1.6
1973	7.2	0.1	0.3	0.2	7.8	15.9	0.6	-	0.3	16.7	1.7	<0.1	-	-	1.7
1974	6.4	0.7	<0.1	0.1	7.1	14.6	1.2	-	1.0	16.8	2.1	0.2	-	-	2.3
1975	3.2	0.2	<0.1	-	3.4	13.8	1.0	-	0.1	14.9	2.0	-	-	-	2.0
1976	1.6	0.2	<0.1	<0.1	1.8	11.4	0.7	-	<0.1	12.1	3.6	0.1	-	-	3.7
1977	2.8	<0.1	<0.1	<0.1	2.9	9.5	0.2	-	-	9.7	3.5	-	-	-	3.5
1978	2.3	0.3	<0.1	-	2.6	4.5	0.5	<0.1	<0.1	5.0	3.7	0.4	-	-	4.1
1979	5.4	0.6	<0.1	-	6.0	5.5	0.6	-	<0.1	6.1	4.2	0.5	-	-	4.7
1980	6.0	0.6	<0.1	-	6.7	6.4	0.7	-	<0.1	7.1	5.1	0.6	-	-	5.7
1981[3]	4.9	1.3	<0.1	-	6.2	6.4	0.5	-	<0.1	6.9	3.2	0.6	-	-	3.8
1982[3]	10.3	3.3			13.6	10.6	1.6			12.2	3.1	0.4	-	-	3.5

[1]Food landings data taken from New England weighout files, state bulletins, and annual canvas data; discard and industrial landings estimated from interview data and commercial sampling of industrial catches. Discard for 1978-1980 taken as 10.7% of the estimated total catch. Discard for 1981 and 1982 estimated from NEFC survey data assuming a 32 cm average minimum market length, and 29 cm minimum retention length as determined by Mayo et al (MS 1981).

[2]Statistical areas 526-539, 522-525, 514 and 521, 611+, and 511-513+515, respectively.

[3]Preliminary.

Table 1. (continuation)

	Mid-Atlantic					Gulf of Maine					Total				
Year	Food landings	Discard	Indust.	Foreign	Total	Food landings[1]	Discard	Indust.	Foreign	Total	Food landings	Discard	Indust.	Foreign	Total
1960	-	-	-	-	-	-	-	-	-	-	13.7	5.2	0.5	-	19.4
1961	-	-	-	-	-	-	-	-	-	-	17.6	6.8	0.7	-	25.1
1962	-	-	-	-	-	-	-	-	-	-	22.7	8.6	0.2	-	31.5
1963	-	-	-	-	-	-	-	-	-	-	36.6	12.0	0.3	0.3	49.2
1964	1.8	-	-	-	1.8	-	-	-	-	-	37.5	15.0	0.5	-	53.0
1965	2.1	-	-	-	2.1	-	-	-	-	-	36.2	11.9	1.0	2.2	51.3
1966	2.4	-	-	-	2.4	-	-	-	-	-	30.4	7.7	2.7	1.0	41.8
1967	5.3	-	-	-	5.3	-	-	-	-	-	26.0	14.0	4.5	4.2	48.7
1968	3.3	-	-	-	3.3	-	-	-	-	-	32.0	10.5	3.9	5.3	51.7
1969	3.9	-	-	0.7	4.6	0.1	-	-	-	0.1	32.6	5.3	4.2	20.7	62.8
1970	4.1	-	-	0.1	4.2	0.1	-	-	-	0.1	34.0	10.6	2.1	2.9	49.6
1971	6.9	-	-	1.0	7.8	0.1	-	-	-	0.1	28.8	7.1	0.4	1.8	38.0
1972	8.8	-	-	0.1	8.9	0.2	-	-	-	0.2	32.8	3.2	0.3	5.3	41.6
1973	4.9	0.2	-	0.2	5.4	0.1	-	-	-	0.1	29.8	0.9	0.3	0.7	31.8
1974	1.9	<0.1	-	<0.1	1.9	0.1	-	-	-	0.1	25.1	2.1	<0.1	1.1	28.3
1975	0.7	<0.1	-	<0.1	0.7	0.2	-	-	-	0.2	19.9	1.2	<0.1	0.1	21.2
1976	0.3	-	-	-	0.3	0.3	-	-	-	0.3	17.2	1.0	<0.1	<0.1	18.2
1977	0.5	<0.1	-	<0.1	0.6	0.2	-	-	-	0.2	16.5	0.2	<0.1	<0.1	16.9
1978	0.4	<0.1	<0.1	-	0.4	0.4	-	-	-	0.4	11.3	1.2	<0.1	<0.1	12.5
1979	0.5	<0.1	<0.1	-	0.6	0.3	-	-	-	0.3	15.9	1.7	<0.1	<0.1	17.7
1980	0.3	<0.1	-	-	0.3	0.5	-	-	-	0.5	18.3	1.9	<0.1	<0.1	20.2
1981	0.7	0.1	-	-	0.8	0.4	-	-	-	0.4	15.6	2.5	<0.1	<0.1	18.1
1982[3]	0.4	<0.1	-	-	0.4	0.5	<0.1	-	-	0.5	24.9	5.3	-	-	30.2

See footnote legends above.

Table 2. Commercial catch (000's tons), days fished (000's) and catch per day (tons)[1] of yellowtail flounder for the Southern New England, Georges Bank, and Cape Cod grounds.

	Southern New England			Georges Bank			Cape Cod		
Year	Total catch	Days fished	Catch/ day	Total catch	Days fished	Catch/ day	Total catch	Days fished	Catch/ day
1960	11.5	4.60	2.5	5.9	2.02	2.9	2.0	1.12	1.8
1961	17.0	4.85	3.5	5.7	1.82	3.1	2.4	.91	2.6
1962	18.6	4.04	4.6	10.3	2.35	4.4	2.5	1.01	2.5
1963	27.9	5.47	5.1	16.7	3.63	4.6	4.6	1.00	4.6
1964	29.0	5.08	5.6	19.8	3.53	5.6	2.4	.71	3.4
1965	27.8	6.61	4.2	19.2	4.68	4.1	2.0	.70	2.8
1966	23.6	8.42	2.8	13.7	5.71	2.4	2.1	1.37	1.6
1967	25.8	6.51	4.0	15.3	4.13	3.7	2.3	1.69	1.4
1968	28.0	6.66	4.2	18.2	4.66	3.9	2.2	.99	2.3
1969	35.6	10.78	3.3	20.9	6.71	3.1	1.6	.68	2.5
1970	22.4	6.40	3.5	21.3	6.26	3.4	1.6	.53	3.0
1971	12.2	3.81	3.2	15.5	6.20	2.5	2.3	.79	2.9
1972	13.2	4.71	2.8	17.6	8.00	2.2	1.6	.67	2.4
1973	7.8	4.11	1.9	16.7	6.96	2.4	1.7	.89	1.9
1974	7.1	3.74	1.9	16.8	8.40	2.0	2.3	1.21	1.9
1975	3.4	2.43	1.4	14.6	8.59	1.7	2.0	1.25	1.6
1976	1.8	1.50	1.2	12.0	7.50	1.6	3.7	2.31	1.6
1977	2.9	2.00	1.4	9.7	6.70	1.4	3.5	2.42	1.4
1978	2.7	1.44	1.8	5.0	3.57	1.4	4.1	2.05	2.0
1979	6.0	3.00	2.0	6.1	3.05	2.0	4.7	2.61	1.8
1980	6.7	3.17	2.1	7.1	4.26	1.7	5.7	3.25	1.8
1981	6.0	2.59	2.3	6.7	4.16	1.6	3.8	2.30	1.9
1982	13.6	3.78	3.6	12.2	5.62	2.2	3.5	2.02	1.8

[1] Calculated for USA trawlers of 5-104 GT using trip data for which 50% of the total catch consisted of yellowtail.

Table 3. Estimated age composition (percent landed at age) plus total numbers landed in 100's of southern New England yellowtail in USA commercial landings 1962-1982.

	Percent Landed at Age								
Year	1	2	3	4	5	6	7	8+	Total Landed (100's)
1962	-	16.2	63.5	17.4	2.0	0.6	0.2	0.1	340710
1963	-	11.5	50.7	30.8	6.0	0.8	0.2	-	538162
1964	0.1	19.2	26.2	30.7	20.5	2.9	0.4	0.1	400804
1965	-	23.5	39.0	16.8	13.5	6.2	1.0	0.1	422827
1966	-	23.7	43.9	18.7	6.9	5.1	1.5	0.2	334249
1967	-	21.3	58.7	15.4	2.6	0.9	0.9	0.1	276651
1968	0.1	11.6	56.1	29.7	1.9	0.4	0.1	0.1	326046
1969	-	9.6	40.9	38.1	9.6	1.2	0.3	0.2	272399
1970	-	10.6	28.3	43.3	14.2	3.2	0.3	0.1	302302
1971	-	13.6	19.3	42.0	19.4	4.4	1.1	0.1	187430
1972	-	15.2	30.2	14.3	31.0	7.0	1.7	0.6	193638
1973	0.1	15.7	41.2	25.2	9.1	7.0	1.3	0.4	180679
1974	2.1	12.7	24.5	31.8	15.4	5.7	6.4	1.4	151477
1975	2.1	34.6	19.3	11.8	17.9	7.4	4.6	2.3	80705
1976	-	39.2	24.1	7.4	10.1	11.3	4.9	2.9	35717
1977	0.3	28.4	55.4	6.4	2.3	3.3	1.6	2.3	69168
1978	0.2	57.8	22.3	15.3	2.5	0.8	0.5	0.7	60299
1979	0.2	39.1	50.9	6.5	2.5	0.7	0.1	-	131773
1980	0.7	32.2	40.8	22.6	2.7	0.7	0.1	0.1	153649
1981	-	22.0	47.4	21.5	7.8	1.3	-	-	103324
1982	0.2	53.8	39.2	5.3	1.3	0.3	-	-	323587

Table 4. Estimated age composition (percent landed at age) plus total numbers landed in 100's of Georges Bank yellowtail in USA commercial landings 1962-1982.

Year	Percent Landed at Age								Total Landed (100's)
	1	2	3	4	5	6	7	8+	
1962	-	19.3	52.6	19.0	5.1	2.5	1.0	0.4	153577
1963	-	6.7	65.1	20.1	6.3	1.2	0.3	0.3	209807
1964	-	7.7	34.8	45.2	9.6	1.7	0.8	0.2	265998
1965	-	9.5	41.6	24.0	18.8	4.6	1.2	0.4	262650
1966	-	11.3	46.9	21.9	12.4	5.9	1.1	0.5	216886
1967	-	33.8	35.0	20.4	6.5	3.0	1.1	0.3	172343
1968	-	22.4	54.9	15.1	4.6	1.9	0.7	0.3	251890
1969	-	10.5	46.8	29.5	8.8	2.7	1.3	0.6	284999
1970	0.1	15.0	40.4	27.7	11.1	3.7	1.2	0.9	291793
1971	-	9.0	40.2	32.2	11.9	4.5	1.4	0.9	218111
1972	-	12.2	39.2	30.7	13.6	3.3	0.7	0.3	280815
1973	-	10.5	41.7	30.0	12.1	4.3	0.9	0.4	307196
1974	1.1	27.9	30.4	25.0	11.0	2.5	1.4	0.5	284996
1975	0.9	52.9	23.4	10.9	7.2	2.7	1.2	0.8	291700
1976	0.1	67.2	21.8	5.4	2.1	1.7	1.1	0.6	257334
1977	0.2	36.7	49.5	8.9	2.0	1.2	0.8	0.7	186277
1978	-	26.4	44.7	21.3	5.1	1.5	0.4	0.6	73252
1979	0.2	52.7	27.5	11.2	5.8	1.2	0.9	0.5	117328
1980	-	14.6	70.5	11.2	2.7	0.8	0.1	0.1	122603
1981	-	2.9	47.5	42.2	6.1	1.2	-	-	100388
1982	0.9	52.7	28.6	13.2	4.3	0.2	0.1	-	248073

Table 5. Stratified mean catch per tow in numbers and weight (kg) for southern New England yellowtail flounder in NEFC offshore[1] and inshore[2] spring, and offshore summer and autumn bottom trawl surveys, 1963-1983.

Year	Spring[3]		Summer		Autumn	
	Nos.	Wt(kg)	Nos.	Wt(kg)	Nos.	Wt(kg)
1963	-	-	28.17	8.96	50.59	16.83
1964	-	-	24.54	11.24	60.76	19.03
1965	-	-	38.48	10.00	38.74	12.68
1966	-	-	-	-	50.25	9.43
1967	-	-	-	-	57.67	14.05
1968	123.22	32.21	-	-	40.21	10.06
1969	100.60	23.10	59.45	12.91	54.75	14.39
1970	74.66	20.28	-	-	39.76	10.96
1971	74.48	18.49	-	-	41.70	9.18
1972	75.15	18.55	-	-	73.28	20.11
1973	57.30	14.69	-	-	7.94	2.25
1974	17.26	5.04	-	-	7.34	2.13
1975	6.99	1.98	-	-	2.89	0.71
1976	6.96(2.48)	2.45(1.36)	-	-	10.69	2.96
1977	5.13(14.45)	1.99(5.06)	9.04	2.98	5.01	1.50
1978	22.93(13.38)	5.15(3.32)	5.41	1.34	11.43	3.06
1979	10.26(2.52)	2.15(0.48)	38.58	10.87	9.00	2.57
1980	16.03(3.65)	5.95(1.42)	6.52	1.38	7.33	1.96
1981	23.26(11.04)	6.85(3.02)	5.67	1.76	14.97	3.79
1982	40.78(13.31)	10.36(3.70)	-	-	34.46	8.13
1983	25.20(13.46)	7.68(3.79)				

1 Offshore strata 5, 6, 9, and 10.

2 Inshore strata 1-5 and 46 (calculated index values in parentheses).

3 Data for 1968-1972 and 1982-1983 adjusted by factors of 1.76 (numbers) and 1.73 (weight) to account for differences in fishing power between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

Table 6. Stratified mean catch per tow at age (numbers) for southern New England yellowtail flounder in NEFC offshore[1] and inshore[2] spring and offshore summer and autumn bottom trawl surveys, 1963-1982.

Year	Age 0	1	2	3	4	5	6	7	8+	Total Age 1+	Age 2+
Spring(offshore)[3]											
1968	0.00	2.80	45.36	46.22	27.17	1.44	0.16	0.09	0.00	123.24	120.44
1969	0.00	7.44	28.12	39.55	21.42	3.84	0.25	0.00	0.00	100.62	93.18
1970	0.00	2.15	15.24	28.93	20.38	5.98	1.55	0.33	0.14	74.70	72.55
1971[4]	-	-	-	-	-	-	-	-	-	74.48	
1972	0.00	0.84	31.38	21.26	6.64	12.69	1.92	0.44	0.00	75.17	74.33
1973	0.00	1.90	10.47	18.34	9.06	6.15	9.53	1.18	0.66	57.29	55.39
1974	0.00	1.07	4.28	3.36	3.60	2.35	0.85	1.44	0.32	17.27	16.20
1975	0.00	0.82	2.25	0.72	1.00	1.28	0.68	0.05	0.21	7.01	6.19
1976	0.00	0.04	4.70	0.75	0.38	0.43	0.38	0.19	0.09	6.96	6.92
1977	0.00	0.35	1.76	2.24	0.22	0.26	0.12	0.04	0.16	5.15	4.80
1978	0.00	4.43	14.04	2.85	1.03	0.27	0.05	0.07	0.20	22.94	18.51
1979	0.00	2.22	4.84	2.57	0.45	0.16	0.00	0.00	0.01	10.25	8.03
1980	0.00	0.54	6.21	4.73	3.90	0.42	0.15	0.02	0.04	16.01	15.47
1981	0.00	0.35	14.55	5.24	2.16	0.78	0.11	0.00	0.00	23.26	22.91
1982	0.00	1.01	22.63	12.81	2.91	0.98	0.35	0.04	0.00	40.73	39.72
Spring(inshore)											
1976	0.00	0.00	1.05	0.32	0.34	0.32	0.23	0.04	0.18	2.48	2.48
1977	0.00	1.60	2.75	8.56	0.48	0.81	0.00	0.08	0.19	14.47	12.87
1978	0.00	0.13	11.35	1.76	0.14	0.00	0.00	0.00	0.00	13.38	13.25
1979	0.00	0.57	1.24	0.47	0.22	0.02	0.00	0.00	0.00	2.52	1.95
1980	0.00	0.00	1.71	1.14	0.79	0.00	0.00	0.00	0.00	3.64	3.64
1981	0.00	1.49	5.62	2.54	0.84	0.46	0.05	0.00	0.00	11.04	9.55
Summer											
1963[4]	-	-	-	-	-	-	-	-	-	28.17	
1964	0.00	0.67	9.34	4.60	6.28	3.00	0.48	0.17	0.00	24.54	23.87
1965	0.00	0.65	21.15	14.42	2.28	0.00	0.00	0.00	0.00	38.50	37.85
1969	0.11	0.07	13.87	41.92	3.49	0.00	0.00	0.00	0.00	59.35	59.28
1977	0.00	2.17	3.05	2.70	0.48	0.09	0.40	0.11	0.05	9.05	6.88
1978	0.00	0.25	4.62	0.20	0.28	0.04	0.00	0.04	0.00	5.43	5.18
1979	0.00	1.83	23.73	12.19	0.73	0.10	0.00	0.00	0.00	38.58	36.75
1980	0.00	1.88	3.15	1.17	0.33	0.00	0.00	0.00	0.00	6.53	4.65
1981	0.00	0.16	3.86	1.00	0.47	0.10	0.00	0.00	0.00	5.59	5.43
Autumn											
1963	0.05	16.46	15.23	13.98	4.26	0.55	0.00	0.08	0.00	50.56	34.10
1964	0.00	18.47	26.19	4.80	7.13	3.27	0.80	0.11	0.00	60.77	42.30
1965	0.26	11.63	16.90	6.20	1.77	1.73	0.21	0.04	0.00	38.48	26.85
1966	0.88	35.92	10.44	1.78	1.02	0.19	0.00	0.00	0.00	49.35	13.43
1967	0.27	18.44	25.65	11.14	1.57	0.40	0.06	0.13	0.00	57.39	38.95
1968	0.00	10.72	9.47	18.08	1.12	0.00	0.61	0.19	0.04	40.23	29.51
1969	0.00	11.88	9.74	27.48	5.47	0.12	0.04	0.04	0.00	54.77	42.89
1970	0.04	4.23	5.52	16.34	10.62	2.51	0.43	0.07	0.00	39.72	35.49
1971	0.00	6.34	10.84	6.25	15.20	2.69	0.22	0.16	0.00	41.70	35.36
1972[4]	-	-	-	-	-	-	-	-	-	73.28	
1973	0.00	1.56	1.19	1.80	1.34	1.00	0.83	0.23	0.00	7.95	6.39
1974	0.21	1.02	1.64	0.59	2.25	0.96	0.40	0.19	0.07	7.12	6.10
1975	0.00	1.67	0.50	0.19	0.23	0.22	0.00	0.09	0.00	2.90	1.23
1976	0.00	2.99	6.18	0.54	0.07	0.11	0.30	0.35	0.15	10.69	7.70
1977	0.04	1.70	2.19	0.80	0.12	0.04	0.04	0.08	0.00	4.97	3.27
1978	0.00	3.26	7.20	0.43	0.38	0.04	0.01	0.08	0.03	11.43	8.17
1979	0.00	1.73	4.42	2.40	0.37	0.04	0.04	0.00	0.00	9.00	7.27
1980	0.00	1.48	4.33	1.18	0.34	0.00	0.00	0.00	0.00	7.33	5.85
1981	0.00	3.24	9.25	1.06	1.21	0.02	0.04	0.00	0.00	14.97	11.73
1982	0.00	2.68	23.76	6.89	0.81	0.34	0.00	0.00	0.00	34.46	31.78

[1] Offshore strata 5, 6, 9, and 10.

[2] Inshore strata 1-5 and 46.

[3] Data for 1968-1972 and 1982 adjusted by a factor of 1.76 to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

[4] Age data not available.

Table 7. Stratified mean catch per tow in numbers and weight (kg) for Georges Bank yellowtail flounder in NEFC offshore spring, summer, and autumn[1] bottom trawl surveys, 1963-1983.

Year	Spring[2]		Summer		Autumn	
	Nos.	Wt(kg)	Nos.	Wt(kg)	Nos.	Wt(kg)
1963	-	-	18.43	6.94	30.12	9.99
1964	-	-	11.18	3.85	22.96	10.64
1965	-	-	17.78	6.00	15.04	7.10
1966	-	-	-	-	14.77	3.12
1967	-	-	-	-	18.58	5.92
1968	11.23	3.77	-	-	25.62	8.22
1969	38.60	15.10	48.26	14.06	23.09	7.25
1970	20.06	7.16	-	-	13.38	3.88
1971	19.57	6.23	-	-	15.24	4.97
1972	27.77	8.72	-	-	14.56	4.93
1973	13.41	3.97	-	-	14.75	5.07
1974	9.08	3.67	-	-	9.95	2.86
1975	6.97	2.26	-	-	7.72	1.81
1976	10.53	3.07	-	-	2.52	1.18
1977	3.28	1.35	1.97	0.79	5.41	2.56
1978	3.62	1.00	3.59	1.18	7.18	2.15
1979	4.45	1.66	3.91	1.59	3.90	1.37
1980	15.98	6.02	3.75	1.44	12.74	6.07
1981	6.46	3.12	10.01	4.59	6.12	2.37
1982	11.42	4.43	-	-	5.50	1.87
1983	7.92	3.53				

[1]Spring and autumn, strata 13-21; summer, strata 13, 16, and 19-21.

[2]Data for 1968-72 and 1982-83 adjusted by factors of 1.76 (numbers) and 1.73 (weight) to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

Table 8. Stratified mean catch per tow at age (numbers) for Georges Bank yellowtail flounder in NEFC offshore spring, summer, and autumn[1] bottom trawl surveys, 1963-1982.

Year	Age 0	1	2	3	4	5	6	7	8+	Total Age 1+	Total Age 2+
Spring[2]											
1968	0.00	0.26	4.79	5.16	0.44	0.11	0.26	0.18	0.00	11.20	10.94
1969	0.00	1.55	13.46	16.05	4.47	2.06	0.65	0.12	0.25	38.61	37.06
1970	0.00	0.12	6.46	8.55	3.66	0.83	0.18	0.18	0.09	20.07	19.95
1971[3]	-	-	-	-	-	-	-	-	-	19.57	
1972	0.00	0.19	10.31	10.40	5.09	1.43	0.05	0.16	0.14	27.77	27.58
1973	0.00	2.80	4.73	3.43	1.54	0.59	0.25	0.03	0.03	13.40	10.60
1974	0.00	0.46	3.22	2.67	1.80	0.52	0.27	0.10	0.03	9.07	8.61
1975	0.00	0.61	4.61	1.01	0.41	0.25	0.07	0.00	0.02	6.98	6.37
1976	0.00	1.58	6.26	1.81	0.45	0.28	0.04	0.07	0.06	10.55	8.97
1977	0.00	0.00	0.98	1.62	0.57	0.09	0.02	0.00	0.00	3.28	3.28
1978	0.00	1.36	1.16	0.73	0.30	0.06	0.00	0.01	0.00	3.62	2.26
1979	0.00	0.40	2.81	0.54	0.47	0.08	0.07	0.05	0.01	4.43	4.03
1980	0.00	0.08	6.69	8.39	0.68	0.08	0.05	0.00	0.00	15.97	15.85
1981	0.00	1.71	3.07	1.09	0.36	0.13	0.03	0.00	0.01	6.46	4.75
1982	0.00	0.08	6.85	1.89	1.64	0.74	0.13	0.00	0.09	11.42	11.34
Summer											
1963[3]	-	-	-	-	-	-	-	-	-	18.43	
1964	0.00	2.38	4.27	2.53	1.48	0.47	0.02	0.00	0.00	11.15	8.77
1965	0.00	0.43	7.21	7.17	1.84	1.09	0.03	0.00	0.00	17.77	17.34
1969	0.00	4.70	23.65	14.94	3.96	0.20	0.58	0.12	0.12	48.27	43.57
1977	0.02	0.31	0.80	0.32	0.36	0.07	0.09	0.00	0.00	1.97	1.64
1978	0.00	1.32	1.07	0.73	0.39	0.07	0.02	0.00	0.00	3.60	2.28
1979	0.00	0.96	1.78	0.46	0.27	0.24	0.21	0.00	0.00	3.92	2.96
1980	0.00	0.21	1.98	1.35	0.13	0.08	0.00	0.00	0.00	3.75	3.54
1981	0.00	0.81	3.09	3.61	2.05	0.29	0.00	0.00	0.00	9.85	9.04
Autumn											
1963	0.00	12.39	6.28	9.53	1.21	0.41	0.08	0.14	0.09	30.13	17.74
1964	0.00	1.42	7.97	6.04	4.92	2.21	0.31	0.08	0.02	22.97	21.55
1965	0.02	0.96	4.79	4.82	2.89	1.29	0.09	0.17	0.02	15.03	14.07
1966	1.17	9.93	1.46	1.40	0.67	0.10	0.04	0.00	0.00	13.60	3.67
1967	0.05	7.49	7.63	2.21	0.83	0.25	0.06	0.05	0.00	18.52	11.03
1968	0.00	9.67	9.72	4.76	0.64	0.78	0.03	0.00	0.00	25.60	15.93
1969	1.05	6.67	8.52	4.79	1.36	0.36	0.22	0.15	0.00	22.07	15.40
1970	0.78	3.77	4.21	2.58	1.60	0.37	0.05	0.01	0.00	12.59	8.82
1971	0.03	2.97	5.64	4.08	1.84	0.45	0.19	0.02	0.02	15.21	12.24
1972[3]	-	-	-	-	-	-	-	-	-	14.56	
1973	0.10	2.04	4.51	4.18	2.41	1.00	0.34	0.14	0.02	14.64	12.60
1974	1.01	3.79	2.35	1.24	0.87	0.38	0.20	0.11	0.00	9.95	5.15
1975	0.36	3.79	2.06	0.72	0.47	0.27	0.03	0.00	0.03	7.73	3.58
1976	0.00	0.27	1.58	0.39	0.10	0.10	0.03	0.00	0.06	2.53	2.26
1977	0.00	0.91	2.13	1.56	0.01	0.10	0.06	0.04	0.02	5.43	4.52
1978	0.04	4.59	1.24	0.75	0.39	0.13	0.01	0.00	0.02	7.13	2.54
1979	0.02	1.27	2.00	0.25	0.13	0.13	0.03	0.06	0.02	3.91	2.62
1980	0.08	0.66	5.27	5.57	0.67	0.27	0.16	0.03	0.03	12.74	12.00
1981	0.00	1.67	2.26	1.28	0,61	0.07	0.05	0.00	0.08	6.12	4.45
1982	0.00	2.02	1.82	1.13	0.31	0.18	0.00	0.00	0.00	5.46	3.44

[1]Spring and autumn, strata 13-21; summer, strata 13, 16, and 19-21.

[2]Data for 1968-1972 and 1982 adjusted by a factor of 1.76 to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

[3]Age data not available.

Table 9. Stratified mean catch per tow in numbers and weight(kg) for Cape Cod yellowtail flounder in NEFC offshore[1] and inshore[2] spring and summer and offshore autumn bottom trawl surveys, 1963-1983.

	Spring[3]		Summer		Autumn	
Year	Nos.	Wt(kg)	Nos.	Wt(kg)	Nos.	Wt(kg)
1963	-	-	5.46	1.33	9.07	3.54
1964	-	-	0.41	0.18	3.67	1.18
1965	-	-	2.39	0.95	4.50	1.23
1966	-	-	-	-	4.02	0.80
1967	-	-	-	-	0.74	0.27
1968	0.40	0.00[4]	-	-	0.88	0.29
1969	0.77	0.43	0.56	0.20	2.37	0.85
1970	4.00	1.16	-	-	1.16	0.31
1971	2.76	0.47	-	-	1.49	0.35
1972	1.78	0.28	-	-	10.24	2.75
1973	1.63	0.31	-	-	1.60	0.58
1974	1.81	0.71	-	-	0.22	0.12
1975	2.62	0.31	-	-	0.93	0.39
1976	3.31	0.84	-	-	4.81	1.21
1977	1.08	0.40	1.15(4.53)	0.52(1.25)	12.93	4.66
1978	0.22	0.08	2.15(25.50)	0.89(3.80)	4.51	1.37
1979	0.47(3.52)	0.11(1.27)	2.65(14.02)	0.88(2.12)	3.87	1.01
1980	2.25(11.18)	0.63(4.61)	2.75(20.93)	1.01(2.85)	12.60	3.47
1981	1.63(14.88)	0.28(5.28)	2.66(3.60)	1.39(0.89)	2.94	0.76
1982	6.20(21.26)	3.53(6.64)	-	-	3.76	1.35
1983	3.48(7.74)	1.92(1.95)	-	-		

1 Offshore strata 24-26.

2 Inshore strata 55, 58-61, and 64-66 (spring); 55, 56, 58-61, and 63-66 (summer) (values in parentheses).

3 Data for 1968-1972 and 1982-1983 adjusted by factors of 1.76 (numbers) and 1.73 (weight) to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

4 Less than 0.01.

Table 10. Stratified mean catch per tow at age (numbers) for Cape Cod yellowtail flounder in NEFC offshore[1] and inshore[2] spring and summer and offshore autumn bottom trawl surveys, 1976-1982.

Year	Age 0	1	2	3	4	5	6	7	8+	Totals Age 1+	Age 2+
Spring(offshore)											
1976	0.00	0.20	1.88	1.06	0.08	0.01	0.02	0.02	0.06	3.33	3.13
1977	0.00	0.00	0.67	0.26	0.07	0.02	0.03	0.00	0.02	1.07	1.07
1978	0.00	0.00	0.05	0.08	0.02	0.08	0.00	0.00	0.00	0.23	0.23
1979	0.00	0.01	0.06	0.24	0.14	0.01	0.00	0.00	0.00	0.46	0.45
1980	0.00	0.00	1.75	0.36	0.13	0.00	0.00	0.00	0.00	2.24	2.24
1981	0.00	0.00	1.06	0.38	0.06	0.03	0.00	0.00	0.00	1.63	1.63
1982[3]	0.00	0.00	0.69	2.17	1.54	0.91	0.31	0.33	0.27	6.22	6.22
Spring(inshore)											
1979	0.00	0.75	0.74	1.29	0.67	0.02	0.05	0.00	0.00	3.52	2.77
1980	0.00	0.00	5.23	4.08	1.53	0.34	0.00	0.00	0.00	11.18	11.18
1981	0.00	0.00	7.53	3.92	1.29	1.31	0.22	0.00	0.03	14.88	14.88
Summer(offshore)											
1977	0.00	0.05	0.69	0.37	0.04	0.00	0.00	0.00	0.00	1.15	1.15
1978	0.00	0.30	0.79	0.39	0.51	0.04	0.00	0.13	0.00	2.16	2.16
1979	0.00	0.20	1.16	0.85	0.28	0.08	0.05	0.03	0.00	2.65	2.65
1980	0.00	0.52	1.23	0.63	0.24	0.05	0.09	0.00	0.00	2.76	2.76
1981	0.00	0.00	0.82	0.87	0.03	0.24	0.00	0.14	0.00	2.10	2.10
Summer(inshore)											
1977	0.00	0.83	2.88	0.76	0.04	0.02	0.00	0.00	0.00	4.53	3.70
1978	0.00	11.81	8.49	3.86	1.23	0.03	0.08	0.00	0.00	25.50	13.69
1979	0.00	7.87	5.37	0.64	0.00	0.14	0.00	0.00	0.00	14.02	6.15
1980	0.00	13.08	5.95	1.41	0.28	0.09	0.12	0.00	0.00	20.93	7.85
1981	0.00	0.32	2.43	0.56	0.29	0.15	0.00	0.00	0.00	3.74	3.43
Autumn											
1976	0.00	2.28	2.18	0.30	0.01	0.03	0.00	0.00	0.00	4.80	2.52
1977	0.00	3.33	6.27	2.98	0.26	0.00	0.00	0.00	0.08	12.92	9.59
1978	0.00	0.25	2.43	1.68	0.14	0.01	0.00	0.00	0.00	4.51	4.26
1979	0.01	1.63	1.26	0.76	0.17	0.03	0.00	0.00	0.00	3.85	2.22
1980	0.00	4.26	5.48	2.00	0.60	0.24	0.00	0.04	0.00	12.62	8.36
1981	0.00	0.72	1.67	0.35	0.07	0.08	0.00	0.00	0.00	2.94	2.22
1982[3]	0.00	0.33	1.69	1.21	0.29	0.24	0.00	0.00	0.00	3.76	3.43

[1]Strata 24-26.

[2]Strata 55, 58-61, and 64-66(spring); 55, 56, 58-61, and 63-66(summer).

[3]Data for 1982 adjusted by a factor of 1.76 to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

Table 11. Stratifed mean catch per tow in numbers and weight (kg) for Mid-Atlantic yellowtail flounder in NEFC offshore[1] and inshore[2] spring, and offshore summer and autumn bottom trawl surveys, 1963-1983.

	Spring[3]		Summer		Autumn	
Year	Nos.	Wt(kg)	Nos.	Wt(kg)	Nos.	Wt(kg)
1963	-	-	4.02	0.66	28.83	8.93
1964	-	-	2.17	0.06	16.40	4.85
1965	-	-	3.33	0.11	49.05	5.82
1966	-	-	-	-	48.27	8.85
1967	-	-	-	-	55.58	9.31
1968	153.00	29.44	-	-	81.32	13.47
1969	120.74	23.87	9.35	1.31	45.35	9.92
1970	83.76	19.46	-	-	45.21	10.31
1971	64.24	13.63	-	-	26.97	3.77
1972	67.39	17.14	-	-	86.24	20.95
1973	32.10	9.19	-	-	8.24	1.87
1974	13.38	4.38	-	-	0.66	0.19
1975	2.01	0.80	-	-	0.87	0.15
1976	4.28(2.08)	0.95(0.69)	-	-	0.38	0.06
1977	7.30(6.77)	1.77(1.33)	0.44	0.05	1.43	0.18
1978	9.93(6.48)	2.02(1.17)	0.17	0.03	1.19	0.22
1979	2.41(1.61)	0.60(0.31)	1.67	0.15	1.04	0.20
1980	11.91(10.57)	3.59(1.99)	0.71	0.08	0.80	0.15
1981	27.97(16.64)	6.37(3.99)	2.49	0.40	18.69	2.38
1982	40.99(16.54)	9.88(3.20)	-	-	10.94	1.80
1983	23.88(7.74)	5.71(1.95)				

1 Offshore strata 69, 70, 73-74, 1, and 2.

2 Inshore strata 7-14, 16-20, 22, 23, and 25 (values in parentheses).

3 Data for 1968-1972 and 1982-1983 adjusted by factors of 1.76 (numbers) and 1.73 (weight) to account for differences between in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

Table 12. Stratified mean catch per tow at age (numbers) for Mid-Atlantic yellowtail flounder in NEFC offshore[1] and inshore[2] spring, and offshore summer and autumn bottom trawl surveys, 1976-1982.

Year	Age 1	2	3	4	5	6	7	8+	Totals Age 1+	Age 2+
Spring(offshore)										
1976	0.00	3.34	0.30	0.21	0.10	0.32	0.02	0.00	4.29	4.29
1977	2.36	1.29	2.77	0.27	0.11	0.26	0.16	0.08	7.30	4.94
1978	1.19	6.68	0.73	0.60	0.23	0.19	0.20	0.12	9.94	8.75
1979	0.00	1.33	0.76	0.13	0.09	0.03	0.03	0.04	2.41	2.41
1980	0.72	5.46	3.88	1.56	0.27	0.00	0.00	0.00	11.89	11.17
1981	1.26	19.25	3.75	3.12	0.37	0.05	0.00	0.00	27.97	26.71
1982[3]	0.31	31.46	6.60	1.96	0.44	0.21	0.00	0.00	40.97	40.66
Spring(inshore)										
1976	0.00	1.01	0.20	0.40	0.13	0.33	0.01	0.00	2.08	2.08
1977	3.96	0.21	1.84	0.22	0.11	0.22	0.14	0.05	6.75	2.79
1978	1.64	3.51	0.59	0.31	0.13	0.11	0.15	0.04	6.48	4.84
1979	0.29	0.48	0.76	0.03	0.06	0.00	0.00	0.00	1.62	1.33
1980	5.02	1.95	2.76	0.79	0.06	0.00	0.00	0.00	10.58	5.56
1981	1.81	8.46	3.59	2.38	0.33	0.02	0.00	0.00	16.64	14.83
Summer										
1977	0.27	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.45	0.45
1978	0.03	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17
1979	1.16	0.48	0.03	0.00	0.00	0.00	0.00	0.00	1.67	1.67
1980	0.51	0.18	0.03	0.00	0.00	0.00	0.00	0.00	0.72	0.72
1981	0.90	0.44	0.12	0.00	0.03	0.00	0.00	0.00	2.49	1.59
Autumn										
1976	0.19	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.38
1977	1.40	0.03	0.00	0.00	0.00	0.00	0.00	0.00	1.43	1.43
1978	0.60	0.54	0.05	0.00	0.00	0.00	0.00	0.00	1.19	1.19
1979	0.43	0.59	0.02	0.00	0.00	0.00	0.00	0.00	1.04	1.04
1980	0.49	0.23	0.03	0.00	0.05	0.00	0.00	0.00	0.80	0.80
1981	13.14	4.91	0.39	0.00	0.04	0.00	0.00	0.00	18.69	5.55
1982[3]	3.34	7.49	0.11	0.00	0.00	0.00	0.00	0.00	10.94	7.60

[1]Offshore strata 69, 70, 73-74, 1 and 2.

[2]Inshore strata 7-14, 16-20, 22, 23, and 25.

[3]Data for 1982 adjusted by a factor of 1.76 to account for differences in catchability between the "36 Yankee" and the "41 Yankee" trawls (Sissenwine and Bowman 1978).

Table 13. Stratified mean catch per tow in numbers and weight (kg) for yellowtail flounder in Massachusetts inshore spring and autumn bottom trawl surveys[1] from Cape Cod to Massachusetts Bay, 1978-1980.

Season/ year	Stratified mean catch per tow at age[1] (numbers) 0	1	2	3	4	5	6	7	8+	Total	Stratified mean catch/tow in weight(kg)
Spring											
1978	0.00	2.71	20.69	11.82	1.60	0.63	0.54	0.10	0.13	38.22	10.16
1979	0.00	2.63	22.58	13.85	3.68	0.86	0.00	0.17	0.00	43.77	11.38
1980	0.00	2.68	17.62	10.10	2.30	0.15	0.00	0.00	0.00	32.85	10.03
1981	0.02	5.61	58.83	9.00	2.26	1.59	0.27	0.00	0.00	77.58	16.35
1982	0.00	0.69	17.06	17.04	4.45	0.94	0.06	0.04	0.00	40.27	12.66
Autumn											
1978	0.04	7.13	7.74	1.45	0.11	0.00	0.01	0.00	0.00	16.48	2.80
1979	0.03	24.11	22.82	1.78	0.06	0.00	0.00	0.00	0.00	48.80	7.33
1980	0.03	26.54	12.38	2.70	0.35	0.00	0.00	0.00	0.00	42.00	5.90
1981	0.00	2.93	6.54	1.54	0.23	0.17	0.00	0.00	0.00	11.41	2.83
1982	0.00	9.58	6.36	5.54	0.30	0.08	0.00	0.00	0.00	21.87	4.10

[1] Regions 3, 4, and 5 (strata 17-21, 25-30, and 31-36).

Table 14. Mean catch per tow in numbers and weight (kg) by individual strata and stratified mean catch per tow (all strata) for yellowtail flounder in cooperative winter surveys on the southern New England grounds, 1980, 1981, and 1983.

Year	Stratum 1	2	3	4	5	6	Stratified mean catch per tow
	Numbers						
1980	182.00	217.36	34.43	163.50	182.90	115.66	159.89
1981	226.00	297.33	70.71	110.60	201.38	65.25	187.58
1983	654.75	495.40	13.00	254.50	319.67	85.20	327.29
	Weight						
1980	65.0	73.8	16.1	72.2	73.7	47.0	60.6
1981	51.6	87.3	24.7	25.6	60.2	33.4	54.8
1983	184.9	120.0	3.7	70.8	107.5	32.7	90.4

Table 15. Stratified mean catch per tow at age (numbers) for yellowtail flounder in cooperative winter surveys on the Southern New England grounds, 1980, 1981, and 1983.

Year	Age Group 1	2	3	4	5	6	7+	Total
1980	0.20	46.48	86.46	23.93	2.12	0.66	0.06	159.91
1981	0.44	117.18	48.73	14.66	6.33	0.28	0.00	187.62
1983	0.00	37.74	221.70	52.38	11.50	3.52	0.45	327.29

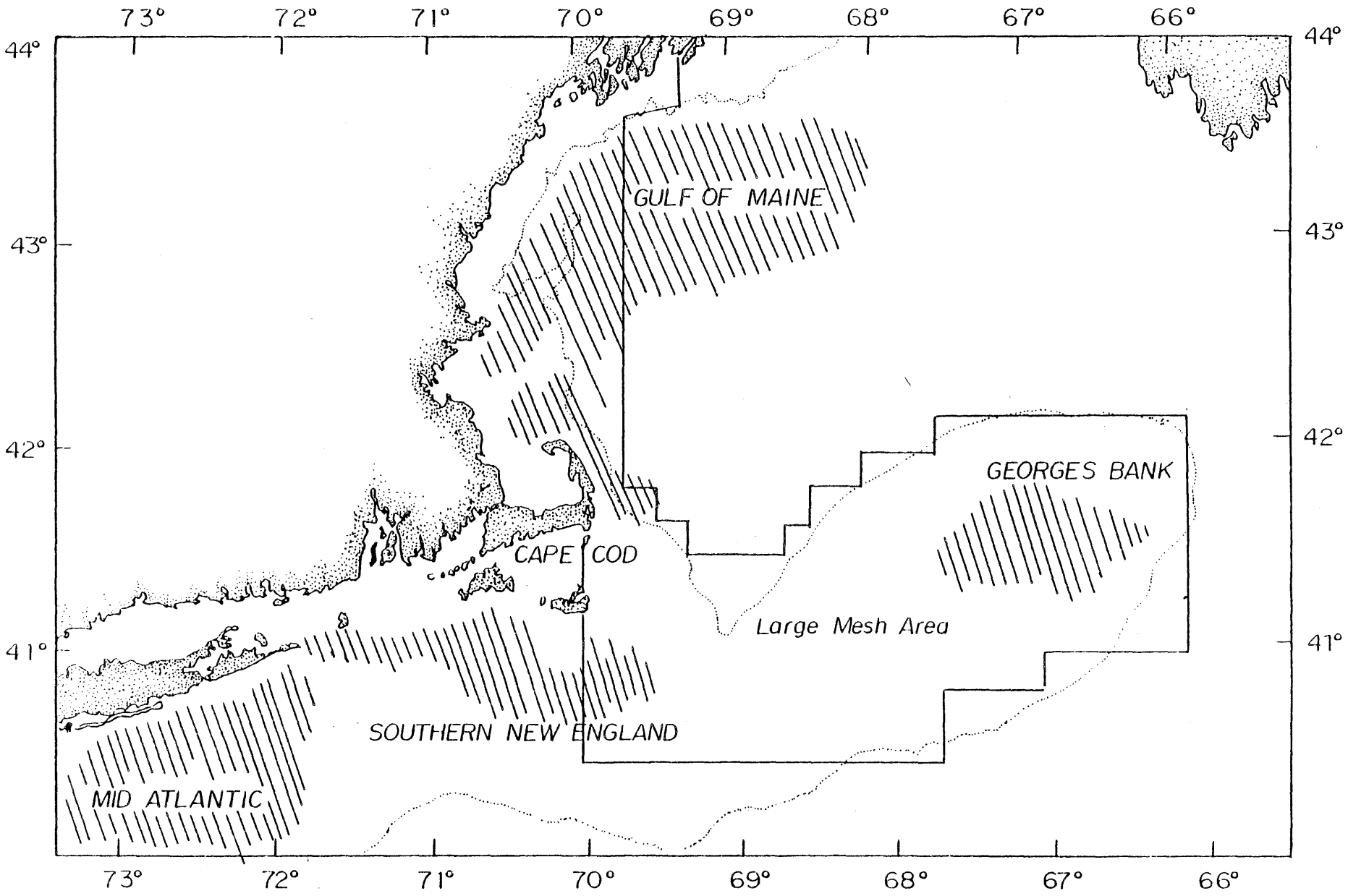

Figure 1. Yellowtail flounder fishing grounds and delineation of large mesh area under the Interim Management Plan.

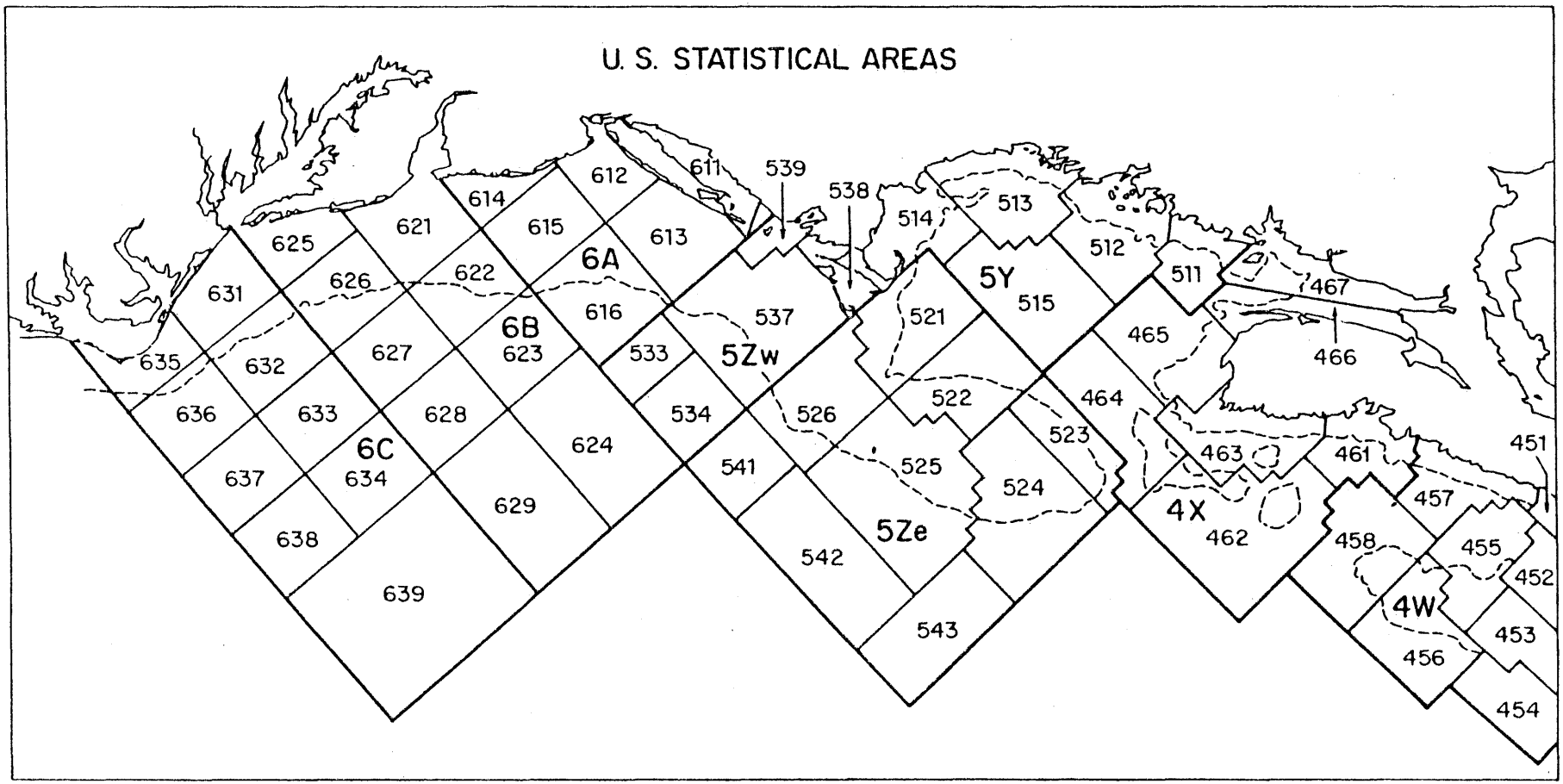

Figure 2. Northwest Atlantic Fisheries Organization divisions and subdivisions (bold lettering) and US statistical areas. Yellowtail fishing grounds defined by statistical area are as follows: Southern New England, 526-539; Georges Bank, 522-525; Cape Cod, 514 and 521; Mid-Atlantic, 611 plus; Gulf of Maine, 511-513 and 515.

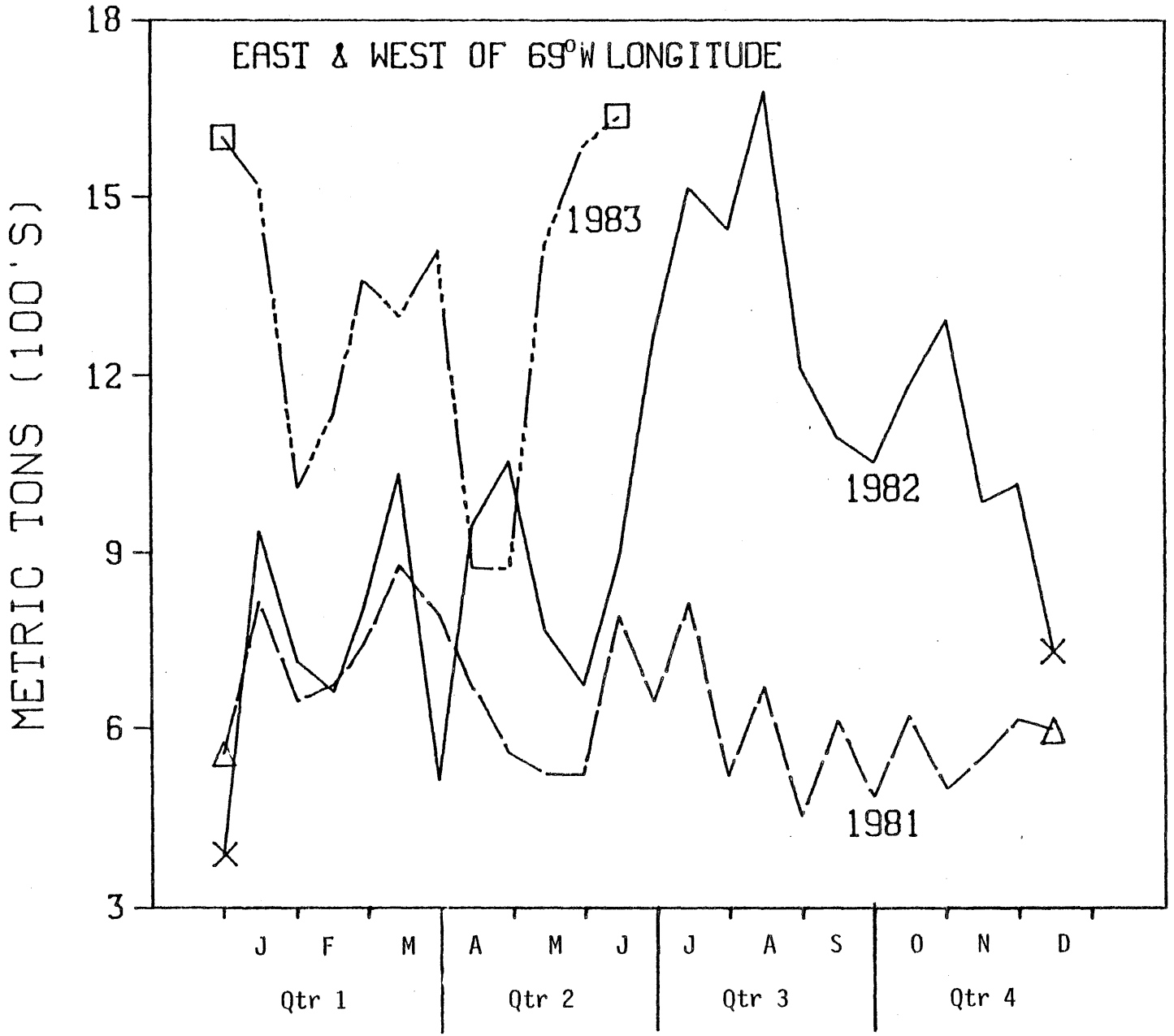

Figure 3. Bimonthly landings trends for yellowtail flounder (all areas) for 1981-1983.

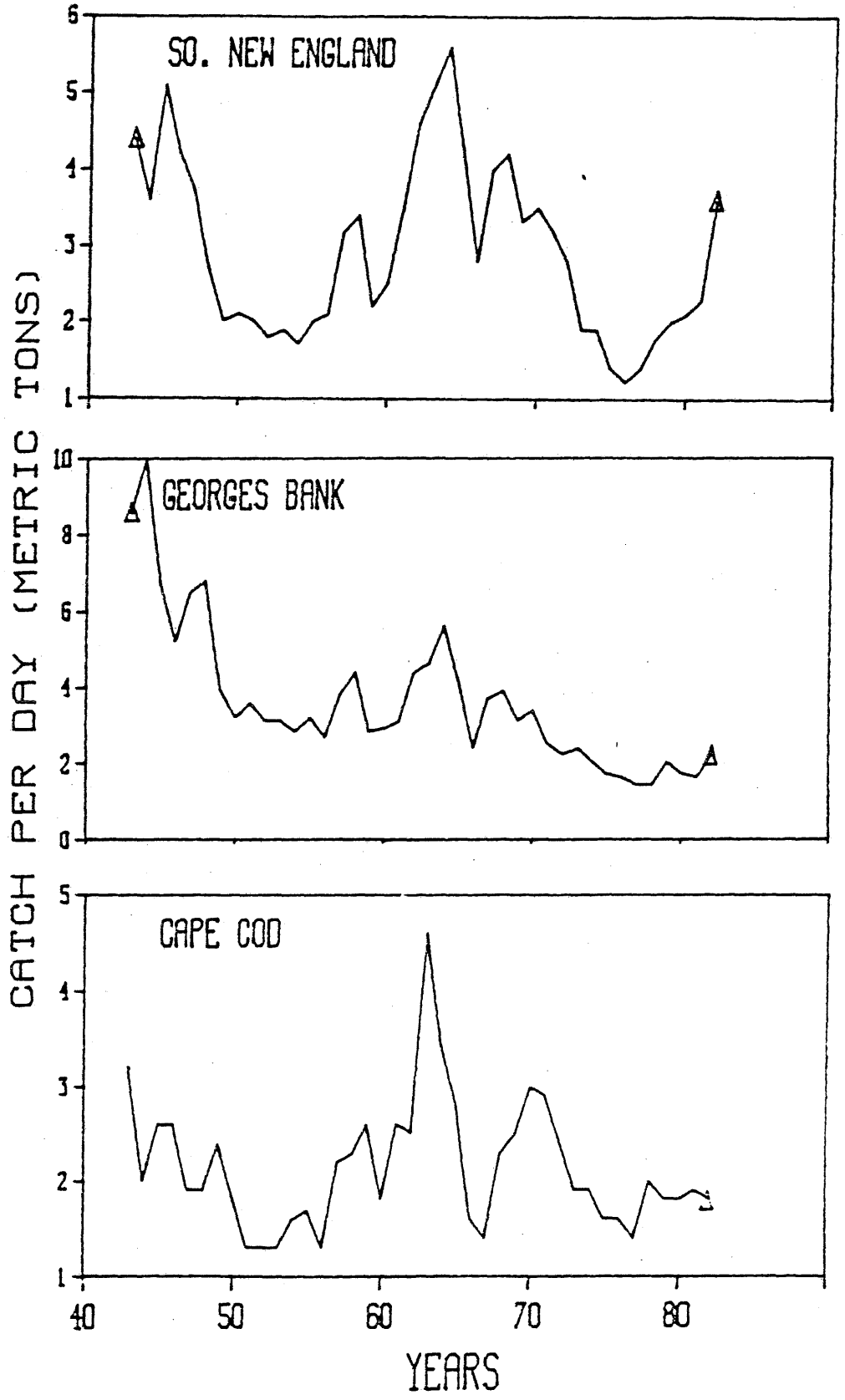

Figure 4. Commercial abundance indices (metric tons per standard day fished) for southern New England, Georges Bank, and Cape Cod yellowtail flounder, 1943-1982.

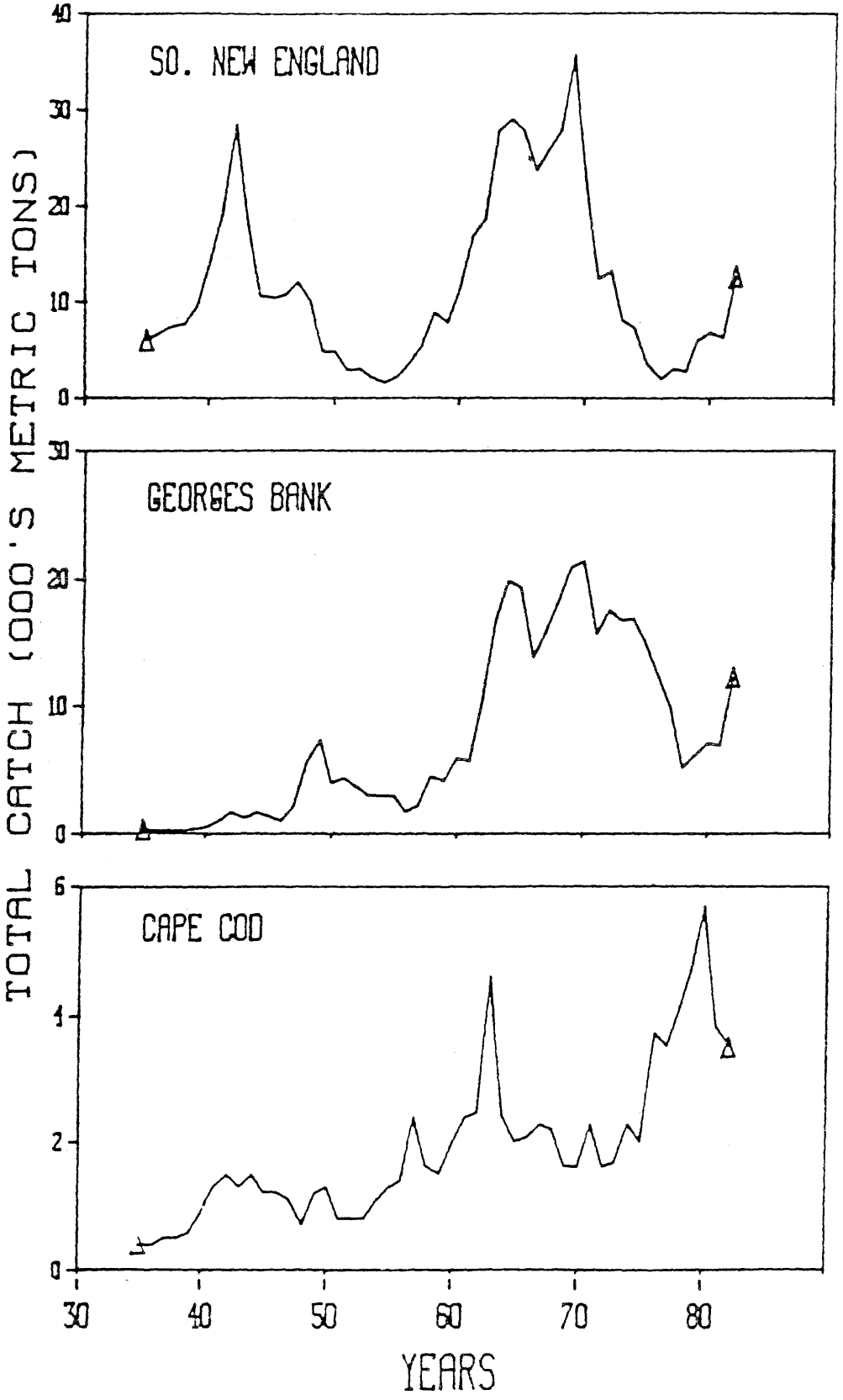

Figure 5. Total commercial catch (000's of metric tons, live) for southern New England, Georges Bank, and Cape Cod yellowtail flounder, 1935-1982.

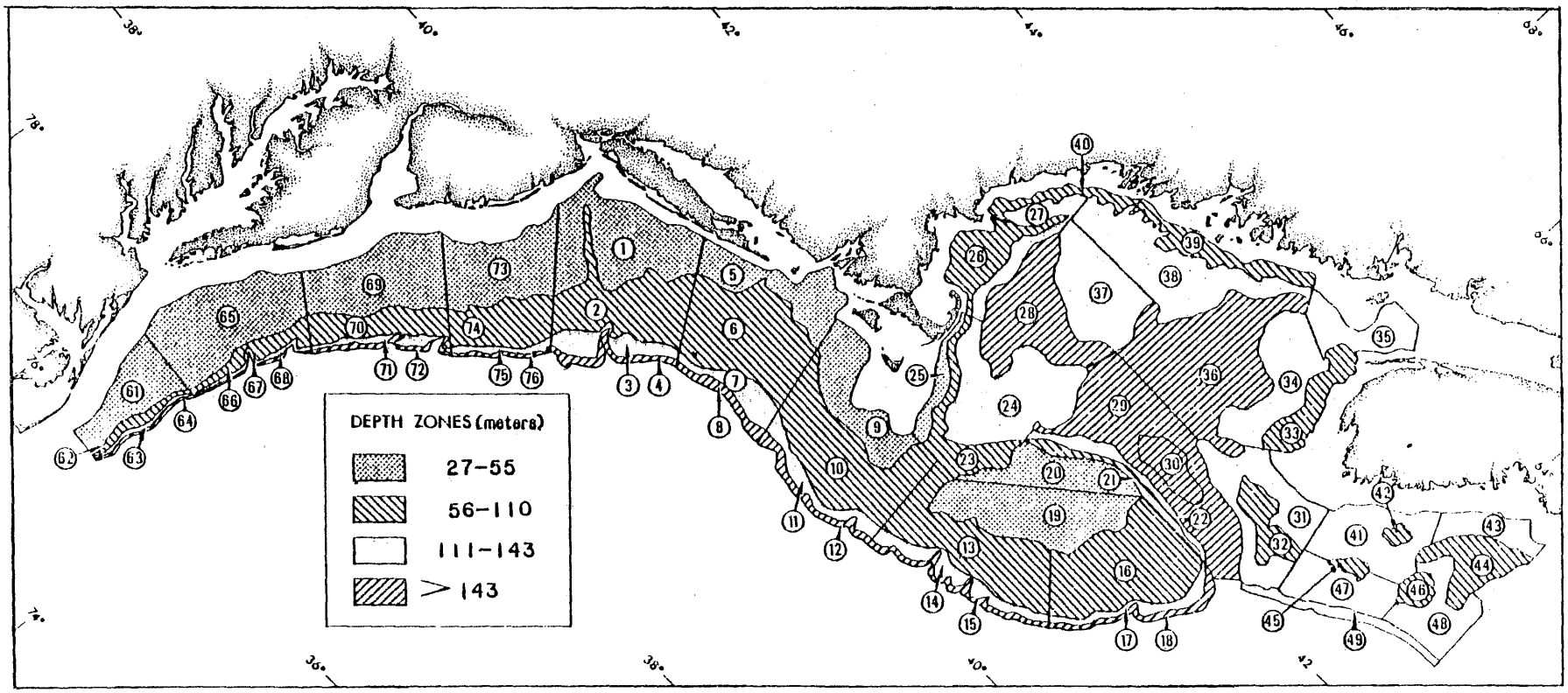

Figure 6. Strata used in NEFC offshore (>27m) spring, summer, and autumn bottom trawl surveys.

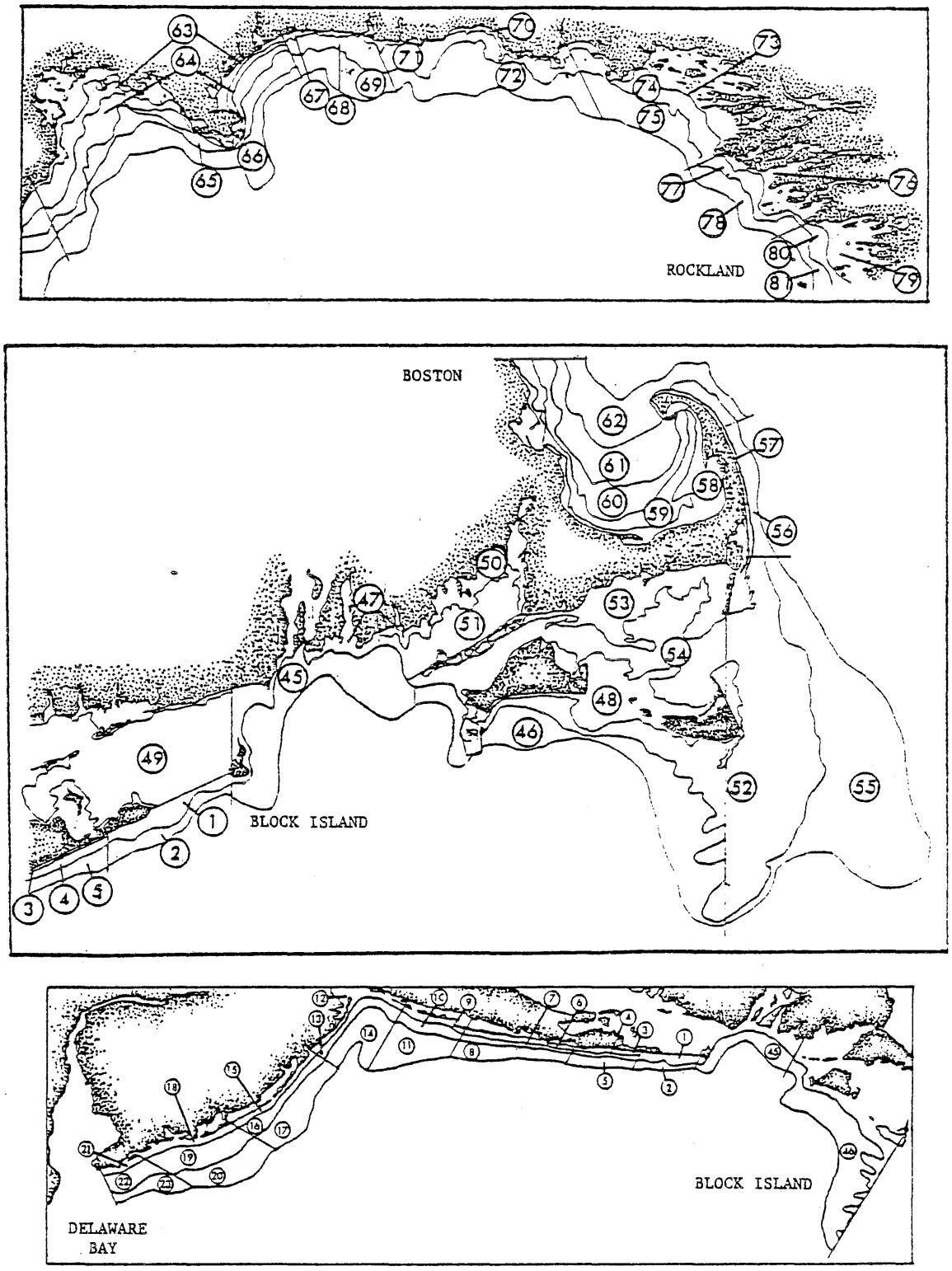

Figure 7. Strata used in NEFC inshore (<27m) spring, summer, and autumn bottom trawl surveys.

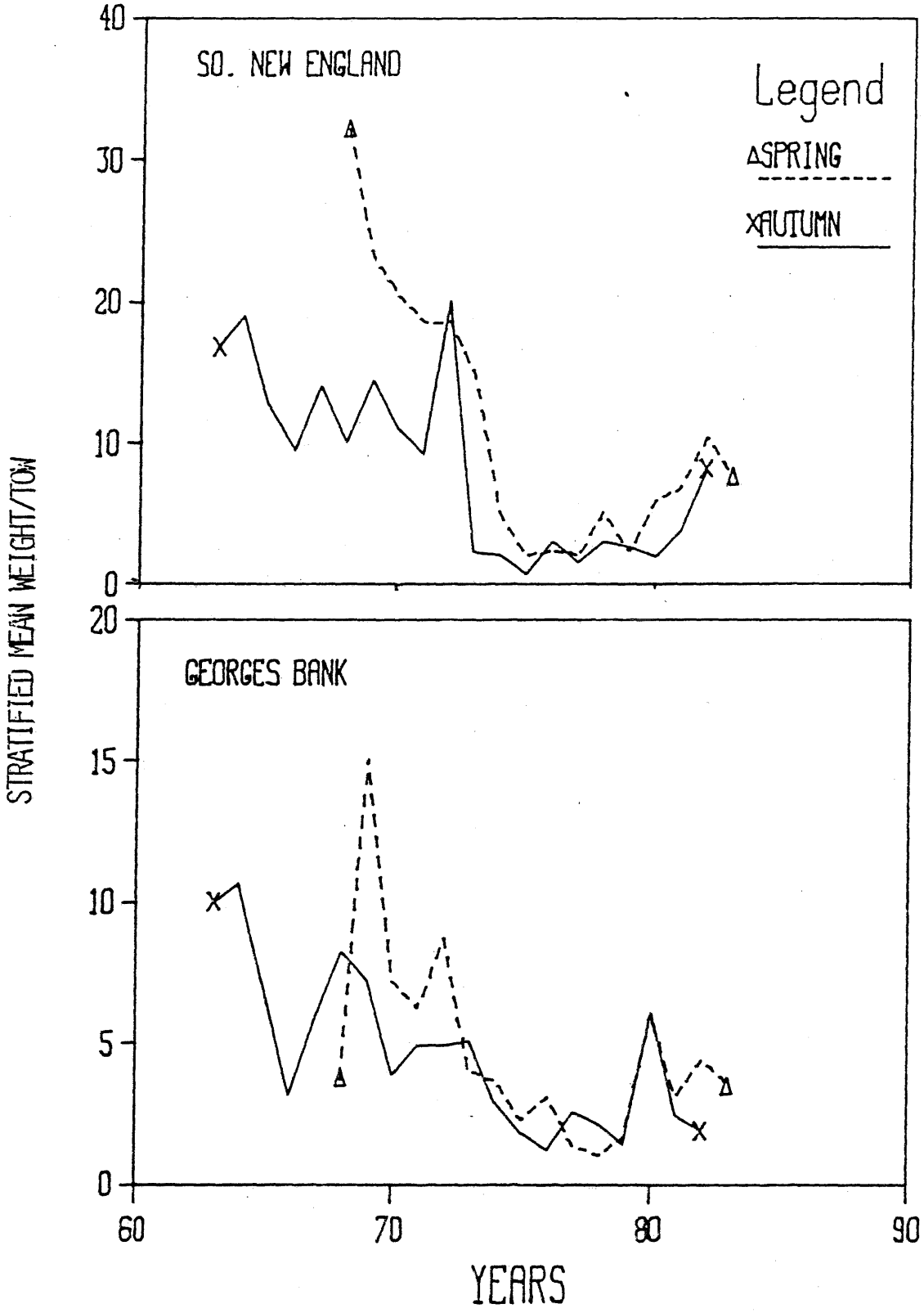

Figure 8. Stratified mean catch per tow (kg) of southern New England and Georges Bank yellowtail flounder from NEFC offshore spring and autumn bottom trawl surveys, 1963-1983.

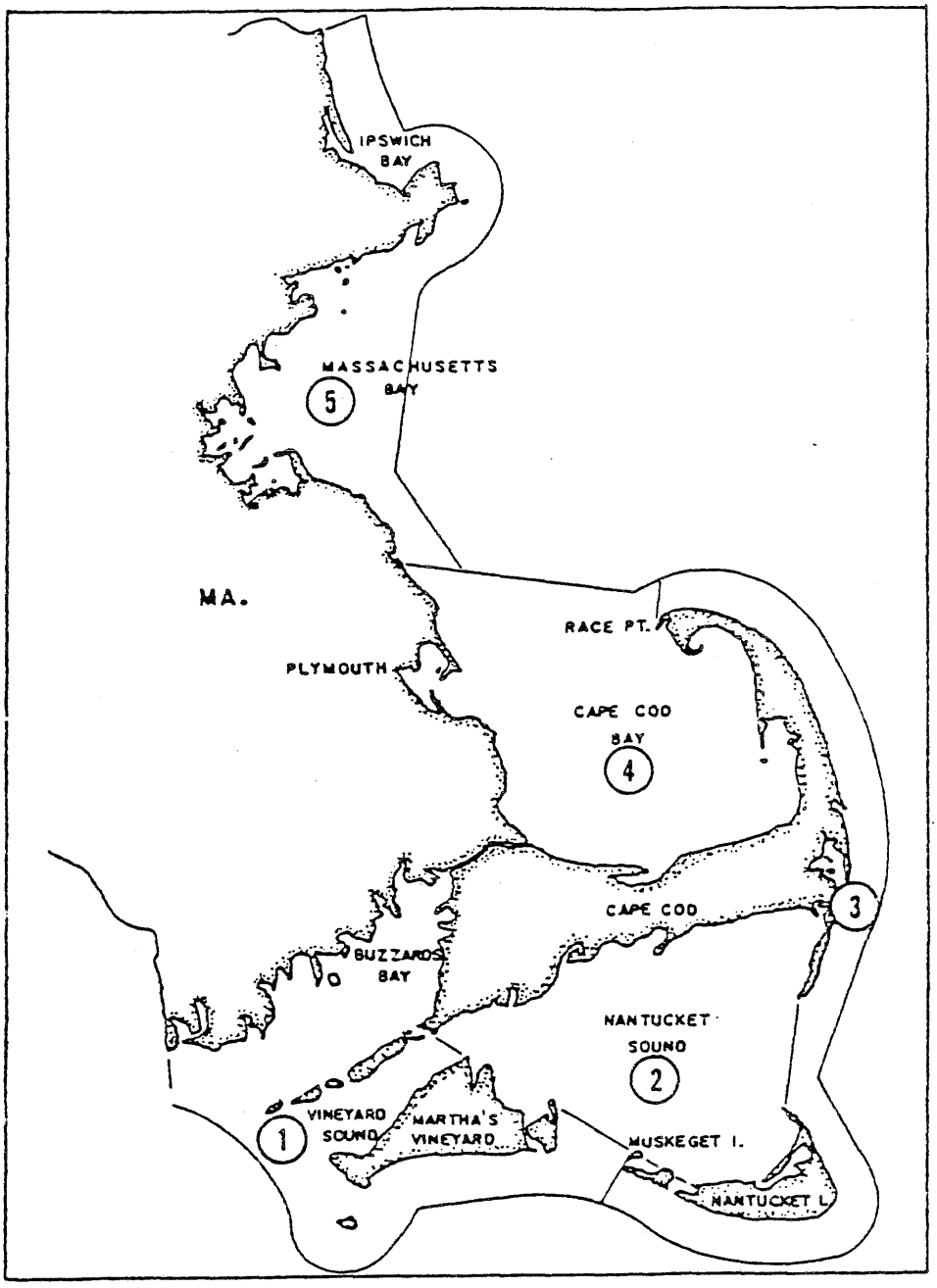

Figure 9. Massachusetts inshore bottom trawl survey area delineated by regions.

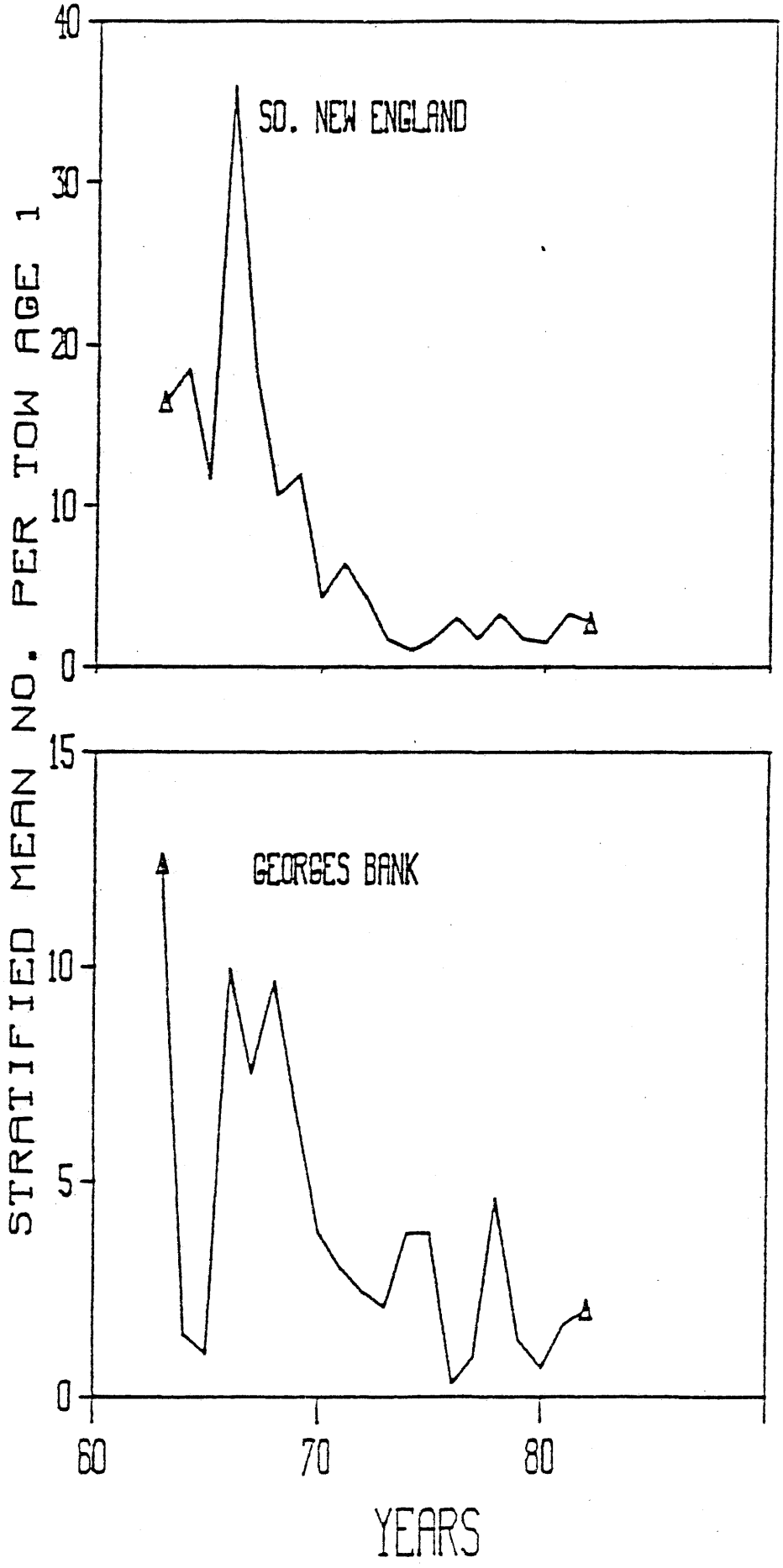

Figure 10. Pre-recruit indices (stratified mean number per tow of age 1 yellowtail) from NEFC offshore autumn bottom trawl survey data, 1963-1982.

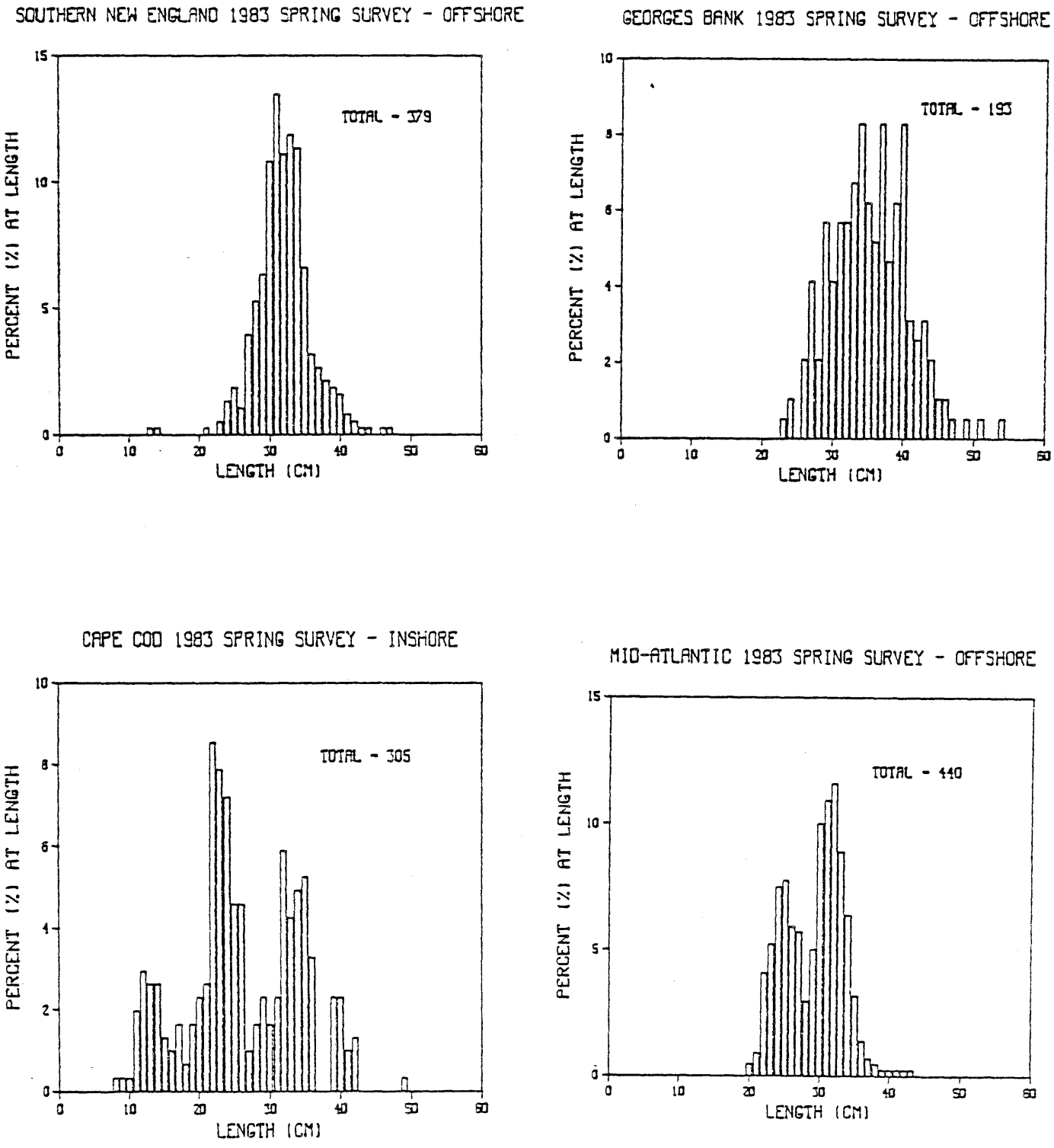

Figure 11. Yellowtail length frequencies (percent at length) by fishing area for NEFC Spring 1983 offshore and inshore bottom trawl surveys.

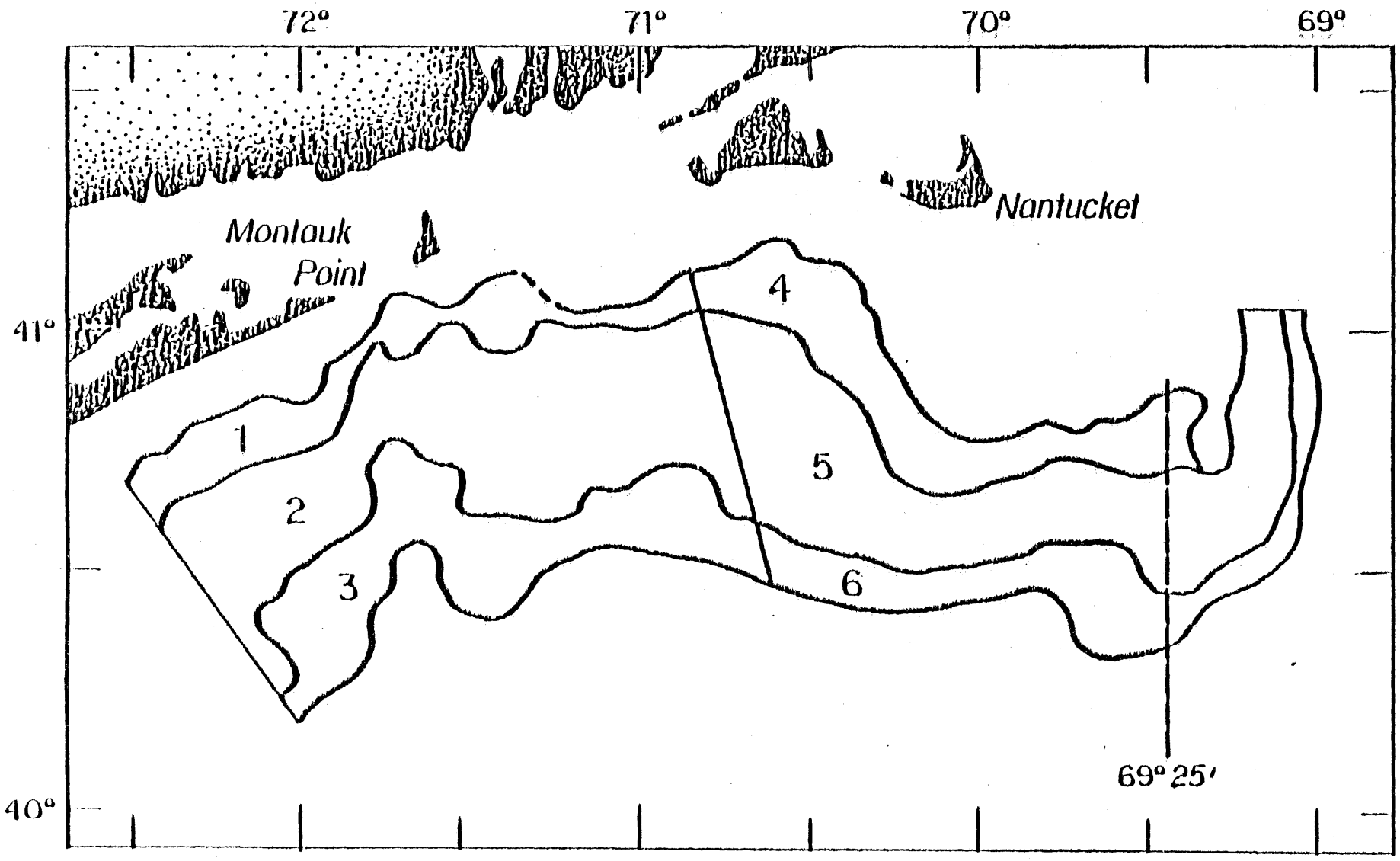

Figure 12. Strata used in cooperative yellowtail flounder surveys, 1980, 1981, and 1983.

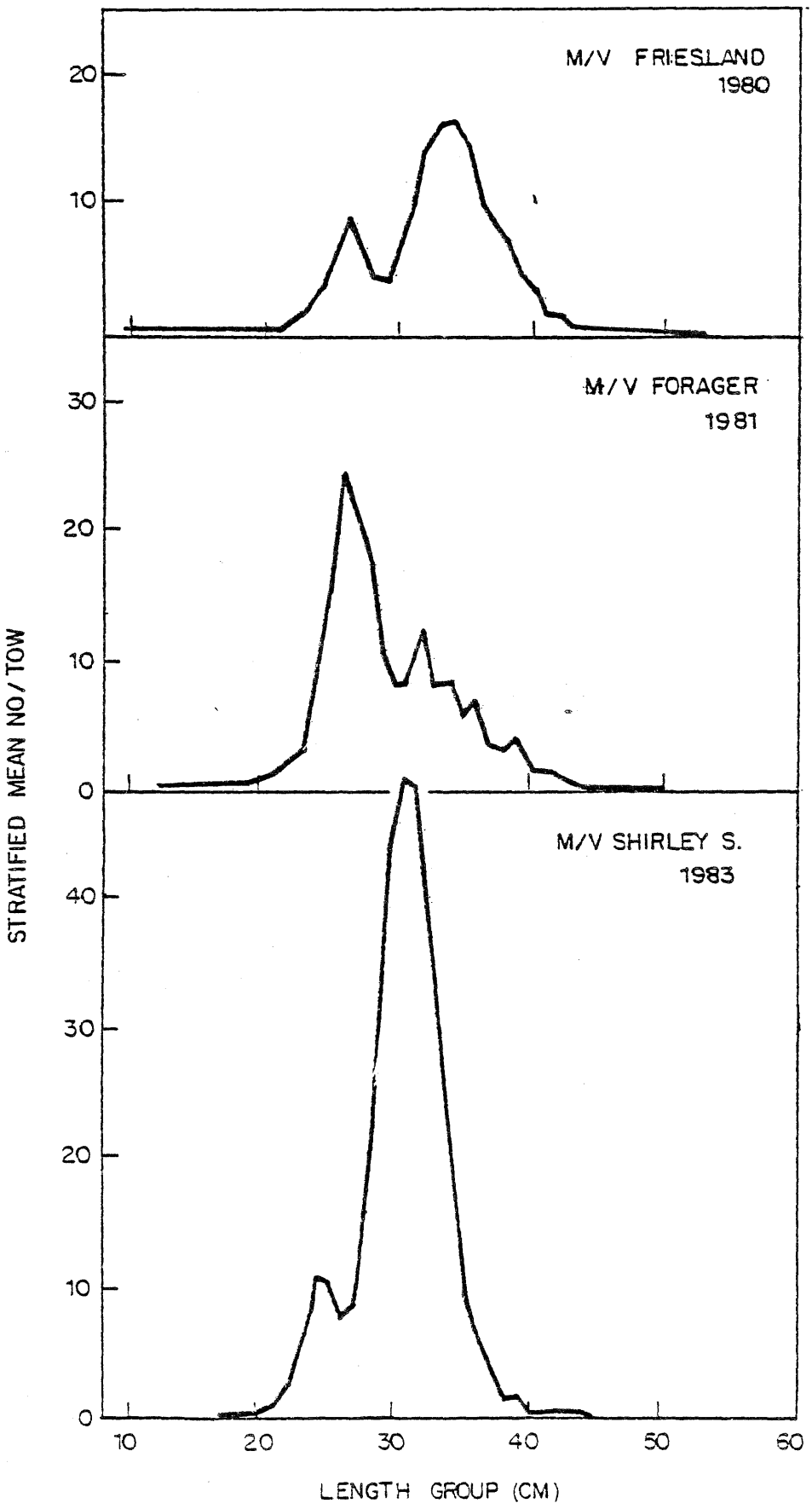

Figure 13. Length-frequency distributions of yellowtail flounder taken in cooperative surveys on the Southern New England grounds, 1980, 1981, and 1983.