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Assessment of the United States Northeast Region Skate Complex for 2000

by

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ABSTRACT

Distribution and abundance of the skate complex, consisting of seven species, off the Northeast coast of the United States was examined. Total landings in U.S. waters have increased from 5,000 mt to 14,000 mt in recent years. Preliminary discard estimates ranged from 20,000 mt to 70,000 mt from 1989-1998. Abundance (no/tow) and biomass (kg/tow) indices were derived for each of the seven species in the complex from research surveys. Winter skate abundance increased from low values in the 1970s to a peak around 1985 and are now about 25% peak abundance. Little skate abundance estimates for the spring are presently at record high levels. Barndoor skate abundance decreased sharply in the early 1960s and remained very low until an increase beginning in the early 1990s. The abundance, however, is still less than 10% of the values in the 1960s. Thorny skate abundance and biomass has decreased over the time series and current abundance is about 15% of the 1960s, the lowest in the time series. Smooth skate survey abundance declined during the 1980s, before stabilizing during the early 1990s at about 25% of the autumn and 50% of the spring survey values of the 1970s. Clearnose skate indices have increased steadily over the time series and are currently two to three times the values in the mid-1970s. Rosette skate abundance peaked in the late 1970s and early 1980s, declined to low levels in the mid-1980s, and have since increased.

Exploitation rates for winter skate decreased in the late 1970s and early 1980s. With the onset of the directed skate fishery fishing mortality increased and was estimated to be 0.4 in 1999. Little skate fishing mortality has also increased in recent years and is estimated to be 0.3 in 1999. Yield-per-recruit analyses for winter skate indicate that $F_{max} = 0.12$ and $F_{0.1} = 0.08$. Little skate F_{max} is undefined and $F_{0.1} = 0.65$

INTRODUCTION

The seven species in the Northeast Region (Maine to Virginia) skate complex are distributed along the coast of the northeast United States from near the tide line to depths exceeding 700 m (383 fathoms). The species are: little skate (*Raja erinacea*), winter skate (*R. ocellata*), barndoor skate (*R. laevis)*, thorny skate (*R. radiata*), smooth skate (*R. senta*), clearnose skate (*R. eglanteria*), and rosette skate (*R. garmani*). A brief discussion of commercial fishery landings and the population dynamics of little skate was presented in the report of Eleventh Northeast Fisheries Center Stock Assessment Workshop (SAW 11; NEFSC 1990).

In the Northeast region, the center of distribution for the little and winter skates is Georges Bank and Southern New England. The barndoor skate is most common in the Gulf of Maine, on Georges Bank, and in Southern New England. The thorny and smooth skates are commonly found in the Gulf of Maine. The clearnose and rosette skates have a more southern distribution, and are found primarily in Southern New England and the Chesapeake Bight. Skates are not known to undertake large-scale migrations, but they do move seasonally in response to changes in water temperature, moving offshore in summer and early autumn and returning inshore during winter and spring. Members of the skate family lay

eggs that are enclosed in a hard, leathery case commonly called a mermaid's purse. Incubation time is 6 to 12 months, with the young having the adult form at the time of hatching (Bigelow and Schroeder 1953).

METHODS

Fishery

United States commercial landings of all species of skate combined were summarized for 1960-1998. Landings could not be prorated to species, gear type or area at this time. Recreational catch was estimated by species using the Marine Recreational Fishery Statistics Survey (MRFSS) database for 1981-1998.

Preliminary commercial fishery discard estimates of skates, for all species combined, were calculated from the NEFSC Domestic Sea Sampling and Dealer Landings data for 1989-1998. The estimates were derived by gear type and primary species group caught on a sea sampled trip. A species group was considered the primary target when it constituted more than 50% of the total trip landings. This may result in an underestimation of total skate discards because some trips (2,604 of 11,834) were mixed and no species or group comprised 50% of the trip. The information is given for all species combined due to poor identification of skates.

The commercial fishery discard rates were initially calculated as the sum of the pounds of skate discarded divided by the sum of the pounds of the single, primary species kept for all years combined, within gear type/primary species cells. The number of trips for some of the gear type/primary species cells was small, so the data were next aggregated into species groups to derive yearly estimates for otter trawls, sink gill nets, and scallop dredges. The other fishing gears had too few trips to dis-aggregate by year. Even with the species groupings, some of the cells remained empty, requiring use of time series arithmetic average discard rates for those cells.

Research Survey Data

Indices of relative abundance were developed from NMFS, Northeast Fisheries Science Center (NEFSC) bottom trawl surveys for the seven species in the skate complex, and these form the basis for most of the conclusions about the status of the complex. All statistically significant NEFSC gear, door, and vessel conversion factors were applied to little, winter, and smooth skate indices when applicable (Sissenwine and Bowman, 1978; NEFSC 1991). Juvenile little and winter skates are not readily distinguished in the field. The numbers of juveniles were split between the two species based on the abundance of the adults in the same tow.

Biological Data and Reference Points

Increases in skate in the United States northeast region landings since 1980 and the potential for rapidly expanding export markets bring into question the level at which sustainable fisheries for these species can be maintained (Holden 1973). Skates have a limited reproductive capacity, and stock size could be quickly reduced through intensive exploitation. In some areas of the world where skates have been the targets of directed fisheries, their numbers have been reduced to extremely low levels (*e.g.*, in the Irish Sea; Brander 1981).

Frisk (MS 1999) compiled a summary of available life history parameters for skate species from around the world, and developed predictive relationships between total length (L_{max}) and length of maturity (L_{mat}) and age of maturity (A_{mat}). Frisk (MS 1999) concluded that the ratio of instantaneous natural mortality to the von Bertalanffy growth coefficient (M/K ratio) was about 1.0 for elasmobranchs (including skates).

Evaluation of Fishing Mortality

The length-based mortality estimators of Beverton and Holt (1956) and Hoenig (1987) were considered for the estimation of fishing mortality rates for winter and little skates from NEFSC spring length frequency distributions. The NEFSC spring survey series exhibit both a long time series and the least evidence of continuous trends in recruitment for the two species, making it amenable for use with these estimators, which can be biased by trends or extreme variation in recruitment over time.

The Beverton and Holt (1956) estimator is:

$$Z = (K(L_{inf} - L_{bar})) / (L_{bar} - L=),$$

and the Hoenig (1987) estimator is:

$$Z = \ln [(e^{-K}(L_{bar}-L_{inf}) + L_{inf} - L=) / (L_{bar} - L=)].$$

For both estimators, L= = the lower limit of the length class in which the fish are assumed fully recruited to the sampling or fishing gear, and L_{bar} = the mean length of fish above L= in the sample length distributions. Hoenig=s (1987) estimator reportedly avoids the positive bias in estimates calculated with the Beverton and Holt (1956) estimator for samples in which L= approaches L_{bar}. The Hoenig (1987) estimates were judged to be more reliable, and those are the fishing mortality rates referenced below. Estimates were calculated for 5 year (winter skate) and 3 year (little skate) moving groups, or windows, of years to smooth the variation in the mortality estimates caused by variations in recruitment over time. No age and growth parameters were available for the other five species in the complex, and so no mortality estimates have been made

RESULTS AND DISCUSSION

Commercial Fishery Landings

The principal commercial fishing method used to catch skates is otter trawling. Skates are frequently taken as bycatch during groundfish trawling and scallop dredge operations and are generally discarded. Recreational and non-U.S.A. landings are currently insignificant, at less than 1% of the total fishery landings. There are currently no regulations specifically governing the harvesting of skates in U.S. waters.

Skates have been reported in New England fishery landings since the late 1800s. However, commercial fishery landings, primarily from off Rhode Island, never exceeded several hundred metric tons until the advent of distant-water fleets during the 1960s. Skate landings reached 9,500 mt in 1969, but declined quickly during the 1970s, falling to 800 mt in 1981. Landings have since increased substantially, partially in response to increased demand for lobster bait, and more significantly, to the increased export market for skate wings. Landings are not reported by species, with over 99% of the landings reported as Aunclassified skates.@ Wings are taken from winter and thorny skates, the two species currently known to be used for human consumption. Bait landings are presumed to be primarily from little skate, based on areas fished and known species distribution patterns. Landings increased to 12,900 mt in 1993 and then declined somewhat to 7,200 mt in 1995. Landings have increased again since 1995, and the 1998 reported commercial landings of 17,000 mt was the highest on record (Table 1, Figure 1).

Commercial Fishery Discards

The commercial fishery discard estimates are the product of Domestic Sea Sampling discard rates and the reported landings of the primary target species groups from the Dealer Landings data. Table 2 gives the sum of the discard estimates by gear type. The estimates have ranged from high values between 50,000 and 70,000 mt in 1989-1990 to a low of 14,700 mt in 1994. Otter trawls and scallop dredges account for >90% of the total discards. Over the 1989-1998 period, the biomass of total discards is estimated to be two (1998) to eight times (1989) the reported total landings. The commercial fishery discard mortality rate of skates, and therefore the magnitude of total skate discard mortality, is unknown.

Calculation of total skate discards on the primary species group/annual discard rate basis provided a higher estimate of discards in 7 of the 10 years of the Domestic Sea Sample time series, when compared with the primary species/time series discard rate estimates. On average, the primary species group/annual discard rate estimates were 5% higher than the primary species based estimates (Table 3).

Recreational Fishery Catch

Aggregate recreational landings of the seven species in the skate complex are relatively insignificant when compared to the commercial landings, never exceeding 300 mt during the 1981-1998 times series of Marine Recreational Fishery Statistics Survey (MRFSS) estimates. Little and clearnose skates are the most frequently landed species of the complex. For little skate, total landings varied between <1000 and 56,000 fish, equivalent to <1 to 15 mt, during 1981-1998. For

clearnose skate, total landings varied between 2,000 and 145,000 fish, equivalent to 2 to 232 mt, during 1981-1998. The number of skates reported as released alive averages an order of magnitude higher than the reported landed number. Party/charter boats have historically been undersampled compared to the private/rental boat sector that accounts for most of the recreational catch, and may have a different discard rate. The recreational fishery release mortality rate of skates is unknown, but is likely comparable to that for flounders and other demersal species, which generally ranges from 10-15%. Assuming a 10-15% release mortality rate would suggest that recreational fishery discard mortality is of about the same magnitude as the recreational landings.

Research Survey Data

For the aggregate skate complex, the spring survey index of biomass was relatively constant from 1968 to 1980, then increased significantly to peak levels in the mid to late 1980s. The index of skate complex biomass then declined steadily until 1994, but has recently begun to increase again (Figure 2).

If the species in the complex are divided into large (barndoor, winter, and thorny) and small sized skates (little, clearnose, rosette, and smooth), it is evident that the large increase in skate biomass in the mid to late 1980s was dominated by winter and little skate (Figures 2-3). The biomass of large sized skates has steadily declined since the mid-1980s (Figure 3, top). The recent increase in aggregate skate biomass has been due to an increase in little skate (Figure 3, bottom).

Winter skate

NEFSC bottom trawl surveys indicate that winter skate are most abundant in the Georges Bank (GBK) and Southern New England (SNE) offshore strata regions, with few fish caught in the Gulf of Maine (GOM), or Mid-Atlantic (MA) regions (Figures 4-7). In the NEFSC spring survey offshore strata (1968-1999), the annual total catch of winter skate has ranged from 160 fish in 1976 to 1,891 fish in 1985. In the NEFSC autumn survey offshore strata (1963-1999), the annual total catch of winter skate has ranged from 115 fish in 1975 to 1,187 fish in 1984. Calculated on a per tow basis, these spring survey catches equate to maximum stratified mean number per tow indices for the GOM-MA offshore strata of about 7.9 fish, or 16.4 kg, per tow during 1985; autumn maximum catches equate to indices of 3.7 fish, or 13.3 kg per tow, in 1984 (Tables 4-5).

The catchability of winter skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series, especially for smaller winter skates. NEFSC winter survey (1992-1999) annual catches of winter skate have ranged from 841 fish in 1993 to 4,055 fish in 1996, equating to a maximum stratified mean catch per tow of 43.5 fish or 25.2 kg per tow in 1996 (Table 6). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine (Figures 8-9).

Indices of winter skate abundance and biomass from the NEFSC spring and autumn surveys were stable, but below the time series mean, during the late 1960s and 1970s. Winter skate indices increased to the time series mean by 1980, and then reached a peak during the mid 1980s. Winter skates indices began to decline in the late 1980s. Current NEFSC indices of winter skate abundance are below the time series mean, at about the same value as during the early 1970s. Current NEFSC indices of winter skate biomass are about 25% of the peak observed during the mid 1980s (Figure 10).

The minimum length of winter skate caught in NEFSC surveys is 15 cm , and the largest individual caught was 113 cm total length. The median length of the survey catch has ranged from 38 cm in the 1992 winter survey to 79 cm in the 1978 spring survey. The median length of the survey catch generally declined from 1979 to the mid-1990s in both the spring and autumn surveys, but has been increasing in recent years, and is currently about 57-58 cm (Figure 11). Length frequency distributions from the NEFSC spring and autumn surveys show several modes, most often at 40, 60, and 80 cm (Figures 12-15). The spring survey length distributions show large modes at about 40 cm during the mid-1980s through the mid 1990s, suggesting strong recruitment during that period. Truncation of the length distributions is evident in the NEFSC spring and autumn series since 1990.

Little skate

NEFSC bottom trawl surveys indicate that little skate are abundant in the inshore and offshore strata in all regions of the

northeast US coast, but are most abundant on Georges Bank and in Southern New England (Figures 16-19). In the NEFSC spring surveys (1976-1999), the annual total catch of little skate has ranged from 3,512 fish in 1986 to 16,406 fish in 1999. In the NEFSC autumn surveys (1975-1999), the annual total catch of little skate in offshore strata has ranged from 1,124 fish in 1993 to 3,848 fish in 1982 and 4,597 fish in 1978. Calculated on a per tow basis, these spring survey catches equate to maximum stratified mean number per tow indices for the GOM-MA inshore and offshore strata of about 28 fish, or 10 kg, per tow during 1999; autumn maximum catches equate to indices of 6 fish, or 3 kg, per tow in 1978, and 15 fish, or 6 kg, per tow in 1982 (due to high variance in survey catch in 1982; Tables 7-8).

The catchability of little skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series. NEFSC winter survey (1992-1999) annual catches of little skate have ranged from 10,113 fish in 1994 to 18,418 fish in 1992, equating to a maximum stratified mean catch per tow of 170 fish or 66 kg per tow in 1992 (Table 9). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine (Figures 20-21).

Indices of little skate abundance and biomass from the NEFSC spring and autumn surveys were stable, but below the time series mean, during the 1970s. Little skate spring survey indices began to increase in 1982, and have reached a peak in 1999. Autumn survey indices have been relatively stable over the duration of the time series (Figure 22). The application of the NEFSC gear conversion factors to spring survey indices decreased the indices in 1981 and earlier years by about 75 percent.

The minimum length of little skate caught in NEFSC surveys is 6 cm, and the largest individual caught was 62 cm total length. The median length of the survey catch has ranged from 31 cm in the 1979 and 1987 spring surveys to 43 cm, most recently in the 1998 autumn survey. The median length of the survey catch has been generally stable over the duration of the spring and autumn surveys and is currently about 38 cm in the spring and 43 cm in the autumn (Figure 23). Length frequency distributions from the NEFSC spring and autumn surveys show several modes, most often at 10, 20, 30, and 45 cm, which may represent ages 0, 1, 2, and 3 and older little skate (Figures 24-26).

Barndoor skate

U.S. Bureau of Fisheries research surveys (Figures 27-28) and NEFSC bottom trawl surveys (Figure 29) indicate that barndoor skate are most abundant in the Gulf of Maine, Georges Bank, and Southern New England offshore strata regions, with very few fish caught in inshore (< 27 meters depth) or Mid-Atlantic regions. Bigelow and Schroder (1953), however, noted that historically barndoor skate were found in inshore waters to the tide-line, and in depths as great as 400 meters off Nantucket. In the NEFSC spring surveys (1968-1999), the annual total catch of barndoor skate has ranged from 0 fish (several years during the 1970s and 1980s) to 22 fish in 1969. In the NEFSC autumn surveys (1963-1999), the annual total catch of barndoor skate has ranged from 0 fish (several years in the 1970s and 1980s) to 120 fish in 1963. Calculated on a per tow basis, the autumn survey catches equate to maximum stratified mean number per tow indices for the GOM-SNE offshore strata of about 0.8 fish, or 2.6 kg, per tow in 1963 (Tables 10-11).

The catchability of barndoor skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series and may be particularly higher for smaller skates as in winter skates. NEFSC winter survey (1992-1999) annual catches of barndoor skate have ranged from 0 fish in 1992 to 81 in 1999, equating to a maximum stratified mean catch per tow of 0.7 fish or 1.0 kg per tow in 1999 (Table 12). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine (Figure 30).

Indices of barndoor skate abundance and biomass from the NEFSC spring survey were at their highest values during early 1960s, and then declined to 0 fish per tow during the early 1980s. Since 1990, both spring and autumn survey indices have steadily increased, but are still only <10% of the peak values observed in the 1960s (Figure 31).

The minimum length of barndoor skate caught in NEFSC surveys is 20 cm, and the largest individual caught was 136 cm total length. The median length of the survey catch has ranged from 20 cm in the 1985 spring survey to 119 cm in the 1972 spring survey. The median length of the survey catch has been increasing in recent years in both the spring and

autumn surveys, and is currently 70-75 cm (28-30 in; Figure 32). Length frequency distributions from the NEFSC spring and autumn surveys illustrate the decline in abundance of barndoor skate to survey catches of zero during the 1980s (Figures 33-36). Recent catches have included individuals as large as those recorded during the peak abundance of the 1960s, but the large number of fish between 40 and 80 cm evident during the 1960s is not apparent in recent surveys. The NEFSC winter survey length frequency distributions for 1998-1999 indicate a significant recent increase in the abundance of barndoor skate at lengths less than 80 cm (Figure 37).

Thorny skate

NEFSC bottom trawl surveys indicate that thorny skate are most abundant in the Gulf of Maine and Georges Bank offshore strata regions, with very few fish caught in inshore (< 27 meters depth), Southern New England, or Mid-Atlantic regions (Figures 38-41). In the NEFSC spring surveys (1968-1999), the annual total catch of thorny skate has ranged from 44 fish in 1999 to 574 fish in 1973. In the NEFSC autumn surveys (1963-1999), the annual total catch of thorny skate has ranged from 60 fish in 1998 to 874 fish in 1978. Calculated on a per tow basis, these spring and autumn survey catches equate to maximum stratified mean number per tow indices for the GOM-MA offshore strata of about 2 to 3 fish, or about 6.0 kg, per tow during the early 1970s (Tables 13-14).

NEFSC survey indices for thorny skate have declined continuously over the last 30 years. Indices of thorny skate abundance and biomass from the NEFSC spring and autumn surveys were at a peak during the early 1970s, reaching 2.9 fish per tow (5.3 kg per tow) in the spring survey and 1.8 fish per tow (5.9 kg per tow) in the autumn survey. NEFSC indices of thorny skate abundance have declined steadily since the late 1970s, reaching historically low values in 1998 and 1999 that are only 10%-15 % of the peak observed in the 1970s (Figure 42).

The minimum length of thorny skate caught in NEFSC surveys is about 10 cm, and the largest individual caught was 111 cm total length. The median length of the survey catch has ranged from 31 cm in the 1988 autumn survey to 63 cm in the 1971 autumn survey. The median length of the survey catch has trended downward through most of the survey time series, but has been increasing in recent years in autumn surveys, and is currently 40-50 cm (Figure 43). Length frequency distributions from the NEFSC spring and autumn surveys show a pattern of decline in abundance of larger individuals consistent with an increase in total mortality over the survey time series (Figures 44-47).

Smooth skate

NEFSC bottom trawl surveys indicate that smooth skate are most abundant in the Gulf of Maine and Georges Bank offshore strata regions, with very few fish caught in inshore (< 27 meters depth), Southern New England, or Mid-Atlantic regions (Figure 48). In the NEFSC spring surveys (1968-1999), the annual total catch of smooth skate has ranged from12 fish in 1996 to 179 fish in 1973. In the NEFSC autumn surveys (1963-1999), the annual total catch of smooth skate has ranged from 10 fish in 1976 to 130 fish in 1978. Calculated on a per tow basis, these spring and autumn survey catches equate to maximum stratified mean number per tow indices for the GOM-MA offshore strata of 0.6 to 1.6 fish, or about 0.6 to 0.9 kg, per tow during the 1970s (Tables 15-16).

Indices of smooth skate abundance and biomass from the NEFSC surveys were at a peak during the early 1970s for the spring series and the late 1970s for the autumn series. NEFSC survey indices declined during the 1980s, before stabilizing during the early 1990s at about 25% of the autumn and 50% of the spring survey index values of the 1970s. There is evidence in the spring 1998-1999 indices of a recent increase in smooth skate abundance (Figure 49). However, the autumn survey does not exhibit the same trend.

The minimum length of smooth skate caught in NEFSC surveys is about 8 cm, and the largest individual caught was 71 cm total length. The median length of the survey catch has ranged from 26 cm in the 1993 autumn survey to 53 cm in the 1971 autumn survey. The median length of the survey catch in the GOM offshore region shows no trend over the full survey time series, and is currently at about 30 cm (Figure 50). Length frequency distributions from the NEFSC spring and autumn survey show modes at 30 and 50 cm (Figures 51-54). The relatively high abundances evident in the 1969-1983 spring surveys at the larger mode may represent the accumulated abundance at several older ages. Truncation of the larger mode is evident in the spring distributions during the 1980s and most of the 1990s. The 1999 spring survey length frequency distribution may indicate strong recruitment in the region.

Clearnose skate

NEFSC bottom trawl surveys indicate that clearnose skate are most abundant in the Mid-Atlantic offshore and inshore strata regions, with very few fish caught in Southern New England and no fish caught in other survey regions (Figure 55). In the NEFSC spring surveys (1976-1999), the annual total catch of clearnose skate has ranged from 9 fish in 1979 to 136 fish in 1993. In the NEFSC autumn surveys (1975-1999), the annual total catch of clearnose skate has ranged from 19 fish in 1983 to 129 fish in 1994. Calculated on a per tow basis, these spring and autumn survey catches equate to maximum stratified mean number per tow indices for the Mid-Atlantic offshore and inshore strata set of 1.2-1.6 fish, or about 0.8-0.9 kg, per tow during the mid 1990s (Tables 17-18).

The catchability of clearnose skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series. NEFSC winter survey (1992-1999) annual catches of clearnose skate have ranged from 343 fish in 1999 to 3,086 fish in 1996, equating to a maximum stratified mean catch per tow of 12 fish or 15 kg per tow in 1996 (Table 19). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine (Figure 56).

NEFSC spring and autumn survey indices for clearnose skate have been increasing since the mid-1980s. (Figure 57).

The minimum length of clearnose skate caught in NEFSC surveys is about 10 cm, and the largest individual caught was 93 cm total length. The median length of the survey catch has ranged from 41 cm in the 1980 spring survey to 67 cm in the 1995 spring survey. The median length of the spring survey catch has increased over the time series, from about 50 cm during the late 1970s to at about 60 cm in recent years (Figure 58). The median length of the autumn survey catch has been stable over the time series, and is also at about 60 cm. Length frequency distributions from the NEFSC spring and autumn surveys show a consistent mode at 60-70 cm that may represent the accumulated abundance of several older ages (Figures 59-61).

Rosette skate

NEFSC bottom trawl surveys indicate that rosette skate are most abundant in the Mid-Atlantic offshore strata region, with very few fish caught in Southern New England and no fish caught in other survey regions (Figure 62). In the NEFSC spring surveys (1968-1999), the annual total catch of rosette skate has ranged from 0 fish, in 1984, to 70 fish in 1977. In the NEFSC autumn surveys (1963-1999), the annual total catch of rosette skate has ranged from 1 fish, most recently in 1982, to 45 fish in 1981. Calculated on a per tow basis, these spring survey catches equate to maximum stratified mean number per tow indices for the Mid-Atlantic offshore strata set of about 0.6 fish, or about 0.1 kg, per tow during 1977 (Tables 20-21).

The catchability of rosette skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series. NEFSC winter survey (1992-1999) annual catches of rosette skate have ranged from 143 fish in 1993 to 899 fish in 1996, equating to a maximum stratified mean catch per tow of 1.4 fish or 0.3 kg per tow in 1996 (Table 22). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine (Figure 63).

Indices of rosette skate abundance and biomass from the NEFSC surveys were at a peak during 1975-1980, before declining through 1986. NEFSC survey indices for rosette skate have been increasing since 1986, and recent indices are at about 50% of the peak values of the late 1970s (Figure 64).

The minimum length of rosette skate caught in NEFSC surveys is about 7 cm, and the largest individual caught was 57 cm total length. The median length of the survey catch has ranged from 18 cm in the 1985 spring survey to 57 cm in the 1971 spring survey, during which only 1 rosette skate was caught. The median length of the survey catch has been stable over the spring and autumn time series at about 36-37 cm (Figure 65). Length frequency distributions from the NEFSC spring and autumn surveys show a consistent mode at 30-40 cm (Figures 66-69).

Biological Data and Reference Points

Winter skate

Winter skates are a relatively long-lived, slow growing species. Estimates of age and growth parameters are available for winter skate in Canadian waters (eastern Scotian Shelf) from Simon and Frank (1996), who reported the preliminary results of an age and growth study conducted at St. Mary=s University by R. Nearing. Simon and Frank (1996) reported that the study of winter skate from 12 to 100 cm found ages from 0-group to 16 years, providing von Bertalanffy parameters of L_{inf} = 114.1 cm, K = 0.14405, and t_0 = 0.00315. Simon and Frank (1996) used the relationships developed by Taylor (1958) and Hoenig (1983) to estimate a maximum age of 20.8 years and a value of M of 0.214 for winter skate. Simon and Frank (1998) found that winter skate on the eastern Scotian Shelf reached 50% maturity at about 75 cm.

Frisk (MS 1999) references McEachran (In press) as the source for a maximum length (L_{max}) of 150 cm and length of maturity (L_{mat}) of 79.5 cm. Using Frisk=s (1999) predictive equations and the NEFSC survey maximum observed length of 113 cm provides estimates of L_{mat} of 85 cm and A_{mat} of 7 years.

We initially used recent NEFSC spring and autumn survey cumulative length distributions (1994-1999), and recent landed skate cumulative length distributions from NEFSC sea sampling of the commercial fishery (1994-1999) to develop a contemporary estimate of the retained or landed length (L_{50} = 77 cm) and age of recruitment of winter skate to the commercial fisheries for use in a Thompson and Bell (1936) yield per recruit analysis (YPR). This retained or landed length reflects the kept portion of the catch recorded in the sea sample data, and is much higher than might be expected given the size of trawl mesh (generally 6 inches or smaller) used in nearly all of the region=s trawl fisheries. We concluded that it was more reasonable to assume a length closer to that assumed for little skate (L= = 45 cm) for use in reference point and mortality rate models, and so the NEFSC survey L= = 50 cm was assumed to be more reasonable as the length of recruitment (L_{50}) to the commercial fishery for winter skate.

Growth parameters and proportions mature at age from Simon and Frank (1996, 1998) for winter skate in Canadian waters were used to estimate parameters for the YPR model. The length-weight equation from NEFSC survey data collected during 1991- 1998 was used to convert length to weight. Winter skate are estimated to attain full recruitment to the fisheries at age 3. Frisk=s (1999) work suggests that the M/K ratio for skates is about 1.0. Taking into consideration the Simon and Frank (1996) estimate of K = 0.14, we concluded that a value of M = 0.1, and an inferred maximum age of 30 years, is appropriate for winter skate, providing estimates of F_{max} = 0.12 and $F_{0.1}$ = 0.08 (Table 23).

Little skate

Little skates are a relatively short-lived, fast growing species. Frisk (MS 1999) references Johnson (1979) as the source for maximum lengths (L_{max}) of 60 cm (males) and 62 cm (females) cm, A_{max} of 4 years for both sexes, L_{mat} of about 45 cm for both sexes, fecundity of 30 egg cases per year, and maximum age of 8 years. Using Frisk=s (1999) predictive equations and the NEFSC survey maximum observed length of 62 cm provides estimates of L_{mat} of 50 cm and A_{mat} of 4 years; using Waring=s (1984) L_{inf} value of about 53 cm provides an estimate of L_{mat} of 43 cm.

Waring (1984) investigated the age, growth, mortality, and yield per recruit of little skate in the Georges Bank-Delaware Bay region using NEFSC trawl survey data collected during 1968-1978. Waring (1984) observed a maximum age of 8 years, and estimated von Bertalanffy growth parameters of L_{inf} = 52.73 cm, K = 0.352, and t_0 = -0.449 years, based on interpretation of presumed annual rings in the centrum of 923 little skate vertebrae. The length-weight relationship for both sexes combined over the years of the Waring (1984) study was $\log_{10}W_g = -2.641 + 3.229 * \log_{10}L_{cm}$. Waring (1984) assumed an age-2 entry to the trawl fishery of the 1970s in estimating values of F_{max} = 1.00 and $F_{0.1}$ = 0.49, for M = 0.4, but warned that fishing at the F_{max} level might result in over-exploitation of little skate due to their low fecundity.

We used recent NEFSC spring and autumn survey cumulative length distributions (1994-1999), and recent landed skate cumulative length distributions from NEFSC sea sampling of the commercial fishery (1994-1999) to develop a contemporary estimate of the length (L_{50} = 45 cm) and age of recruitment of little skate to the commercial fisheries for use in a Thompson and Bell (1936) yield per recruit analysis (YPR). Waring=s (1984) growth parameters were used to convert lengths to age. NEFSC length-weight equations from the 1991-1999 surveys were used to convert mean lengths at age to mean weights at age. In the current analysis, little skate do not approach full recruitment to the fisheries until age 4 (70% at age 3, 90% at age 4, 100% at ages 5 to 8), F_{max} is undefined, and $F_{0.1}$ = 0.65, about 33% higher than

Waring=s (1984) analysis (Table 24).

Barndoor skate

Barndoor skates are presumed to be a relatively long-lived, slow growing species, but no estimates of age and growth parameters are currently available. Casey and Myers (1998) proposed that barndoor skate might have characteristics similar to the European common skate, (*Raja batis*). By analogy, Casey and Myers (1998) suggested an L_{max} of 153 cm, A_{mat} of 11 years, and F of 47 egg cases per year for barndoor skate. Using Frisk=s (1999) predictive equations and the NEFSC survey maximum observed length of 136 cm provides estimates of L_{mat} of 102 cm and A_{mat} of 8 years.

Thorny skate

Simon and Frank (1996) reported that nearly all thorny skate smaller than 50 cm sampled during a 1996 research cruise were immature, while nearly all skate larger than 50 cm were mature. These results were comparable to maturity studies of thorny skate conducted by Templeman (1982) on the Newfoundland shelf.

Frisk (1999) references Templeman (1965) for estimates of L_{max} = 102 cm and a maximum age of 20 years, which would infer a value for M of 0.2. Frisk=s (1999) predictive equations and the NEFSC survey L_{max} of 111 cm provides estimates of L_{mat} of 84 cm and A_{mat} of 7 years.

Smooth skate

Frisk=s (1999) predictive equations and the NEFSC survey L_{max} of 71 cm provides estimates of L_{mat} of 56 cm and A_{mat} of 5 years.

Clearnose skate

Frisk (1999) references McEachran (In press) as the source for estimates of L_{max} = 128 cm and L_{mat} = 66 cm, and a maximum age of 7 years Frisk=s (1999) predictive equations and the NEFSC survey L_{max} of 78 cm provides estimates of L_{mat} of 61 cm and A_{mat} of 5 to 6 years.

Rosette skate

Frisk (1999) references McEachran (In press) as the source for estimates of L_{max} = 46 cm and L_{mat} = 36 cm. Frisk=s (1999) predictive equations and the NEFSC survey L_{max} of 57 cm provides estimates of L_{mat} of 46 cm and A_{mat} of 4 years.

Evaluation of Fishing Mortality

Winter skate

Investigation of the NEFSC spring survey length frequencies determined that the appropriate value for L= was 50 cm, based on the time series average of the 1 cm length intervals with the most abundant survey catches. The von Bertalaffy growth parameters reported in Simon and Frank (1996) were used in the mortality rate estimator, and initially a value of M = 0.2 was used based on assumed maximum age of about 20 years.

For M = 0.2, Hoenig (1987) estimates of F for winter skate were about 0.2 during the 1970s, falling to very low levels during the 1980s, and then increasing during the 1990s to 0.2-0.3. The very low to negative values of F during the 1980s with M = 0.2, however, indicated that some of the parameters used in the estimators (either the growth parameters, L=, or M) might be mis-specified, and so the fishing mortality estimates may be negatively biased. Frisk=s (1999) work suggests that the M/K ratio for skates is about 1.0. Taking into consideration the Simon and Frank (1996) estimate of K = 0.14, we concluded that a value of M = 0.1, and an inferred maximum age of 30 years, was appropriate for winter skate.

With M=0.1, fishing mortality on winter skate was estimated to be about 0.30 (Table 25, Figure 70). Fishing mortality decreased in concert with a drop in reported landings of all species of skates (Figure 1) and an increase in abundance of winter skate (Figure 10) during the late 1970s and into the mid 1980s. Fishing mortality was near or below F = 0.1 during 1979-1992 (Table 25, Figure 70). Fishing mortality on winter skate has increased during the 1990s as reported landings of all species of skates have increased (Figure 1) and the abundance of winter skate has decreased (Figure 10).

Little skate

Waring (1984) used catch curve analysis of the NEFSC survey catch at age data for 1968-1978 to estimate an instantaneous total mortality rate (Z) of 1.76 in the early 1970s, which declined to 0.54 in the late 1970s. Assuming values of instantaneous natural mortality (M) of 0.4-0.5, Waring (1984) inferred that fishing mortality rates therefore ranged from 1.26-1.35 in the early 1970s to 0.17 to 0.27 in the late 1970s.

Investigation of the NEFSC winter, spring, and autumn length frequencies determined that the appropriate value for L**=** was 45 cm in the NEFSC winter, spring and autumn surveys, based on the time series average of the 1 cm length intervals with the most abundant survey catches. Investigation of NEFSC survey cumulative length distributions (1994-1999) and recent landed skate cumulative length distributions from NEFSC sea sampling of the commercial fishery (1994-1999) indicated that the contemporary estimate of the length of recruitment to the fishery was very similar, at 43 cm, and so fishing mortality estimates with the survey L**=** = 45 cm are considered valid estimates of the fully recruited fishing mortality rate. The von Bertalanffy growth parameters reported in Waring (1984) were used in both mortality rate estimators, and a value of M = 0.4 was used based on an assumed maximum age of about 8 years.

The time series of little skate mortality begins with the 1982-1984 three year window (1984 in Table 26) to ensure a series with consistent survey vessel and gear catch conversion factors. Estimates of fishing mortality for little skate have risen from about 0.20 during 1984-1990 to about 0.30 during the 1990s. The estimates of fishing mortality for little skate are sensitive to small changes in the value of Lbar (about 47 cm), which is both within the large accumulation of skates between 40 and 50 cm in most annual NEFSC spring length frequency distributions (Figures 24-26) and within 6 cm of Linf (53 cm). The 1997-1999 increase in F (1999 in Table 26) is due to a time series low value of L_{bar}, and that in turn is due at least in part to recent increased abundance of smaller skates in the survey length distributions (Figure 26). Thus, the apparent recent increase in fishing mortality of little skate from the spring survey may be an artifact of recently improved recruitment. The current fishing mortality rate on little skate is estimated to be 0.34

CONCLUSIONS

Conclusions about the status of the seven species in the northeast US region skate complex are based mainly on standardized research trawl survey data collected by the US and Canada during 1963-1999. For the aggregate complex, the NEFSC spring survey index of biomass was relatively constant from 1968 to 1980, then increased significantly to peak levels in the mid to late 1980s. The index of skate complex biomass then declined steadily until 1994, but recently began to increase again (Figure 2). The large increase in skate biomass in the mid to late 1980s was dominated by winter and little skate. The biomass of large sized skates (>100 cm maximum length; barndoor, winter, and thorny) has steadily declined since the mid-1980s. The recent increase in aggregate skate biomass has been due to an increase in small sized skates (<100 cm maximum length; little, clearnose, rosette, and smooth), mainly little skate (Figure 3). All large-bodied skates (winter, barndoor, and thorny) and all primary skate species in the Gulf of Maine (thorny and smooth) are currently at low biomass.

Winter skate abundance is currently about same as in the early 1970s, at about 25% of the peak observed during the mid 1980s. Little skate abundance began to increase in the early 1980s, and has increased to the highest abundance since 1975. The abundance of barndoor skate declined continuously through the 1960s to historic lows during the early 1980s. Since 1990, the abundance of barndoor skate has increased slightly on Georges Bank, the western Scotian Shelf and in Southern New England, although the current NEFSC autumn survey biomass index is still less than 5% of the peak observed in 1963.

The abundance of thorny skate has declined to historic lows. Current abundance is about 10%-15 % of the peak observed in the late 1960s to early 1970s. The abundance of smooth skate was highest during the early 1960s and late 1970s. The abundance of clearnose skate has been increasing since the mid 1980s. The abundance of rosette skate has been increasing since 1986.

REFERENCES

BEVERTON, R.J.H., and S.J. HOLT. 1956. A review of methods for estimating mortlaity rates in fish populations, with special reference to sources of bias in catch sampling. Rapp. P.v. Reun. Cons. Int. Explor. Mer 140: 67-83.

BIGELOW, H.B., and W.C. SCHROEDER. 1953. Fishes of the Gulf of Maine. Fish. Bull., U.S. Fish. Wildl. Serv. 74(53).

BRANDER, K. 1981. Disappearance of common skate *Raja batis* from Irish Sea. Nature 290: 48-49.

CASEY, J.M, and R.A. MYERS. 1998. Near extinction of a larger, widely distributed fish. Science 281: 690-692.

FRISK, M.G. MS 1999. Estimation and analysis of biological parameters in elasmobranch fishes: a comparative life history study. Unpublished manuscript, University of Maryland Center for Environmental Sciences. 44 p.

HOENIG, J.M. 1983. Empirical use of longevity data to estimate mortality rates. Fish. Bull. U.S. 81:898-902.

HOENIG, J.M. 1987. Estimation of growth and mortality parameters for use in length-structured stock production models, p. 121-128. In D. Pauly and G.R. Morgan (eds.) Length-based methods in fisheries research. ICLARM Conference Proceedings 13, 468 p. International Center for Living Aquatic Resources Management, Manila, Phillippines, and Kuwait Institute for Scientific Re search, Safat, Kuwait.

HOLDEN, M.J. 1973. Are long-term sustainable fisheries for elasmobranchs possible? Rapp. P.-V. Reun. Cons. Int. Explor. Mer 164:360-367.

JOHNSON. G.F. 1979. The biology of the little skate, *Raja erinacea* Mitchill 1825, in Block Island Sound, Rhode Island. University of Rhode Island.

NEFSC [Northeast Fisheries Science Center]. 1990. Report of the 11th Stock Assessment Workshop (11th SAW), Fall 1990. Woods Hole, MA: NOAA/NMFS/NEFC. NEFC Ref. Doc. 90-09.

NEFSC [Northeast Fisheries Science Center]. 1991. Report of the 12th Stock Assessment Workshop (12th SAW), Spring 1991. Woods Hole, MA: NOAA/NMFS/NEFC. NEFC Ref. Doc. 91-03.

SIMON, J.E., and K.T. FRANK. 1996. Assessment of the division 4VsW skate fishery. DFO Atlantic Fisheries Research Document 96/105. 51 p.

SIMON, J.E., and K.T. FRANK. 1998. Assessment of the winter skate fishery in division 4VsW. Canadian Stock Assessment Secretariat Research Document 98/145. 41 p.

SISSENWINE, M.P. and E.W. BOWMAN. 1978. An analysis of some factors affecting the catchability of fish by bottom trawls. ICNAF Res Bull. 13:81-87.

TAYLOR, C.C. 1958. Cod growth and temperature. J. Cons. Explor. Mer. 23: 366-370.

TEMPLEMAN, W. 1965. Rare skates of the Newfoundland and neighboring areas. Journal of the Fisheries Research Board of Canada. 22:259-279.

TEMPLEMAN, W. 1982. Development, occurrence, and characteristics of egg capsules of the thorny skate, Raja radiata, in the Northwest Atlantic. J. Northw. Atl. Fishery Sci. 3(1):47-56.

THOMPSON, W.F., and F.H. BELL. 1934. Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear. Rep. Int. Fish. (Pacific halibut) Comm. 8: 49 p.

WARING, G.T. 1984. Age, growth and mortality of the little skate off the northeast coast of the United States. Trans. Amer. Fish. Soc. 113:314-321.

Table 1. Total commercial landings of skate (mt) in NAF subareas 5 and 6 by country from 1960-1998.

	US	USSR	Others	Total
1960	61	0	0	61
1961	36	0	0	36
1962	44	0	0	44
1963	33	0	0	33
1964	4081	0	2	4083
1965	2343	0	20	2363
1966	2738	0	106	2844
1967	2715	2121	62	4898
1968	2417	3974	92	6483
1969	3045	6410	7	9462
1970	1583	2544	1	4128
1971	900	5000	5	5905
1972	866	7957	0	8823
1973	1191	6754	18	7963
1974	2026	1623	2	3651
1975	752	3216	0	3968
1976	754	412	46	1212
1977	1143	240	35	1418
1978	1130	216	7	1353
1979	1280	79	1	1360
1980	1577	0	4	1581
1981	838	0	9	847
1982	878	0	0	878
1983	3603	0	0	3603
1984	4157	0	0	4157
1985	3984	0	0	3984
1986	4159	0	94	4253
1987	5078	0	0	5078
1988	7255	0	9	7264
1989	6717	0	0	6717
1990	11403	0	0	11403
1991	11332	0	0	11332
1992	12525	0	0	12525
1993	12904	0	0	12904
1994	8829	0	0	8829
1995	7222	0	0	7222
1996	14226	0	0	14226
1997	10952	0	0	10952
1998	16936	0	0	16936
1999	12159	0	0	12159

Table 2. Discards of skates by gear type. (ot = otter trawls; sgn = sink gill net; dgn = drift gill net; sd = scallop dredge; mpt = cp = conch pots; lp = lobster pot; bt = beam trawl; mt = midwater trawl; lt = line trawl; ll = longline;pt = pair trawl;

	skate discards in mt									
gear	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
ot	20430	32673	19389	23021	8298	4586	6212	24442	11248	14332
sgn	110	259	138	230	212	326	224	172	196	138
dgn	5	5	5	4	3	1	3	11	10	12
sd	29108	34391	24561	19659	14826	8088	20483	15012	15558	10174
mpt	0	0	0	0	0	0	0	0	0	0
cp	648	1291	982	1526	1251	1084	818	930	815	484
lp	17	20	21	19	19	18	16	24	28	27
bt	0	0	0	0	0	39	62	0	0	0
mt	0	0	4	0	4	0	0	10	4	1
lt	818	401	851	680	465	460	567	450	455	578
ll	0	0	0	0	0	0	0	0	0	0
pt	0	28	37	24	31	0	0	0	0	0
st	104	136	98	96	67	108	201	278	189	109
Total	51240	69203	46086	45259	25176	14711	28586	41330	28502	25855

Table 3. Comparison of estimates of total skate discard (metric tons) by initial method (primary species/gear cells, discard rates calculated as mean of the 1989-1998 time series: T), and by final method (primary species group/gear cells, discard rates calculated annually: A).

Year		Primary species, Time series (T)		Species group, Annual (A)		Percent difference (A/T)
1989		45,498		51,240		12.6
1990		62,039		69,203		11.5
1991		53,451		46,086		-13.8
1992		42,666		45,259		6.1
1993		27,420		25,176		-8.2
1994		25,201		14,711		-41.6
1995		25,212		28,586		13.4
1996		28,854		41,330		43.2
1997		25,895		28,502		10.1
1998		22,295		25,855		16.0
Mean		35,853		37,595		4.9

Table 4. Abundance and biomass from NEFSC spring surveys for winter skate for the Gulf of Maine to Mid-Atlantic region (offshore strata 1-30,33-40,61-76). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1968	2.171	1.640	2.978	0.854	0.530	1.178	2.542	32	42	56	58.6	79	112	36	232
1969	5.913	4.283	7.543	2.790	1.907	3.672	2.119	15	25	53	53.5	79	111	68	640
1970	2.645	1.627	3.663	0.971	0.626	1.317	2.723	37	43	59	61.0	83	103	44	275
1971	3.387	2.066	4.708	1.894	0.873	2.915	1.788	15	30	48	51.8	76	103	41	513
1972	4.620	3.033	6.207	2.602	1.253	3.951	1.776	15	24	48	49.5	74	97	63	634
1973	2.905	2.024	3.786	1.257	0.824	1.689	2.311	21	32	55	55.5	79	100	49	347
1974	2.091	1.352	2.830	0.943	0.505	1.381	2.218	29	34	53	55.6	76	101	46	222
1975	2.395	1.521	3.269	0.893	0.556	1.230	2.682	17	38	59	59.4	79	99	46	227
1976	2.153	1.075	3.231	0.628	0.279	0.978	3.428	22	38	64	63.1	86	97	29	160
1977	3.111	1.815	4.408	0.838	0.513	1.163	3.712	20	29	69	64.7	93	106	35	204
1978	8.275	-0.327	16.877	1.355	0.121	2.589	6.108	43	62	79	78.5	89	96	41	395
1979	1.852	1.095	2.608	0.333	0.206	0.459	5.568	23	35	78	73.5	93	105	50	204
1980	2.990	1.751	4.229	0.538	0.331	0.745	5.559	22	45	78	74.8	97	104	49	187
1981	4.140	2.905	5.376	2.083	1.199	2.966	1.988	15	22	39	47.6	91	104	56	586
1982	5.773	3.876	7.670	2.137	1.195	3.080	2.701	15	26	46	54.9	95	109	64	707
1983	14.329	8.182	20.476	3.264	1.772	4.756	4.391	15	28	67	64.4	96	108	65	817
1984	10.480	6.816	14.144	2.948	1.694	4.201	3.555	15	22	60	59.0	94	106	59	753
1985	16.373	11.119	21.627	7.861	4.653	11.069	2.083	15	22	46	54.3	94	116	65	1891
1986	10.019	6.973	13.064	3.538	2.181	4.894	2.832	15	27	58	62.2	97	108	67	969
1987	13.126	8.428	17.824	4.821	2.926	6.716	2.723	15	29	56	60.8	97	108	69	1221
1988	14.543	10.508	18.577	7.409	4.736	10.082	1.963	15	25	43	53.4	95	107	73	1827
1989	10.141	7.736	12.546	4.252	3.095	5.409	2.385	15	25	59	61.4	94	109	74	1429
1990	7.183	5.184	9.183	5.087	2.657	7.517	1.412	15	27	41	49.9	91	105	67	1678
1991	6.965	4.012	9.918	3.239	1.979	4.499	2.150	17	29	54	58.6	93	107	57	1027
1992	5.988	3.369	8.607	5.208	0.635	9.780	1.150	15	23	42	46.2	82	106	51	1303
1993	4.761	3.392	6.131	4.305	2.561	6.049	1.106	15	25	42	46.5	82	103	62	1118
1994	1.421	0.990	1.852	1.673	1.150	2.196	0.849	20	32	43	46.5	69	99	49	519
1995	2.151	1.340	2.961	1.998	1.231	2.766	1.076	15	34	44	48.4	71	103	49	476
1996	4.547	2.499	6.594	4.470	2.384	6.556	1.017	15	34	46	49.0	68	96	56	1004
1997	3.065	1.325	4.806	1.834	0.987	2.680	1.672	15	23	51	53.5	78	93	39	458
1998	1.504	0.913	2.096	1.045	0.561	1.529	1.439	15	32	51	53.4	79	94	52	341
1999	2.968	1.303	4.632	1.876	0.870	2.883	1.582	16	27	54	54.9	79	100	52	482

Table 5. Abundance and biomass from NEFSC autumn surveys for winter skate for the Gulf of Maine to Mid-Atlantic region (offshore strata 1-30,33-40,61-76). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1967-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1967	2.159	1.248	3.070	0.825	0.544	1.106	2.617	15	32	56	57.0	83	107	35	213
1968	1.865	1.264	2.466	0.928	0.573	1.284	2.009	15	25	51	51.8	80	100	56	227
1969	1.315	0.856	1.774	0.540	0.351	0.730	2.435	16	37	58	58.3	78	90	36	161
1970	2.996	1.663	4.328	1.357	0.576	2.138	2.208	21	33	54	56.0	77	97	53	331
1971	1.078	0.542	1.615	0.588	0.238	0.938	1.833	18	27	50	50.5	77	93	35	163
1972	2.958	2.113	3.804	2.071	1.413	2.728	1.429	15	24	42	46.9	74	96	64	592
1973	4.686	3.348	6.024	2.238	1.510	2.967	2.093	21	32	54	55.1	78	101	48	662
1974	2.097	1.418	2.777	1.024	0.672	1.376	2.048	17	30	52	53.6	77	103	39	262
1975	1.315	0.682	1.948	0.420	0.260	0.580	3.130	16	24	62	60.9	84	103	31	115
1976	2.655	0.918	4.392	0.766	0.257	1.274	3.468	19	22	70	59.9	83	98	21	190
1977	4.095	2.814	5.376	1.617	1.049	2.185	2.533	15	25	47	54.8	87	100	51	662
1978	4.989	3.778	6.199	1.042	0.777	1.307	4.787	15	36	77	73.6	94	105	94	762
1979	5.121	3.768	6.475	1.290	0.976	1.603	3.971	20	31	75	66.0	93	113	89	975
1980	6.233	3.806	8.660	1.558	1.015	2.100	4.002	15	37	66	66.4	95	108	60	602
1981	5.668	3.726	7.610	1.505	0.916	2.094	3.766	15	25	61	62.3	99	110	54	516
1982	8.306	4.780	11.831	3.889	0.502	7.275	2.136	15	22	35	46.7	92	112	45	950
1983	12.852	5.693	20.012	2.590	1.447	3.733	4.962	16	28	78	70.5	95	108	42	843
1984	13.323	8.465	18.181	3.653	2.450	4.857	3.647	15	21	55	59.0	95	110	52	1187
1985	9.182	6.552	11.811	2.665	1.842	3.488	3.446	15	32	79	69.7	97	107	37	827
1986	15.800	7.184	24.415	4.196	2.496	5.895	3.766	15	34	75	71.5	97	110	46	1089
1987	11.063	8.200	13.925	4.291	2.783	5.800	2.578	15	25	58	60.1	97	109	49	1165
1988	7.564	4.961	10.167	3.126	2.223	4.028	2.420	15	23	49	57.4	97	110	45	888
1989	5.081	3.288	6.874	2.084	1.422	2.745	2.439	15	27	59	61.0	96	106	48	720
1990	7.145	4.658	9.632	2.451	1.397	3.505	2.915	22	33	68	66.5	97	107	44	895
1991	4.724	3.627	5.821	2.631	1.866	3.396	1.796	17	31	48	56.3	94	106	58	941
1992	3.582	2.140	5.024	1.862	1.116	2.608	1.923	22	33	51	57.4	91	103	39	509
1993	1.905	1.280	2.530	1.458	0.965	1.951	1.307	16	33	48	52.8	88	104	50	452
1994	2.120	1.432	2.808	1.925	1.217	2.633	1.101	15	26	44	47.6	84	106	52	503
1995	1.985	1.214	2.757	1.769	1.047	2.491	1.122	17	31	46	49.4	77	102	43	424
1996	2.276	1.615	2.937	1.426	0.985	1.867	1.596	17	35	51	54.9	83	104	44	370
1997	2.455	1.150	3.760	1.611	0.738	2.484	1.524	19	34	54	55.5	79	101	55	415
1998	3.753	2.488	5.018	2.140	1.438	2.843	1.753	19	27	55	56.8	83	101	50	609
1999	5.089	2.080	8.098	2.642	1.320	3.963	1.927	15	31	58	58.0	80	111	53	966

Table 6. Abundance and biomass from NEFSC winter surveys for winter skate for the Georges Bank to Mid-Atlantic region (offshore strata 1-3,5-7,9-11,13-14,16,61-63,65-67,69-71,73-75). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1992	31.571	21.666	41.476	39.759	23.811	55.707	0.794	15	24	38	42.4	74	105	62	4042
1993	10.261	6.052	14.469	10.676	2.331	19.021	0.961	15	23	41	44.1	81	106	47	841
1994	14.439	10.586	18.293	14.216	8.465	19.966	1.016	15	29	40	45.4	81	102	33	1079
1995	23.268	14.507	32.029	35.528	18.060	52.996	0.655	15	27	40	42.2	59	104	53	3773
1996	25.239	7.110	43.369	43.515	7.434	79.596	0.580	15	25	40	41.2	56	99	59	4055
1997	11.643	7.287	15.999	12.565	7.109	18.022	0.927	15	27	45	46.9	71	98	46	1414
1998	22.464	15.878	29.050	19.950	13.556	26.344	1.126	15	26	48	49.4	74	105	60	2092
1999	21.089	13.628	28.549	18.380	10.899	25.860	1.147	15	24	49	49.0	74	101	52	1932

Table 7. Abundance and biomass from NEFSC spring surveys for little skate for the Gulf of Maine to Mid-Atlantic region (offshore strata 1-30,33-40,61-76, and inshore strata 1-66). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1976-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1976	1.308	0.861	1.755	3.218	2.136	4.301	0.406	8	12	40	36.9	48	58	172	4202
1977	1.347	0.882	1.811	3.336	2.177	4.494	0.404	6	19	41	38.7	48	57	160	4218
1978	1.391	0.962	1.821	3.286	2.363	4.209	0.423	8	11	42	37.5	48	62	160	3945
1979	0.650	0.501	0.799	2.182	1.429	2.934	0.298	4	12	31	32.7	48	56	204	5684
1980	2.206	1.705	2.707	5.898	4.384	7.413	0.374	8	12	37	36.0	48	57	224	9031
1981	1.501	1.200	1.803	3.426	2.714	4.137	0.438	6	15	41	38.3	49	55	175	4113
1982	3.627	2.644	4.611	7.214	5.351	9.076	0.503	9	18	43	40.7	49	55	153	3564
1983	5.718	4.017	7.420	13.024	9.215	16.832	0.439	6	16	42	37.9	48	57	167	6365
1984	4.094	2.615	5.574	10.023	6.787	13.258	0.409	7	11	40	35.8	48	55	139	4573
1985	6.265	4.628	7.901	15.175	10.575	19.775	0.413	8	11	40	36.8	48	57	148	6535
1986	2.753	1.712	3.795	8.554	3.399	13.709	0.322	6	14	33	34.5	48	57	153	3512
1987	4.625	3.149	6.102	16.031	10.222	21.839	0.289	8	12	32	33.1	47	55	145	9584
1988	5.083	3.444	6.721	14.593	9.688	19.498	0.348	8	11	36	34.5	48	55	130	4195
1989	6.634	3.434	9.834	21.643	9.844	33.441	0.307	8	13	34	33.4	46	55	144	10760
1990	4.993	2.397	7.589	14.979	5.250	24.708	0.333	8	11	37	34.7	47	56	132	7085
1991	5.990	4.672	7.308	18.731	14.059	23.403	0.320	8	13	34	34.2	47	58	178	11986
1992	5.297	2.477	8.118	16.793	5.234	28.352	0.315	8	16	33	34.1	46	57	136	6392
1993	7.524	5.187	9.862	22.361	15.110	29.611	0.336	9	12	36	35.0	47	54	160	9574
1994	3.622	2.425	4.819	9.365	6.297	12.434	0.387	9	19	39	37.3	46	54	154	8548
1995	2.872	2.024	3.720	7.574	5.215	9.933	0.379	8	10	39	36.1	47	59	148	3801
1996	7.574	5.522	9.626	18.185	12.647	23.722	0.417	7	17	41	38.3	48	58	168	9086
1997	2.708	2.231	3.184	6.671	5.504	7.837	0.406	9	13	40	37.8	48	54	151	4840
1998	7.471	6.156	8.787	20.938	16.232	25.644	0.357	7	17	37	35.8	47	56	195	15710
1999	9.978	7.688	12.267	28.377	20.345	36.409	0.352	8	12	38	35.4	47	56	157	16406

Table 8. Abundance and biomass from NEFSC autumn surveys for little skate for the Gulf of Maine to Mid-Atlantic region (offshore strata 1-30,33-40,61-76, and inshore strata 1-66). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1975-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1975	2.379	1.508	3.249	4.858	3.063	6.654	0.490	10	18	43	40.3	49	56	118	1386
1976	2.185	1.582	2.788	4.576	3.278	5.875	0.477	8	22	43	40.6	48	58	74	1421
1977	3.172	2.271	4.072	6.589	4.683	8.495	0.481	9	22	43	40.7	49	56	122	2438
1978	2.938	2.140	3.736	5.613	3.947	7.279	0.523	10	22	44	42.0	49	62	144	3171
1979	2.902	2.343	3.461	5.944	4.790	7.098	0.488	8	21	44	41.0	49	58	177	4597
1980	2.312	1.768	2.855	5.055	4.102	6.008	0.457	9	13	43	37.9	49	55	142	2451
1981	2.779	2.175	3.382	5.847	4.479	7.215	0.475	9	19	43	39.9	49	58	111	1728
1982	5.799	2.673	8.925	15.391	6.979	23.803	0.377	9	18	36	36.4	48	56	123	3848
1983	1.990	1.340	2.639	5.244	3.268	7.219	0.379	8	17	38	36.6	49	55	100	1313
1984	2.483	1.688	3.279	5.487	3.789	7.185	0.453	10	13	43	38.3	49	56	95	1350
1985	2.423	1.629	3.217	6.103	4.006	8.199	0.397	9	17	40	37.5	49	58	119	2761
1986	1.502	1.125	1.879	4.203	2.759	5.648	0.357	10	16	36	35.7	49	55	96	1240
1987	2.311	1.532	3.090	8.104	4.084	12.124	0.285	10	14	31	32.4	48	55	96	2093
1988	1.177	0.663	1.692	3.524	2.144	4.903	0.334	9	13	34	33.8	48	56	80	1128
1989	2.321	1.091	3.552	6.698	3.574	9.823	0.347	5	13	38	35.2	48	56	100	2288
1990	1.242	0.802	1.681	3.204	1.913	4.495	0.388	9	17	40	37.3	48	54	98	1183
1991	3.552	1.494	5.610	8.854	3.301	14.408	0.401	11	24	40	39.3	47	55	102	2866
1992	1.542	1.126	1.958	4.294	2.993	5.595	0.359	6	14	38	36.0	49	63	107	1460
1993	1.180	0.805	1.555	3.136	2.174	4.099	0.376	10	14	41	36.3	49	55	115	1124
1994	1.906	1.349	2.463	4.329	3.102	5.556	0.440	9	18	42	39.4	49	59	131	1729
1995	2.682	1.795	3.569	5.527	3.739	7.316	0.485	9	21	43	41.2	48	56	118	2058
1996	2.239	1.504	2.973	5.146	3.582	6.711	0.435	9	13	42	38.1	49	60	112	1878
1997	2.148	1.533	2.763	4.825	3.407	6.243	0.445	10	21	43	40.0	49	60	109	1757
1998	2.704	1.968	3.441	5.914	4.237	7.591	0.457	10	20	43	40.2	49	57	129	1713
1999	3.210	5.042	10.355	7.698	5.042	10.355	0.417	6	21	41	38.4	48	58	143	2289

Table 9. Abundance and biomass from NEFSC winter surveys for little skate for the Georges Bank to Mid-Atlantic region (offshore strata 1-3,5-7,9-11,13-14,16,61-63,65-67,69-71,73-75). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1992	66.321	50.335	82.306	170.155	127.459	212.852	0.390	9	21	39	38.0	47	62	89	18418
1993	56.377	43.992	68.761	166.927	120.808	213.045	0.338	9	19	36	35.8	46	53	94	16026
1994	49.812	37.387	62.236	131.570	95.199	167.940	0.379	10	20	39	37.5	47	60	67	10113
1995	57.368	39.311	75.424	138.769	87.458	190.081	0.413	8	24	40	39.1	47	53	95	14530
1996	64.056	47.616	80.495	150.579	108.945	192.213	0.425	9	15	41	38.7	47	62	102	15701
1997	51.901	39.986	63.816	117.751	92.288	143.214	0.441	9	23	42	40.2	47	58	92	12084
1998	57.512	49.249	65.775	138.503	111.869	165.136	0.415	9	20	41	38.7	47	57	105	14492
1999	58.566	46.296	70.837	138.876	104.459	173.292	0.422	6	22	41	39.3	48	55	99	14740

Table 10. Abundance and biomass from NEFSC spring surveys for barndoor skate for the Gulf of Maine to Southern New England region (offshore strata 1-30, 33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1968	0.374	0.075	0.673	0.138	0.026	0.249	2.716	41	46	61	71.7	115	118	10	21
1969	0.658	-0.364	1.681	0.145	-0.011	0.301	4.539	33	42	70	83.1	119	120	8	22
1970	0.111	0.033	0.188	0.047	0.017	0.078	2.350	45	44	62	68.2	104	105	9	10
1971	0.116	0.018	0.214	0.102	0.021	0.183	1.134	26	31	59	57.1	69	80	8	20
1972	0.222	0.028	0.416	0.023	0.005	0.041	9.617	63	62	119	104.7	123	124	6	6
1973	0.010	-0.001	0.022	0.017	0.000	0.034	0.621	51	51	51	54.1	59	60	3	3
1974	0.020	-0.005	0.045	0.017	-0.002	0.037	1.146	43	43	58	53.3	59	60	3	3
1975	0.001	-0.001	0.003	0.001	-0.001	0.003	0.900	60	60	60	60.0	60	60	1	1
1976	0.010	-0.010	0.030	0.006	-0.005	0.017	1.800	61	61	61	61.0	61	61	1	1
1977	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1978	0.015	-0.009	0.040	0.016	-0.006	0.039	0.933	51	50	55	56.3	61	62	2	3
1979	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1980	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1981	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1982	0.002	-0.001	0.005	0.002	-0.002	0.005	1.000	54	54	54	54.0	54	54	1	1
1983	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1984	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1985	0.001	0.000	0.002	0.007	-0.004	0.017	0.076	20	20	20	24.6	37	38	2	2
1986	0.003	-0.001	0.007	0.011	-0.004	0.026	0.250	33	33	41	37.5	41	42	2	2
1987	0.002	-0.002	0.006	0.007	-0.006	0.020	0.300	37	37	37	37.0	37	37	1	1
1988	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1989	0.007	-0.007	0.021	0.006	-0.006	0.019	1.100	60	60	60	60.0	60	60	1	1
1990	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1991	0.002	-0.002	0.006	0.007	-0.006	0.020	0.300	38	38	38	38.0	38	38	1	1
1992	0.136	-0.117	0.389	0.013	-0.006	0.032	10.397	41	41	117	98.2	124	125	2	4
1993	0.032	0.024	0.039	0.028	0.005	0.051	1.147	31	31	37	45.3	89	90	5	5
1994	0.084	-0.023	0.191	0.029	-0.001	0.059	2.926	46	46	65	70.1	120	121	4	6
1995	0.015	-0.007	0.037	0.012	-0.005	0.029	1.254	55	55	63	59.6	63	64	2	2
1996	0.062	-0.039	0.162	0.025	-0.003	0.054	2.465	23	23	66	63.2	111	112	4	6
1997	0.077	0.006	0.148	0.035	0.007	0.063	2.216	39	39	67	68.7	89	90	6	7
1998	0.169	-0.024	0.363	0.061	0.015	0.106	2.799	26	26	60	64.4	122	123	8	15
1999	0.279	-0.102	0.660	0.052	0.011	0.094	5.343	28	28	74	80.9	125	126	8	11

Table 11. Abundance and biomass from NEFSC autumn surveys for barndoor skate for the Gulf of Maine to Southern New England region (offshore strata 1-30, 33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1963-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1963	2.633	1.604	3.663	0.762	0.468	1.056	3.458	28	44	69	74.6	121	136	47	120
1964	1.212	0.489	1.934	0.400	0.229	0.570	3.030	40	41	69	72.7	112	122	32	63
1965	1.822	1.115	2.528	0.695	0.441	0.949	2.622	27	42	67	69.9	111	134	36	95
1966	0.811	0.394	1.229	0.459	0.243	0.675	1.767	23	38	60	63.0	88	115	26	62
1967	0.438	-0.025	0.901	0.064	0.017	0.111	6.844	45	52	65	81.0	119	120	10	14
1968	0.285	0.123	0.447	0.132	0.067	0.198	2.150	42	42	67	69.1	96	132	18	29
1969	0.054	-0.003	0.111	0.035	-0.006	0.076	1.551	51	51	62	62.0	73	74	5	8
1970	0.066	-0.046	0.178	0.011	-0.005	0.027	5.868	66	66	65	89.1	128	129	2	2
1971	0.170	-0.051	0.392	0.117	-0.077	0.311	1.455	35	35	53	54.6	63	120	6	19
1972	0.096	-0.073	0.265	0.012	-0.001	0.026	7.751	59	59	70	90.3	132	133	3	3
1973	0.004	-0.001	0.009	0.008	-0.003	0.019	0.474	41	41	47	48.7	52	53	2	3
1974	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1975	0.017	-0.016	0.049	0.010	-0.010	0.031	1.600	70	70	70	70.0	70	70	1	2
1976	0.047	0.002	0.091	0.058	-0.003	0.119	0.810	50	50	51	54.6	61	62	7	10
1977	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1978	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1979	0.009	-0.008	0.026	0.003	-0.003	0.009	3.000	78	78	78	78.0	78	78	1	1
1980	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1981	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1982	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1983	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1984	0.010	-0.004	0.024	0.003	0.000	0.007	2.900	61	61	84	73.0	84	85	2	2
1985	0.004	-0.004	0.012	0.002	-0.002	0.005	2.300	70	70	70	70.0	70	70	1	1
1986	0.029	-0.018	0.077	0.015	-0.002	0.032	2.008	22	22	52	51.0	90	91	3	3
1987	0.014	-0.005	0.032	0.012	-0.004	0.027	1.200	53	53	63	58.5	63	64	2	2
1988	0.007	-0.005	0.020	0.009	-0.005	0.022	0.850	34	34	33	44.8	76	77	2	2
1989	0.005	-0.005	0.014	0.002	-0.002	0.007	2.100	71	71	71	71.0	71	71	1	1
1990	0.028	-0.022	0.078	0.010	-0.005	0.024	2.964	60	60	66	76.3	95	96	2	3
1991	0.031	0.000	0.062	0.020	0.000	0.040	1.579	54	54	61	61.3	73	74	4	5
1992	0.002	-0.002	0.007	0.004	-0.004	0.013	0.550	46	46	51	49.0	51	52	1	2
1993	0.141	-0.040	0.321	0.023	0.004	0.042	6.180	45	45	74	86.6	127	128	5	6
1994	0.035	0.001	0.069	0.044	0.006	0.082	0.790	33	33	47	49.4	75	76	6	9
1995	0.111	-0.009	0.231	0.040	-0.006	0.085	2.810	48	48	62	70.9	113	114	4	10
1996	0.042	-0.020	0.104	0.023	0.000	0.046	1.841	25	25	61	59.8	92	93	4	5
1997	0.105	-0.024	0.234	0.026	0.004	0.047	4.065	36	36	79	73.3	124	125	5	5
1998	0.089	-0.036	0.214	0.026	0.002	0.050	3.453	48	48	71	73.9	120	121	4	5
1999	0.300	0.051	0.549	0.085	0.041	0.130	3.511	23	23	54	68.0	120	121	13	15

Table 12. Abundance and biomass from NEFSC winter surveys for barndoor skate for the Georges Bank to Mid-Atlantic region (offshore strata 1-3,5-7,9-11,13-14,16,61-63,65-67,69-71,73-75). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1992	0.000	0.000	0.000	0.000	0.000	0.000	-	-			-		-	0	0
1993	0.123	-0.066	0.311	0.052	0.004	0.100	2.358	20	20	65	57.3	119	120	4	6
1994	0.185	-0.027	0.397	0.080	0.011	0.148	2.328	21	21	60	63.5	102	103	5	7
1995	0.362	0.121	0.603	0.198	0.056	0.340	1.828	33	33	62	63.6	88	109	11	24
1996	0.291	0.079	0.503	0.203	0.054	0.352	1.434	19	20	61	56.4	85	92	12	23
1997	0.618	0.208	1.028	0.275	0.032	0.519	2.247	35	38	65	67.7	112	117	10	28
1998	0.455	0.146	0.765	0.464	0.092	0.837	0.980	20	26	41	46.8	83	123	12	57
1999	1.053	0.347	1.760	0.709	0.318	1.099	1.486	23	27	46	53.2	113	124	22	81

Table 13. Abundance and biomass from NEFSC spring surveys for thorny skate for the Gulf of Maine to Southern New England region (offshore strata 1-30,33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1968	3.181	2.137	4.225	1.600	1.067	2.134	1.987	12	16	44	47.8	91	105	60	252
1969	4.526	3.186	5.865	1.680	1.161	2.199	2.694	12	13	47	51.1	98	109	64	294
1970	4.202	3.229	5.174	1.990	1.478	2.502	2.112	12	16	41	48.2	95	110	84	363
1971	3.683	2.475	4.891	1.974	1.473	2.475	1.866	12	15	44	47.8	95	116	81	424
1972	4.984	3.757	6.212	2.219	1.773	2.665	2.246	12	16	47	50.7	94	110	91	443
1973	6.622	4.867	8.377	3.562	2.640	4.483	1.859	12	15	44	47.9	91	108	75	574
1974	3.774	2.939	4.608	2.450	1.938	2.962	1.540	9	14	43	45.8	87	106	81	376
1975	3.189	2.222	4.157	1.360	0.990	1.731	2.344	10	15	46	50.5	95	102	62	192
1976	2.895	2.041	3.750	1.671	1.281	2.060	1.733	13	15	43	47.2	90	106	79	339
1977	1.623	1.175	2.070	0.942	0.675	1.209	1.722	12	15	42	48.1	89	111	74	213
1978	1.250	0.806	1.695	0.800	0.579	1.020	1.564	10	15	49	46.8	83	97	71	191
1979	1.079	0.729	1.429	0.582	0.410	0.754	1.853	12	17	51	50.5	84	102	68	163
1980	2.105	1.308	2.901	1.319	0.880	1.757	1.596	11	13	37	43.6	92	100	60	250
1981	2.700	2.065	3.335	1.535	1.139	1.930	1.760	9	13	47	48.1	87	100	60	255
1982	2.345	1.685	3.004	1.144	0.878	1.411	2.049	10	17	53	52.4	85	97	62	218
1983	2.142	1.398	2.886	0.968	0.728	1.209	2.212	12	15	52	52.3	91	103	55	156
1984	1.453	0.818	2.087	0.608	0.462	0.755	2.389	12	16	51	53.0	96	100	40	97
1985	3.074	2.124	4.024	1.413	1.060	1.766	2.175	11	14	44	48.4	95	102	59	209
1986	2.619	1.974	3.263	1.718	1.377	2.058	1.525	10	15	38	44.0	83	98	69	276
1987	1.469	0.805	2.133	0.852	0.646	1.058	1.724	14	16	42	46.6	87	109	53	141
1988	1.173	0.735	1.612	1.106	0.766	1.446	1.061	11	14	32	38.5	82	98	59	176
1989	1.481	0.793	2.169	1.221	0.801	1.640	1.213	11	15	34	40.0	84	101	57	175
1990	1.565	0.833	2.296	1.097	0.688	1.506	1.427	14	16	39	44.5	82	99	49	167
1991	1.542	0.945	2.139	0.858	0.569	1.147	1.797	11	13	47	48.5	89	99	47	132
1992	1.092	0.621	1.564	0.612	0.384	0.840	1.784	14	15	47	48.4	89	102	31	86
1993	0.700	0.366	1.034	0.486	0.327	0.646	1.440	13	13	36	42.0	91	105	37	79
1994	0.435	0.242	0.629	0.439	0.270	0.609	0.991	12	12	37	39.3	67	92	39	80
1995	0.564	0.307	0.821	0.384	0.236	0.533	1.467	9	12	42	45.8	84	92	31	66
1996	0.371	0.178	0.563	0.321	0.106	0.535	1.156	12	12	36	40.8	80	93	24	63
1997	0.422	0.117	0.727	0.270	0.153	0.387	1.560	15	20	47	47.9	82	87	25	47
1998	0.480	0.209	0.752	0.334	0.236	0.431	1.440	12	14	35	40.8	89	98	42	85
1999	0.369	0.093	0.646	0.255	0.163	0.347	1.448	11	17	40	46.2	83	89	26	44

Table 14. Abundance and biomass from NEFSC autumn surveys for thorny skate for the Gulf of Maine to Southern New England region (offshore strata 1-30, 33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1963-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1963	5.371	3.788	6.954	1.672	1.305	2.039	3.213	10	15	60	60.4	99	107	65	297
1964	4.403	3.273	5.534	1.651	1.110	2.192	2.667	10	14	49	52.7	96	110	66	278
1965	4.474	3.268	5.681	1.825	1.243	2.408	2.451	10	14	45	49.6	95	107	55	352
1966	7.971	6.163	9.780	2.371	1.855	2.886	3.362	9	13	61	59.4	95	112	72	364
1967	2.712	1.422	4.001	0.982	0.383	1.580	2.763	12	14	49	52.5	95	100	54	165
1968	4.421	3.321	5.521	1.440	1.040	1.840	3.071	12	16	55	57.5	97	107	59	217
1969	5.715	4.320	7.110	1.833	1.359	2.307	3.117	12	14	55	56.7	97	106	72	289
1970	7.347	5.630	9.065	2.216	1.474	2.958	3.316	8	19	57	60.4	98	109	77	403
1971	5.357	4.149	6.565	1.434	1.095	1.774	3.735	12	18	63	64.1	99	111	69	284
1972	4.119	2.974	5.263	1.717	1.302	2.132	2.399	12	16	51	53.1	94	105	75	306
1973	4.564	3.227	5.902	1.536	1.134	1.939	2.971	12	17	59	61.2	95	111	72	274
1974	3.038	2.166	3.910	1.392	1.025	1.759	2.182	10	14	50	51.1	89	111	79	293
1975	2.474	1.483	3.464	1.027	0.716	1.338	2.409	10	12	47	50.0	94	106	70	232
1976	1.720	1.003	2.437	0.798	0.543	1.052	2.157	12	15	44	49.1	91	103	57	143
1977	3.221	2.513	3.928	1.548	1.223	1.874	2.080	10	13	49	50.7	89	107	108	446
1978	4.291	3.473	5.109	2.145	1.643	2.648	2.000	10	16	49	51.1	88	107	155	874
1979	3.612	2.750	4.474	1.283	0.864	1.702	2.815	11	21	59	59.5	89	101	134	486
1980	4.601	3.344	5.859	1.882	1.484	2.280	2.445	11	14	54	54.4	90	100	84	416
1981	3.339	2.551	4.127	1.305	0.957	1.653	2.559	12	15	55	57.1	90	103	71	223
1982	0.646	0.312	0.981	0.393	0.194	0.592	1.644	11	13	33	43.0	85	96	31	83
1983	2.409	1.553	3.266	0.833	0.589	1.077	2.892	15	20	56	58.8	93	108	49	121
1984	2.887	1.978	3.795	1.270	0.975	1.565	2.272	10	13	48	49.8	94	107	70	211
1985	2.877	1.765	3.988	1.438	1.094	1.783	2.000	12	16	49	49.6	87	103	66	260
1986	1.629	1.068	2.189	1.019	0.771	1.268	1.598	11	15	35	44.2	83	101	61	183
1987	0.944	0.590	1.297	0.841	0.600	1.082	1.123	12	14	36	40.2	78	92	49	143
1988	1.488	0.998	1.978	1.099	0.702	1.497	1.354	13	15	31	41.5	84	101	56	208
1989	1.883	0.980	2.786	1.129	0.787	1.471	1.668	12	14	40	46.2	85	101	63	198
1990	1.704	1.090	2.318	1.040	0.744	1.335	1.639	12	17	42	47.2	85	95	53	202
1991	1.632	0.519	2.745	0.921	0.591	1.251	1.772	13	15	47	49.5	86	108	54	153
1992	0.962	0.551	1.373	0.775	0.461	1.088	1.242	12	13	36	41.2	83	99	48	144
1993	1.658	0.639	2.676	0.901	0.440	1.361	1.840	12	13	47	47.8	91	101	50	157
1994	1.509	0.343	2.675	0.981	0.311	1.652	1.538	13	17	45	46.9	84	97	41	170
1995	0.783	0.331	1.235	0.639	0.183	1.095	1.226	13	14	39	42.2	72	99	37	107
1996	0.814	0.360	1.269	0.602	0.362	0.842	1.352	14	14	39	43.3	85	99	37	102
1997	0.849	0.405	1.293	0.404	0.241	0.567	2.101	12	20	50	52.3	83	99	33	79
1998	0.648	0.297	0.999	0.307	0.145	0.468	2.113	13	14	51	52.4	87	93	30	60
1999	0.479	0.249	0.710	0.326	0.195	0.457	1.469	13	14	41	46.3	87	94	38	72

Table 15. Abundance and biomass from NEFSC spring surveys for smooth skate for the Gulf of Maine to Southern New England region (offshore strata 1-30,33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1968	0.211	0.080	0.342	0.484	0.129	0.838	0.436	12	24	41	42.1	58	64	17	41
1969	0.377	0.193	0.562	0.834	0.521	1.147	0.452	11	19	48	43.3	58	63	28	82
1970	0.346	0.134	0.557	0.702	0.376	1.028	0.492	9	14	47	40.9	57	61	25	68
1971	0.800	0.395	1.205	1.185	0.650	1.719	0.675	9	20	51	48.2	61	63	40	114
1972	0.621	0.355	0.886	1.016	0.582	1.450	0.611	14	20	47	44.3	59	64	34	122
1973	1.000	0.745	1.255	1.907	1.401	2.414	0.524	9	24	45	44.2	59	65	51	179
1974	1.092	0.594	1.590	2.003	1.109	2.896	0.545	9	9	47	42.7	59	63	47	172
1975	0.240	0.133	0.346	0.383	0.224	0.543	0.626	19	25	49	46.8	59	61	22	37
1976	0.534	0.413	0.655	1.150	0.870	1.429	0.464	12	16	43	39.8	57	60	49	134
1977	0.122	0.066	0.178	0.302	0.158	0.445	0.405	15	18	40	41.4	57	60	28	45
1978	0.251	0.144	0.358	0.413	0.258	0.567	0.609	24	26	50	46.7	58	61	33	56
1979	0.218	0.097	0.340	0.410	0.163	0.657	0.533	15	19	39	40.2	54	61	27	54
1980	0.484	0.316	0.651	0.948	0.625	1.271	0.510	16	20	42	41.9	56	60	42	84
1981	0.358	0.227	0.489	0.782	0.513	1.050	0.458	8	13	38	37.2	57	65	38	70
1982	0.152	0.057	0.247	0.225	0.092	0.357	0.677	11	10	52	45.6	57	64	14	23
1983	0.363	0.219	0.507	0.531	0.335	0.727	0.683	11	21	50	47.9	57	69	25	50
1984	0.065	0.010	0.120	0.124	0.026	0.221	0.523	19	20	48	39.8	59	60	9	13
1985	0.211	0.136	0.286	0.450	0.298	0.602	0.469	18	20	41	40.4	57	63	31	59
1986	0.250	0.137	0.362	0.466	0.256	0.677	0.536	20	24	48	46.7	59	65	30	93
1987	0.069	0.029	0.108	0.105	0.044	0.166	0.655	43	42	48	50.2	59	62	12	15
1988	0.115	0.044	0.186	0.328	0.175	0.480	0.350	11	13	36	36.3	57	60	24	49
1989	0.225	0.107	0.343	0.620	0.402	0.838	0.363	13	15	37	38.8	60	63	30	88
1990	0.152	0.010	0.294	0.294	0.080	0.509	0.515	11	16	46	44.0	57	62	18	40
1991	0.137	0.073	0.200	0.237	0.136	0.337	0.576	11	17	49	47.1	59	62	22	34
1992	0.063	0.025	0.101	0.104	0.035	0.172	0.608	22	40	49	48.5	56	57	12	16
1993	0.086	0.021	0.151	0.214	0.020	0.408	0.403	21	23	42	41.2	56	58	14	35
1994	0.098	0.043	0.153	0.176	0.082	0.269	0.558	29	29	47	47.1	56	58	15	30
1995	0.101	0.050	0.152	0.234	0.119	0.349	0.432	9	20	42	41.9	55	59	18	33
1996	0.036	0.014	0.058	0.084	0.038	0.129	0.429	20	19	48	43.8	53	59	10	12
1997	0.037	0.015	0.059	0.122	0.035	0.208	0.307	17	20	36	38.9	55	58	11	22
1998	0.200	0.089	0.311	0.410	0.206	0.613	0.489	9	19	46	44.6	56	60	28	77
1999	0.243	0.068	0.418	0.925	-0.074	1.924	0.262	18	20	32	35.6	51	65	23	111

Table 16. Abundance and biomass from NEFSC autumn surveys for smooth skate for the Gulf of Maine to Southern New England region (offshore strata 1-30,33-40). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1963-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1963	0.498	0.306	0.689	0.543	0.282	0.804	0.917	9	20	48	43.9	58	62	26	53
1964	0.326	0.152	0.501	0.360	0.209	0.512	0.906	9	20	42	41.7	59	64	19	35
1965	0.475	0.140	0.811	1.221	0.440	2.001	0.389	11	16	35	38.1	56	64	27	94
1966	0.323	0.175	0.471	0.867	0.519	1.216	0.372	13	17	37	38.6	58	59	28	60
1967	0.152	0.036	0.268	0.293	0.118	0.469	0.518	22	24	48	46.5	62	69	16	27
1968	0.385	0.211	0.559	0.665	0.375	0.955	0.579	17	20	48	45.9	58	62	24	56
1969	0.290	0.131	0.449	0.604	0.282	0.925	0.481	12	16	41	39.6	58	64	21	50
1970	0.232	0.121	0.343	0.530	0.289	0.771	0.437	9	13	45	38.3	59	62	25	50
1971	0.157	0.077	0.238	0.250	0.120	0.379	0.631	17	36	53	51.0	57	59	18	27
1972	0.332	0.185	0.478	0.499	0.285	0.713	0.664	16	24	49	49.8	62	64	30	52
1973	0.311	0.199	0.423	0.506	0.344	0.667	0.614	17	22	48	46.9	58	60	32	56
1974	0.123	0.055	0.192	0.180	0.088	0.273	0.684	11	11	50	48.5	60	63	13	21
1975	0.076	0.029	0.123	0.104	0.043	0.165	0.727	21	30	49	46.7	56	57	12	15
1976	0.039	0.004	0.074	0.077	0.020	0.135	0.501	17	36	41	43.9	52	60	9	10
1977	0.376	0.274	0.478	0.600	0.443	0.757	0.627	19	24	48	44.9	56	61	50	84
1978	0.450	0.240	0.661	0.635	0.359	0.912	0.709	8	25	50	48.0	59	66	49	130
1979	0.182	0.075	0.288	0.239	0.116	0.362	0.761	9	29	50	48.7	60	62	31	60
1980	0.343	0.167	0.519	0.522	0.254	0.789	0.658	15	23	52	46.4	58	62	37	60
1981	0.119	0.039	0.199	0.167	0.069	0.264	0.715	23	26	49	48.1	60	61	13	18
1982	0.039	0.007	0.071	0.074	0.025	0.123	0.521	9	9	49	41.9	63	64	11	11
1983	0.146	0.056	0.236	0.255	0.085	0.426	0.573	14	14	46	40.9	57	59	12	24
1984	0.199	0.106	0.292	0.389	0.171	0.607	0.512	14	22	37	39.2	58	71	23	39
1985	0.210	0.088	0.332	0.340	0.180	0.500	0.617	12	15	51	45.2	59	63	28	64
1986	0.209	0.118	0.300	0.392	0.216	0.567	0.534	13	21	47	45.0	63	66	24	63
1987	0.095	0.045	0.145	0.164	0.081	0.247	0.581	15	15	48	44.8	60	61	19	28
1988	0.284	0.103	0.465	0.446	0.223	0.670	0.637	20	20	51	48.3	59	65	27	90
1989	0.128	0.072	0.185	0.336	0.194	0.478	0.382	13	16	33	36.8	59	62	27	52
1990	0.194	0.120	0.268	0.332	0.202	0.462	0.584	16	23	48	46.4	58	62	27	45
1991	0.167	0.070	0.265	0.335	0.188	0.482	0.500	18	20	46	43.9	57	62	25	59
1992	0.126	0.024	0.228	0.316	0.120	0.511	0.400	12	18	43	40.0	58	60	16	56
1993	0.227	0.107	0.346	0.818	0.273	1.362	0.277	13	13	26	32.6	56	62	29	123
1994	0.099	0.030	0.169	0.269	0.105	0.433	0.370	11	11	36	38.0	57	59	17	36
1995	0.189	0.115	0.263	0.764	0.315	1.214	0.247	10	13	30	32.6	56	59	29	119
1996	0.176	0.093	0.260	0.421	0.249	0.594	0.418	15	18	46	41.6	56	59	26	55
1997	0.232	0.117	0.347	0.449	0.232	0.665	0.517	16	21	47	45.2	60	64	20	59
1998	0.028	0.005	0.051	0.108	0.021	0.194	0.263	18	17	29	35.2	51	53	11	18
1999	0.070	0.032	0.109	0.110	0.050	0.171	0.638	22	22	50	48.7	60	62	16	22

Table 17. Abundance and biomass from NEFSC spring surveys for clearnose skate for the Mid-Atlantic region (offshore strata 61-76, inshore strata 15-44). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1976-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1976	0.100	0.020	0.179	0.129	0.040	0.218	0.770	26	26	43	48.5	66	67	8	12
1977	0.509	0.297	0.722	0.500	0.260	0.741	1.017	23	23	56	52.5	63	64	17	41
1978	0.211	-0.094	0.516	0.237	-0.057	0.530	0.893	20	20	57	52.2	68	69	8	21
1979	0.109	0.010	0.209	0.125	0.004	0.247	0.875	25	25	42	50.3	77	78	6	9
1980	0.319	0.100	0.538	0.456	0.136	0.775	0.700	25	25	41	45.1	64	69	14	44
1981	0.891	-0.141	1.923	0.606	0.106	1.107	1.469	24	26	60	55.9	67	72	10	44
1982	0.328	0.165	0.491	0.368	0.126	0.610	0.892	30	32	52	53.6	66	71	14	40
1983	0.138	0.005	0.270	0.127	0.003	0.252	1.081	13	13	58	51.3	65	66	7	11
1984	0.380	0.103	0.658	0.288	0.018	0.557	1.321	48	48	62	60.7	70	74	11	25
1985	0.493	-0.166	1.151	0.436	-0.203	1.076	1.129	48	48	58	59.3	69	72	10	37
1986	0.155	0.035	0.274	0.232	0.038	0.427	0.666	27	27	44	44.8	68	69	11	15
1987	0.306	0.150	0.463	0.202	0.109	0.204	1.519	49	51	63	61.9	69	72	16	20
1988	0.340	0.171	0.508	0.300	0.097	0.502	1.134	44	44	58	57.1	67	71	11	19
1989	0.424	0.258	0.590	0.415	0.275	0.554	1.023	25	25	58	52.3	68	72	14	40
1990	0.501	0.283	0.719	0.420	0.243	0.597	1.192	30	30	59	56.2	67	72	15	52
1991	0.690	0.463	0.918	0.543	0.354	0.731	1.272	27	27	62	58.8	68	71	23	59
1992	0.748	0.324	1.172	0.489	0.218	0.760	1.529	46	46	63	63.0	68	80	23	47
1993	0.856	0.479	1.233	0.656	0.216	1.096	1.305	21	33	63	58.6	70	74	12	136
1994	0.319	0.052	0.585	0.188	0.043	0.333	1.699	51	57	65	66.0	73	74	8	24
1995	0.669	0.361	0.977	0.464	0.261	0.666	1.443	46	46	67	62.4	68	74	18	32
1996	1.224	0.194	2.254	0.948	0.255	1.641	1.291	13	27	62	59.8	70	75	30	95
1997	1.290	0.885	1.695	0.972	0.542	1.403	1.326	33	39	63	61.3	71	78	22	80
1998	0.903	0.674	1.133	0.667	0.369	0.964	1.355	26	38	62	60.2	70	74	29	81
1999	0.943	0.647	1.238	0.862	0.470	1.255	1.093	26	28	59	57.3	67	72	19	54

Table 18. Abundance and biomass from NEFSC autumn surveys for clearnose skate for the Mid-Atlantic region (offshore strata 61-76, inshore strata 15-44). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1975-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1975	0.237	0.086	0.388	0.246	0.133	0.360	0.961	21	21	53	50.3	63	66	31	49
1976	0.302	0.189	0.415	0.348	0.236	0.459	0.869	18	34	52	52.1	64	69	26	54
1977	0.768	0.288	1.248	0.742	0.281	1.203	1.035	15	37	57	55.4	65	68	32	106
1978	0.156	0.073	0.240	0.224	0.086	0.363	0.697	10	10	44	40.8	64	66	14	23
1979	0.419	0.116	0.721	0.346	0.146	0.545	1.211	22	24	56	55.4	67	71	27	46
1980	0.685	0.408	0.961	0.549	0.322	0.775	1.248	33	37	59	58.1	69	72	32	80
1981	0.171	0.081	0.260	0.179	0.087	0.271	0.954	27	27	55	51.5	65	68	19	28
1982	0.213	0.099	0.326	0.183	0.095	0.271	1.163	32	43	59	58.3	67	72	26	37
1983	0.141	0.027	0.254	0.127	0.043	0.210	1.110	16	16	57	52.2	64	70	15	19
1984	0.178	0.064	0.293	0.189	0.063	0.315	0.945	34	37	53	54.0	67	83	20	32
1985	0.306	0.173	0.439	0.315	0.182	0.447	0.974	32	41	56	54.9	66	71	23	42
1986	0.545	-0.038	1.027	0.591	0.091	1.092	0.921	23	23	59	52.6	64	71	31	62
1987	0.320	0.176	0.465	0.289	0.167	0.412	1.107	15	41	56	55.5	69	70	23	42
1988	0.335	0.157	0.513	0.329	0.163	0.495	1.019	33	37	57	56.0	66	71	19	60
1989	0.273	0.075	0.471	0.324	0.064	0.584	0.843	37	37	52	52.7	63	70	20	39
1990	0.402	0.157	0.646	0.306	0.114	0.499	1.311	16	41	60	57.9	69	72	17	50
1991	0.922	0.279	1.566	0.816	0.339	1.294	1.130	35	39	58	57.1	69	71	35	119
1992	0.345	0.185	0.505	0.312	0.185	0.440	1.104	16	42	59	56.7	67	69	22	48
1993	0.495	0.145	0.844	0.474	0.188	0.759	1.044	35	40	57	56.8	66	73	27	104
1994	0.938	0.479	1.398	0.842	0.494	1.190	1.115	35	40	57	57.1	66	73	35	129
1995	0.331	0.189	0.473	0.426	0.233	0.618	0.777	14	14	51	45.5	66	72	25	63
1996	0.430	0.194	0.666	0.369	0.163	0.576	1.165	29	45	59	58.8	68	72	20	42
1997	0.614	0.296	0.932	0.484	0.281	0.688	1.269	43	43	61	60.2	69	77	27	60
1998	1.121	0.115	2.128	1.096	0.124	2.068	1.023	34	43	57	57.5	68	73	32	98
1999	1.053	0.536	1.570	0.928	0.525	1.332	1.134	15	32	61	57.8	69	71	41	84

Table 19. Abundance and biomass from NEFSC winter surveys for clearnose skate for the Georges Bank to Mid-Atlantic region (offshore strata 1-3,5-7,9-11,13-14,16,61-63,65-67,69-71,73-75). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1992	5.622	3.247	7.997	5.247	2.974	7.519	1.072	23	26	59	54.7	67	93	22	551
1993	6.013	3.818	8.208	5.973	3.852	8.093	1.007	22	33	57	54.3	67	81	23	716
1994	8.854	4.037	13.672	7.692	2.152	13.233	1.151	27	33	60	57.5	69	77	16	639
1995	7.924	2.521	13.327	6.247	1.301	11.194	1.268	24	45	61	60.2	69	76	23	737
1996	14.725	8.266	21.183	11.555	6.347	16.762	1.274	22	40	61	60.0	69	77	32	3086
1997	5.522	3.154	7.890	5.069	2.158	7.980	1.089	22	35	59	56.2	70	76	32	682
1998	6.031	4.470	7.592	4.878	3.195	6.560	1.236	22	36	60	58.3	71	88	32	1091
1999	3.826	2.335	5.317	3.022	1.586	4.459	1.266	23	37	61	59.6	70	76	30	343

Table 20. Abundance and biomass from NEFSC spring surveys for rosette skate for the Mid-Atlantic region (offshore strata 61-76). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1968	0.005	-0.002	0.012	0.014	0.000	0.029	0.356	33	33	33	34.4	35	36	3	3
1969	0.001	-0.001	0.002	0.003	-0.003	0.010	0.200	37	37	37	37.0	37	37	1	1
1970	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1971	0.005	-0.005	0.014	0.010	-0.009	0.028	0.500	57	57	57	57.0	57	57	1	1
1972	0.000	0.000	0.001	0.003	-0.003	0.010	0.100	35	35	35	35.0	35	35	1	1
1973	0.006	-0.001	0.012	0.023	-0.006	0.052	0.240	38	38	38	38.6	41	42	4	5
1974	0.005	-0.005	0.015	0.025	-0.024	0.074	0.200	41	41	41	41.0	41	41	1	1
1975	0.001	-0.001	0.003	0.005	-0.005	0.014	0.200	38	38	38	38.5	39	39	1	2
1976	0.007	0.000	0.015	0.035	-0.003	0.073	0.208	31	31	36	36.9	44	45	4	6
1977	0.102	0.019	0.186	0.552	0.107	0.998	0.185	20	26	32	33.6	37	42	11	70
1978	0.010	0.001	0.019	0.041	0.008	0.074	0.232	12	25	35	35.3	40	41	7	10
1979	0.007	0.005	0.009	0.040	0.031	0.048	0.171	13	13	34	31.6	40	41	4	10
1980	0.072	0.030	0.115	0.373	0.167	0.580	0.194	26	27	34	35.3	41	42	15	47
1981	0.013	0.001	0.025	0.057	0.006	0.109	0.231	19	28	37	36.3	41	42	6	17
1982	0.025	0.010	0.040	0.108	0.043	0.174	0.234	22	25	37	37.4	43	44	11	20
1983	0.002	-0.001	0.004	0.012	-0.006	0.029	0.147	29	29	34	34.2	35	36	2	5
1984	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	0	0
1985	0.005	-0.001	0.011	0.059	0.040	0.079	0.080	17	17	18	21.0	29	42	3	9
1986	0.002	-0.002	0.006	0.012	-0.008	0.031	0.182	32	32	35	35.3	35	36	2	2
1987	0.003	-0.002	0.009	0.017	-0.012	0.046	0.200	35	35	36	36.7	36	37	2	2
1988	0.020	-0.001	0.041	0.111	-0.002	0.223	0.180	26	26	35	32.8	35	36	4	6
1989	0.010	-0.004	0.025	0.051	-0.036	0.137	0.200	28	28	34	34.6	40	41	2	15
1990	0.010	-0.004	0.024	0.049	-0.022	0.121	0.200	36	36	35	36.0	35	36	3	3
1991	0.036	0.014	0.058	0.143	0.057	0.228	0.253	19	33	37	37.2	40	42	7	19
1992	0.014	-0.001	0.029	0.063	0.012	0.113	0.223	24	24	37	36.0	40	41	5	5
1993	0.009	0.007	0.011	0.037	0.030	0.043	0.255	38	38	37	38.6	39	40	2	5
1994	0.005	0.001	0.009	0.021	0.006	0.035	0.243	36	36	38	38.7	40	41	4	4
1995	0.010	0.000	0.020	0.056	0.003	0.110	0.173	19	19	35	32.9	36	37	3	5
1996	0.014	-0.011	0.039	0.095	-0.013	0.203	0.149	9	9	35	29.3	42	43	5	19
1997	0.028	0.022	0.033	0.138	0.091	0.186	0.200	30	30	34	35.6	41	42	4	25
1998	0.038	0.007	0.068	0.132	0.041	0.223	0.287	32	33	38	38.0	41	42	11	15
1999	0.043	0.003	0.083	0.206	0.012	0.399	0.211	15	29	37	36.7	42	43	9	16

Table 21. Abundance and biomass from NEFSC autumn surveys for rosette skate for the Mid-Atlantic region (offshore strata 61-76). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1967-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1967	0.019	0.002	0.037	0.117	0.010	0.224	0.166	10	18	34	34.3	39	42	7	17
1968	0.003	-0.001	0.008	0.023	-0.019	0.065	0.135	28	28	28	28.9	37	38	2	2
1969	0.002	-0.002	0.006	0.010	-0.009	0.028	0.200	38	38	38	38.0	38	38	1	1
1970	0.009	-0.006	0.024	0.033	-0.025	0.090	0.276	39	39	39	39.5	39	40	2	3
1971	0.001	-0.001	0.004	0.006	-0.005	0.016	0.250	40	40	40	40.5	40	41	1	2
1972	0.016	0.001	0.032	0.058	0.021	0.094	0.285	12	12	34	34.2	40	41	7	8
1973	0.012	-0.008	0.032	0.053	-0.016	0.122	0.224	16	16	28	29.0	40	41	3	5
1974	0.012	-0.002	0.026	0.079	-0.014	0.171	0.156	23	23	34	33.8	40	41	4	11
1975	0.004	-0.001	0.009	0.034	-0.001	0.070	0.122	25	25	34	33.6	38	39	4	8
1976	0.024	0.003	0.045	0.149	0.016	0.281	0.163	28	28	33	33.7	37	40	7	21
1977	0.020	-0.002	0.043	0.087	-0.011	0.185	0.231	31	31	33	35.2	40	41	5	8
1978	0.007	-0.007	0.022	0.015	-0.014	0.043	0.500	39	39	39	39.0	39	39	1	1
1979	0.010	-0.004	0.025	0.043	-0.016	0.101	0.242	22	22	35	36.1	39	40	3	6
1980	0.090	0.042	0.138	0.312	0.120	0.505	0.287	14	25	38	36.6	41	42	10	24
1981	0.079	0.011	0.148	0.296	0.052	0.539	0.268	27	28	37	37.5	41	43	10	45
1982	0.006	-0.006	0.018	0.020	-0.019	0.059	0.300	39	39	39	39.0	39	39	1	1
1983	0.001	-0.001	0.003	0.010	-0.010	0.030	0.100	12	12	12	20.7	36	37	1	3
1984	0.029	0.005	0.053	0.128	0.033	0.223	0.229	13	26	36	35.6	39	40	7	16
1985	0.005	0.004	0.007	0.036	0.019	0.054	0.146	14	14	25	28.0	35	36	5	6
1986	0.003	0.001	0.004	0.009	0.005	0.013	0.300	37	37	37	38.2	39	40	3	3
1987	0.028	0.006	0.050	0.112	0.040	0.183	0.253	11	15	38	32.7	41	42	7	10
1988	0.021	0.000	0.043	0.093	-0.002	0.188	0.228	30	30	32	35.0	41	42	5	8
1989	0.018	-0.005	0.041	0.046	-0.012	0.105	0.378	33	33	33	33.5	36	37	3	4
1990	0.023	-0.004	0.049	0.099	0.001	0.198	0.228	32	32	37	37.7	41	42	5	10
1991	0.005	-0.004	0.014	0.021	-0.009	0.051	0.237	15	15	34	31.4	34	35	3	3
1992	0.035	0.006	0.064	0.170	0.033	0.308	0.203	25	25	35	35.3	41	42	9	11
1993	0.021	0.005	0.037	0.102	0.033	0.170	0.211	25	25	37	35.1	40	41	4	8
1994	0.073	0.000	0.146	0.301	0.006	0.597	0.242	27	27	37	36.8	42	43	6	21
1995	0.039	-0.005	0.084	0.174	-0.009	0.358	0.227	19	24	35	35.1	38	39	7	13
1996	0.043	-0.014	0.100	0.273	-0.127	0.674	0.158	7	19	32	31.6	38	42	7	21
1997	0.013	0.000	0.026	0.074	-0.014	0.162	0.176	31	31	33	34.0	42	43	4	6
1998	0.050	-0.008	0.108	0.208	-0.042	0.458	0.241	33	33	37	38.1	40	41	7	22
1999	0.067	0.038	0.096	0.380	0.182	0.578	0.177	12	18	34	32.6	41	42	8	46

Table 22. Abundance and biomass from NEFSC winter surveys for rosette skate for the Georges Bank to Mid-Atlantic region (offshore strata 1-3,5-7,9-11,13-14,16,61-63,65-67,69-71,73-75). The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow				length						nonzero	
	mean	lower	upper	mean	lower	upper	ind wt	min	5%	50%	mean	95%	max	tows	no fish
1992	0.264	0.138	0.390	1.125	0.619	1.632	0.235	16	27	36	36.4	41	45	15	230
1993	0.149	0.048	0.251	0.663	0.197	1.130	0.225	26	29	36	36.7	39	41	9	143
1994	0.199	0.148	0.249	0.761	0.608	0.914	0.261	16	28	37	36.8	40	44	15	162
1995	0.195	0.066	0.323	0.774	0.273	1.275	0.252	19	32	37	37.9	41	42	23	197
1996	0.324	0.121	0.526	1.410	0.443	2.376	0.230	19	28	36	36.3	40	46	23	899
1997	0.258	-0.051	0.567	1.079	-0.194	2.353	0.239	13	30	36	36.9	40	44	21	238
1998	0.160	0.102	0.219	0.664	0.421	0.907	0.241	15	30	36	36.5	40	45	21	350
1999	0.271	0.043	0.500	1.151	0.082	2.220	0.236	24	27	37	36.6	41	44	25	228

Table 23. Input data and results of Thompson and Bell (1936) yield and spawning biomass per recruit calculations for winter skate, for M = 0.1

Winter Skate - SAW30

Proportion of F before spawning: .5000
Proportion of M before spawning: .5000
Natural Mortality is Constant at: .100
Initial age is: 1; Last age is: 30
Last age is a TRUE AGE

Age-specific Input data for Yield per Recruit Analysis

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights Catch	Stock
1	.0000	1.0000	.0000	.059	.059
2	.2000	1.0000	.0000	.255	.255
3	1.0000	1.0000	.0000	.623	.623
4	1.0000	1.0000	.1000	1.153	1.153
5	1.0000	1.0000	.2000	1.816	1.816
6	1.0000	1.0000	.4000	2.573	2.573
7	1.0000	1.0000	.7000	3.386	3.386
8	1.0000	1.0000	.9000	4.222	4.222
9	1.0000	1.0000	1.0000	5.054	5.054
10	1.0000	1.0000	1.0000	5.861	5.861
11	1.0000	1.0000	1.0000	6.629	6.629
12	1.0000	1.0000	1.0000	7.348	7.348
13	1.0000	1.0000	1.0000	8.014	8.014
14	1.0000	1.0000	1.0000	8.623	8.623
15	1.0000	1.0000	1.0000	9.176	9.176
16	1.0000	1.0000	1.0000	9.675	9.675
17	1.0000	1.0000	1.0000	10.121	10.121
18	1.0000	1.0000	1.0000	10.519	10.519
19	1.0000	1.0000	1.0000	10.873	10.873
20	1.0000	1.0000	1.0000	11.185	11.185
21	1.0000	1.0000	1.0000	11.461	11.461
22	1.0000	1.0000	1.0000	11.703	11.703
23	1.0000	1.0000	1.0000	11.916	11.916
24	1.0000	1.0000	1.0000	12.102	12.102
25	1.0000	1.0000	1.0000	12.266	12.266
26	1.0000	1.0000	1.0000	12.408	12.408
27	1.0000	1.0000	1.0000	12.532	12.532
28	1.0000	1.0000	1.0000	12.641	12.641
29	1.0000	1.0000	1.0000	12.735	12.735
30	1.0000	1.0000	1.0000	12.817	12.817

Slope of the Yield/Recruit Curve at F=0.00: --> 43.0186
F level at slope=1/10 of the above slope (F0.1): -----> .078
Yield/Recruit corresponding to F0.1: -----> 1.3909
F level to produce Maximum Yield/Recruit (Fmax): -----> .119
Yield/Recruit corresponding to Fmax: -----> 1.4649
F level at 50 % of Max Spawning Potential (F50): -----> .060
SSB/Recruit corresponding to F50: --------> 18.1308

Table 23 continued.

Listing of Yield per Recruit Results for:
Winter Skate - SAW30

	FMORT	TOTCTHN	TOTCTHW	TOTSTKN	TOTSTKW	SPNSTKN	SPNSTKW	% MSP
	.000	.00000	.00000	9.9852	45.4547	5.2131	39.1993	100.00
F0.1	.078	.36367	1.39090	6.8187	19.7492	2.3907	14.7897	37.73
F50%	.060	.31053	1.28401	7.3111	23.3627	2.8085	18.1308	46.25
	.100	.41683	1.45212	6.3157	16.2633	1.9768	11.6179	29.64
Fmax	.119	.45324	1.46489	5.9656	13.9785	1.6982	9.5757	24.43
	.200	.55807	1.35654	4.9392	8.0907	.9445	4.5366	11.57
	.300	.62845	1.16228	4.2436	4.9385	.5149	2.1028	5.36
	.400	.67087	1.00462	3.8257	3.4275	.3053	1.0882	2.78
	.500	.69936	.88619	3.5468	2.5910	.1921	.6083	1.55
	.600	.71988	.79705	3.3473	2.0792	.1266	.3606	.92
	.700	.73542	.72872	3.1974	1.7424	.0866	.2241	.57
	.800	.74764	.67524	3.0805	1.5081	.0611	.1448	.37
	.900	.75753	.63254	2.9867	1.3378	.0442	.0968	.25
	1.000	.76573	.59783	2.9096	1.2096	.0327	.0666	.17
	1.100	.77265	.56915	2.8451	1.1103	.0246	.0471	.12
	1.200	.77859	.54510	2.7901	1.0315	.0188	.0340	.09
	1.300	.78376	.52467	2.7427	.9676	.0146	.0250	.06
	1.400	.78831	.50711	2.7013	.9149	.0114	.0187	.05
	1.500	.79235	.49185	2.6648	.8707	.0090	.0142	.04
	1.600	.79598	.47848	2.6322	.8333	.0072	.0110	.03
	1.700	.79926	.46664	2.6030	.8011	.0058	.0085	.02
	1.800	.80225	.45609	2.5765	.7731	.0047	.0067	.02
	1.900	.80498	.44661	2.5524	.7486	.0038	.0053	.01
	2.000	.80750	.43803	2.5302	.7268	.0031	.0042	.01

Table 24. Input data and results of Thompson and Bell (1936) yield and spawning biomass per recruit calculations for little skate.

Little Skate - SAW30
Proportion of F before spawning: .5000
Proportion of M before spawning: .5000
Natural Mortality is Constant at: .400
Initial age is: 1; Last age is: 8
Last age is a TRUE Age;
Original age-specific PRs, Mats, and Mean Wts from file:
==> LITTSKAT.DAT

Age-specific Input data for Yield per Recruit Analysis

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights Catch	Stock
1	.0000	1.0000	.0000	.119	.119
2	.1000	1.0000	.0000	.254	.254
3	.7000	1.0000	.5000	.378	.378
4	.9000	1.0000	1.0000	.507	.507
5	1.0000	1.0000	1.0000	.614	.614
6	1.0000	1.0000	1.0000	.697	.697
7	1.0000	1.0000	1.0000	.761	.761
8	1.0000	1.0000	1.0000	.807	.807

Summary of Yield per Recruit Analysis for:
Little Skate - SAW30

Slope of the Yield/Recruit Curve at F=0.00: --> .5027
F level at slope=1/10 of the above slope (F0.1): -----> .651
Yield/Recruit corresponding to F0.1: -----> .1179
F level to produce Maximum Yield/Recruit (Fmax): -----> 6.995
Yield/Recruit corresponding to Fmax: -----> .1505
F level at 50 % of Max Spawning Potential (F50): -----> .342
SSB/Recruit corresponding to F50: --------> .2350

Table 24. Continued

Listing of Yield per Recruit Results for:
Little Skate - SAW30

	FMORT	TOTCTHN	TOTCTHW	TOTSTKN	TOTSTKW	SPNSTKN	SPNSTKW	% MSP
	.000	.00000	.00000	2.9096	.9481	.8307	.4701	100.00
	.100	.07958	.04089	2.7675	.8532	.6850	.3755	79.87
	.200	.13720	.06796	2.6570	.7810	.5747	.3057	65.03
	.300	.18032	.08634	2.5695	.7252	.4896	.2533	53.88
F50%	.342	.19539	.09231	2.5378	.7053	.4594	.2350	49.99
	.400	.21360	.09917	2.4989	.6812	.4226	.2131	45.34
	.500	.24006	.10837	2.4411	.6460	.3691	.1818	38.67
	.600	.26164	.11516	2.3929	.6173	.3255	.1570	33.39
F0.1	.651	.27120	.11795	2.3714	.6047	.3063	.1463	31.11
	.700	.27964	.12030	2.3523	.5936	.2895	.1370	29.13
	.800	.29495	.12429	2.3175	.5738	.2594	.1206	25.65
	.900	.30817	.12747	2.2873	.5569	.2339	.1070	22.77
	1.000	.31976	.13004	2.2610	.5425	.2122	.0957	20.35
	1.100	.33003	.13216	2.2377	.5299	.1933	.0861	18.30
	1.200	.33922	.13394	2.2170	.5190	.1770	.0778	16.55
	1.300	.34752	.13546	2.1984	.5092	.1626	.0707	15.04
	1.400	.35506	.13676	2.1816	.5006	.1499	.0645	13.73
	1.500	.36196	.13790	2.1663	.4928	.1386	.0591	12.58
	1.600	.36831	.13889	2.1523	.4859	.1286	.0543	11.56
	1.700	.37419	.13978	2.1395	.4795	.1195	.0501	10.66
	1.800	.37965	.14056	2.1276	.4737	.1114	.0464	9.86
	1.900	.38474	.14127	2.1166	.4684	.1040	.0430	9.14
	2.000	.38950	.14191	2.1064	.4635	.0973	.0400	8.50

Table 25. Hoenig (1987) estimates of fishing mortality for winter skate estimated from NEFSC spring (GOM-MA, offshore) trawl survey length frequency distributions. Winter skate von Bertalanffy growth parameters from Simon and Frank (1996). Assumes recruitment to NEFSC survey sampling gear at 50 cm. Year of estimate is the last year of a five year moving window, to smooth the variation in estimates resulting from variation in recruitment over time.

Winter skate: Linf = 114.01 cm, K = 0.14405, Spring survey L= = 50 cm, M = 0.1

Year	Lbar	Hoenig F	Year	Lbar	Hoenig F
1972	63.9	0.29	1986	75.9	0.08
1973	64.2	0.28	1987	75.6	0.08
1974	64.3	0.28	1988	75.5	0.08
1975	64.5	0.28	1989	74.9	0.09
1976	65.0	0.26	1990	74.7	0.09
1977	67.6	0.20	1991	74.4	0.10
1978	72.0	0.13	1992	73.3	0.11
1979	74.0	0.10	1993	71.2	0.14
1980	76.4	0.08	1994	69.7	0.16
1981	77.5	0.06	1995	67.6	0.20
1982	77.6	0.06	1996	63.1	0.32
1983	77.1	0.07	1997	61.6	0.37
1984	76.8	0.07	1998	60.7	0.41
1985	76.0	0.08	1999	61.1	0.39

Table 26. Beverton-Holt (1956) and Hoenig (1987) estimates of fishing mortality for little skate estimated from NEFSC spring (GOM-MA, inshore and offshore regions) trawl survey length frequency distributions. Little skate von Bertalanffy growth parameters from Waring (1984). Assumes recruitment to NEFSC spring survey sampling gear at 45 cm in. Year of estimate is the last year of a three year moving window, to smooth the variation in estimates resulting from variation in recruitment over time.

Little skate: Linf = 52.73 cm, K = 0.352, Spring survey L= = 45 cm, M = 0.4

Year	Lbar	Hoenig F
1984	47.1	0.20
1985	47.1	0.19
1986	47.2	0.15
1987	47.2	0.17
1988	47.2	0.16
1989	47.0	0.23
1990	47.0	0.22
1991	46.9	0.26
1992	46.9	0.24
1993	46.9	0.26
1994	46.8	0.30
1995	46.8	0.30
1996	46.8	0.27
1997	46.9	0.24
1998	46.8	0.28
1999	46.7	0.34

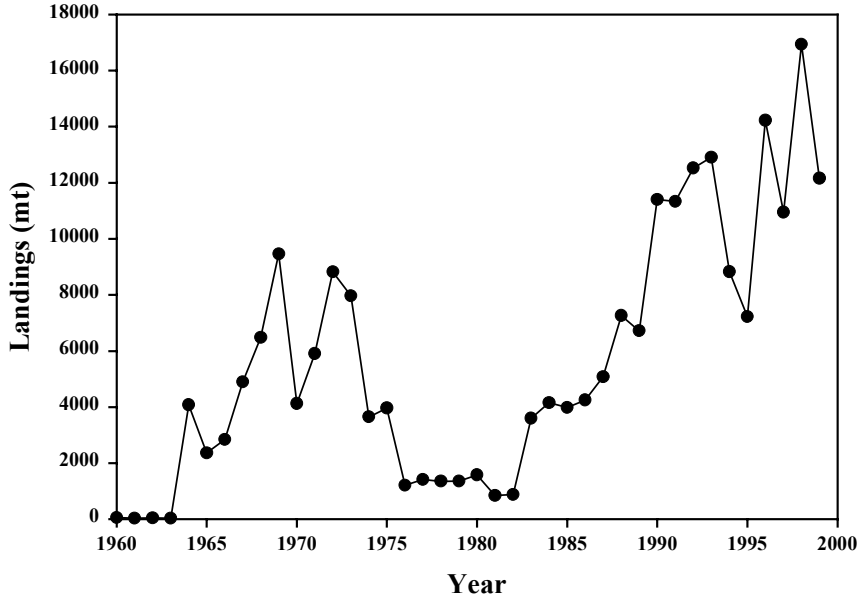

Figure 1. Total landings of skates in NAFO subareas 5 and 6.

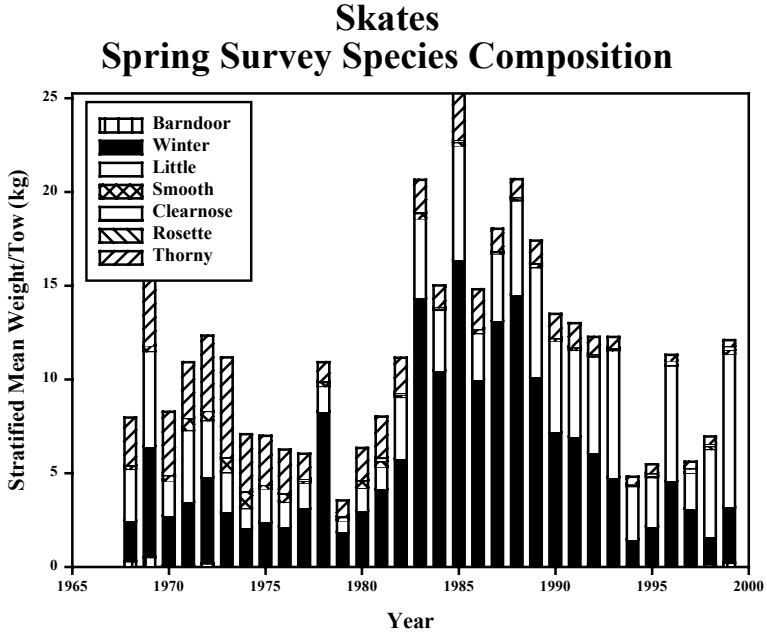

Figure 2. Species composition and biomass of skates from the NEFSC spring survey.

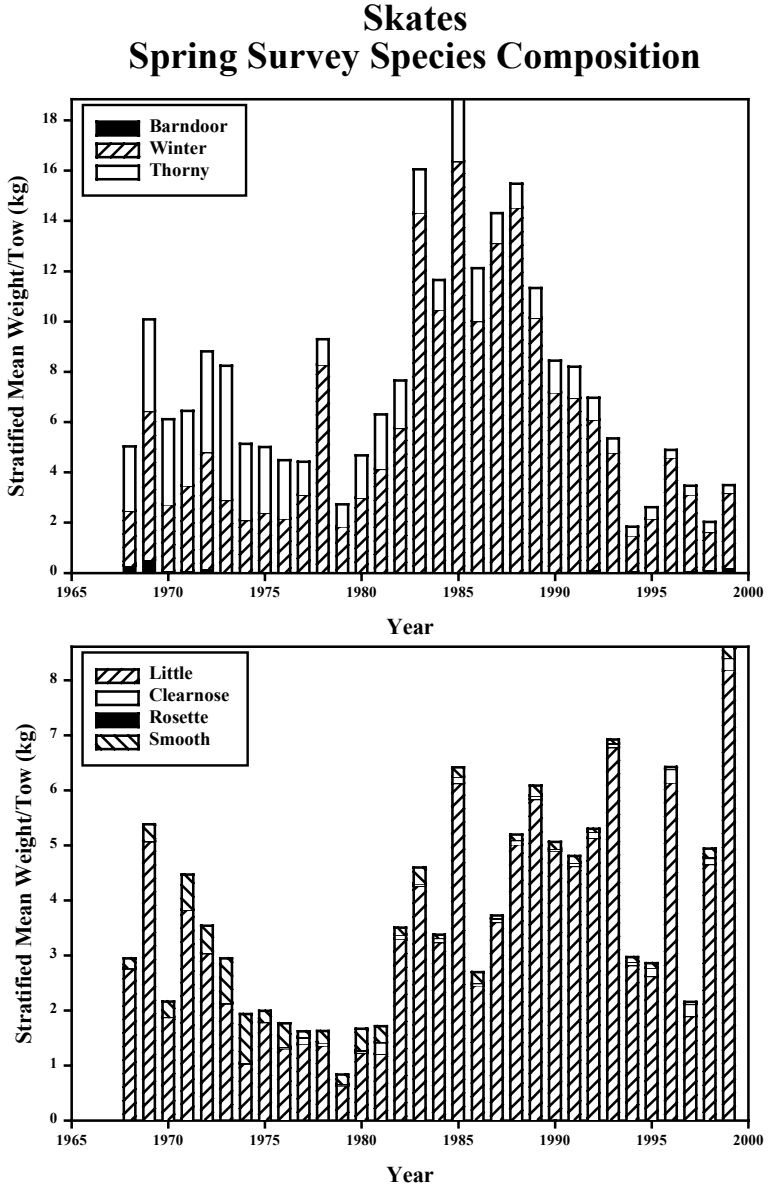

Figure 3. Species composition of skates from the spring survey. The top panel shows the composition of large species (>100 cm maximum length) while the bottom panel shows the composition of the small species (maximum length < 100cm).

Winter Skate

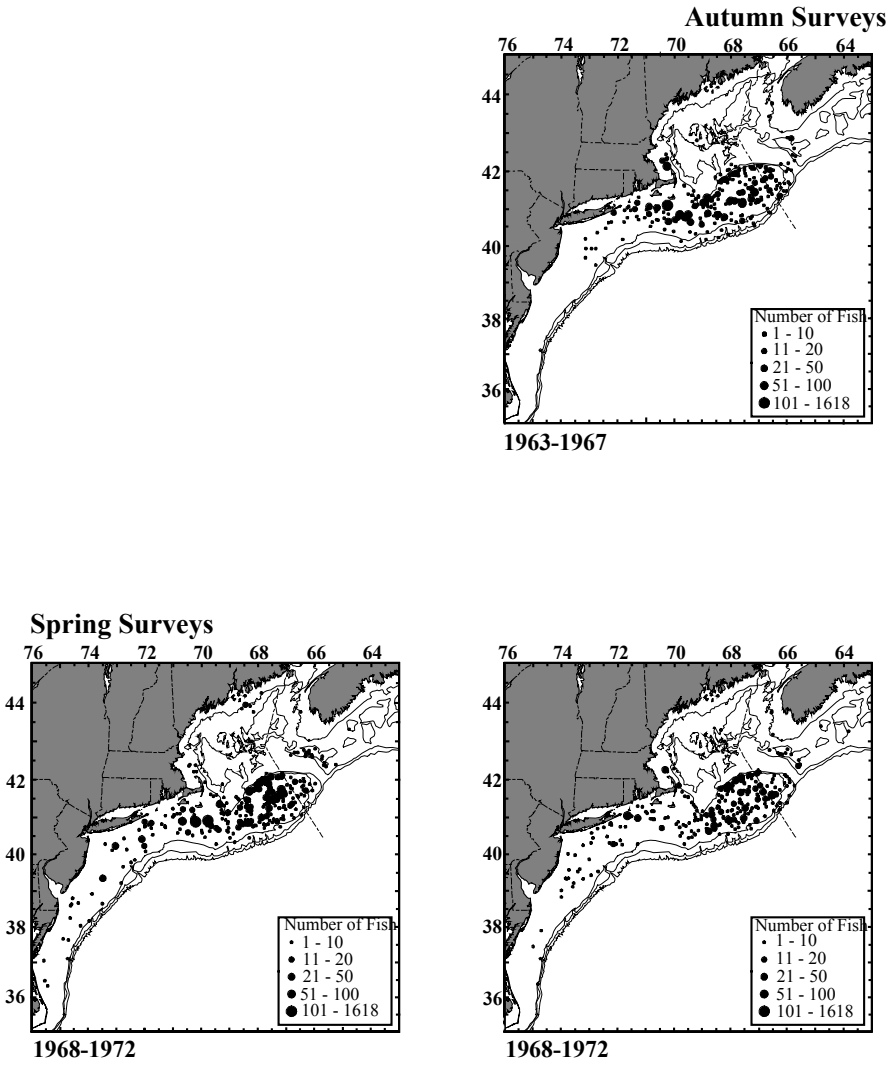

Figure 4. Distribution of winter skate in the NEFSC spring and autumn bottom trawl surveys from 1963-1972.

Winter Skate

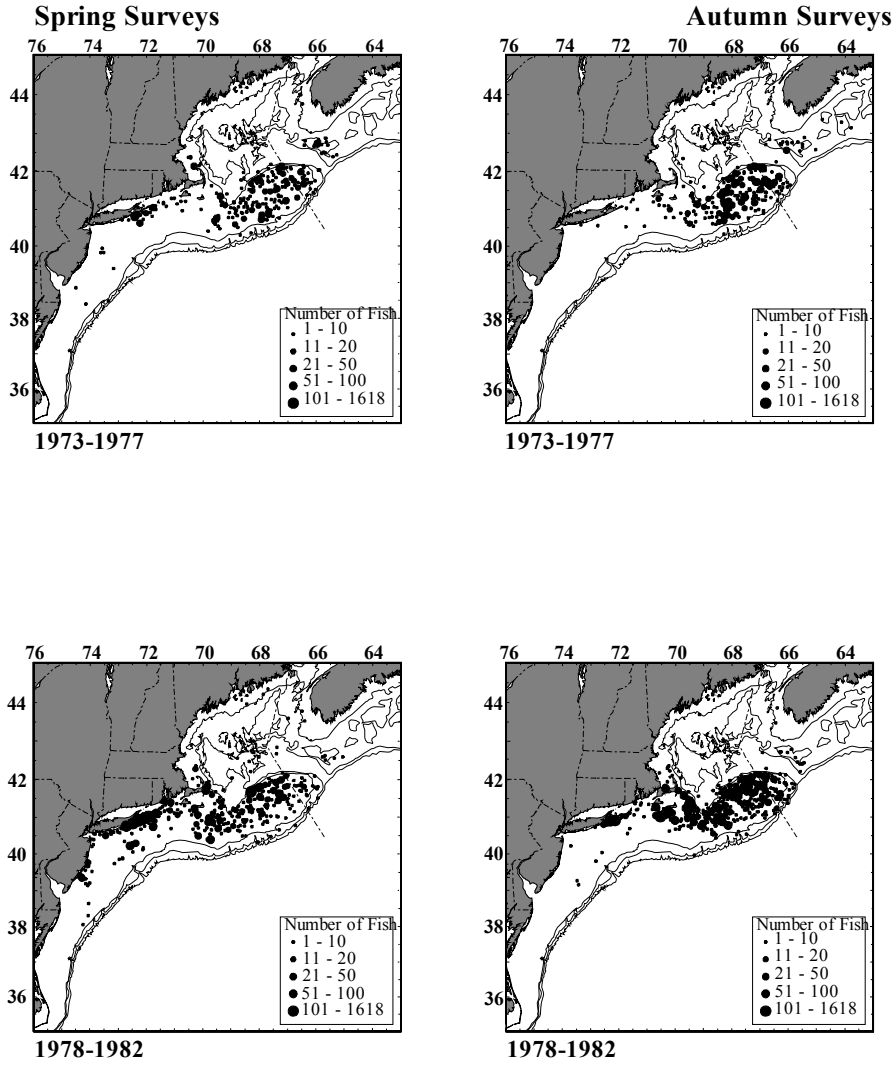

Figure 5. Distribution of winter skate in the NEFSC spring and autumn bottom trawl surveys from 1973-1982.

Winter Skate

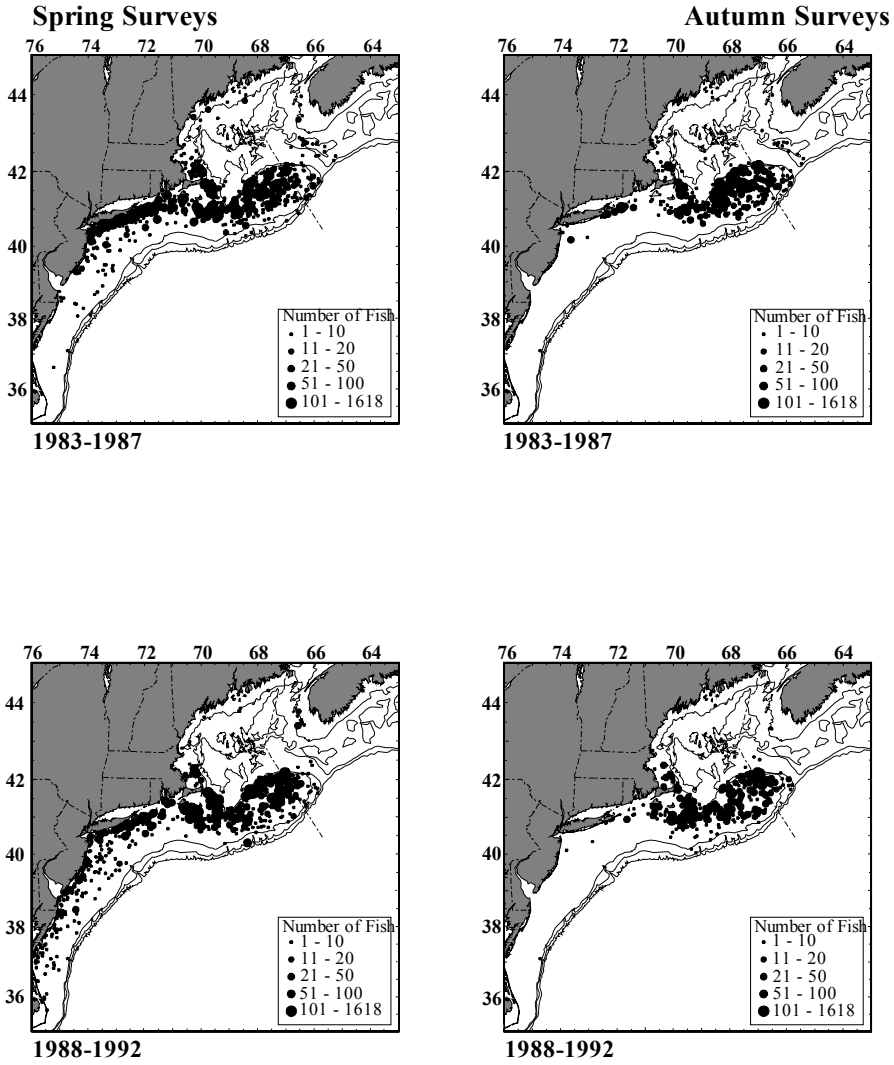

Figure 6. Distribution of winter skate in the NEFSC spring and autumn bottom trawl surveys from 1983-1992.

Winter Skate

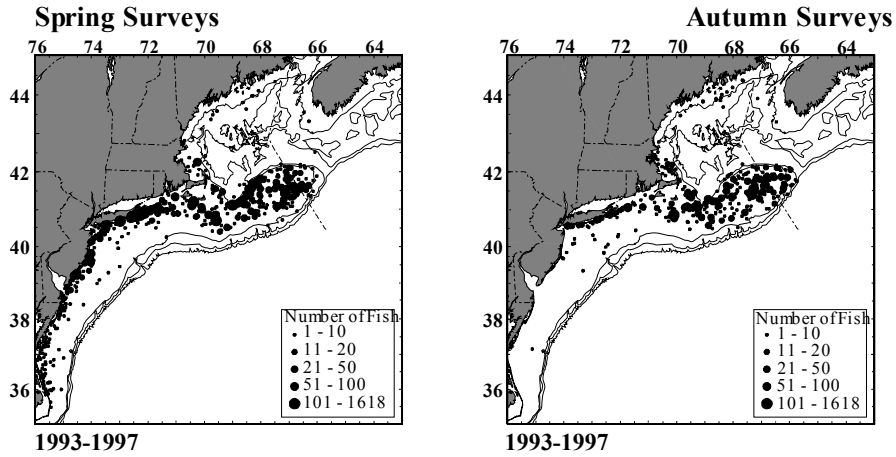

Figure 7. Distribution of winter skate in the NEFSC spring and autumn bottom trawl surveys from 1993-1997.

Winter Skate

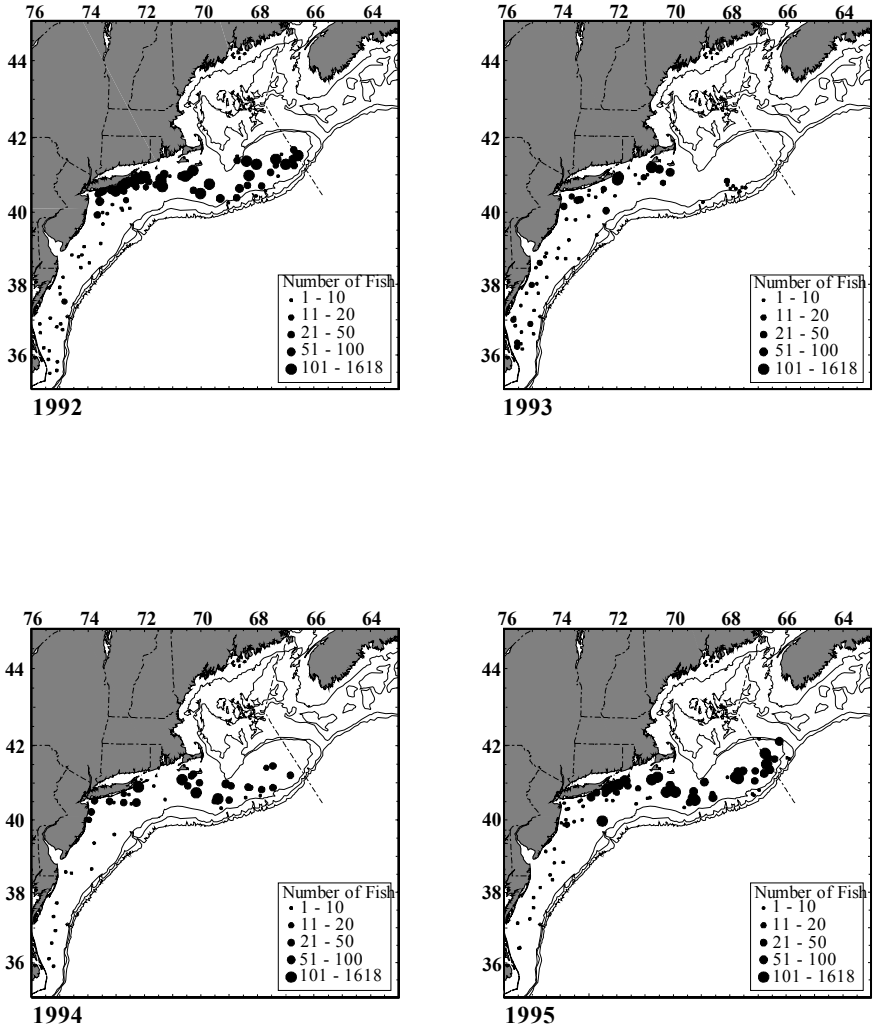

Figure 8. Distribution of winter skate in the NEFSC winter bottom trawl survey from 1992-1995.

Winter Skate

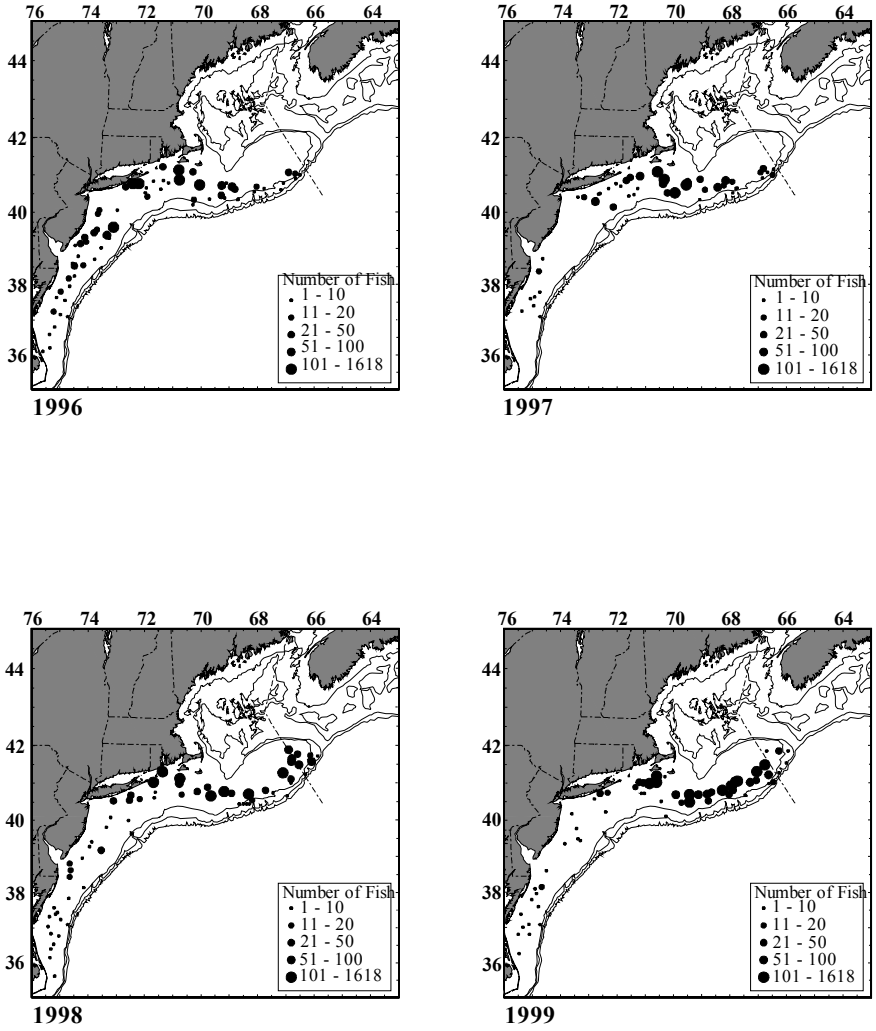

Figure 9. Distribution of winter skate in the NEFSC winter bottom trawl survey from 1996-1999.

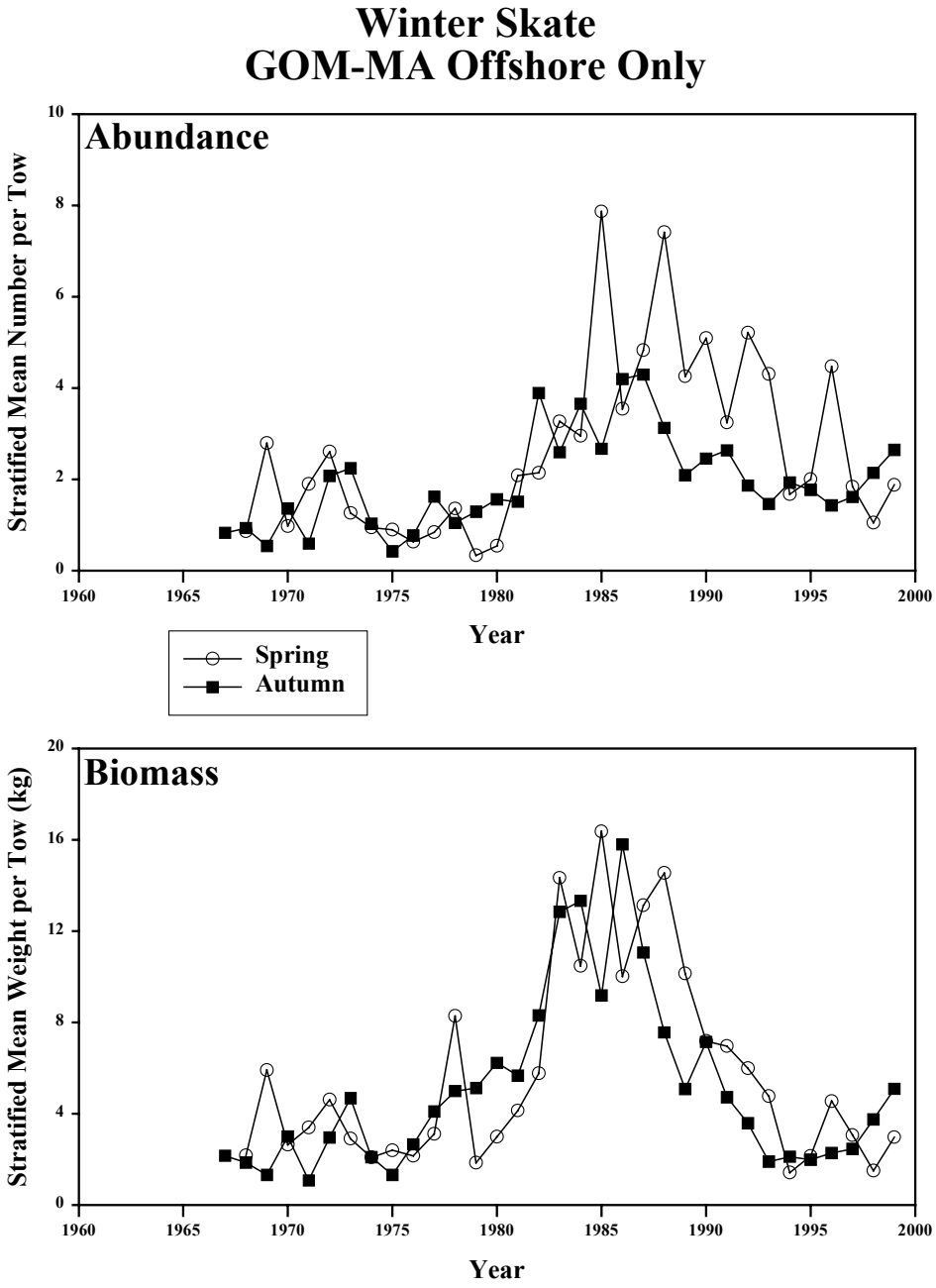

Figure 10. Abundance and biomass of winter skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1967-1999 in the Gulf of Maine to Mid-Atlantic offshore region.

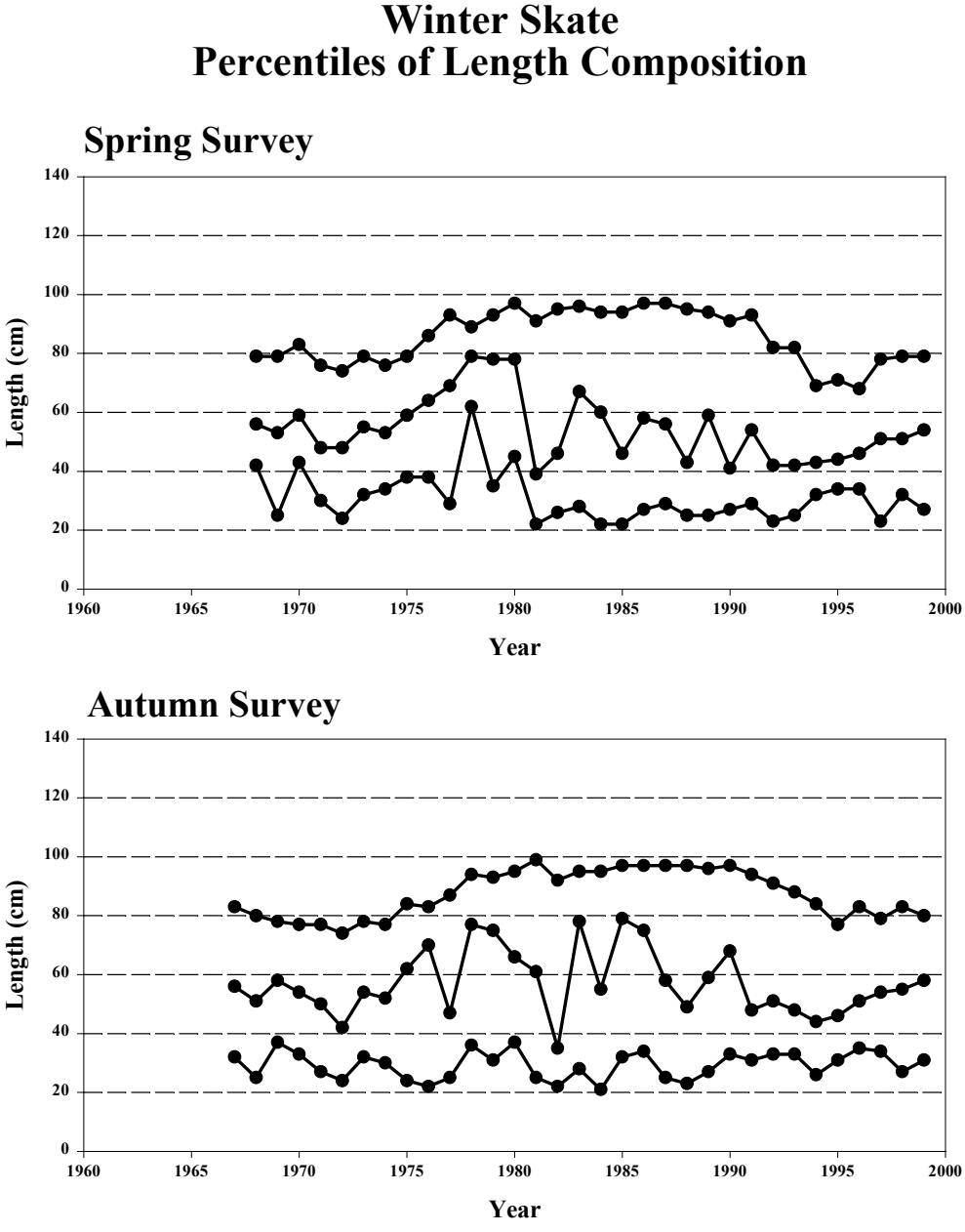

Figure 11. Percentiles of length composition (5, 50, and 95) of winter skate from the NESFC spring and autumn bottom trawl surveys from 1963-1999 in the Gulf of Maine to Mid-Atlantic offshore region.

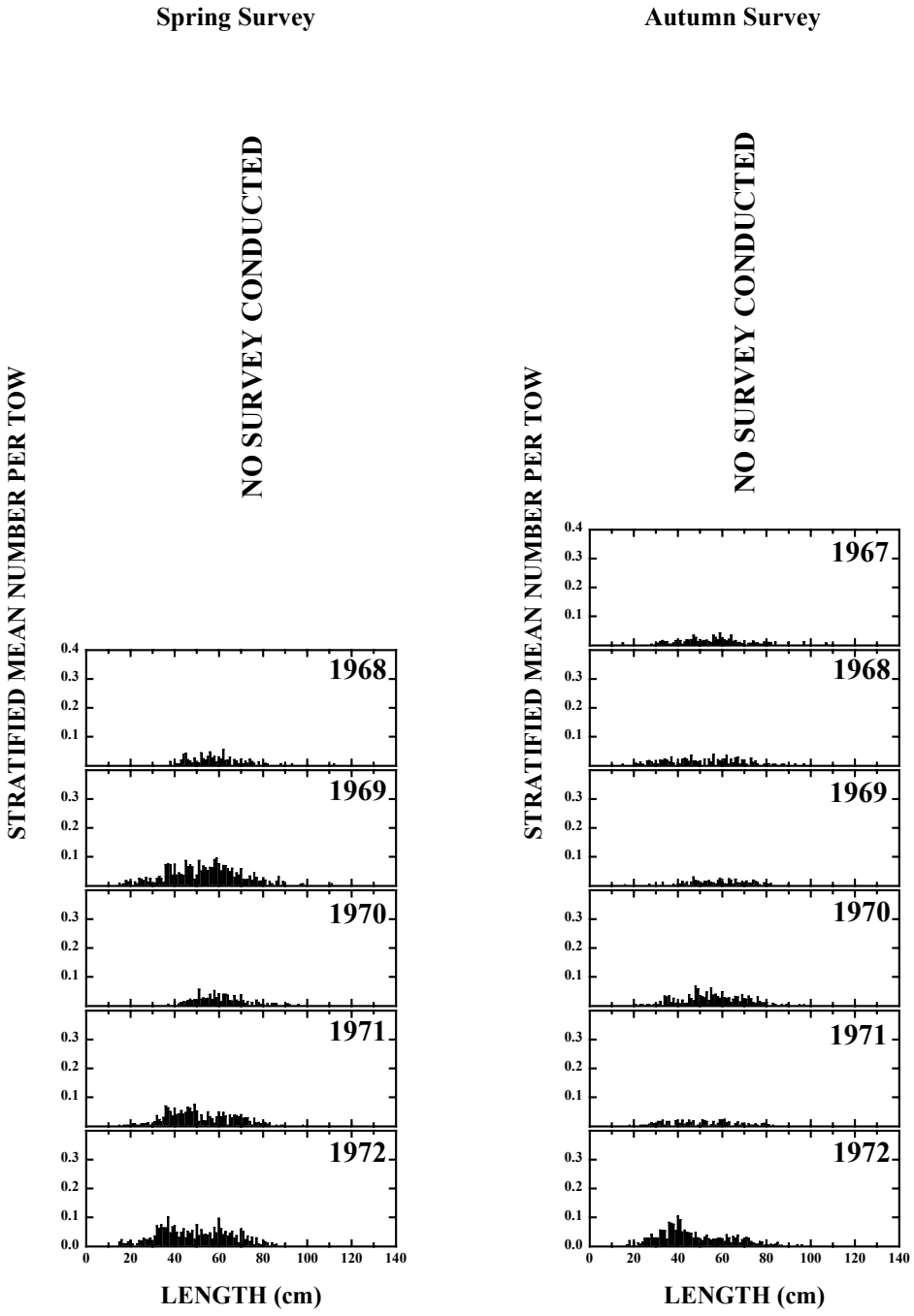

Figure 12. Winter skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore regions, 1967-1972.

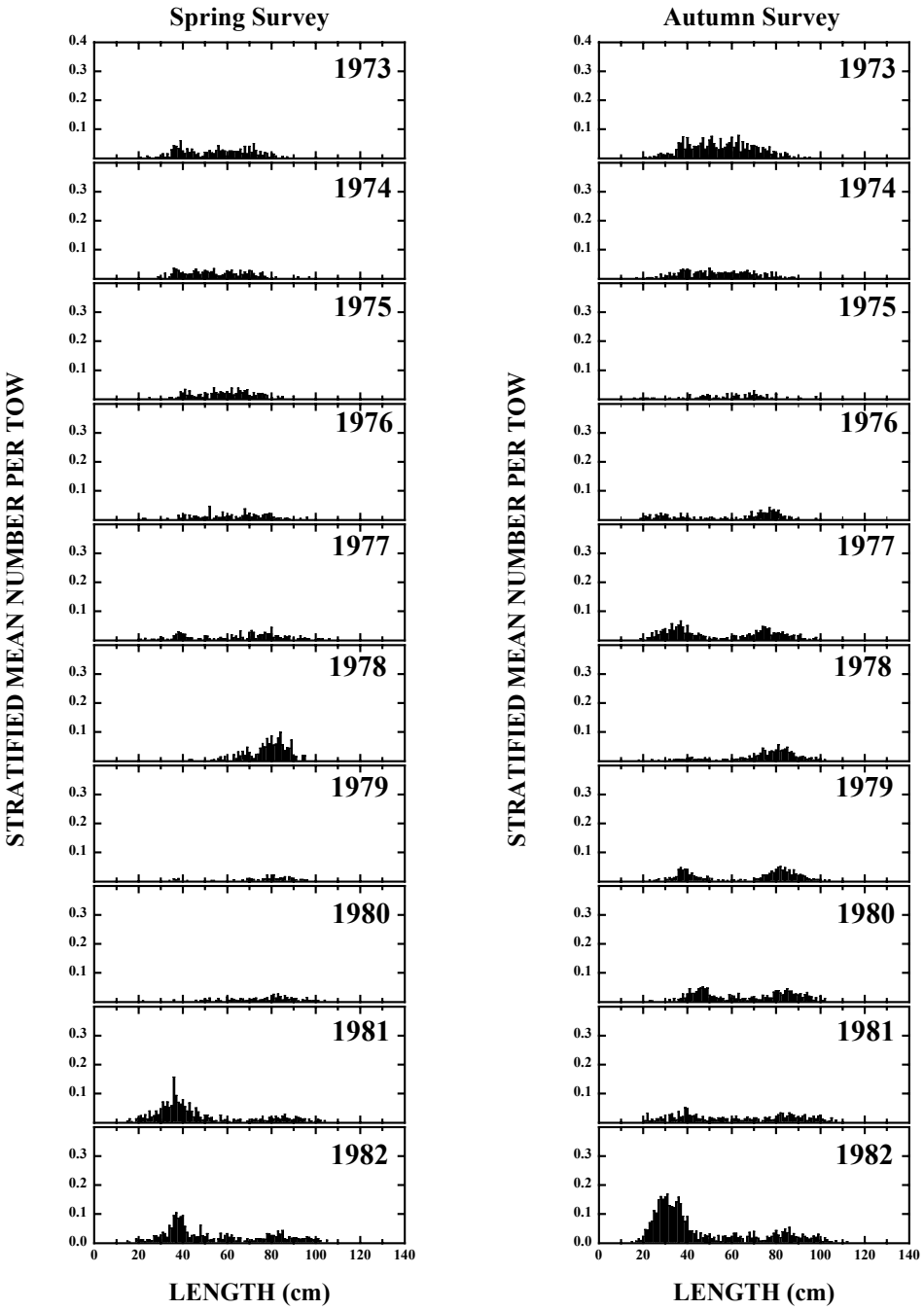

Figure 13. Winter skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore regions, 1973-1982.

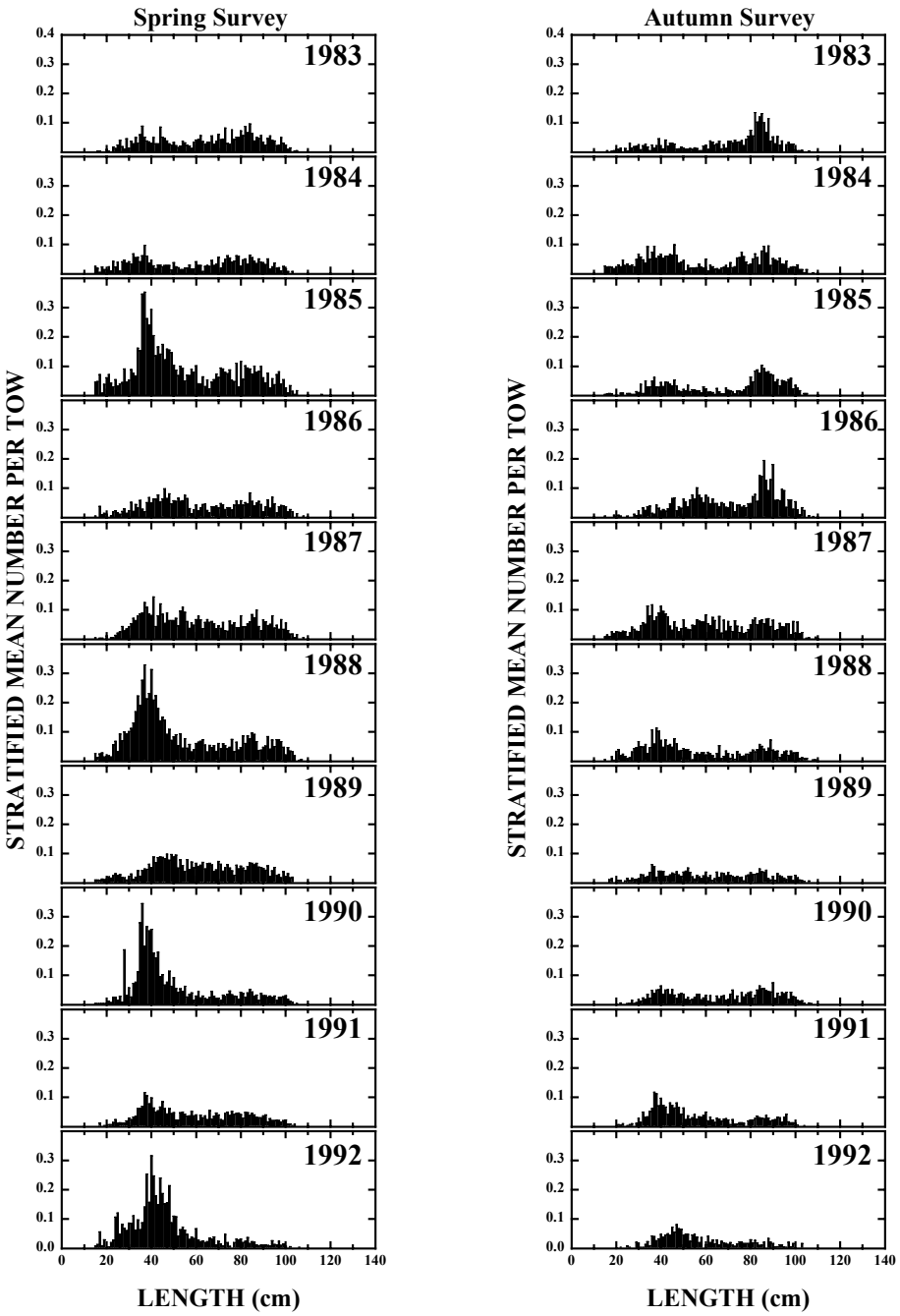

Figure 14. Winter skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore regions, 1983-1992.

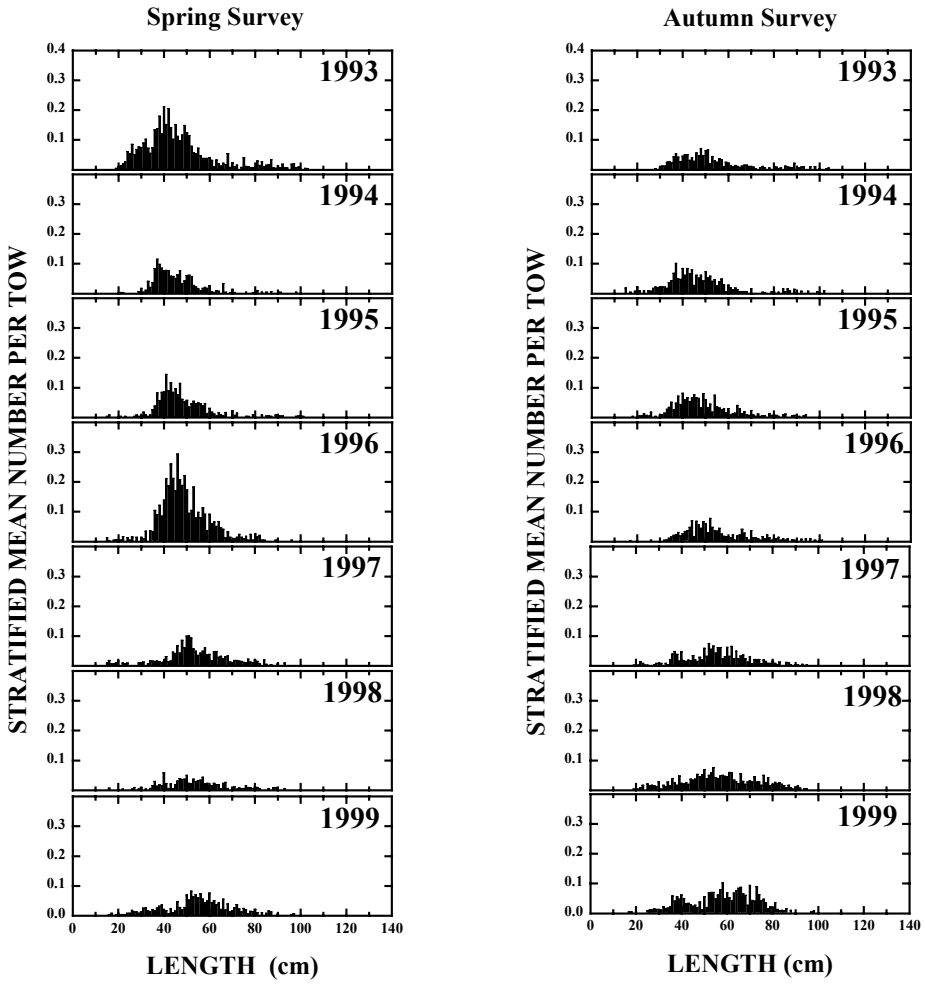

Figure 15. Winter skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore regions, 1993-1999.

Little Skate

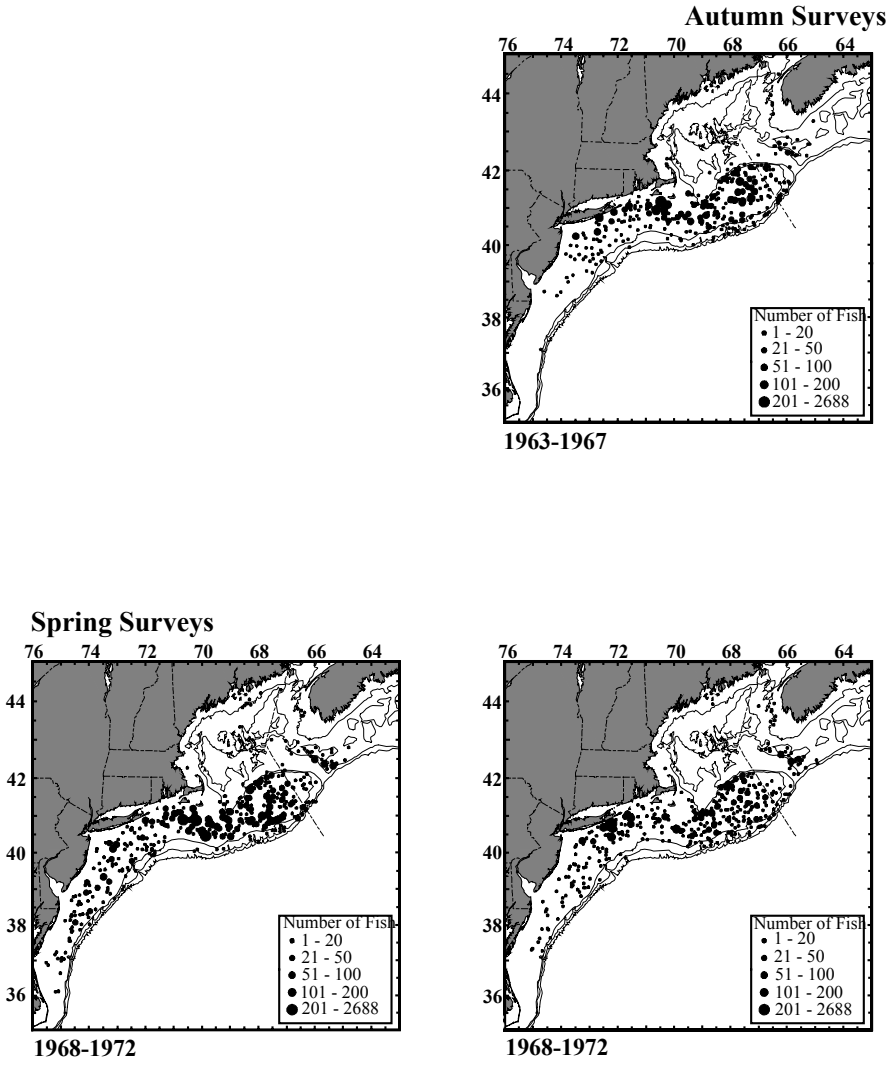

Figure 16. Distribution of little skate in the NEFSC spring and autumn bottom trawl surveys from 1963-1972.

Little Skate

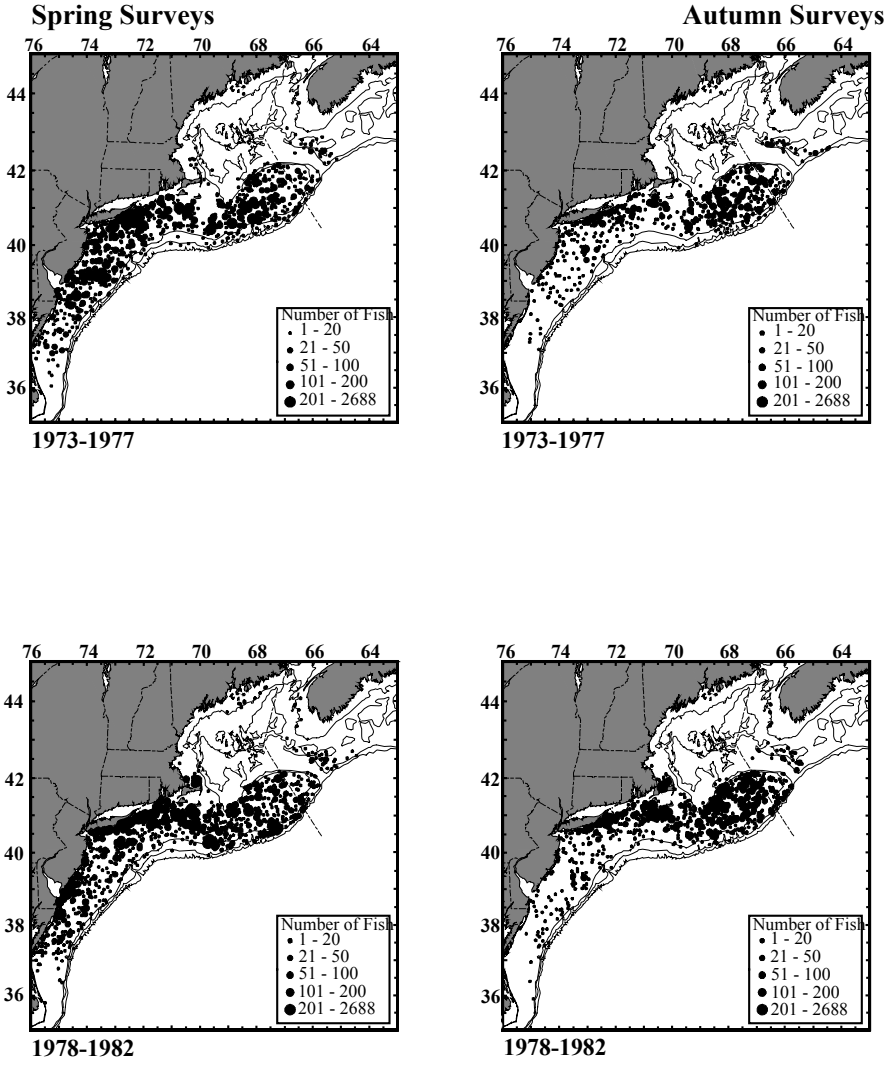

Figure 17. Distribution of little skate in the NEFSC spring and autumn bottom trawl surveys from 1973-1982.

Little Skate

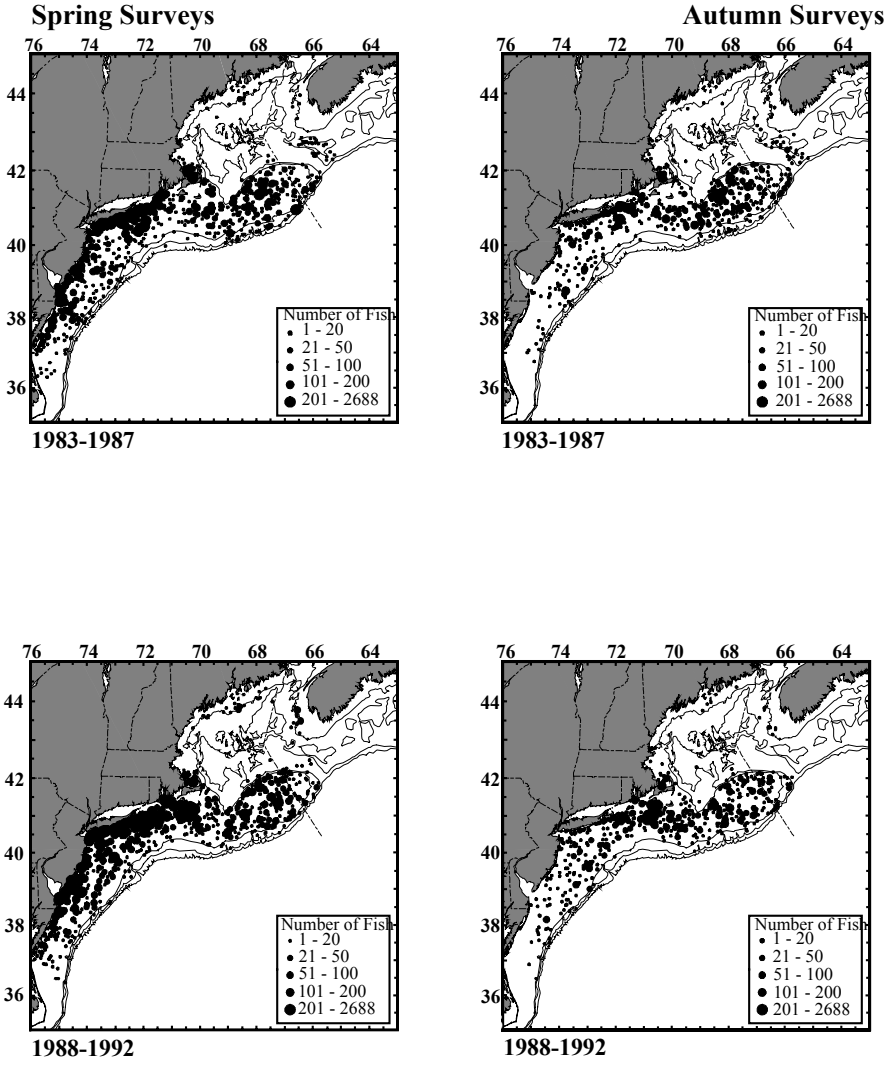

Figure 18. Distribution of little skate in the NEFSC spring and autumn bottom trawl surveys from 1983-1992.

Little Skate

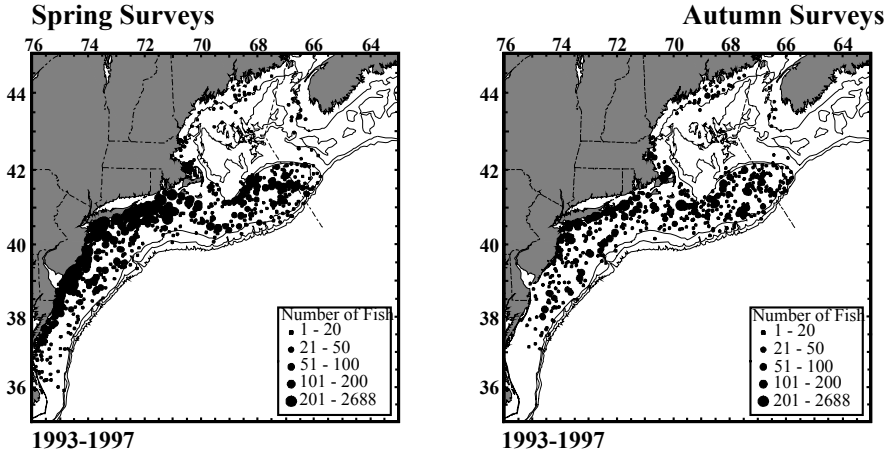

Figure 19. Distribution of little skate in the NEFSC spring and autumn bottom trawl surveys from 1993-1997.

Little Skate

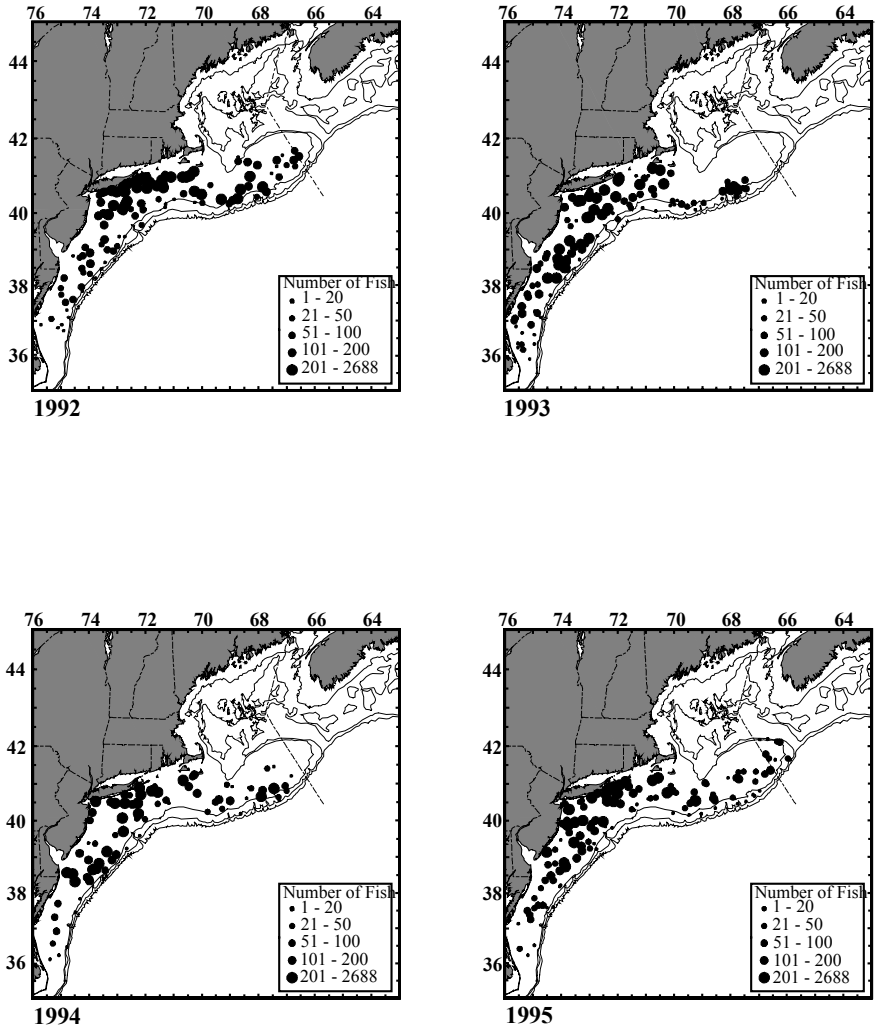

Figure 20. Distribution of little skate in the NEFSC winter bottom trawl survey from 1992-1995.

Little Skate

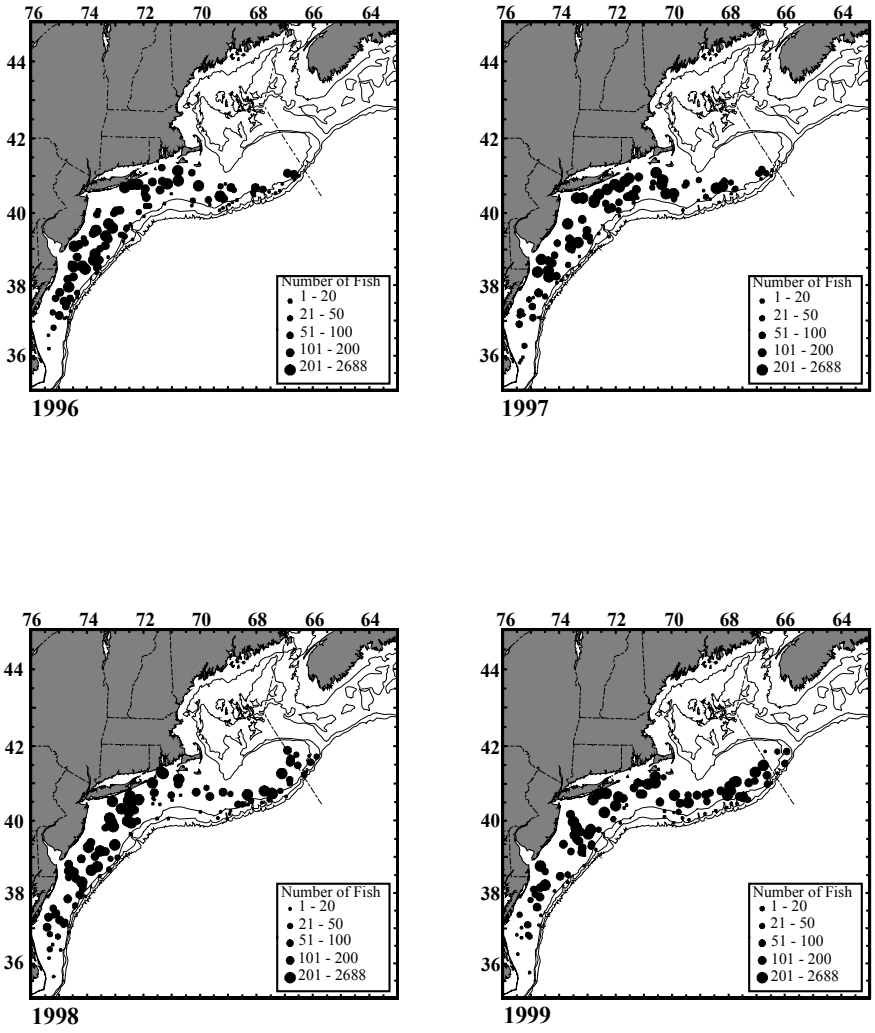

Figure 21. Distribution of little skate in the NEFSC winter bottom trawl survey from 1996-1999.

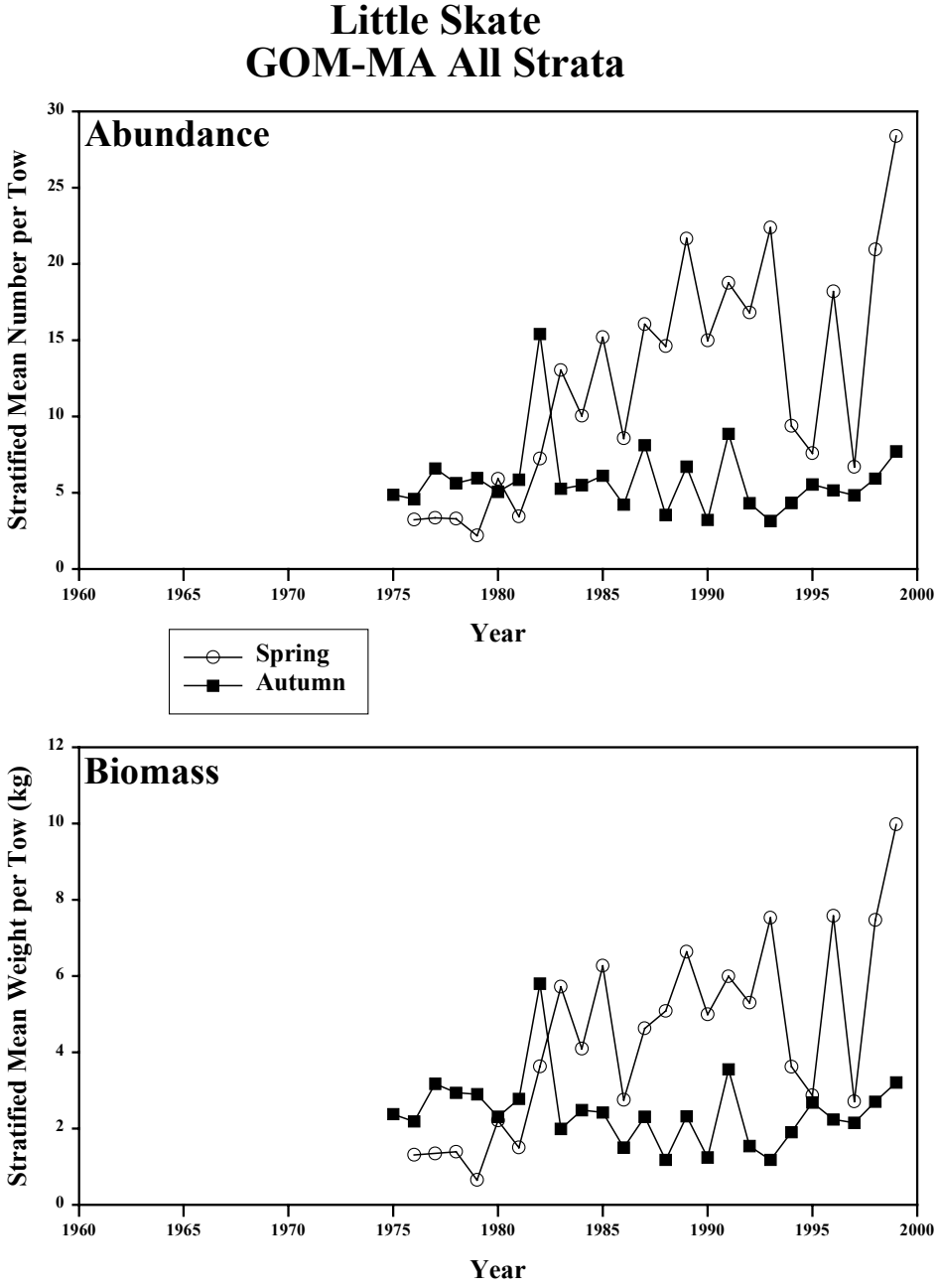

Figure 22. Abundance and biomass of little skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1975-1999 in the Gulf of Maine to Mid-Atlantic offshore and inshore regions.

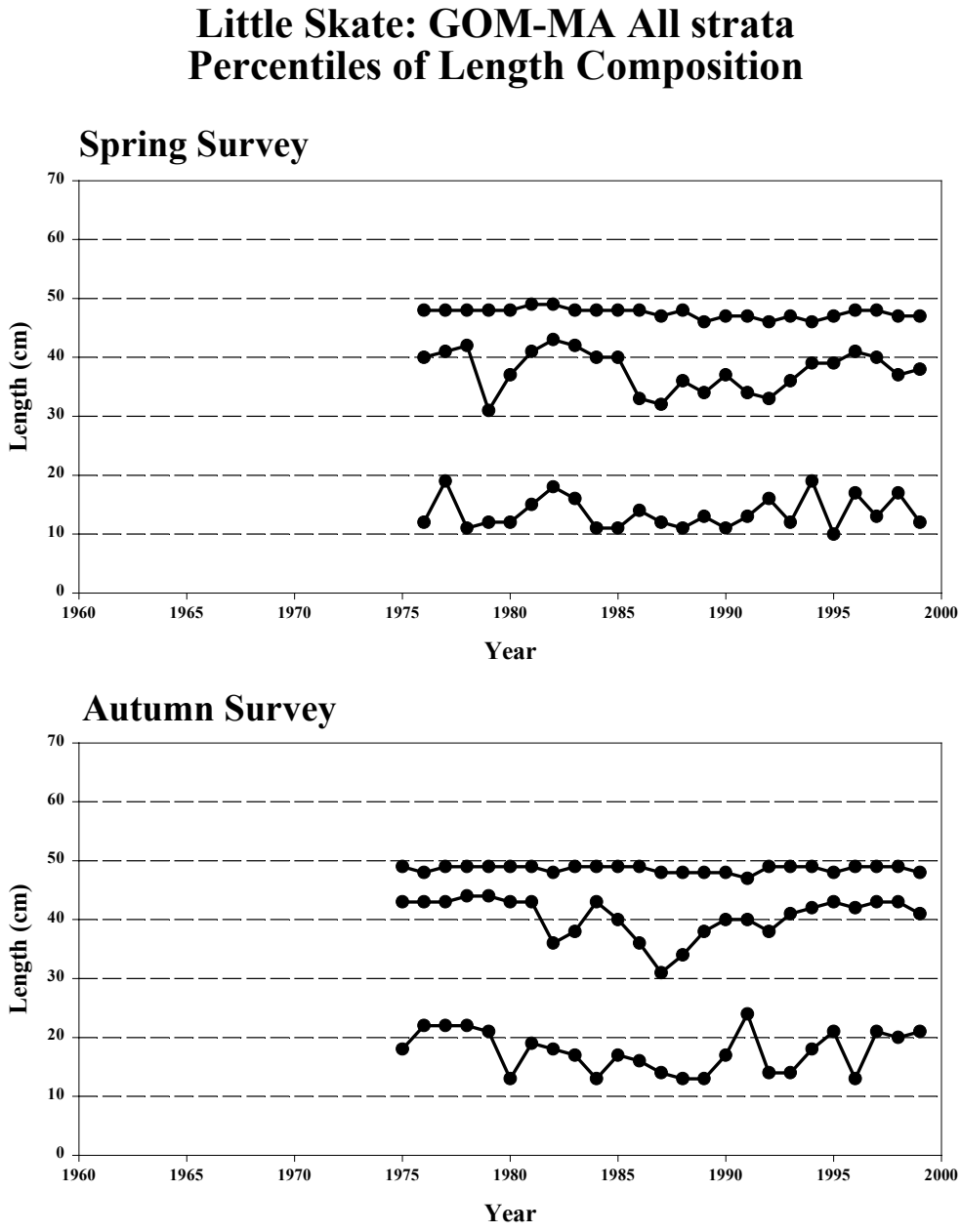

Figure 23. Percentiles of length composition (5, 50, 95) of little skate from the NESFC spring and autumn bottom trawl surveys from 1975-1999 in the Gulf of Maine to Mid-Atlantic offshore and inshore regions.

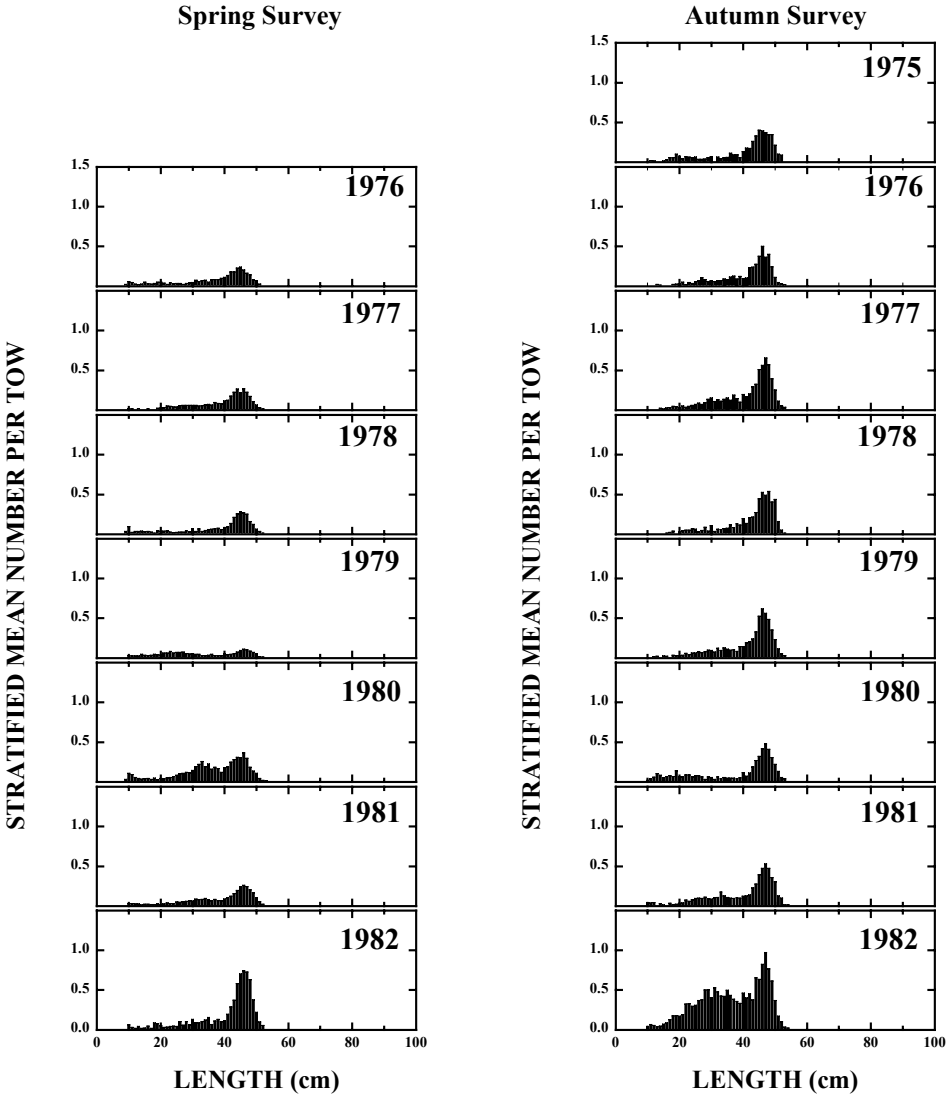

Figure 24. Little skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore and inshore regions, 1975-1982.

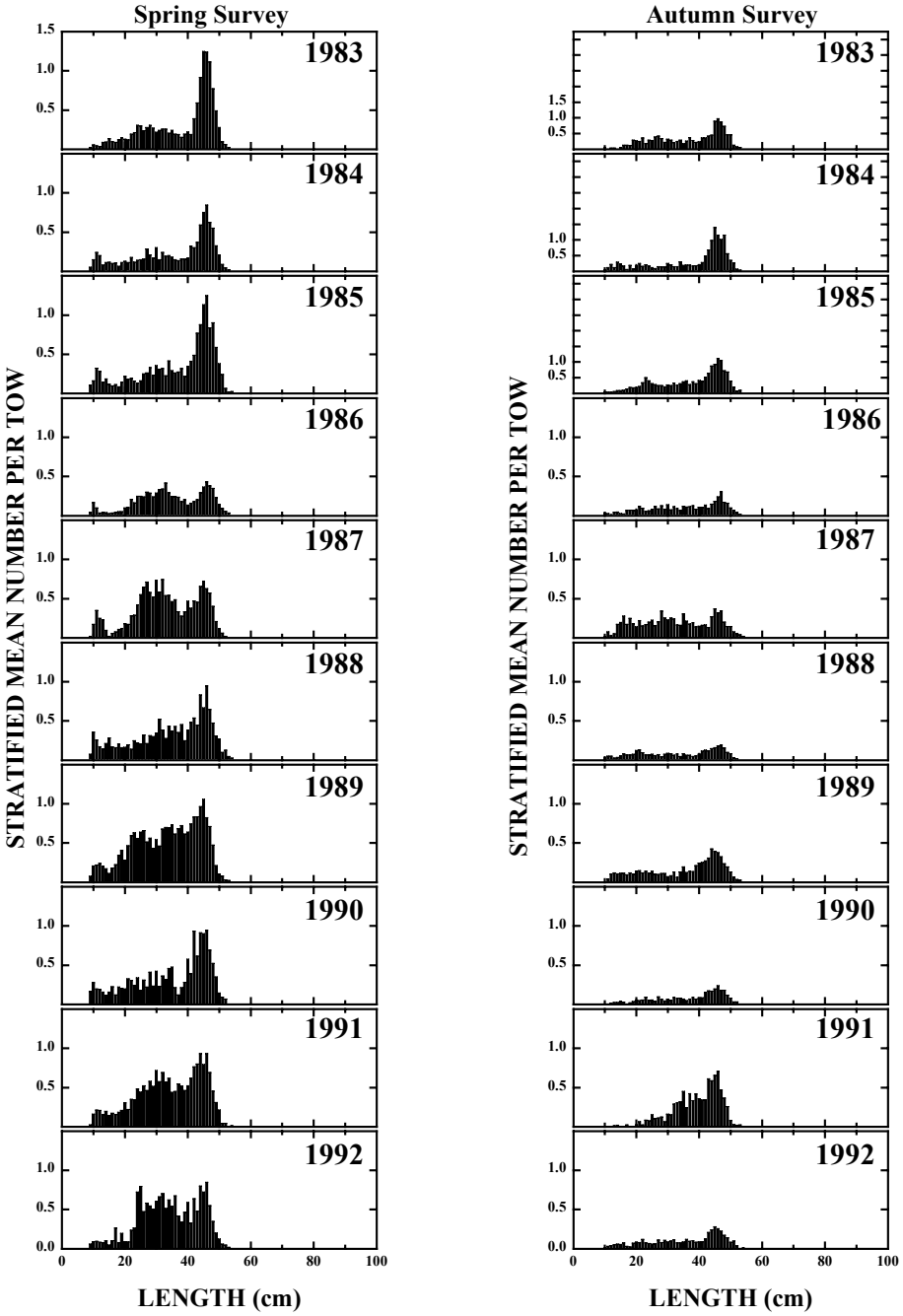

Figure 25. Little skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore and inshore regions, 1983-1992.

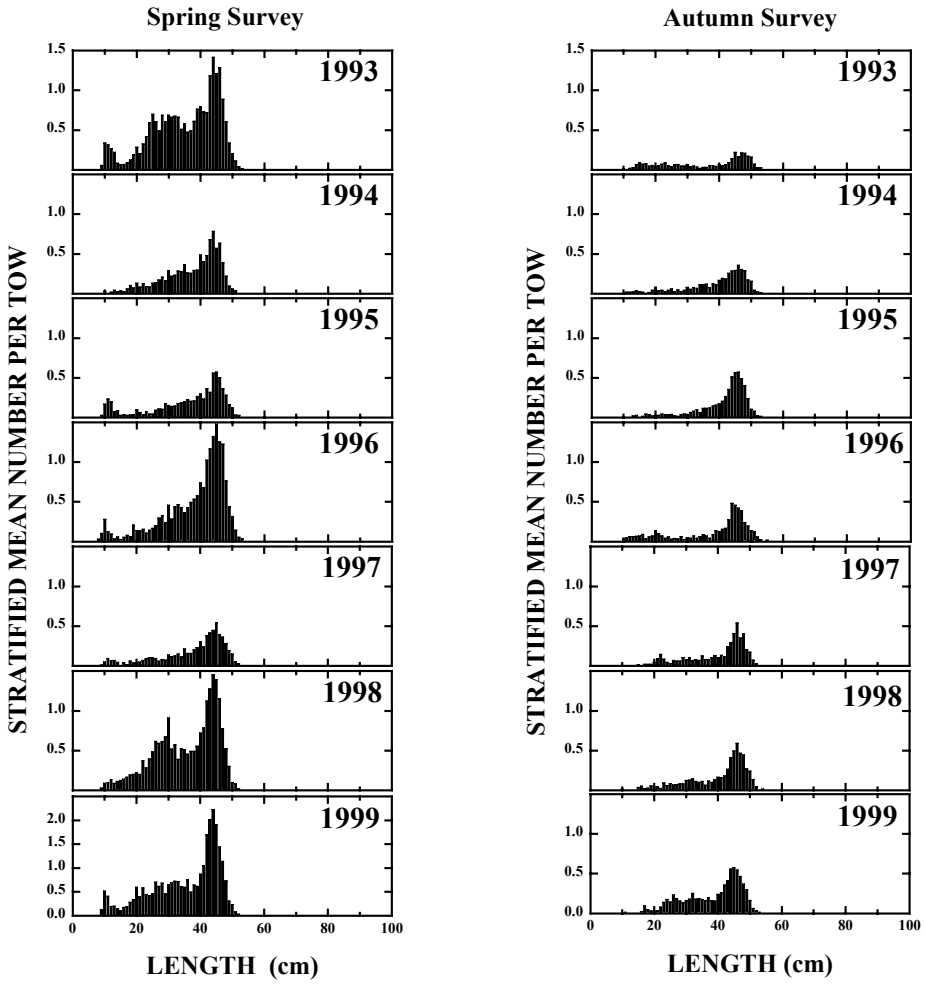

Figure 26. Little skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Mid-Atlantic offshore and inshore regions, 1993-1999.

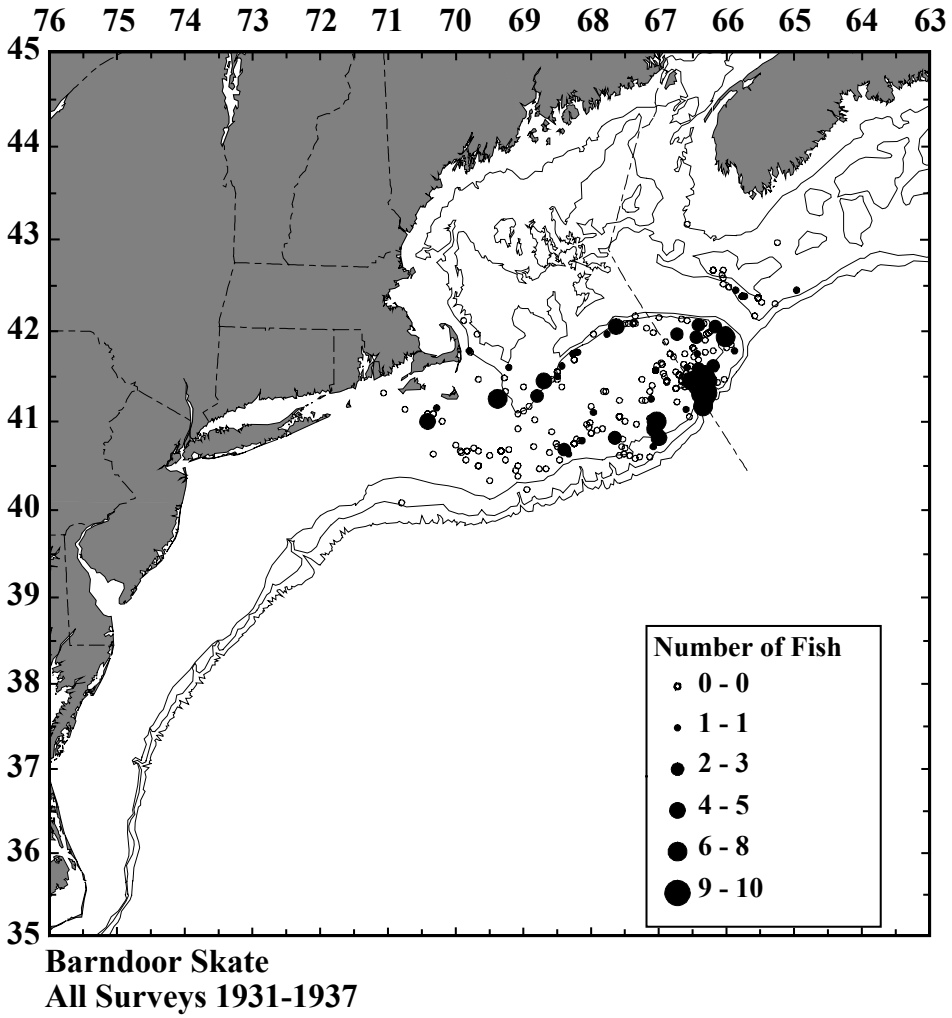

Figure 27. Distribution of barndoor skate in surveys from 1931-1937.

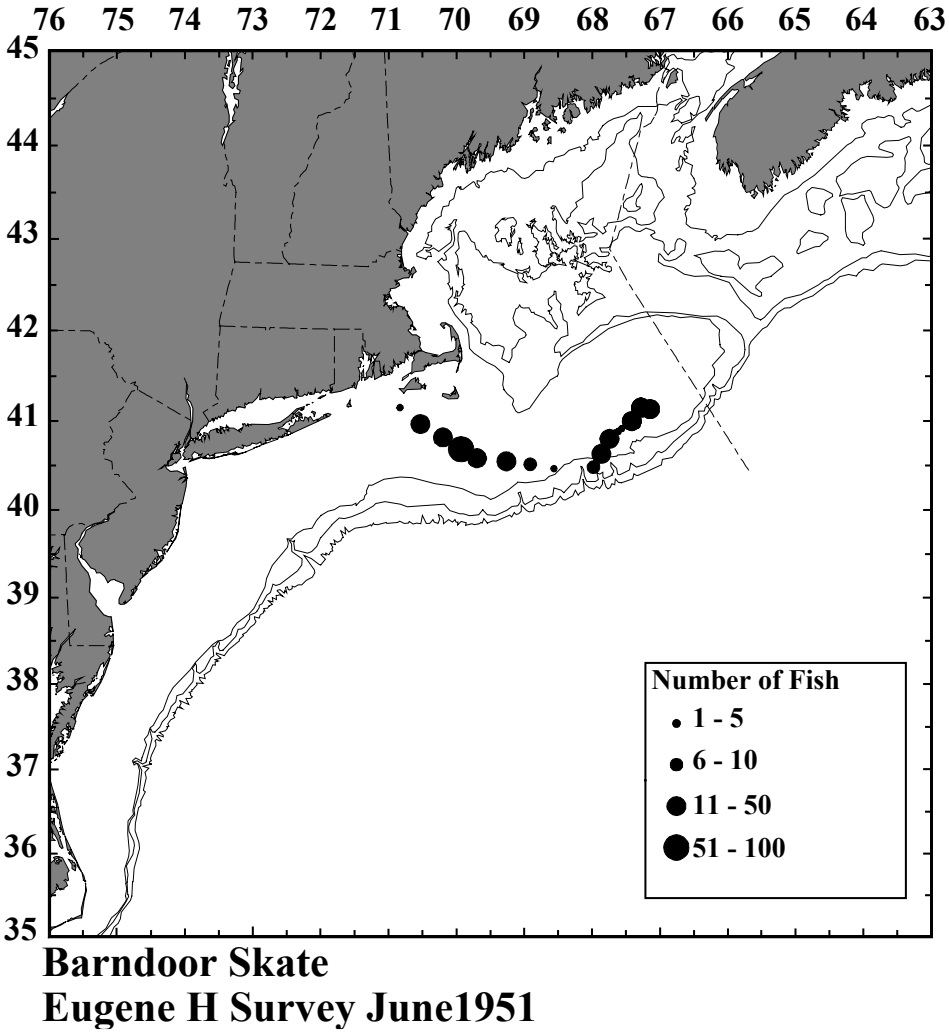

Figure 28. Distribution of barndoor skate in a survey conducted on the Eugene H during June 1951.

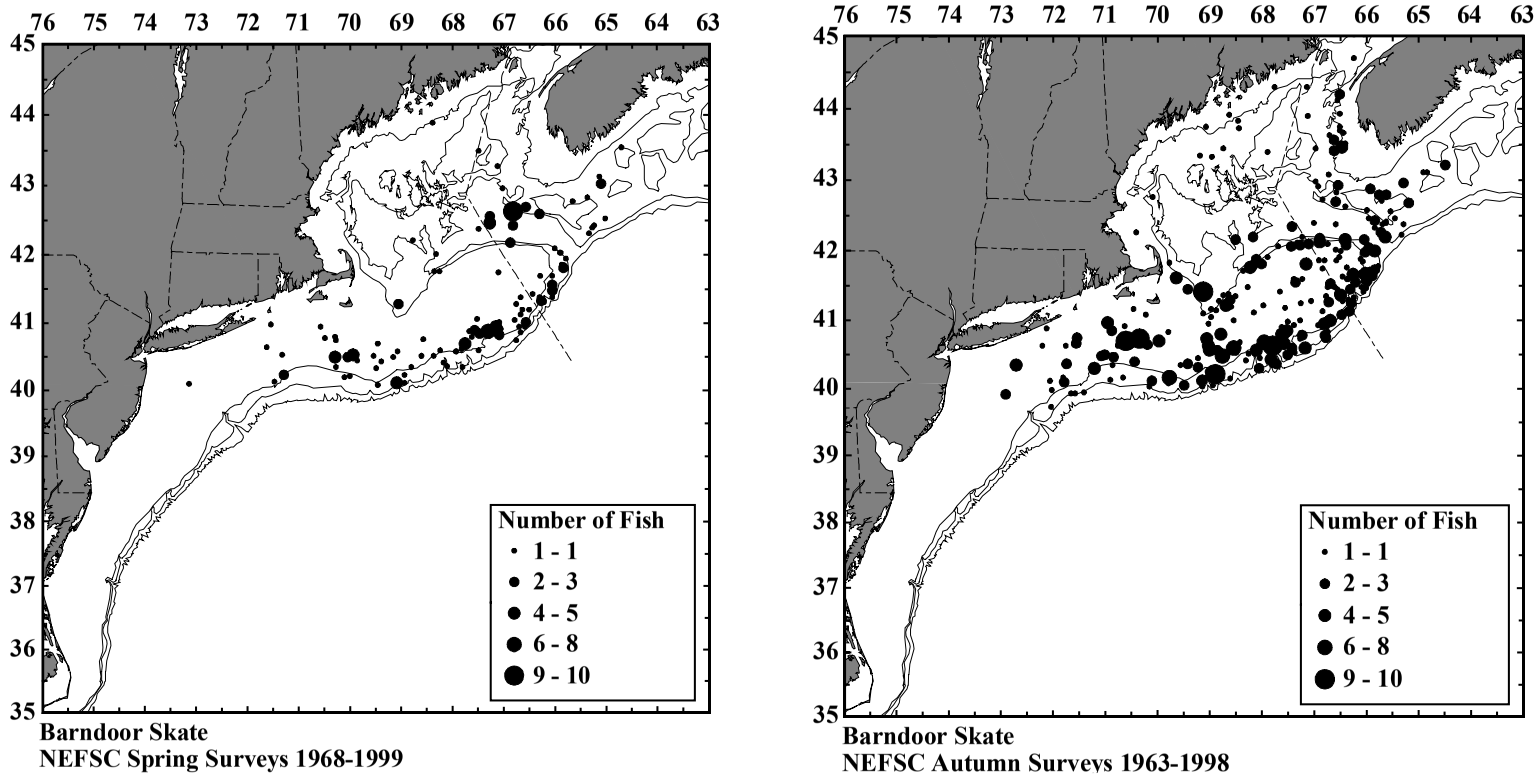

Figure 29. Distribution of barndoor skate in the NEFSC spring and autumn surveys from 1963-1999.

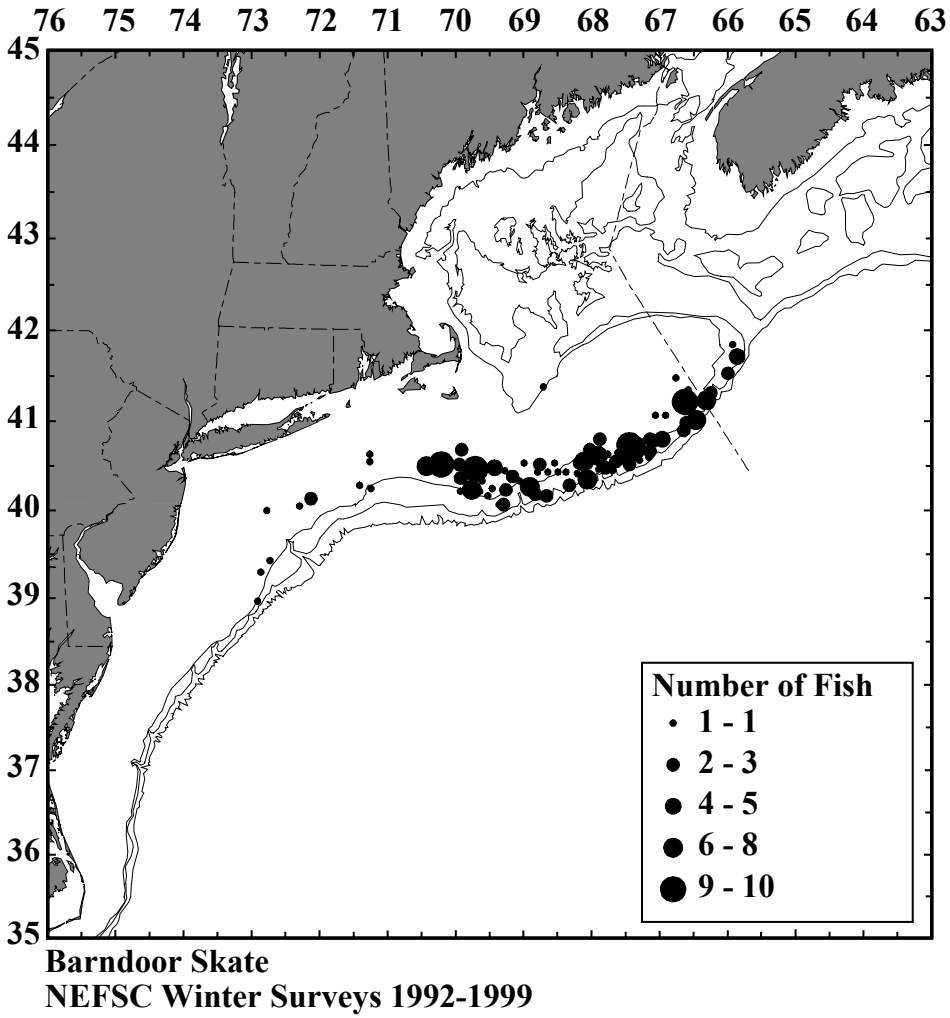

Figure 30. Distribution of barndoor skate in the NEFSC winter surveys from 1992-1999.

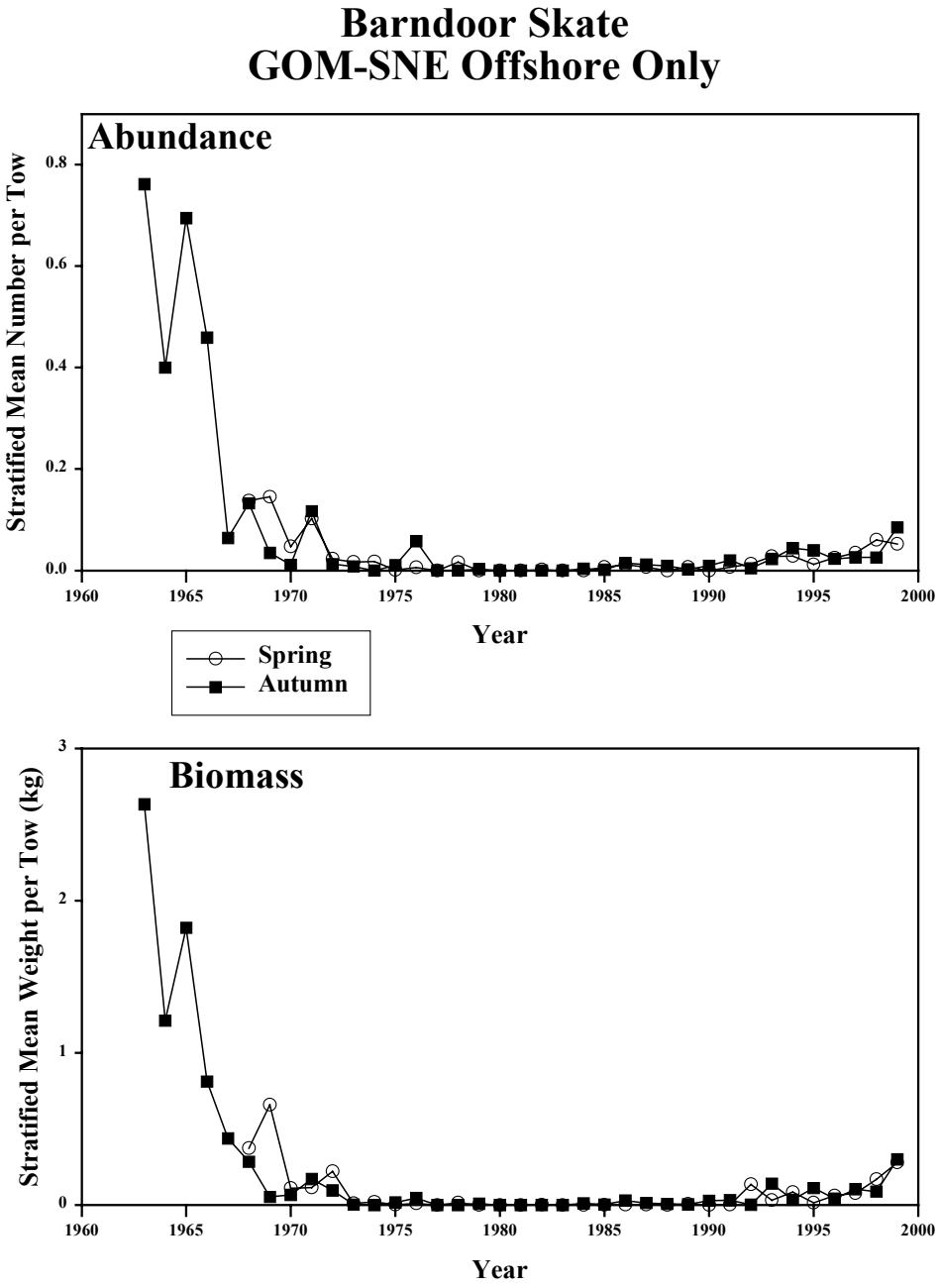

Figure 31. Abundance and biomass of barndoor skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1963-1999 in the Gulf of Maine-Southern New England offshore region.

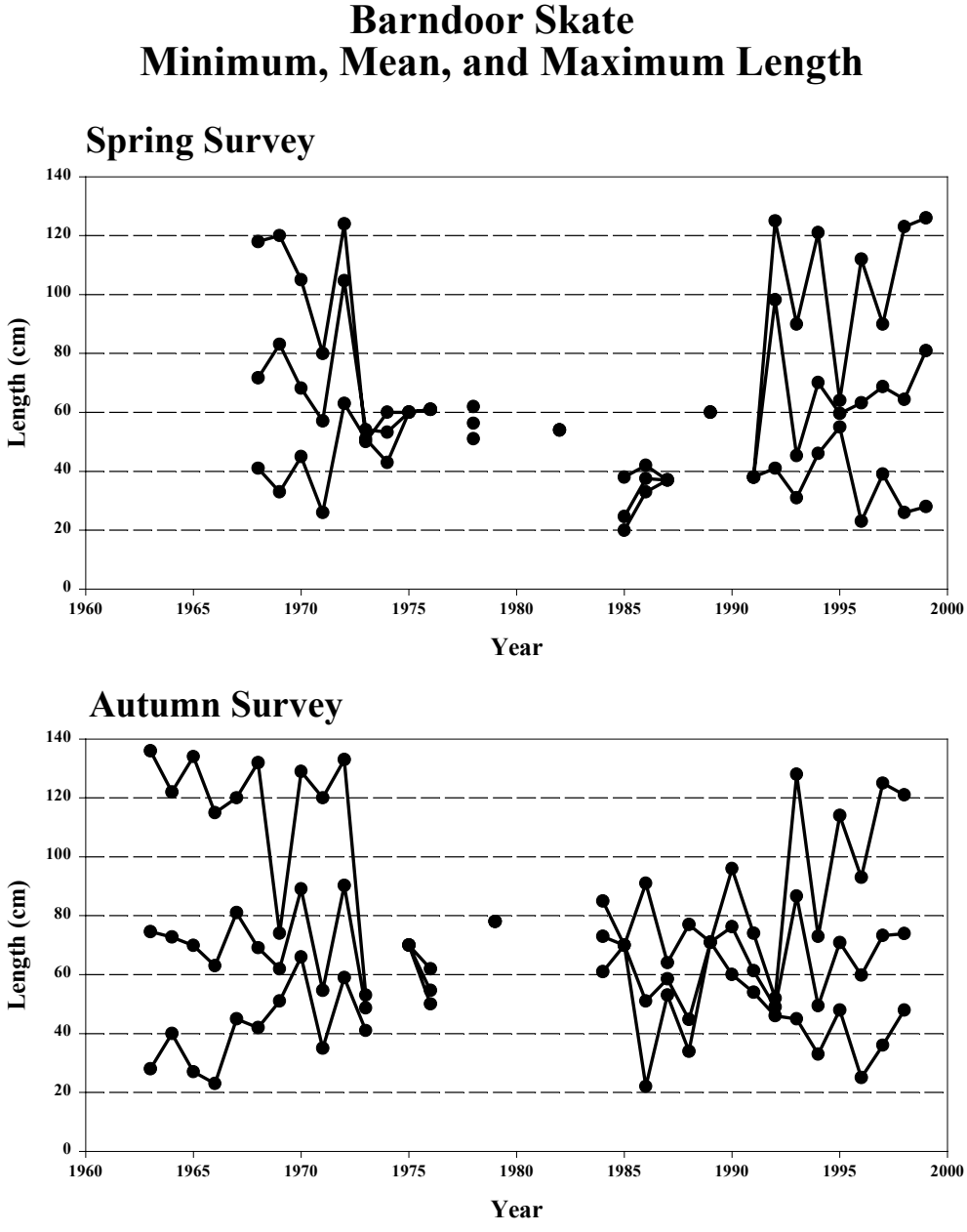

Figure 32. Minimum, mean, and maximum total length (cm) of barndoor skate from the NESFC spring and autumn bottom trawl surveys from 1963-1999 in the Gulf of Maine to Southern New England offshore region.

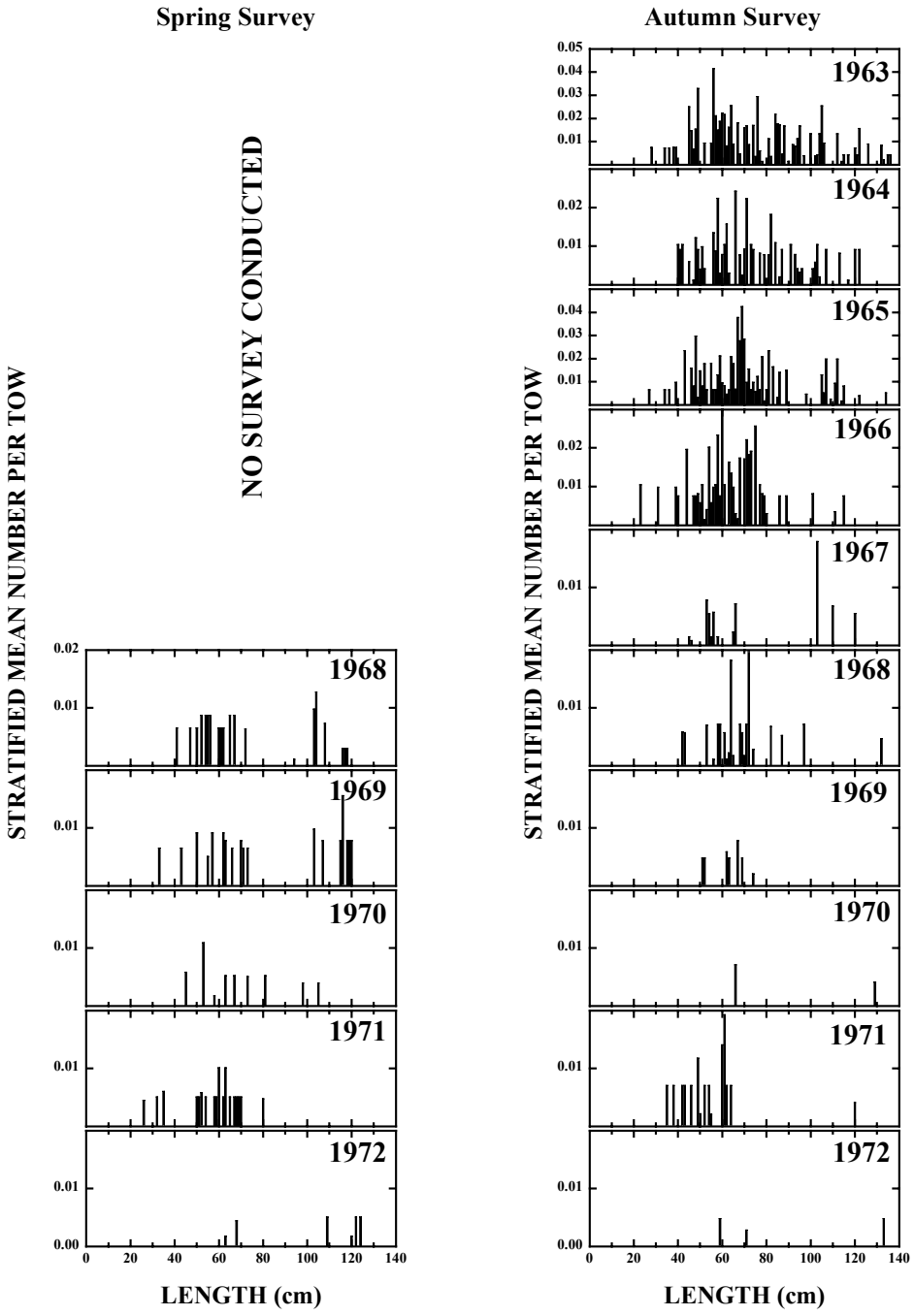

Figure 33. Barndoor skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore regions, 1963-1972.

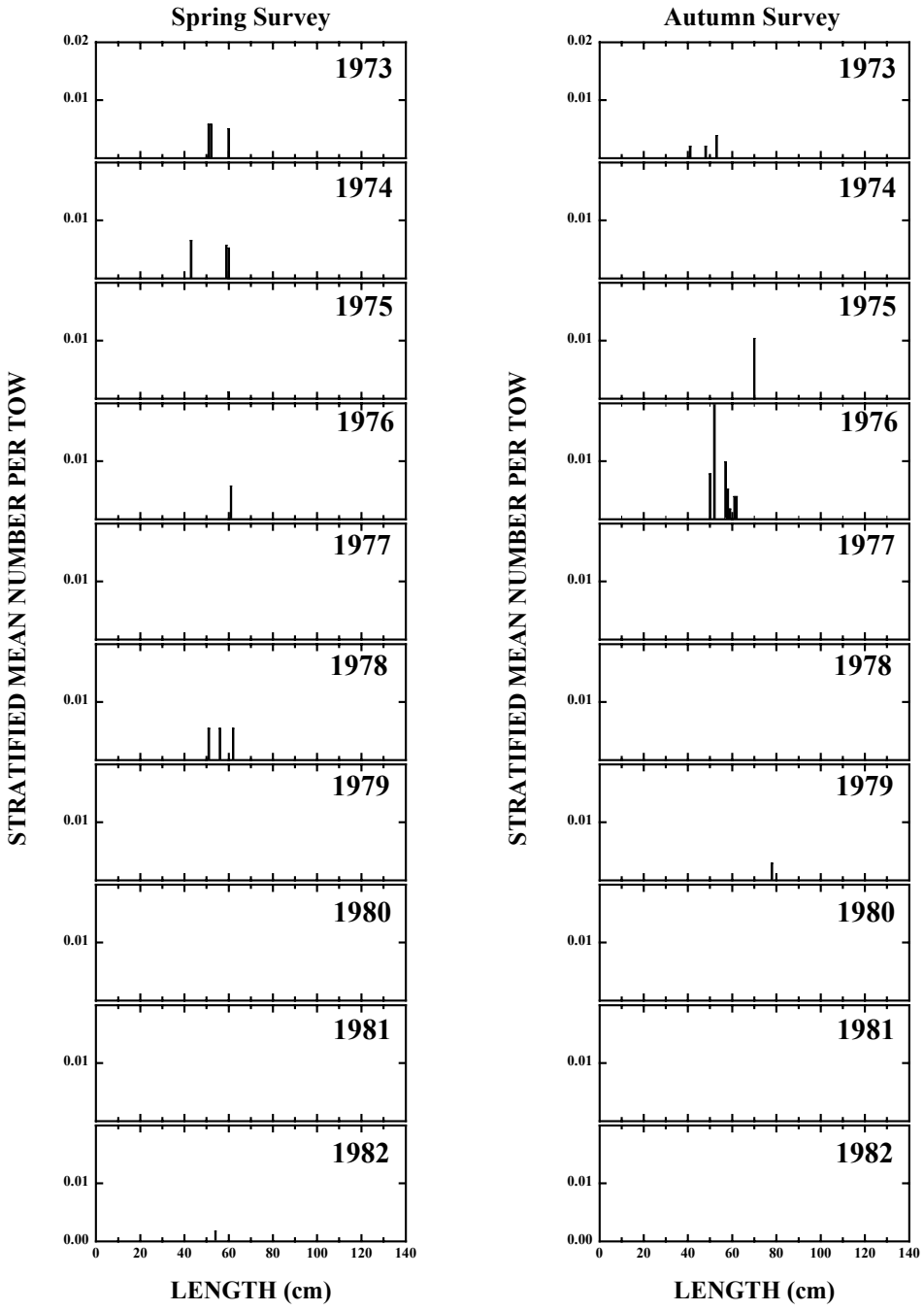

Figure 34. Barndoor skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore regions, 1973-1982.

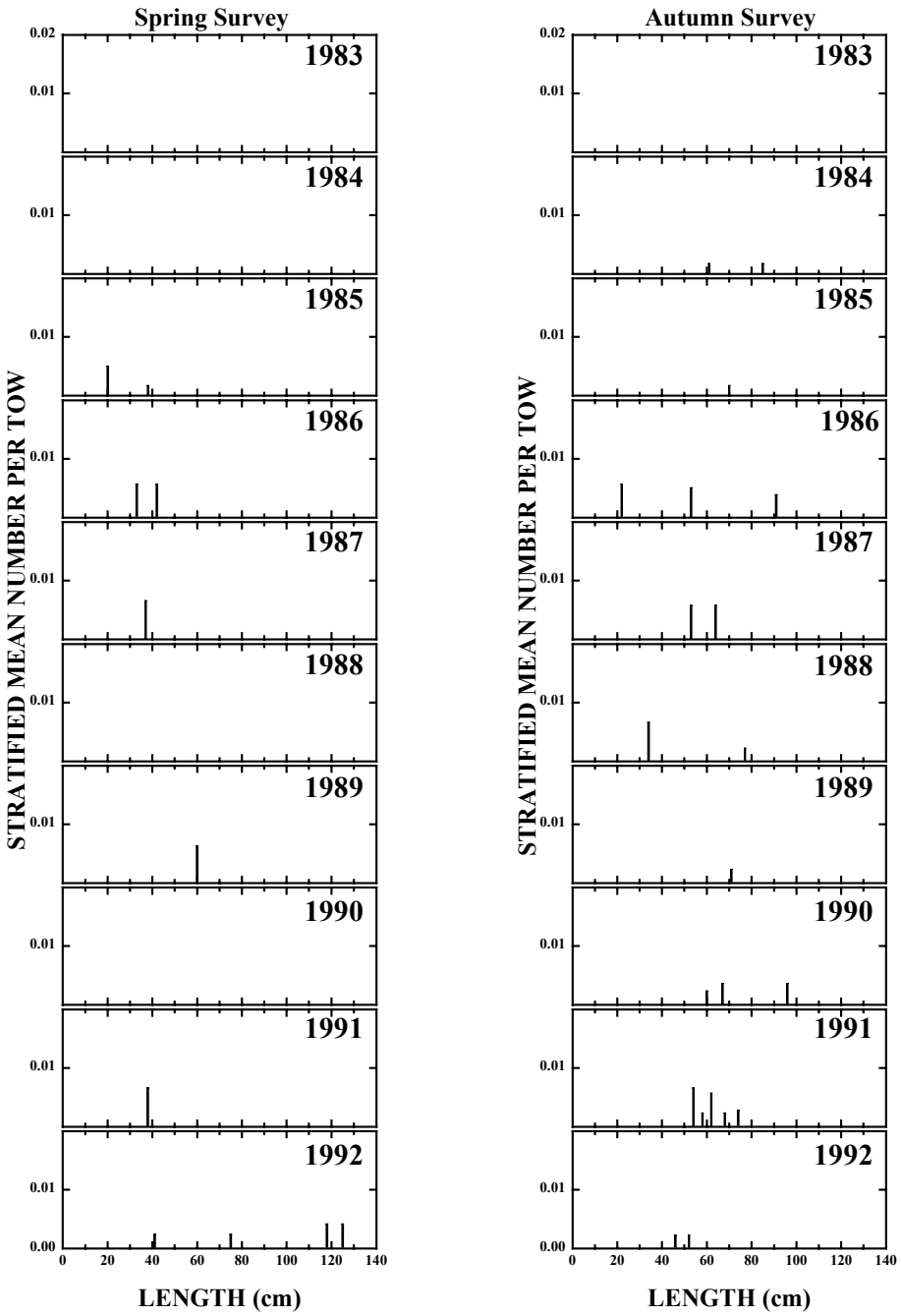

Figure 35. Barndoor skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore regions, 1983-1992.

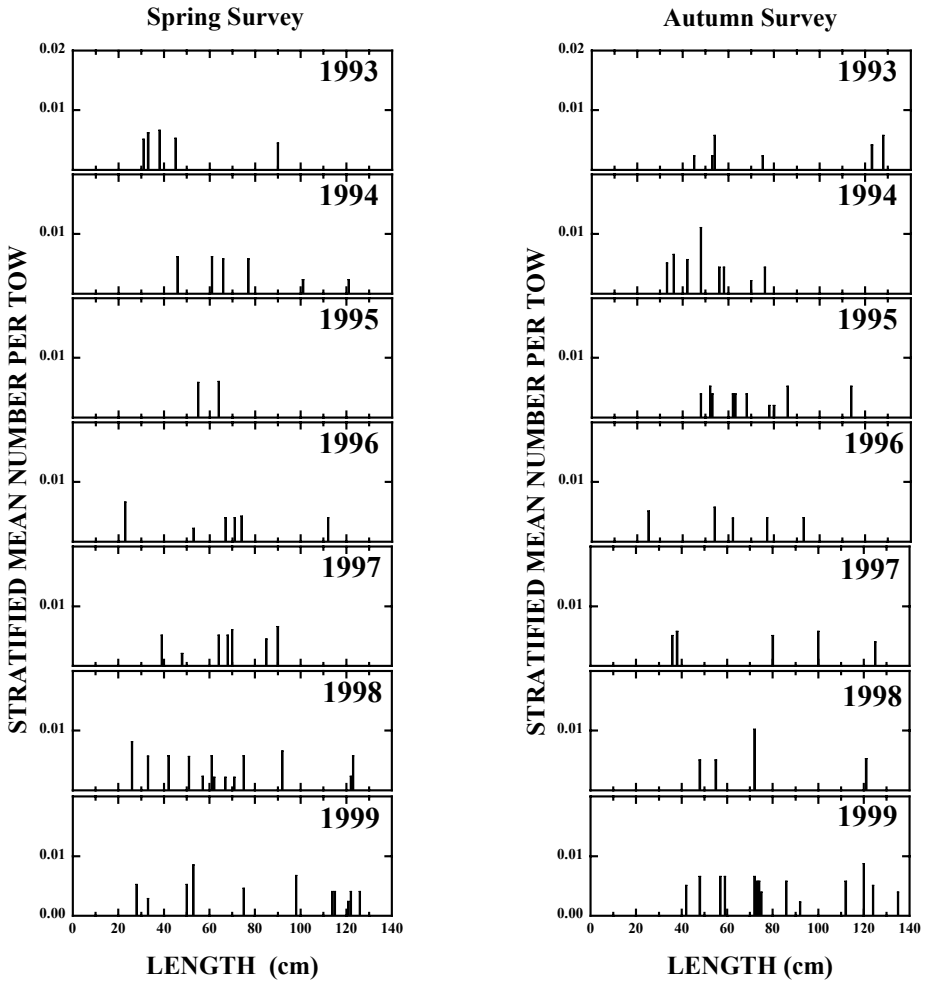

Figure 36. Barndoor skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore regions, 1993-1999.

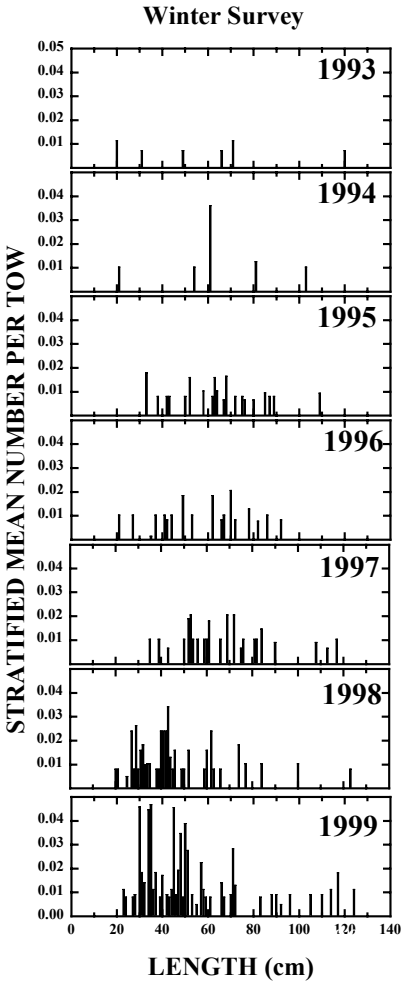

Figure 37. Barndoor skate length composition from the NEFSC winter flatfish surveys, 1993-1999.

Thorny Skate

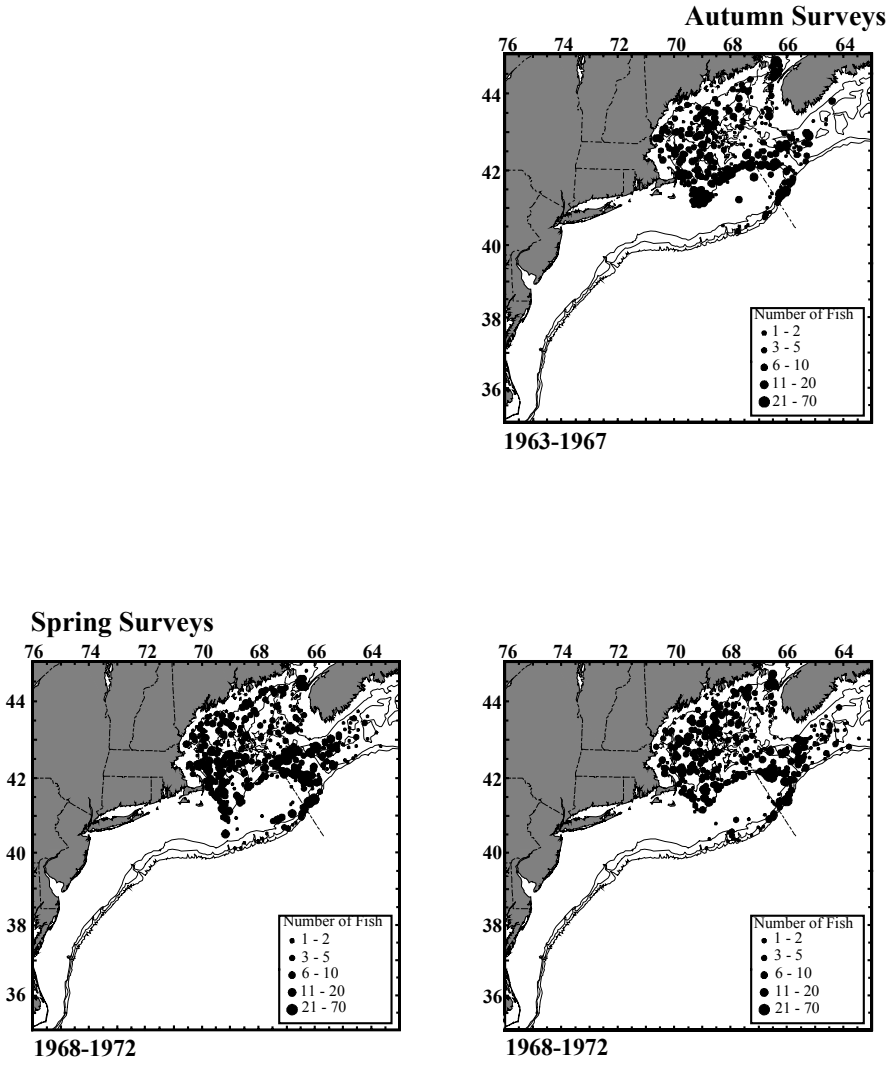

Figure 38. Distribution of thorny skate in the NEFSC spring and autumn bottom trawl surveys from 1963-1972.

Thorny Skate

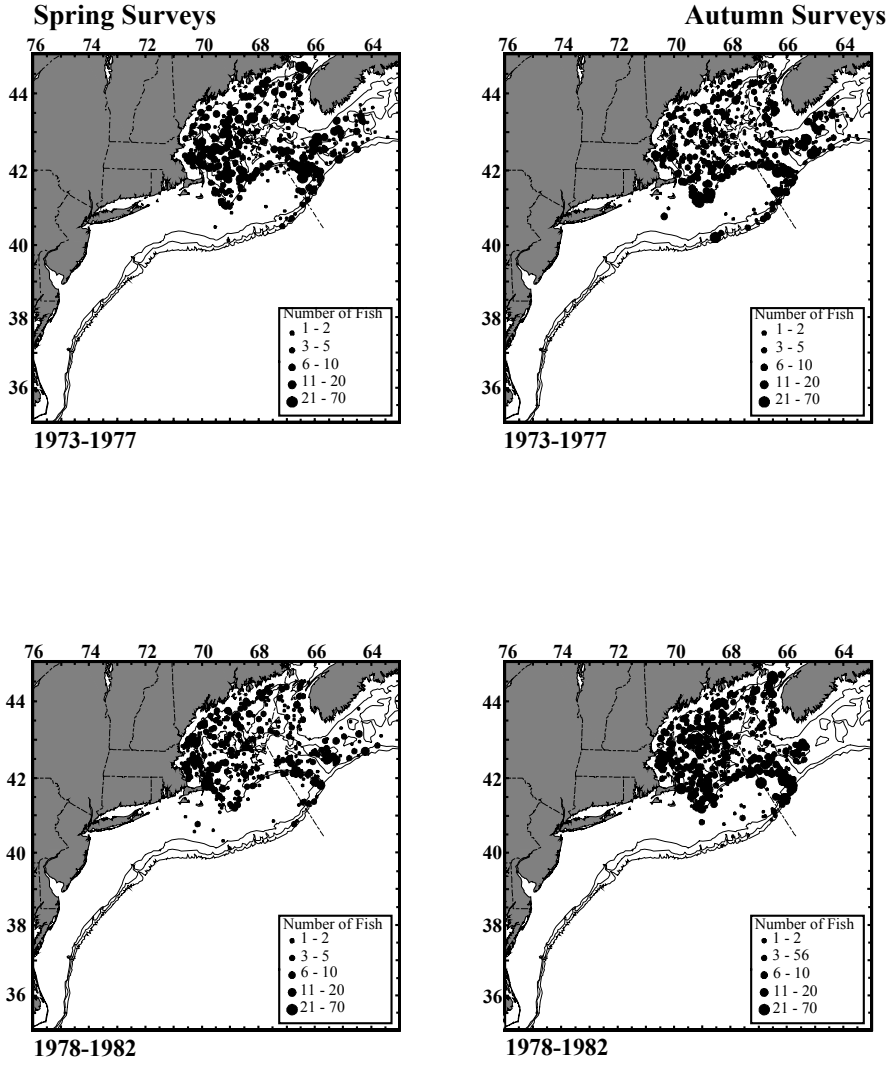

Figure 39. Distribution of thorny skate in the NEFSC spring and autumn bottom trawl surveys from 1973-1982.

Thorny Skate

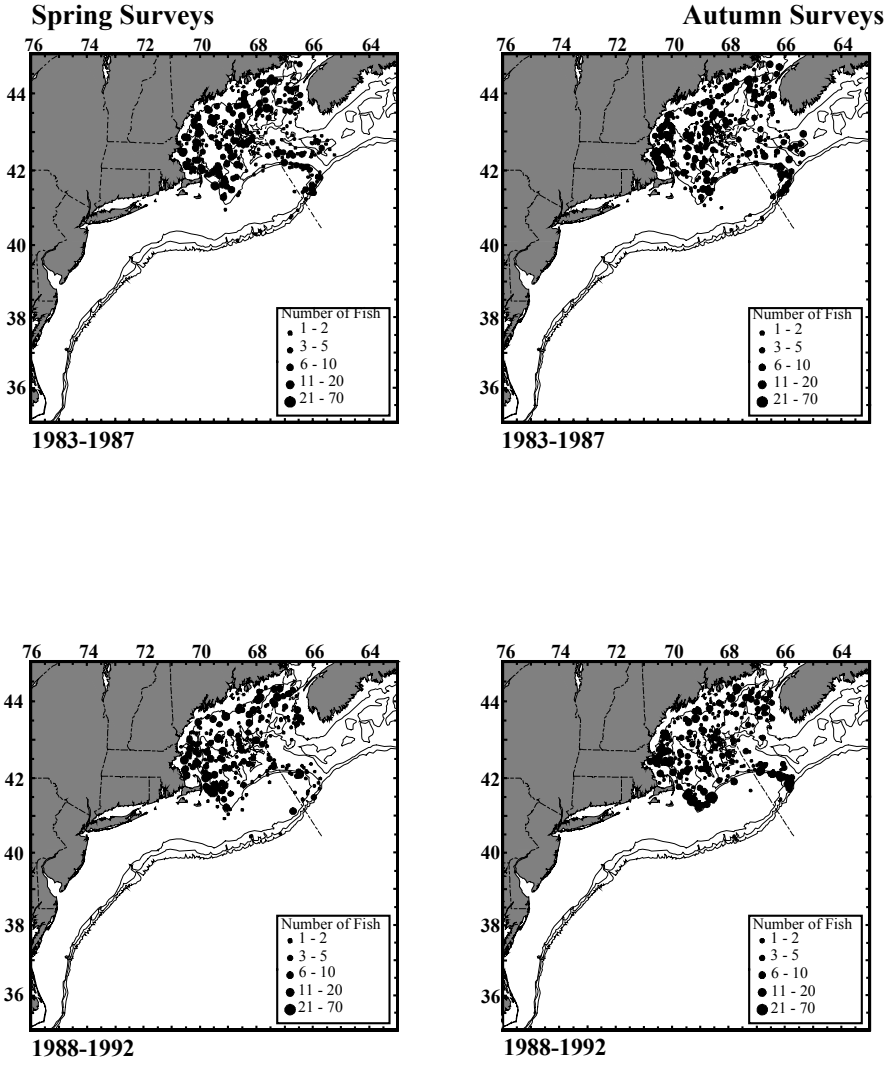

Figure 40. Distribution of thorny skate in the NEFSC spring and autumn bottom trawl surveys from 1983-1992.

Thorny Skate

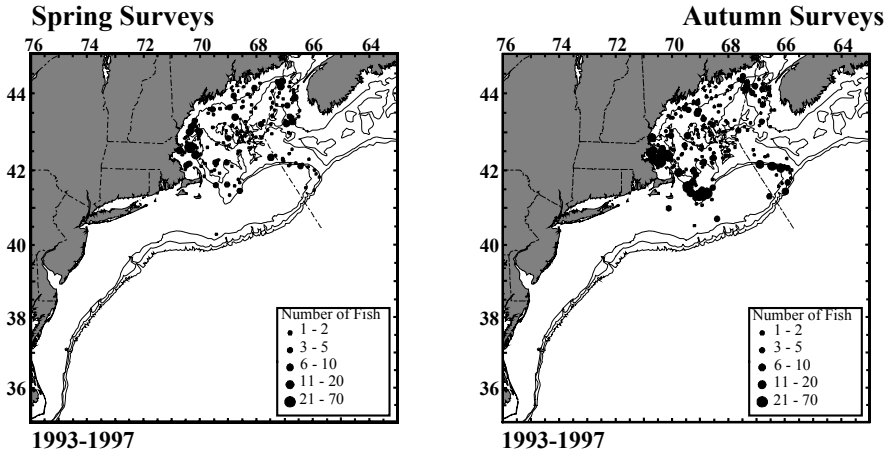

Figure 41. Distribution of thorny skate in the NEFSC spring and autumn bottom trawl surveys from 1993-1997.

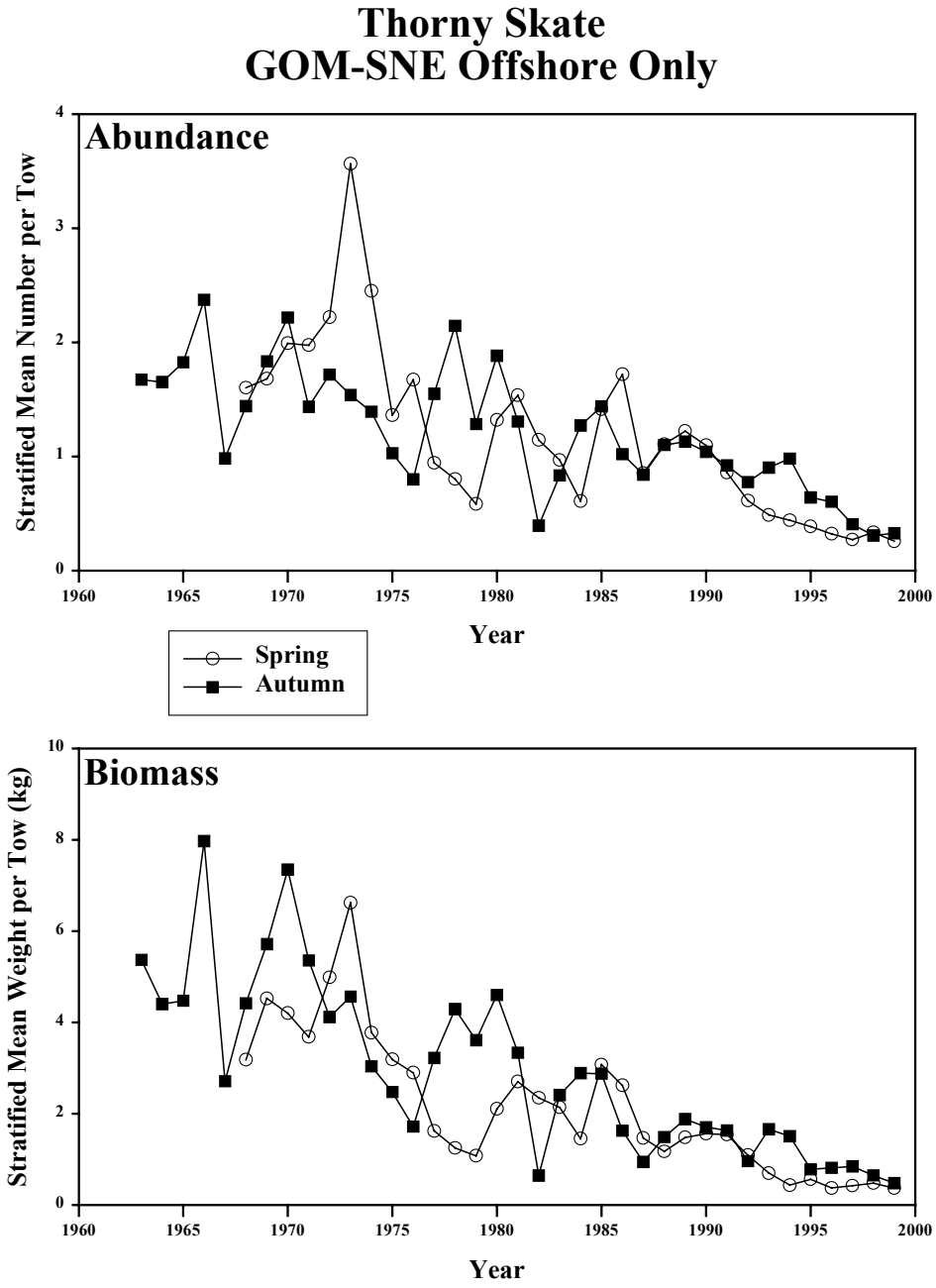

Figure 42. Abundance and biomass of thorny skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1963-1999 in the Gulf of Maine to Southern New England offshore region.

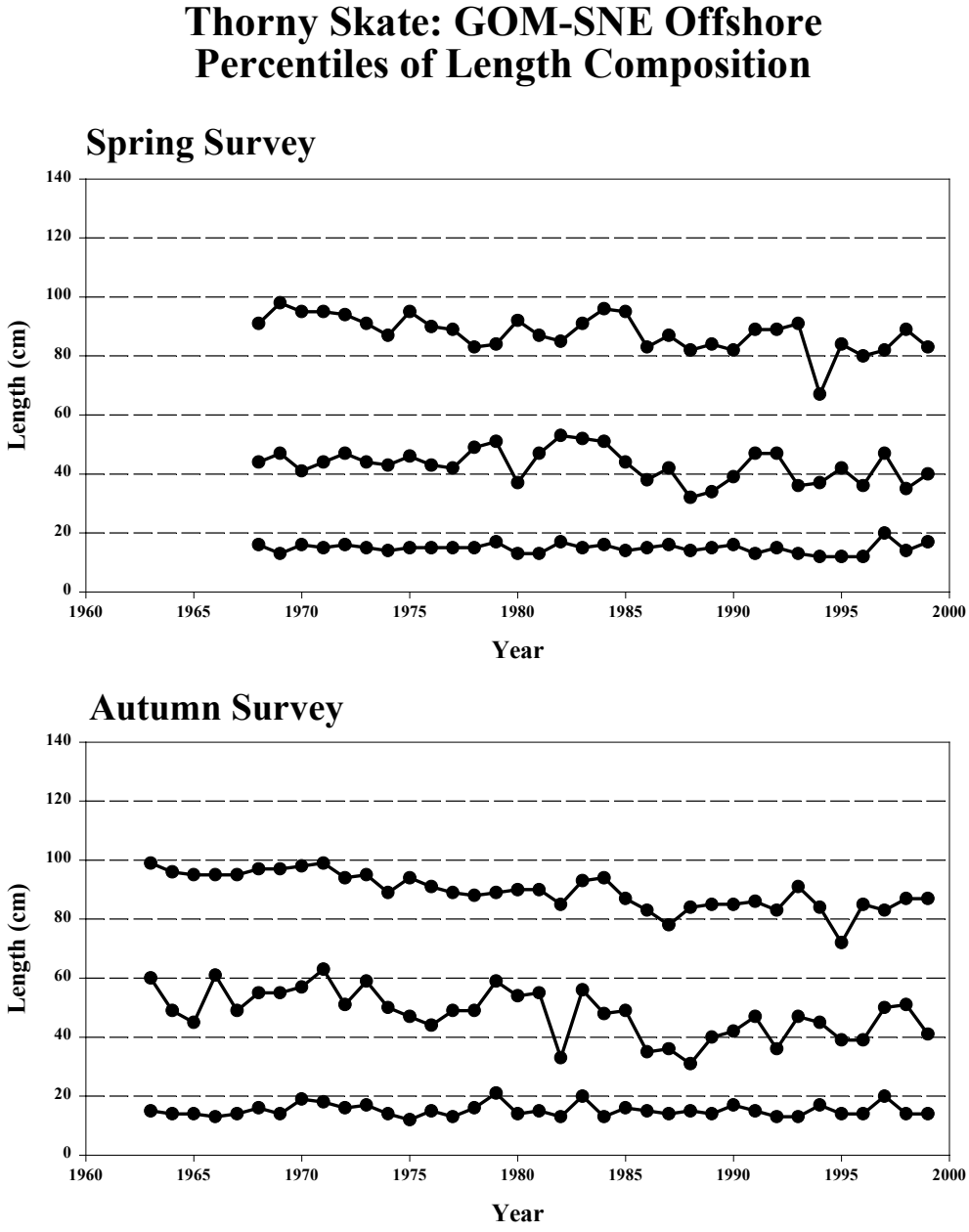

Figure 43. Percentiles of length composition (5, 50, and 95) of thorny skate from the NESFC spring and autumn bottom trawl surveys from 1963-1999 in the Gulf of Maine to Southern New England offshore region.

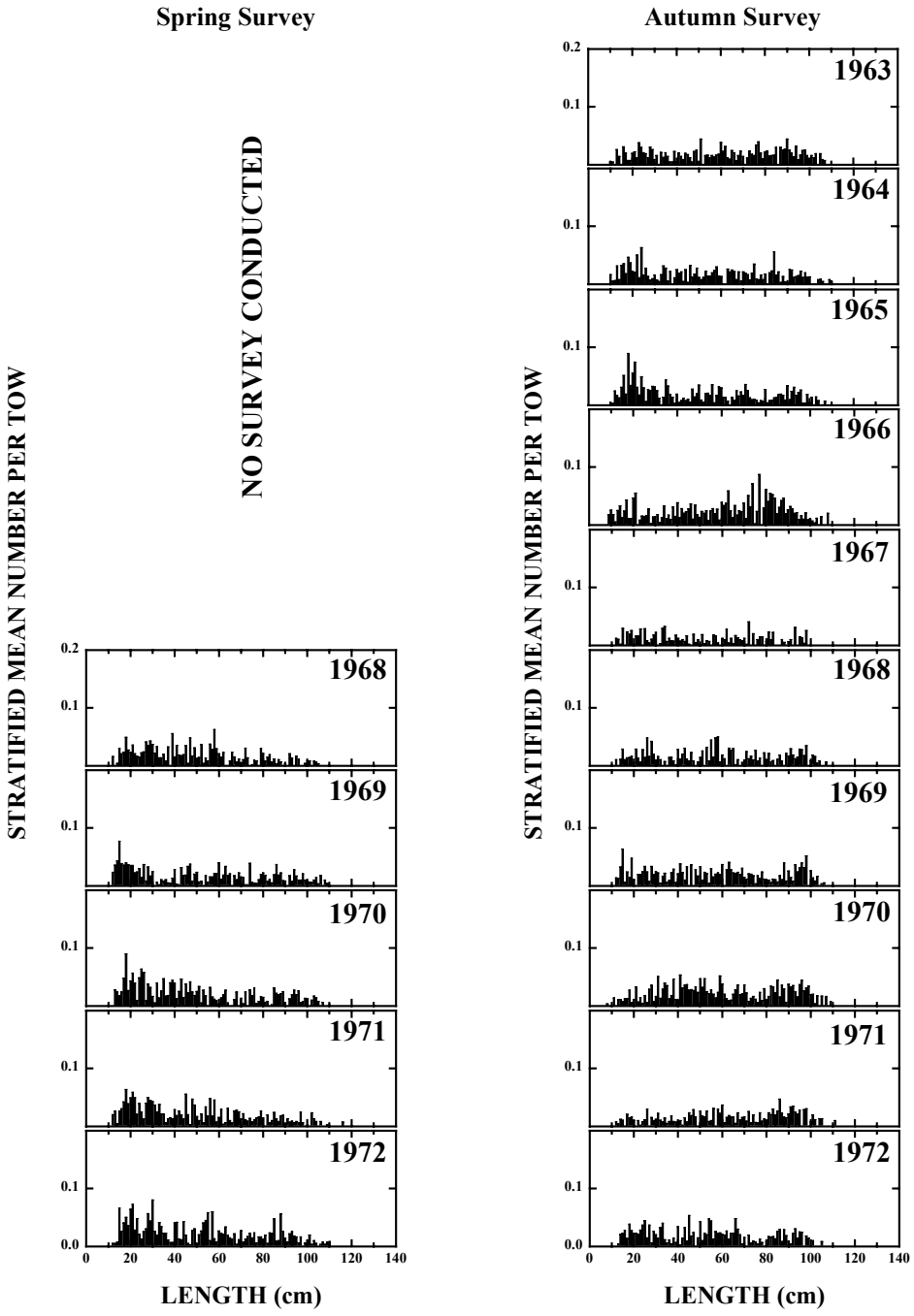

Figure 44. Thorny skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1963-1972.

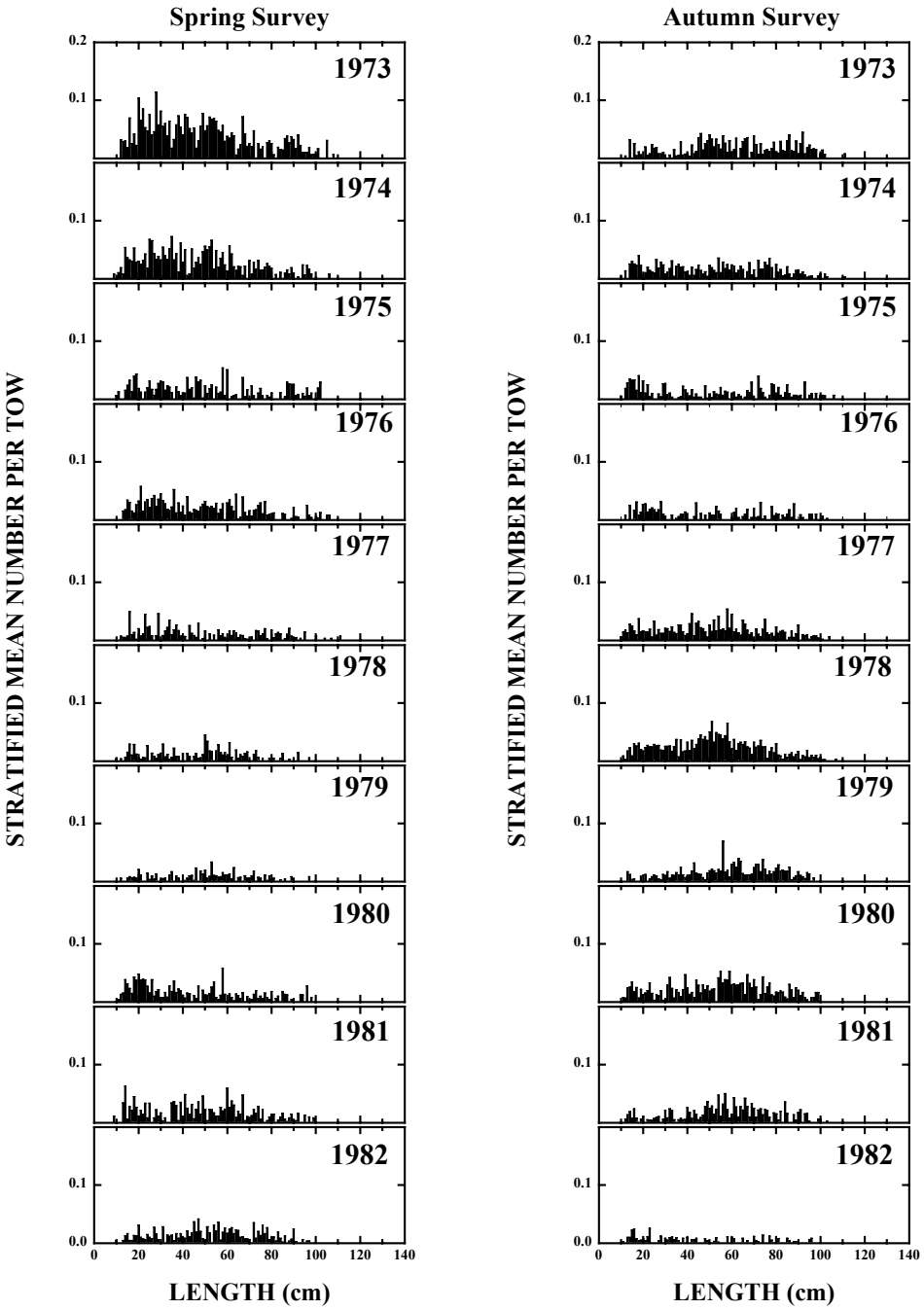

Figure 45. Thorny skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1973-1982.

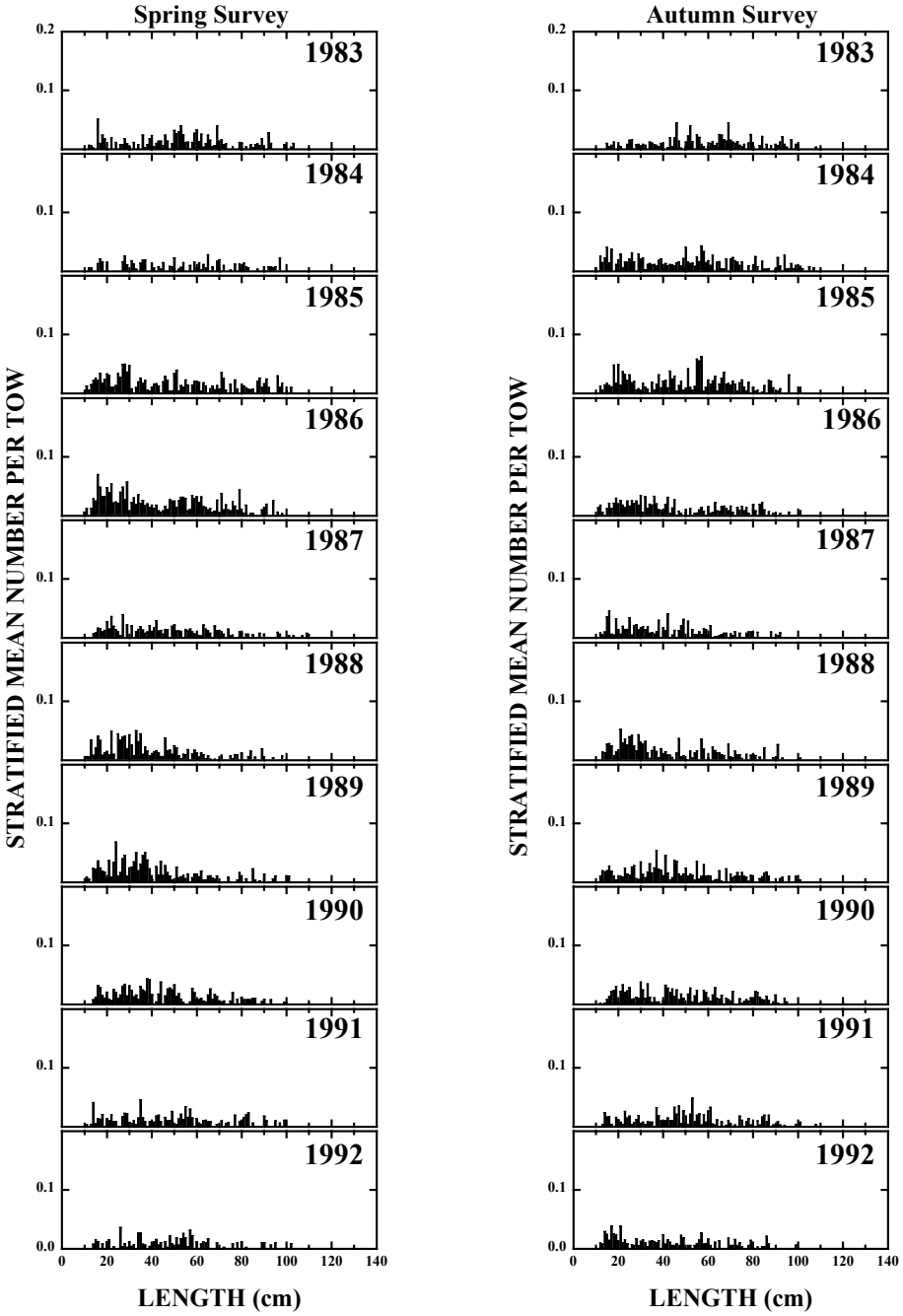

Figure 46. Thorny skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1983-1992.

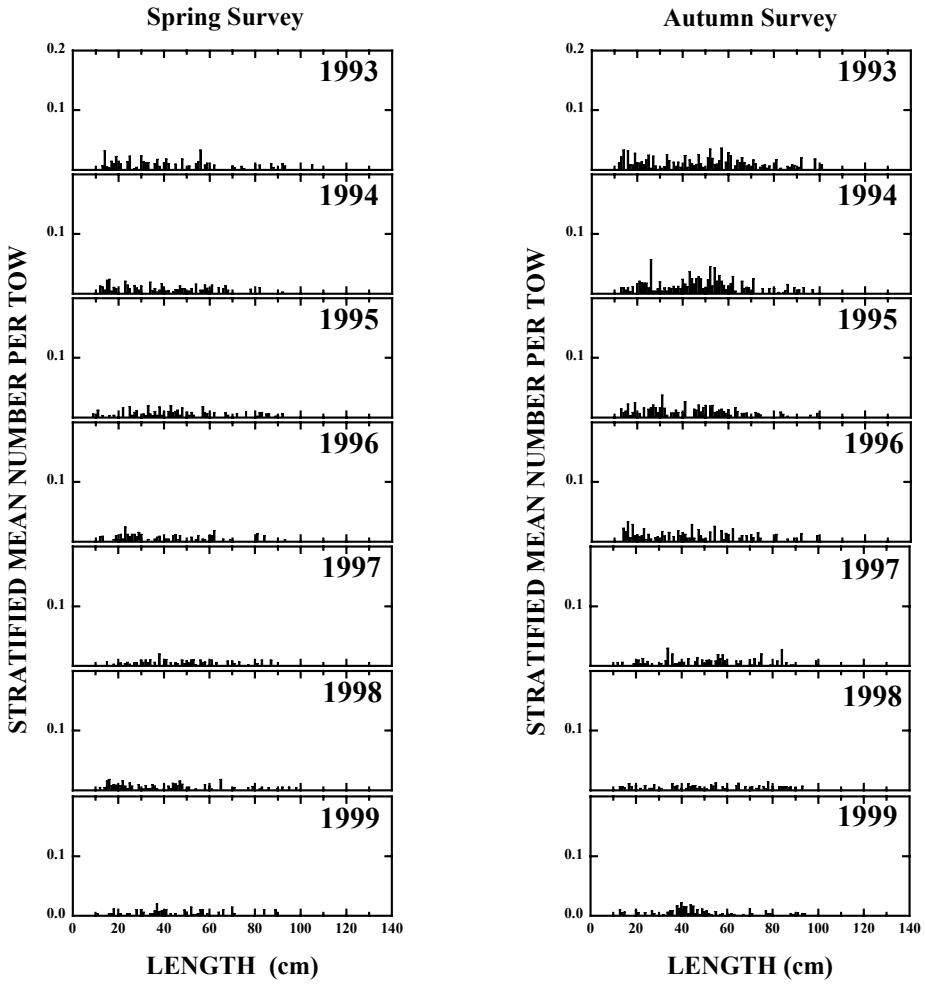

Figure 47. Thorny skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1993-1999.

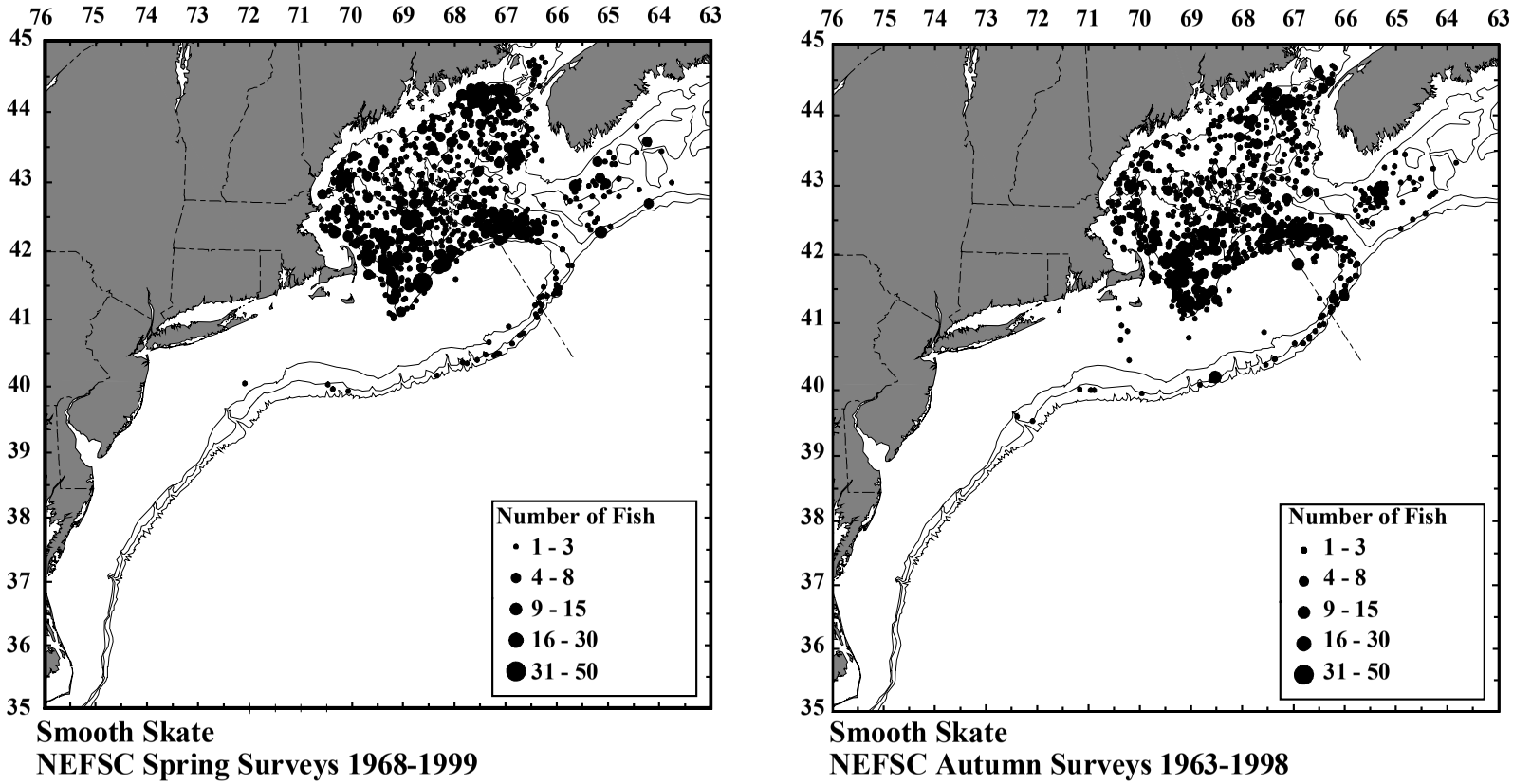

Figure48. Distribution of smooth skate in the NEFSC spring and autumn surveys from 1963-1999.

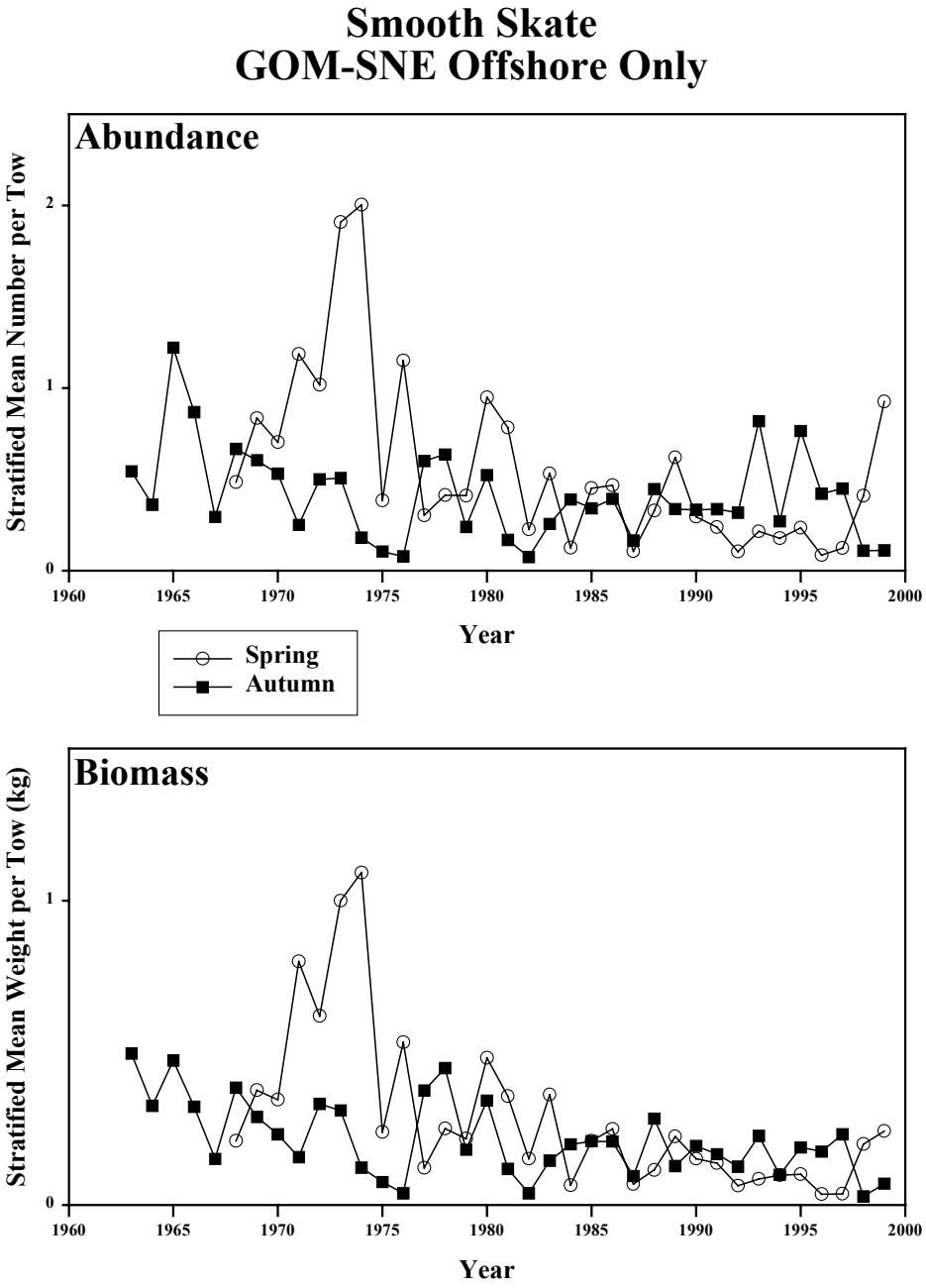

Figure 49. Abundance and biomass of smooth skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1967-1999 in the Gulf of Maine to Southern New England offshore region.

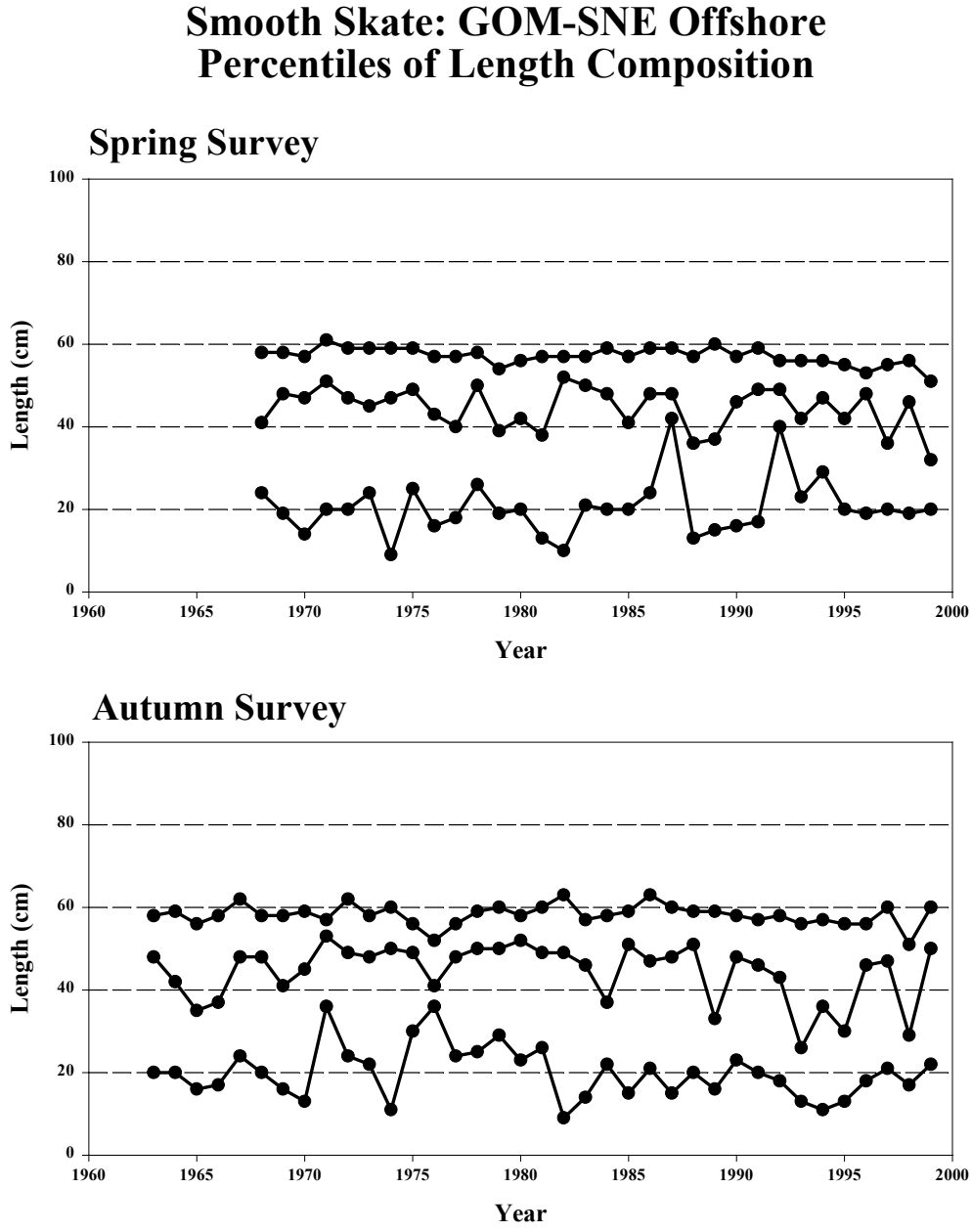

Figure 50. Percentiles of length composition (5, 50, and 95) of smooth skate from the NESFC spring and autumn bottom trawl surveys from 1963-1999 in the Gulf of Maine to Southern New England offshore region.

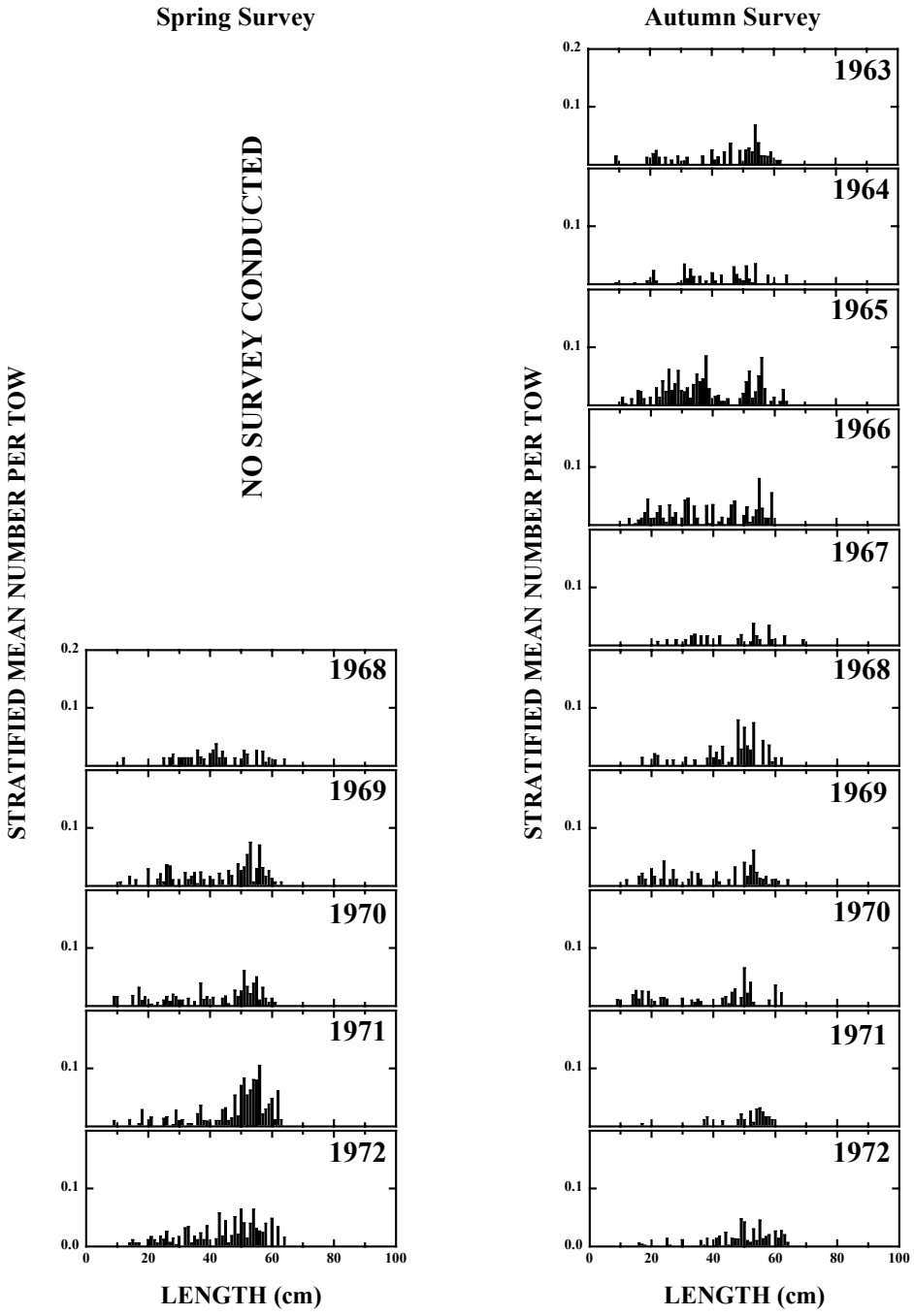

Figure 51. Smooth skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1963-1972.

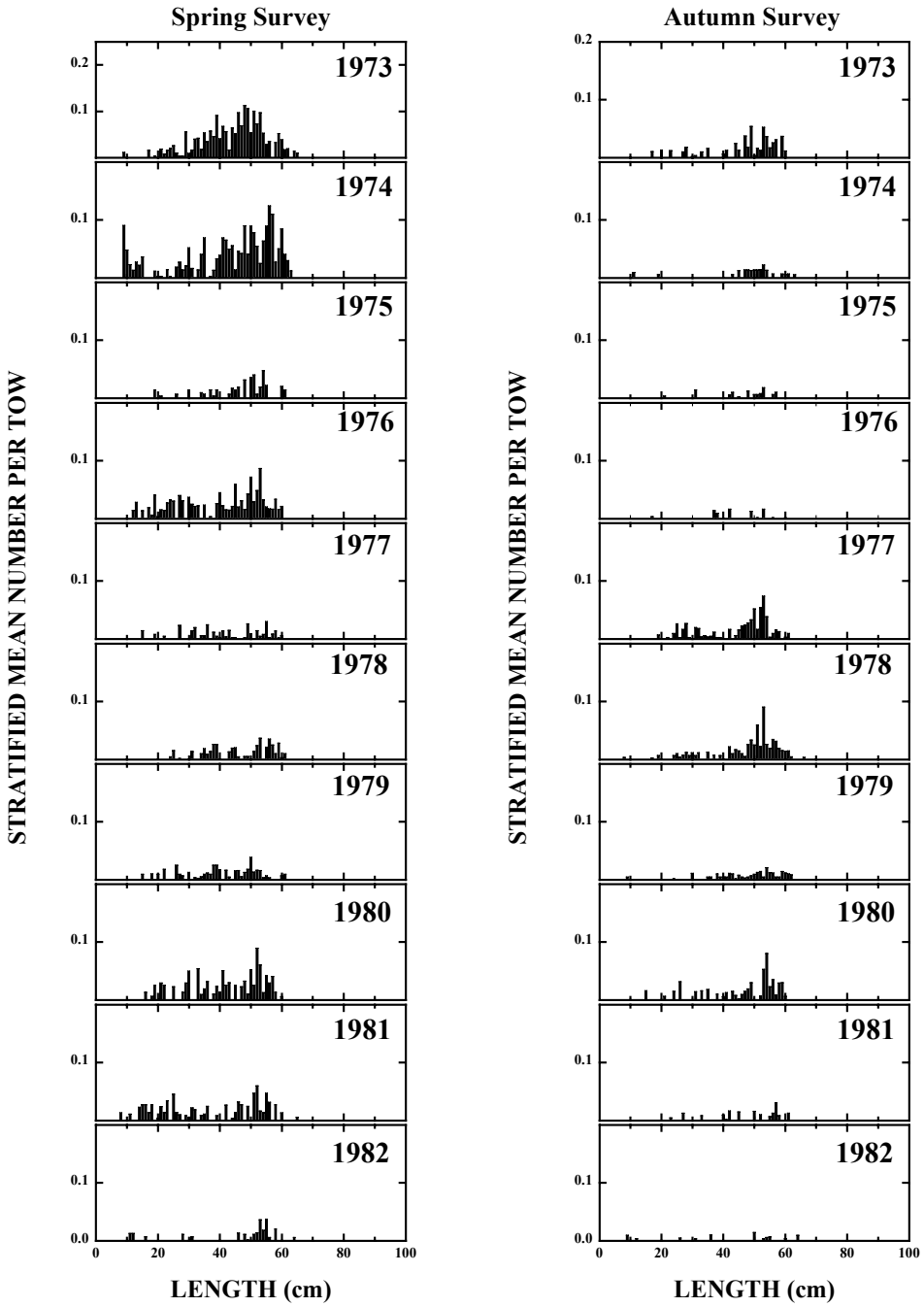

Figure 52. Smooth skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1973-1982.

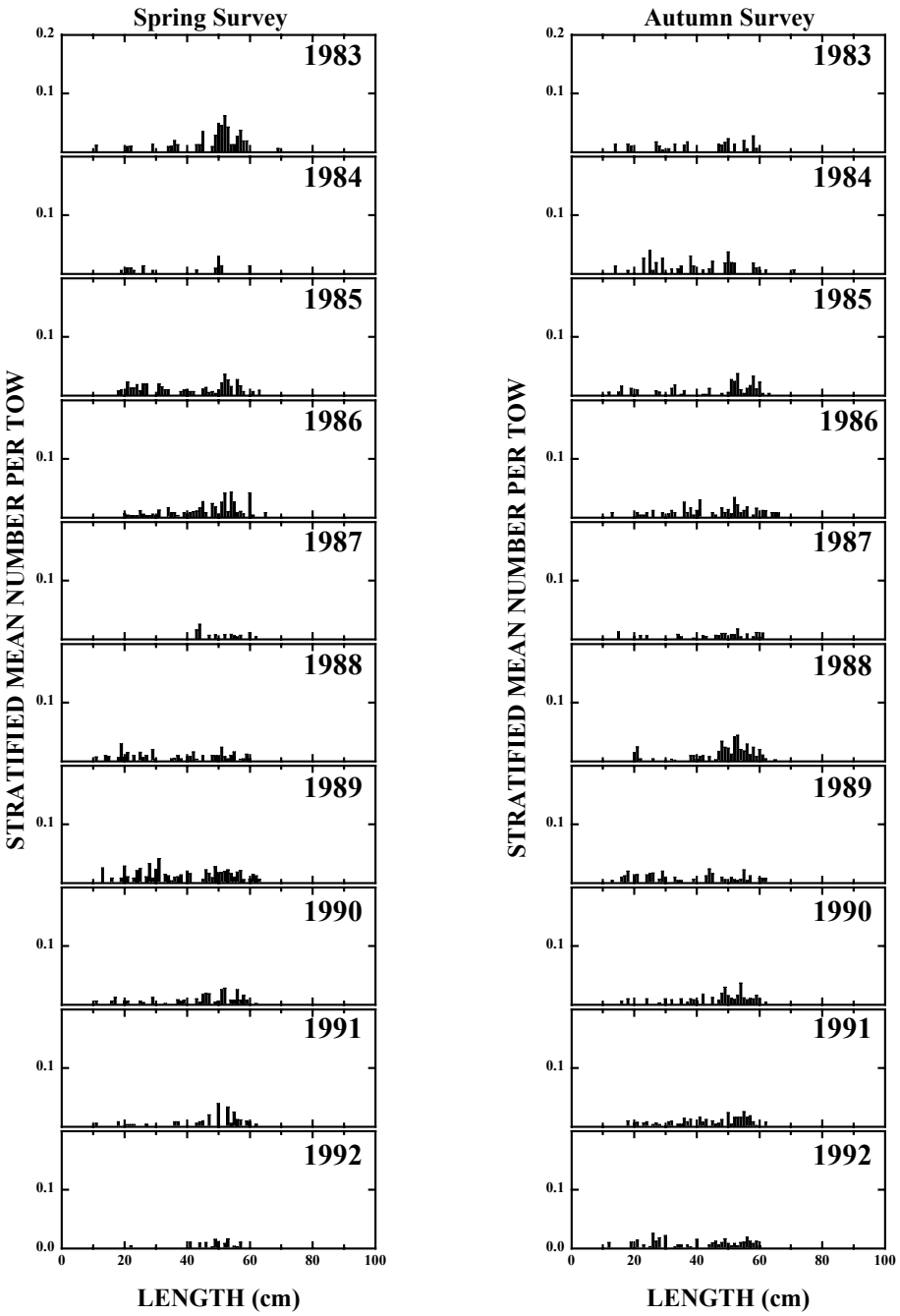

Figure 53. Smooth skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1983-1992.

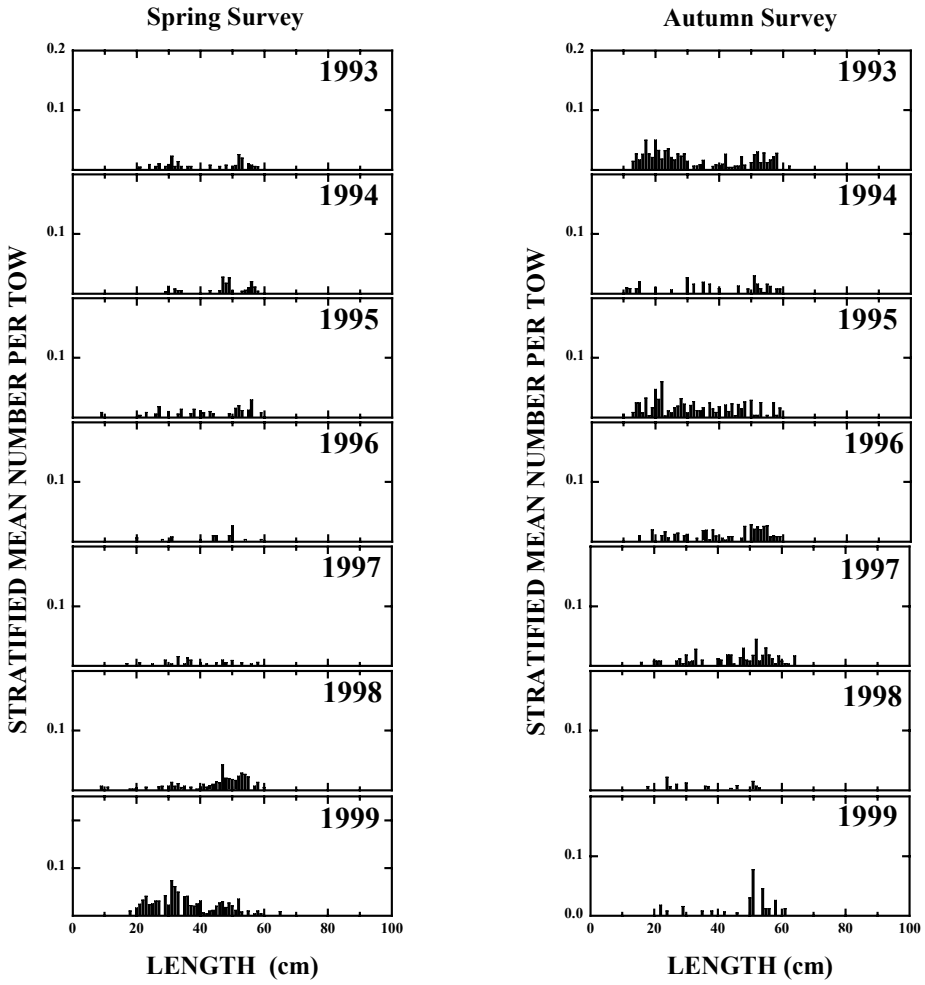

Figure 54. Smooth skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1993-1999.

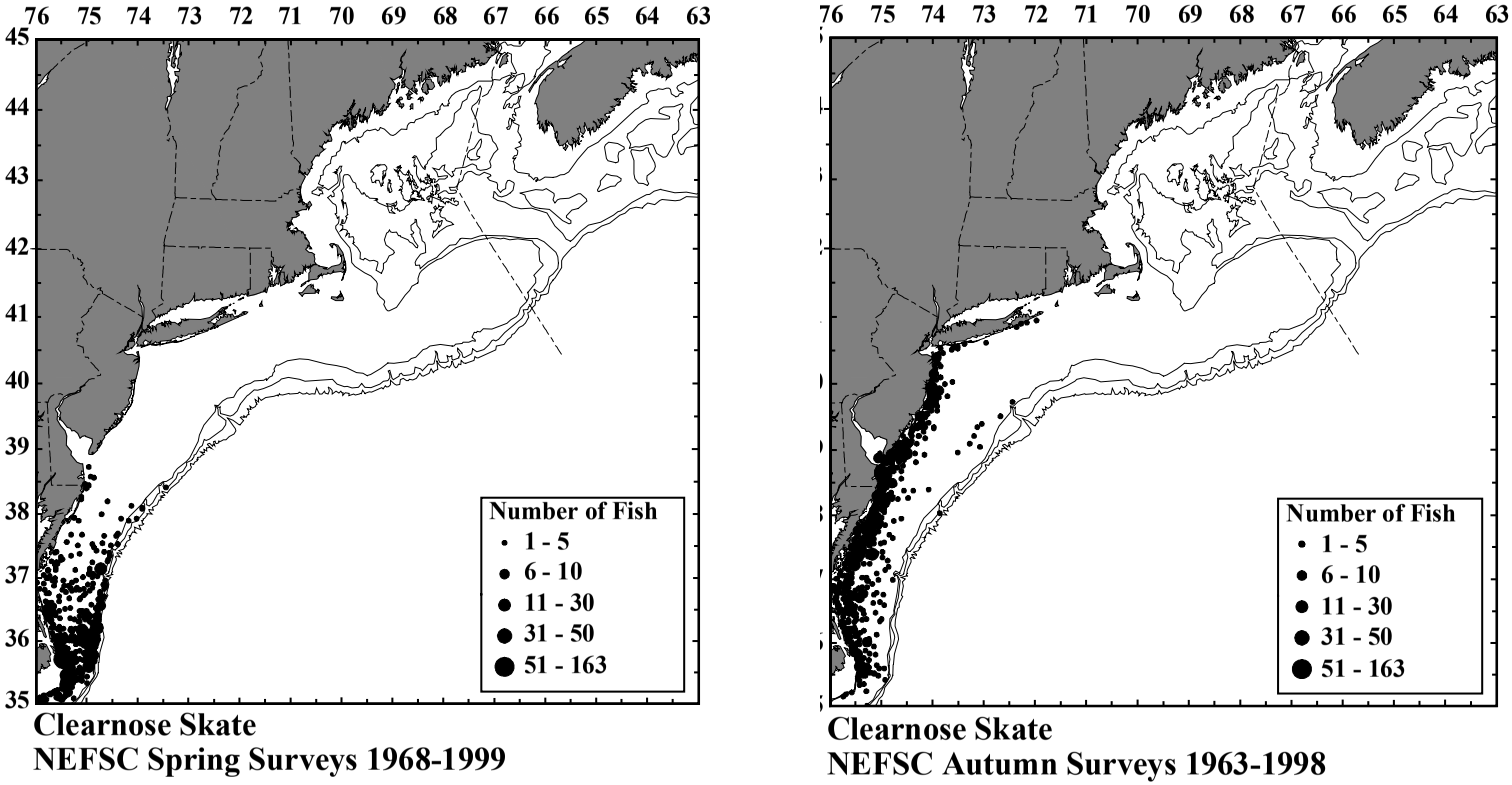

Figure 55. Distribution of clearnose skate in the NEFSC spring and autumn surveys from 1963-1999.

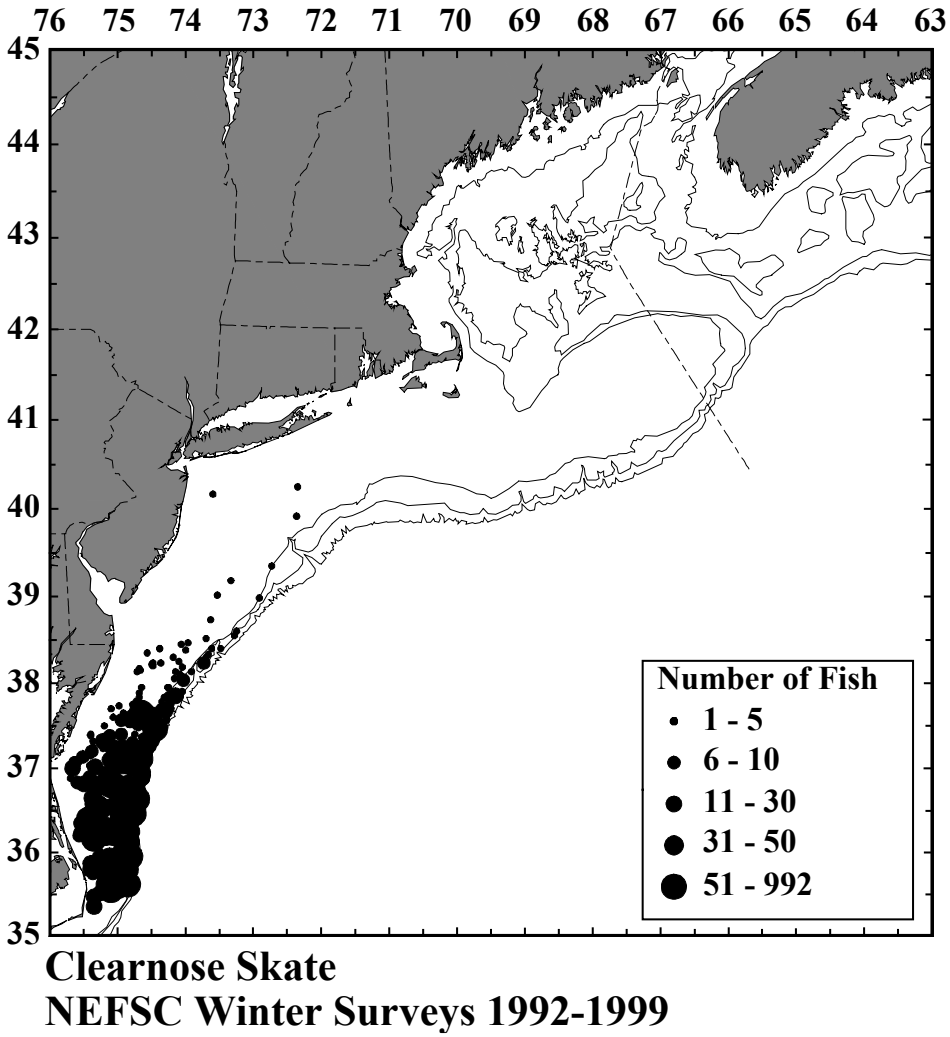

Figure 56. Distribution of clearnose skate in the NEFSC winter surveys from 1992-1999.

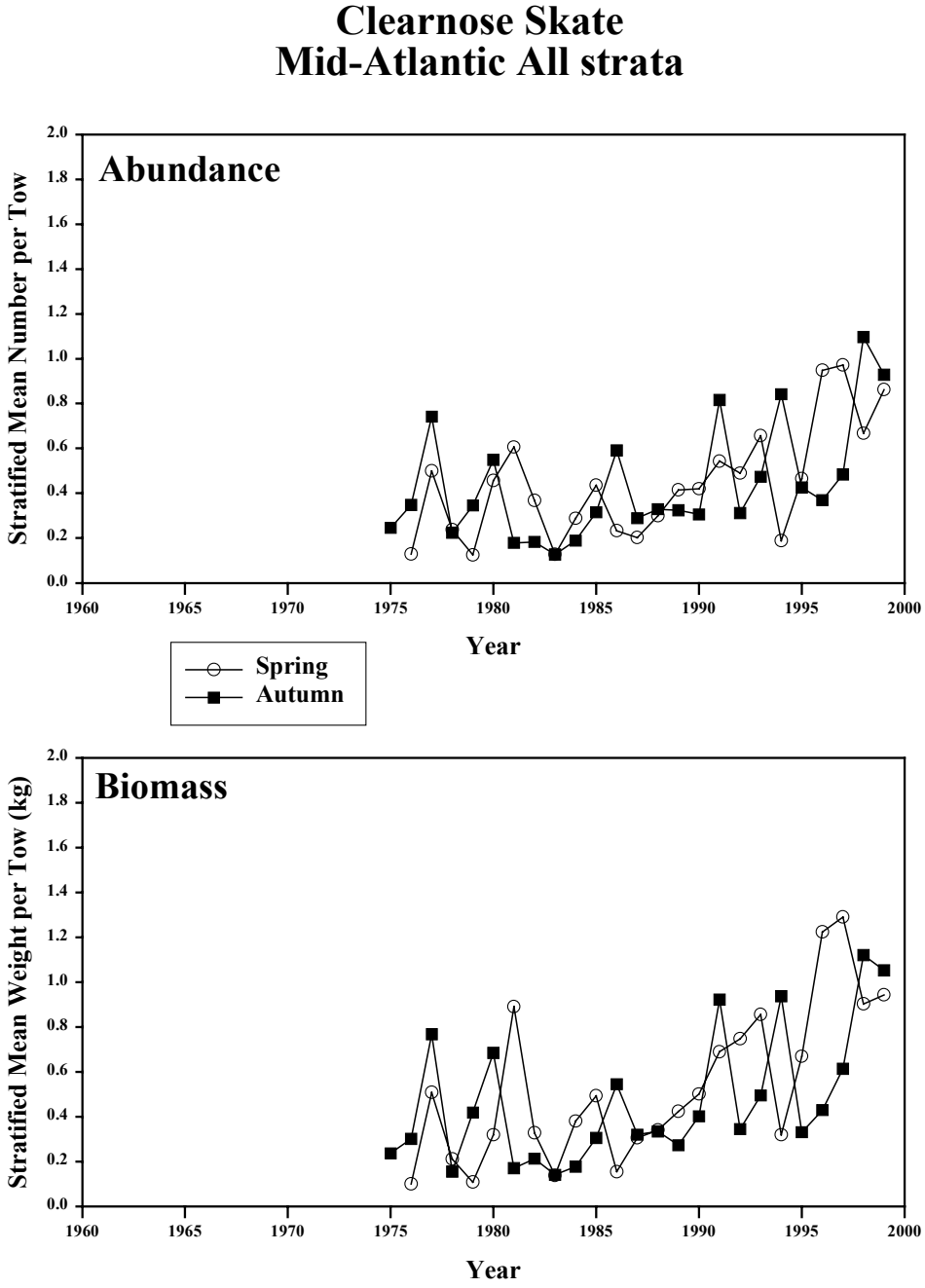

Figure 57. Abundance and biomass of clearnose skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1975-1999 in the Mid-Atlantic offshore and inshore regions.

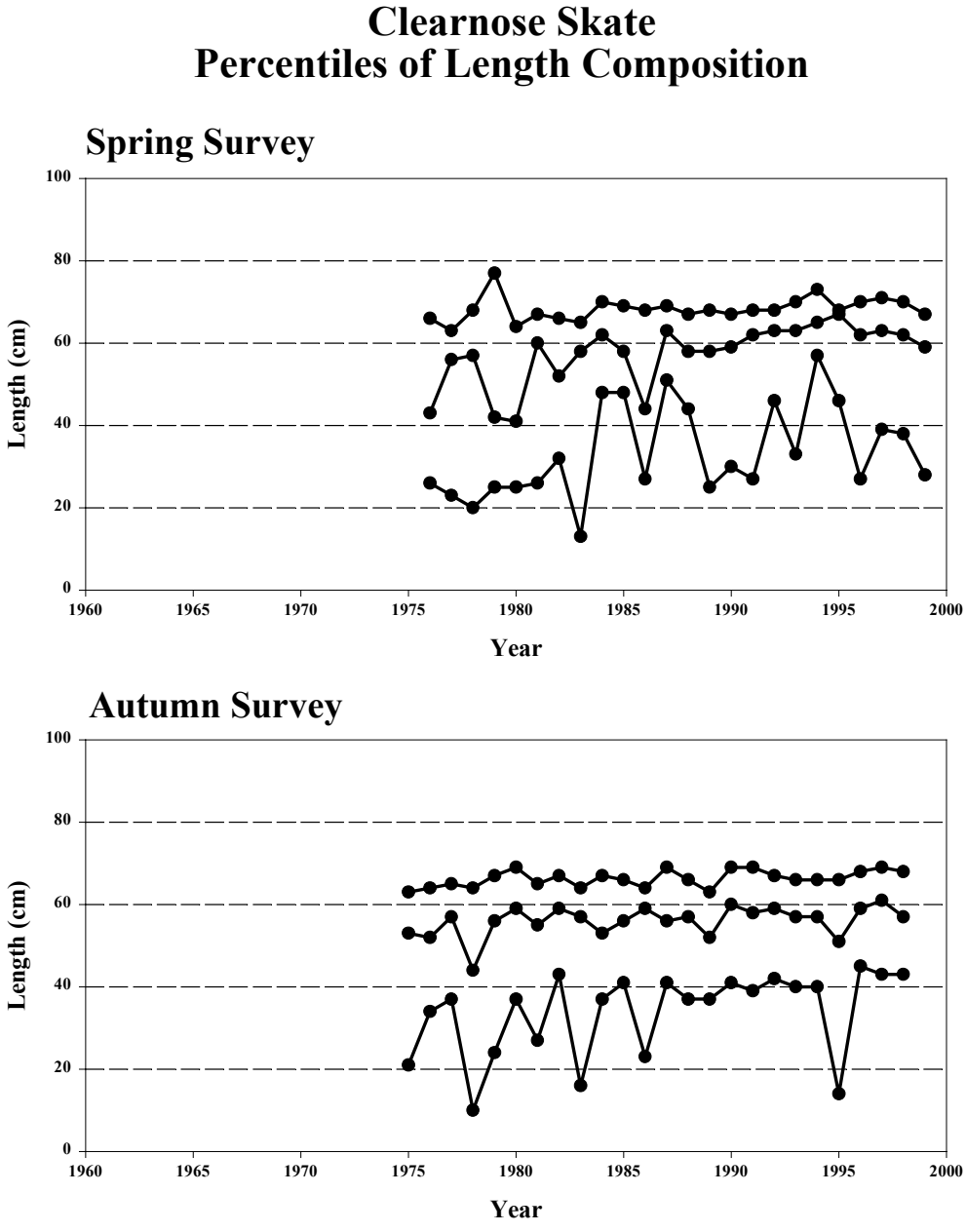

Figure 58. Percentiles of length composition (5, 50, 95) of clearnose skate from the NESFC spring and autumn bottom trawl surveys from 1975-1999 in the Mid-Atlantic offshore and inshore regions.

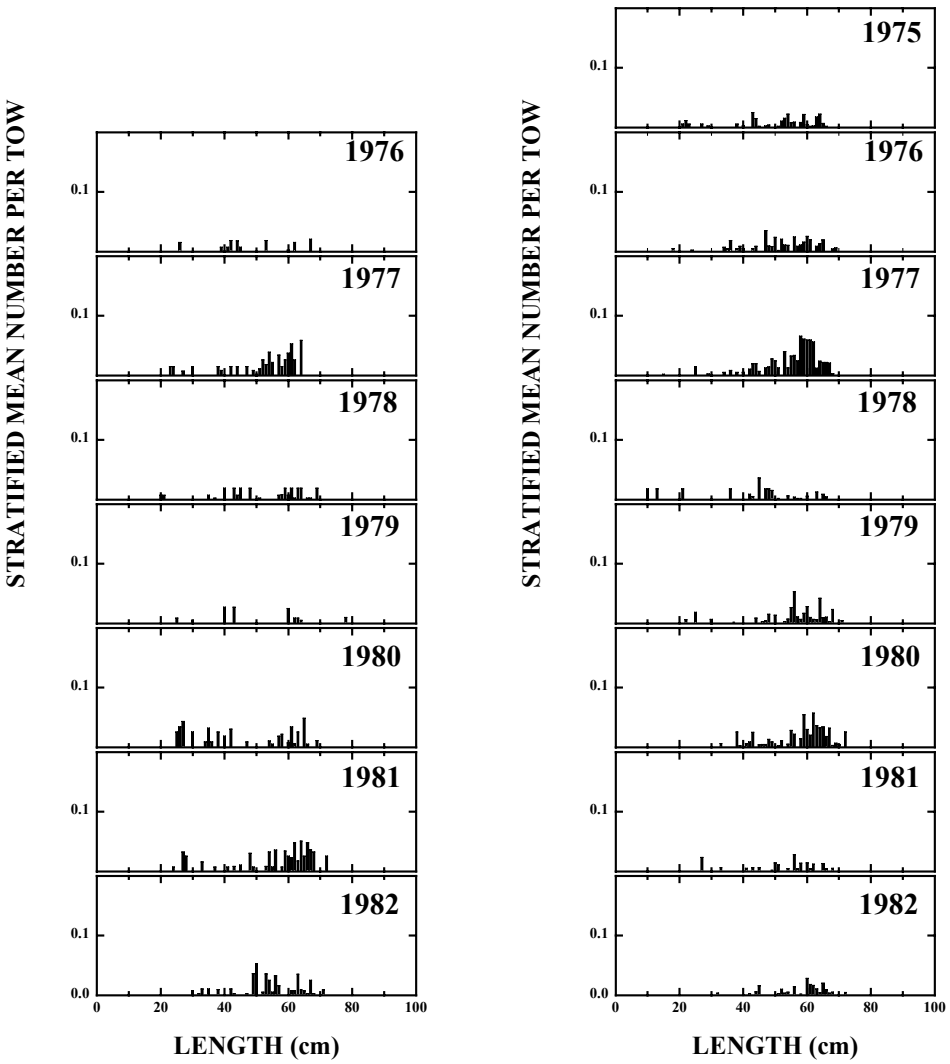

Figure 59. Clearnose skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore and inshore regions, 1975-1982.

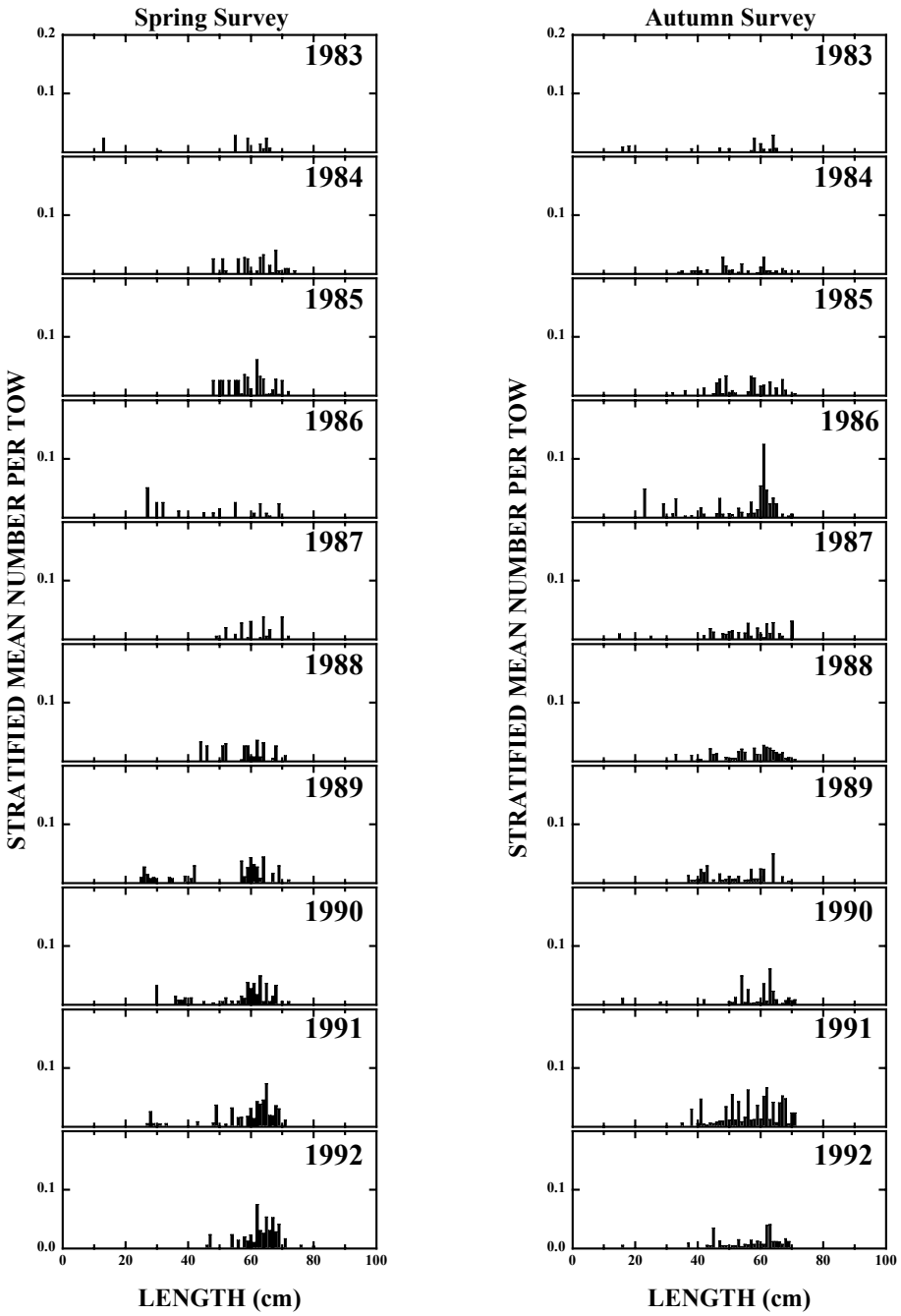

Figure 60. Clearnose skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore and inshore regions, 1983-1992.

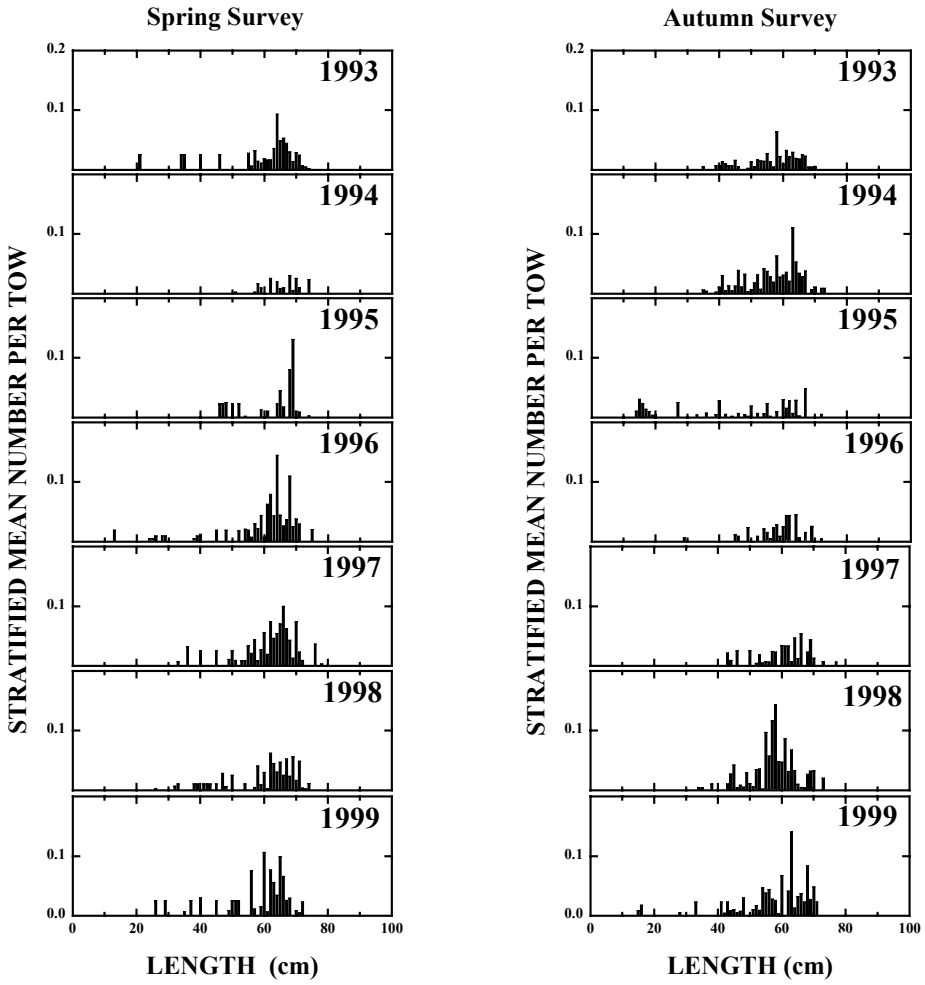

Figure 61. Clearnose skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore and inshore regions, 1993-1999.

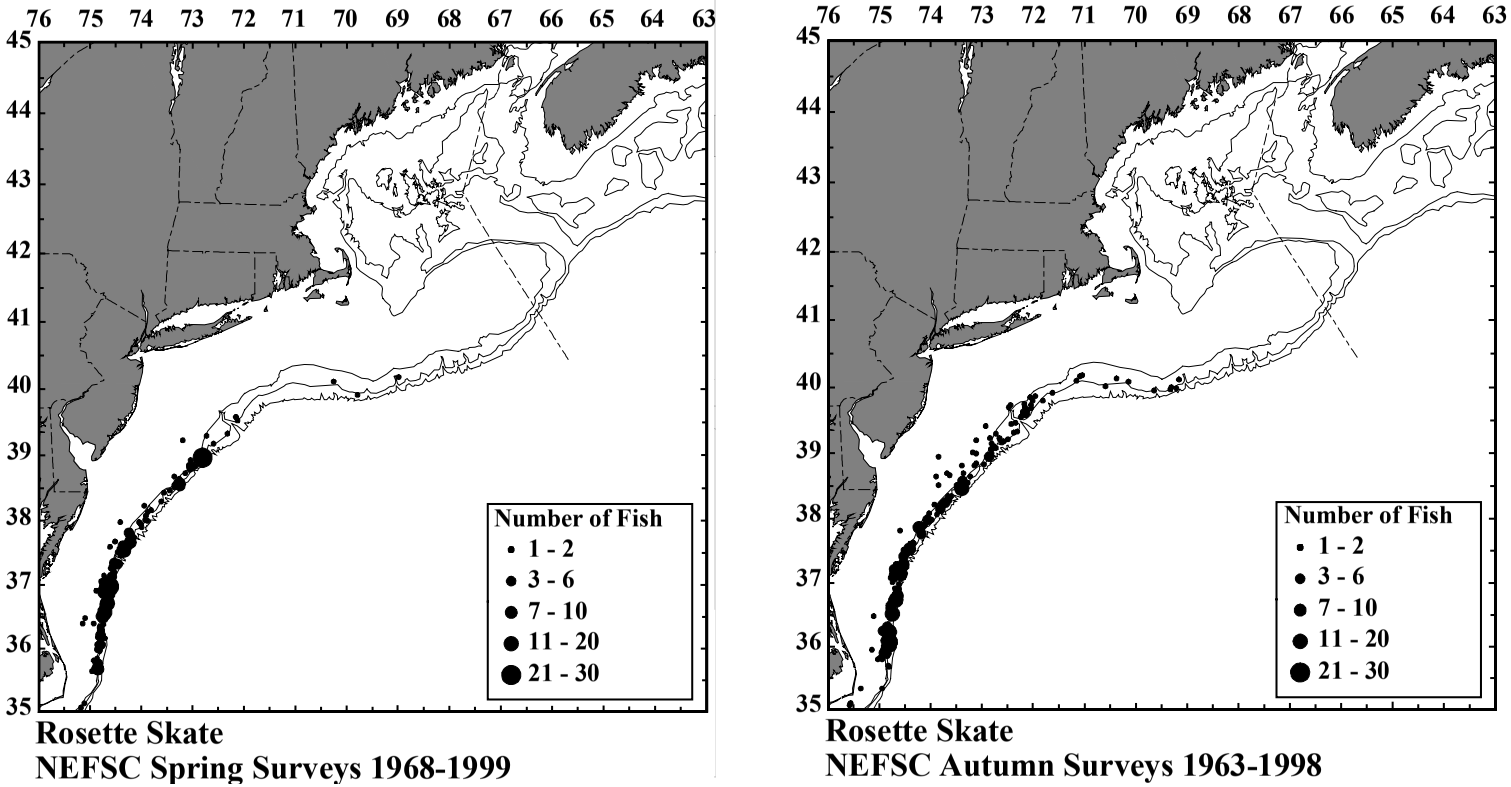

Figure 62. Distribution of rosette skate in the NEFSC spring and autumn surveys from 1963-1999.

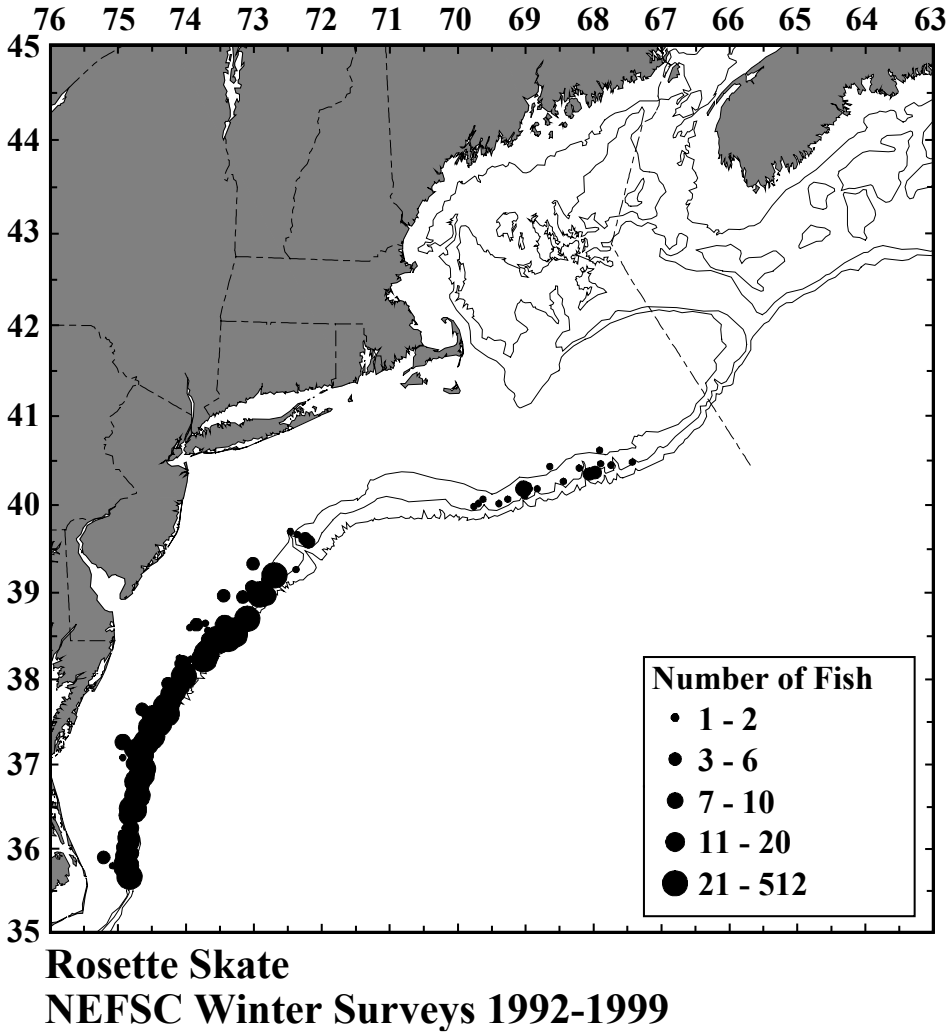

Figure 63. Distribution of rosette skate in the NEFSC winter surveys from 1992-1999.

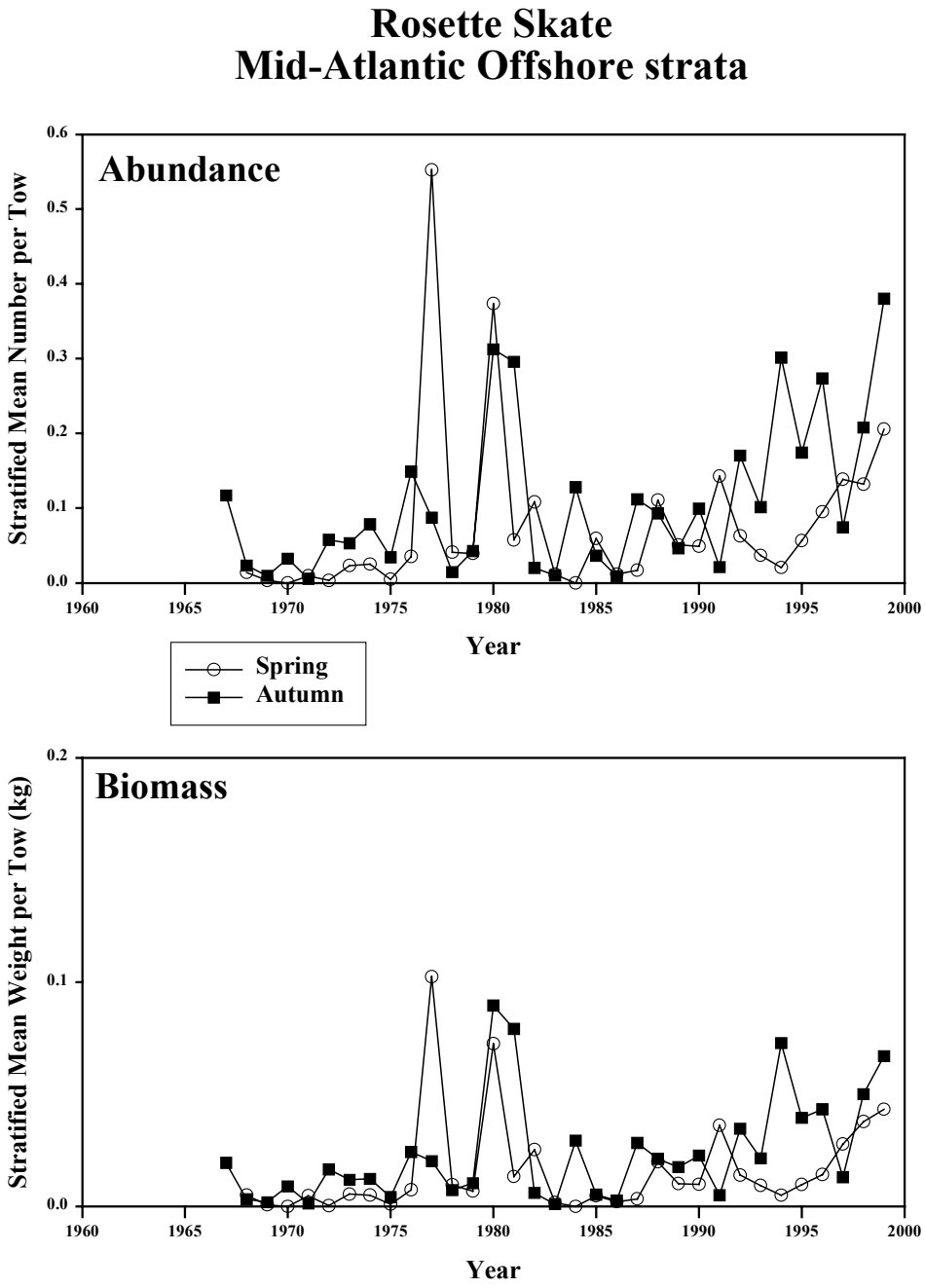

Figure 64. Abundance and biomass of rosette skate from the NESFC spring (circles) and autumn (squares) bottom trawl surveys from 1967-1999 in the Mid-Atlantic offshore region.

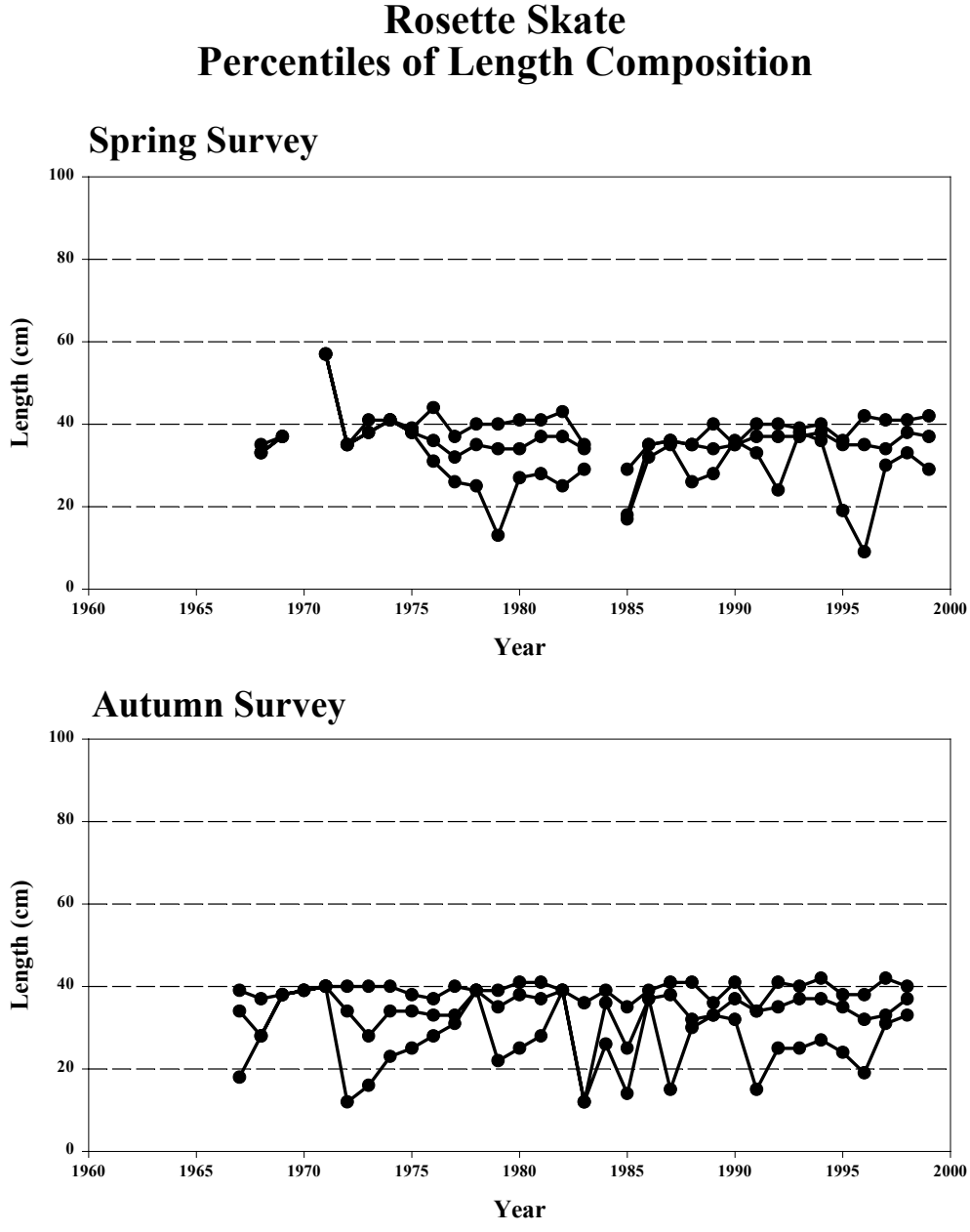

Figure 65. Percentiles of length composition (5, 50 95) of rosette skate from the NESFC spring and autumn bottom trawl surveys from 1967-1999 in the Mid-Atlantic offshore region.

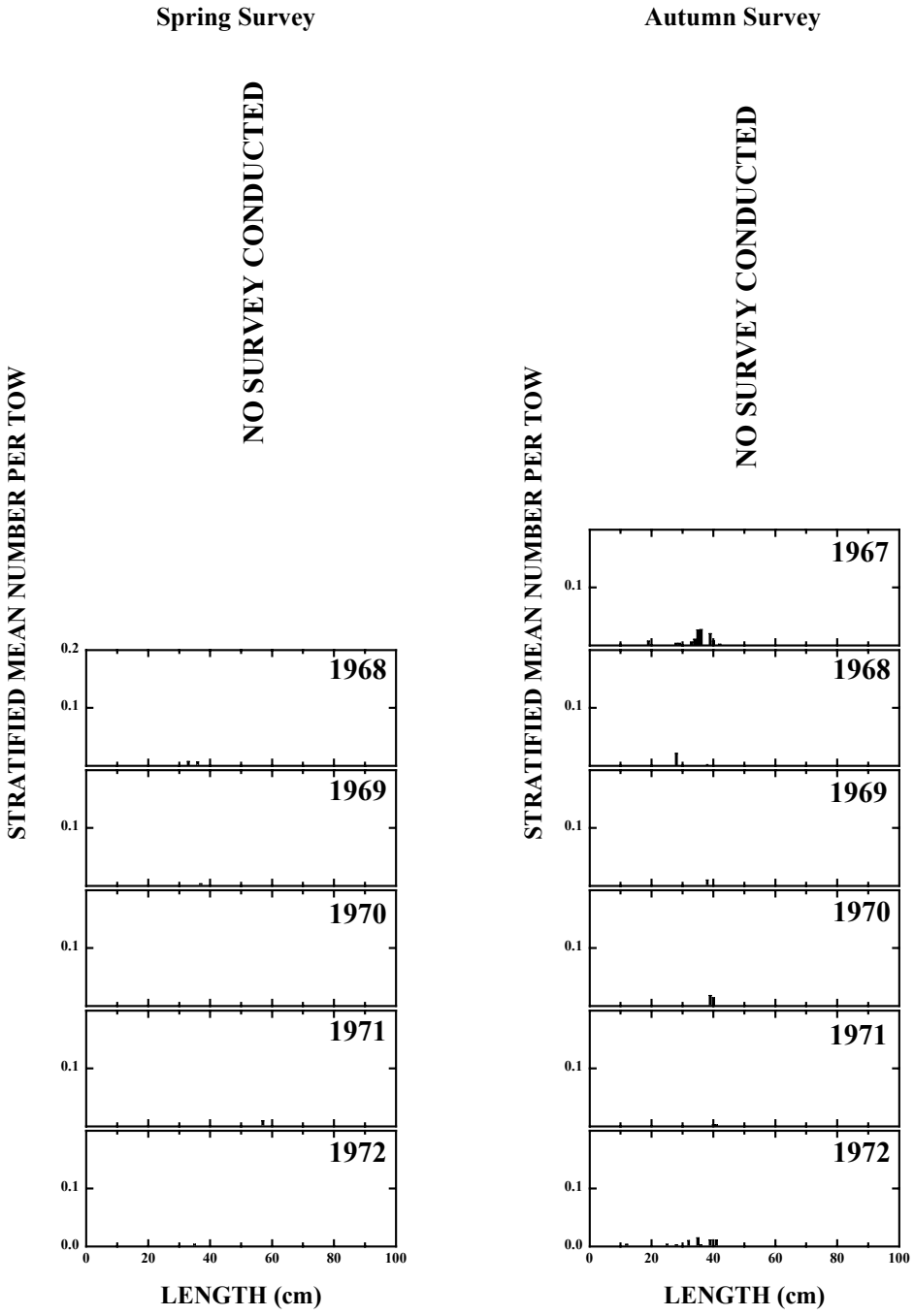

Figure 66. Rosette skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore region, 1967-1972.

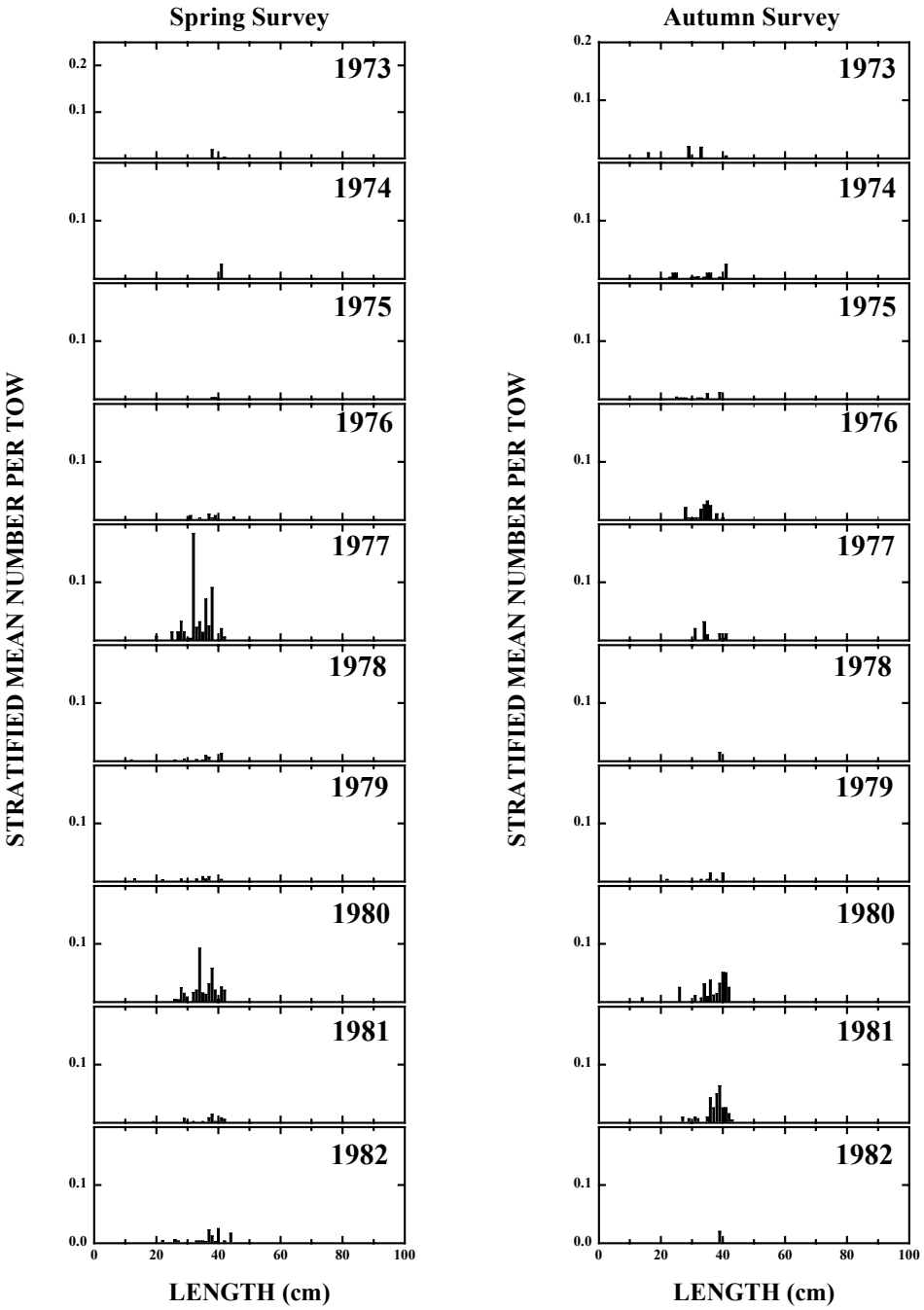

Figure 67. Rosette skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore region, 1973-1982.

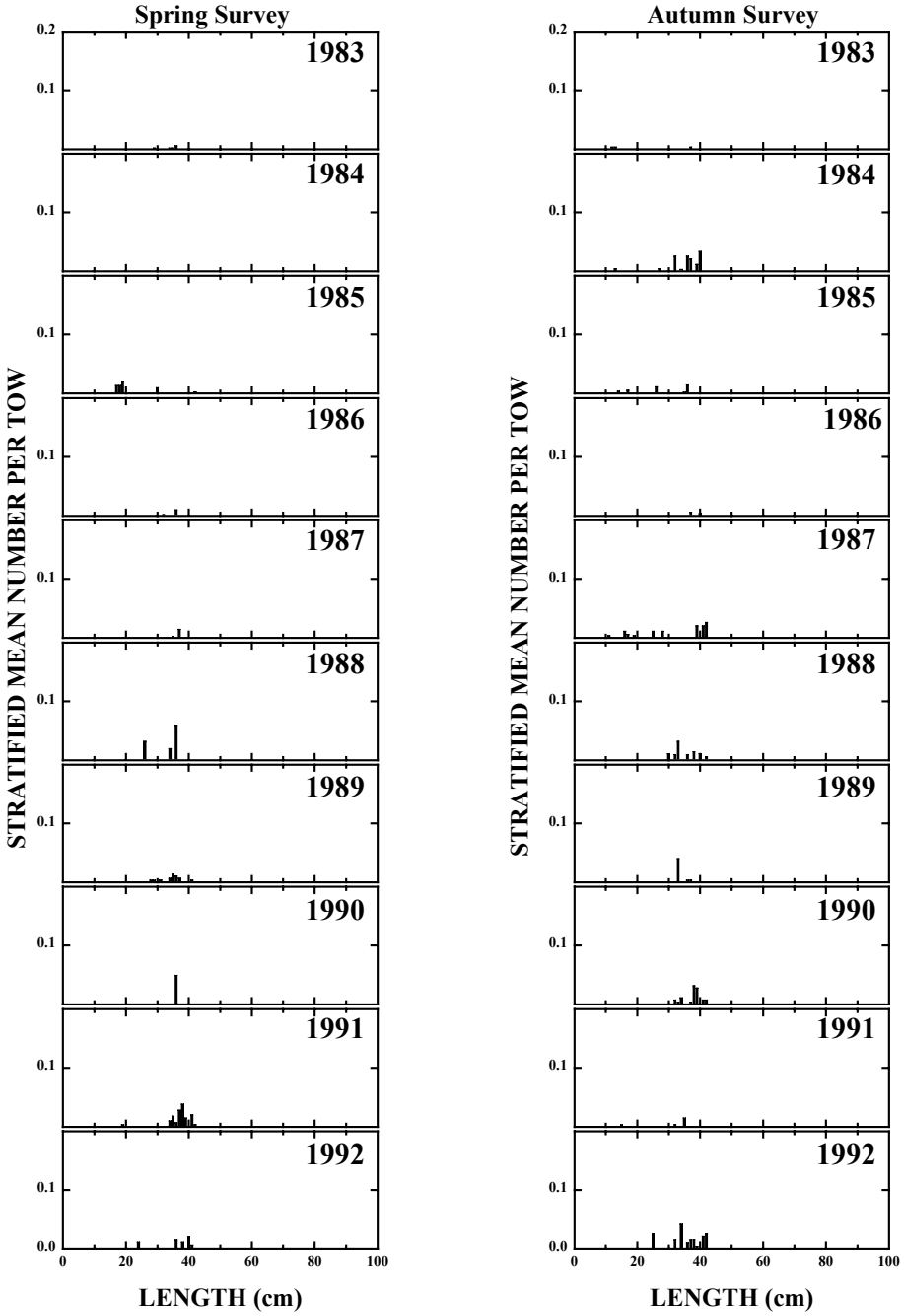

Figure 68. Rosette skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore region, 1983-1992.

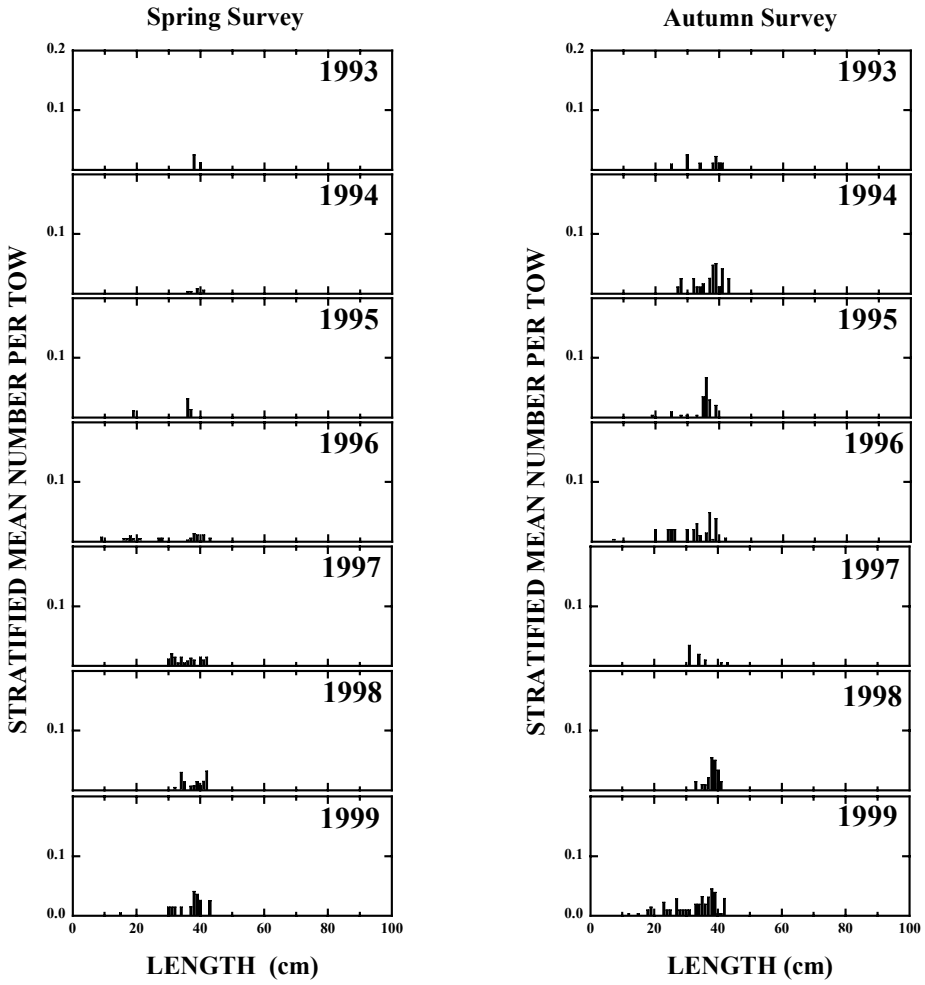

Figure 69. Rosette skate length composition from the NEFSC spring and autumn bottom trawl surveys in the Mid-Atlantic offshore region, 1993-1999.

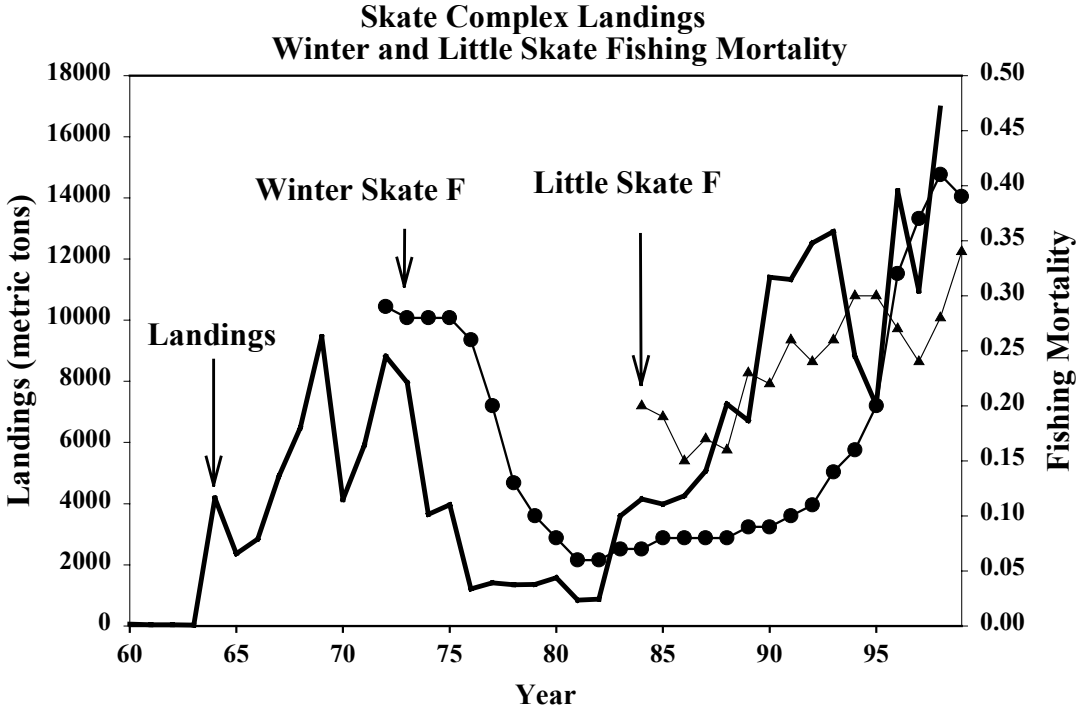

Figure 70. Commercial fishery landings of skates (all species) in the Northeast Region. Winter and little skate fishing mortality rates calculated from NEFSC spring survey length distributions.