Northeast Fisheries Science Center Reference Document 16-08

Update of Thorny Skate *(Amblyraja radiata)* Commercial and Survey Data

by Katherine Sosebee, Alicia Miller, Loretta O'Brien,
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ABSTRACT/EXECUTIVE SUMMARY

The 7 species in the Northeast Region (Maine to Virginia) skate complex are: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). Landings have generally been increasing since 2000, and the 2007 reported commercial landings of 20,342 metric tons (mt) were the highest on record. The principal commercial fishing method in the directed skate fishery is otter trawling. Skates are frequently taken as bycatch during groundfish trawling and scallop dredge operations and discarded. Discard estimates from the Data Poor Stocks Working Group were revised in this assessment based on new data and new imputation according to the Standardized Bycatch Reporting Methodology (NEFSC 2009). Differences were generally minor and mostly caused by the imputation. Recreational and foreign landings are currently insignificant. Landings and discard estimates were disaggregated to skate species by using several methods, all of which showed a decline for thorny skate over the time series.

Northeast Fisheries Science Center (NEFSC) indices of thorny skate abundance have declined steadily since the late 1970s, reaching historically low values in 2012 and 2013 that are less than 5% of the peak observed in the 1970s. The minimum swept area abundance and biomass in 2015 are 628,000 individuals and 843 mt in the fall and 867,000 skates and 1,264 mt in the spring. Survey indices from other surveys are generally in agreement with either a decline since the 80s or a flat survey during the 2000s. In 2014 a new cooperative bottom longline survey was implemented that is able to cover rough bottom that the regular bottom trawl cannot survey. This survey, while currently only 2 years in duration, indicates that more thorny skate are caught on rough bottom than on smooth.

INTRODUCTION

The 7 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; Bigelow and Schroeder 1953; Collette and Klein-McPhee 2002). The species are: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

The first stock assessment for the skate complex was conducted in 1999 at the 30th Stock Assessment Review Committee (SARC 30) meeting (NEFSC 2000). At that time there was no Fishery Management Plan (FMP) in place. The National Marine Fisheries Service (NMFS) had been petitioned to list barndoor skate as endangered based on a paper by Casey and Myers (1998) and was also asked to assess the other species in the complex. SARC 30 found no cause to list barndoor as endangered but recommended that the species remain on the candidate species list as well as adding thorny skate as a candidate species. Biomass reference points were developed for all 7 species and 4 (winter, barndoor, thorny, and smooth skates) were listed as overfished. Fishing mortality reference points were only developed for winter and little skate and overfishing was occurring for winter skate.

A Fishery Management Plan (FMP) was developed by the New England Fishery Management Council (NEFMC), following SARC 30, when they were informed of the

overfished status of thorny and barndoor skate (biomass of both winter and smooth skate increased in the 1999 fall survey, and they were no longer considered overfished; NEFMC 2003). The FMP was implemented in September of 2003 with a primary requirement for mandatory reporting of skate landings by species by both dealers and vessels. Possession prohibitions of barndoor and thorny skate as well as smooth skate in the Gulf of Maine were also provisions of the FMP. A trip limit of 10,000 lbs was implemented for winter skate with a Letter of Authorization for the bait fishery (little skate) to exceed the trip limit. The biomass reference points developed at SARC 30 were maintained, but new fishing mortality reference points were developed. Management measures in other FMPs (groundfish, monkfish, and scallop) were specified and if these changed, the Plan Development Team would need to address the change.

The stock complex was next assessed in 2006 at SARC/Stock Assessment Workshop (SAW) 44 (NEFSC 2007). Several methods were attempted to develop fishing mortality estimates and biological reference points. These included the Gedamke and Hoenig (2006) length-based mortality estimator, length-based yield-per-recruit, spawner-per-recruit, and a length-tuned model. None of these methods were accepted, although some showed promise. The existing reference points were maintained.

The last benchmark assessment was conducted through the Data Poor Stocks Working Group (DPSWG) in 2008 (NEFSC 2009). The reference points were updated with the same method, but through fall 2007 or spring 2008, since the fall survey was not completed. One of the new developments at that assessment was the derivation of catches by species. Two methods were developed, and neither was considered superior. The catches by species have been used in the development of Allowable Biological Catches since 2012.

In 2009, Amendment 3 to the Skate FMP was implemented (NEFMC 2010). This amendment removed the specified management measures in other FMPs, since many of these were obsolete and no longer applied. Measures were developed to limit catches (Annual Catch Limits, Accountability Measures) for the bait and wing fisheries. The wing fishery trip limit was reduced from 10,000 lbs to 5,000 lbs while a possession limit of 20,000 lbs was introduced for the bait fishery. Seasonal quotas were introduced for the bait fishery. The updated reference points from the DPSWG were formally adopted.

In May of 2015, NMFS was petitioned to list thorny skate as endangered. To provide guidance in addressing this issue, this paper updates the landings and discards of all skates through 2014, updates the available survey information for thorny skate through 2015, and provides results for thorny skate from a new longline survey conducted in 2014 and 2015.

FISHERY DEPENDENT INFORMATION

Commercial Fishery Landings

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 and the industrial fishery during the 1950s and 1960s. The landings in this paper were taken from a different data source than the previous assessment (NEFSC 2009). In examining the landings by state from the NMFS weighout system and the historical general canvas system (Rounsefell 1948) it appeared that the general canvas had higher landings for most states. The landings from the general canvas were

used instead of the weighout when this occurred (Table 1). The total landings prior to 1994 are not different since the totals were derived from the Northwest Atlantic Fisheries Organization (NAFO) database (www.nafo.int) in the same manner as the last assessment (NEFSC 2009). The NAFO database has much higher landings because the industrial fishery landings are not in either the weighout or general canvas by species. They were sampled to derive species composition and then sent to NAFO. Another difference between this paper and the last assessment (NEFSC 2009) is that bait landings reported on Vessel Trip Reports as sold from boat-to-boat are now included in the totals.

United States (US) landings have generally been from US waters, but have occasionally come from Canadian waters and more recently the Grand Banks off Newfoundland outside Canadian territorial waters (Table 2). The main statistical areas for skate landings have been 513 and 514 in the Gulf of Maine (GM, Table 2, Figure 1), 521 on Georges Bank (GB), and 537 and 539 in Southern New England (SNE). The Mid-Atlantic (MA; statistical areas >= 600) landings are generally dominated by statistical area 611, which is Long Island Sound.

Total skate landings reached 9,462 mt in 1969 but declined quickly during the 1970s, falling to 847 mt in 1981 (Table 3, Figure 2). Landings then increased substantially, partially in response to increased demand for lobster bait, and more significantly, to the increased export market for skate wings. Landings increased to 12,904 mt in 1993 and then declined to 7,978 mt in 1995. Landings increased again, and the 2007 reported commercial landings of 20,342 mt were the highest on record (Table 3, Figure 2). Landings have since declined to between 15,000 and 16,000 mt.

United States landings were dominated by the industrial fishery from 1964-1981 and peaked at 4,081 tons at the beginning of the time series (Table 3). With the increased demand for bait and increased export market for wings, landings increased, peaking in 2007. Landings from other countries were dominated by the USSR between 1967 and 1979, peaking at 7,957 mt in 1972. Landings from other countries generally accounted for less than 100 mt.

United States landings of skates are reported in all months (Table 4). There is a relatively even distribution of landings across months, but the summer months do show a slightly higher percentage, probably because of the increased demand for lobster bait during those months.

Skate landings are primarily from Massachusetts and Rhode Island (mainly New Bedford and Point Judith) with 80-95% of the landings occurring in those 2 states (Table 5). Landings from other states did occur, and some are becoming more important over time with New York and New Jersey accounting for about 10 -15% in the last 5 years.

Otter trawls have been the primary gear used to land skates in the United States, with landings also coming from sink gill nets, longlines, and other/unknown gear (Table 6). Over the last 5 years, the use of sink gill nets is almost equal to otter trawl and even exceeded otter trawls in 2011 and 2014. Longline landings exceeded 100 mt in 1995, 1996, and 2005, but generally remain low comparatively. The increase in other gear after 2004 was a result of the reporting system implemented in 2004.

Landings historically were taken from Georges Bank and Southern New England during the early 1960s as the industrial fishery operated mainly out of Point Judith, RI, and Maine, and the distant-water fleet fished mainly on Georges Bank and in Southern New England (Table 7). Landings from the Mid-Atlantic increased through the early 2000s, while landings from Georges Bank were the highest on record in 2007.

Commercial Fishery Discards

Discard estimates from DPSWG (NEFSC 2009) were revised in this assessment. The same ratio-estimator was used in this assessment and is based on the methodology described in Rago et al. (2005) and updated in Wigley et al. 2007. It relies on a discard/kept (d/k) ratio where the kept component is defined as the total landings of all species within a "fishery," which is defined as a homogeneous group of vessels with respect to gear type (longline, otter trawl, shrimp trawl, sink gill net, and scallop dredge), quarter (months 1-4, 5-6, 7-8, 9-12), and area fished (GM (areas 510-515), GB (areas 520-525, 561, 562), SNE (areas 530-539, 540-543), MA (areas >= 600)). Mesh size was not used to split out otter trawl trips or sink gill net trips. All trips were included if they occurred within this stratification, regardless of whether or not they caught skates.

The discard rate (R_h) for skates in stratum h is the sum of discard weight over all trips divided by sum of kept weights over all trips:

$$\hat{R}_h = \frac{\sum_{i=1}^{n_h} d_{ih}}{\sum_{i=1}^{n_h} k_{ih}} \qquad (1)$$

where d_{ih} is the discards for skates within trip i in stratum h, and k_{ih} is the kept component of the catch for all species. The total discard amount within a stratum is simply the product of the estimated discard rate R_h and the total landings for the fishery defined as stratum h, i.e., $D_h=R_hK_h$. The total discards are the sum of all the strata.

There are 2 differences between the discards estimated from the last assessment (NEFSC 2009) and those from this paper. The first is that some of the data have changed, with more trips included in the observer data and some updates to the landings data. The second is that the imputation was done for missing cells as well as cells in which the number of trips was less than 3. These were imputed by using weighted averages of existing cells (sum discards/sum kept). Imputation occurred semiannually within an area, then relaxed to annually within area fished, then annual over region (i.e., SNE and MA or GM and GB). There were some cases for the longline fishery in which the entire year was averaged for all areas or for a span of 12 years (1993-2004) and for which ratios were used from GM-GB for SNE-MA. To hindcast the discard estimates back to 1964, a 3-year weighted average (the earliest 3 years of data) of the discards of skates to the landings of all species was used to calculate the d/k ratio.

The updates in data did not impact the discard estimates as much as the change in imputation (Figure 3), although even the imputation only impacted 1 year by reducing a large peak. Discards were above 100,000 mt in the early 1960s and declined to below 60,000 mt in the 1970s (Figure 3, Tables 8-10). Discards generally increased to a peak in 1990 and then declined to a stable value of around 40,000 mt from the late 1990s through 2014. The 2 main gear types that account for the majority if the discards are otter trawl and scallop dredge (Tables 8-10). Discards from GM-GB accounted for a higher proportion of the total early in the time series but declined to less than 50% of the total during the last few years.

Recreational Fishery Catch

Recreational catches were very low in the last assessment (NEFSC 2009) and were not updated for this paper.

Landings by Species Estimation

Landings were generally not reported by species, with over 99% of the landings reported as "unclassified skates" until the FMP was implemented in September of 2003 (Table 11). Wings were most likely taken from winter and thorny skates, the 2 species historically known to be used for human consumption. Since the implementation of the FMP there should not be any barndoor or thorny skate landed as wings since these species are prohibited. Bait landings are presumed to be primarily from little skate, based on areas fished, known species distribution patterns, and size of the bait. Landings of barndoor and thorny skate are being reported by the dealers even though there is a possession prohibition for those 2 species. There are also wings reported for rosette, little, and smooth which are known to be too small for wings. The distribution of skate landings by state and species also shows that some species are landed in areas that they likely do not occur (Table 12). For example, in 2004, barndoor were landed in Virginia, which is beyond the southerly extent of their range. Even with all these caveats, these landings by species were used to raise the total landings by market to species.

The landings estimates were first disaggregated to skate species by the DPSWG (NEFSC 2009) by using 2 methods (length composition and selectivity ogive methods), each of which had both strengths and weaknesses. The selectivity ogive method could not be updated for this paper. The comparison will be made between the reported landings raised to total, the first method used in the previous assessment (NEFSC 2009), and 2 variations of the first method. For the wing fishery, another method using port samples (Curtis and Sosebee 2016) will also be compared.

The method used in the last assessment (NEFSC 2009) involved using the observer lengths of the kept component of the catch directly. In order to split the data into the bait (whole) and wing components of the fishery, a length cutoff of 60 cm was used, since there was no direct way of determining the disposition of the landings until recently. This seemed justified, since the maximum size in the bait fishery (23 in or 58 cm) was set to be close to the minimum accepted length (around 60 cm) for the wing fishery. Examination of the samples by the 2 main gear types (otter trawl and sink gill net) also showed 2 groups of fish with a trough at about 60 cm (Figure 4). The data were apportioned into 2 regions (region method), Gulf of Maine to Georges Bank (GM-GB – Divisions 51 and 52), and Southern New England to Mid-Atlantic (SNE-MA – Divisions 53 and Subarea 6). The number of fish measured in these regions was barely sufficient prior to about 2002 (Tables 13-16), so no further areal division was attempted for the last assessment. For this paper, the data were also split by the 4 areas (area method; GM, GB, SNE, and MA). For a final 3rd method, a combination of the 1st method (region) and the 2nd method (area) was used to get as much refinement as possible, but avoid pooling over too many years (final pooling method). For all 3 methods, an average skate length-weight equation was applied to the samples and used to estimate the landings numbers at length for each market category which were then summed to get total number at length (Figures 5 and 6 show the region and area methods, respectively). For most years, the numbers are dominated by a peak around 40-50 cm which represents the bait fishery and then a broader secondary peak which is the wing fishery.

Length compositions of each species for the 2 regions (GM-GB – Offshore strata 13-30, 36-40, and Inshore strata 56-66; SNE-MA – Offshore strata 1-12, 61-76, and Inshore strata 1-55

and 4 areas (GM – Offshore Strata 26-30,36-40, and Inshore Strata 56-66; GB – Offshore Strata 13-25; SNE Offshore Strata 1-12 and Inshore Strata 1-14, 45-55; MA Offshore Strata 61-76 and Inshore Strata 15-44) were estimated from the spring and fall NEFSC surveys (Figures 7 and 8). The species length-weight equations were then applied to determine weight-at-length by species (Wigley et al. 2003). The proportions at length by species for both number and weight were applied to the commercial landings-at-length to estimate landings-at-length by species. The lengths had to be grouped into 5 cm intervals starting at 16 cm (the first interval was 1-15 cm) through 90 cm to avoid zero cells in the survey. The last length group was 91-112, and all fish greater than 112 cm were set to be barndoor skate. Even with the grouping by length, there were some missing cells that required imputation, more so in the areal split than the regional split. These were filled by using a weighted average of the proportions in the length groups surrounding the missing value. All 3 methods assume that the proportion by species in the survey is the same as in the fishery with several different gear types. This may be the case if the selection of the gear is by length. If the behaviors of the species differ, then this assumption may not be valid.

The proportions of thorny skate in the landings as estimated by the 4 methods were fairly similar (Figure 9). The areal method generally estimates less thorny skate than the regional method. The reported landings were in the middle until the last few years and were the lowest proportion in the last couple of years. The proportion of thorny skate in the wing fishery was higher in the mid-2000s and has declined to low values (Table 17, Figure 10). The reported wing and the proportion from Curtis and Sosebee 2016 were lower than the estimated values. This discrepancy is likely because the survey method overestimates the proportion as there is no mechanism to reduce the proportion given fishers will likely discard the species that are prohibited. All methods indicate that thorny skate landings were around 1,000-2,000 mt in the mid-1990s and have declined below 250 mt in recent years (Figure 11).

Discards by Species Estimation

The discard estimates were first disaggregated to skate species by the DPSWG (NEFSC 2009), as were the landings, but used only 1 method, the length-based method, at that time. For this paper there will be a comparison between the discards as identified by the observer raised to total, the method used in the previous assessment, and the 2 variations described in the Landings by Species Estimation section. The discards were estimated by species, using the identification by the observer, the same way that the total discards were estimated. There are 2 additional species categories, unclassified and little/winter skate. The little/winter category was split by using the proportion of the observed little and winter skates, and then the unclassified were split by using the overall species proportions. In recent assessments (NEFSC 2007, 2009) it has been noted that there were species identification issues, with clearnose and rosette skates identified from the Gulf of Maine, which is too far north for these species. Thorny and smooth skate have also been identified in the Mid-Atlantic which may be possible in deep water (Figure 12). Even without species identification issues, the amount of thorny skate in the longline fishery will be biased high because the discard ratios from the GM-GB region were used to estimate those in SNE-MA. Since few thorny skate are in SNE-MA, using ratios from GM-GB for thorny skate will overestimate the SNE-MA discards.

The observer length frequencies of the discarded component of the catch were used by gear type, and the data were apportioned into the same regions and areas as the landings (Tables

18-24).For the longline and shrimp trawl discards, only 1 method was used because the sampling was poor for both gear types (Table 24). For all 3 methods, an average skate length-weight equation was applied to the samples and used to estimate the discard numbers at length by gear category which were then summed to get total number at length (Figures 13 and 14 show the region and area methods, respectively). The length frequencies from both methods show a single peak for most years. In the first 3 years there is a secondary peak at a smaller size. This is from the scallop dredge length frequency from 1994. There were sufficient lengths (354), but they may have been all small fish. The species compositions were derived from the length compositions in the same manner as the landings.

The proportion of thorny skate in the discards ranged from less than 0.005 to about 0.055 (Figure 15). The methods were generally in agreement at the end of the time series with thorny skate accounting for about 1% of the skate discards. This 1% of discards translates into about 400-600 mt of total discards (Table 17, Figure 16). To estimate dead discards, mortality rates were applied by species and gear. When experimental data were available, the rates from these experiments were used. If there were no data, a mortality rate of 50% was assumed as a very rough guess. For otter trawl discards, rates of 9%, 22%, 23%, and 60% were applied to winter, little, thorny, and smooth skate respectively (Mandelman et al. 2013). For scallop dredge discards, rates of 34% and 48% were applied to winter and little skate respectively (Rudders et al. 2015). When these rates are applied, the amount of dead discards of thorny skate in recent years is estimated between 100 and 200 mt (Figure 17).

Hindcast Species Estimation for Both Landings and Discards

Landings and discards by species were hindcast from 1993 back to 1968 by using the proportion of species in the spring and fall surveys by weight. The majority of the skate landings were winter and little skate (Table 25). Clearnose skate landings increased in importance as the amount of landings coming from the Mid-Atlantic increased. Barndoor skate landings also increased as their abundance increased, while landings of thorny skate decreased. The same trends were observed about the total discards except clearnose skate were a larger proportion of the discards through the time series (Table 26). Because the discard mortality rate for winter skate was so low (0.09), the amount of winter skate from the dead discards was lower and little and thorny skate were also slightly lower (Table 27, Figure 18). Total catch (landings plus dead discards) of skates ranged from a low of 15,693 mt in 1976 to a high of 44,307 mt in 1990. After the peak in total catch, the discards declined to a relatively stable value of 30,000 mt (Table 28). Thorny skate were an important part of the catch in the early part of the time series but were later replaced by barndoor skate.

Thorny Skate Catch

Total catch of thorny skate declined from over 5,000 mt in the late 1960s and early 1970s to about 200-300 mt in recent years (Table 29, Figure 19). Most of the early catch was from otter trawl discards while landings from all gear types dominated the 1990s. Discards from scallop dredges increased in importance during the late 1970s and again during the late 1990s.

RESEARCH SURVEY DATA-MOBILE GEAR SURVEYS

NEFSC Indices

Indices of relative abundance were developed from NEFSC research bottom trawl surveys (BTS) for thorny skate (strata set = offshore strata 1-30, 34-40) (Figures 7 and 8). The BTS was conducted in the fall from the Gulf of Maine to Southern New England from 1963 through the present (Azarovitz 1981; Johnston and Sosebee 2014) and the Mid-Atlantic from 1967 through the present. A spring survey was started in 1968. There are no statistically significant NEFSC gear, door, and vessel (RV *Delaware II* to RV *Alabatross IV*) conversion factors for thorny skate (Sissenwine and Bowman 1978; Byrne and Forrester 1991a, 1991b). The calibration factors estimated in Miller et al. (2010) for thorny skate were applied for both surveys from 2009-2015 (3.626 for weight and 3.792 for numbers) by dividing the numbers and weights from those surveys by the factors.

NEFSC BTS indicate that thorny skate are most abundant in the GM and GB offshore strata regions, with very few fish caught in inshore (< 27 meters depth), SNE, or MA regions (NEFSC 2007; Figures 20 and 21). The surveys agree fairly well with the observed catches. In the NEFSC spring surveys (1968-2015), the annual total catch of thorny skate has ranged from 29 fish in 2006 to 571 fish in 1973 (Table 30). In the NEFSC fall surveys (1963-2015), the annual total catch of thorny skate has ranged from 26 fish in 2008 to 852 fish in 1978 (Table 31). Calculated on a per tow basis, these spring and fall survey catches equate to maximum stratified mean number per tow indices for the GM-SNE offshore strata of about 2 to 3 fish, or about 6.0 kg, per tow during the early 1970s (Tables 30-31).

NEFSC spring and fall BTS indices for thorny skate have declined continuously over the last 50 years (Figures 22-24). Indices of thorny skate abundance and biomass from the BTS 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 fall survey. Kulka and Mowbray (1998) indicated a similar period of high abundance for thorny skate in Canadian waters. BTS indices of thorny skate abundance have declined steadily since the late 1970s, reaching historically low values in 2012 and 2013 that are less than 5% of the peak observed in the 1970s (Figures 22-24).

Minimum swept area was calculated by multiplying the mean wt or number per tow by the total area of the survey and dividing by the area swept by a tow (0.0112 nm^2; NEFSC 2006). These indicate that there were about 20,000-30,000 mt (equating to 10-16 million fish) of thorny skate biomass in the 1960s and 1970s if 100% efficiency of the survey gear is assumed (Table 32). Most of the biomass and abundance was found in the Gulf of Maine with lesser amounts on Georges Bank and the Scotian Shelf (Figures 25 and 26). Edwards (1968) estimated an efficiency of 0.1 for thorny skate in the NEFSC survey. This would mean that the 2015 estimates of 843 mt and 628,000 fish in the fall survey could be as high as 8,430 mt and 6 million fish.

The minimum length of thorny skate caught in BTS was about 10 cm, and the largest individual caught was 112 cm total length, during the 1966 fall survey (Tables 30-31). The median length of the survey catch ranged from 23 cm in the 2003 fall survey to 63 cm in the 1971 fall survey. The median length of the survey catch trended downward through most of the survey time series but was stable in recent years in fall surveys at around 40-50 cm (Figures 27 and 28). Length frequency distributions from the BTS show a pattern of decline in abundance of larger individuals consistent with an increase in total mortality over the survey time series (Figures 29-34).

NEFSC BTS Indices of Spatial Distribution

There are several indicators of possible contractions in distribution. The first is the proportion of positive tows in the survey (Tables 30-31 and Figure 35). In the spring and fall surveys, the proportion of positive tows generally declined through 2008. The increase seen in 2009 is driven by the change in survey vessel and gear, which not only caught more thorny skate per tow, but also had a higher proportion of positive tows (Miller et al. 2010).

Another distributional index is the Gini index, derived from a Lorenz curve, which simultaneously takes into account biomass and area (Wigley 1996). For this index, the cumulative percent biomass or abundance by stratum is plotted on the y-axis, and the cumulative percent area by stratum is plotted on the x-axis for each year (Figure 36). If the fish are spread out, this line would fall on the unity line. The more concentrated the fish are, the greater the difference between the unity line and the plotted line. The Gini index is twice the area between the 2 lines. A high index indicates that the fish are more concentrated. Thorny skate were less concentrated in the early part of the time series and have become more concentrated over time (Figure 37).

The last distributional index, design-weighted area of occupancy (DWAO), takes into account the area swept by the tows and the proportion of positive tows (Swain et al. 2012). The calculation is the proportion of positive tows within a stratum multiplied by the area of that stratum and summed over the stock area. The DWAO in both the spring and the fall surveys was around 20,000 nm^2 at the beginning of the time series, declined to about 5,000 nm^2 by 2008 and increased again to around 8,000-10,000 nm^2 in 2015 (Figure 38). This index is also influenced by the change in survey vessel and gear. The changes in distribution can be seen in Figures 39 and 40 with the broadest distribution found in the early time period (1968-1970) and the sparsest in 2007-2009. The last time period shows a broadening of the distribution into deeper water but also a concentration in the western Gulf of Maine.

Shrimp Survey

Indices of abundance for thorny skate were available from the Atlantic States Marine Fisheries Commission shrimp surveys in the offshore waters of the Gulf of Maine from 1985-2015. This survey occurred during the summer in the deeper parts of the Gulf of Maine (Figure 41). Throughout the time series only 6 strata were sampled consistently (1, 3, and 5-8, Johnston and Sosebee 2014). Shrimp survey indices of thorny skate biomass were variable over the time series but decreased in both abundance and biomass (Table 33, Figure 42).

The minimum length of thorny skate caught in the shrimp survey was about 8 cm, and the largest individual caught was 106 cm total length, most recently during the 2014 shrimp survey (Table 33). The median length of the survey catch ranged from 34 cm in the 2009 survey to 67 cm in the 2005 survey. The median length of the survey catch increased through the early 2000s, declined through 2009 and has since been mostly stable (Figure 43). Length frequency distributions from the shrimp survey are highly variable (Figures 44-45).

Massachusetts Inshore Survey

Indices of abundance for thorny skate were available from the Massachusetts Division of Marine Fisheries (MADMF) spring and fall research trawl surveys in the inshore waters of Massachusetts for the years 1978-2015 (Figure 46; Howe 1989; Sosebee and Cadrin 2006). All strata were used to derive the indices. MADMF indices of thorny skate biomass have been variable over the time series, but there is a decreasing trend evident in both the spring and fall

time series (Figure 47, Tables 34 and 35). The spring index had stabilized around the median of 0.07 kg/tow throughout the 2000s, but has since declined, and none were caught in 2013 (Figure 48, Table 34). The fall index has generally been below the median of 0.14 kg/tow since 1994 (Figure 49, Table 35).

The minimum length of thorny skate caught in MADMF surveys was about 12 cm, and the largest individual caught was 96 cm total length, most recently during the 1991 fall survey (Tables 34-35, Figures 50-51). The median length of the survey catch has ranged from 22 cm in the 1992 spring survey to 91 cm in the 2006 spring survey. The median length of the survey catch has been variable (Figures 50 and 51). Length frequency distributions from the MADMF spring and fall surveys show mostly small fish over the survey time series (Figures 52-55).

Maine-New Hampshire Survey

The Maine-New Hampshire (MENH) Inshore Trawl Survey began in 2000 to fill a significant information gap in resource assessment surveys on approximately two-thirds of the inshore portion of the Gulf of Maine. Now in its 16th year, the MENH Inshore Trawl Survey is the longest sustained and comprehensive fisheries-independent survey of the Gulf of Maine inshore waters north of Massachusetts. The survey is conducted in collaboration with New Hampshire Fish and Game and its industry partner, Robert Michael, Inc.

The survey operates on a random stratified sampling scheme and follows published standard protocols. In total, 20 strata are distributed over 4 depth strata: 5-20 fathoms, 21-35 fathoms, 36-55 fathoms, and >55 fathoms roughly bounded by the 12-mi limit, and 5 longitudinal regions (Figure 56). Twenty minute standard bottom trawls are performed with a sample net specifically designed to sample the bottom populations while not targeting any specific species. The current survey objective is to complete 120 random sampling stations along the coastal waters of Maine and New Hampshire in the spring and fall.

Thorny skate is one of the species that is regularly caught at low abundance levels in the survey. In the spring, thorny skate are seen in 10-25% of the tows, and that range is fairly constant over the time series (Figure 57). The fall percent occurrence is more variable and shows a drop in positive tows since 2010 with a slight recovery in 2014.

The relative abundance indices for thorny skate were estimated for all strata (Figures 58 and 59). Abundance is low and variable over the time series. Thorny skate are consistently sampled in low numbers. For the spring, the range in number of individuals seen in any one survey is from 9 to 47, with a series average of 31 individuals per survey. Fall abundance levels are also low, with fall 2011 being the lowest of the time series. For the fall, the number of individuals caught ranged from 6 to 50, with a seasonal average of 24 individuals. Seasonal mean length for thorny skate caught in the spring survey ranged from 27 to 57 cm over the time series (Figure 60). Length distribution is similar in the fall surveys, with the seasonal mean lengths ranging from 32 to 60 cm (Figure 61). Thorny skate are distributed at higher concentrations at the southwestern and northeastern limits of the survey area (Figures 62-65).

RESEARCH SURVEY DATA-NEFSC BOTTOM LONGLINE SURVEY

Survey Design

The GM NEFSC Northeast Cooperative Research Program bottom longline survey (LLS) was designed to sample complex, rocky habitat not easily accessible to the BTS. The LLS stratified random design is based on the NEFSC BTS stratification of depth and area and further stratified by "rough" and "smooth" bottom type using a rugosity index (Hare et al. 2012). Stations were allocated based on stratum area and bottom type, with 2 stations assigned to "smooth" bottom and the remainder to "rough" bottom in each stratum. Two industry longline vessels conduct the survey, deploying a line of 1000 hooks over approximately 1 nm and baited with squid, at each of 45 stations for 2 hours across slack tide. The survey has been conducted in the spring and fall in NEFSC offshore BTS strata 26, 27, 28, 29, 36, and 37 during 2014-2015.

The central GM strata (28, 29, 36) area was too large to complete given the LLS budget, so parts of the strata were truncated and thus not part of the sample area. Since US commercial vessels conduct the survey, those parts of the strata in Canadian waters could not be sampled (Figure 66).

Distribution and Indices

The distribution of thorny skate by number (Figures 67-68) and by weight (Figures 69-70) sampled on the LLS are compared to those sampled on the BTS. The distribution of catch is similar between the 2 surveys with the LLS having higher catches in "rough" bottom stations than in the "smooth" stations. (There was 1 station in stratum 28 where the length frequency was not collected, although the weight was obtained).

The LLS caught between 260-308 individuals during the 4 surveys, the majority at the "rough" stations, and almost all of these were measured for length (Figure 71). The catchability of the gears differ, with the BTS capturing smaller skates than the LLS, but both gears capturing similar maximum lengths, although the LLS appears to catch higher numbers of the larger skates (e.g. fall 2015).

While there are only 4 data points, the LLS stratified mean numbers per set for thorny skate for all stations and for "rough" stations only (Figure 72) are relatively stable over the 2 years, showing a slight increase in spring of 2015. The stratified mean weight per set, however, shows an increase in 2015 compared to 2014 (Figure 72) which can be explained, in part, by the increased proportion of larger skates captured in spring and fall 2015 compared to fall 2014 (Figure 71).

The catchability of thorny skate by the LLS is compared to that of the BTS by using the ratio of LLS/BTS mean catch as a relative catchability index. The LLS mean was estimated by adding the "rough" and "smooth" mean estimates, weighted by bottom type area (O'Brien et al. in prep)).The BTS thorny skate stratified mean number and weight per tow was estimated with only those BTS stations that occurred in the truncated LLS strata areas. This specification was accomplished by identifying BTS stations within the LLS survey stratum polygons by using ArcGIS algorithms (Figure 66). Thus, the stratified means for number and weight were estimated with the exact same stratum area and total area for both the LLS and BTS estimates.

The ratio of LLS/BTS of stratified mean number and weight (Table 36) indicates that the LLS had higher catchability (LLS/BTS > 1) of thorny skate than that of the BTS. The LLS/BTS is greater than 1.3 for all seasons with the exception of mean weight in spring 2015.

Some caveats apply when comparing the LLS and BTS results. Besides the catchability of the gears being different, the LLS was designed to be stratified by bottom type, whereas the BTS was not. There are only 2 “smooth” stations in each LLS stratum and the majority of BTS stations occur on “smooth” bottom. The number of LLS stations per area is over-allocated relative to the BTS; however, this will only affect the variance of the mean, not the mean itself.

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Table 1. Source of landings of skates (all species) for United States from 1964-1988. "gen can" = general canvas.

	CT	DE	ME	MD	MA	NH	NJ	NY	RI	VA
1962	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1963	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1964	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1965	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1966	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1967	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1968	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1969	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1970	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1971	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1972	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1973	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1974	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1975	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1976	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1977	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1978	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1979	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1980	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1981	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1982	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can	gen can
1983	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	gen can	gen can	gen can	gen can
1984	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	gen can	gen can	gen can	gen can
1985	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	gen can	gen can	gen can	gen can
1986	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	**weighout**	**weighout**	gen can	gen can
1987	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	**weighout**	**weighout**	gen can	gen can
1988	gen can	gen can	**weighout**	gen can	**weighout**	**weighout**	**weighout**	**weighout**	gen can	gen can

Table 2. United States landings (mt, live weight) of skates (all species) by statistical area. US landings are from Northwest Atlantic Fisheries Organization (NAFO) database from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014. Statistical areas identified in Figure 1.

Year	Unknown (State waters)	3[1]	4[2]	464	465	51	511	512	513	514	515	521	522	525	526	53	537	538
1964	4,034	0	0	0	0	0	5	0	4	18	1	7	1	0	0	0	0	0
1965	2,275	0	0	0	0	0	2	0	2	16	1	7	10	0	0	0	0	0
1966	2,694	0	0	0	0	0	1	0	5	13	0	8	4	0	0	0	0	0
1967	2,629	0	0	0	0	0	2	0	8	50	0	8	3	0	0	0	0	0
1968	2,369	0	0	0	0	0	5	1	8	19	0	0	1	0	0	0	0	0
1969	2,980	0	0	0	0	0	3	0	14	32	2	1	2	0	0	0	0	0
1970	1,502	0	0	0	0	0	2	0	10	50	1	3	4	0	0	0	0	0
1971	816	0	0	0	0	0	4	1	31	33	0	8	1	0	1	0	0	1
1972	776	0	0	0	0	0	0	1	25	48	0	9	1	0	0	0	0	0
1973	1,092	0	0	0	0	0	0	0	25	53	0	4	1	0	0	0	1	0
1974	1,930	0	0	0	0	0	0	0	27	48	0	1	0	0	0	0	1	0
1975	605	0	0	0	0	0	0	2	38	52	2	13	1	0	0	0	1	0
1976	614	0	0	0	0	0	4	3	51	40	1	12	1	0	0	0	0	2
1977	966	0	0	0	0	0	5	3	71	50	2	15	2	0	0	0	1	1
1978	770	0	0	0	0	0	7	12	97	70	3	53	5	0	18	0	32	7
1979	0	0	0	0	0	0	53	84	349	267	41	192	37	0	5	0	35	18
1980	0	0	0	0	0	0	24	86	376	281	31	314	12	31	37	0	30	7
1981	0	0	0	0	1	0	10	58	257	133	35	148	13	3	8	0	27	2
1982	0	0	0	0	3	0	48	94	159	188	53	189	1	2	9	0	19	0
1983	0	0	0	1	3	0	5	91	140	206	42	219	6	1	12	0	2,728	3
1984	0	0	0	0	9	0	2	59	144	209	28	215	2	1	5	0	3,304	6
1985	0	0	0	0	0	0	0	3	135	202	31	180	0	0	1	0	3,231	27
1986	0	0	0	0	0	0	1	6	108	225	9	103	0	0	8	0	3,246	9
1987	0	1	0	0	0	0	3	13	181	365	25	237	7	1	21	0	3,761	37
1988	5	0	0	0	0	0	1	1	143	979	4	358	20	5	16	0	5,213	18
1989	0	6	0	0	0	0	0	2	88	809	6	807	169	32	141	0	4,228	20
1990	0	1	0	0	0	0	1	2	56	1,009	6	2,548	916	305	637	3	4,817	26
1991	0	0	0	0	0	0	0	5	46	922	6	1,700	1,166	479	622	0	4,954	19
1992	0	0	0	0	0	0	0	2	72	556	13	927	1,261	366	438	0	5,415	305
1993	0	0	0	0	0	0	2	12	106	778	85	1,460	1,118	384	593	0	499	109
1994	110	0	1	3	0	0	16	103	204	321	141	2,426	1,293	127	868	2	602	289
1995	41	0	0	5	4	0	11	60	119	240	150	1,038	618	128	112	33	1,997	477
1996	24	0	0	2	11	0	14	43	96	274	140	2,885	2,650	334	1,157	15	2,915	68
1997	173	0	0	2	8	0	2	35	75	300	119	1,185	953	489	106	10	3,882	594
1998	102	0	0	4	6	0	3	26	49	868	107	1,856	1,594	750	420	12	3,778	623
1999	67	0	0	5	2	0	4	36	64	680	112	1,528	1,103	435	452	3	3,473	252
2000	79	0	0	3	3	0	4	16	75	898	50	2,128	1,310	1,004	358	109	2,646	519
2001	64	0	0	1	1	0	2	21	69	542	57	2,744	930	1,009	496	160	2,830	138
2002	266	0	0	3	2	0	5	17	72	653	48	2,630	1,156	405	234	20	2,618	64
2003	117	0	0	4	1	0	1	6	36	433	52	3,564	1,100	518	259	78	2,957	244
2004	520	0	0	0	0	0	0	0	28	173	51	4,016	1,429	1,364	255	5	2,196	262
2005	720	0	0	43	0	0	0	3	23	166	60	2,562	1,118	2,015	460	29	2,723	197
2006	723	0	0	2	1	0	0	4	9	248	68	3,737	1,307	1,778	957	7	2,832	847
2007	600	0	0	7	0	0	0	4	7	359	38	5,353	2,589	1,718	942	0	2,870	773
2008	1,286	0	0	19	0	0	1	1	14	309	39	4,347	1,621	890	919	6	3,327	573

Table 2, continued. United States landings (mt, live wt) of skates (all species) by statistical area. US landings are from Northwest Atlantic Fisheries Organization (NAFO) database from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014. Statistical areas identified in Figure 1.

Year	Unknown (State waters)	3[1]	4[2]	464	465	51	511	512	513	514	515	521	522	525	526	53	537	538
2009	**1,313**	**0**	**20**	**6**	**0**	**0**	**2**	**40**	**18**	**424**	**60**	**3,021**	**2,392**	**1,288**	**212**	**10**	**3,673**	**619**
2010	**1,311**	**0**	**0**	**18**	**0**	**0**	**0**	**1**	**37**	**893**	**86**	**2,856**	**865**	**912**	**693**	**5**	**3,554**	**158**
2011	**1,947**	**0**	**0**	**8**	**1**	**0**	**0**	**8**	**22**	**500**	**42**	**3,071**	**483**	**331**	**56**	**2**	**2,796**	**537**
2012	**1,044**	**0**	**0**	**4**	**0**	**0**	**2**	**1**	**13**	**213**	**24**	**2,629**	**760**	**273**	**62**	**0**	**3,600**	**248**
2013	**820**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**3**	**181**	**12**	**2,349**	**365**	**138**	**140**	**0**	**2,872**	**427**
2014	**451**	**4**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**52**	**7**	**3,383**	**304**	**89**	**92**	**5**	**3,203**	**360**

[1]Includes Subarea 3 (Grand Banks)
[2]Includes Subarea 4 (Scotian Shelf excluding 464, 465)

Table 2, continued. United States landings (mt, live wt) of skates (all species) by statistical area. US landings are from Northwest Atlantic Fisheries Organization (NAFO) database from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014. Statistical areas identified in Figure 1.

Year	539	561	562	5[3]	611	612	613	614	615	616	621	622	625	626	63	6[4]	Total Stock	Total
1964	3	0	0	0	2	3	2	0	0	0	0	0	0	0	0	0	4,081	4,081
1965	4	1	0	0	17	1	5	0	0	0	0	0	0	0	0	0	2,343	2,343
1966	1	1	0	0	3	2	6	0	0	0	0	0	0	0	0	0	2,738	2,738
1967	2	1	0	0	7	1	2	0	0	0	0	0	0	0	0	0	2,715	2,715
1968	2	1	0	0	1	2	2	0	0	0	0	0	0	0	0	0	2,411	2,411
1969	1	1	0	0	5	2	2	0	0	0	0	0	0	0	0	0	3,045	3,045
1970	1	0	1	0	4	2	4	0	0	0	0	0	0	0	0	0	1,583	1,583
1971	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	900	900
1972	3	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	866	866
1973	2	0	0	0	1	9	3	0	0	0	0	0	0	0	0	0	1,191	1,191
1974	2	0	0	0	2	11	4	0	0	0	0	0	0	0	0	0	2,026	2,026
1975	3	1	0	0	6	10	17	0	0	0	0	0	0	0	0	0	752	752
1976	2	0	0	0	4	8	11	0	0	0	0	0	0	0	0	0	754	754
1977	1	0	0	0	6	5	11	0	0	0	0	0	2	0	0	0	1,143	1,143
1978	2	0	0	0	8	10	30	0	0	5	0	0	0	0	0	0	1,130	1,130
1979	69	4	4	0	41	14	56	0	1	5	0	0	3	0	2	0	1,280	1,280
1980	171	11	6	0	34	20	89	0	0	14	0	0	0	1	1	0	1,577	1,577
1981	49	1	2	0	19	7	64	0	0	2	0	0	0	0	0	0	838	838
1982	37	2	6	0	26	4	33	0	0	3	0	0	0	0	0	0	878	878
1983	70	0	2	0	39	8	27	0	0	0	0	0	0	0	0	0	3,603	3,603
1984	69	0	5	0	51	14	32	0	0	1	0	0	0	0	0	0	4,156	4,156
1985	103	0	0	0	19	12	36	0	0	3	0	0	0	0	0	0	3,984	3,984
1986	326	0	0	0	55	16	47	0	0	1	0	0	0	0	0	0	4,159	4,159
1987	167	32	35	0	85	17	90	0	0	0	0	0	0	0	0	0	5,078	5,078
1988	211	1	7	0	98	20	155	0	0	1	0	0	1	0	0	0	7,255	7,255
1989	146	20	74	0	94	28	28	0	0	15	0	0	1	0	0	0	6,710	6,716
1990	403	52	447	0	100	14	49	0	0	7	2	0	1	0	0	0	11,403	11,404
1991	333	189	645	0	100	37	23	19	4	8	56	0	0	0	1	0	11,332	11,332
1992	709	732	1,220	0	103	43	84	36	1	47	177	15	1	0	0	0	12,525	12,525
1993	5,217	455	1,134	0	411	43	120	66	8	38	258	7	1	0	1	1	12,904	12,904
1994	942	315	861	0	331	39	143	115	25	96	79	3	5	4	2	1	9,462	9,464
1995	1,923	64	88	0	311	91	164	79	61	38	98	10	2	12	0	4	7,978	7,978
1996	2,380	393	778	0	651	98	224	99	114	35	117	2	5	8	6	4	15,543	15,543
1997	2,137	87	247	0	941	279	418	166	157	80	150	8	0	18	11	0	12,630	12,630
1998	2,497	293	347	0	1,102	361	774	206	231	28	143	15	5	36	9	1	16,250	16,250
1999	2,163	278	306	0	2,452	242	888	124	171	13	99	77	49	26	21	22	15,150	15,150
2000	2,388	358	383	0	1,843	226	813	97	250	14	163	4	116	22	133	0	16,012	16,012
2001	2,462	385	306	0	1,896	305	907	79	238	12	122	46	31	32	2	0	15,888	15,888
2002	2,393	151	339	0	1,876	334	991	110	191	15	124	14	2	7	0	0	14,740	14,740
2003	2,892	435	903	0	1,508	183	623	54	101	9	99	17	13	14	1	0	16,224	16,224
2004	2,940	350	950	0	1,845	153	160	37	92	31	164	2	25	15	1	0	17,063	17,063
2005	2,734	80	313	0	1,046	112	125	37	152	64	44	26	6	25	1	0	14,885	14,885
2006	2,925	115	99	0	606	184	323	91	66	42	170	6	4	14	0	0	17,168	17,168
2007	2,481	538	298	0	801	193	289	64	246	25	65	2	10	44	3	0	20,320	20,320
2008	3,194	1,228	280	0	891	434	261	133	233	21	70	3	25	25	9	1	20,159	20,159

Table 2, continued. United States landings (mt, live wt) of skates (all species) by statistical area. US landings are from Northwest Atlantic Fisheries Organization (NAFO) database from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014. Statistical areas identified in Figure 1.

Year	539	561	562	5[3]	611	612	613	614	615	616	621	622	625	626	63	6[4]	Total Stock	Total
2009	2,898	587	210	0	1,092	504	446	108	434	25	124	14	91	94	14	11	19,730	19,750
2010	3,430	150	34	0	1,150	563	667	372	494	44	123	4	26	224	14	5	18,688	18,688
2011	2,776	175	74	0	1,307	716	871	311	463	111	131	9	70	127	17	3	16,965	16,965
2012	4,245	367	71	0	796	722	1,050	249	456	40	109	12	39	101	12	1	17,144	17,144
2013	3,841	145	41	0	886	574	893	330	369	40	99	8	53	105	5	1	14,698	14,698
2014	4,117	84	18	0	1,137	698	1,175	230	292	52	85	9	5	42	10	0	15,904	15,909

[3]Includes statistical areas 500, 531, 533, 534, 536, 541, 542, 543
[4]Includes statistical areas 600, 610, 627, 628, 629

Table 3. Total commercial landings of skate (mt, live weight) in Northwest Atlantic Fisheries Organization (NAFO) subareas 5 and 6 by country from 1960-2014. US landings are from NAFO database from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014. USSR and Others landings are from NAFO website (www.nafo.int).

Year	US	USSR	Others	Total
1964	4,081	0	2	4,083
1965	2,343	0	20	2,363
1966	2,738	0	106	2,844
1967	2,715	2,121	62	4,898
1968	2,417	3,974	92	6,483
1969	3,045	6,410	7	9,462
1970	1,583	2,544	1	4,128
1971	900	5,000	5	5,905
1972	866	7,957	0	8,823
1973	1,191	6,754	18	7,963
1974	2,026	1,623	2	3,651
1975	752	3,216	0	3,968
1976	754	412	46	1,212
1977	1,143	240	35	1,418
1978	1,130	216	7	1,353
1979	1,280	79	1	1,360
1980	1,577	0	4	1,581
1981	838	0	9	847
1982	878	0	0	878
1983	3,603	0	0	3,603
1984	4,156	0	0	4,156
1985	3,984	0	0	3,984
1986	4,159	0	94	4,253
1987	5,078	0	0	5,078
1988	7,255	0	9	7,264
1989	6,710	0	0	6,710
1990	11,403	0	0	11,403
1991	11,332	0	0	11,332
1992	12,525	0	0	12,525
1993	12,904	0	0	12,904
1994	9,463	0	0	9,463
1995	7,978	0	0	7,978
1996	15,539	0	0	15,539
1997	12,630	0	0	12,630
1998	16,250	0	0	16,250
1999	15,148	0	0	15,148
2000	16,012	0	0	16,012
2001	15,888	0	0	15,888
2002	14,740	0	0	14,740
2003	16,254	0	0	16,254
2004	17,063	0	0	17,063
2005	14,885	0	0	14,885
2006	17,168	0	0	17,168
2007	20,342	0	0	20,342
2008	20,191	0	0	20,191
2009	19,731	0	0	19,731
2010	18,683	0	0	18,683
2011	16,963	0	0	16,963
2012	17,144	0	0	17,144
2013	14,698	0	0	14,698
2014	15,904	0	0	15,904

Table 4. US commerical landings (mt, live wt) of skates (all species) by month from 1964-2014. Landings are from Northwest Atlantic Fisheries Organization (NAFO) database and general canvas from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014.

Year	Unk.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1964	4,081	0	0	0	0	0	0	0	0	0	0	0	0	4,081
1965	2,343	0	0	0	0	0	0	0	0	0	0	0	0	2,343
1966	2,738	0	0	0	0	0	0	0	0	0	0	0	0	2,738
1967	2,715	0	0	0	0	0	0	0	0	0	0	0	0	2,715
1968	2,417	0	0	0	0	0	0	0	0	0	0	0	0	2,417
1969	3,045	0	0	0	0	0	0	0	0	0	0	0	0	3,045
1970	1,583	0	0	0	0	0	0	0	0	0	0	0	0	1,583
1971	900	0	0	0	0	0	0	0	0	0	0	0	0	900
1972	866	0	0	0	0	0	0	0	0	0	0	0	0	866
1973	1,191	0	0	0	0	0	0	0	0	0	0	0	0	1,191
1974	2,026	0	0	0	0	0	0	0	0	0	0	0	0	2,026
1975	752	0	0	0	0	0	0	0	0	0	0	0	0	752
1976	754	0	0	0	0	0	0	0	0	0	0	0	0	754
1977	1,143	0	0	0	0	0	0	0	0	0	0	0	0	1,143
1978	1,130	0	0	0	0	0	0	0	0	0	0	0	0	1,130
1979	1,280	0	0	0	0	0	0	0	0	0	0	0	0	1,280
1980	1,577	0	0	0	0	0	0	0	0	0	0	0	0	1,577
1981	838	0	0	0	0	0	0	0	0	0	0	0	0	838
1982	878	0	0	0	0	0	0	0	0	0	0	0	0	878
1983	2,886	76	83	119	86	92	67	29	37	28	33	39	28	3,603
1984	3,478	77	113	112	99	74	26	22	23	25	35	40	33	4,156
1985	3,428	61	59	124	135	25	27	16	19	22	20	29	21	3,984
1986	3,621	61	53	99	107	55	11	13	22	9	23	37	46	4,159
1987	4,001	67	79	170	164	216	89	34	45	32	36	64	81	5,078
1988	5,563	202	292	326	232	122	59	150	109	53	26	26	96	7,255
1989	4,166	240	150	227	454	293	103	142	267	222	175	173	98	6,710
1990	4,255	137	182	425	834	947	1,175	764	819	624	266	542	433	11,403
1991	4,256	464	424	461	606	420	370	658	926	515	565	959	708	11,332
1992	4,782	517	458	510	567	564	816	764	718	862	639	771	555	12,525
1993	4,860	335	266	471	742	875	823	1,006	859	712	536	864	555	12,904
1994	176	338	310	292	522	886	1,310	919	1,408	1,082	1,020	831	370	9,463
1995	1	220	341	474	606	785	967	864	869	688	807	900	457	7,978
1996	2	225	234	236	380	1,029	1,415	1,762	1,921	2,002	2,638	2,561	1,134	15,539
1997	0	550	500	643	414	1,004	1,248	1,511	1,482	1,319	1,393	1,444	1,122	12,630
1998	0	578	623	718	858	1,506	1,964	2,131	2,032	1,894	1,508	1,407	1,030	16,250
1999	0	550	447	643	799	1,380	1,816	1,700	1,830	1,962	1,393	1,552	1,076	15,148
2000	0	733	660	1,053	898	1,297	1,892	1,622	2,050	1,684	1,299	1,835	990	16,012
2001	0	880	632	1,052	1,046	1,131	1,364	1,634	1,985	1,597	1,377	1,933	1,257	15,888
2002	0	786	760	832	1,154	824	1,584	1,116	1,958	1,600	1,590	1,307	1,229	14,740

Table 4, continued. US commerical landings (mt, live wt) of skates (all species) by month from 1964-2014. Landings are from Northwest Atlantic Fisheries Organization (NAFO) database and general canvas from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014.

Year	Unk.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
2003	0	558	449	878	1,067	1,032	1,258	1,788	2,135	2,057	2,170	1,833	1,028	16,254
2004	0	544	1,289	1,335	1,466	1,267	1,597	2,147	1,676	1,680	1,184	1,698	1,180	17,063
2005	0	888	1,208	1,094	1,207	1,133	1,390	1,929	1,922	1,424	871	1,000	820	14,885
2006	0	952	1,065	1,519	1,628	960	1,444	1,923	2,009	1,162	1,570	1,736	1,199	17,168
2007	0	856	722	1,246	1,534	1,343	2,658	3,173	2,690	1,690	1,659	1,483	1,288	20,342
2008	0	922	1,361	1,195	1,548	1,373	2,235	2,586	2,547	2,079	1,515	1,459	1,370	20,191
2009	0	997	930	1,093	1,599	1,582	2,173	2,049	1,876	1,925	1,920	1,978	1,608	19,731
2010	0	1,264	948	1,284	1,978	2,694	3,238	1,789	1,983	913	933	980	680	18,683
2011	0	505	373	461	724	2,408	2,331	1,845	1,648	1,922	1,734	1,521	1,491	16,963
2012	0	1,002	1,033	943	1,441	2,591	2,223	1,677	1,599	1,297	1,374	1,052	911	17,144
2013	0	628	583	725	926	1,505	1,691	2,014	1,661	1,382	1,342	1,146	1,094	14,698
2014	0	763	597	622	838	1,875	1,753	1,634	1,567	1,971	1,746	1,291	1,247	15,904

Table 5. US commercial landings (mt, live wt) of skates (all species) by state from 1964-2014. Landings are from Northwest Atlantic Fisheries Organization (NAFO) database and general canvas from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014.

Year	CT	DE	ME	MD	MA	NH	NJ	NY	NC	RI	VA	Unknown	Total
1964	3.2			2.7	28.2		0.2	6.5		6.3		4,033.9	4,081.0
1965	16.6				38.1		0.2	6.1		6.7		2,275.3	2,343.0
1966	3.4				30.1			9.3		1.5		2,693.8	2,738.0
1967	8.0				71.0			4.8		2.3		2,628.7	2,714.8
1968	5.5				35.8		0.3	4.6		1.8		2,369.0	2,417.0
1969	8.0				51.6		0.5	3.8		0.9		2,980.3	3,045.0
1970	4.6				69.0			5.9		1.7		1,501.8	1,583.0
1971	4.6				61.9			15.0		2.9		815.6	900.0
1972	0.2				85.1			1.0		3.6		776.1	866.0
1973			1.5		80.9			10.9		5.8		1,091.9	1,191.0
1974			8.8		67.2		1.1	14.7		4.6		1,929.6	2,026.0
1975			15.0		94.8			32.4		5.0		604.8	752.0
1976	1.2		36.2		75.0	3.0	0.1	22.1		2.0		614.4	754.0
1977	3.6		62.6		81.9	2.6	0.3	19.8		4.3	2.4	965.6	1,143.0
1978	3.1		87.0		162.8	4.8	2.9	47.8		50.9	0.4	770.3	1,130.0
1979	29.3		411.5		595.1	16.6	1.5	102.9		116.8	5.9		1,279.6
1980	0.6		446.9		683.1	17.9	0.8	151.6		273.9	2.4		1,577.2
1981	2.0		340.2		324.0	2.1	1.9	84.4		83.9			838.3
1982	3.0		315.2		423.1	3.9	0.2	61.9		70.5			877.8
1983	23.0		258.8		455.0	3.3	0.9	40.6		2,821.5			3,602.9
1984	21.9		230.8		445.3	2.6	0.7	49.9		3,404.7	0.5		4,156.5
1985	2.4		144.5		409.2	2.3	2.4	50.2		3,373.0			3,984.0
1986	8.2		107.6		363.8	1.1	10.8	55.0		3,612.5	0.5		4,159.5
1987	23.4		168.4		746.2	20.6	8.9	133.1		3,977.0	0.3		5,077.9
1988	55.7		81.9		1,376.2	51.9	10.5	172.2		5,501.3	0.6	5.2	7,255.5
1989	12.2		94.1		2,032.3	18.6	18.2	114.1		4,420.0	0.7		6,710.1
1990	146.9		45.7	1.7	5,741.9	10.5	8.7	164.2		5,282.1	1.1		11,402.9
1991	113.3		16.9		5,696.0	12.4	125.4	56.9		5,310.7	0.6		11,332.2
1992	97.0		45.1	0.6	5,923.2	10.1	267.2	231.1		5,950.0	0.8		12,525.2
1993	237.9		167.0	4.1	6,118.5	9.5	376.1	168.2		5,820.2	2.3		12,903.9
1994	308.4		442.7	74.0	6,623.3	37.1	186.0	229.2	0.0	1,555.6	6.4		9,462.8
1995	394.7		349.7	49.4	3,022.3	24.6	295.4	150.8	0.0	3,673.5	17.3		7,977.8
1996	608.8		267.4	106.2	9,027.0	20.7	340.1	183.9	0.0	4,977.1	8.3		15,539.4
1997	558.7		221.3	121.3	4,031.1	17.1	802.2	427.4	9.4	6,433.7	8.1		12,630.3
1998	703.2		162.3	133.7	6,639.7	19.3	854.2	602.8	9.1	7,102.3	23.6		16,250.1
1999	899.4		218.9	90.3	5,127.4	26.9	648.2	525.2	2.6	7,506.5	102.6		15,147.9
2000	858.3		138.8	115.6	6,674.5	39.7	570.5	536.7	20.6	6,744.7	312.2		16,011.7
2001	1,026.3		142.9	94.9	6,838.0	33.9	643.4	460.1	0.1	6,585.4	63.4		15,888.4
2002	621.7		138.2	94.5	6,468.2	24.5	611.6	584.6	0.3	6,183.4	12.8		14,739.6
2003	747.7		78.9	46.2	8,194.1	14.9	449.9	453.4	0.8	6,232.2	35.8		16,253.7
2004	763.6	0.0	13.3	31.3	10,100.7	10.6	397.8	294.8	0.5	5,404.7	45.8		17,063.1
2005	598.0		10.9	10.7	8,991.3	9.4	366.3	182.6	0.5	4,684.4	30.3		14,884.5
2006	424.8		1.5	18.0	11,182.6	11.2	477.8	298.7	0.1	4,748.1	5.6		17,168.3
2007	440.7		30.0	29.2	13,854.5	5.6	543.3	364.1	0.3	5,024.3	50.5		20,342.4
2008	855.5		7.6	73.7	12,327.0	4.4	782.6	483.0	0.0	5,602.7	54.3		20,190.9
2009	692.7		0.4	83.7	11,805.2	8.6	1,082.3	615.0	5.2	5,267.4	170.7		19,731.2
2010	445.6		5.0	42.8	8,933.0	3.8	1,558.6	1,056.7	3.4	6,373.9	260.2		18,683.0
2011	539.9		5.4	89.2	7,128.3	4.5	1,643.8	959.7	6.5	6,372.2	213.8		16,963.2
2012	723.1		1.6	43.2	6,898.8	4.3	1,502.9	1,039.7	2.1	6,760.8	167.0		17,143.5
2013	661.1		0.5	38.1	5,246.9	29.2	1,372.4	861.6	0.9	6,249.4	237.4		14,697.5
2014	794.5		0.1	38.1	5,864.0	24.3	1,325.3	952.7	9.7	6,790.5	105.3		15,904.5

Table 6. US Commercial landings (mt, live wt) of skates (all species) by gear type from 1964-2014. US landings are from Northwest Atlantic Fisheries Organization (NAFO) database and general canvas from 1964-1988, weighout (WO) from 1989-1993, and WO and Vessel Trip Report (VTR) bait landings sold boat to boat from 1994-2014.

year	longline	otter trawl	sink gill net	other/unknown	total
1964	0.2	44.0	0.0	4,036.7	4,081
1965	0.3	63.0	0.0	2,279.7	2,343
1966	0.0	43.5	0.0	2,694.5	2,738
1967	0.1	83.5	0.0	2,631.1	2,715
1968	0.0	45.4	0.0	2,371.5	2,417
1969	0.3	62.3	0.5	2,981.9	3,045
1970	0.6	78.5	0.7	1,503.2	1,583
1971	1.2	80.9	0.1	817.7	900
1972	3.7	81.9	1.3	779.1	866
1973	7.0	88.6	0.2	1,095.2	1,191
1974	10.6	78.5	5.0	1,931.8	2,026
1975	11.8	133.3	0.9	606.0	752
1976	17.1	117.9	3.5	615.6	754
1977	15.1	149.7	7.8	970.5	1,143
1978	6.1	341.0	5.9	777.0	1,130
1979	45.0	1,187.7	33.4	13.5	1,280
1980	40.5	1,481.1	40.9	14.7	1,577
1981	13.6	795.3	26.8	2.7	838
1982	38.1	809.3	17.4	13.1	878
1983	5.3	3,564.0	10.7	22.8	3,603
1984	7.0	4,120.5	10.3	18.7	4,156
1985	3.9	3,942.3	20.3	17.6	3,984
1986	7.6	4,125.5	11.5	14.8	4,159
1987	23.7	5,022.2	17.0	14.9	5,078
1988	6.2	7,206.0	24.3	19.0	7,255
1989	31.2	6,638.6	16.7	23.6	6,710
1990	37.2	11,340.4	13.0	12.3	11,403
1991	28.9	11,169.8	61.6	71.8	11,332
1992	25.9	12,242.4	228.8	28.0	12,525
1993	64.4	11,913.6	724.2	201.7	12,904
1994	233.3	7,849.6	1,047.9	332.0	9,463
1995	119.8	6,445.3	987.8	425.0	7,978
1996	90.2	14,076.3	1,207.2	165.7	15,539
1997	62.9	10,778.4	1,673.4	115.6	12,630
1998	56.2	14,098.1	1,912.3	183.4	16,250
1999	41.3	13,527.2	1,535.2	44.2	15,148
2000	42.6	14,065.4	1,827.7	75.9	16,012
2001	15.0	13,544.2	2,293.3	35.8	15,888
2002	17.1	11,246.0	3,449.1	27.3	14,740
2003	51.5	11,764.4	4,410.4	27.4	16,254
2004	41.7	12,295.0	4,292.8	433.5	17,063
2005	197.3	9,988.4	3,685.1	1,013.7	14,885
2006	22.4	11,484.3	4,836.2	825.4	17,168
2007	13.7	13,913.9	6,179.6	235.1	20,342
2008	12.4	12,999.9	6,122.5	1,055.8	20,191
2009	26.7	11,565.2	7,128.8	1,010.6	19,731
2010	10.9	8,835.7	8,831.6	1,004.8	18,683
2011	12.0	7,860.3	7,967.1	1,123.9	16,963
2012	14.0	8,425.8	7,934.4	769.3	17,144
2013	6.8	7,728.6	6,355.8	606.3	14,698
2014	6.8	7,228.2	8,497.6	171.9	15,904

Table 7. Landings of skate, all species, (mt, live wt) by region. Landings from unknown region were apportioned by using 50/50 Georges Bank (GB) and Southern New England (SNE) for non-US landings, 80/20 SNE/ Gulf of Maine (GM) for the 1968-1980 industrial fishery, and the ratio of known regions for the rest of the time series.

	GM	GB	SNE	MA
1968	508	2,035	3,935	5
1969	646	3,213	5,594	9
1970	364	1,280	2,475	9
1971	233	2,512	3,158	3
1972	229	3,990	4,602	2
1973	297	3,392	4,263	12
1974	461	814	2,360	17
1975	216	1,623	2,096	33
1976	223	242	724	23
1977	325	155	913	24
1978	342	189	768	53
1979	795	282	162	121
1980	799	412	207	159
1981	493	174	78	93
1982	546	209	57	66
1983	488	239	2,802	73
1984	451	228	3,380	98
1985	371	182	3,362	69
1986	348	111	3,582	119
1987	586	333	3,965	193
1988	1,129	406	5,446	274
1989	905	1,243	4,395	166
1990	1,075	4,905	5,249	174
1991	979	4,801	5,306	246
1992	643	4,944	6,430	508
1993	982	5,143	5,826	953
1994	797	5,959	1,855	851
1995	592	2,059	4,452	875
1996	580	8,208	5,384	1,366
1997	549	3,109	6,714	2,259
1998	1,071	5,294	6,953	2,931
1999	908	4,120	5,917	4,203
2000	1,055	5,567	5,689	3,700
2001	697	5,894	5,613	3,685
2002	813	5,005	5,188	3,733
2003	538	6,841	6,228	2,647
2004	260	8,627	5,572	2,603
2005	311	6,880	5,971	1,721
2006	348	8,344	6,902	1,574
2007	428	11,800	6,317	1,797
2008	409	9,933	7,595	2,254
2009	589	8,261	7,714	3,167
2010	1,113	5,925	7,685	3,960
2011	656	4,733	6,903	4,671
2012	274	4,432	8,618	3,820
2013	210	3,365	7,561	3,561
2014	66	4,085	7,908	3,845

Table 8. Estimated discards (mt, live wt) of skates (all species) by gear type taken in the Gulf of Maine-Georges Bank region, 1964-2014.

	Half 1							Half 2							
year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 2		Grand Total
1964	361	36,599	0	12	6,433	43,404		402	22,820		7	7,825	31,054		74,458
1965	425	37,899	0	17	2,588	40,928		491	24,325		5	642	25,462		66,390
1966	311	39,141	0	26	730	40,208		625	22,370		7	1,562	24,565		64,772
1967	319	29,986	0	22	610	30,936		470	19,144		8	2,578	22,201		53,137
1968	224	25,468	0	37	766	26,496		414	18,033		10	1,862	20,318		46,814
1969	295	24,422	0	32	1,048	25,796		668	15,907		6	2,282	18,863		44,660
1970	329	22,184	0	22	1,346	23,881		584	15,206		7	2,163	17,960		41,841
1971	517	21,090	0	21	1,818	23,446		769	14,939		8	1,806	17,522		40,968
1972	523	18,889	0	31	1,181	20,624		711	12,399		13	1,915	15,038		35,662
1973	605	18,957	0	31	1,724	21,317		718	13,556		15	1,664	15,954		37,271
1974	664	17,180	0	58	1,106	19,007		763	11,945		24	1,521	14,253		33,260
1975	693	15,315	283	61	1,331	17,683		729	11,790	36	26	2,243	14,823		32,506
1976	495	14,747	66	99	1,705	17,111		429	12,138	0	37	3,229	15,833		32,944
1977	319	19,178	39	169	3,631	23,336		310	14,145	0	47	8,122	22,625		45,961
1978	580	22,489	0	189	4,468	27,727		446	14,380	0	66	9,135	24,028		51,754
1979	905	22,301	26	156	5,673	29,061		760	16,610	0	67	9,967	27,403		56,464
1980	833	28,089	23	194	7,452	36,590		187	18,063	0	96	8,353	26,699		63,289
1981	260	29,358	92	262	8,467	38,439		88	15,640	0	93	11,769	27,590		66,029
1982	254	26,373	117	94	6,054	32,893		96	19,492	7	83	9,578	29,258		62,151
1983	340	29,158	116	117	4,983	34,715		140	16,464	22	69	6,869	23,565		58,280
1984	282	27,426	152	125	3,458	31,444		30	13,638	53	94	5,229	19,043		50,488
1985	240	21,701	214	117	2,279	24,551		86	10,746	70	81	5,794	16,778		41,329
1986	275	18,687	256	171	4,247	23,637		72	8,855	83	87	7,322	16,419		40,056
1987	567	15,012	264	141	4,098	20,081		260	8,271	46	85	8,981	17,644		37,725
1988	539	16,809	158	163	6,472	24,142		324	8,409	46	90	11,846	20,714		44,856
1989	483	18,497	73	56	6,567	25,676		236	8,722	17	92	13,149	22,216		47,892
1990	347	22,874	223	347	7,560	31,352		237	9,910	71	73	18,614	28,905		60,256
1991	729	11,624	232	99	10,858	23,542		234	8,680	44	113	12,297	21,367		44,909
1992	1,658	8,056	255	162	9,879	20,009		893	2,848	0	56	13,873	17,670		37,679
1993	28	4,528	35	119	5,024	9,734		22	11,686	1	65	5,819	17,591		27,325
1994	26	4,759	11	130	1,877	6,802		25	10,295	1	72	1,853	12,246		19,048
1995	25	7,359	8	209	405	8,006		26	2,317	1	259	1,307	3,909		11,915
1996	21	7,506	26	279	739	8,572		21	1,743	8	65	2,789	4,625		13,197
1997	20	4,378	34	106	1,642	6,180		21	3,816	4	16	2,796	6,653		12,833
1998	17	3,197	9	50	3,399	6,672		24	6,290	1	56	4,278	10,650		17,322
1999	19	1,689	4	98	1,004	2,815		21	7,055	0	110	3,093	10,280		13,095
2000	11	4,531	6	121	2,558	7,227		22	7,650	0	740	1,386	9,798		17,025
2001	15	19,301	0	188	472	19,975		16	6,310		153	555	7,034		27,009
2002	17	11,090	1	135	944	12,187		20	5,783		200	2,040	8,043		20,230

Table 8, continued. Estimated discards (mt, live wt) of skates (all species) by gear type taken in the Gulf of Maine-Georges Bank region, 1964-2014.

	Half 1								Half 2						
year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Grand Total
2003	32	11,666	8	254	1,132	13,092		13	9,875		153	1,731	11,772		24,864
2004	3	11,476	4	269	317	12,069		10	13,927	0	219	1,044	15,201		27,270
2005	88	9,482	2	399	589	10,561		51	12,773	0	204	2,238	15,267		25,828
2006	54	8,082	0	173	1,059	9,369		17	9,408	1	294	2,482	12,202		21,570
2007	70	10,577	0	359	892	11,897		22	10,870	0	360	3,179	14,431		26,328
2008	69	6,662	2	139	1,549	8,420		13	8,648	0	302	2,136	11,099		19,519
2009	60	7,109	1	563	1,155	8,889		48	10,573	0	203	1,401	12,224		21,113
2010	143	7,421	0	94	291	7,950		46	9,038	0	274	1,031	10,390		18,340
2011	89	7,672	3	153	269	8,187		55	8,538	0	257	1,963	10,813		18,999
2012	29	5,170	3	114	1,140	6,456		25	7,103	0	127	2,597	9,853		16,310
2013	26	4,205	0	67	1,541	5,839		79	9,183	0	211	2,159	11,632		17,471
2014	11	5,158		45	1,236	6,449		107	6,083		262	2,476	8,928		15,377

Table 9. Estimated discards (mt, live wt) of skates (all species) by gear type taken in the Southern New England-Mid-Atlantic region, 1964-2014.

	Half 1							Half 2							
Year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 2		Grand Total
1964	0	16,916		0	1	16,917		0	15,172		0	463	15,635		32,552
1965	0	20,746		0	2,441	23,187		0	16,887		0	8,298	25,185		48,372
1966	0	23,680		0	4,813	28,494		0	13,499		0	4,961	18,460		46,954
1967	0	26,886		0	2,273	29,159		0	15,909		0	2,157	18,066		47,225
1968	0	30,741		0	2,905	33,646		0	15,978		0	3,028	19,006		52,652
1969	2	30,557		0	1,246	31,805		1	13,392		0	735	14,128		45,933
1970	2	21,694		0	492	22,188		0	11,596		0	579	12,175		34,363
1971	2	13,419		0	98	13,519		0	5,158		0	746	5,904		19,422
1972	2	13,272		0	819	14,094		1	5,566		0	644	6,210		20,304
1973	13	15,425		0	379	15,816		6	6,182		0	182	6,369		22,185
1974	34	19,170		0	888	20,091		15	5,810		0	1,324	7,148		27,239
1975	34	9,882		0	1,284	11,200		15	5,522		0	2,515	8,052		19,252
1976	19	7,688		0	2,381	10,089		11	7,512		0	5,085	12,608		22,697
1977	10	7,639		0	3,579	11,228		4	7,534		0	1,984	9,521		20,750
1978	248	12,605		1	4,580	17,434		215	9,103		0	5,317	14,635		32,069
1979	114	16,229		1	3,513	19,857		211	11,372		0	3,574	15,157		35,014
1980	224	11,730		1	2,448	14,403		167	11,570		0	2,750	14,487		28,890
1981	244	13,828		1	1,036	15,108		169	10,820		0	1,049	12,038		27,147
1982	146	17,088		1	1,725	18,960		101	18,388		0	2,994	21,483		40,442
1983	131	20,196		1	3,672	23,999		86	17,247		0	5,096	22,429		46,428
1984	95	21,023		1	4,879	25,998		57	17,623		1	4,674	22,354		48,353
1985	80	18,452		2	4,542	23,076		87	12,760		0	3,689	16,536		39,612
1986	132	18,225		2	3,574	21,932		99	16,662		1	4,758	21,520		43,452
1987	126	21,129		2	8,589	29,846		104	12,907		1	9,972	22,984		52,829
1988	98	18,544		3	7,319	25,964		17	12,771		1	7,231	20,020		45,984
1989	59	19,166		18	11,639	30,882		28	11,537		20	6,303	17,887		48,769
1990	43	26,989		0	9,602	36,634		37	29,098		0	4,844	33,978		70,612
1991	110	11,258		0	8,457	19,824		63	8,799		0	6,515	15,377		35,201
1992	392	5,763		107	3,800	10,062		377	16,761		51	8,950	26,139		36,202
1993	14	3,358		92	6,243	9,708		6	15,139		45	6,881	22,072		31,780
1994	7	52,689		60	4,607	57,363		3	7,561		158	3,768	11,490		68,853
1995	5	14,621		234	6,980	21,840		4	8,898		91	18,174	27,167		49,007
1996	7	8,716		135	7,636	16,494		6	28,879		60	8,469	37,413		53,908
1997	10	3,207		282	8,488	11,986		8	3,582		74	3,264	6,928		18,914
1998	8	2,906		168	5,670	8,752		6	4,198		196	4,264	8,665		17,417
1999	4	966		500	7,537	9,007		3	2,802		150	3,056	6,011		15,018
2000	3	2,252		60	6,466	8,782		4	10,525		51	3,573	14,153		22,935
2001	5	773		216	3,143	4,138		6	2,138		54	2,694	4,893		9,031
2002	4	1,078		256	5,711	7,050		5	4,284		2,519	6,006	12,814		19,863

Table 9, continued. Estimated discards (mt, live wt) of skates (all species) by gear type taken in the Southern New England-Mid-Atlantic region, 1964-2014.

	Half 1							Half 2							
year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Grand Total
2003	6	6,592		269	6,090	12,957		6	7,854		289	6,234	14,382		27,339
2004	6	2,848		181	5,227	8,261		6	7,809		284	3,192	11,290		19,552
2005	0	4,822		642	5,823	11,287		0	6,496		355	2,507	9,359		20,646
2006	1	2,470		680	3,720	6,872		1	2,960		68	3,092	6,121		12,993
2007	0	3,990		631	4,920	9,541		0	5,345		396	3,309	9,050		18,591
2008	49	3,729		1,093	3,261	8,132		43	4,490		442	2,403	7,378		15,511
2009	104	3,944		1,070	3,748	8,867		137	4,125		406	2,792	7,461		16,328
2010	125	2,040		963	7,364	10,493		163	2,834		1,070	3,865	7,932		18,425
2011	83	4,095		1,823	4,794	10,795		116	6,222		948	1,678	8,965		19,760
2012	17	4,771		1,543	3,075	9,405		27	6,283		697	1,551	8,559		17,964
2013	278	10,266		1,334	2,106	13,984		377	7,756		312	2,798	11,244		25,227
2014	3	7,479		1,632	6,279	15,392		4	8,400		618	3,025	12,047		27,439

Table 10. Estimated discards (mt, live wt) of skates (all species) by gear type, 1964-2014.

	Half 1							Half 2							
Year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 2		Grand Total
1964	361	53,514	0	12	6,434	60,321		402	37,992	0	7	8,288	46,690		107,011
1965	425	58,644	0	17	5,029	64,115		491	41,212	0	5	8,940	50,647		114,762
1966	311	62,821	0	26	5,543	68,701		625	35,869	0	7	6,524	43,025		111,726
1967	319	56,872	0	22	2,882	60,095		470	35,053	0	8	4,735	40,267		100,362
1968	224	56,209	0	37	3,672	60,142		414	34,010	0	10	4,890	39,324		99,466
1969	296	54,979	0	32	2,294	57,602		669	29,299	0	6	3,017	32,991		90,593
1970	331	43,878	0	22	1,838	46,069		584	26,802	0	7	2,742	30,135		76,204
1971	519	34,509	0	21	1,916	36,965		769	20,097	0	8	2,552	23,426		60,391
1972	525	32,161	0	31	2,000	34,718		711	17,965	0	13	2,559	21,248		55,966
1973	618	34,382	0	31	2,103	37,134		724	19,738	0	15	1,846	22,323		59,457
1974	697	36,349	0	58	1,994	39,099		778	17,754	0	24	2,845	21,401		60,499
1975	727	25,197	283	61	2,615	28,883		744	17,313	36	26	4,757	22,875		51,758
1976	514	22,435	66	99	4,086	27,200		441	19,650	0	37	8,313	28,441		55,641
1977	329	26,817	39	169	7,210	34,564		314	21,679	0	47	10,106	32,146		66,710
1978	829	35,094	0	190	9,048	45,161		661	23,484	0	66	14,452	38,662		83,823
1979	1,019	38,530	26	157	9,186	48,918		971	27,982	0	67	13,540	42,560		91,478
1980	1,056	39,819	23	195	9,900	50,993		354	29,633	0	96	11,104	41,186		92,179
1981	503	43,186	92	264	9,502	53,547		257	26,460	0	93	12,818	39,628		93,175
1982	400	43,461	117	95	7,779	51,853		197	37,880	7	84	12,572	50,740		102,593
1983	471	49,354	116	118	8,655	58,714		226	33,711	22	70	11,965	45,994		104,708
1984	378	48,449	152	126	8,337	57,442		87	31,261	53	94	9,903	41,398		98,840
1985	321	40,153	214	119	6,821	47,628		173	23,506	70	81	9,483	33,314		80,941
1986	406	36,913	256	173	7,821	45,569		171	25,517	83	88	12,080	37,938		83,508
1987	692	36,141	264	143	12,687	49,927		364	21,178	46	86	18,953	40,627		90,554
1988	638	35,353	158	166	13,791	50,106		341	21,180	46	91	19,077	40,734		90,840
1989	542	37,663	73	74	18,206	56,558		264	20,260	17	111	19,452	40,104		96,661
1990	390	49,863	223	347	17,162	67,986		273	39,008	71	73	23,458	62,883		130,869
1991	839	22,882	232	99	19,314	43,366		297	17,478	44	113	18,812	36,744		80,110
1992	2,050	13,819	255	269	13,679	30,072		1,270	19,609	0	107	22,823	43,809		73,881
1993	42	7,886	35	211	11,268	19,442		28	26,825	1	110	12,700	39,663		59,105
1994	33	57,447	11	190	6,484	64,165		28	17,856	1	230	5,621	23,735		87,900
1995	30	21,980	8	443	7,385	29,846		30	11,215	1	350	19,481	31,077		60,922
1996	28	16,222	26	414	8,376	25,066		27	30,622	8	125	11,258	42,039		67,105
1997	30	7,584	34	388	10,130	18,166		30	7,398	4	90	6,059	13,581		31,747
1998	25	6,103	9	218	9,069	15,425		30	10,488	1	252	8,543	19,314		34,739
1999	23	2,655	4	598	8,542	11,823		24	9,857	0	261	6,149	16,291		28,113
2000	14	6,783	6	181	9,024	16,009		26	18,175	0	791	4,959	23,951		39,960
2001	20	20,075	0	404	3,615	24,114		22	8,449	0	207	3,249	11,927		36,040
2002	21	12,168	1	392	6,655	19,237		25	10,067	0	2,718	8,046	20,857		40,094

Table 10, continued. Estimated discards (mt, live wt) of skates (all species) by gear type, 1964-2014.

	Half 1								Half 2						
year	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1		Grand Total
2003	38	18,258	8	522	7,222	26,048		18	17,728	0	442	7,965	26,154		52,203
2004	9	14,324	4	450	5,544	20,331		16	21,736	0	503	4,236	26,491		46,822
2005	88	14,304	2	1,041	6,412	21,848		51	19,269	0	559	4,746	24,626		46,473
2006	55	10,552	0	854	4,779	16,241		18	12,368	1	362	5,574	18,323		34,564
2007	70	14,566	0	990	5,812	21,438		22	16,214	0	756	6,488	23,481		44,919
2008	119	10,391	2	1,232	4,810	16,553		56	13,138	0	744	4,539	18,478		35,030
2009	164	11,054	1	1,634	4,903	17,756		185	14,698	0	609	4,193	19,685		37,441
2010	269	9,461	0	1,058	7,655	18,443		209	11,872	0	1,344	4,896	18,322		36,765
2011	172	11,768	3	1,976	5,063	18,982		171	14,760	0	1,205	3,642	19,777		38,759
2012	46	9,941	3	1,657	4,215	15,861		53	13,386	0	825	4,149	18,412		34,274
2013	304	14,471	0	1,401	3,647	19,823		457	16,939	0	523	4,957	22,875		42,698
2014	14	12,637	0	1,677	7,514	21,842		111	14,483	0	880	5,502	20,975		42,817

Table 11. US landings (mt, live wt) of skates by market and species from 1983-2014. Data are from Weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

YEAR	*Uncl.*	*Uncl.*	*Winter*	*Winter*	*Little*	*Little*	*Barndoor*	*Barndoor*	*Thorny*	*Thorny*
	Whole	Wings	Whole	Wings	Whole	Wings	Whole	Wings	Whole	Wings
1983	3,009.2	593.7								
1984	3,530.3	626.2								
1985	3,449.1	535.0								
1986	3,660.5	498.9								
1987	4,036.7	1,041.2								
1988	5,572.0	1,678.3								
1989	4,163.1	2,547.0								
1990	5,002.9	6,400.0								
1991	5,069.2	6,262.5			0.6					
1992	5,860.5	6,664.7								
1993	5,526.6	7,377.4								
1994	1,384.4	8,078.4								
1995	3,855.8	3,985.4			136.6					
1996	5,308.2	10,231.0	0.4		0.2					
1997	7,054.8	5,575.5								
1998	7,810.2	8,439.9								
1999	8,490.8	6,655.1					2.1			
2000	6,285.3	8,690.4			1035.9	0.1				
2001	7,167.6	8,718.4	2.2			0.1				
2002	6,132.6	8,606.8				0.1		0.1		
2003	5,540.5	10,650.0	4.5	26.0	24.1		6.8			
2004	1,837.4	8,450.3	6.3	2,697.4	3,010.8	8.6	0.3	0.1		95.6
2005	943.3	6,679.3	59.3	3,301.3	3,693.3	15.6	0.2	5.4	1.5	126.2
2006	1,972.2	8,543.4	79.2	2,904.6	3,269.8	6.4		2.2	0.5	137.4
2007	2,222.6	11,183.0	41.3	2,796.4	3,730.2	0.3	0.1	1.1	14.6	113.4
2008	2,009.9	10,923.0	167.2	2,682.2	4,269.6	15.8	0.5			0.8
2009	2,369.9	10,831.0	112.9	2,283.2	3,952.3	11.0	0.7			0.9
2010	1,217.6	7,813.6	286.0	4,905.6	4,330.6	22.4	0.1		0.4	18.8
2011	990.7	5,543.9	125.4	5,445.3	4,570.6	21.0				0.5
2012	961.0	6,269.0	7.6	4,598.2	5,113.7	31.7	0.2	1.4		0.2
2013	957.6	5,841.8	30.5	2,567.8	5,106.8	34.9		3.5	21.9	26.8
2014	1,096.9	2,954.7	205.8	7,110.4	4,289.3	46.7		5.1		0.7

Table 11, continued. US landings (mt, live wt) of skates by market and species from 1983-2014. Data are from Weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

YEAR	*Smooth*	*Smooth*	*Clearnose*	*Clearnose*	*Rosette*	*Rosette*	*Total*	
	Whole	Wings	Whole	Wings	Whole	Wings	Whole	Wings
1983							3,009.2	593.7
1984							3,530.3	626.2
1985							3,449.1	535.0
1986							3,660.5	498.9
1987							4,036.7	1,041.2
1988							5,572.0	1,678.3
1989							4,163.1	2,547.0
1990							5,002.9	6,400.0
1991							5,069.8	6,262.5
1992							5,860.5	6,664.7
1993							5,526.6	7,377.4
1994							1,384.4	8,078.4
1995							3,992.4	3,985.4
1996							5,308.8	10,231.0
1997							7,054.8	5,575.5
1998							7,810.2	8,439.9
1999							8,492.9	6,655.1
2000							7,321.2	8,690.5
2001							7,169.8	8,718.5
2002							6,132.6	8,607.0
2003	2.0		0.2				5,577.9	10,676.0
2004	1.0	927.2	8.8	16.6		2.7	4,864.6	12,198.5
2005	0.6	1.0	35.1		16.6	5.9	4,749.8	10,134.7
2006	2.1	31.9	190.7		8.5	14.5	5,523.0	11,640.4
2007	4.3	26.7	179.6		15.1	14.8	6,207.7	14,135.7
2008	0.3	7.1	100.6		4.9	9.6	6,552.9	13,638.5
2009	2.7	6.9	157.4	1.9		0.7	6,595.9	13,135.6
2010	0.8	1.1	85.9			0.1	5,921.4	12,761.6
2011	0.5	110.9	125.0	6.9		22.5	5,812.1	11,151.0
2012	0.5	19.5	114.6	9.7	16.2		6,213.8	10,929.7
2013		8.2	67.3	22.7	7.7		6,191.7	8,505.7
2014	4.6	117.8	42.4	17.8		12.3	5,638.9	10,265.5

Table 12. US landings (mt, live wt) of skates by state and species from 2004-2014. Data are from weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

					Species					
YEAR	State	Uncl.	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
2004	CT	728.9	0.0	34.7	0.0	0.0	0.0	0.0	0.0	763.6
	DE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ME	12.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	13.3
	MD	17.3	6.2	6.5	0.0	0.0	0.0	1.2	0.0	31.3
	MA	6,523.2	2,468.0	99.1	0.0	83.4	926.9	0.0	0.1	10,100.7
	NH	5.2	5.4	0.0	0.0	0.1	0.0	0.0	0.0	10.6
	NJ	150.9	135.8	107.0	0.0	0.1	0.0	4.0	0.0	397.8
	NY	261.0	1.8	18.7	0.0	12.0	1.3	0.0	0.0	294.8
	NC	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	RI	2,563.4	85.4	2,753.3	0.0	0.0	0.0	0.0	2.6	5,404.7
	VA	25.1	0.0	0.0	0.5	0.0	0.0	20.2	0.0	45.8
	Total	10,287.6	2,703.8	3,019.4	0.5	95.6	928.2	25.4	2.7	17,063.1
2005	CT	379.8	0.0	218.2	0.0	0.0	0.0	0.0	0.0	598.0
	ME	10.2	0.5	0.2	0.0	0.0	0.0	0.0	0.0	10.9
	MD	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
	MA	5,761.0	3,093.4	21.8	1.3	113.1	0.7	0.0	0.0	8,991.3
	NH	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4
	NJ	150.0	135.2	46.3	0.0	0.0	0.4	34.4	0.0	366.3
	NY	130.3	2.0	16.7	4.3	12.6	0.3	0.0	16.6	182.6
	NC	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	RI	1,140.9	129.7	3,405.7	0.0	2.0	0.3	0.0	5.9	4,684.4
	VA	29.6	0.0	0.0	0.0	0.0	0.0	0.7	0.0	30.3
	Total	7,622.5	3,360.6	3,708.9	5.6	127.6	1.6	35.1	22.5	14,884.5
2006	CT	301.5	0.0	123.2	0.0	0.0	0.0	0.0	0.0	424.8
	ME	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
	MD	9.2	2.3	4.5	0.0	0.5	1.5	0.0	0.0	18.0
	MA	8,456.9	2,380.6	207.9	0.0	136.6	0.6	0.0	0.0	11,182.6
	NH	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2
	NJ	76.3	166.6	14.9	0.0	0.0	31.8	187.4	0.8	477.8
	NY	256.3	19.3	10.1	2.2	0.0	0.1	0.0	10.8	298.7
	NC	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	RI	1,399.1	415.1	2,920.6	0.0	0.8	0.0	0.0	12.4	4,748.1
	VA	3.4	0.0	0.0	0.0	0.0	0.0	2.2	0.0	5.6
	Total	10,515.5	2,983.9	3,281.2	2.2	138.0	34.0	189.6	24.1	17,168.3

Table 12, continued. US landings (mt, live wt) of skates by state and species from 2004-2014. Data are from weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

					Species					
YEAR	State	Uncl.	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
2007	CT	308.2	0.0	132.4	0.0	0.0	0.0	0.0	0.0	440.7
	ME	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0
	MD	23.6	1.5	0.7	0.3	3.1	0.0	0.0	0.0	29.2
	MA	11,149.8	2,413.5	158.5	0.0	114.8	18.0	0.0	0.0	13,854.5
	NH	5.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	5.6
	NJ	126.4	205.2	31.8	0.0	0.0	8.3	171.6	0.0	543.3
	NY	293.8	36.2	7.8	1.1	9.4	0.4	3.5	11.9	364.1
	NC	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	RI	1,426.2	180.0	3,399.3	0.0	0.8	3.3	0.0	14.8	5,024.3
	VA	41.8	1.1	0.0	0.0	0.0	0.0	4.5	3.2	50.5
	Total	13,405.3	2,837.8	3,730.5	1.4	127.9	30.0	179.6	29.8	20,342.4
2008	CT	757.7	0.1	97.8	0.0	0.0	0.0	0.0	0.0	855.5
	ME	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6
	MD	70.1	3.1	0.0	0.5	0.0	0.0	0.0	0.0	73.7
	MA	9,682.4	2,157.6	480.8	0.0	0.0	6.2	0.0	0.0	12,327.0
	NH	3.7	0.0	0.0	0.0	0.7	0.0	0.0	0.0	4.4
	NJ	138.4	354.6	189.0	0.0	0.0	0.1	100.5	0.0	782.6
	NY	420.7	48.0	9.0	0.0	0.1	0.3	0.0	4.9	483.0
	NC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	RI	1,797.6	285.9	3,508.8	0.0	0.0	0.8	0.0	9.5	5,602.7
	VA	54.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.3
	Total	12,932.5	2,849.4	4,285.4	0.5	0.8	7.4	100.5	14.4	20,190.9
2009	CT	584.0	0.0	108.7	0.0	0.0	0.0	0.0	0.0	692.7
	ME	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
	MD	81.9	1.1	0.0	0.7	0.0	0.0	0.0	0.0	83.7
	MA	9,474.5	1,435.0	893.8	0.0	0.0	1.8	0.0	0.0	11,805.2
	NH	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6
	NJ	324.3	503.0	119.5	0.0	0.0	3.9	131.5	0.0	1,082.3
	NY	527.5	70.8	15.6	0.0	0.9	0.4	0.0	0.0	615.0
	NC	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2
	RI	2,051.5	386.2	2,825.6	0.0	0.0	3.4	0.0	0.7	5,267.4
	VA	142.8	0.0	0.0	0.0	0.0	0.1	27.8	0.0	170.7
	Total	13,220.5	2,396.2	3,963.3	0.7	0.9	9.5	159.3	0.7	19,731.2

Table 12, continued. US landings (mt, live wt) of skates by state and species from 2004-2014. Data are from weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

					Species					
YEAR	State	Uncl.	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
2010	CT	319.6	1.1	124.9	0.0	0.0	0.0	0.0	0.0	445.6
	ME	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
	MD	40.8	0.1	1.9	0.0	0.0	0.0	0.0	0.0	42.8
	MA	5,143.7	3,227.3	562.0	0.0	0.0	0.0	0.0	0.0	8,933.0
	NH	3.7	0.0	0.0	0.0	0.1	0.0	0.0	0.0	3.8
	NJ	246.3	1,027.0	204.0	0.0	3.9	0.1	77.4	0.0	1,558.6
	NY	871.0	169.0	1.0	0.1	14.4	1.2	0.0	0.1	1,056.7
	NC	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
	RI	2,146.2	767.1	3,459.0	0.0	0.9	0.8	0.0	0.0	6,373.9
	VA	251.5	0.0	0.2	0.0	0.0	0.0	8.5	0.0	260.2
	Total	9,031.2	5,191.6	4,352.9	0.1	19.2	2.0	85.9	0.1	18,683.0
2011	CT	469.0	1.7	69.3	0.0	0.0	0.0	0.0	0.0	539.9
	ME	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
	MD	87.8	0.0	1.3	0.0	0.0	0.0	0.0	0.0	89.2
	MA	2,449.2	3,471.1	1,107.0	0.0	0.0	101.1	0.0	0.0	7,128.3
	NH	3.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.5
	NJ	245.0	1,109.1	160.2	0.0	0.0	0.0	129.5	0.0	1,643.8
	NY	723.7	202.5	0.1	0.0	0.5	10.4	0.0	22.5	959.7
	NC	6.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	6.5
	RI	2,333.7	784.7	3,253.8	0.0	0.0	0.0	0.0	0.0	6,372.2
	VA	211.4	0.0	0.0	0.0	0.0	0.0	2.4	0.0	213.8
	Total	6,534.5	5,570.7	4,591.6	0.0	0.5	111.5	131.9	22.5	16,963.2
2012	CT	574.1	0.0	149.0	0.0	0.0	0.0	0.0	0.0	723.1
	ME	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	MD	35.6	7.6	0.0	0.0	0.0	0.0	0.0	0.0	43.2
	MA	3,910.7	2,276.1	712.0	0.0	0.0	0.0	0.0	0.0	6,898.8
	NH	4.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	4.3
	NJ	84.0	1,032.9	271.3	0.0	0.0	0.2	114.5	0.0	1,502.9
	NY	327.2	674.7	0.3	1.6	0.2	19.6	0.0	16.2	1,039.7
	NC	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
	RI	2,147.3	601.6	4,011.8	0.0	0.0	0.2	0.0	0.0	6,760.8
	VA	143.4	12.8	1.0	0.0	0.0	0.0	9.8	0.0	167.0
	Total	7,230.1	4,605.8	5,145.4	1.6	0.2	20.0	124.3	16.2	17,143.5

Table 12, continued. US landings (mt, live wt) of skates by state and species from 2004-2014. Data are from weighout (WO) and Vessel Trip Reports (VTR, only for bait landings sold boat to boat). Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). "Uncl." = unclassified.

					Species					
YEAR	State	Uncl.	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
2013	CT	582.1	79.0	0.0	0.0	0.0	0.0	0.0	0.0	661.1
	ME	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	MD	38.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	38.1
	MA	3,202.0	1,123.5	919.4	2.0	0.0	0.0	0.0	0.0	5,246.9
	NH	29.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	29.2
	NJ	91.0	826.5	387.7	0.0	0.0	0.0	67.2	0.0	1,372.4
	NY	554.7	285.4	1.5	1.4	0.0	8.2	2.7	7.7	861.6
	NC	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.9
	RI	2,083.9	398.8	3,718.0	0.0	48.7	0.0	0.0	0.0	6,249.4
	VA	217.2	0.0	0.0	0.0	0.0	0.0	20.2	0.0	237.4
	Total	6,799.4	2,713.5	5,026.5	3.5	48.7	8.2	90.1	7.7	14,697.5
2014	CT	621.2	73.7	97.8	1.0	0.0	0.9	0.0	0.0	794.5
	ME	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	MD	37.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	38.1
	MA	1,685.7	3,985.3	85.7	3.8	0.0	103.4	0.1	0.0	5,864.0
	NH	0.4	0.0	23.9	0.0	0.0	0.0	0.0	0.0	24.3
	NJ	53.0	856.3	373.6	0.0	0.0	0.1	42.3	0.0	1,325.3
	NY	357.3	562.6	3.5	0.3	0.3	16.4	0.0	12.3	952.7
	NC	7.2	1.0	0.0	0.0	0.0	0.4	1.1	0.0	9.7
	RI	1,203.8	1,836.0	3,750.3	0.0	0.3	0.0	0.0	0.0	6,790.5
	VA	86.0	0.1	1.2	0.0	0.0	1.3	16.6	0.0	105.2
	Total	3,590.4	7,315.8	4,209.2	5.1	0.7	122.5	60.1	12.3	15,904.5

Table 13. Number of landed skates (all species) measured by the bait fishery, region, and season. The bait fishery are fish <= 60 cm. The lines indicate which years were pooled by area (Gulf of Maine [GM] and Georges Bank [GB],first 4 columns) and area combined (columns under GM-GB). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		GM-GB		Half 1		Half 2	
	GB	GM	GB	GM	Half 1	Half 2	GB	GM	GB	GM
1994				19		19				19
1995										
1996		45			45			45		
1997			4	1		5			4	1
1998										
1999										
2000	8	9			17		8	9		
2001	34			1	34	1	34			1
2002			39	13		52			39	13
2003	1	3	9	2	4	11	1	3	9	2
2004		46	164	12	46	176		46	164	12
2005	17	47	102	125	64	227	17	47	102	125
2006	100	2	21	4	102	25	100	2	21	4
2007	32	232	171	39	264	210	32	232	171	39
2008	36	2	124	19	38	143	36	2	124	19
2009	9	10	35		19	35	9	10	35	
2010	38	44	71	22	82	93	38	44	71	22
2011	28	65	15	4	93	19	28	65	15	4
2012		16	19	2	16	21		16	19	2
2013			42			42			42	
2014	2	2	23		4	23	2	2	23	
2015	2		107	9	2	116	2		107	9

Table 14. Number of landed skates (all species) measured by the wing fishery, region, and season. The wing fishery are fish > 60 cm. The lines indicate which years were pooled by area (Gulf of Maine [GM] and Georges Bank [GB], first 4 columns) and area combined (columns under GM-GB). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		GM-GB		Half 1		Half 2	
	GB	GM	GB	GM	Half 1	Half 2	GB	GM	GB	GM
1994		1		20	1	20		1		20
1995	35	3			38		35	3		
1996	115				115		115			
1997	38		14	6	38	20	38		14	6
1998		3	9		3	9		3	9	
1999	14	1		33	15	33	14	1		33
2000	159	82	218	43	241	261	159	82	218	43
2001	20	59	395	174	79	569	20	59	395	174
2002	319	253	1,048	818	572	1,866	319	253	1,048	818
2003	338	109	1,270	268	447	1,538	338	109	1,270	268
2004	1,195	100	6,388	285	1,295	6,673	1,195	100	6,388	285
2005	1,440	48	5,639	304	1,488	5,943	1,440	48	5,639	304
2006	873	133	1,256	90	1,006	1,346	873	133	1,256	90
2007	926	46	6,987	21	972	7,008	926	46	6,987	21
2008	2,325	393	2,719	34	2,718	2,753	2,325	393	2,719	34
2009	780	72	797	17	852	814	780	72	797	17
2010	1,047	978	2,004	696	2,025	2,700	1,047	978	2,004	696
2011	506	233	2,459	201	739	2,660	506	233	2,459	201
2012	374	121	583	21	495	604	374	121	583	21
2013	113		1,635	34	113	1,669	113		1,635	34
2014	198	3	1,108	12	201	1,120	198	3	1,108	12
2015	204		1,769	76	204	1,845	204		1,769	76

Table 15. Number of landed skates (all species) measured by the bait fishery, region, and season. The bait fishery are fish <= 60 cm. The lines indicate which years were pooled by area (Southern New England [SNE] and Mid-Atlantic [MA], first 4 columns) and area combined (columns under SNE-MA). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		SNE-MA		Half 1		Half 2	
Year	SNE	MA	SNE	MA	Half 1	Half 2	SNE	MA	SNE	MA
1994			155			155			155	0
1995		9	301		9	301		9	301	
1996	1	1	1	151	2	152	1	1	1	151
1997	294	1	11	3	295	14	294	1	11	3
1998	8	19	191	8	27	199	8	19	191	8
1999	27	40	18	58	67	76	27	40	18	58
2000	30	101	399	127	131	526	30	101	399	127
2001	195	691	195	1,164	886	1,359	195	691	195	1,164
2002	932		75	20	932	95	932		75	20
2003	540		828	111	540	939	540		828	111
2004	739	72	98	61	811	159	739	72	98	61
2005	692	14	349	772	706	1,121	692	14	349	772
2006	1,296	4	466	118	1,300	584	1,296	4	466	118
2007	615	134	1,558	730	749	2,288	615	134	1,558	730
2008	423	181	381	164	604	545	423	181	381	164
2009	533	1,030	451	448	1,563	899	533	1,030	451	448
2010	594	278	183	1,091	872	1,274	594	278	183	1,091
2011	489	120	83	194	609	277	489	120	83	194
2012	127	7	1		134	1	127	7	1	
2013			1	159		160			1	159
2014	84	143	34	13	227	47	84	143	34	13
2015	219	63	260	11	282	271	219	63	260	11

Table 16. Number of landed skates (all species) measured by the wing fishery, region, and season. The wing fishery are fish > 60 cm. The lines indicate which years were pooled by area (Southern New England [SNE] and Mid-Atlantic [MA], first 4 columns) and area combined (columns under SNE-MA). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		SNE-MA		Half 1		Half 2	
Year	SNE	MA	SNE	MA	Half 1	Half 2	SNE	MA	SNE	MA
1994			128	63	,	191			128	63
1995	5	322	17		327	17	5	322	17	
1996	36	372	86	42	408	128	36	372	86	42
1997	133	124	124	317	257	441	133	124	124	317
1998	223	1,239	450	203	1,462	653	223	1,239	450	203
1999	241	64	242	22	305	264	241	64	242	22
2000	265	70	39	30	335	69	265	70	39	30
2001	188	314	571	1,396	502	1,967	188	314	571	1,396
2002	873		252	34	873	286	873		252	34
2003	489		1,960	268	489	2228	489		1,960	268
2004	2,250	292	607	338	2,542	945	2,250	292	607	338
2005	369	508	743	31	877	774	369	508	743	31
2006	435	128	48	104	563	152	435	128	48	104
2007	414	192	184	148	606	332	414	192	184	148
2008	402	59	387	10	461	397	402	59	387	10
2009	485	112	129	11	597	140	485	112	129	11
2010	532	162	40	615	694	655	532	162	40	615
2011	585	341	255	127	926	382	585	341	255	127
2012	431	278	126		709	126	431	278	126	
2013		49	75	65	49	140		49	75	65
2014	447	131	104	43	578	147	447	131	104	43
2015	168	164	50	6	332	56	168	164	50	6

Table 17. Landings (Lnd), total discards (TD), dead discards (DD), and total catch (Cat) for thorny skate (*Amblyraja radiata*) using reported species and 3 different pooling schemes (Region Method (Gulf of Maine-Georges Bank [GM-GB] and Southern New England-Mid-Atlantic [SNE-MA]), Area Method (GM, GB, SNE, MA)), and Final Pooling (a combination of the first two methods))) to derive species proportion. All catches are in mt.

	Reported or Observed				*Region Method*				*Area Method*				*Final Pooling*			
Year	*Lnd*	*TD*	*DD*	*Cat*	*Lnd*	*TD*	*DD*	*Cat*	*Lnd*	*TD*	*DD*	*Cat*	*Lnd*	*TD*	*DD*	*Cat*
1994		*383*	*191*		*1,915*	*4,132*	*1,166*	*3,081*	*1,514*	*4,504*	*1,343*	*2,858*	*1,915*	*4,140*	*1,170*	*3,085*
1995		*298*	*93*		*653*	*1,246*	*368*	*1,021*	*677*	*1,125*	*404*	*1,080*	*653*	*1,251*	*371*	*1,024*
1996		*544*	*229*		*1,670*	*846*	*322*	*1,992*	*930*	*996*	*363*	*1,293*	*1,670*	*863*	*329*	*1,999*
1997		*1,610*	*762*		*936*	*1,275*	*407*	*1,343*	*831*	*1,679*	*496*	*1,328*	*936*	*1,286*	*412*	*1,348*
1998		*992*	*253*		*1,375*	*1,589*	*510*	*1,885*	*1,331*	*1,529*	*491*	*1,822*	*1,375*	*1,593*	*512*	*1,887*
1999		*570*	*167*		*381*	*686*	*213*	*594*	*636*	*805*	*247*	*883*	*502*	*687*	*214*	*715*
2000		*1,045*	*295*		*1,109*	*866*	*265*	*1,375*	*1,315*	*790*	*230*	*1,545*	*1,110*	*870*	*267*	*1,376*
2001		*1,117*	*284*		*479*	*2,027*	*491*	*970*	*767*	*1,216*	*332*	*1,100*	*940*	*1,114*	*282*	*1,222*
2002		*2,256*	*546*		*1,019*	*1,139*	*289*	*1,308*	*650*	*852*	*228*	*878*	*961*	*835*	*219*	*1,180*
2003		*1,061*	*267*		*760*	*2,612*	*674*	*1,433*	*540*	*1,483*	*392*	*932*	*549*	*1,564*	*433*	*982*
2004	*311*	*1,344*	*326*	*637*	*1,176*	*1,615*	*401*	*1,577*	*545*	*1,590*	*393*	*938*	*546*	*1,612*	*404*	*950*
2005	*372*	*735*	*192*	*564*	*897*	*1,604*	*420*	*1,316*	*252*	*1,324*	*343*	*595*	*250*	*1,373*	*368*	*617*
2006	*517*	*734*	*191*	*709*	*1,362*	*1,310*	*359*	*1,721*	*245*	*668*	*177*	*422*	*242*	*796*	*241*	*484*
2007	*566*	*649*	*172*	*738*	*865*	*931*	*259*	*1,124*	*304*	*655*	*176*	*480*	*304*	*737*	*217*	*522*
2008	*4*	*400*	*109*	*113*	*344*	*293*	*86*	*430*	*126*	*163*	*52*	*178*	*115*	*184*	*62*	*178*
2009	*5*	*424*	*120*	*125*	*135*	*465*	*127*	*262*	*103*	*358*	*98*	*201*	*90*	*376*	*106*	*196*
2010	*49*	*498*	*132*	*181*	*230*	*721*	*184*	*414*	*248*	*460*	*125*	*373*	*203*	*464*	*128*	*330*
2011	*1*	*519*	*143*	*144*	*65*	*461*	*126*	*191*	*134*	*373*	*101*	*236*	*120*	*396*	*113*	*233*
2012	*0*	*694*	*185*	*185*	*73*	*413*	*115*	*189*	*32*	*325*	*89*	*121*	*71*	*355*	*104*	*175*
2013	*111*	*521*	*155*	*266*	*120*	*585*	*164*	*284*	*84*	*465*	*128*	*213*	*123*	*493*	*142*	*266*
2014	*1*	*738*	*210*	*211*	*155*	*660*	*184*	*339*	*70*	*374*	*100*	*170*	*177*	*445*	*135*	*312*

Table 18. Number of length samples by region, year, and season for the discarded component of the otter trawl skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Gulf of Maine [GM] and Georges Bank [GB], first 4 columns) and area combined (columns under GM-GB). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		GM-GB		Half 1		Half 2	
Year	GB	GM	GB	GM	Half 1	Half 2	GB	GM	GB	GM
1994										
1995	683	43	17	73	726	90	683	43	17	73
1996	626			107	626	107	626			107
1997	263		168	15	263	183	263		168	15
1998			60			60			60	
1999				77		77				77
2000	307	157	346	47	464	393	307	157	346	47
2001	1,200	1		167	1,201	167	1,200	1		167
2002	752		4,837	1,252	752	6,089	752		4,837	1,252
2003	4,863	2,645	5,638	1,311	7,508	6,949	4,863	2,645	5,638	1,311
2004	4,893	890	7,241	988	5,783	8,229	4,893	890	7,241	988
2005	17,953	1,224	11,938	988	19,177	12,926	17,953	1,224	11,938	988
2006	7,444	652	7,342	678	8,096	8,020	7,444	652	7,342	678
2007	8,630	746	11,160	1,308	9,376	12,468	8,630	746	11,160	1,308
2008	10,848	1,856	9,314	344	12,704	9,658	10,848	1,856	9,314	344
2009	4,491	236	3,565	448	4,727	4,013	4,491	236	3,565	448
2010	7,028	1,056	4,823	2,071	8,084	6,894	7,028	1,056	4,823	2,071
2011	5,162	1,239	3,540	1,250	6,401	4,790	5,162	1,239	3,540	1,250
2012	2,402	1,954	1,756	594	4,356	2,350	2,402	1,954	1,756	594
2013	1,261	456	2,047	181	1,717	2,228	1,261	456	2,047	181
2014	637	241	687	348	878	1,035	637	241	687	348
2015	675	433	1,531	331	1,108	1,862	675	433	1,531	331

Table 19. Number of length samples by region, year, and season for the discarded component of the otter trawl skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Southern New England [SNE] and Mid-Atlantic [MA], first 4 columns) and area combined (columns under SNE-MA). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		SNE-MA		Half 1		Half 2	
Year	SNE	MA	SNE	MA	Half 1	Half 2	SNE	MA	SNE	MA
1994			244	375		619			244	375
1995		261		500	261	500		261		500
1996		19	46	201	19	247		19	46	201
1997	91	316	719	604	407	1,323	91	316	719	604
1998		1	43		1	43		1	43	
1999										
2000	64	292	293	629	356	922	64	292	293	629
2001	271	671	1	1,663	942	1,664	271	671	1	1,663
2002		190	45	1,656	190	1,701		190	45	1,656
2003		30	247	273	30	520		30	247	273
2004	468	817	1,102	1,661	1,285	2,763	468	817	1,102	1,661
2005	1,398	1,025	3,219	1,066	2,423	4,285	1,398	1,025	3,219	1,066
2006	451	357	115	1,791	808	1,906	451	357	115	1,791
2007	239	501	420	588	740	1,008	239	501	420	588
2008	669	811	1,015	946	1,480	1,961	669	811	1,015	946
2009	772	315	765	1,284	1,087	2,049	772	315	765	1,284
2010	413	545	1,551	1,324	958	2,875	413	545	1,551	1,324
2011	957	312	931	1,587	1,269	2,518	957	312	931	1,587
2012	815	296	255	495	1,111	750	815	296	255	495
2013	240	351	294	586	591	880	240	351	294	586
2014	430	133	414	1,021	563	1,435	430	133	414	1,021
2015	253	64	278	109	317	387	253	64	278	109

Table 20. Number of length samples by region, year, and season for the discarded component of the sink gill net skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Gulf of Maine [GM] and Georges Bank [GB], first 4 columns) and area combined (columns under GM-GB). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		GM-GB		Half 1		Half 2	
Year	GB	GM	GB	GM	Half 1	Half 2	GB	GM	GB	GM
1991	1	1			2		1	1		
1992		6		3	6	3		6		3
1993		1			1			1		
1994				9		9				9
1995		55	2	35	55	37		55	2	35
1996		17		7	17	7		17		7
1997				25		25				25
1998		13	9	204	13	213		13	9	204
1999		52		18	52	18		52		18
2000		13	97		13	97		13	97	
2001		83	20	38	83	58		83	20	38
2002	133	45	28	196	178	224	133	45	28	196
2003	295	269	289	469	564	758	295	269	289	469
2004	992	718	821	937	1,710	1,758	992	718	821	937
2005	61	642	419	360	703	779	61	642	419	360
2006	15	445	365	53	460	418	15	445	365	53
2007	167	226	1,701	248	393	1,949	167	226	1,701	248
2008	225	161	303	222	386	525	225	161	303	222
2009		134	178	118	134	296		134	178	118
2010	278	387	1,004	1,451	665	2,455	278	387	1,004	1,451
2011	217	903	942	1,125	1,120	2,067	217	903	942	1,125
2012	92	1,601	170	594	1,693	764	92	1,601	170	594
2013	75	27	614	126	102	740	75	27	614	126
2014	4	84	477	265	88	742	4	84	477	265
2015	102	162	1,149	155	264	1,304	102	162	1,149	155

Table 21. Number of length samples by region, year, and season for the discarded component of the sink gill net skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Southern New England [SNE] and Mid-Atlantic [MA], first 4 columns) and area combined (columns under SNE-MA). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		SNE-MA		Half 1		Half 2	
Year	SNE	MA	SNE	MA	Half 1	Half 2	SNE	MA	SNE	MA
1994			23	32	,	55			23	32
1995	2	696		12	698	12	2	696		12
1996		346			346	,		346		
1997	4	184	25	21	188	46	4	184	25	21
1998	9	2	22	6	11	28	9	2	22	6
1999	62	16		10	78	10	62	16		10
2000	51	37	7	25	88	32	51	37	7	25
2001		72	70	4	72	74		72	70	4
2002	320	50	164		370	164	320	50	164	
2003	226	20	1,309	3	246	1,312	226	20	1,309	3
2004	614		116	514	614	630	614		116	514
2005	427	318	757	5	745	762	427	318	757	5
2006	56	5	7	195	61	202	56	5	7	195
2007	167	52	38	9	219	47	167	52	38	9
2008	580	158	140		738	140	580	158	140	
2009	464	404	267	27	868	294	464	404	267	27
2010	2,091	73	211	351	2,164	562	2,091	73	211	351
2011	951	122	711	107	1,073	818	951	122	711	107
2012	916	194	31		1,110	31	916	194	31	
2013	104		235	8	104	243	104		235	8
2014	166	223	73	3	389	76	166	223	73	3
2015	665	250		19	915	19	665	250		19

Table 22. Number of length samples by region, year, and season for the discarded component of the scallop dredge skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Gulf of Maine [GM] and Georges Bank [GB], first 4 columns) and area combined (columns under GM-GB). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		GM-GB		Half 1		Half 2	
Year	GB	GM	GB	GM	Half 1	Half 2	GB	GM	GB	GM
1994			332			332			332	
1995										
1996			45			45			45	
1997	9				9		9			
1998	1499				1,499		1499			
1999	110		768		110	768	110		768	
2000	46		4		46	4	46		4	
2001										
2002			756	6		762			756	6
2003	12		80		12	80	12		80	
2004	652	2	1,123	244	654	1,367	652	2	1,123	244
2005	1,016	26	2,124		1,042	2,124	1,016	26	2,124	
2006	440		2,949		440	2,949	440		2,949	
2007	1,714		3,514		1,714	3,514	1,714		3,514	
2008	1,799		2,604	6	1,799	2,610	1,799		2,604	6
2009	845		799		845	799	845		799	
2010	374		2,032	58	374	2,090	374		2,032	58
2011	361		1,049		361	1,049	361		1,049	
2012	1,885		4,751		1,885	4,751	1,885		4,751	
2013	2,183	33	1,707	24	2,216	1,731	2,183	33	1,707	24
2014	1,135	15	1,264	8	1,150	1,272	1,135	15	1,264	8
2015	2,300	10	171	2	2,310	173	2,300	10	171	2

Table 23. Number of length samples by region, year, and season for the discarded component of the scallop dredge skate catch (all species) from the Observer Program. The lines indicate which years were pooled by area (Southern New England [SNE] and Mid-Atlantic [MA], first 4 columns) and area combined (columns under SNE-MA). The third part of the table shows the final pooling chosen.

	Half 1		Half 2		SNE-MA		Half 1		Half 2	
	SNE	MA	SNE	MA	Half 1	Half 2	SNE	MA	SNE	MA
1994				354		354				354
1995										
1996		379			379			379		
1997		52		179	52	179		52		179
1998										
1999										
2000				86		86				86
2001				57		57				57
2002				2,125		2,125				2,125
2003		1,525		987	1,525	987		1,525		987
2004		6,762	19	7,527	6,762	7,546		6,762	19	7,527
2005	104	2,640	102	1,940	2,744	2,042	104	2,640	102	1,940
2006				3,844		3,844				3,844
2007	113	2,706		3,819	2,819	3,819	113	2,706		3,819
2008	23	8,422	115	4,957	8,445	5,072	23	8,422	115	4,957
2009		7,135	26	2,190	7,135	2,216		7,135	26	2,190
2010	56	4,869		3,517	4,925	3,517	56	4,869		3,517
2011	13	4,121		1,454	4,134	1,454	13	4,121		1,454
2012		3,574		1,468	3,574	1,468		3,574		1,468
2013		1,105	62	1,324	1,105	1,386		1,105	62	1,324
2014		2,157	83	3,749	2,157	3,832		2,157	83	3,749
2015	153	2,554	92	2,306	2,707	2,398	153	2,554	92	2,306

Table 24. Number of length samples by year and season for the discarded component of the shrimp trawl and longline (LL) skate catch (all species)from the Observer Program in the Gulf of Maine (GM) and Georges Bank (GB) area.

	shrimp trawl (GM-GB)	
	1	2
1989	4	
1990		
1991		
1992		
1993		
1994	30	
1995	3	
1996	7	
1997		
1998	4	
1999		
2000		
2001		
2002		
2003		
2004	181	
2005	15	
2006	29	
2007		
2008		
2009	23	
2010		
2011		
2012		
2013		
2014		

	LL - both areas	
	1	2
1994		
1995		
1996		
1997		
1998		
1999		
2000		
2001		
2002		
2003	22	
2004	41	56
2005	74	13
2006	74	36
2007	3	52
2008	427	124
2009	11	63
2010	451	310
2011	130	17
2012	44	6
2013	10	26
2014	14	16

Table 25. Total landings (mt, live wt) of skates by species from 1968-2015, using the final pooling method. Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

Year	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
1968	2,689	2,793	315	596	81	1	8	6,483
1969	3,905	5,071	69	177	4	234	2	9,462
1970	1,363	2,312	66	361	26	0	0	4,128
1971	1,693	3,307	69	768	68	0	1	5,905
1972	3,380	3,638	119	1,529	154	0	2	8,823
1973	3,512	2,611	11	1,555	254	16	5	7,963
1974	1,594	1,662	6	344	35	10	1	3,651
1975	1,735	1,356	3	800	63	9	2	3,968
1976	336	657	2	169	21	23	3	1,212
1977	328	834	0	156	14	72	14	1,418
1978	540	555	0	159	29	66	3	1,353
1979	401	516	0	402	44	57	3	1,423
1980	595	391	0	520	94	38	12	1,650
1981	280	172	0	310	32	50	3	847
1982	268	246	0	342	18	3	0	878
1983	1,319	1,853	0	364	50	17	0	3,603
1984	1,453	2,336	0	331	11	14	12	4,156
1985	2,120	1,506	0	339	14	5	0	3,984
1986	2,793	1,084	0	241	20	113	2	4,253
1987	2,360	2,185	1	463	28	33	8	5,078
1988	3,603	2,752	1	757	108	20	24	7,264
1989	2,133	3,983	4	511	60	17	2	6,710
1990	5,820	4,279	7	1,112	120	61	3	11,403
1991	4,790	5,045	21	1,205	127	141	4	11,332
1992	5,465	6,163	43	635	62	120	38	12,525
1993	4,215	7,077	76	1,294	168	58	17	12,904
1994	6,212	952	207	1,915	2	173	2	9,463
1995	3,971	3,104	79	653	1	164	6	7,978
1996	9,516	2,889	324	1,670	0	1,135	6	15,539
1997	5,578	4,382	313	936	10	1,406	6	12,630
1998	7,852	6,151	127	1,375	11	717	16	16,250
1999	7,032	6,508	327	501	6	761	12	15,148
2000	7,423	5,621	456	1,109	224	1,157	22	16,012
2001	6,769	4,869	1,362	940	29	1,915	5	15,888
2002	7,347	4,012	1,084	961	24	1,287	25	14,740
2003	9,253	4,413	903	549	11	1,115	10	16,254
2004	10,983	3,414	909	546	7	1,185	20	17,063
2005	8,174	3,931	1,930	250	11	579	9	14,885
2006	9,021	3,838	3,283	243	24	753	5	17,168
2007	12,822	4,535	1,971	304	18	637	54	20,342
2008	11,973	4,569	2,821	115	22	666	24	20,191
2009	12,767	5,191	672	90	19	883	108	19,731
2010	12,370	4,409	1,030	203	48	617	8	18,683
2011	10,621	4,580	1,067	120	22	542	12	16,963
2012	9,227	4,563	2,470	71	3	802	7	17,144
2013	8,119	3,913	1,683	123	12	829	18	14,698
2014	8,715	3,981	2,516	177	3	500	13	15,904

Table 26. Total discards (mt, live wt) of skates by species from 1968-2015, using the final pooling method. Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

Year	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
1968	35 ,519	39,452	4,359	18,050	1,501	474	112	99,466
1969	31,764	40,884	1,311	14,863	901	860	10	90,593
1970	24,856	32,087	887	16,542	948	851	32	76,204
1971	17,029	22,455	674	17,772	1,867	584	9	60,391
1972	20,891	17,881	622	14,427	1,416	701	29	55,966
1973	19,983	21,121	85	15,920	1,975	340	33	59,457
1974	22,534	19,640	109	14,169	2,768	1,200	79	60,499
1975	15,499	20,744	43	14,108	745	569	50	51,758
1976	16,244	22,877	175	11,607	1,235	2,640	861	55,641
1977	27,322	21,545	3	13,657	1,242	2,650	293	66,710
1978	38,837	23,466	34	11,803	1,871	7,295	517	83,823
1979	41,242	31,612	21	13,001	1,417	3,999	187	91,478
1980	48,389	22,849	3	15,809	2,563	1,965	601	92,179
1981	52,939	21,826	3	14,987	1,331	1,937	152	93,175
1982	52,829	38,355	9	10,350	582	418	49	102,593
1983	56,193	32,992	1	10,282	1,098	4,094	46	104,708
1984	50,390	34,422	7	9,398	423	3,152	1,047	98,840
1985	43,767	25,501	4	9,883	488	1,278	20	80,941
1986	51,644	15,478	24	7,352	665	8,288	58	83,508
1987	45,440	30,851	20	6,101	429	6,177	1,536	90,554
1988	51,125	29,173	18	5,344	803	805	3,571	90,840
1989	47,770	39,318	32	5,146	541	3,492	364	96,661
1990	66,332	45,412	73	8,802	874	8,657	719	130,869
1991	37,598	25,401	59	6,645	642	9,604	161	80,110
1992	33,314	27,386	255	3,752	369	6,307	2,498	73,881
1993	17,268	33,266	375	5,495	603	1,453	644	59,105
1994	32,857	39,388	1,098	4,140	713	9,679	41	87,914
1995	17,865	36,638	223	1,251	468	4,113	375	60,932
1996	17,044	45,829	64	863	340	2,782	218	67,141
1997	9,250	19,571	578	1,286	429	616	57	31,786
1998	10,533	20,604	472	1,593	443	969	134	34,750
1999	7,498	17,685	1,034	687	252	959	43	28,158
2000	9,521	24,748	1,372	870	363	2,890	202	39,967
2001	14,554	17,948	1,351	1,114	252	748	74	36,041
2002	14,321	20,508	1,475	835	399	2,506	50	40,095
2003	15,699	32,173	1,101	1,564	569	1,079	27	52,212
2004	19,773	22,075	1,206	1,612	1,016	1,082	64	46,827
2005	16,015	22,789	2,885	1,373	1,365	1,847	204	46,477
2006	12,478	15,986	3,084	796	909	1,263	49	34,565
2007	15,712	21,085	3,272	737	476	3,583	56	44,921
2008	13,801	14,752	2,910	184	469	2,821	96	35,033
2009	16,847	14,483	2,256	376	402	2,996	82	37,442
2010	17,619	13,659	2,765	464	320	1,906	34	36,766
2011	19,049	11,689	4,625	396	625	2,353	28	38,764
2012	14,901	11,372	4,008	355	658	2,808	177	34,278
2013	18,449	16,065	4,010	493	449	3,105	128	42,700
2014	17,666	17,422	5,398	445	362	1,403	122	42,818

Table 27. Dead discards (mt, live wt) of skates by species from 1968-2015, using the final pooling method. Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

Year	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
1968	4,422	9,417	2,179	4,417	891	237	56	21,620
1969	3,563	9,574	656	3,690	536	430	5	18,454
1970	2,918	7,405	443	4,144	563	426	16	15,914
1971	1,990	5,373	337	4,617	1,101	292	5	13,715
1972	2,379	4,373	311	3,846	829	350	14	12,102
1973	2,323	4,958	42	4,218	1,160	170	17	12,888
1974	2,526	4,814	55	3,691	1,632	600	39	13,357
1975	1,823	5,659	21	3,976	435	285	25	12,225
1976	2,267	6,502	87	3,152	722	1,320	431	14,481
1977	4,306	6,262	1	3,807	728	1,325	146	16,575
1978	6,028	6,942	17	3,359	1,098	3,648	259	21,350
1979	6,674	8,975	10	3,791	822	1,999	93	22,366
1980	6,937	6,648	1	4,797	1,466	982	301	21,131
1981	8,137	6,113	2	4,493	764	969	76	20,552
1982	7,695	10,405	5	2,836	339	209	25	21,514
1983	7,493	9,165	1	2,854	639	2,047	23	22,221
1984	6,830	9,137	4	2,538	248	1,576	524	20,856
1985	5,941	7,430	2	2,622	287	639	10	16,931
1986	7,663	4,284	12	1,973	388	4,144	29	18,493
1987	7,866	9,930	10	1,686	250	3,089	768	23,599
1988	9,247	9,412	9	1,655	458	403	1,785	22,969
1989	9,811	12,047	16	1,621	307	1,746	182	25,729
1990	13,073	11,860	36	2,747	501	4,329	359	32,904
1991	8,571	8,273	29	2,348	358	4,802	80	24,462
1992	8,931	9,054	127	1,470	196	3,154	1,249	24,182
1993	3,452	10,812	188	1,817	339	727	322	17,657
1994	3,692	10,936	549	1,170	417	4,839	20	21,623
1995	3,292	13,383	112	371	273	2,056	187	19,674
1996	2,569	14,082	32	329	188	1,391	109	18,700
1997	1,715	7,451	289	412	239	308	28	10,442
1998	1,993	7,834	236	512	243	485	67	11,369
1999	1,584	6,776	517	214	143	480	22	9,735
2000	1,675	8,250	686	267	210	1445	101	12,634
2001	1,659	5,471	675	282	146	374	37	8,645
2002	2,813	7,816	738	219	231	1,253	25	13,095
2003	1,905	10,680	551	433	324	539	14	14,446
2004	2,618	6,605	603	404	597	541	32	11,399
2005	2,397	7,036	1,442	368	800	923	102	13,068
2006	2,031	5,292	1,542	241	528	631	25	10,291
2007	2,435	7,103	1,636	217	273	1,791	28	13,483
2008	1,994	5,139	1,455	62	260	1,411	48	10,368
2009	2,746	4,764	1,128	106	232	1,498	41	10,516
2010	3,003	5,333	1,382	128	184	953	17	10,999
2011	3,158	3,991	2,312	113	356	1,177	14	11,121
2012	2,466	4,013	2,004	104	374	1,404	88	10,454
2013	3,013	4,847	2,005	142	253	1,553	64	11,878
2014	3,104	6,110	2,699	135	204	701	61	13,014

Table 28. Total catch (mt, live wt, landings + dead discards) of skates by species from 1968-2015, using the final pooling method. Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

Year	Winter	Little	Barndoor	Thorny	Smooth	Clearnose	Rosette	Total
1968	7,111	12,210	2,495	5,013	972	238	64	28,103
1969	7,469	14,644	725	3,867	540	664	7	27,916
1970	4,280	9,717	510	4,505	588	426	16	20,042
1971	3,682	8,681	406	5,385	1,169	292	5	19,620
1972	5,759	8,011	430	5,375	983	351	16	20,925
1973	5,835	7,569	53	5,773	1,414	185	22	20,851
1974	4,120	6,476	61	4,035	1,667	610	40	17,008
1975	3,558	7,015	25	4,776	499	294	27	16,193
1976	2,603	7,159	89	3,321	744	1,343	434	15,693
1977	4,634	7,096	1	3,963	742	1,397	160	17,993
1978	6,568	7,497	17	3,518	1,127	3,713	262	22,703
1979	7,075	9,492	11	4,193	866	2,056	97	23,788
1980	7,532	7,038	1	5,316	1,560	1,021	313	22,781
1981	8,417	6,285	2	4,803	796	1,019	79	21,400
1982	7,964	10,651	5	3,178	357	213	25	22,392
1983	8,812	11,018	1	3,217	689	2,064	23	25,824
1984	8,283	11,473	4	2,869	259	1,590	536	25,013
1985	8,061	8,936	2	2,961	301	644	10	20,915
1986	10,456	5,368	12	2,215	408	4,257	31	22,747
1987	10,226	12,115	11	2,149	279	3,122	776	28,677
1988	12,850	12,163	11	2,412	566	423	1,810	30,234
1989	11,944	16,030	20	2,132	367	1,763	183	32,439
1990	18,893	16,139	43	3,859	621	4,390	363	44,307
1991	13,360	13,317	51	3,553	486	4,943	84	35,794
1992	14,396	15,218	170	2,105	258	3,273	1,287	36,708
1993	7,667	17,889	263	3,111	507	785	339	30,561
1994	9,904	11,888	756	3,084	418	5,012	23	31,085
1995	7,264	16,486	191	1,024	274	2,221	193	27,652
1996	12,085	16,971	356	1,999	188	2,526	115	34,240
1997	7,293	11,832	602	1,348	250	1,714	34	23,073
1998	9,845	13,985	364	1,887	254	1,202	83	27,619
1999	8,616	13,284	844	715	150	1,240	34	24,883
2000	9,099	13,870	1,142	1,376	434	2,602	123	28,646
2001	8,428	10,340	2,037	1,222	175	2,289	42	24,533
2002	10,161	11,828	1,821	1,180	254	2,540	50	27,835
2003	11,159	15,093	1,454	982	335	1,655	23	30,700
2004	13,600	10,019	1,512	950	603	1,726	52	28,463
2005	10,571	10,968	3,373	617	810	1,503	111	27,952
2006	11,052	9,131	4,825	484	553	1,384	30	27,459
2007	15,257	11,638	3,607	522	291	2,428	82	33,825
2008	13,967	9,708	4,276	178	281	2,077	72	30,559
2009	15,513	9,955	1,800	196	251	2,381	149	30,247
2010	15,373	9,742	2,413	330	231	1,569	25	29,682
2011	13,779	8,571	3,379	233	378	1,719	26	28,084
2012	11,694	8,576	4,474	175	377	2,206	96	27,597
2013	11,132	8,761	3,687	266	265	2,382	82	26,575
2014	11,818	10,091	5,215	312	208	1,201	73	28,919

Table 29. Landings of thorny skate (*Amblyraja radiata*) and total and dead discards of thorny skate by gear type (ll = longline; ot = otter trawl + shrimp trawl; sgn = sink gill net; sd = scallop dredge).

		Total discards				Dead Discards				
	Landings	ll	ot	sgn	sd	ll	ot	sgn	sd	Total Catch
1968	595.7	200.4	17,065.7	42.4	741.5	100.2	3,925.1	21.2	370.7	5,013.0
1969	177.3	226.8	13,856.6	30.2	748.9	113.4	3,187.0	15.1	374.4	3,867.3
1970	360.7	283.4	15,283.6	26.3	948.8	141.7	3,515.2	13.2	474.4	4,505.2
1971	767.8	516.2	15,811.5	24.7	1,419.9	258.1	3,636.6	12.4	710.0	5,384.8
1972	1,529.4	505.5	12,473.8	35.7	1,412.5	252.7	2,869.0	17.8	706.2	5,375.2
1973	1,555.2	567.8	13,860.8	40.1	1,451.2	283.9	3,188.0	20.0	725.6	5,772.8
1974	344.0	554.1	12,566.7	66.6	981.3	277.0	2,890.3	33.3	490.6	4,035.3
1975	800.1	592.8	11,398.3	80.5	2,036.0	296.4	2,621.6	40.2	1,018.0	4,776.4
1976	169.5	305.6	9,821.2	112.6	1,367.9	152.8	2,258.9	56.3	684.0	3,321.4
1977	155.7	221.8	11,190.3	190.0	2,054.9	110.9	2,573.8	95.0	1,027.4	3,962.9
1978	159.0	190.3	9,416.1	205.3	1,991.2	95.2	2,165.7	102.7	995.6	3,518.1
1979	401.7	280.3	10,033.7	143.7	2,543.0	140.2	2,307.8	71.9	1,271.5	4,193.0
1980	519.6	173.4	11,511.2	184.8	3,939.8	86.7	2,647.6	92.4	1,969.9	5,316.1
1981	310.3	120.7	11,114.2	270.5	3,481.8	60.4	2,556.3	135.2	1,740.9	4,803.1
1982	341.7	68.1	8,664.0	112.6	1,505.6	34.1	1,992.7	56.3	752.8	3,177.6
1983	363.7	36.1	8,471.7	122.2	1,651.9	18.0	1,948.5	61.1	825.9	3,217.3
1984	330.8	24.7	8,005.4	136.5	1,231.9	12.3	1,841.2	68.2	616.0	2,868.6
1985	338.7	28.8	8,591.6	145.0	1,117.7	14.4	1,976.1	72.5	558.9	2,960.6
1986	241.2	33.5	6,306.4	174.5	837.9	16.8	1,450.5	87.3	419.0	2,214.7
1987	462.9	34.0	5,054.6	159.8	853.1	17.0	1,162.6	79.9	426.5	2,148.9
1988	756.9	37.3	3,768.4	141.4	1,397.3	18.6	866.7	70.7	698.7	2,411.6
1989	510.8	46.0	3,526.4	62.5	1,511.0	23.0	811.1	31.3	755.5	2,131.7
1990	1,112.2	65.6	6,127.9	299.6	2,309.3	32.8	1,409.4	149.8	1,154.7	3,858.9
1991	1,204.6	240.0	3,609.0	140.1	2,656.3	120.0	830.1	70.1	1,328.1	3,552.9
1992	634.8	173.0	1,502.6	138.3	1,938.4	86.5	345.6	69.1	969.2	2,105.3
1993	1,293.6	11.6	3,445.2	81.1	1,957.0	5.8	792.4	40.5	978.5	3,110.9
1994	1,914.8	18.6	3,334.4	31.0	755.9	9.3	766.9	15.5	377.9	3,084.5
1995	652.6	13.8	942.8	52.6	241.9	6.9	216.8	26.3	120.9	1,023.6
1996	1,670.0	18.1	377.7	20.4	446.7	9.0	86.9	10.2	223.3	1,999.4
1997	936.1	16.0	855.7	7.1	406.9	8.0	196.8	3.5	203.4	1,347.8
1998	1,375.5	9.4	1,054.5	8.7	520.6	4.7	242.5	4.3	260.3	1,887.3

Table 29, continued. Landings of thorny skate (*Amblyraja radiata*) and total and dead discards of thorny skate by gear type (ll = longline; ot = otter trawl + shrimp trawl; sgn = sink gill net; sd = scallop dredge).

		Total discards				Dead Discards				Total Catch
	Landings	ll	ot	sgn	sd	ll	ot	sgn	sd	
1999	501.5	4.3	481.3	12.0	189.5	2.2	110.7	6.0	94.8	715.2
2000	1,109.5	6.6	622.3	83.7	156.9	3.3	143.1	41.9	78.4	1,376.2
2001	940.2	2.0	1,020.6	32.0	59.6	1.0	234.7	16.0	29.8	1,221.7
2002	961.3	2.6	735.0	32.4	65.2	1.3	169.0	16.2	32.6	1,180.4
2003	549.1	7.7	1,292.3	44.3	219.3	3.9	297.2	22.2	109.6	982.0
2004	546.2	1.6	1,488.9	53.0	68.2	0.8	342.4	26.5	34.1	950.0
2005	249.5	12.2	1,180.9	53.4	126.8	6.1	271.6	26.7	63.4	617.3
2006	243.2	5.0	581.1	32.4	177.9	2.5	133.6	16.2	88.9	484.5
2007	304.4	5.1	559.9	34.4	137.2	2.5	128.8	17.2	68.6	521.5
2008	115.4	2.1	109.3	11.4	60.9	1.1	25.1	5.7	30.5	177.8
2009	89.9	2.6	301.5	17.3	54.2	1.3	69.4	8.7	27.1	196.3
2010	202.6	7.4	387.9	23.2	46.1	3.7	89.2	11.6	23.0	330.2
2011	120.0	5.1	315.7	17.4	57.6	2.5	72.6	8.7	28.8	232.7
2012	70.7	2.1	271.2	14.6	67.4	1.0	62.4	7.3	33.7	175.1
2013	123.4	4.1	385.9	15.4	87.9	2.0	88.7	7.7	44.0	265.8
2014	176.7	2.8	322.8	14.2	105.1	1.4	74.2	7.1	52.6	312.0

Table 30. Abundance and biomass from Northeast Fisheries Science Center (NEFSC) spring surveys for thorny skate (Amblyraja radiata) for the Gulf of Maine to Southern New England region (offshore strata 1-30, 34-40). The mean index (mn), 95% confidence intervals (L [lower], U [upper]), individual fish weight (ind wt [kg]), minimum, mean (mn), and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1968-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
1968	2.694	1.704	3.683		1.514	0.973	2.054		1.779		12	16	42	46.2	87	105		54	236	51,218	5.0	125.2	91	180
1969	4.620	3.238	6.002		1.705	1.177	2.232		2.711		12	13	48	51.5	98	109		64	294	51,218	5.5	125.3	84	190
1970	4.269	3.280	5.257		2.016	1.496	2.537		2.117		12	16	41	48.1	95	110		82	361	51,218	6.0	129.7	93	199
1971	3.801	2.577	5.025		2.007	1.498	2.517		1.894		12	15	44	47.8	95	116		81	424	51,218	6.0	124.7	89	203
1972	5.052	3.803	6.301		2.244	1.790	2.697		2.252		12	16	47	50.8	94	110		88	440	51,218	6.4	127.1	92	206
1973	6.731	4.946	8.515		3.609	2.672	4.546		1.865		12	16	44	48.1	91	108		74	571	51,218	6.7	124.9	102	219
1974	3.797	2.951	4.643		2.462	1.942	2.981		1.542		9	14	43	45.8	88	106		78	369	51,218	7.1	127.9	103	177
1975	3.189	2.222	4.157		1.360	0.990	1.731		2.344		10	15	46	50.4	95	102		62	192	49,391	6.9	122.5	103	188
1976	2.919	2.051	3.787		1.690	1.294	2.086		1.727		13	15	42	47.1	90	106		77	337	51,218	7.2	128.0	94	200
1977	1.636	1.182	2.091		0.945	0.674	1.217		1.731		12	15	42	48.1	89	111		72	210	51,218	5.9	123.6	116	207
1978	1.197	0.756	1.638		0.793	0.569	1.016		1.510		10	15	49	46.3	83	97		68	185	51,218	5.2	122.7	115	220
1979	1.120	0.769	1.471		0.620	0.447	0.792		1.807		12	17	50	50.0	83	102		69	168	51,218	5.9	122.8	110	281
1980	2.132	1.323	2.942		1.299	0.857	1.740		1.642		11	13	38	44.2	92	100		58	240	51,218	6.1	124.6	110	239
1981	2.694	2.053	3.336		1.499	1.097	1.900		1.798		9	13	48	48.7	87	100		57	244	51,046	5.8	125.5	119	179
1982	2.367	1.697	3.036		1.155	0.885	1.426		2.049		10	17	53	52.4	85	97		60	216	51,218	5.5	129.3	110	192
1983	2.178	1.421	2.934		0.985	0.740	1.229		2.212		12	15	52	52.3	91	103		55	156	51,218	6.3	126.3	102	188
1984	1.438	0.795	2.082		0.579	0.438	0.720		2.484		16	16	52	54.2	96	100		38	90	51,218	6.2	128.0	95	185
1985	3.097	2.133	4.061		1.414	1.058	1.771		2.190		11	14	44	48.5	95	102		58	205	51,218	6.2	127.9	88	177
1986	2.644	1.990	3.298		1.735	1.390	2.081		1.524		10	15	38	43.9	83	98		67	274	51,218	7.2	128.5	100	189
1987	1.466	0.792	2.140		0.841	0.634	1.048		1.744		14	16	42	46.8	87	109		51	135	50,654	6.2	128.8	108	182
1988	1.168	0.722	1.613		1.102	0.756	1.448		1.060		11	13	32	38.3	82	98		56	172	50,654	6.4	126.6	91	176
1989	1.481	0.794	2.169		1.221	0.801	1.640		1.214		11	15	34	40.0	84	101		57	175	50,654	4.5	127.6	86	170
1990	1.571	0.828	2.314		1.077	0.668	1.486		1.458		14	16	39	44.8	82	99		48	158	50,482	5.3	127.5	90	173
1991	1.521	0.917	2.126		0.805	0.517	1.093		1.890		11	15	48	49.7	89	99		44	120	50,654	6.5	131.1	91	171
1992	1.093	0.622	1.565		0.612	0.384	0.840		1.785		14	15	47	48.4	89	102		31	86	49,945	6.1	125.7	92	166
1993	0.691	0.353	1.028		0.472	0.311	0.633		1.464		13	13	36	42.3	91	105		35	75	50,478	5.5	123.6	101	170
1994	0.412	0.226	0.599		0.413	0.254	0.571		0.999		12	14	38	39.7	66	92		38	74	50,478	6.7	126.2	98	173
1995	0.574	0.313	0.835		0.391	0.240	0.542		1.468		9	12	42	45.8	84	92		31	66	50,654	7.1	127.2	102	172
1996	0.377	0.181	0.573		0.318	0.100	0.535		1.188		13	18	36	41.5	80	93		23	62	50,654	6.1	126.4	108	167
1997	0.429	0.119	0.739		0.275	0.156	0.394		1.561		15	20	47	47.9	82	87		25	47	50,478	6.7	120.7	93	174
1998	0.489	0.212	0.765		0.339	0.240	0.438		1.440		12	14	35	40.8	89	98		42	85	50,654	5.9	125.5	92	200
1999	0.369	0.093	0.646		0.255	0.163	0.347		1.448		11	17	40	46.2	83	89		26	44	50,121	6.7	127.1	98	172
2000	0.431	0.169	0.692		0.478	0.013	0.943		0.901		12	12	24	34.0	82	89		28	103	50,654	7.3	121.3	105	174
2001	0.501	0.221	0.781		0.224	0.081	0.368		2.230		14	33	56	57.7	80	92		16	35	50,654	6.5	131.1	99	174
2002	0.337	0.140	0.534		0.253	0.130	0.376		1.335		13	15	38	41.9	88	93		24	53	50,654	7.5	126.1	96	176
2003	0.605	0.274	0.936		0.337	0.206	0.469		1.793		19	19	50	50.9	86	102		30	57	50,654	5.5	127.2	98	169
2004	0.373	0.181	0.565		0.210	0.126	0.295		1.774		15	15	47	50.2	91	95		21	47	50,654	5.0	128.7	95	173
2005	0.444	0.157	0.731		0.378	0.170	0.586		1.175		16	17	44	44.4	76	89		19	62	50,654	5.5	127.4	95	172
2006	0.205	0.036	0.374		0.189	0.021	0.358		1.084		12	14	41	41.9	83	87		15	29	50,654	7.1	125.4	92	181
2007	0.396	0.147	0.644		0.437	0.232	0.642		0.906		9	11	24	32.3	88	98		26	99	50,654	5.9	123.4	96	186
2008	0.259	0.089	0.429		0.187	0.087	0.286		1.387		10	12	37	41.5	90	94		20	39	50,654	6.0	124.6	101	180
2009	0.155	0.086	0.225		0.152	0.087	0.216		1.025		13	14	37	39.5	74	97		41	162	50,654	6.2	125.9	103	220
2010	0.202	0.122	0.281		0.201	0.125	0.278		1.001		11	13	34	38.1	76	96		46	183	50,654	6.9	124.3	98	214
2011	0.211	0.136	0.286		0.207	0.125	0.289		1.022		12	12	28	35.3	87	94		47	176	50,654	7.0	127.3	101	198
2012	0.168	0.090	0.245		0.255	0.102	0.408		0.657		12	12	24	31.4	61	98		52	214	50,654	8.1	124.8	102	215
2013	0.093	0.040	0.147		0.128	0.061	0.195		0.729		11	14	29	34.6	64	91		35	179	50,654	7.1	123.8	105	223
2014	0.190	0.090	0.291		0.168	0.109	0.228		1.131		11	16	41	42.2	66	94		46	141	50,654	6.9	129.5	125	196
2015	0.280	0.102	0.457		0.191	0.118	0.265		1.461		14	25	45	47.5	74	97		48	177	50,654	6.1	124.2	106	215

Table 31. Abundance and biomass from Northeast Fisheries Science Center (NEFSC) fall surveys for thorny skate (Amblyraja radiata) for the Gulf of Maine to Southern New England region (offshore strata 1-30, 34-40). The mean index (mn), 95% confidence intervals (L [lower], U [upper]), individual fish weight (ind wt [kg]), minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1963-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
1963	5.082	3.511	6.652		1.632	1.262	2.002		3.114		10	16	60	59.4	97	107		64	291	49,945	8.6	120.6	333	164
1964	4.332	3.193	5.472		1.671	1.121	2.221		2.593		10	14	49	52.5	95	110		71	312	51,218	7.9	119.8	313	170
1965	4.542	3.318	5.765		1.857	1.266	2.448		2.445		10	14	45	49.3	95	107		62	389	51,218	8.4	120.9	296	173
1966	7.958	6.118	9.798		2.375	1.850	2.900		3.350		9	13	62	59.2	95	112		77	389	51,218	7.8	119.6	301	169
1967	2.806	1.496	4.117		1.005	0.396	1.615		2.792		12	14	50	52.5	95	100		54	166	51,218	7.5	124.7	318	190
1968	4.508	3.395	5.622		1.464	1.057	1.871		3.080		12	16	56	57.5	97	107		59	217	51,218	9.3	128.9	307	188
1969	5.749	4.331	7.167		1.865	1.382	2.348		3.083		12	14	56	56.6	97	106		71	287	51,218	9.1	128.0	306	188
1970	7.432	5.687	9.178		2.240	1.486	2.995		3.318		8	19	57	60.4	98	109		75	400	51,218	9.2	122.0	304	193
1971	5.327	4.103	6.551		1.425	1.081	1.768		3.739		12	18	64	64.2	99	111		66	276	51,218	10.0	126.1	296	208
1972	4.130	2.968	5.291		1.708	1.286	2.130		2.418		12	17	52	53.3	94	105		71	297	51,218	10.3	121.1	299	202
1973	4.628	3.269	5.988		1.551	1.142	1.960		2.984		12	17	60	61.3	95	111		70	272	51,218	10.6	126.8	296	194
1974	3.003	2.116	3.889		1.349	0.976	1.721		2.227		10	14	51	51.7	90	111		75	277	51,218	10.7	126.9	289	200
1975	2.455	1.448	3.461		1.002	0.687	1.318		2.449		10	12	48	50.2	94	106		66	222	51,218	10.0	122.7	293	209
1976	1.749	1.020	2.479		0.811	0.552	1.070		2.157		12	15	45	49.1	91	103		57	143	51,218	10.7	123.4	302	190
1977	3.157	2.448	3.867		1.524	1.198	1.850		2.072		10	13	50	50.5	89	107		106	437	51,218	10.4	123.6	308	236
1978	4.192	3.379	5.005		2.089	1.579	2.600		2.007		10	16	50	51.2	89	107		151	852	51,218	9.3	124.7	294	370
1979	3.663	2.786	4.540		1.292	0.867	1.718		2.834		11	23	60	59.8	89	101		132	483	50,121	10.1	123.0	301	369
1980	4.579	3.309	5.850		1.846	1.459	2.234		2.480		11	14	56	54.6	90	100		82	404	51,218	10.0	122.2	297	209
1981	3.284	2.494	4.074		1.251	0.904	1.599		2.624		12	18	57	58.1	90	103		68	205	51,218	9.2	125.0	296	190
1982	0.655	0.315	0.995		0.389	0.186	0.591		1.686		11	13	35	43.4	85	96		29	81	51,218	10.0	123.2	294	190
1983	2.423	1.553	3.293		0.834	0.587	1.082		2.904		15	23	57	58.9	93	108		47	118	50,121	9.9	123.5	292	178
1984	2.851	1.934	3.769		1.254	0.957	1.551		2.274		10	13	49	49.5	95	107		66	202	51,218	10.5	129.8	287	186
1985	2.890	1.762	4.019		1.447	1.096	1.797		1.998		12	16	50	49.5	88	103		64	258	51,218	10.2	125.1	298	181
1986	1.602	1.035	2.170		0.990	0.741	1.239		1.618		11	14	36	44.1	83	101		58	172	51,218	10.1	126.5	292	187
1987	0.945	0.587	1.304		0.851	0.606	1.096		1.111		12	14	37	40.1	78	92		48	142	50,654	9.0	126.5	284	174
1988	1.495	0.997	1.992		1.107	0.703	1.511		1.351		13	15	32	41.3	84	101		54	206	50,654	9.1	125.8	285	173
1989	1.810	0.896	2.723		1.101	0.756	1.447		1.643		12	14	40	45.7	85	101		60	187	50,654	8.6	125.7	286	172
1990	1.721	1.098	2.345		1.044	0.745	1.344		1.648		12	17	43	47.2	85	95		52	199	50,654	5.8	125.6	281	180
1991	1.636	0.505	2.766		0.924	0.589	1.258		1.771		13	15	48	49.4	86	108		53	150	50,654	10.1	121.3	279	173
1992	0.931	0.522	1.339		0.765	0.448	1.083		1.216		12	13	36	40.6	84	99		46	140	50,654	9.9	126.8	284	171
1993	1.686	0.650	2.722		0.907	0.439	1.376		1.858		12	13	50	48.1	91	101		49	155	50,654	10.0	128.1	279	171
1994	1.529	0.343	2.715		0.995	0.313	1.676		1.537		13	17	46	46.9	84	97		40	169	50,654	11.0	129.1	282	176
1995	0.776	0.318	1.234		0.641	0.177	1.105		1.210		13	14	40	42.0	72	99		35	105	50,654	11.0	124.5	278	177
1996	0.803	0.341	1.265		0.561	0.317	0.805		1.431		14	15	40	44.0	88	99		36	99	50,654	9.5	123.8	281	173
1997	0.838	0.388	1.289		0.398	0.233	0.564		2.105		12	20	51	52.1	83	99		30	76	50,654	10.5	123.5	284	175
1998	0.660	0.303	1.016		0.312	0.147	0.476		2.115		13	14	52	52.4	87	93		30	60	50,654	9.0	123.8	292	189
1999	0.459	0.228	0.691		0.315	0.182	0.447		1.460		13	14	42	46.2	88	94		35	68	50,654	11.4	122.0	295	191
2000	0.835	0.386	1.283		0.372	0.235	0.510		2.243		13	17	49	52.6	92	102		25	68	50,654	10.6	121.3	276	173
2001	0.321	0.074	0.568		0.294	0.156	0.433		1.090		16	17	43	43.7	74	82		22	59	50,654	10.0	122.3	277	175
2002	0.406	0.164	0.648		0.253	0.119	0.386		1.608		14	15	33	43.0	85	95		24	50	50,654	10.8	126.1	281	170
2003	0.755	0.457	1.052		0.946	0.171	1.720		0.798		12	14	23	34.2	74	89		34	175	50,654	10.0	126.9	280	173

Table 31, continued. Abundance and biomass from Northeast Fisheries Science Center (NEFSC) fall surveys for thorny skate (*Amblyraja radiata*) for the Gulf of Maine to Southern New England region (offshore strata 1-30, 34-40). The mean index (mn), 95% confidence intervals (L [lower],U [upper]), individual fish weight (ind wt [kg]), minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1963-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
2004	0.722	0.276	1.168		0.364	0.170	0.559		1.981		14	18	45	50.1	87	90		23	65	50,654	9.1	122.6	283	172
2005	0.204	0.078	0.330		0.197	-0.045	0.438		1.038		13	18	39	41.5	76	90		16	34	50,654	9.8	122.1	285	173
2006	0.739	0.393	1.085		0.258	0.157	0.360		2.860		13	15	51	54.6	93	94		27	52	50,654	10.7	121.0	277	200
2007	0.321	0.084	0.558		0.301	0.073	0.529		1.067		10	13	19	34.6	84	92		22	45	50,654	9.3	126.0	284	186
2008	0.199	0.032	0.365		0.121	0.052	0.189		1.650		14	14	25	40.0	84	89		15	26	50,654	4.1	125.0	284	186
2009	0.274	0.124	0.424		0.190	0.111	0.269		1.441		13	14	40	42.6	83	97		46	145	50,654	10.6	127.0	297	191
2010	0.301	0.145	0.456		0.306	0.129	0.482		0.984		12	13	31	36.6	82	109		43	211	50,654	11.0	125.3	299	191
2011	0.188	0.092	0.283		0.564	-0.149	1.277		0.333		11	12	17	24.5	54	94		42	432	50,654	11.0	127.2	290	177
2012	0.081	0.038	0.123		0.115	0.078	0.152		0.703		10	14	31	35.2	58	82		40	101	50,654	11.4	128.4	287	208
2013	0.110	0.063	0.158		0.107	0.074	0.141		1.027		12	13	35	38.7	65	99		41	104	50,654	10.8	125.3	294	207
2014	0.213	0.123	0.304		0.216	0.114	0.319		0.985		12	16	39	41.0	64	97		40	175	50,654	11.8	124.3	291	206
2015	0.186	0.110	0.263		0.139	0.079	0.199		1.342		11	16	41	44.0	74	101		36	143	50,654	na	128.4	283	215

Table 32. Minimum swept area biomass and abundance of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) spring and fall surveys.

	Spring survey		Fall Survey	
Year	Min Biomass (mt)	Min Abundance (000s)	Min Biomass (mt)	Min Abundance (000s)
1963			22,661.8	7,276.9
1964			19,812.0	7,639.5
1965			20,769.3	8,493.1
1966			36,393.0	10,862.8
1967			12,833.4	4,597.2
1968	12,318.4	6,923.1	20,617.4	6,694.4
1969	21,127.8	7,794.8	26,291.1	8,528.0
1970	19,521.4	9,220.5	33,988.5	10,245.2
1971	17,382.1	9,179.3	24,361.0	6,515.0
1972	23,103.2	10,260.2	18,885.9	7,810.8
1973	30,780.7	16,503.8	21,165.5	7,093.2
1974	17,364.6	11,258.3	13,732.4	6,166.8
1975	14,063.8	5,999.6	11,226.1	4,583.5
1976	13,347.5	7,729.6	8,000.3	3,708.4
1977	7,482.3	4,323.8	14,438.0	6,969.0
1978	5,475.2	3,625.4	19,170.8	9,553.5
1979	5,120.7	2,834.4	16,391.9	5,783.5
1980	9,751.8	5,939.2	20,940.7	8,443.7
1981	12,280.3	6,830.2	15,017.6	5,722.4
1982	10,823.0	5,282.4	2,995.5	1,776.8
1983	9,958.9	4,502.7	10,843.0	3,734.2
1984	6,577.8	2,648.0	13,039.0	5,733.7
1985	14,162.1	6,468.1	13,217.6	6,615.1
1986	12,090.9	7,936.3	7,327.1	4,529.0
1987	6,631.6	3,803.0	4,275.3	3,848.0
1988	5,280.3	4,983.6	6,760.3	5,005.9
1989	6,699.8	5,520.4	8,184.5	4,981.3
1990	7,079.8	4,854.8	7,785.6	4,723.7
1991	6,880.1	3,639.8	7,397.6	4,178.1
1992	4,874.5	2,730.5	4,208.5	3,461.6
1993	3,114.2	2,127.2	7,626.0	4,104.1
1994	1,858.3	1,859.8	6,915.6	4,498.5
1995	2,595.5	1,768.0	3,508.0	2,899.1
1996	1,705.7	1,436.2	3,631.6	2,538.7
1997	1,934.4	1,239.6	3,792.1	1,801.2
1998	2,209.5	1,534.0	2,982.9	1,410.5
1999	1,653.0	1,141.3	2,076.9	1,423.1
2000	1,947.0	2,162.1	3,775.4	1,683.0
2001	2,264.0	1,015.2	1,451.8	1,331.5
2002	1,525.2	1,142.3	1,837.0	1,142.7
2003	2,736.1	1,526.3	3,413.2	4,276.4
2004	1,687.6	951.2	3,265.7	1,648.2
2005	2,008.3	1,708.6	923.8	889.9
2006	928.0	856.5	3,340.7	1,168.3
2007	1,789.6	1,976.3	1,452.4	1,361.6
2008	1,171.9	844.7	899.0	545.0
2009	702.6	685.3	1,238.8	859.4
2010	911.6	910.4	1,360.8	1,382.7
2011	956.0	935.8	849.9	2,549.2
2012	757.7	1,153.9	365.0	518.9
2013	422.3	579.3	498.6	485.4
2014	861.6	761.6	964.2	978.7
2015	1,264.3	865.6	843.5	628.3

Table 33. Abundance and biomass from Atlantic States Marine Fisheries Commission shrimp trawl surveys for thorny skate (Amblyraja radiata) for shrimp strata 1, 3, 5-8). The mean index (mn), 95% confidence intervals (L [lower], U [upper]), individual fish weight (ind wt [kg]), minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1985-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
1985	7.320	4.345	10.295		1.427	0.833	2.021		5.129		-	-	-	-	-	-		32	59	6,147	4.0	187.8	221	44
1986	1.366	0.611	2.120		1.528	0.577	2.479		0.894		-	-	-	-	-	-		18	47	6,147	6.3	184.3	214	40
1987	4.969	0.804	9.134		3.201	2.269	4.133		1.552		-	-	-	-	-	-		30	95	6,147	6.0	151.5	221	41
1988	0.000	0.000	0.000		0.000	0.000	0.000		-		-	-	-	-	-	-		0	0	6,147	6.5	200.7	222	41
1989	1.053	0.346	1.760		0.694	0.398	0.991		1.517		-	-	-	-	-	-		23	32	6,147	5.6	183.7	217	43
1990	1.015	0.268	1.763		1.043	0.539	1.547		0.973		-	-	-	-	-	-		21	44	6,147	3.6	192.0	216	43
1991	0.419	0.005	0.833		0.744	0.376	1.112		0.564		-	-	-	-	-	-		18	34	6,147	6.1	145.3	214	43
1992	0.931	0.187	1.675		0.754	0.376	1.131		1.236		14	14	27	36.5	81	89		17	33	6,147	6.3	191.7	220	45
1993	1.508	0.244	2.771		1.540	-0.343	3.424		0.979		10	10	17	29.5	75	100		15	57	6,147	5.8	193.8	219	46
1994	0.839	-0.042	1.721		0.495	0.142	0.848		1.696		15	15	31	41.8	97	98		12	18	6,147	6.8	177.2	218	43
1995	0.597	0.074	1.119		0.370	0.166	0.574		1.613		10	10	19	39.3	83	98		11	14	6,147	6.6	178.3	218	35
1996	0.394	-0.200	0.988		0.263	0.064	0.463		1.495		8	8	37	41.6	83	84		8	13	6,147	7.1	172.8	216	32
1997	0.336	-0.119	0.792		0.097	0.007	0.187		3.477		13	13	67	60.1	85	86		5	5	6,147	6.8	188.0	213	40
1998	0.543	0.107	0.980		0.294	0.130	0.459		1.845		17	18	50	53.2	78	79		11	14	6,147	6.3	175.5	214	35
1999	2.359	1.048	3.670		0.909	0.518	1.300		2.595		12	15	54	56.6	87	99		19	44	6,147	6.1	180.6	212	42
2000	0.857	0.157	1.556		0.273	0.073	0.473		3.138		16	16	59	58.1	92	93		8	12	6,147	6.7	178.8	210	35
2001	0.405	-0.037	0.848		0.311	0.046	0.577		1.302		12	12	34	40.1	84	98		9	12	6,147	6.5	176.8	209	36
2002	1.624	0.566	2.682		0.560	0.338	0.782		2.9		11	11	62	56.5	95	101		15	24	6,147	7.1	178.1	208	38
2003	4.089	2.063	6.116		1.071	0.591	1.552		3.817		10	15	70	66.3	90	95		23	48	6,147	5.6	167.5	213	37
2004	0.159	0.004	0.315		0.064	0.007	0.120		2.504		49	49	62	63.4	81	82		4	5	6,147	4.7	181.0	214	35
2005	1.667	0.588	2.746		0.419	0.151	0.686		3.981		13	15	73	66.7	90	93		12	22	6,147	4.9	185.0	212	46
2006	0.911	0.275	1.547		0.232	0.094	0.370		3.925		21	21	75	65.8	98	99		8	13	6,147	7.1	180.9	213	29
2007	1.982	0.639	3.324		0.616	0.269	0.963		3.216		12	12	49	52.0	102	105		15	29	6,147	5.9	164.3	213	43
2008	1.052	0.345	1.760		0.811	0.352	1.270		1.298		14	14	21	34.8	87	93		16	32	6,147	5.9	176.1	216	37
2009	0.609	0.157	1.060		0.553	0.288	0.818		1.101		12	12	20	33.8	84	88		17	30	6,147	6.0	168.7	205	49
2010	0.897	0.286	1.509		0.399	0.187	0.610		2.251		14	15	35	47.9	87	90		14	23	6,147	7.4	172.8	203	49
2011	1.110	0.282	1.938		0.373	0.163	0.583		2.977		10	10	40	48.9	97	98		13	20	6,147	7.7	169.2	203	47
2012	0.650	0.122	1.178		0.343	0.117	0.569		1.896		12	12	15	37.9	97	102		12	22	6,147	7.9	170.7	217	49
2013	0.275	-0.002	0.552		0.258	0.109	0.408		1.066		14	14	32	38.2	91	92		12	16	6,147	7.1	175.4	214	46
2014	0.396	0.007	0.784		0.310	0.136	0.484		1.276		15	15	36	39.7	66	106		13	19	6,147	6.2	185.2	211	47
2015	0.862	0.214	1.510		0.255	0.061	0.449		3.381		30	30	54	59.6	95	96		9	15	6,147	5.8	176.5	213	32

Table 34. Abundance and biomass from Massachusetts Division of Marine Fisheries (DMF) spring trawl surveys for thorny skate (Amblyraja radiata) for the (Mass strata 11-36). The mean index (mn), 95% confidence intervals (L [lower], U [upper]), individual fish weight (ind wt [kg]), minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1978-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
1978	0.000	0.000	0.000		0.000	0.000	0.000		-		-	-	-	-	-	-		0	0	1,761	10.5	19.0	148	95
1979	0.375	-0.082	0.831		0.287	0.099	0.474		1.306		18	18	42	42.3	71	84		13	43	1,833	9.4	21.2	130	100
1980	0.073	-0.043	0.189		0.067	-0.006	0.140		1.088		19	19	27	36.1	83	84		4	9	1,833	9.5	21.4	135	98
1981	0.460	-0.123	1.043		0.188	0.015	0.362		2.440		20	20	44	50.6	90	91		6	22	1,833	8.6	21.4	133	97
1982	0.474	-0.147	1.096		0.147	0.021	0.273		3.227		17	17	57	54.5	95	96		11	16	1,833	8.1	19.6	132	95
1983	0.173	-0.082	0.428		0.153	0.005	0.301		1.130		13	26	38	41.5	59	85		5	19	1,833	9.0	21.6	136	94
1984	0.087	0.022	0.151		0.202	0.078	0.325		0.429		12	15	32	31.0	39	59		11	24	1,833	8.6	22.2	135	99
1985	0.472	-0.074	1.017		0.462	-0.051	0.974		1.022		13	15	27	35.8	77	97		12	51	1,833	9.2	22.3	134	93
1986	0.282	-0.053	0.617		0.308	-0.072	0.689		0.915		21	25	39	39.6	69	86		5	29	1,833	8.6	21.9	133	94
1987	0.037	-0.004	0.078		0.073	-0.005	0.151		0.507		24	24	37	35.3	43	44		4	9	1,833	8.8	22.5	131	97
1988	0.061	-0.011	0.133		0.123	0.030	0.216		0.498		18	18	31	34.2	60	61		6	13	1,833	8.5	22.0	138	91
1989	0.173	-0.034	0.380		0.240	-0.045	0.524		0.723		16	16	31	34.4	73	74		6	27	1,833	6.7	21.4	136	94
1990	0.056	0.011	0.102		0.107	0.039	0.176		0.524		22	22	31	32.9	46	47		7	12	1,833	8.2	22.1	135	95
1991	0.084	-0.008	0.176		0.070	0.006	0.135		1.197		31	31	40	46.6	62	63		5	10	1,833	10.4	21.4	134	98
1992	0.114	0.001	0.228		0.183	-0.062	0.429		0.624		17	17	22	30.3	72	73		4	16	1,833	8.4	21.6	134	92
1993	0.095	0.037	0.154		0.190	0.077	0.302		0.503		24	24	29	35.0	55	56		7	17	1,833	8.7	22.1	132	88
1994	0.000	0.000	0.000		0.000	0.000	0.000		-		-	-	-	-	-	-		0	0	1,833	8.3	22.2	137	87
1995	0.051	-0.032	0.135		0.110	-0.002	0.223		0.467		15	15	20	28.7	58	59		5	14	1,833	8.7	22.3	136	97
1996	0.140	0.021	0.259		0.227	0.067	0.387		0.617		15	15	37	34.9	59	60		8	32	1,833	8.3	22.2	135	101
1997	0.057	-0.016	0.130		0.141	0.012	0.270		0.406		22	22	29	32.3	55	56		5	14	1,833	8.3	22.3	133	98
1998	0.055	-0.044	0.155		0.070	-0.024	0.164		0.797		28	28	41	40.8	63	64		3	8	1,833	8.5	22.4	133	89
1999	0.038	-0.013	0.089		0.051	-0.014	0.115		0.747		27	27	34	39.2	54	55		3	4	1,833	10.3	22.1	138	96
2000	0.105	0.018	0.192		0.087	0.021	0.152		1.216		33	33	40	45.6	71	72		6	11	1,833	10.0	22.1	137	97
2001	0.157	0.008	0.306		0.184	-0.051	0.418		0.856		25	25	39	41.4	57	59		5	24	1,833	9.2	22.7	135	98
2002	0.041	-0.008	0.091		0.032	0.002	0.062		1.301		36	36	50	49.8	59	60		4	5	1,833	9.5	21.8	134	100
2003	0.085	-0.009	0.180		0.037	0.005	0.069		2.311		40	40	66	58.8	70	71		4	4	1,833	8.3	22.7	133	96
2004	0.086	-0.022	0.193		0.076	-0.011	0.163		1.127		34	34	47	47.6	62	63		4	10	1,833	8.4	21.9	132	99
2005	0.062	-0.047	0.170		0.030	-0.013	0.072		2.075		40	40	57	55.0	80	81		2	4	1,833	8.1	22.9	139	94
2006	0.093	-0.089	0.275		0.023	-0.022	0.068		4.050		54	54	91	73.0	91	92		1	2	1,833	9.5	22.3	137	100
2007	0.025	-0.012	0.062		0.029	-0.015	0.073		0.878		40	40	42	42.7	45	46		2	3	1,833	8.8	22.3	136	101
2008	0.157	0.007	0.307		0.083	0.011	0.155		1.900		35	35	44	52.4	77	78		6	8	1,833	8.2	22.5	134	103
2009	0.056	-0.018	0.129		0.050	0.014	0.086		1.119		14	14	27	39.8	66	67		5	5	1,833	8.9	21.9	132	101
2010	0.042	0.003	0.080		0.071	0.016	0.127		0.582		25	25	36	37.9	49	50		5	8	1,833	9.2	22.2	130	103
2011	0.029	-0.013	0.071		0.035	-0.003	0.072		0.830		35	35	40	43.0	56	57		3	4	1,833	8.9	21.7	131	102
2012	0.034	0.002	0.065		0.084	-0.014	0.181		0.404		30	30	30	34.2	45	46		3	8	1,833	10.9	22.0	135	100
2013	0.000	0.000	0.000		0.000	0.000	0.000		-		-	-	-	-	-	-		0	0	1,833	10.2	21.8	134	100
2014	0.012	-0.007	0.030		0.015	-0.003	0.033		0.780		31	31	51	41.5	51	52		2	2	1,833	9.1	22.4	133	102
2015	0.001	-0.001	0.003		0.007	-0.007	0.022		0.121		24	24	24	24.0	24	24		1	1	1,833	9.1	22.2	132	99

Table 35. Abundance and biomass from Massachusetts Division of Marine Fisheries (DMF) fall trawl surveys for thorny skate (Amblyraja radiata) for the (Mass strata 11-36). The mean index (mn), 95% confidence intervals (L [lower], U [upper]), individual fish weight (ind wt [kg]), minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of positive tows (pos), and number of fish (fish) caught, area sampled, mean bottom temperature (°C) and depth (m), mean day of year, and total number of tows are presented for 1978-2015.

	weight/tow (kg)				number/tow				ind		length (cm)														
	mn	L	U		mn	L	U		wt		min	5	50	mn	95	max		pos	fish	area	temp	depth	day	tows
1978	0.897	0.093	1.701		0.591	0.223	0.960		1.517		18	24	41	47.2	76	102		12	74	1,812	13.0	21.1	261	91
1979	0.308	-0.042	0.658		0.279	0.079	0.478		1.106		16	16	37	40.8	66	83		10	36	1,833	13.0	21.0	265	98
1980	0.262	0.061	0.462		0.195	0.059	0.331		1.341		15	15	37	40.3	79	97		12	29	1,833	14.7	21.2	262	97
1981	0.007	-0.004	0.017		0.015	-0.006	0.035		0.456		30	30	40	35.6	40	41		2	2	1,833	15.6	21.2	268	95
1982	0.104	-0.059	0.266		0.077	0.020	0.133		1.352		19	19	27	39.7	74	75		7	9	1,833	13.7	21.4	260	93
1983	0.608	0.088	1.128		0.705	0.399	1.012		0.862		14	14	27	35.5	66	96		14	70	1,833	13.6	21.2	258	85
1984	0.223	-0.111	0.556		0.197	0.030	0.363		1.132		14	14	28	35.8	96	97		7	20	1,833	13.8	21.8	262	92
1985	0.152	0.028	0.275		0.348	0.177	0.518		0.437		17	17	28	30.6	59	62		11	36	1,812	15.6	22.1	253	88
1986	0.208	0.052	0.364		0.306	0.135	0.478		0.679		17	18	33	36.2	61	66		12	41	1,833	14.0	22.1	258	90
1987	0.237	-0.014	0.488		0.157	0.022	0.292		1.509		14	19	32	40.2	86	87		8	15	1,797	12.3	22.5	260	88
1988	0.168	-0.162	0.498		0.435	-0.418	1.288		0.387		17	17	23	27.6	55	63		1	23	1,797	12.5	22.0	259	75
1989	0.208	0.181	0.234		0.332	0.273	0.391		0.625		13	13	26	32.2	66	67		5	15	1,739	13.9	21.8	255	68
1990	0.300	-0.051	0.652		0.252	-0.016	0.520		1.193		24	24	32	38.6	96	97		7	22	1,833	15.9	21.8	254	87
1991	0.451	-0.005	0.907		0.502	0.133	0.872		0.898		13	18	32	37.1	69	96		10	61	1,778	16.1	21.7	255	86
1992	0.154	0.056	0.251		0.230	0.094	0.365		0.668		15	17	30	33.1	64	78		8	26	1,833	13.7	22.0	261	77
1993	0.170	0.023	0.317		0.304	0.075	0.532		0.560		14	16	31	34.4	55	67		6	26	1,833	13.7	22.3	258	81
1994	0.008	-0.001	0.016		0.042	-0.010	0.095		0.178		15	15	21	24.0	30	31		3	5	1,833	15.9	22.2	257	97
1995	0.144	-0.012	0.299		0.247	0.026	0.468		0.583		11	17	30	33.8	55	57		7	30	1,833	10.4	22.0	256	95
1996	0.041	-0.018	0.100		0.058	-0.021	0.137		0.706		15	15	40	36.2	55	56		4	11	1,833	15.2	22.4	255	95
1997	0.098	-0.030	0.226		0.274	-0.018	0.566		0.358		22	22	31	32.7	51	52		3	15	1,833	15.3	21.6	259	90
1998	0.026	-0.025	0.076		0.014	-0.014	0.042		1.800		59	59	59	59.0	59	59		1	1	1,833	13.5	22.2	261	86
1999	0.114	-0.036	0.264		0.097	0.003	0.191		1.171		27	27	54	49.1	64	65		5	16	1,833	15.2	22.3	258	91
2000	0.107	-0.016	0.231		0.081	-0.012	0.174		1.321		17	17	48	46.4	67	68		3	10	1,833	15.9	21.9	257	93
2001	0.300	0.005	0.595		0.055	0.003	0.106		5.487		42	42	81	76.3	93	94		4	8	1,833	14.2	22.4	255	96
2002	0.303	-0.031	0.638		0.112	-0.005	0.229		2.705		41	41	64	63.0	82	83		6	13	1,833	16.4	22.0	254	89
2003	0.018	-0.003	0.039		0.019	0.002	0.035		0.967		31	31	42	44.3	58	59		3	3	1,833	14.4	22.3	253	93
2004	0.074	0.010	0.139		0.042	0.010	0.075		1.750		41	41	56	54.6	63	64		5	7	1,833	13.0	22.3	265	84
2005	0.002	-0.002	0.005		0.009	-0.009	0.027		0.200		29	29	29	29.0	29	29		1	1	1,833	14.5	23.1	256	92
2006	0.179	0.046	0.311		0.147	0.003	0.292		1.212		27	27	49	47.4	66	67		4	16	1,833	15.2	22.2	259	96
2007	0.071	-0.027	0.169		0.025	-0.004	0.054		2.854		22	22	75	51.4	77	78		3	3	1,812	14.4	22.1	254	101
2008	0.140	-0.034	0.314		0.100	0.014	0.186		1.399		22	22	29	42.0	88	89		5	10	1,833	15.8	22.2	255	98
2009	0.108	-0.034	0.250		0.095	0.025	0.166		1.133		22	22	37	42.4	78	79		5	11	1,812	15.9	21.8	259	96
2010	0.071	-0.046	0.187		0.051	-0.012	0.114		1.378		30	30	40	46.9	74	75		3	6	1,833	15.1	21.5	258	90
2011	0.395	-0.070	0.860		0.500	0.109	0.890		0.791		18	22	39	41.8	63	81		9	55	1,833	15.6	21.8	257	93
2012	0.023	-0.007	0.052		0.051	-0.009	0.110		0.445		23	23	32	34.9	49	50		3	6	1,833	15.2	21.3	257	92
2013	0.027	-0.007	0.061		0.037	0.001	0.072		0.735		33	33	41	41.9	53	54		4	4	1,833	14.9	21.7	254	98
2014	0.047	-0.005	0.099		0.053	0.008	0.099		0.872		28	28	37	41.4	67	68		5	6	1,833	15.0	21.6	252	100
2015	0.070	-0.002	0.141		0.106	0.026	0.186		0.661		16	16	36	35.7	64	65		6	9	1,833	15.7	22.1	259	94

Table 36. Ratio of the bottom longline survey to the bottom trawl survey (LLS/BTS) of thorny skate (*Amblyraja radiata*) stratified mean number and weight per set/tow of the LLS to the BTS for all stations types combined, and for rough and smooth station type, in the Gulf of Maine (strata 27, 28, 29, 36, 37) during spring and fall, 2014-2015.

Year season	2014 spring	2014 fall	2015 spring	2015 fall
mean number	1.32	1.32	1.32	1.65
mean weight	1.56	1.74	1.03	2.52

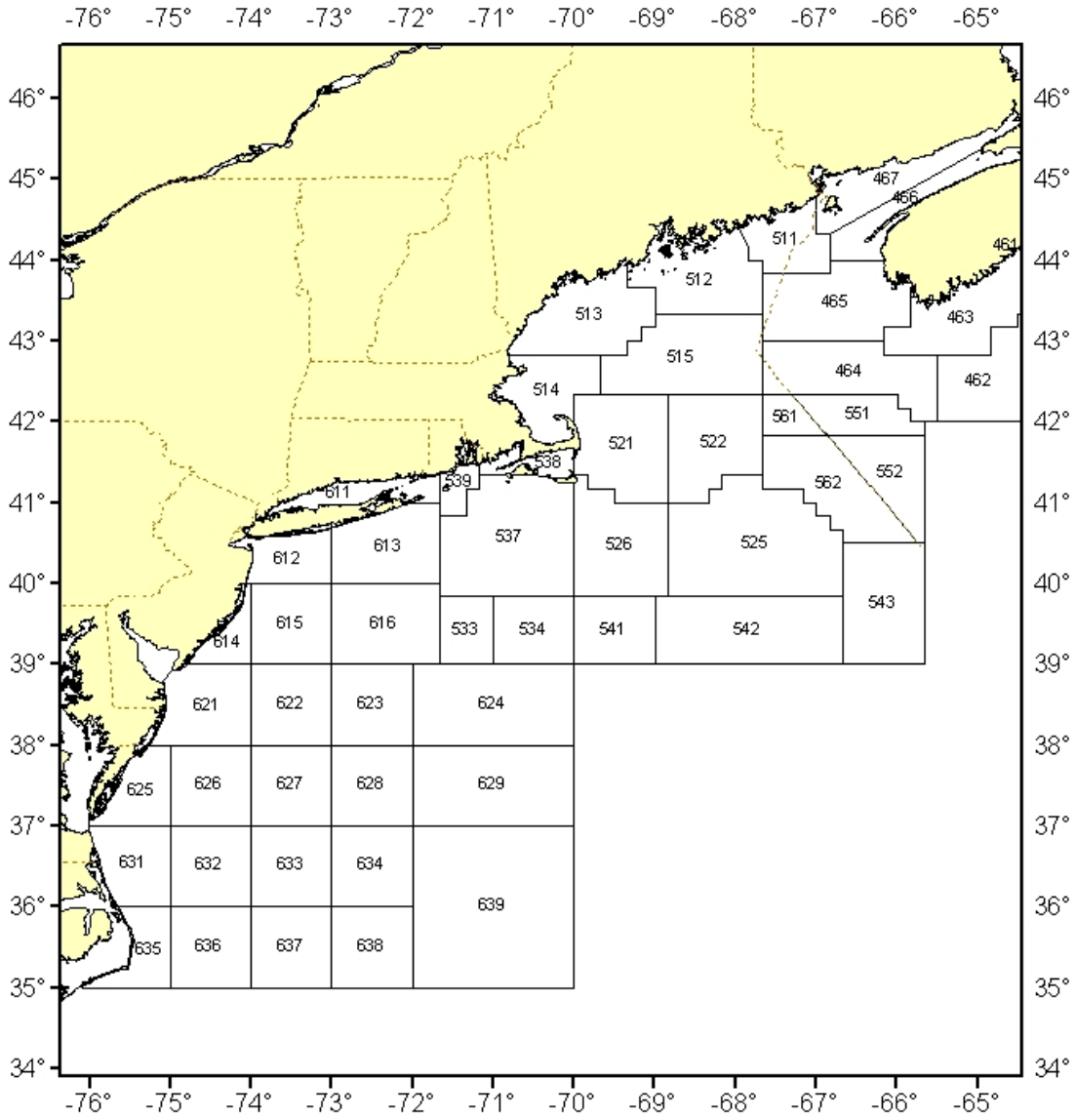

Figure 1. Statistical areas used for reporting United States commercial landings of all species of fish.

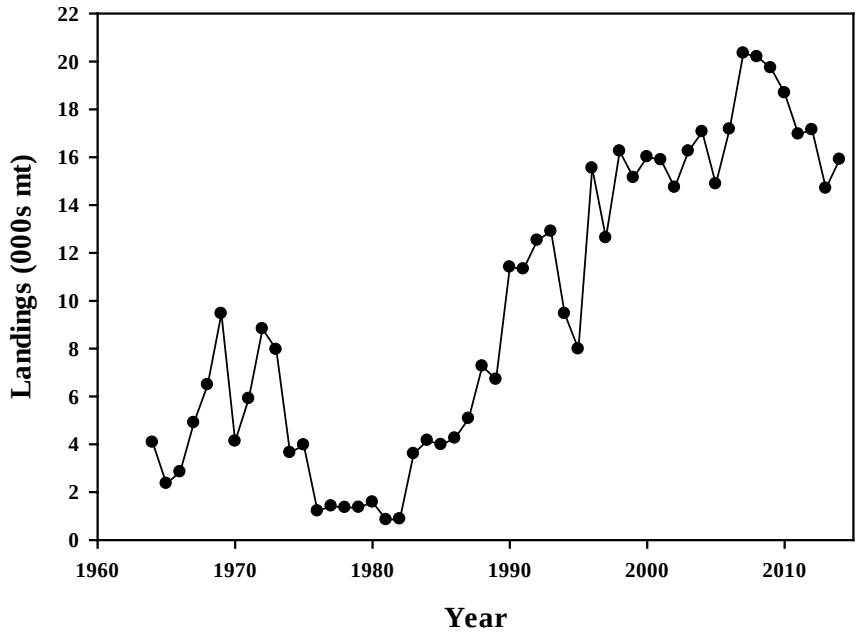

Figure 2. Total reported landings of skates (all species) in Northwest Atlantic Fisheries Organization (NAFO) subareas 5 and 6.

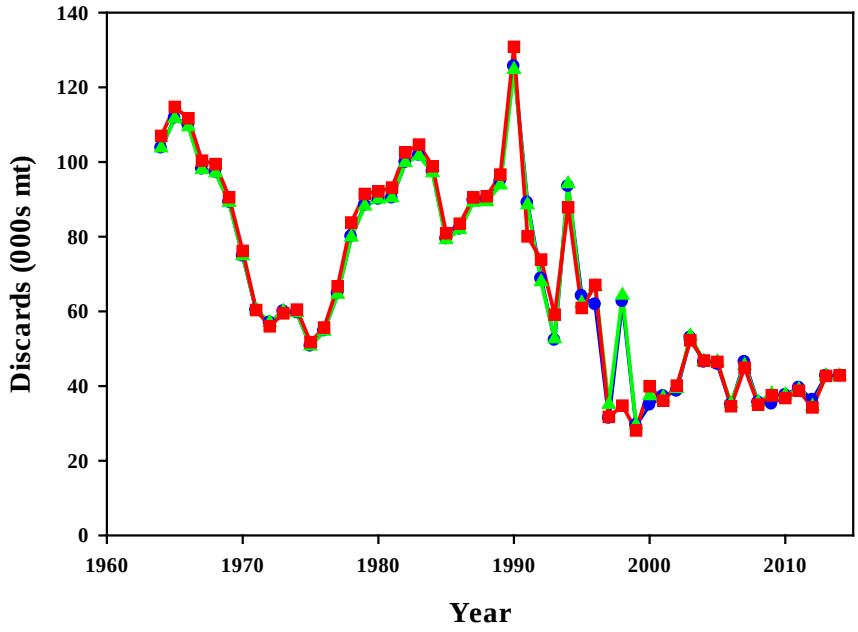

Figure 3. Total discards of skates (all species) in Northwest Atlantic Fisheries Organization (NAFO) subareas 5 and 6. The green triangles represent the old estimates from the Data Poor Stocks Working Group. The blue circles are updated with changes in data. The red squares are estimates using the changes in data but imputing for cells in which the number of trips sampled was less than 3.

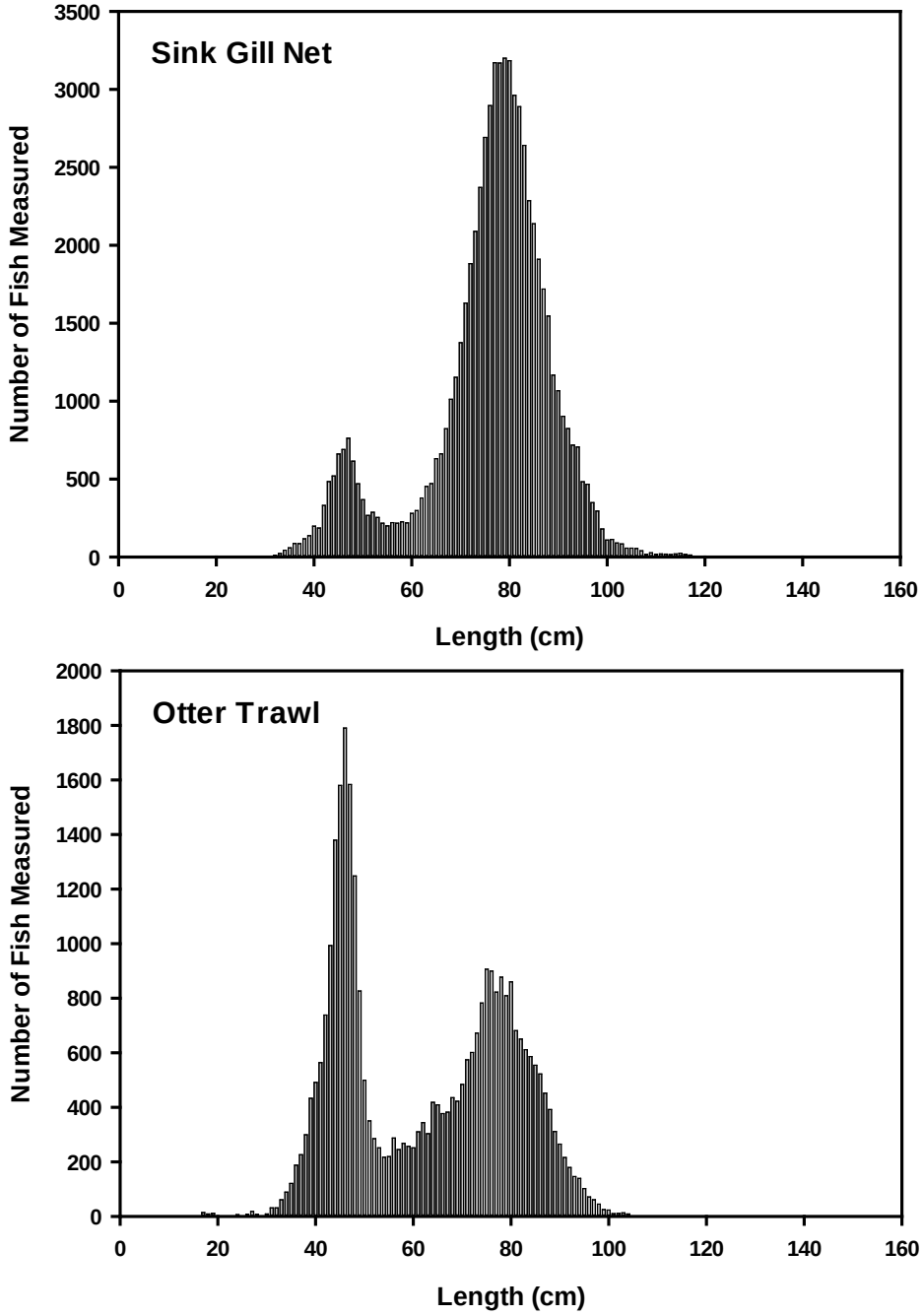

Figure 4. Length composition of the kept skate (all species) measured by the Observer Program by gear type.

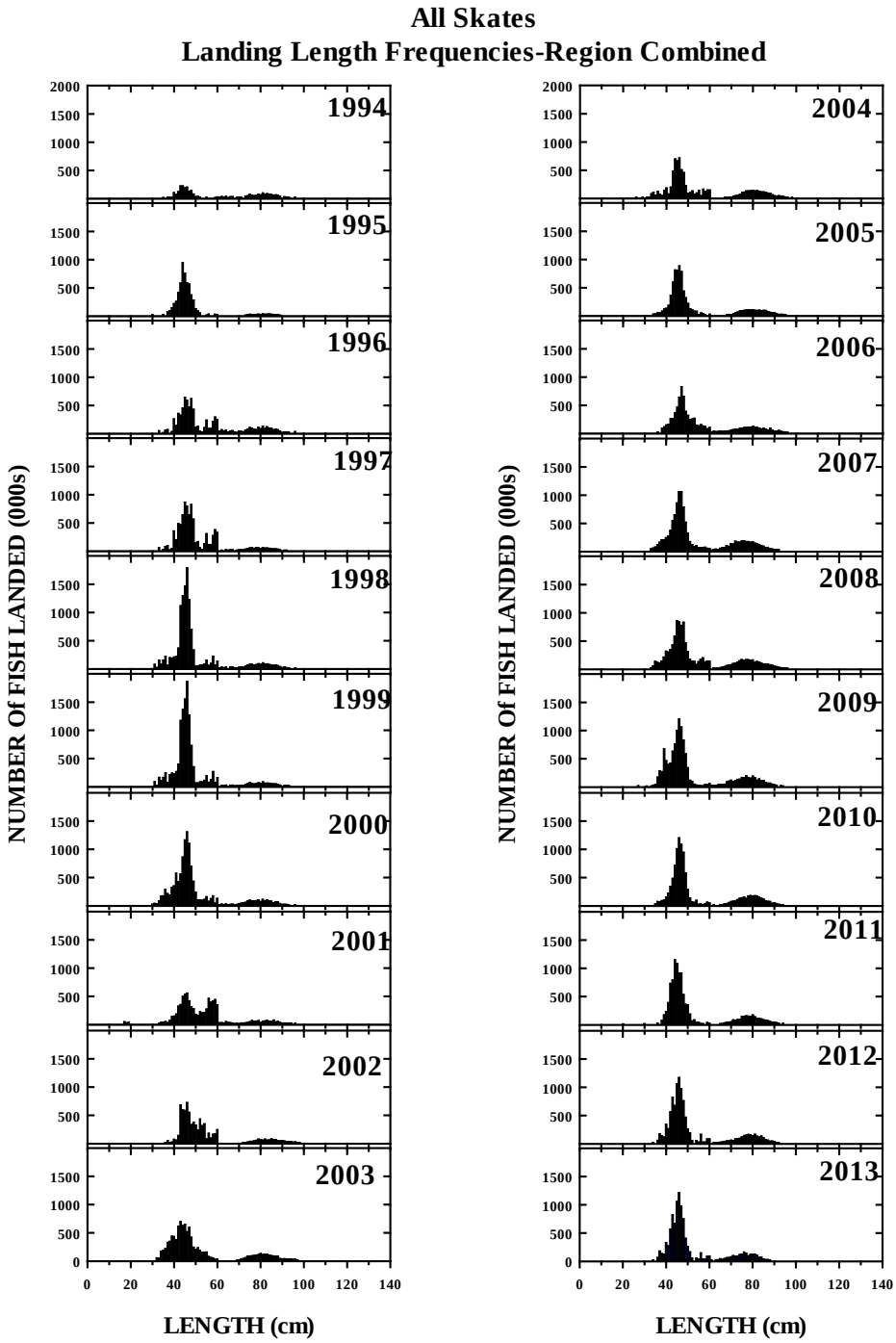

Figure 5. Skate (all species) length composition from commercial landings data, 1994-2013, pooling length frequencies by region.

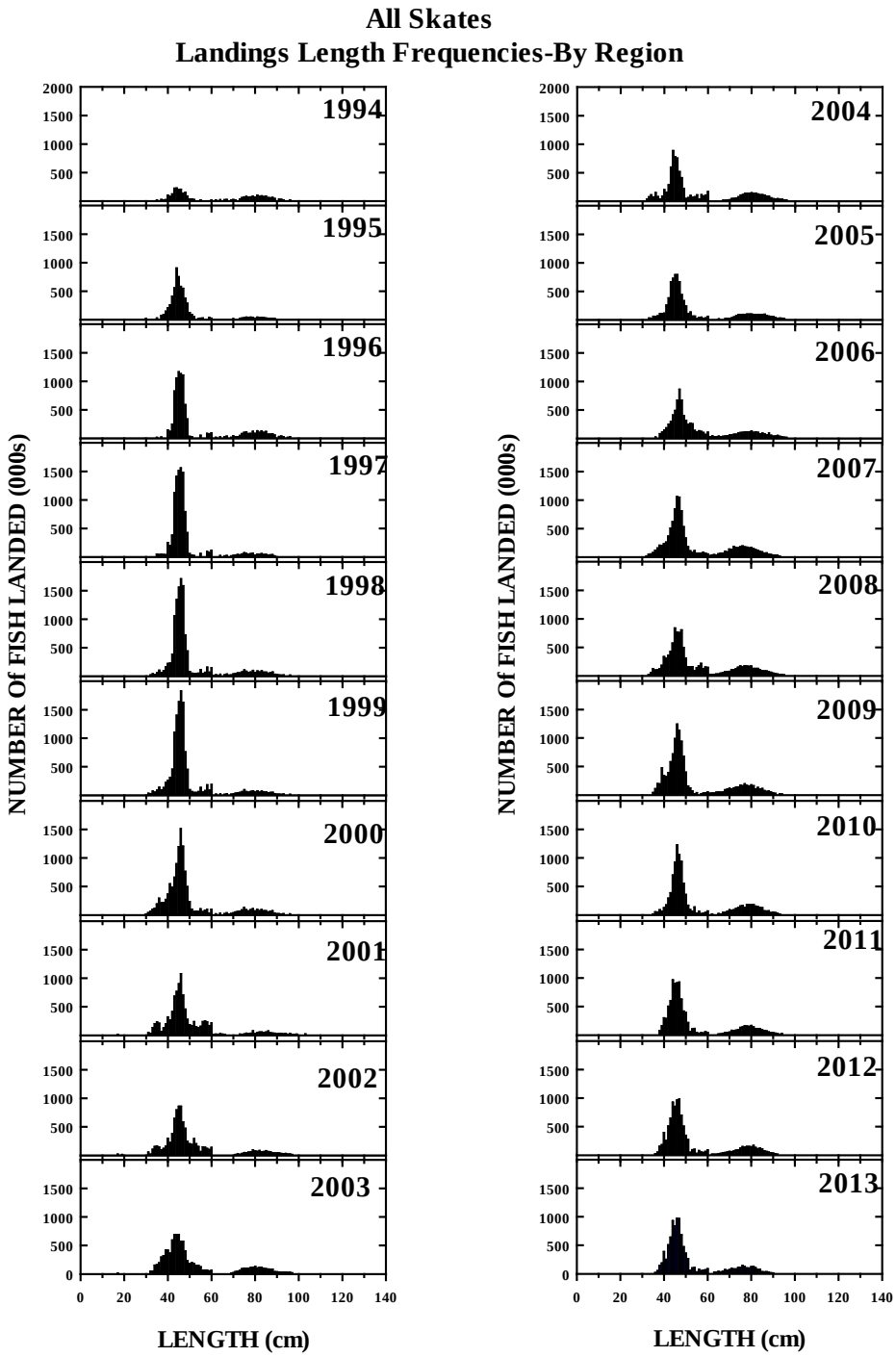

Figure 6. Skate (all species) length composition from commercial landings data, 1994-2013, pooling length frequencies by area.

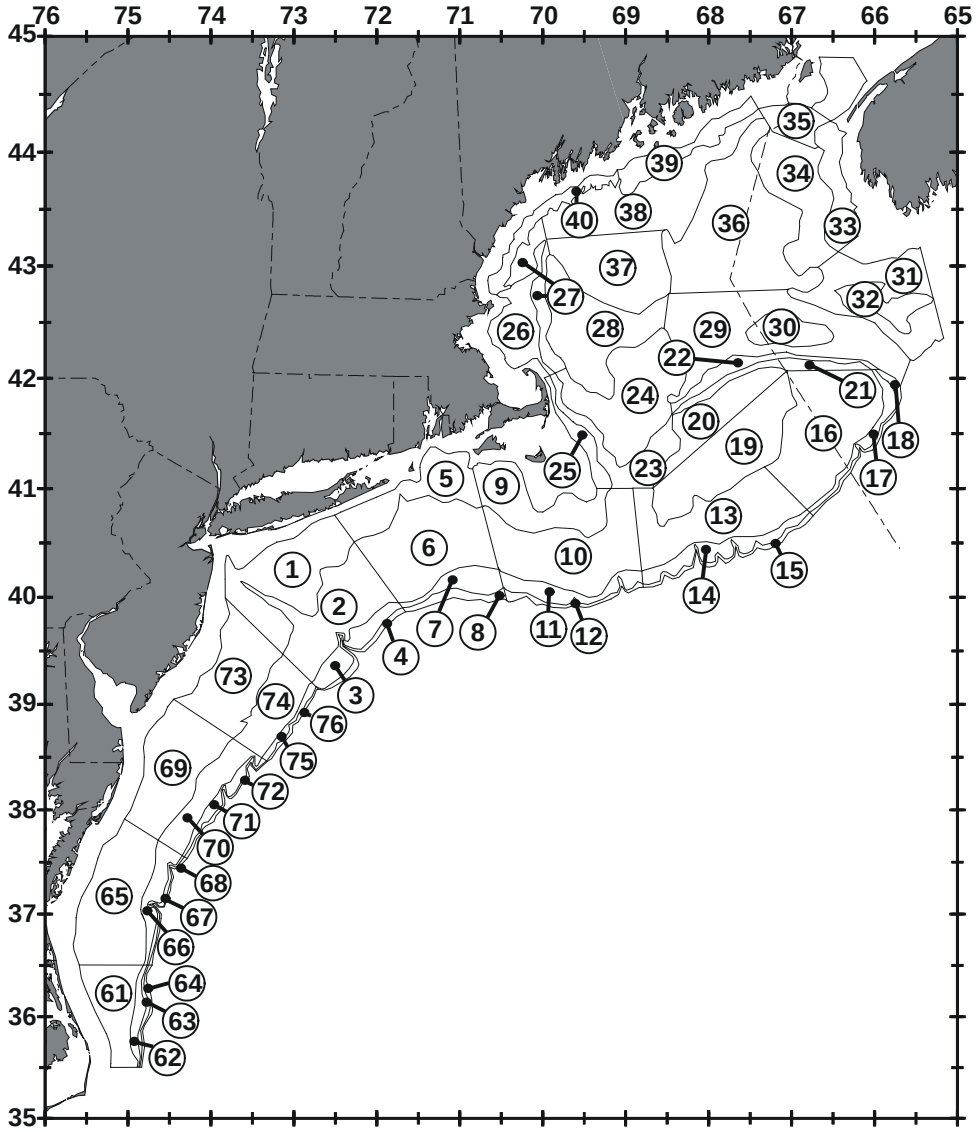

Figure 7. Map of offshore strata for the Northeast Fisheries Science Center (NEFSC) fall and spring surveys.

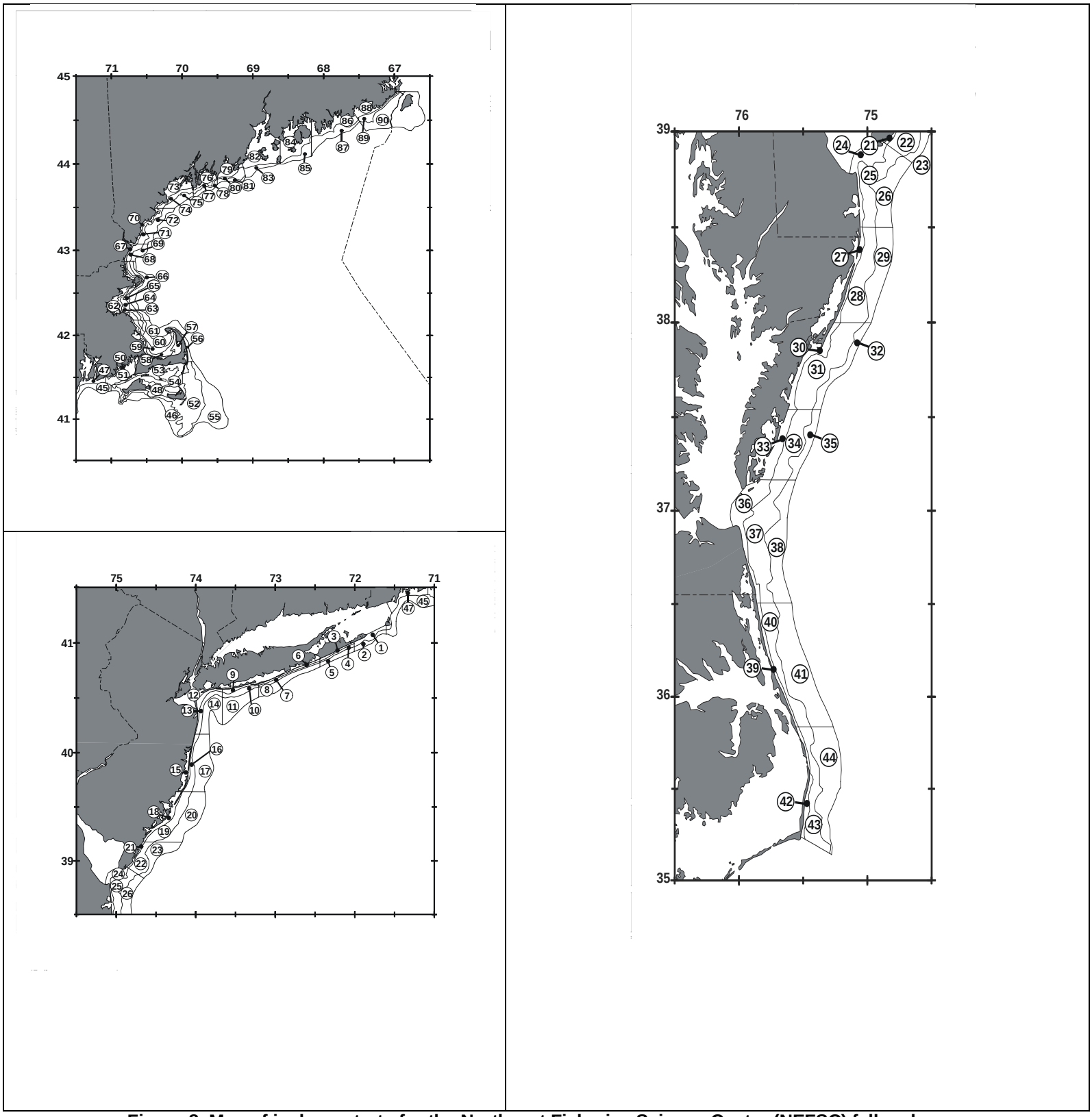

Figure 8. Map of inshore strata for the Northeast Fisheries Science Center (NEFSC) fall and spring surveys.

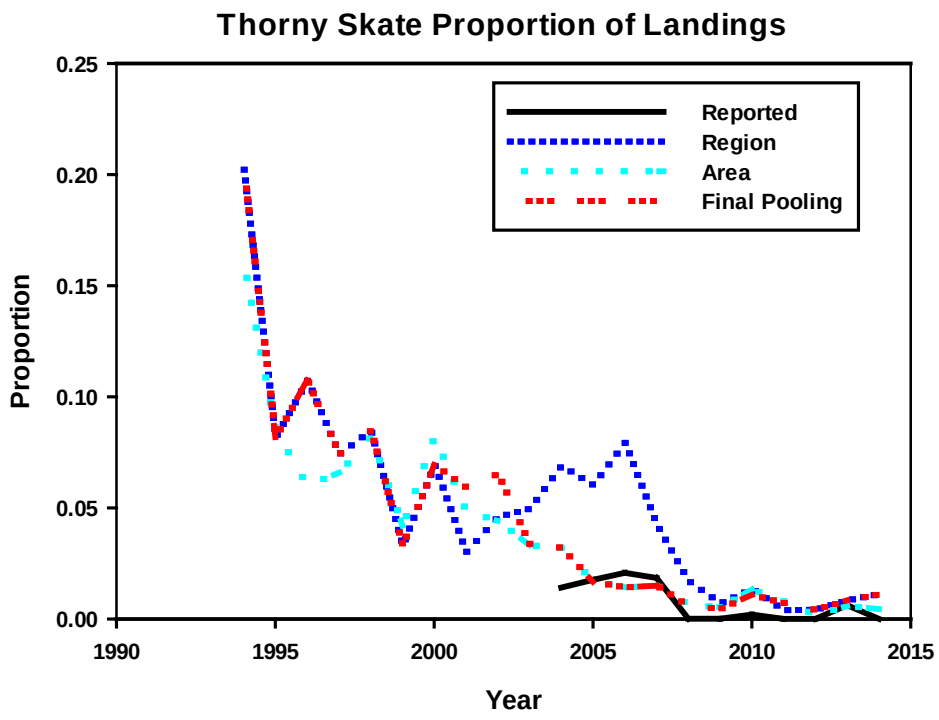

Figure 9. Comparison of proportion thorny skate (*Amblyraja radiata*) of total skate landings by reported species and using 3 different methods.

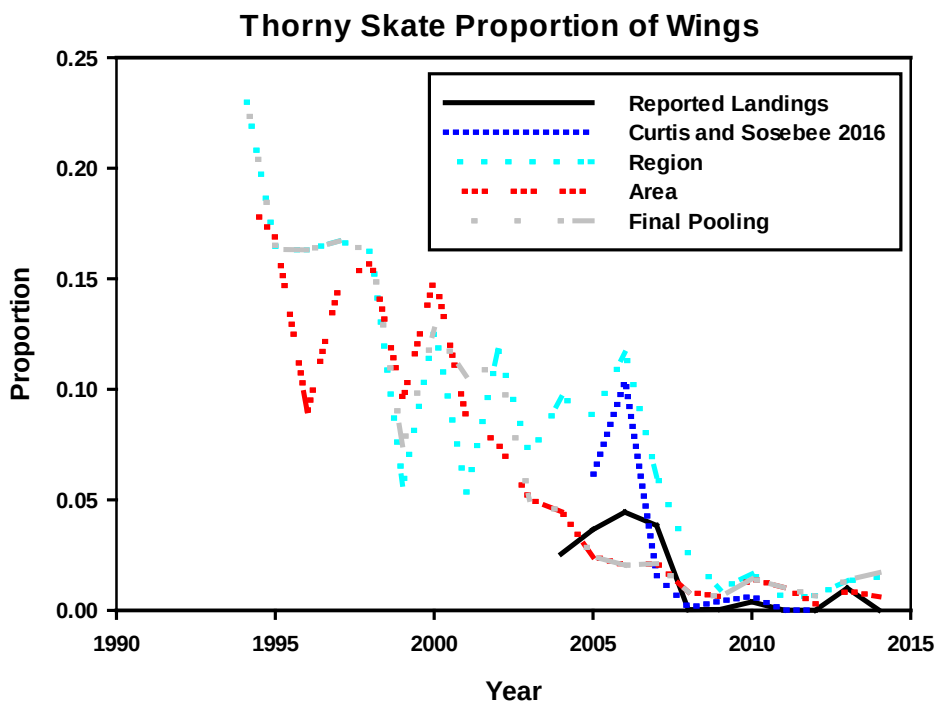

Figure 10. Comparison of proportion thorny skate (*Amblyraja radiata*) of total skate wing landings by reported species and using 4 different methods.

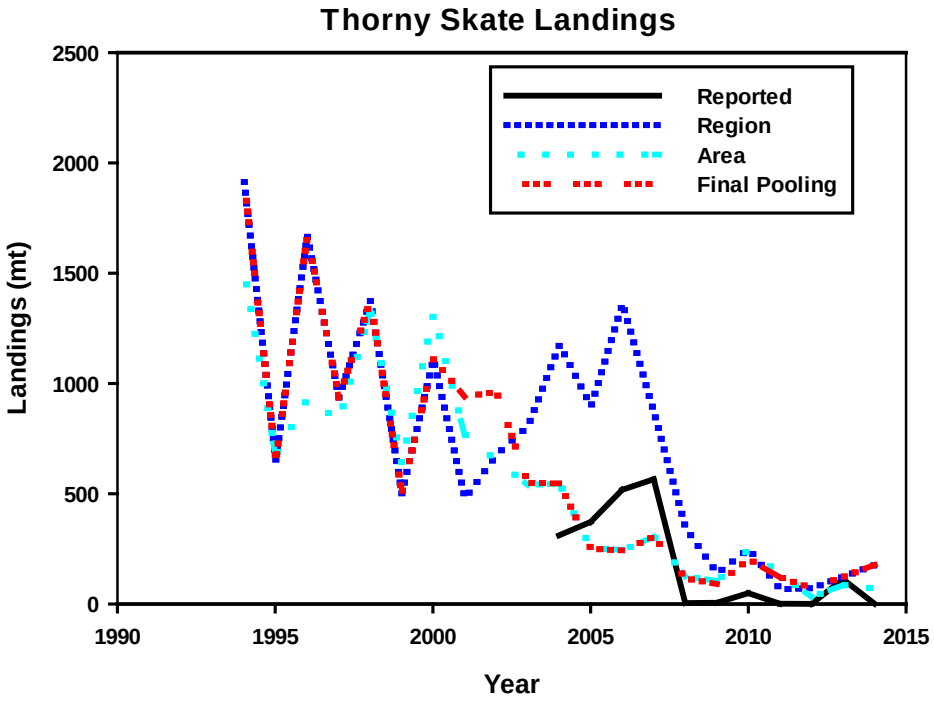

Figure 11. Comparison of thorny skate (*Amblyraja radiata*) landings by reported species and using 3 different methods.

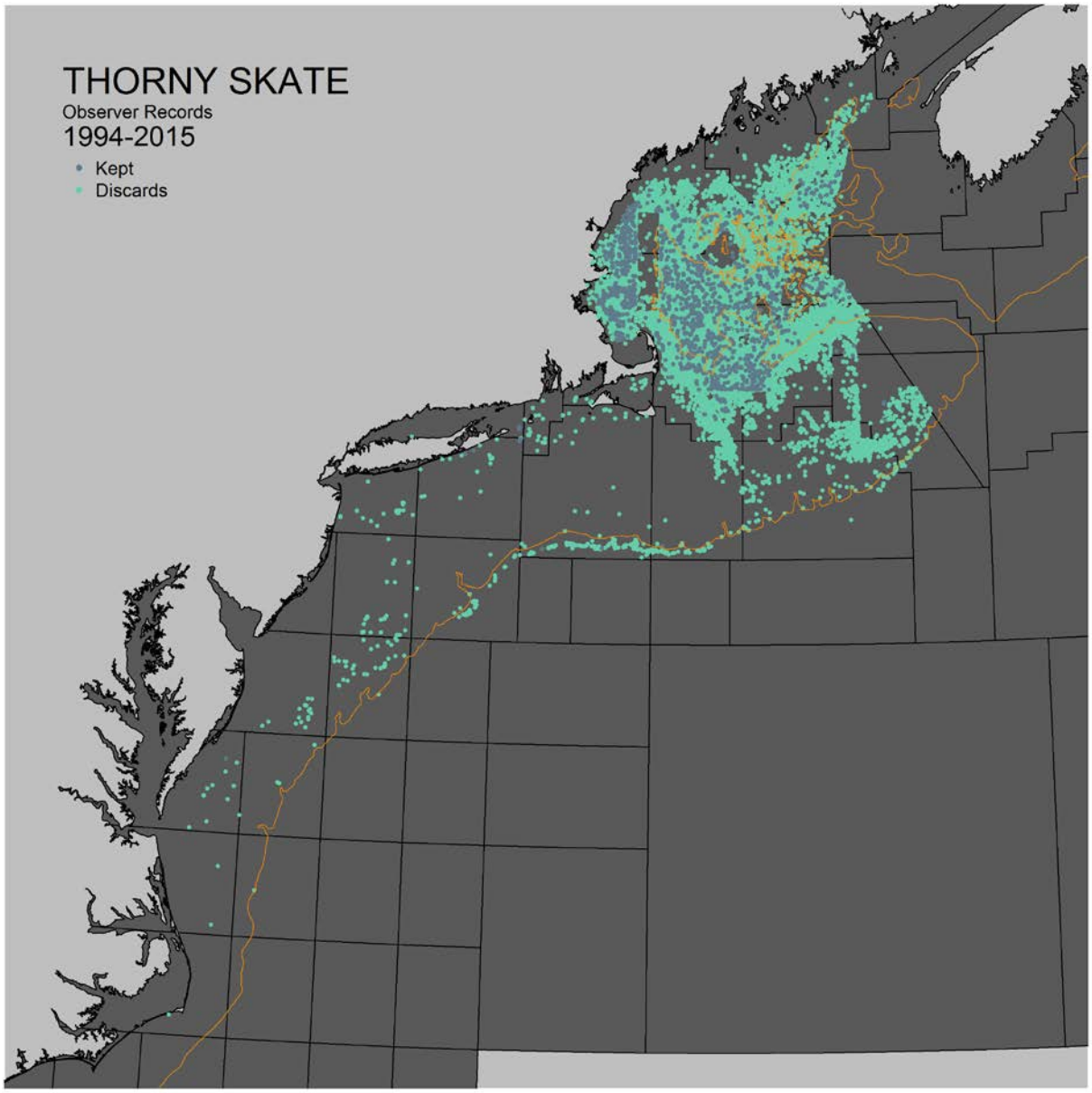

Figure 12. Kept and discards of thorny skate (*Amblyraja radiata*) from the observer program from 1994-2015.

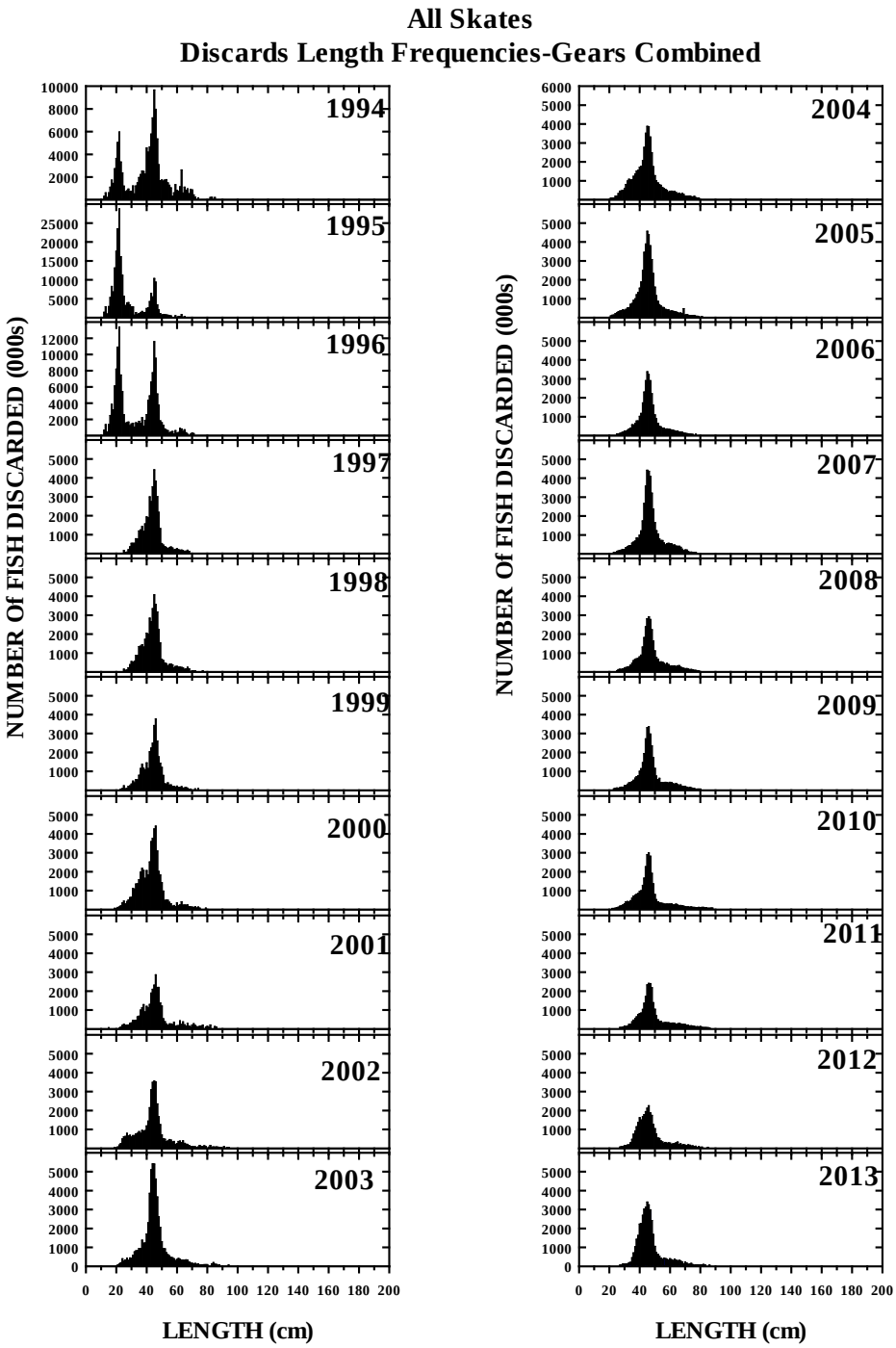

Figure 13. Skate (all species) length composition from commercial discard data, 1994-2013, pooling length frequencies by region.

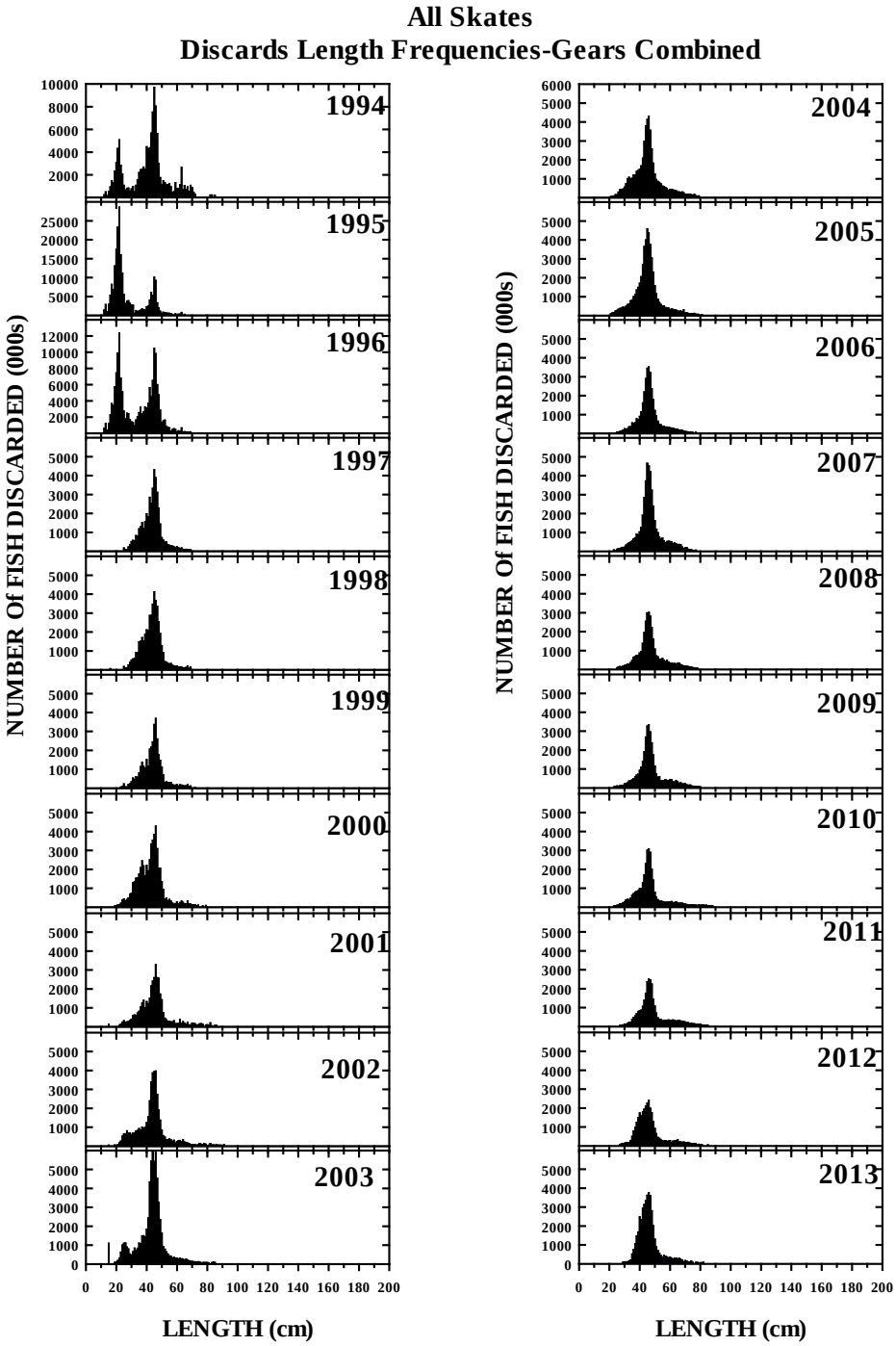

Figure 14. Skate (all species) length composition from commercial discard data, 1994-2013, pooling length frequencies by area.

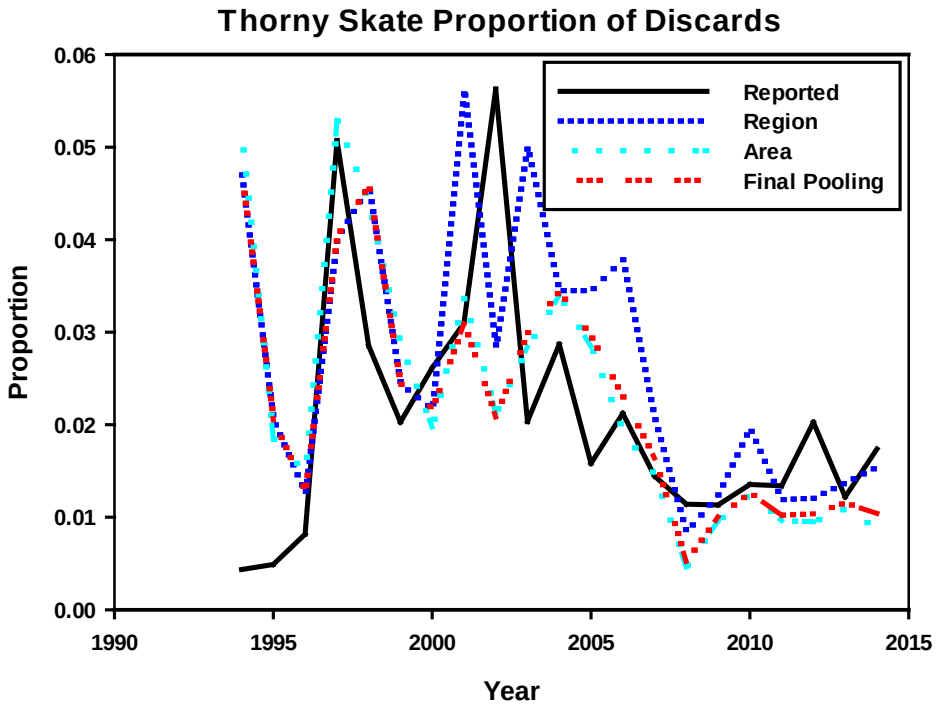

Figure 15. Comparison of percentage thorny skate (*Amblyraja radiata*) of total skate discards by reported species and using 3 different methods.

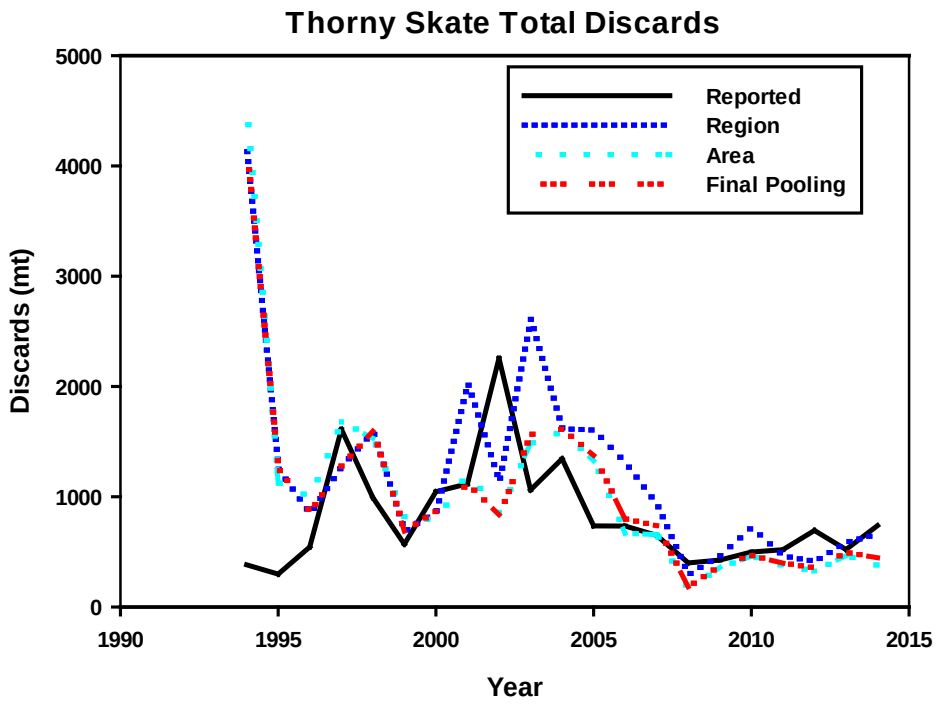

Figure 16. Comparison of total thorny skate (*Amblyraja radiata*) discards by observed species and using 3 different methods.

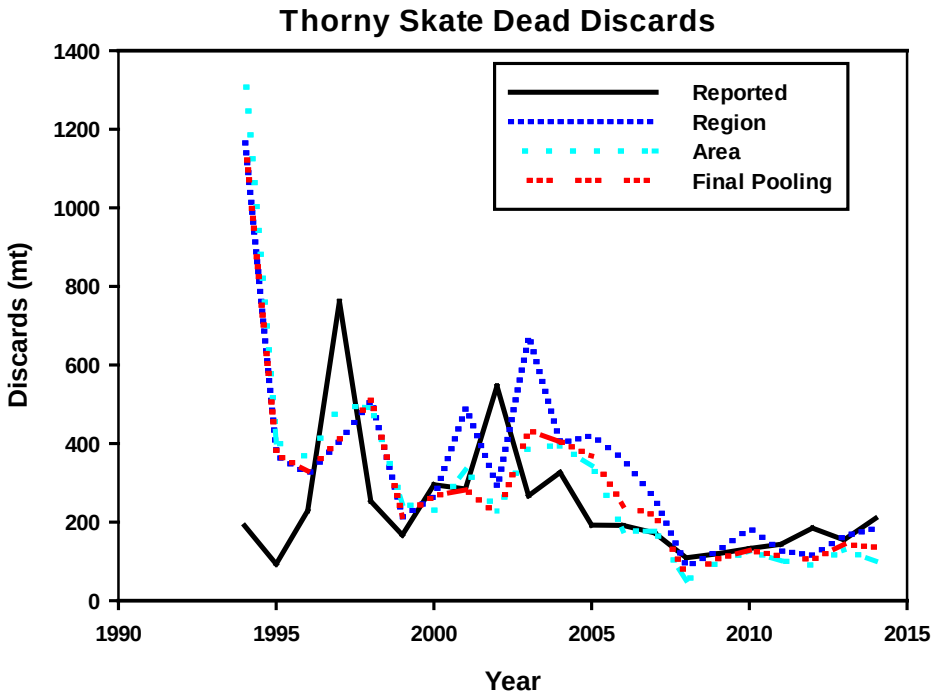

Figure 17. Comparison of dead thorny skate (*Amblyraja radiata*) discards by observed species and using 3 different methods.

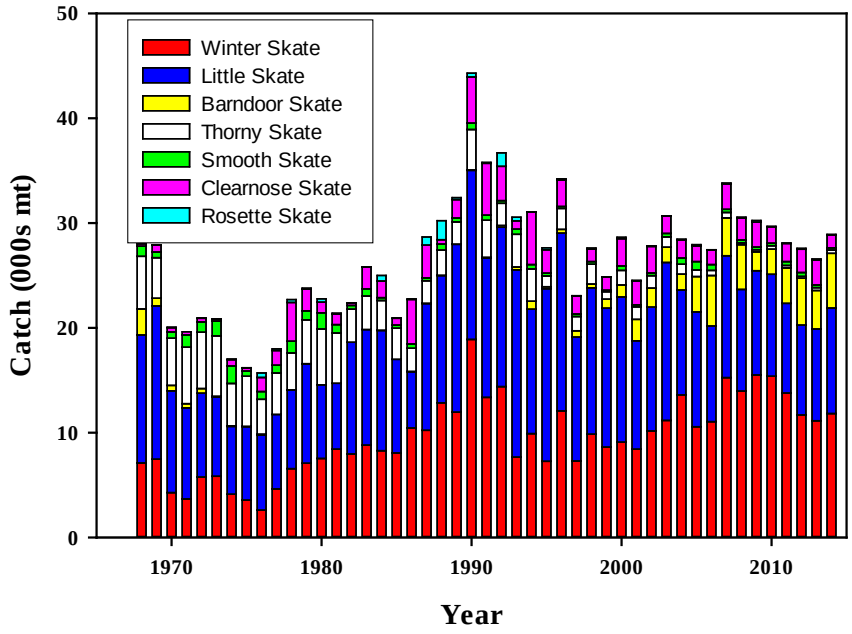

Figure 18. Catch (landings plus dead discards) by species from 1968-2014. Skate species include: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis)*, thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*).

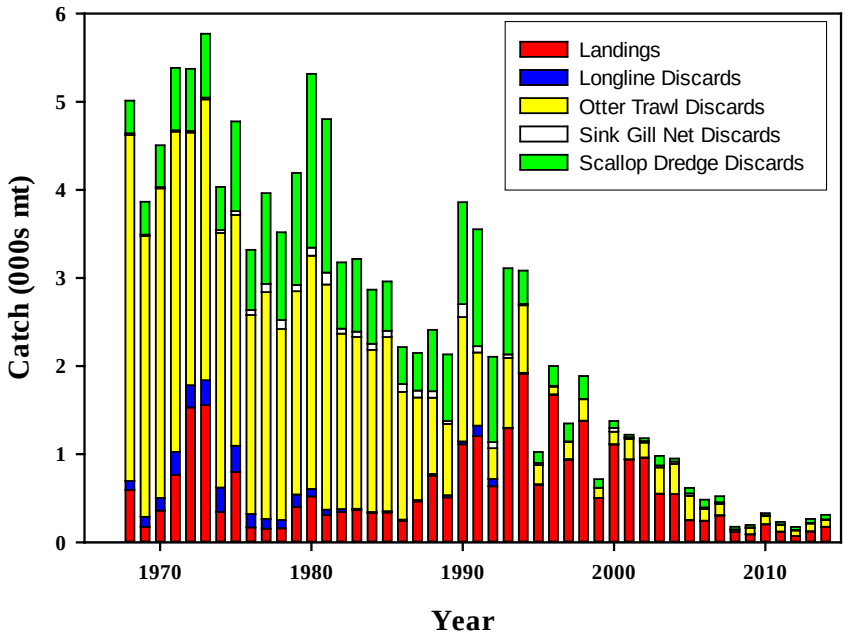

Figure 19. Catch of thorny skate (*Amblyraja radiata*) by disposition and gear type from 1968-2014.

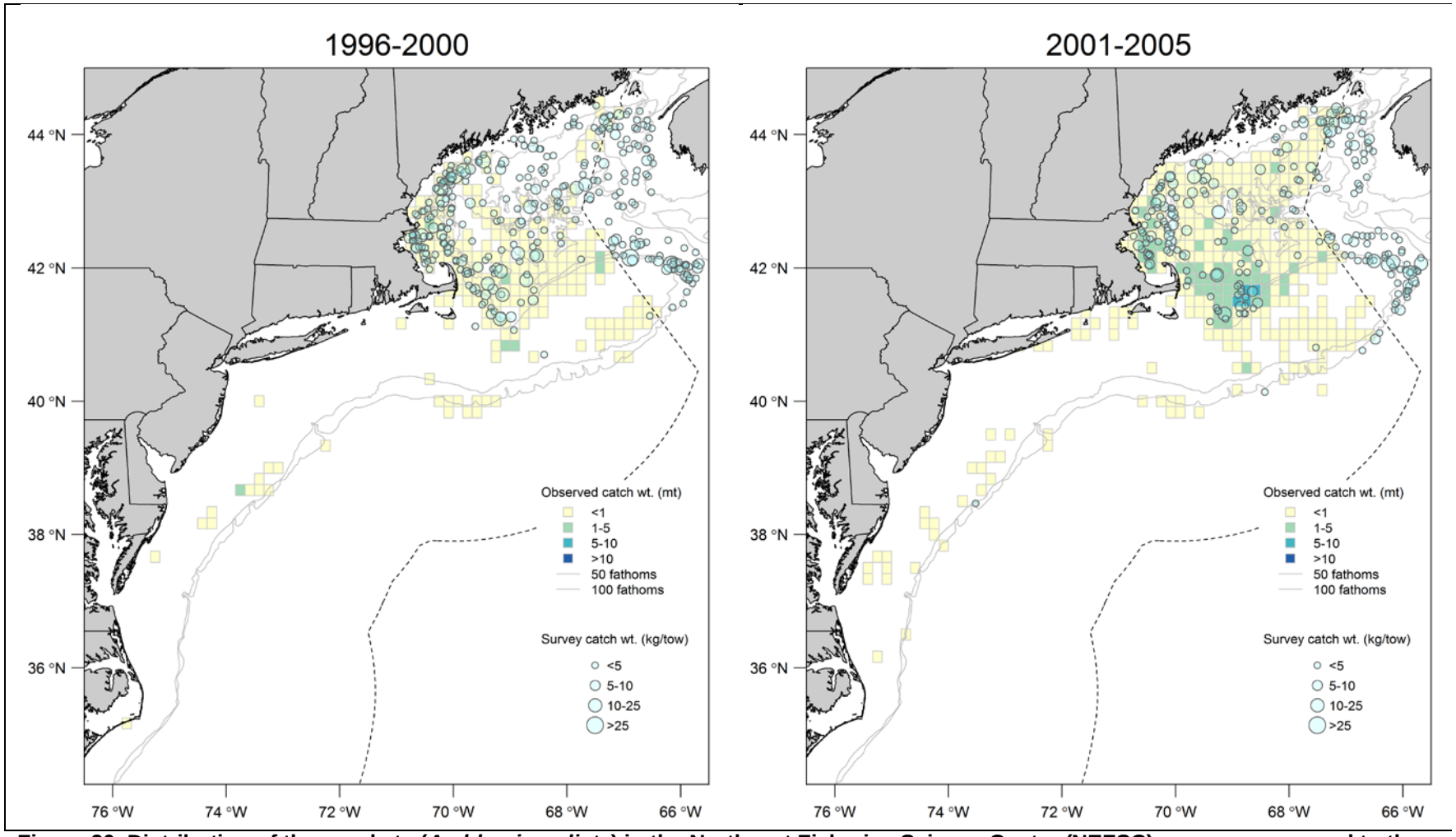

Figure 20. Distribution of thorny skate (*Amblyraja radiata*) in the Northeast Fisheries Science Center (NEFSC) surveys compared to the observed catches in the fisheries for 1996-2005.

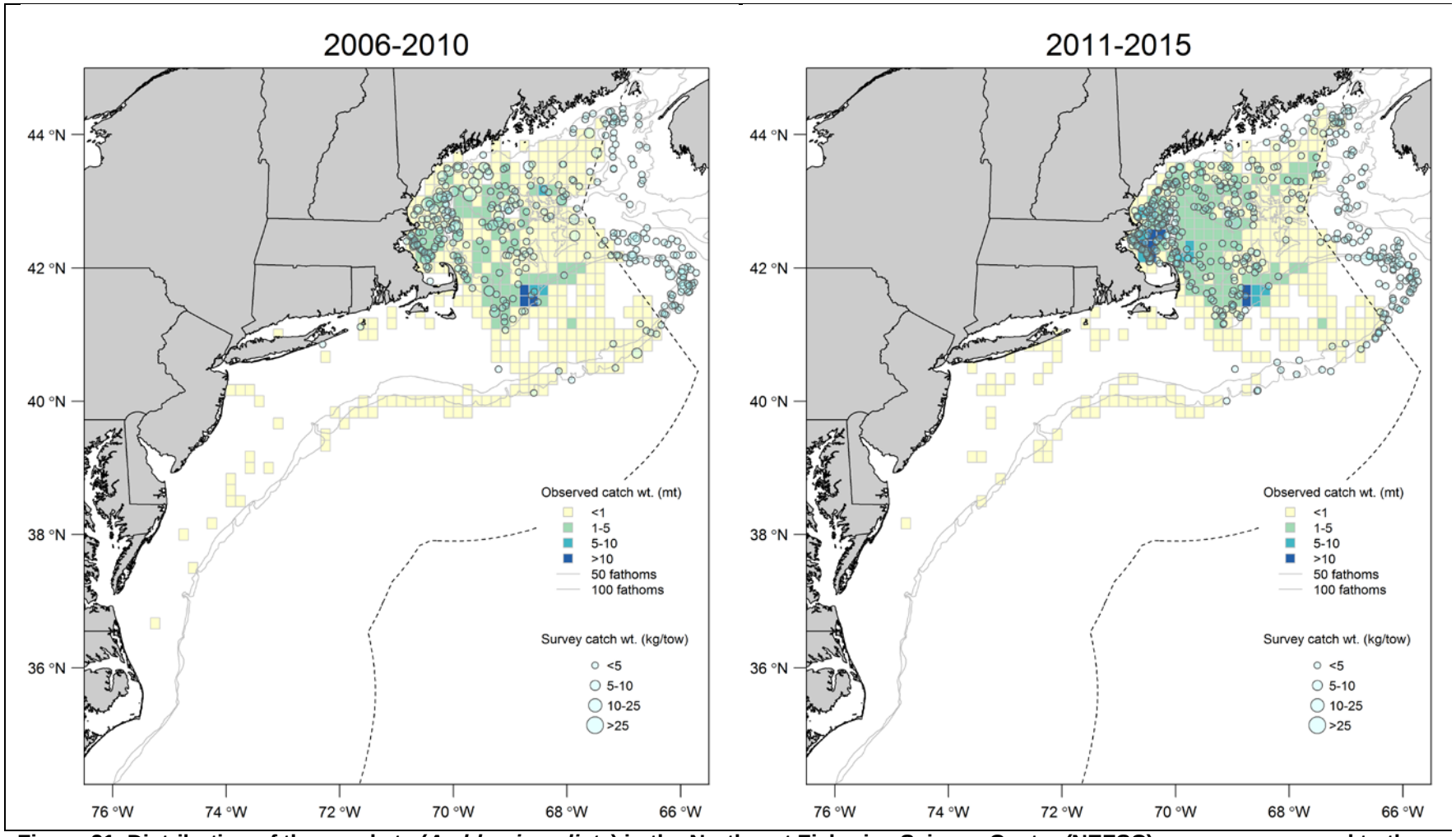

Figure 21. Distribution of thorny skate (*Amblyraja radiata*) in the Northeast Fisheries Science Center (NEFSC) surveys compared to the observed catches in the fisheries for 2006-2015.

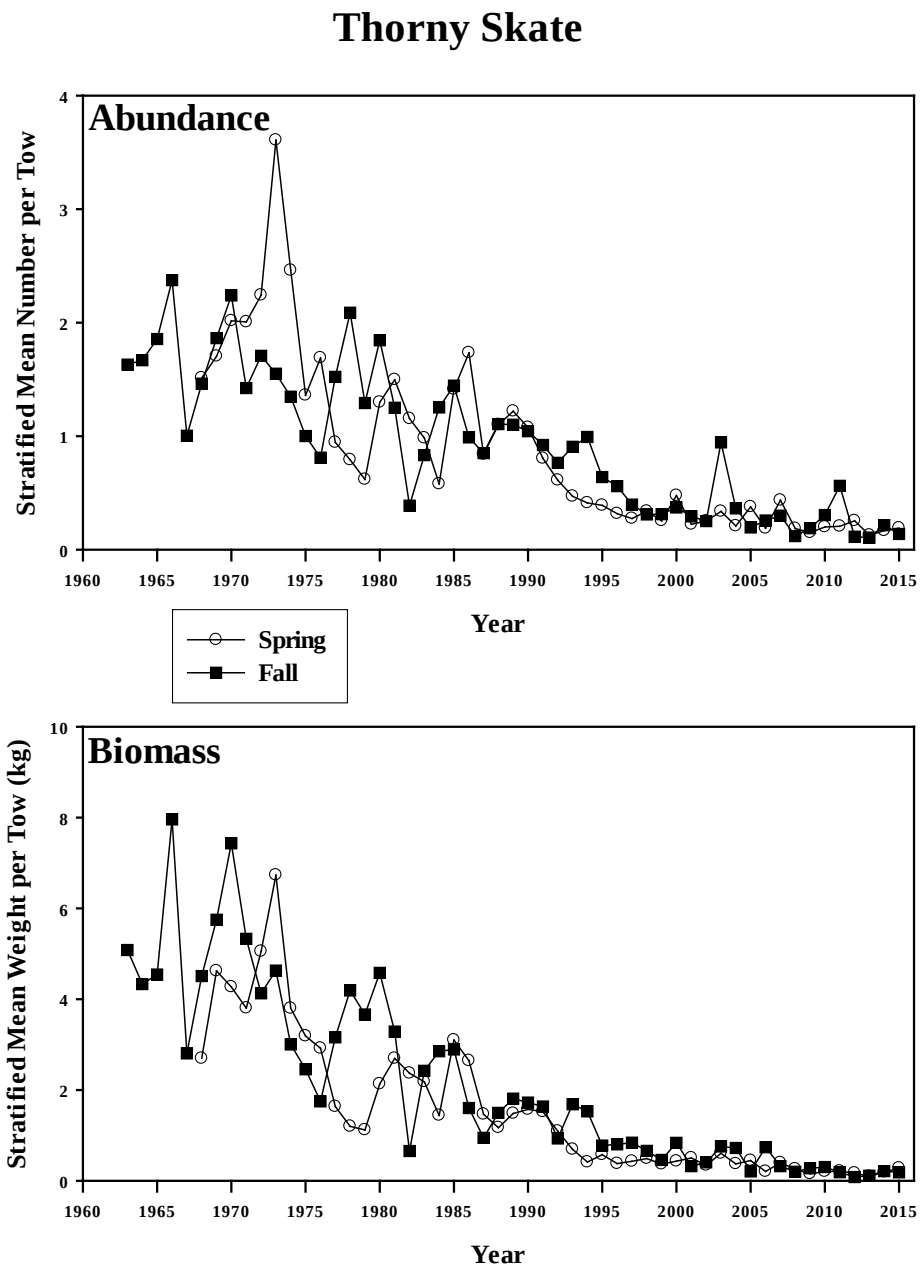

Figure 22. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) spring (circles) and fall (squares) bottom trawl surveys from 1963-2015 in the Gulf of Maine to Southern New England offshore region.

Thorny Skate - Spring Survey

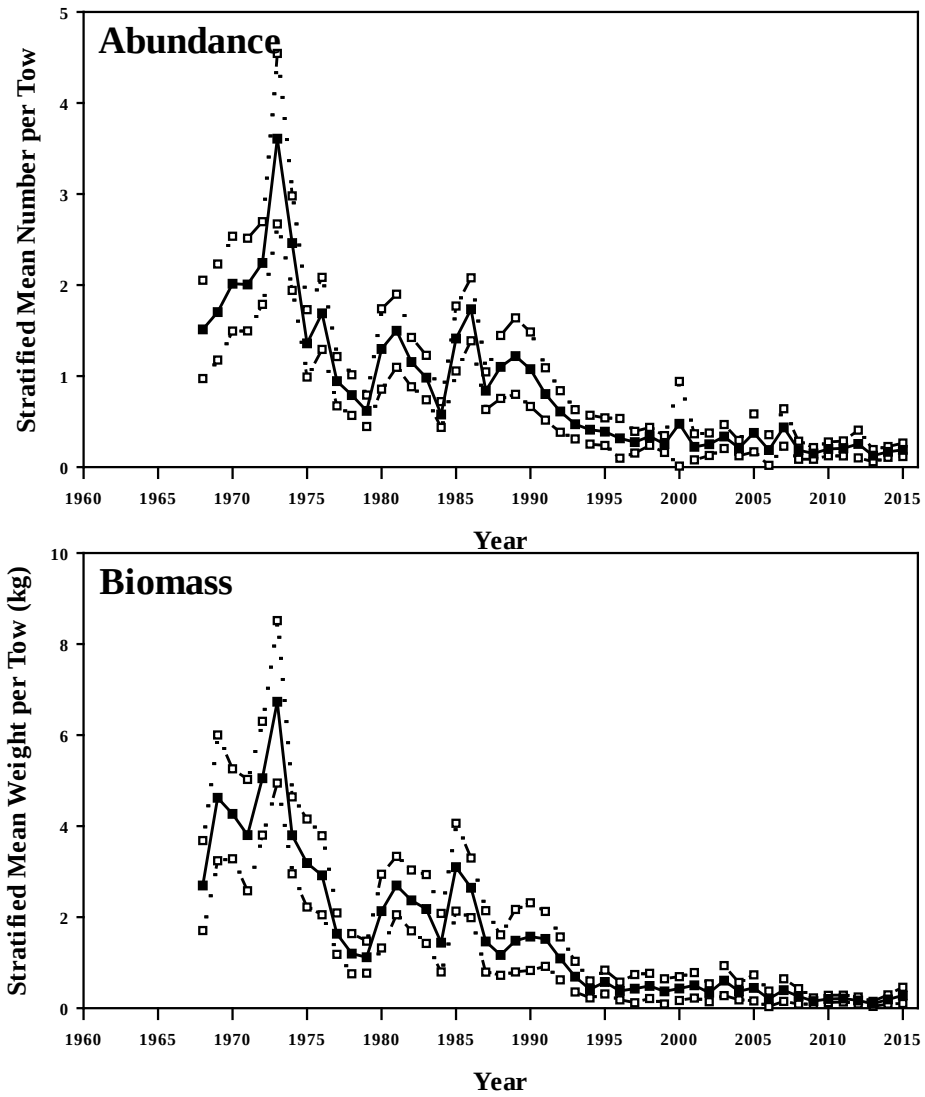

Figure 23. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) spring bottom trawl surveys from 1968-2015 in the Gulf of Maine to Southern New England offshore region. Mean index in solid squares, 95% confidence interval in open squares.

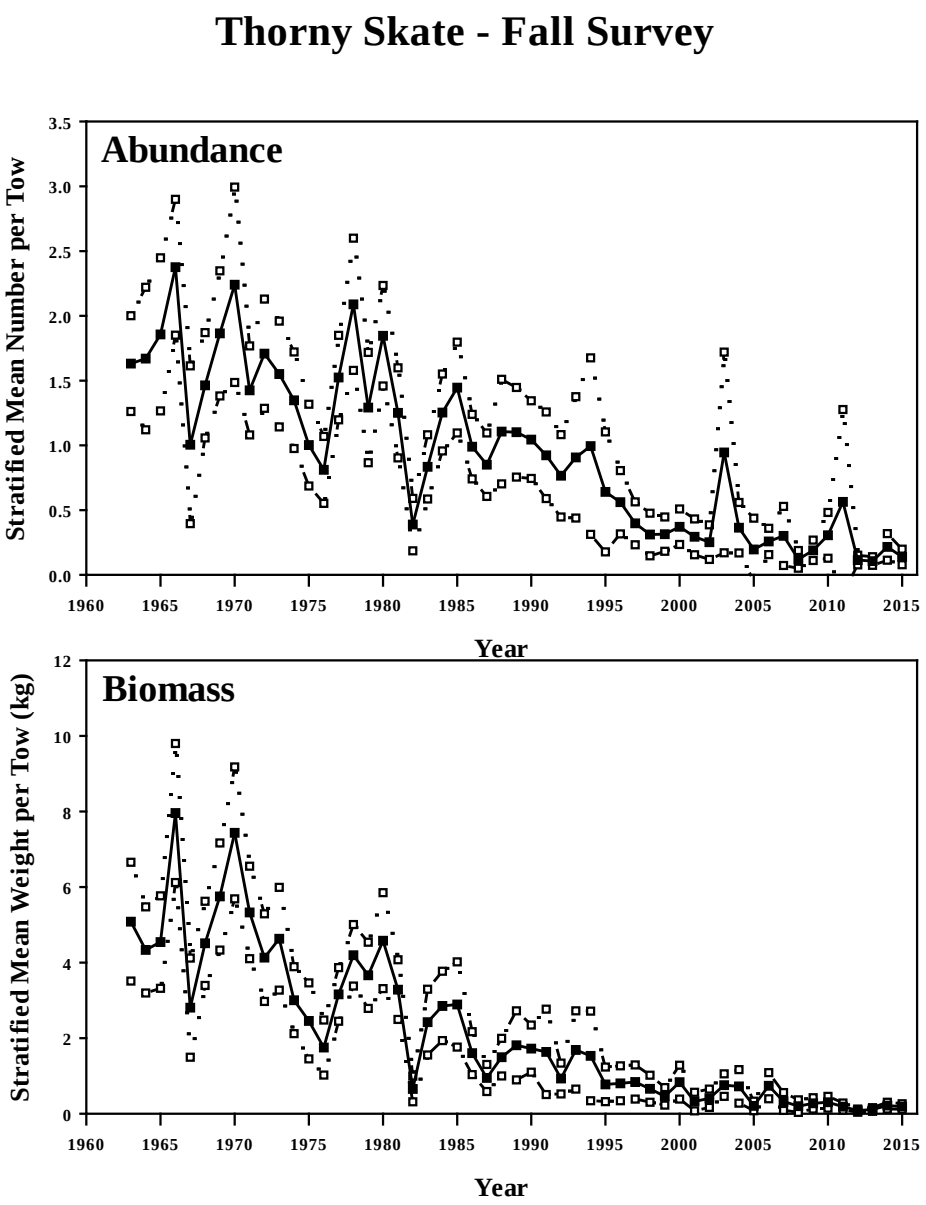

Figure 24. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the NEFSC fall bottom trawl surveys from 1963-2015 in the Gulf of Maine to Southern New England offshore region. Mean index in solid squares, 95% confidence interval in open squares.

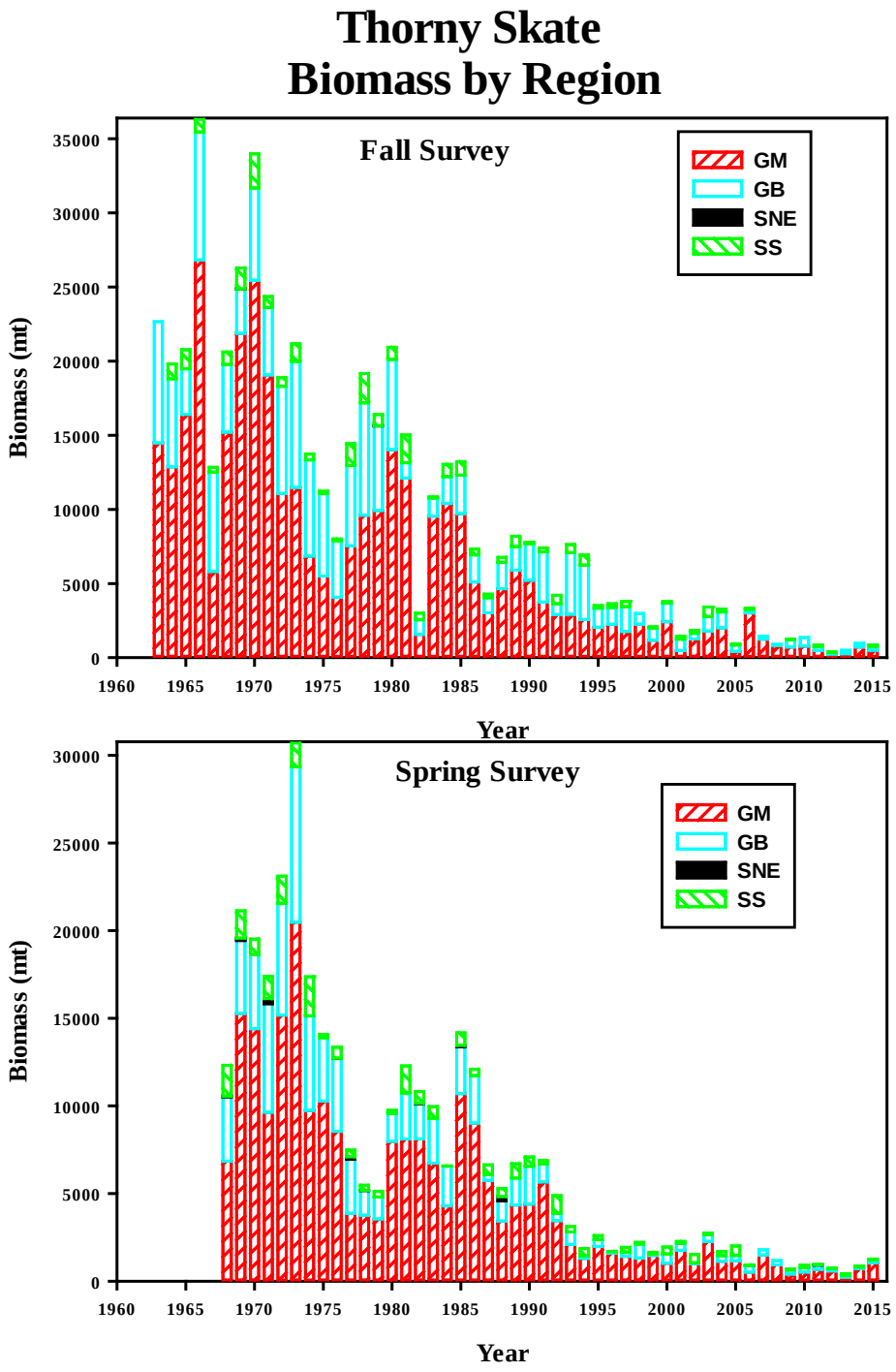

Figure 25. Minimum swept area biomass of thorny skate (*Amblyraja radiata*) in the Northeast Fisheries Science Center (NEFSC) spring (bottom panel) and fall surveys (top panel) from 1963-2015 by region (GM = Gulf of Maine; GB = Georges Bank; SNE = Southern New England; SS = Scotian Shelf).

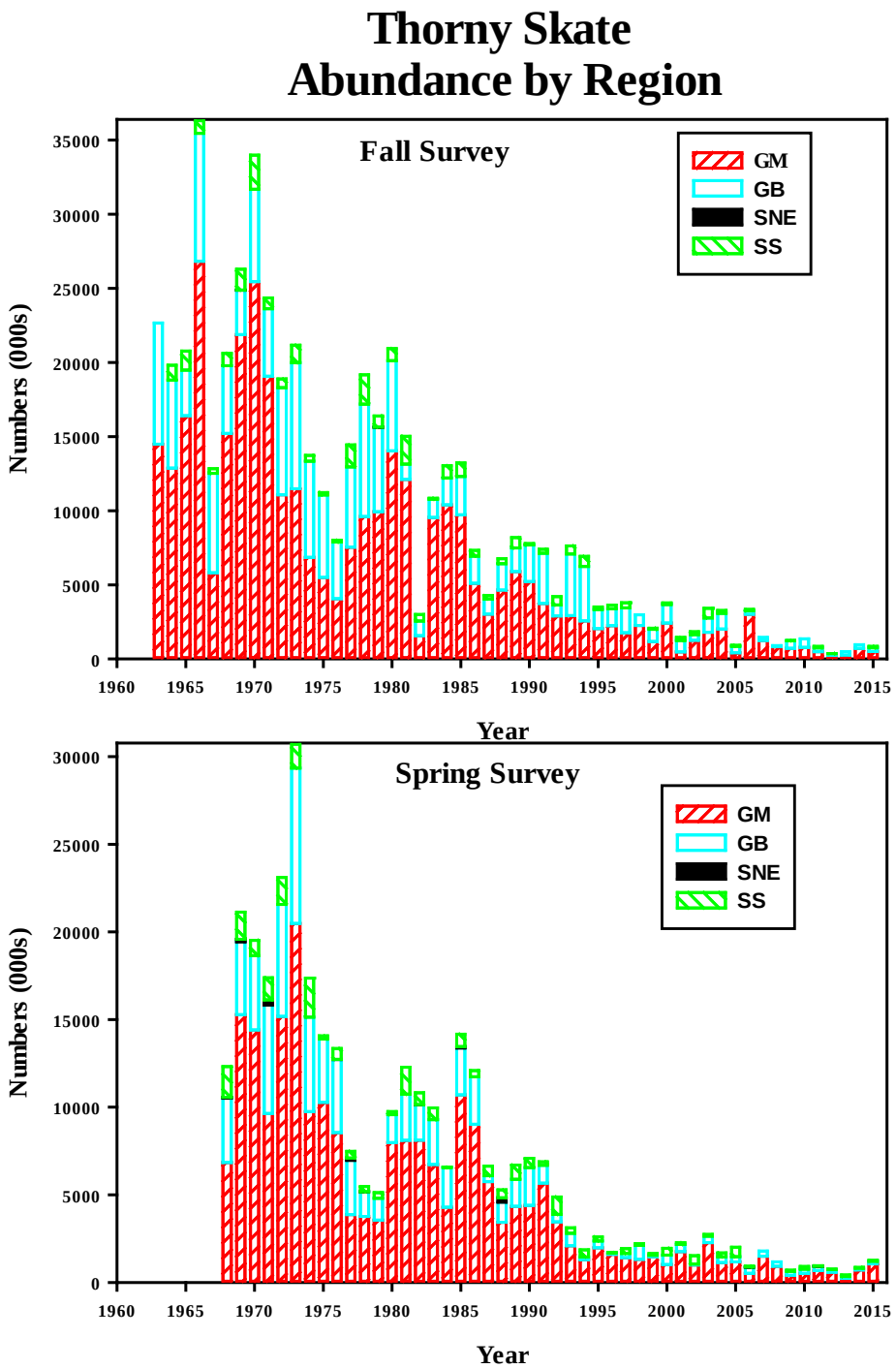

Figure 26. Minimum swept area abundance of thorny skate (*Amblyraja radiata*) in the Northeast Fisheries Science Center (NEFSC) spring (bottom panel) and fall surveys (top panel) from 1963-2015 by region (GM = Gulf of Maine; GB = Georges Bank; SNE = Southern New England; SS = Scotian Shelf).

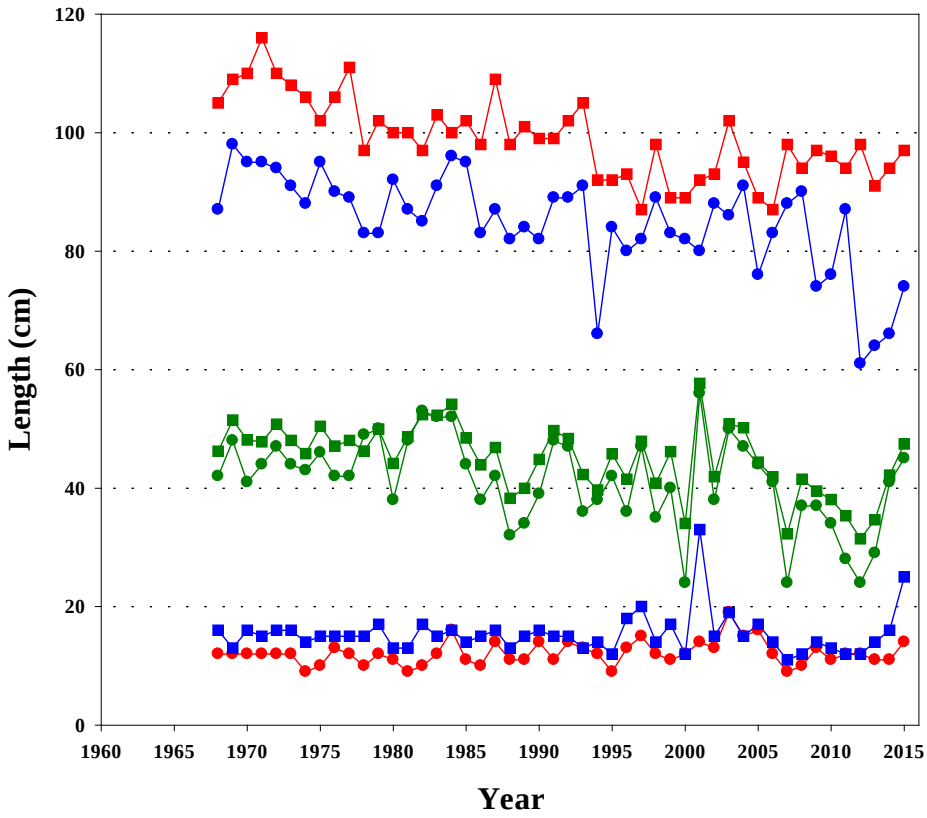

Figure 27. Minimum (red circles), 5th percentile (blue squares), mean (green squares), median (green circles), 95th percentile (blue circles) and maximum (red squares) total length (cm) of thorny skate (*Amblyraja radiata*) from the spring bottom trawl surveys from 1968-2015 in the Gulf of Maine to Southern New England region.

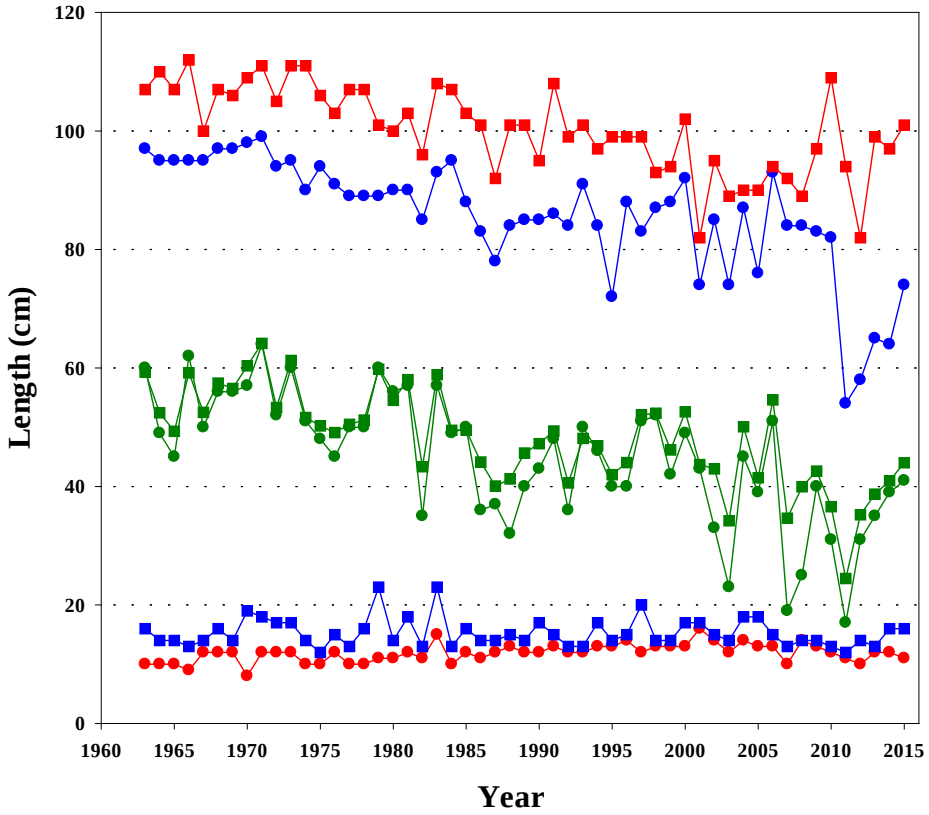

Figure 28. Minimum (red circles), 5th percentile (blue squares), mean (green squares), median (green circles), 95th percentile (blue circles) and maximum (red squares) total length (cm) of thorny skate (*Amblyraja radiata*) from the fall bottom trawl surveys from 1963-2015 in the Gulf of Maine to Southern New England region.

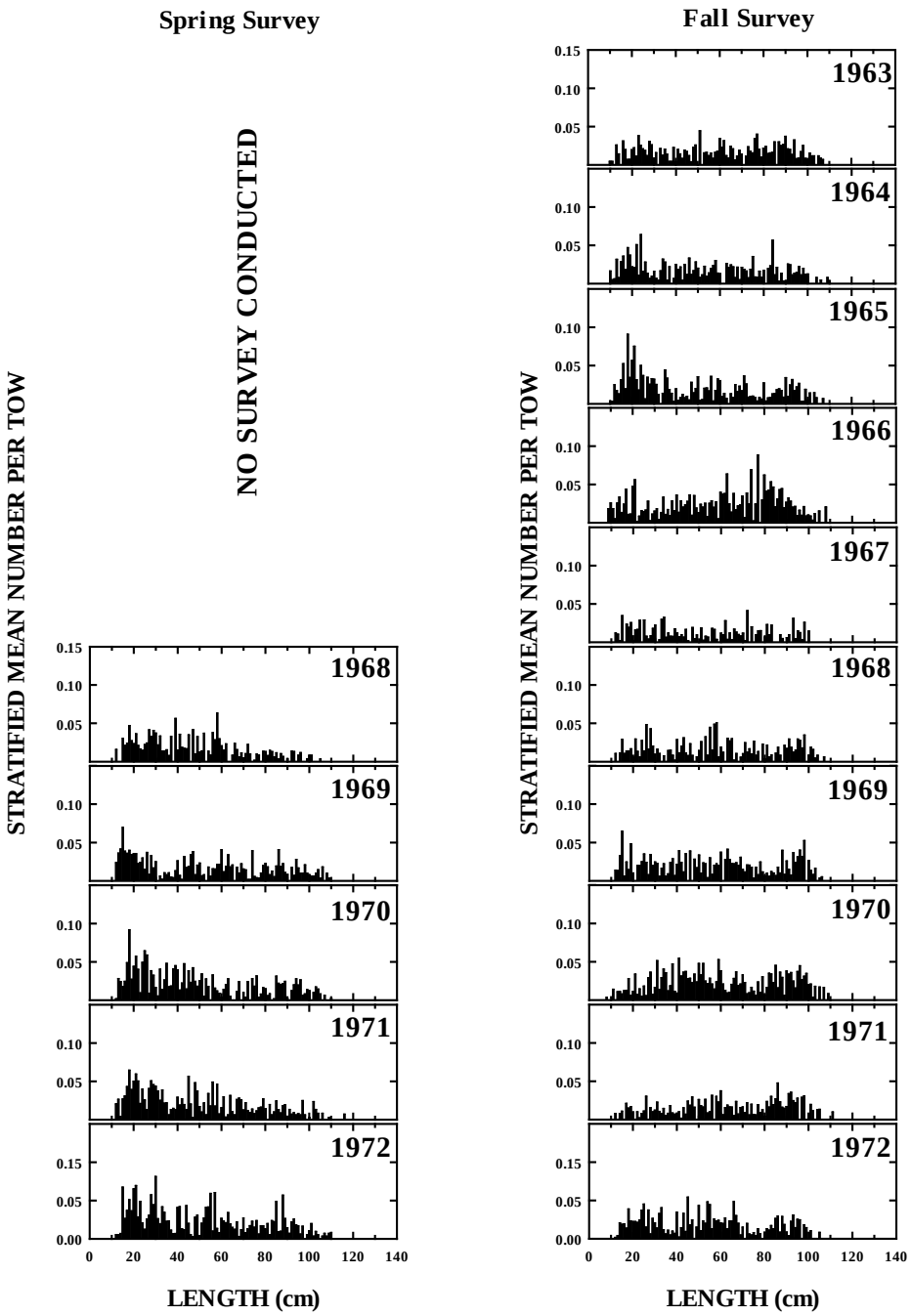

Figure 29. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1963-1972.

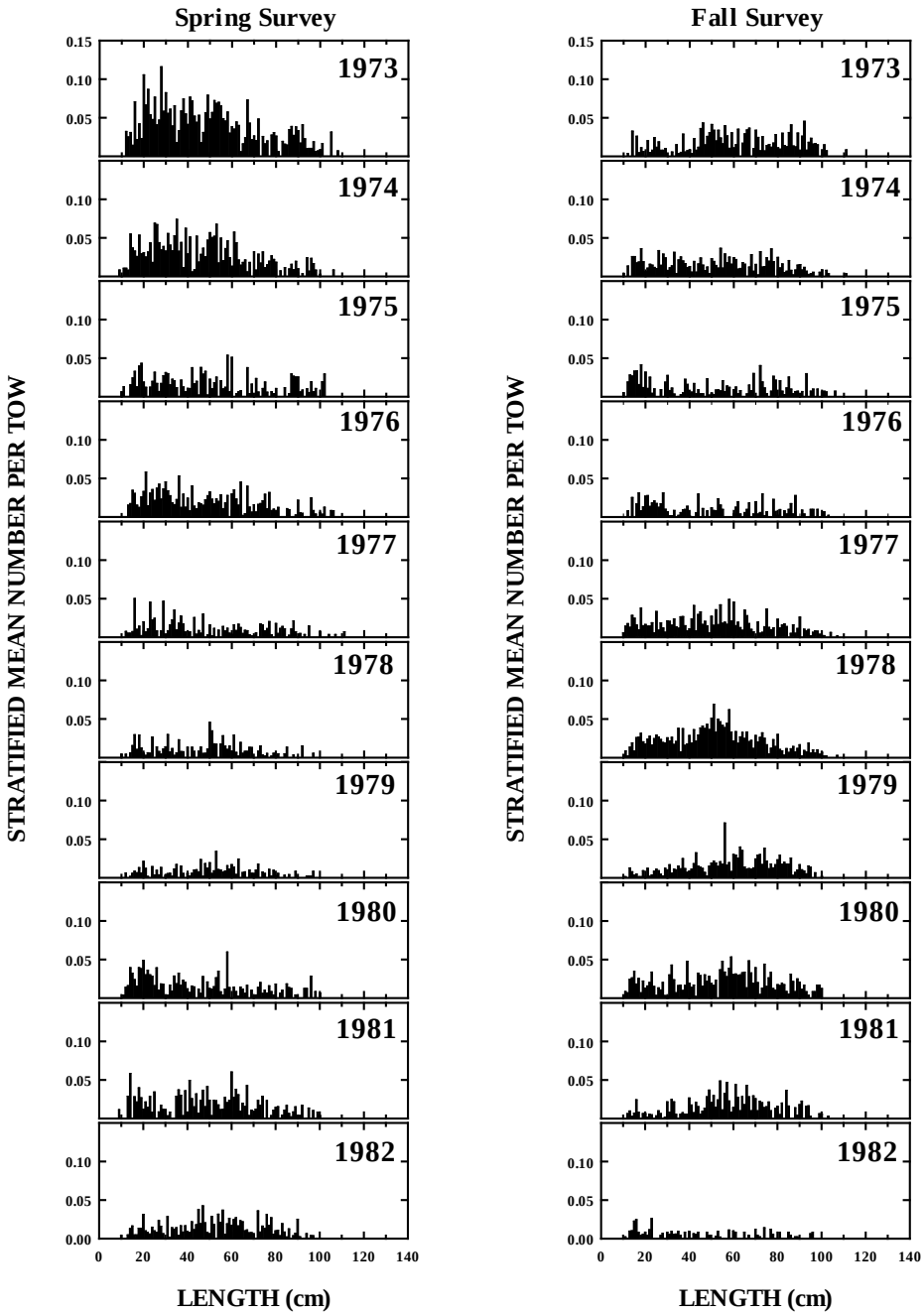

Figure 30. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1973-1982.

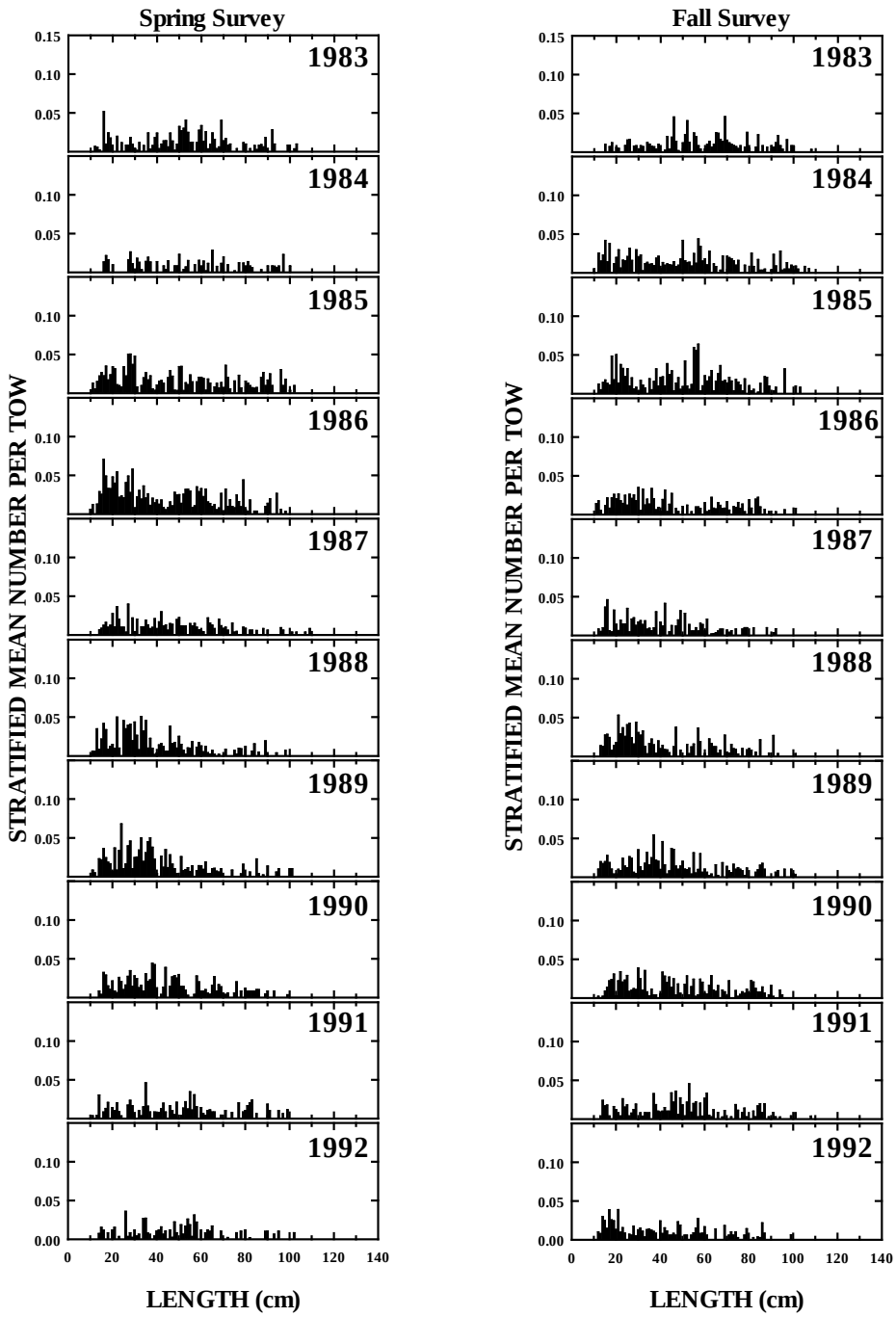

Figure 31. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1983-1992.

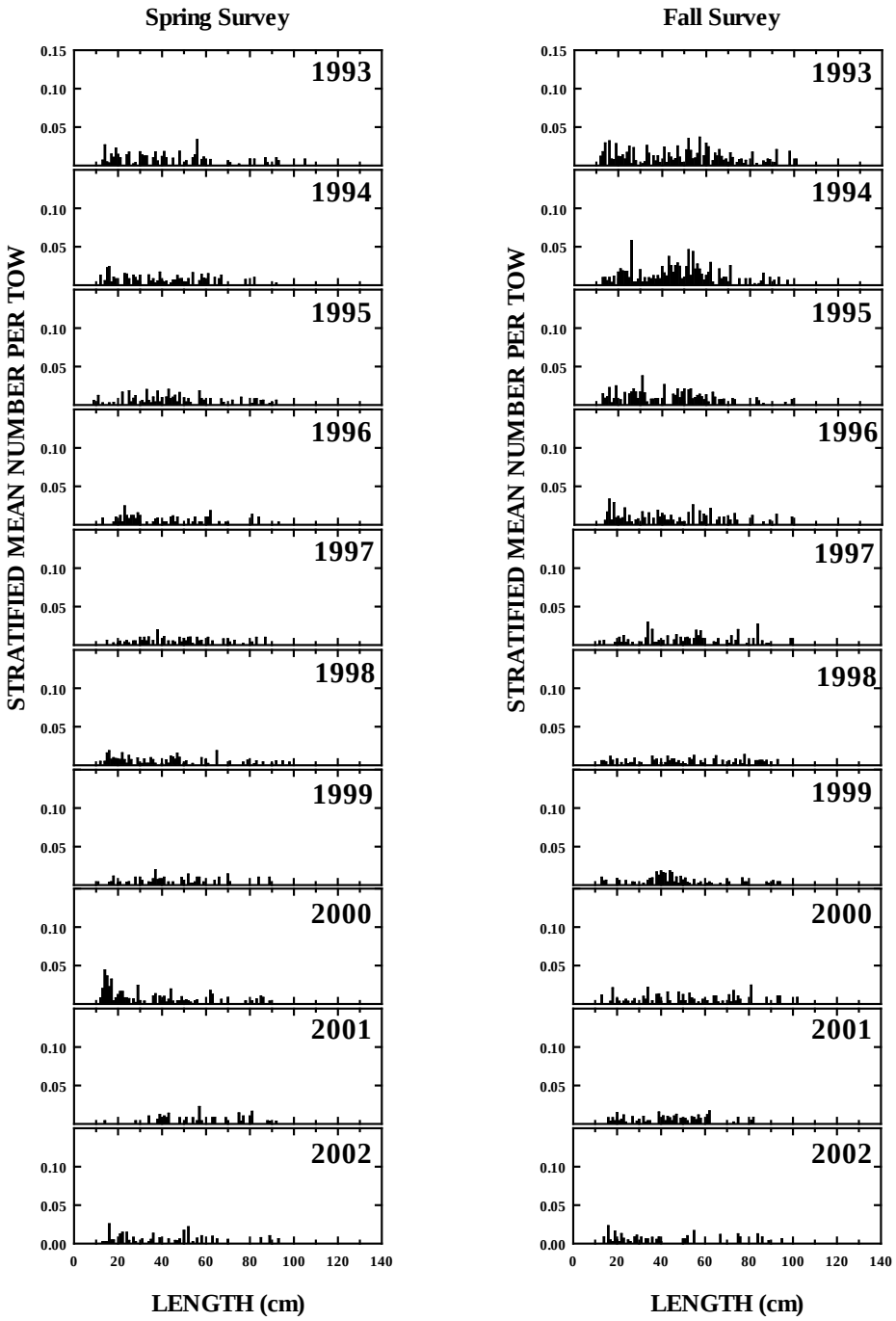

Figure 32. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 1993-2002.

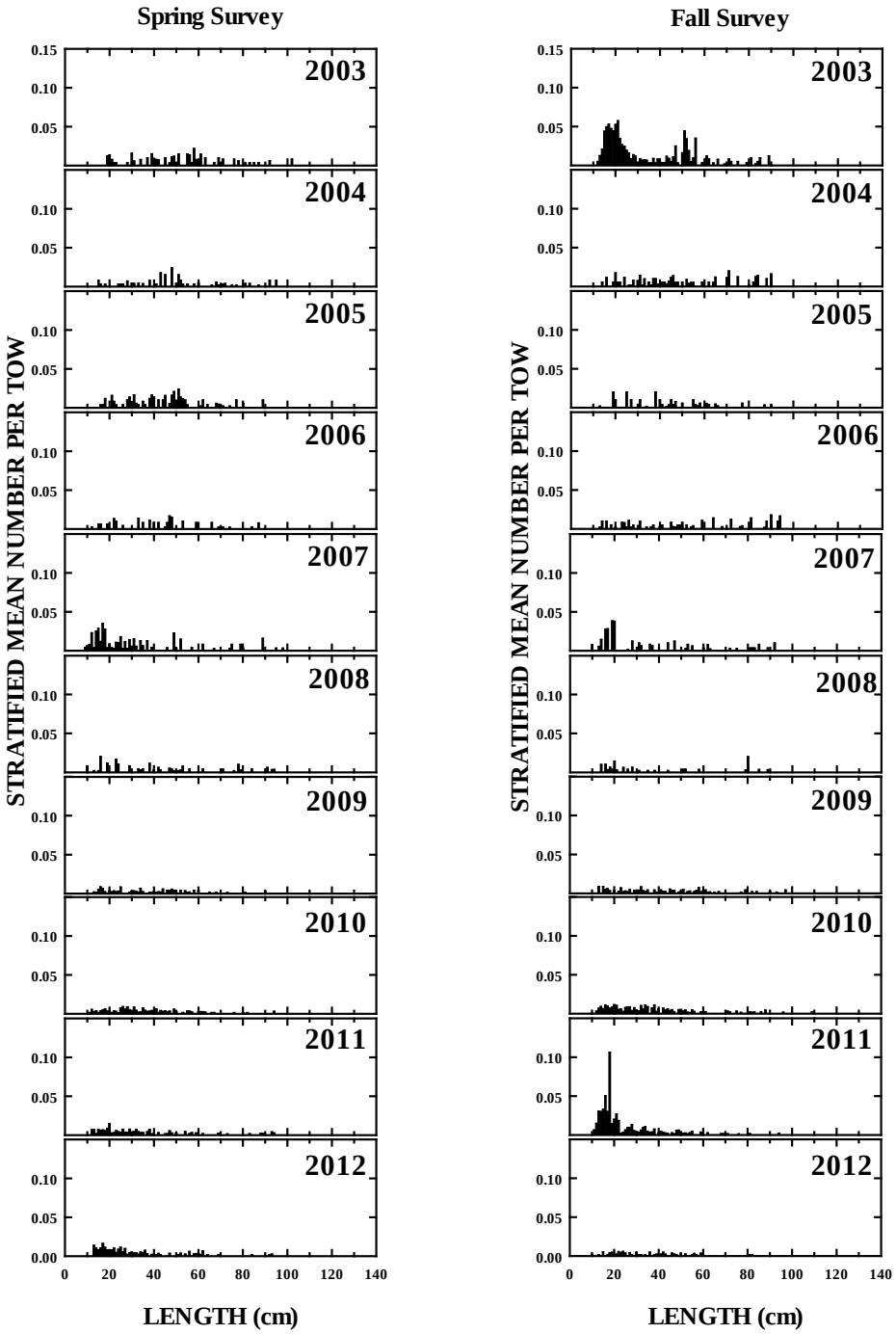

Figure 33. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 2003-2012.

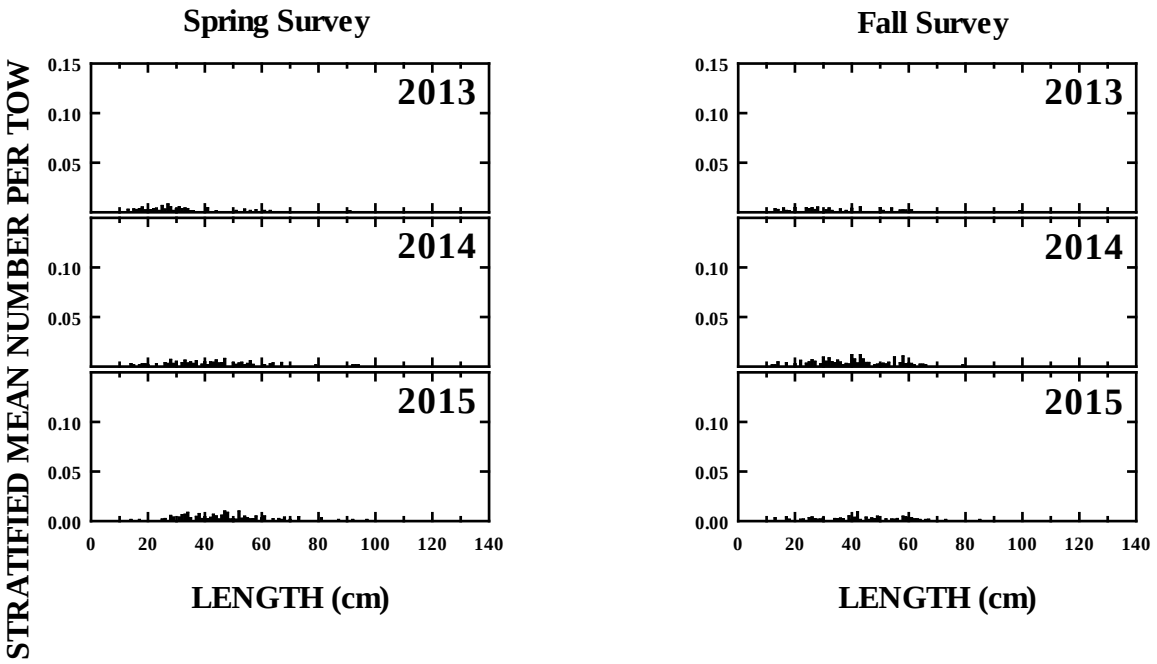

Figure 34. Thorny skate (*Amblyraja radiata*) length composition from the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys in the Gulf of Maine to Southern New England offshore region, 2013-2015.

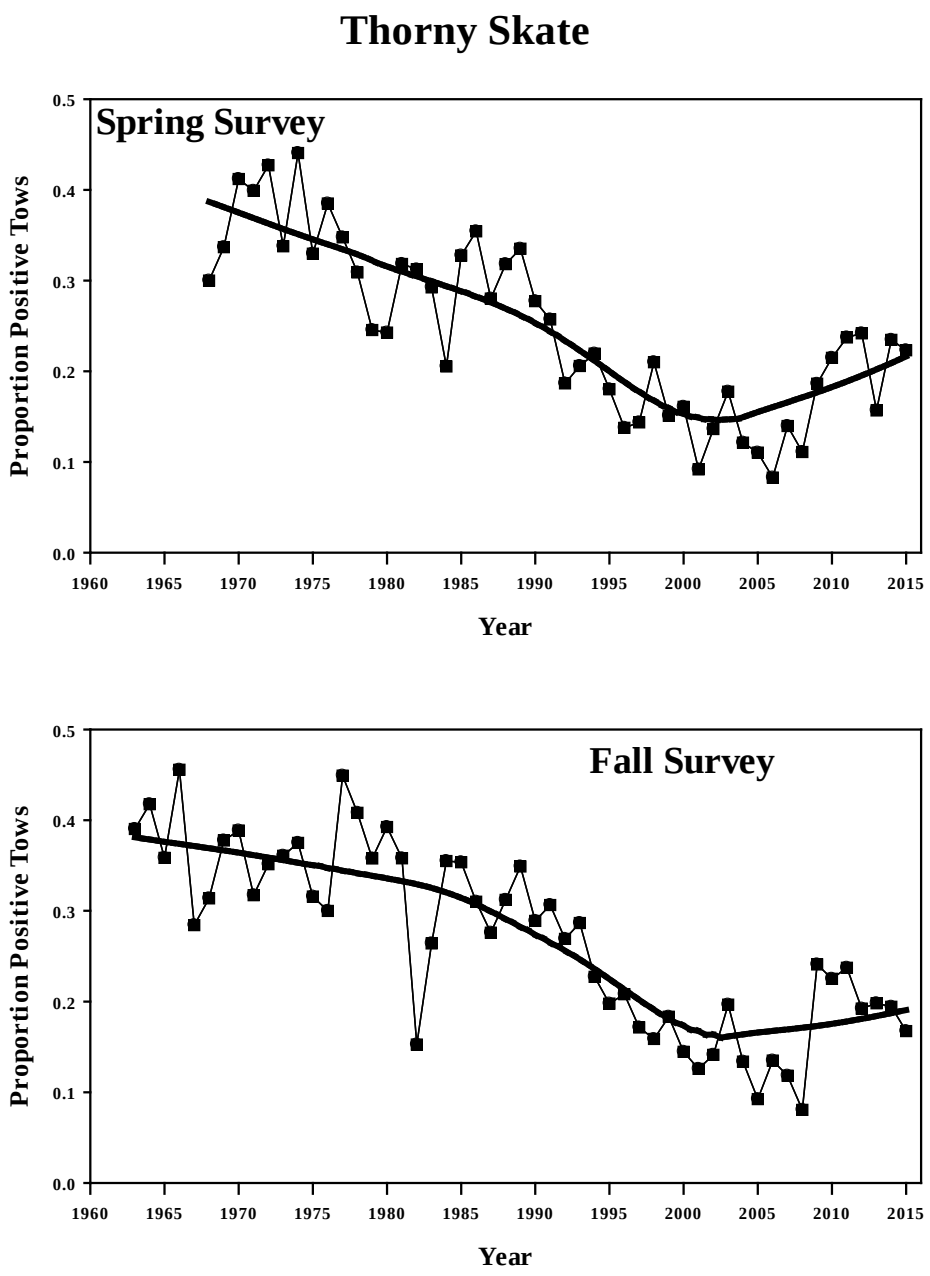

Figure 35. Fraction positive tows of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) spring and fall surveys. The solid line is a Loess smooth of 0.5.

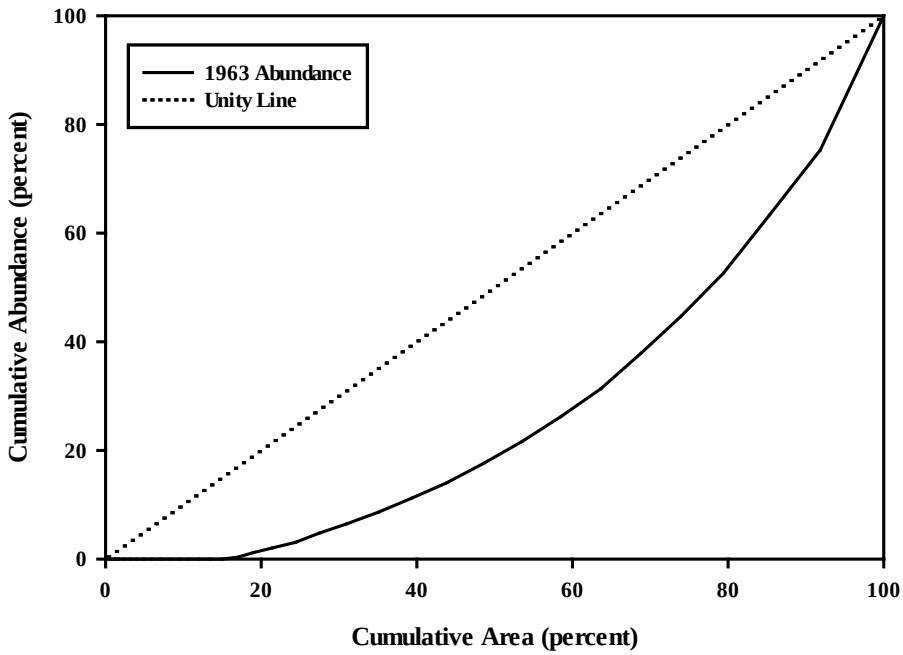

Figure 36. Example computation of the Gini index for thorny skate (*Amblyraja radiata*) during fall 1963 in the Gulf of Maine to Southern New England region.

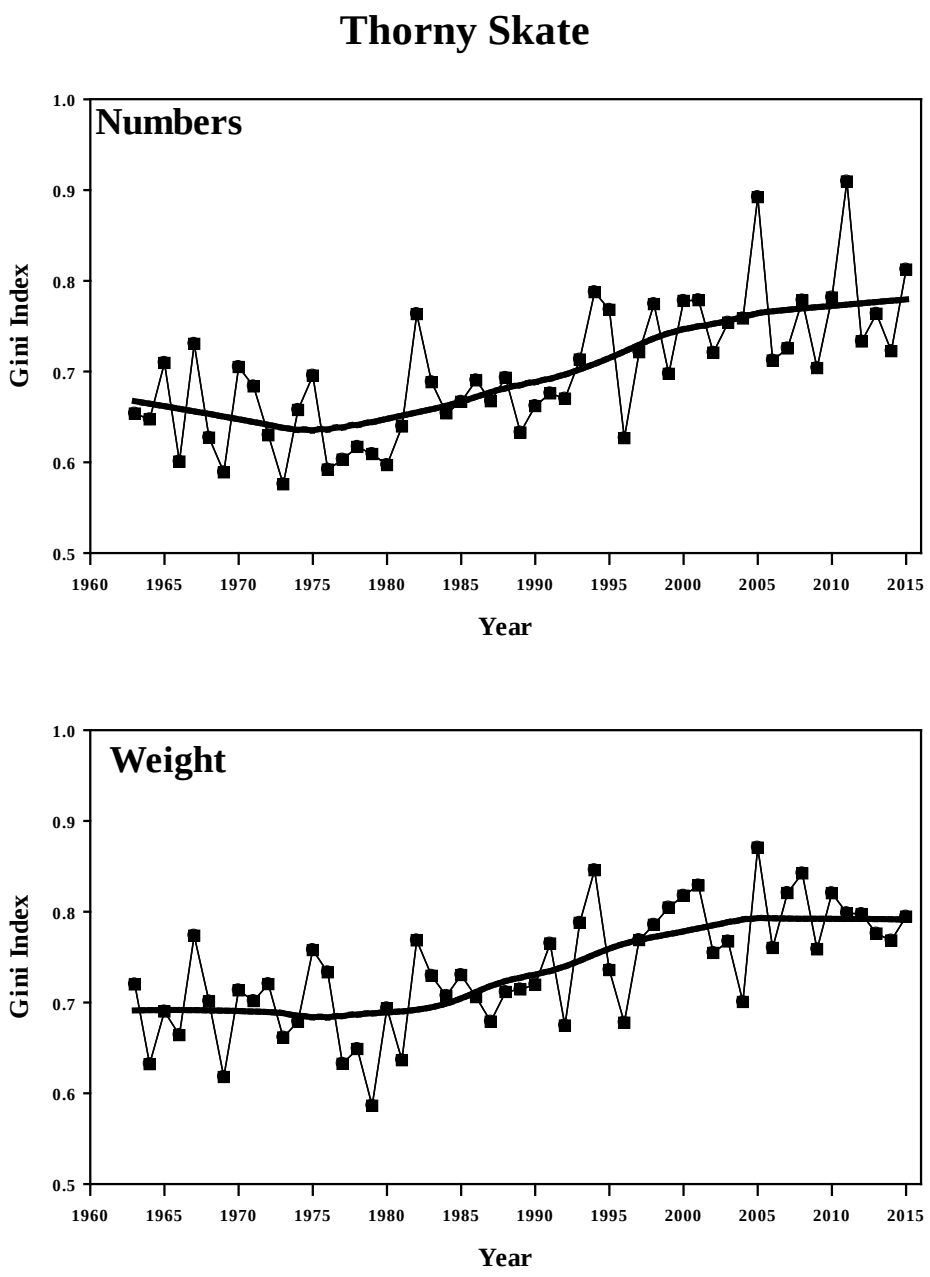

Figure 37. Gini indices of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) fall survey. The solid line is a Loess smooth of 0.4

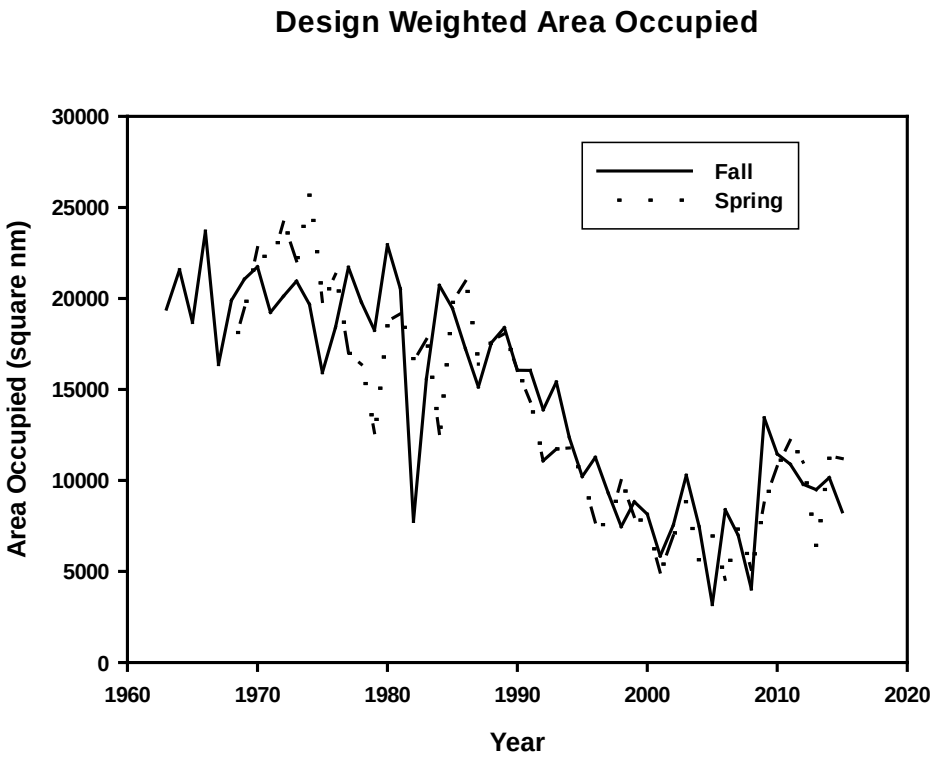

Figure 38. Design-weighted area occupied (DWAO) of thorny skate (*Amblyraja radiata*) in the spring and fall surveys.

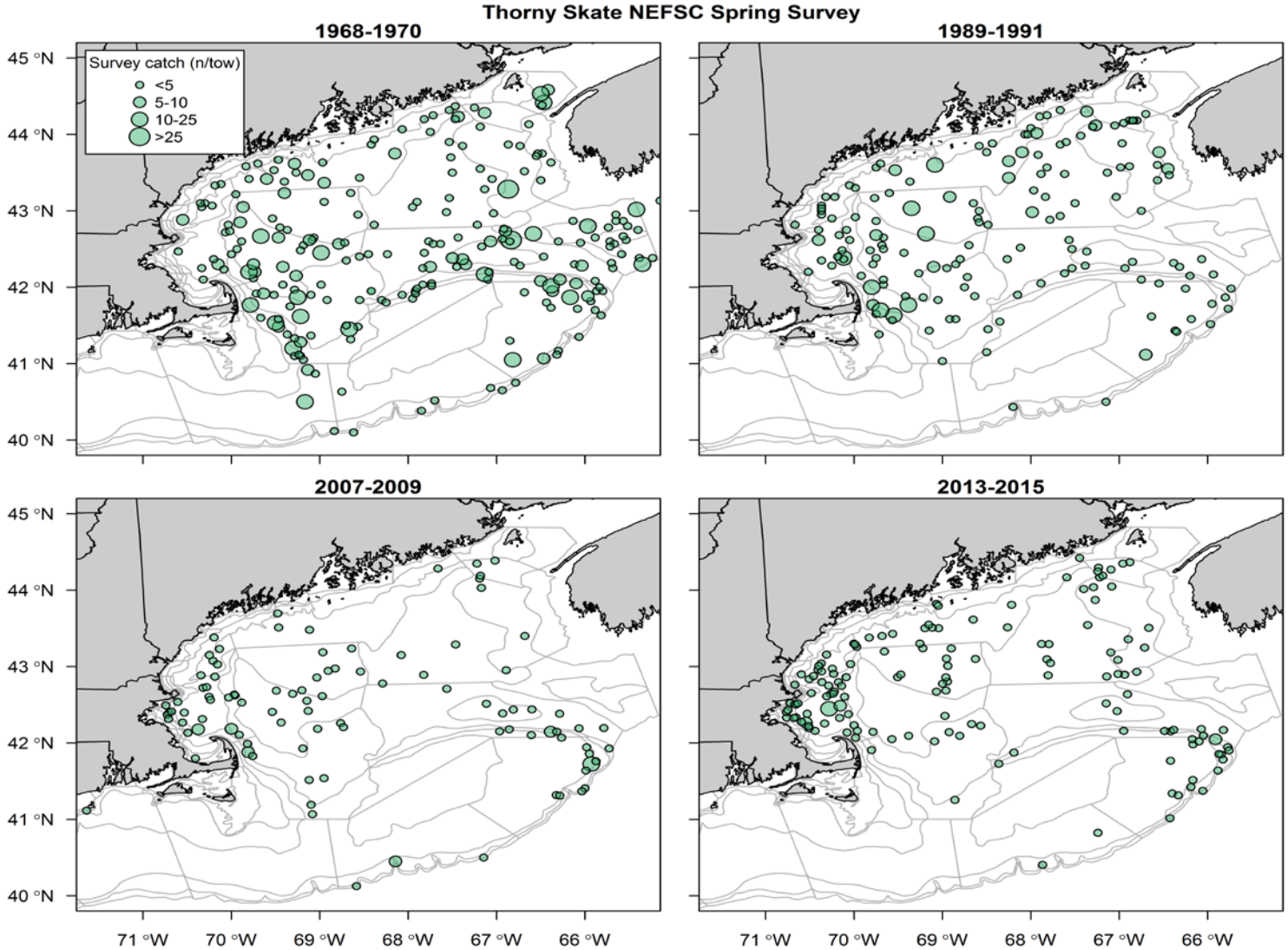

Figure 39. Distribution of thorny skate (*Amblyraja radiata*) in 4 time periods (1968-1970, 1989-1991, 2007-2009, and 2013-2015) from the Northeast Fisheries Science Center (NEFSC) spring survey.

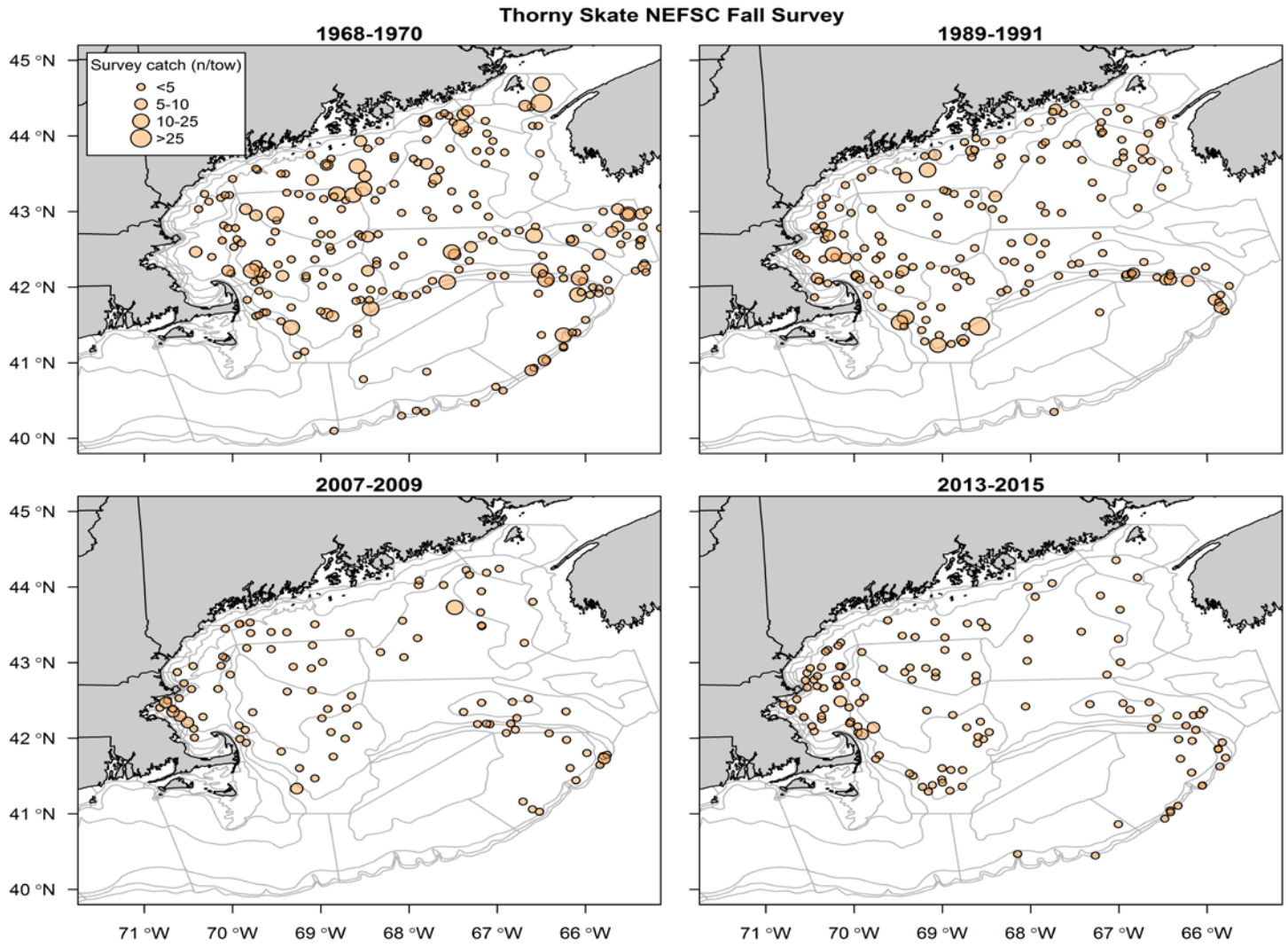

Figure 40. Distribution of thorny skate (*Amblyraja radiata*) in 4 time periods (1968-1970, 1989-1991, 2007-2009, and 2013-2015) from the Northeast Fisheries Science Center (NEFSC) fall survey.

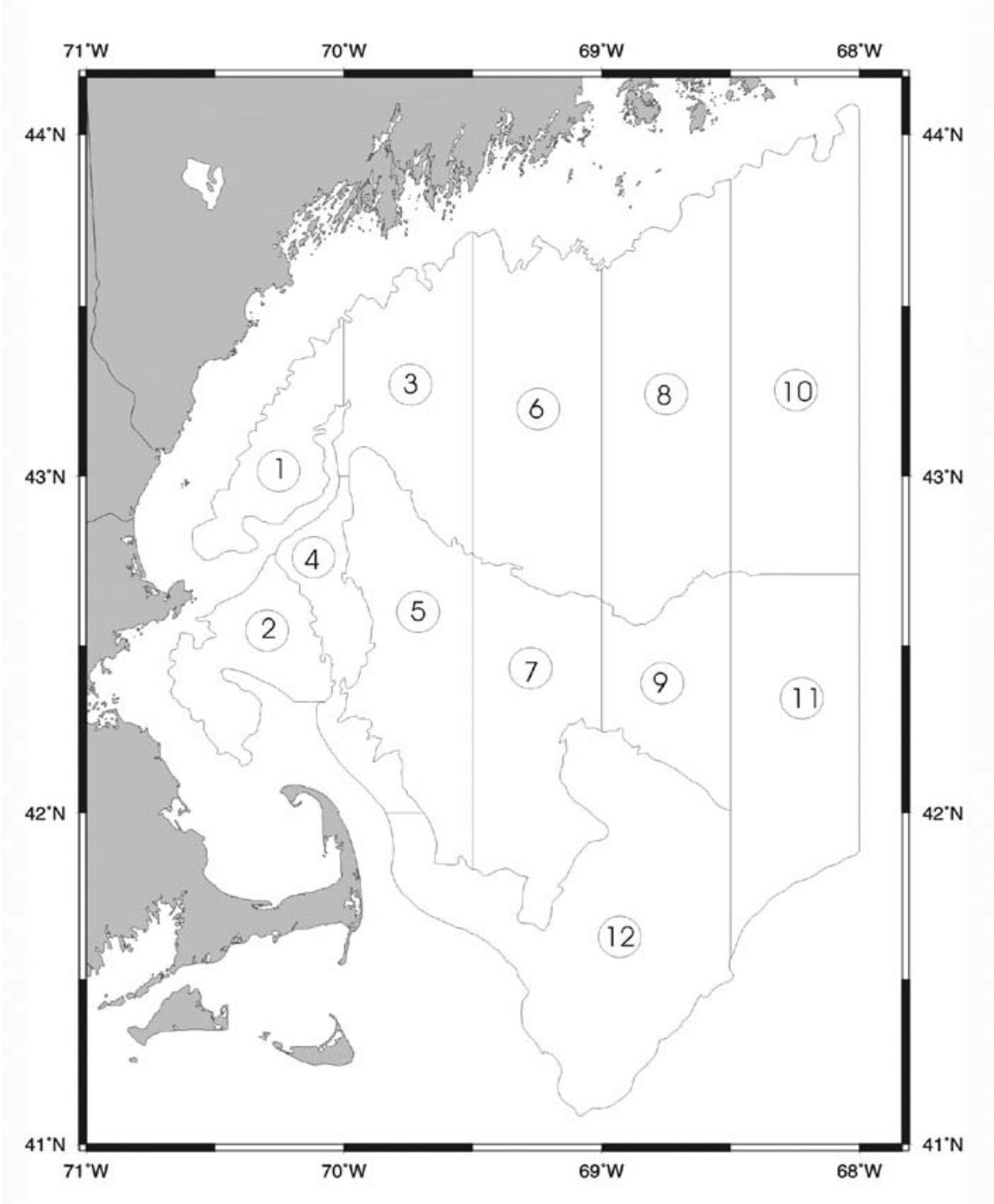

Figure 41. Map of survey strata for the Atlantic States Marine Fisheries Commission shrimp survey.

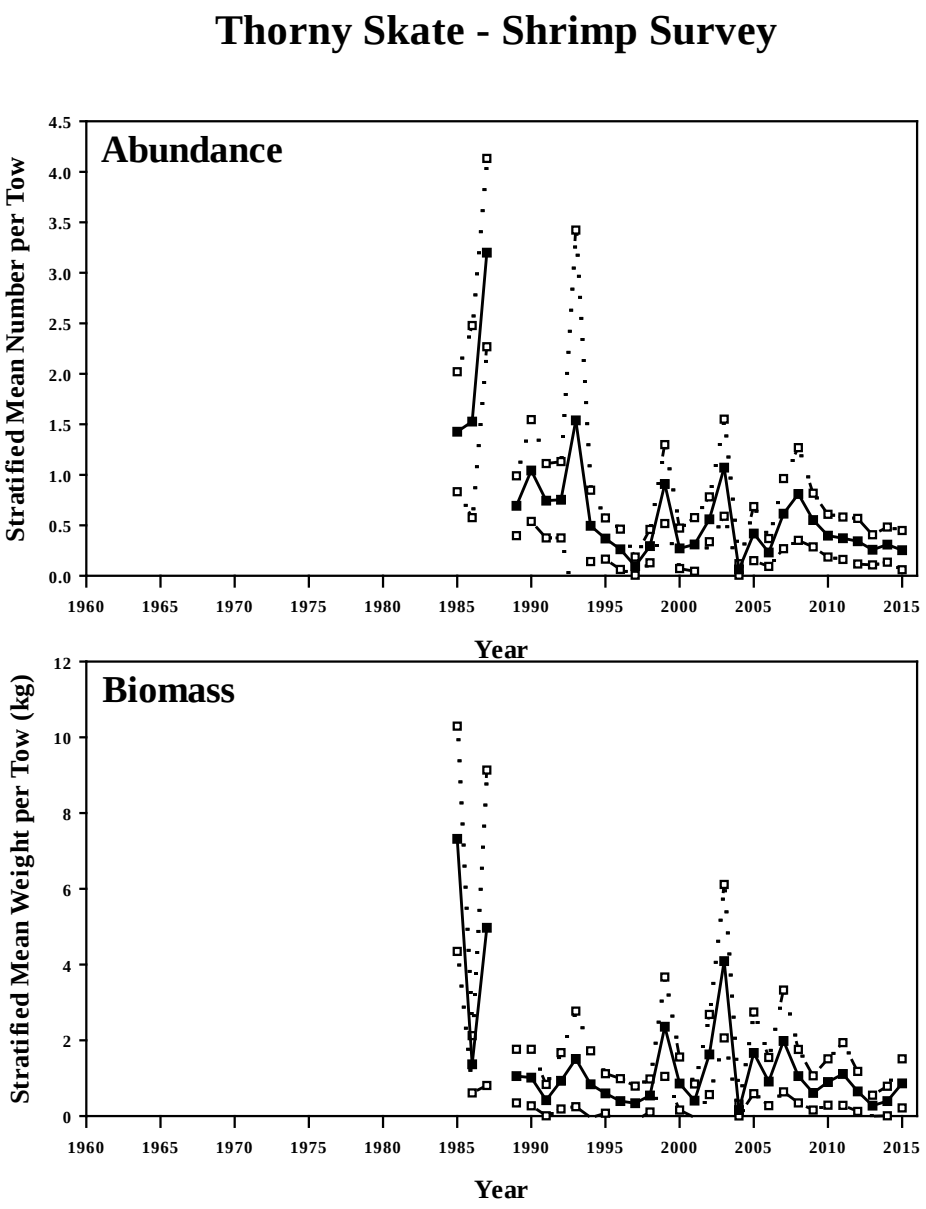

Figure 42. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Atlantic States Marine Fisheries Commission shrimp surveys from 1985-2015. Mean index in solid squares, 95% confidence interval in open squares.

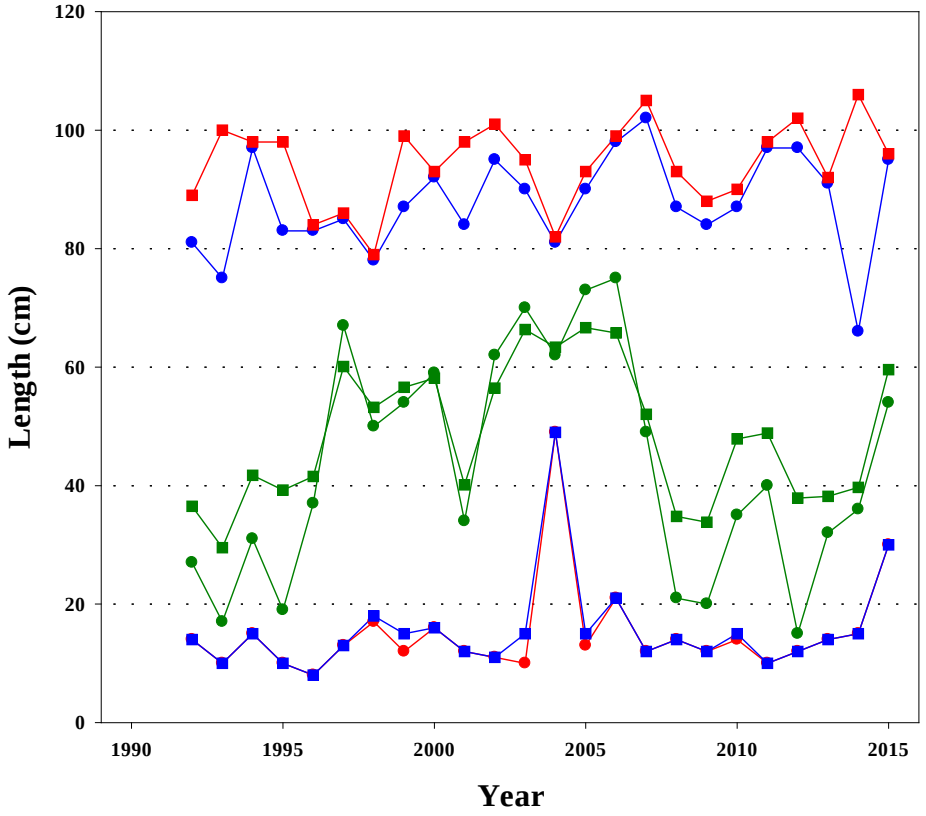

Figure 43. Minimum (red circles), 5th percentile (blue circles), mean (green squares), median (green circles), 95th percentile (blue circles) and maximum (red circles) total length (cm) of thorny skate (*Amblyraja radiata*) from the Atlantic States Marine Fisheries Commission shrimp surveys from 1992-2015.

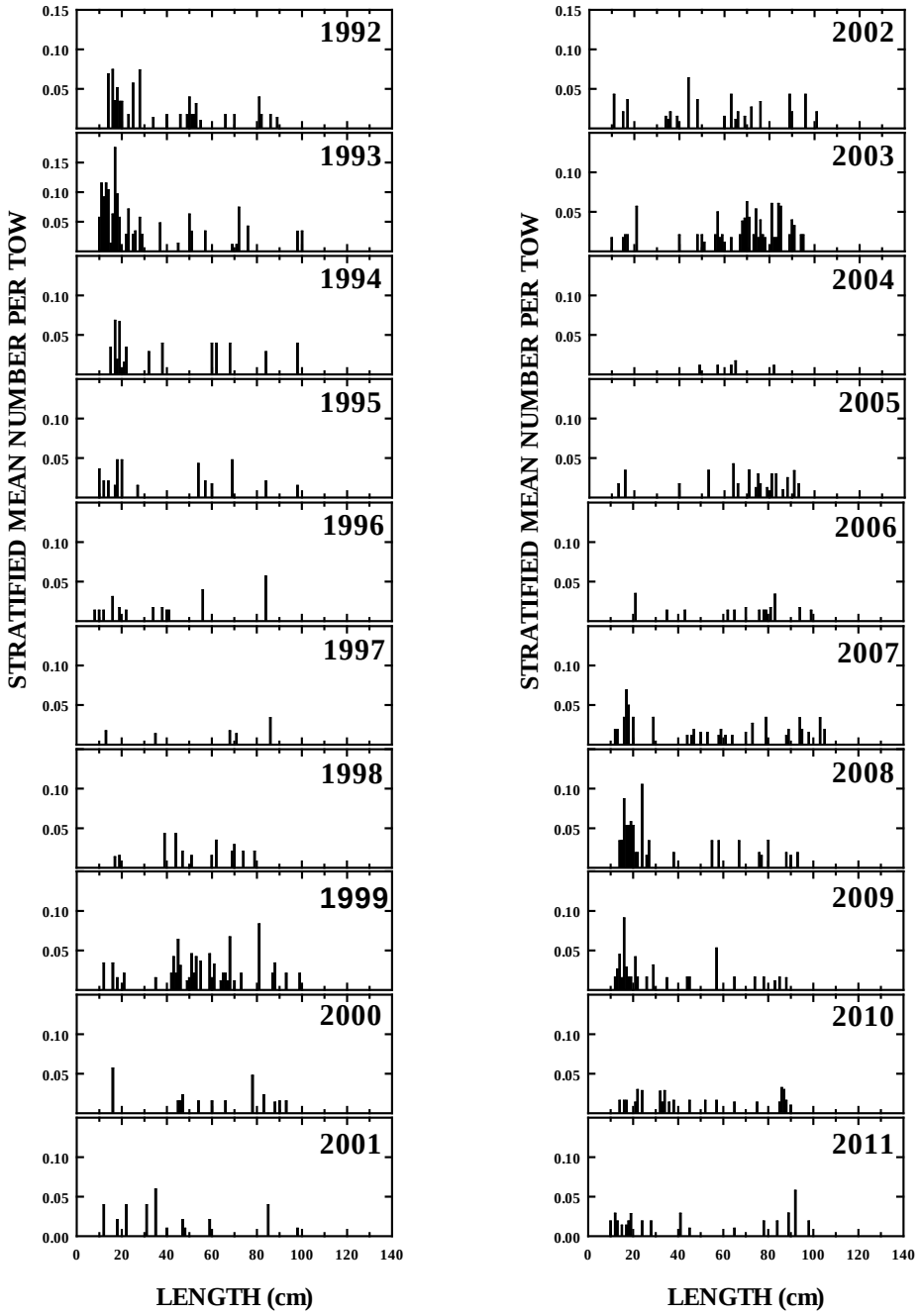

Figure 44. Thorny skate (*Amblyraja radiata*) length composition from the Atlantic States Marine Fisheries Commission shrimp surveys, 1992-2011.

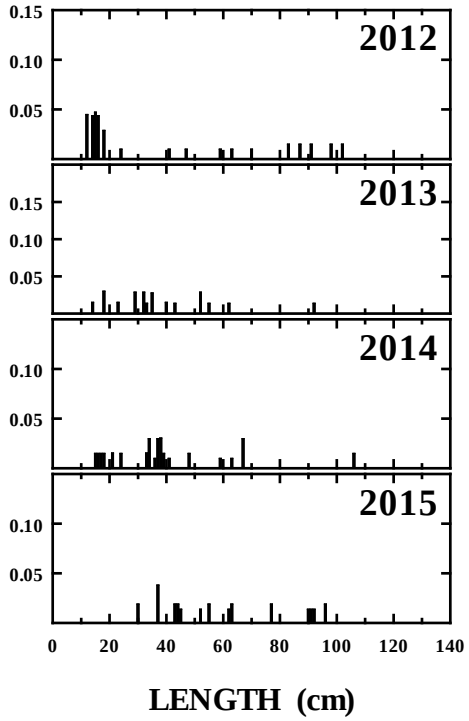

Figure 45. Thorny skate (*Amblyraja radiata*) length composition from the Atlantic States Marine Fisheries Commission shrimp surveys, 2012-2015.

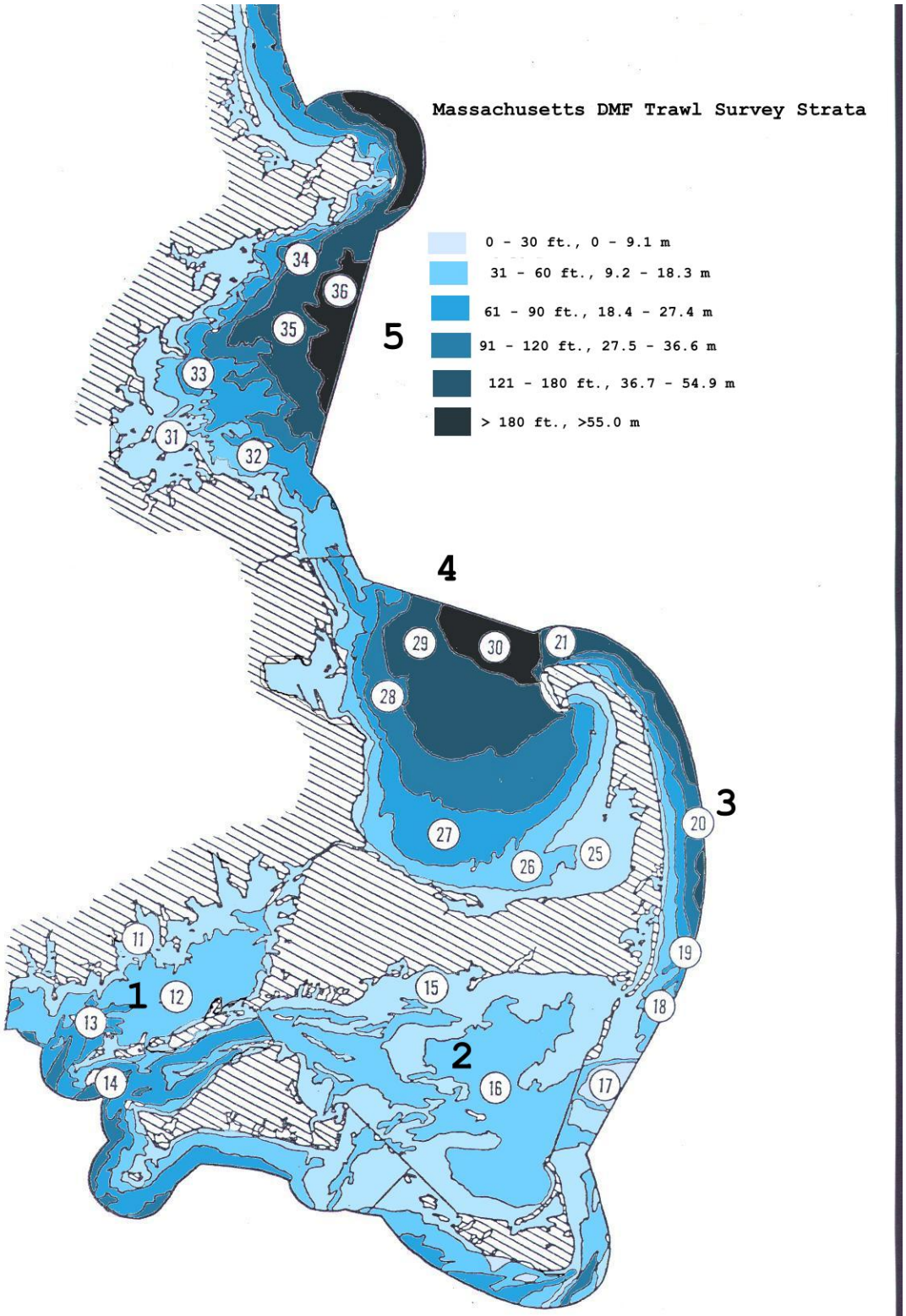

Figure 46. Map of survey strata sampled by the Massachusetts Division of Marine Fisheries (DMF) from Sosebee and Cadrin 2005.

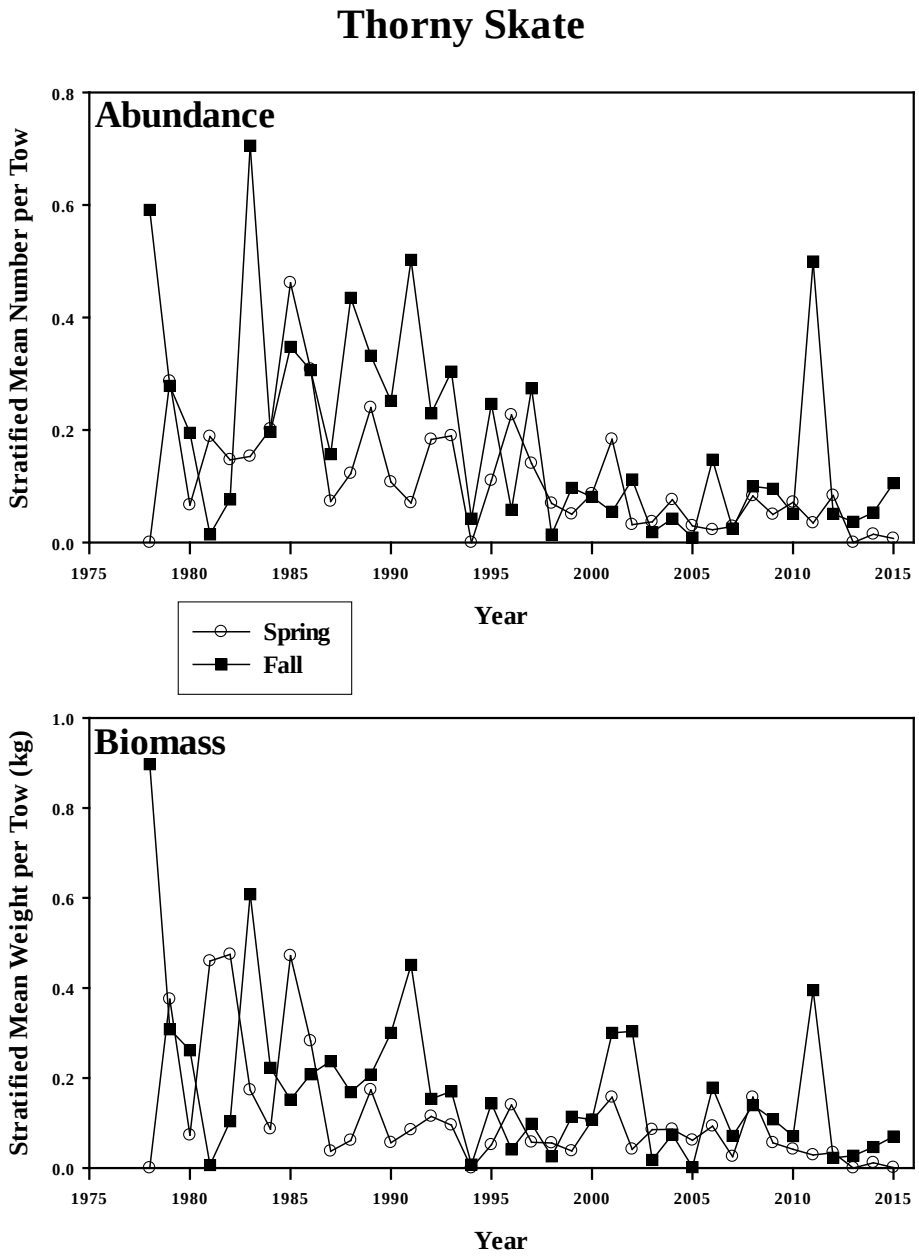

Figure 47. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Massachusetts Division of Marine Fisheries (DMF) spring and fall bottom trawl survey in state waters (Strata 11-36).

Thorny Skate - Spring Survey

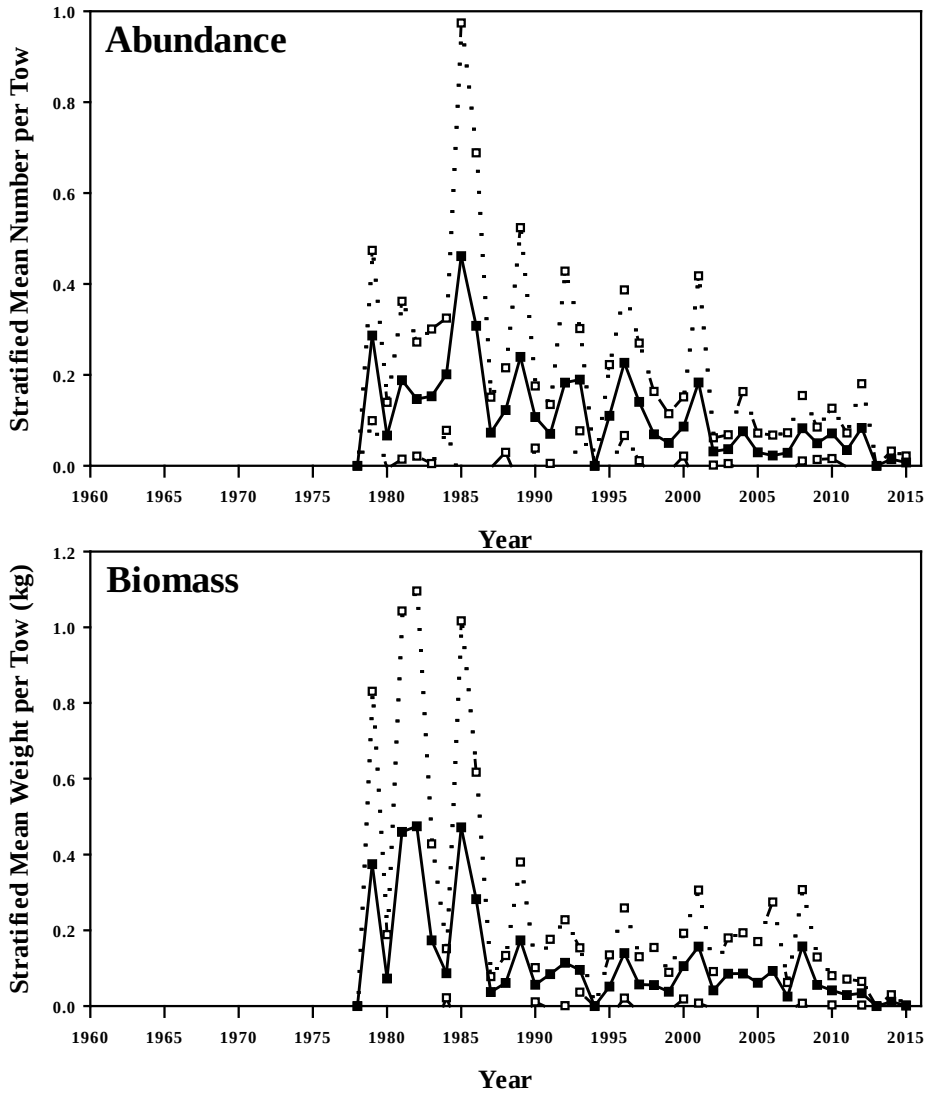

Figure 48. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Massachusetts Division of Marine Fisheries spring bottom trawl surveys from 1978-2015. Mean index in solid squares, 95% confidence interval in open squares.

Thorny Skate - Fall Survey

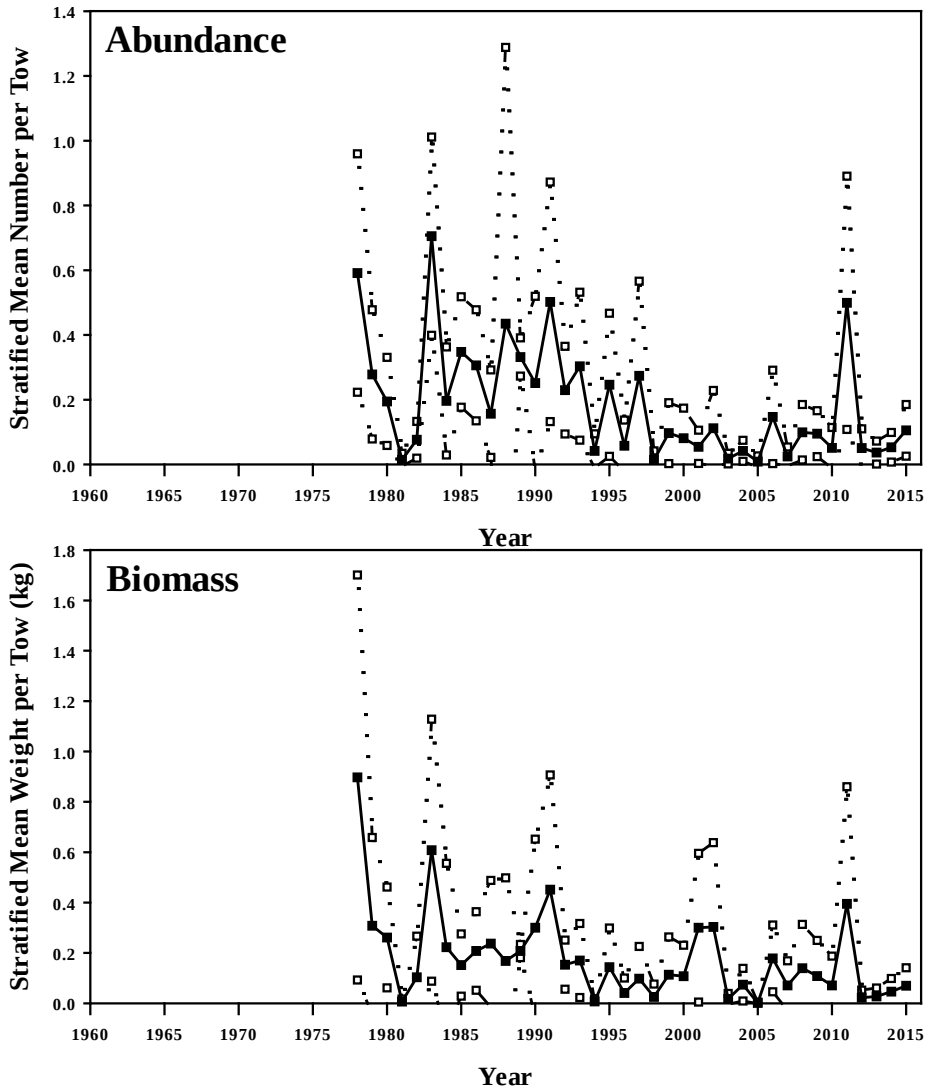

Figure 49. Abundance and biomass of thorny skate (*Amblyraja radiata*) from the Massachusetts Division of Marine Fisheries fall bottom trawl surveys from 1978-2015. Mean index in solid squares, 95% confidence interval in open squares.

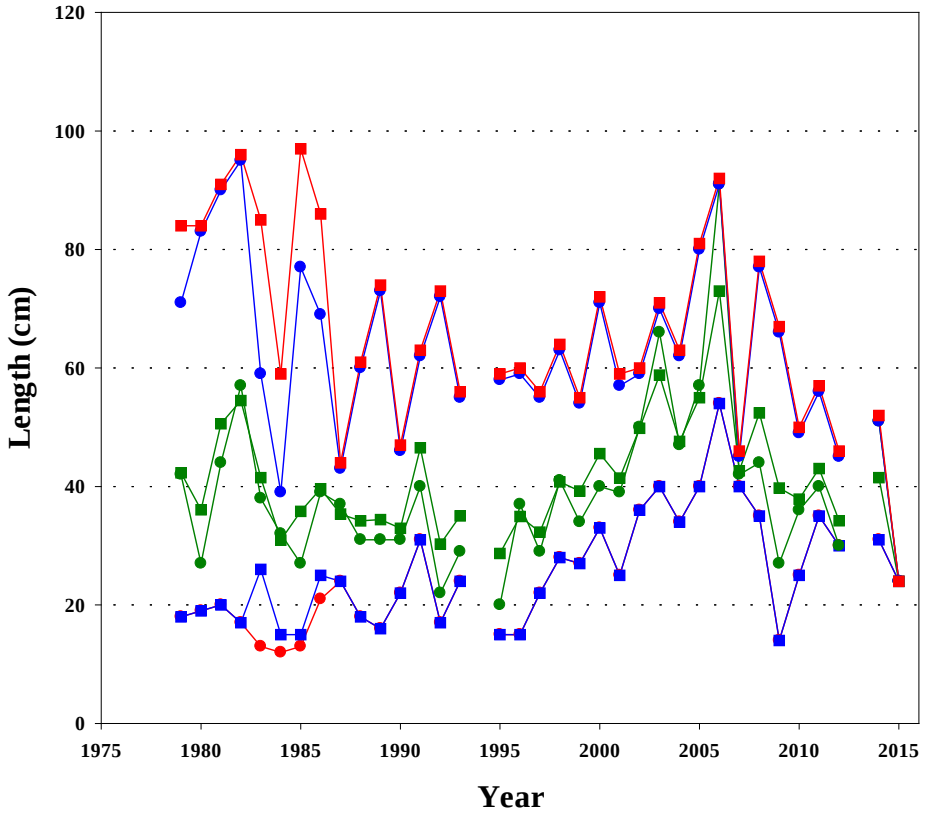

Figure 50. Minimum (red circles), 5th percentile (blue squares), mean (green squares), median (green circles), 95th percentile (blue circles) and maximum (red squares) total length (cm) of thorny skate (*Amblyraja radiata*) from the Massachusetts Division of Marine Fisheries spring bottom trawl surveys from 1978-2015.

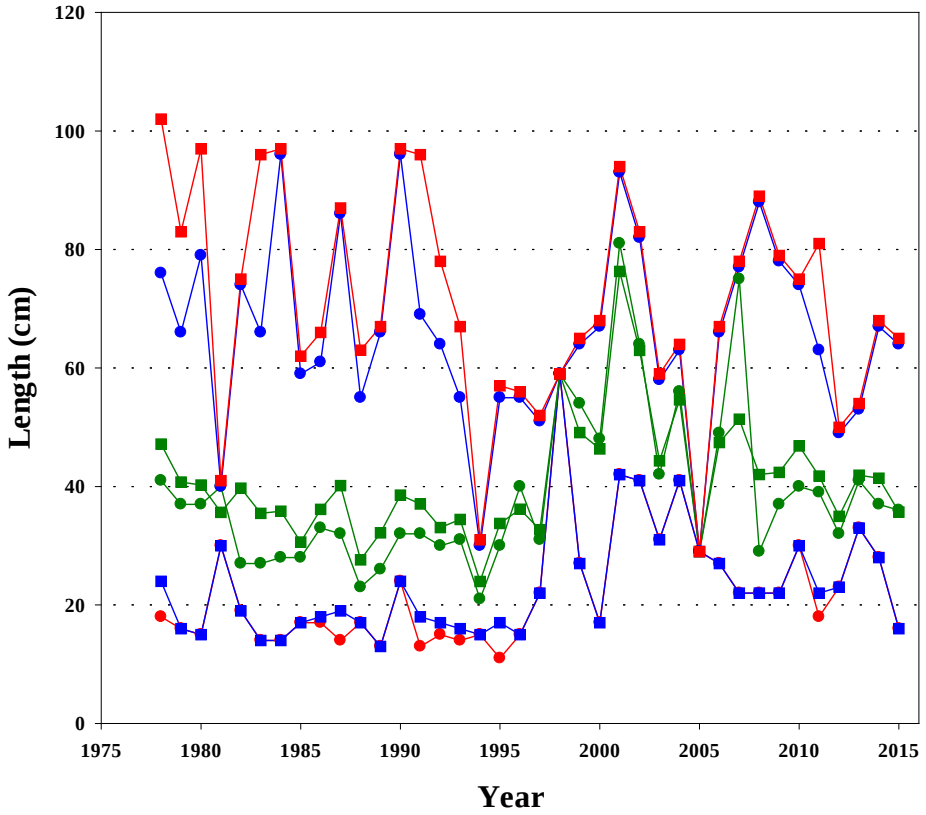

Figure 51. Minimum (red circles), 5th percentile (blue circles), mean (green squares), median (green circles), 95th percentile (blue circles) and maximum (red circles) total length (cm) of thorny skate (*Amblyraja radiata*) from the Massachusetts Division of Marine Fisheries fall bottom trawl surveys from 1978-2015.

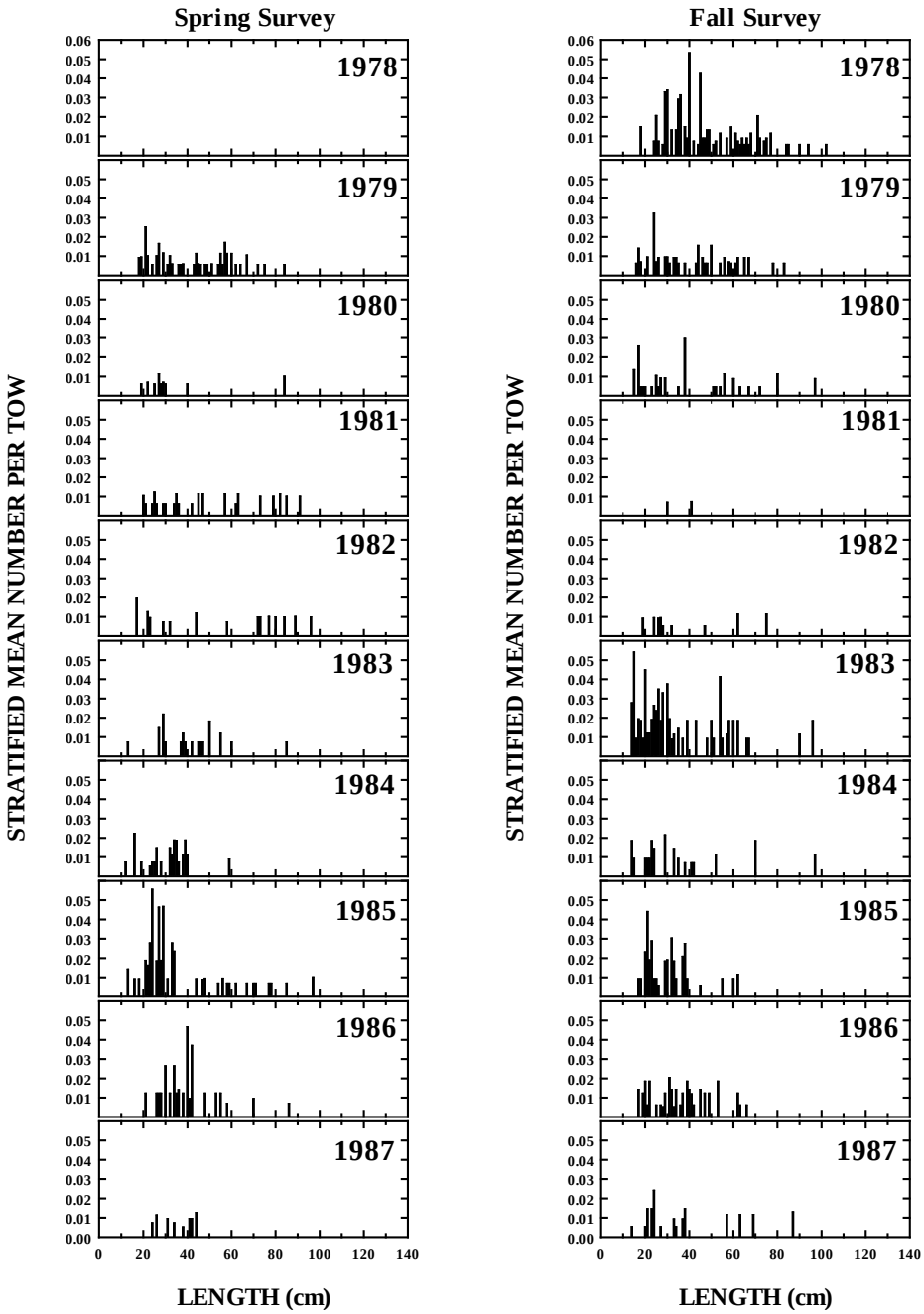

Figure 52. Thorny skate (*Amblyraja radiata*) length composition from the Massachusetts Division of Marine Fisheries (MA DMF) spring and fall bottom trawl surveys, 1978-1987.

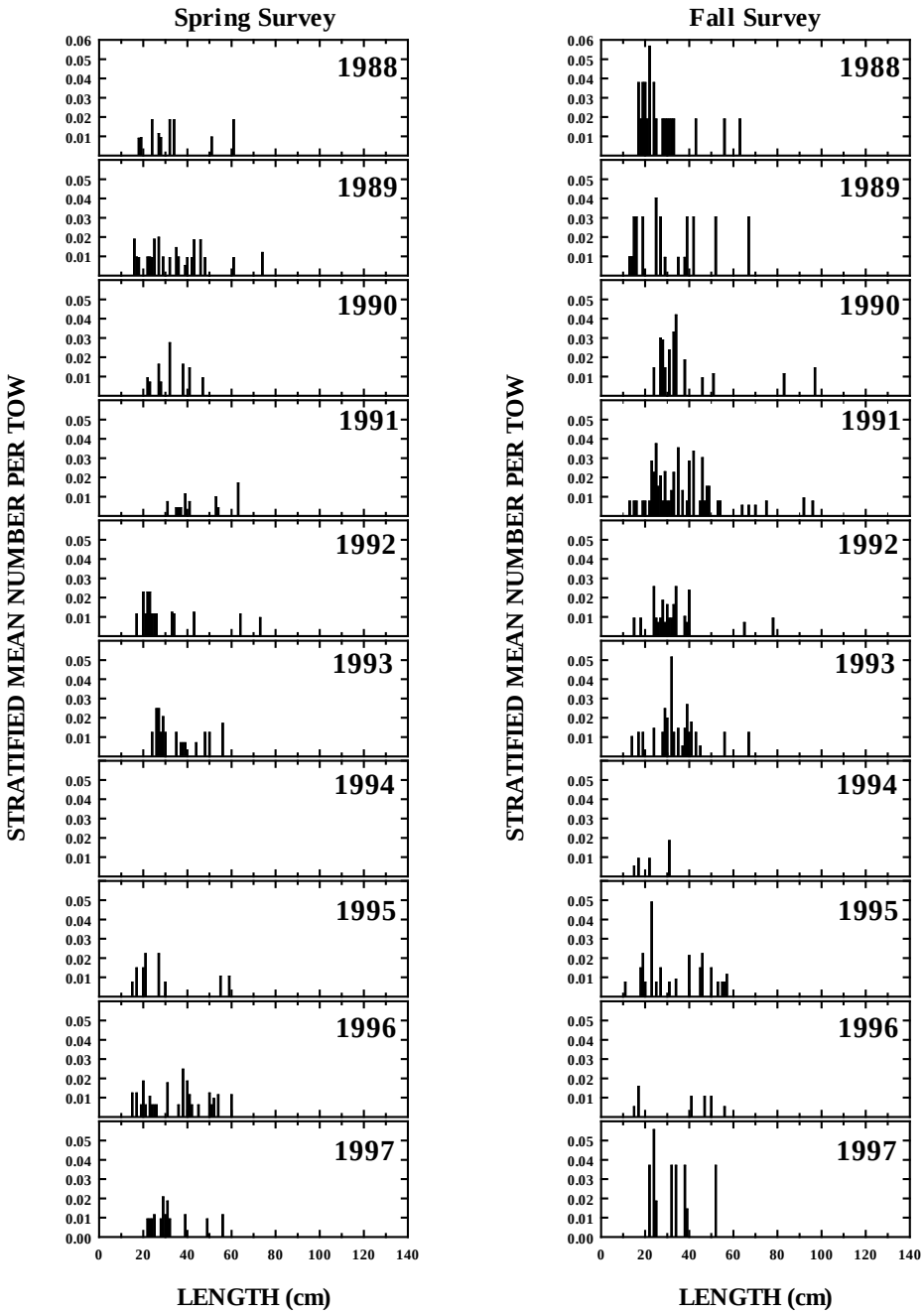

Figure 53. Thorny skate (*Amblyraja radiata*) length composition from the Massachusetts Division of Marine Fisheries (MA DMF) spring and fall bottom trawl surveys, 1988-1997.

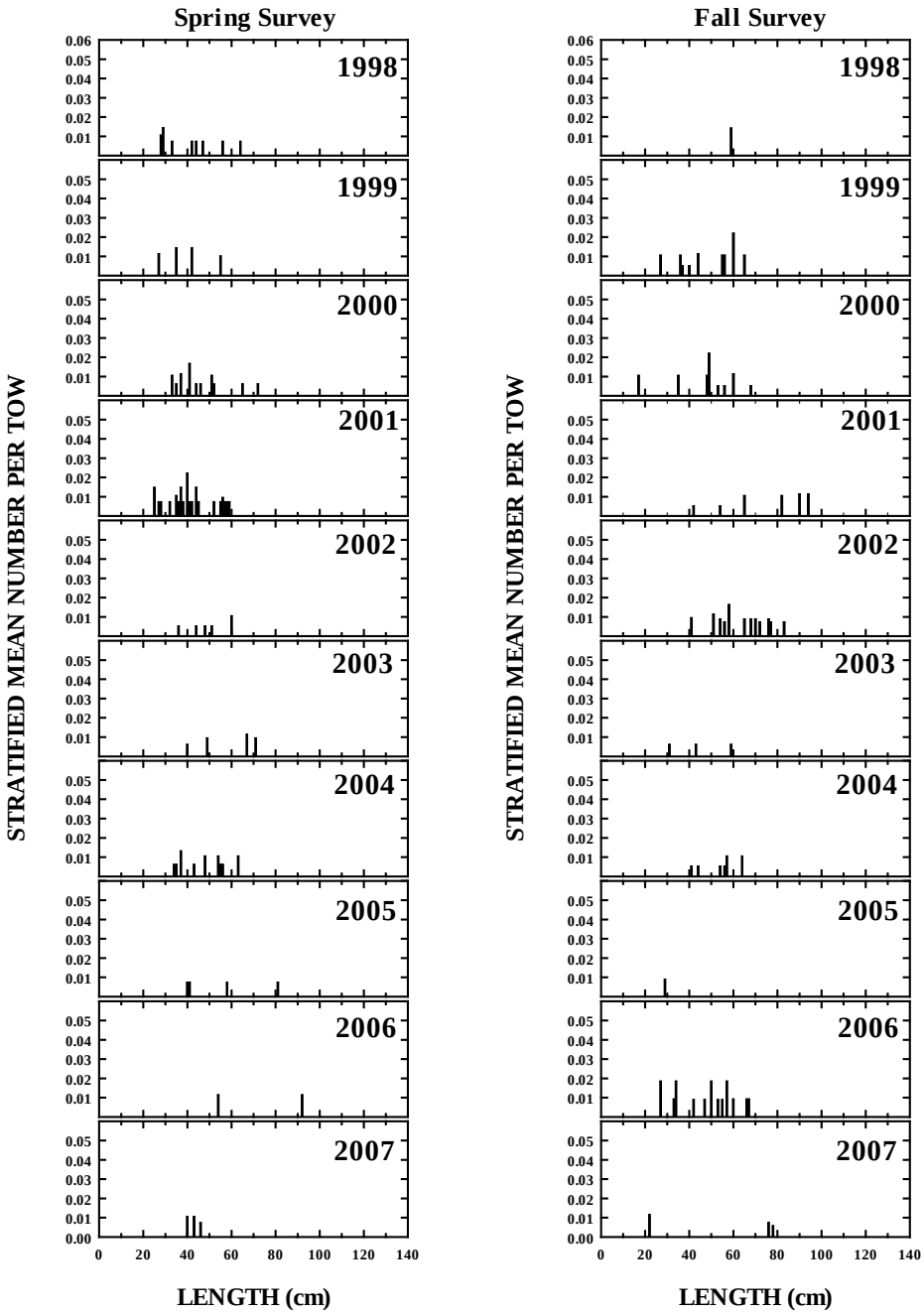

Figure 54. Thorny skate (*Amblyraja radiata*) length composition from the Massachusetts Division of Marine Fisheries (MA DMF) spring and fall bottom trawl surveys, 1998-2007.

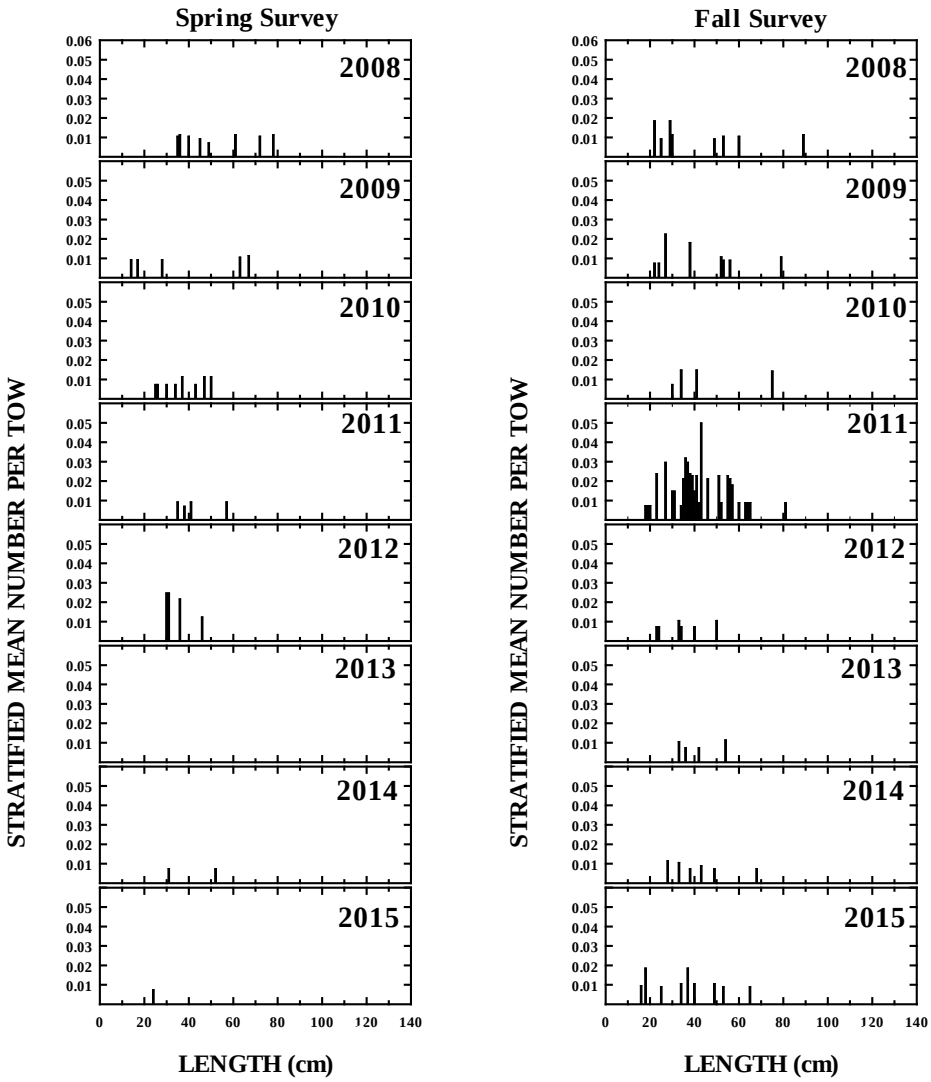

Figure 55. Thorny skate (*Amblyraja radiata*) length composition from the Massachusetts Division of Marine Fisheries (MA DMF) spring and fall bottom trawl surveys, 2008-2015.

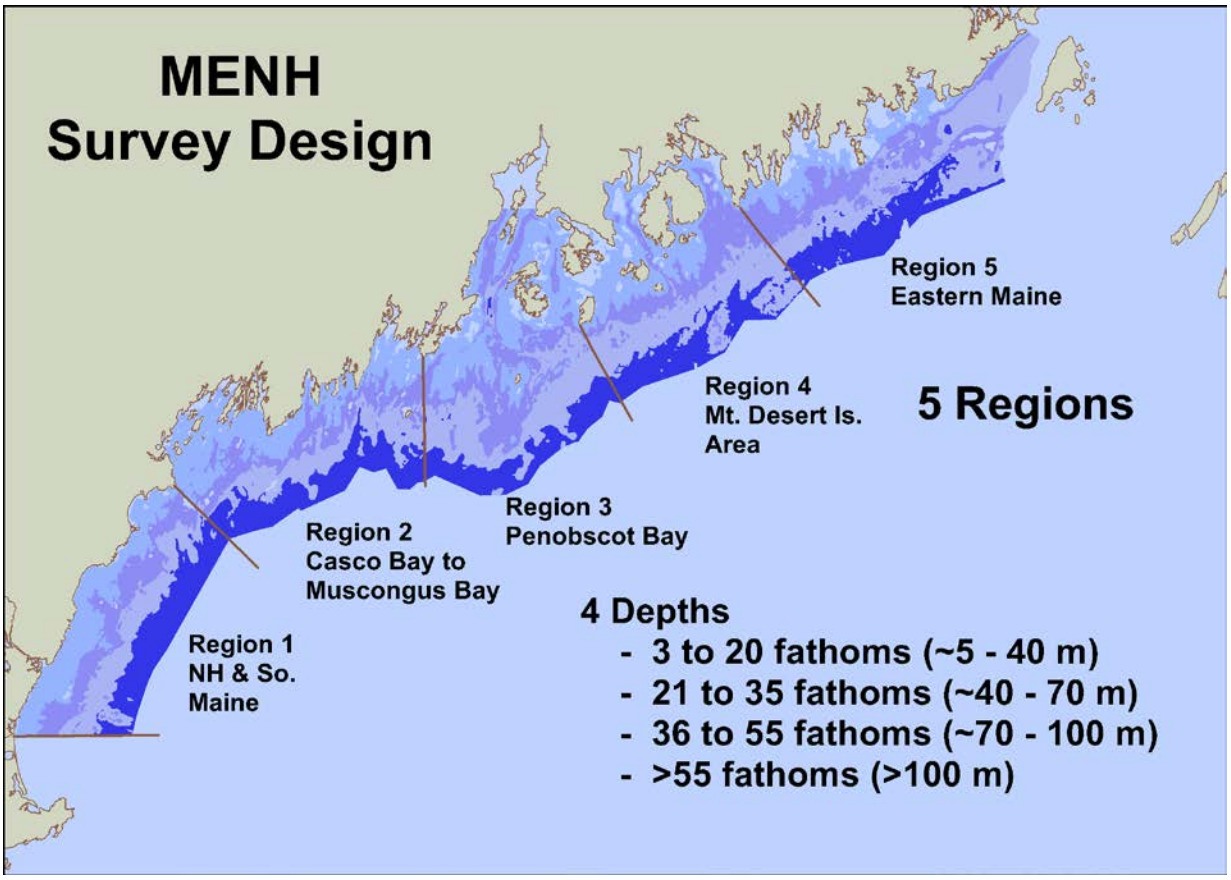

Figure 56. Map of the Maine – New Hampshire (MENH) survey area. There are 5 geographic regions and 4 depth strata.

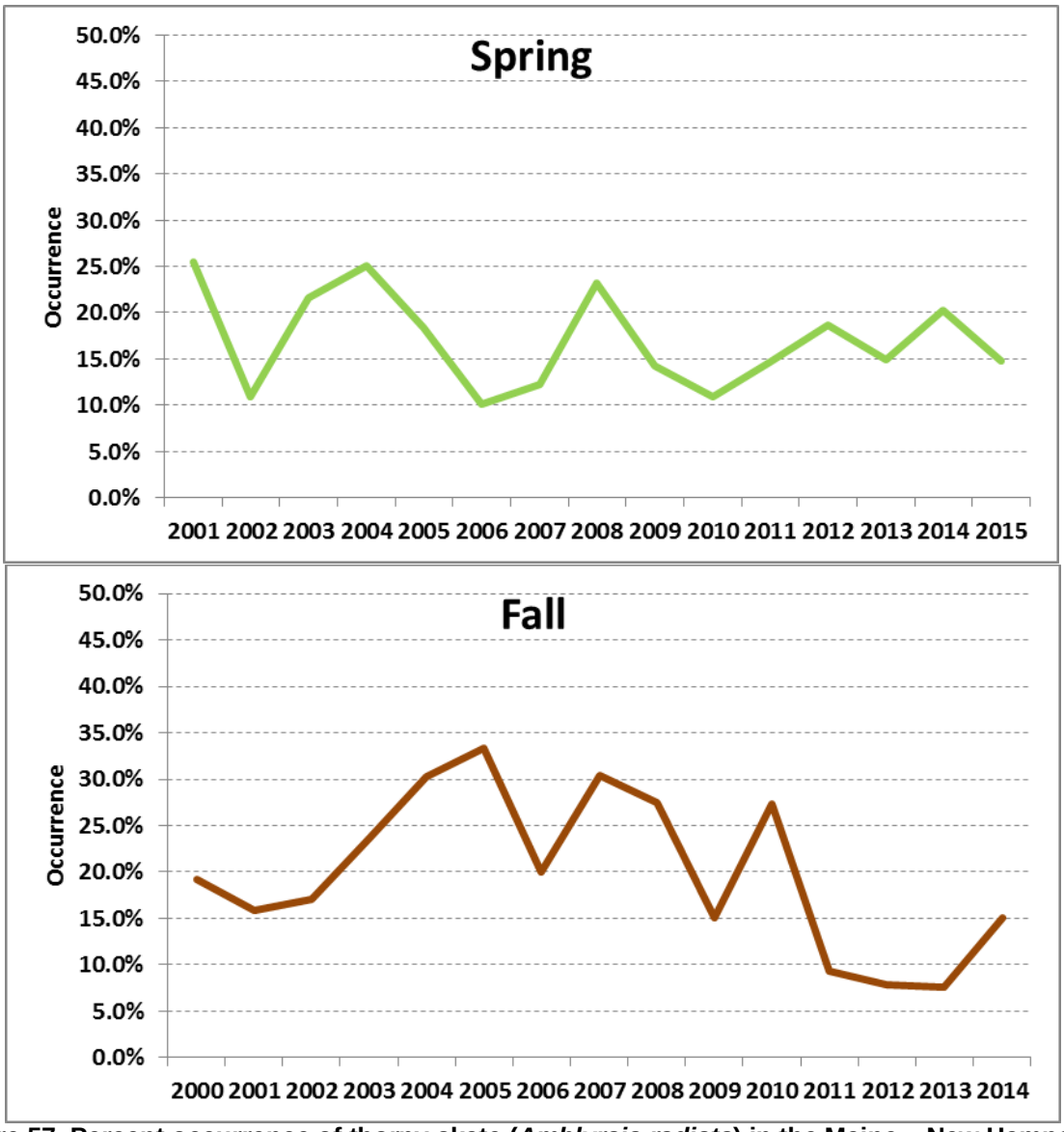

Figure 57. Percent occurrence of thorny skate (*Amblyraja radiata*) in the Maine – New Hampshire (MENH) survey.

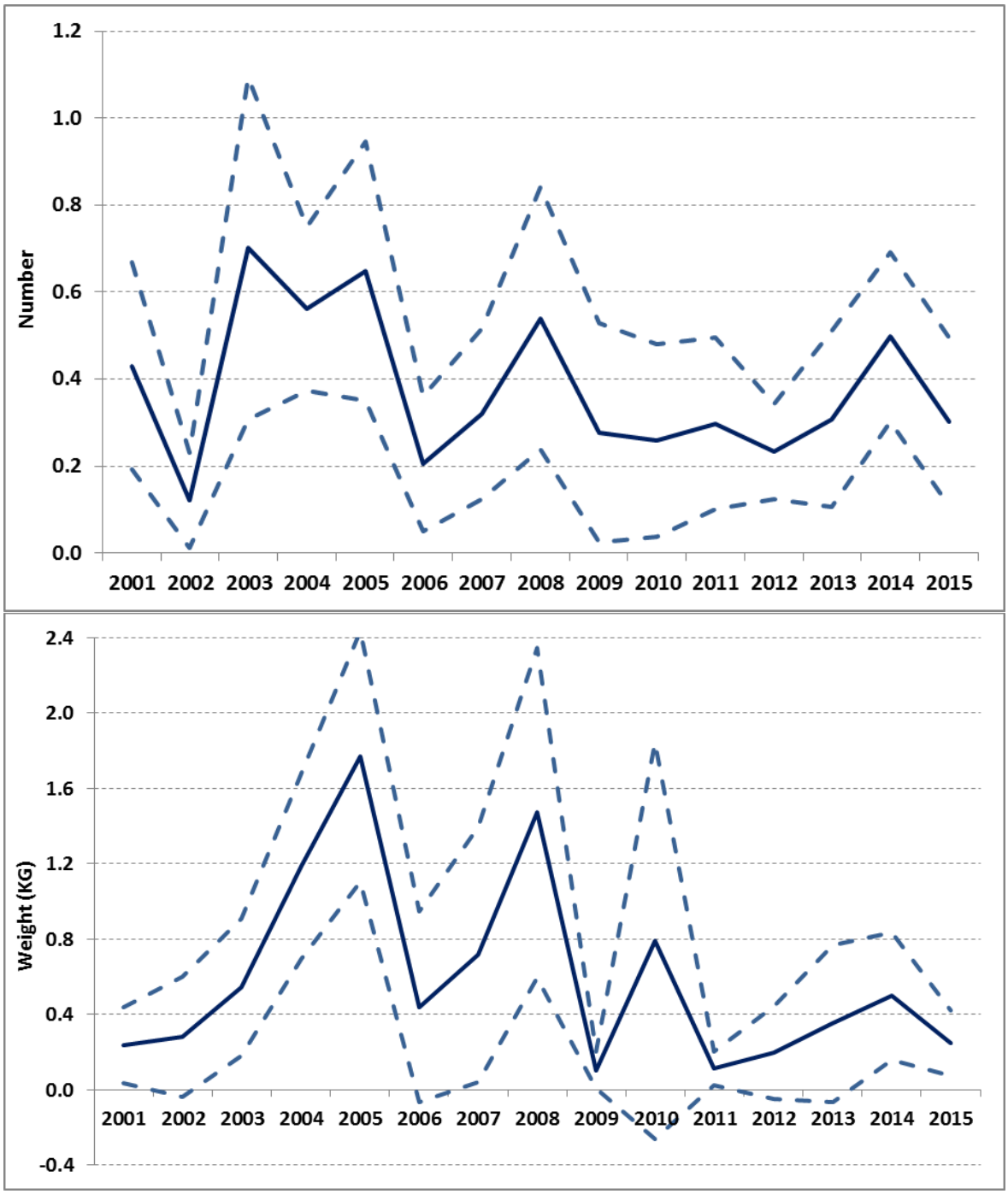

Figure 58. Relative abundance (top panel) and biomass (bottom panel) indices of thorny skate (*Amblyraja radiata*)from the Maine – New Hampshire (MENH) spring survey. The confidence intervals are 2 standard errors.

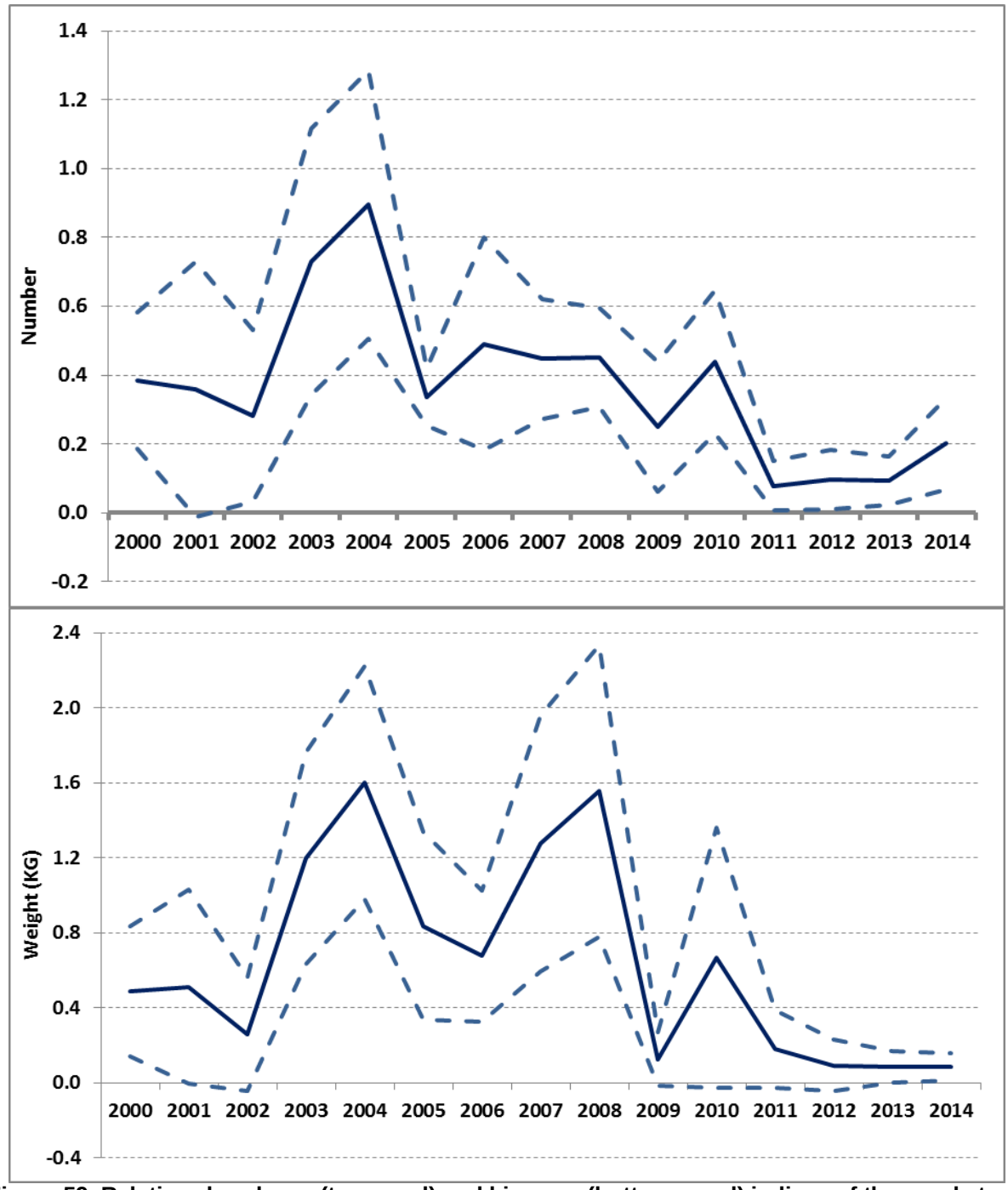

Figure 59. Relative abundance (top panel) and biomass (bottom panel) indices of thorny skate (*Amblyraja radiata*) from the Maine – New Hampshire (MENH) fall survey. The confidence intervals are 2 standard errors.

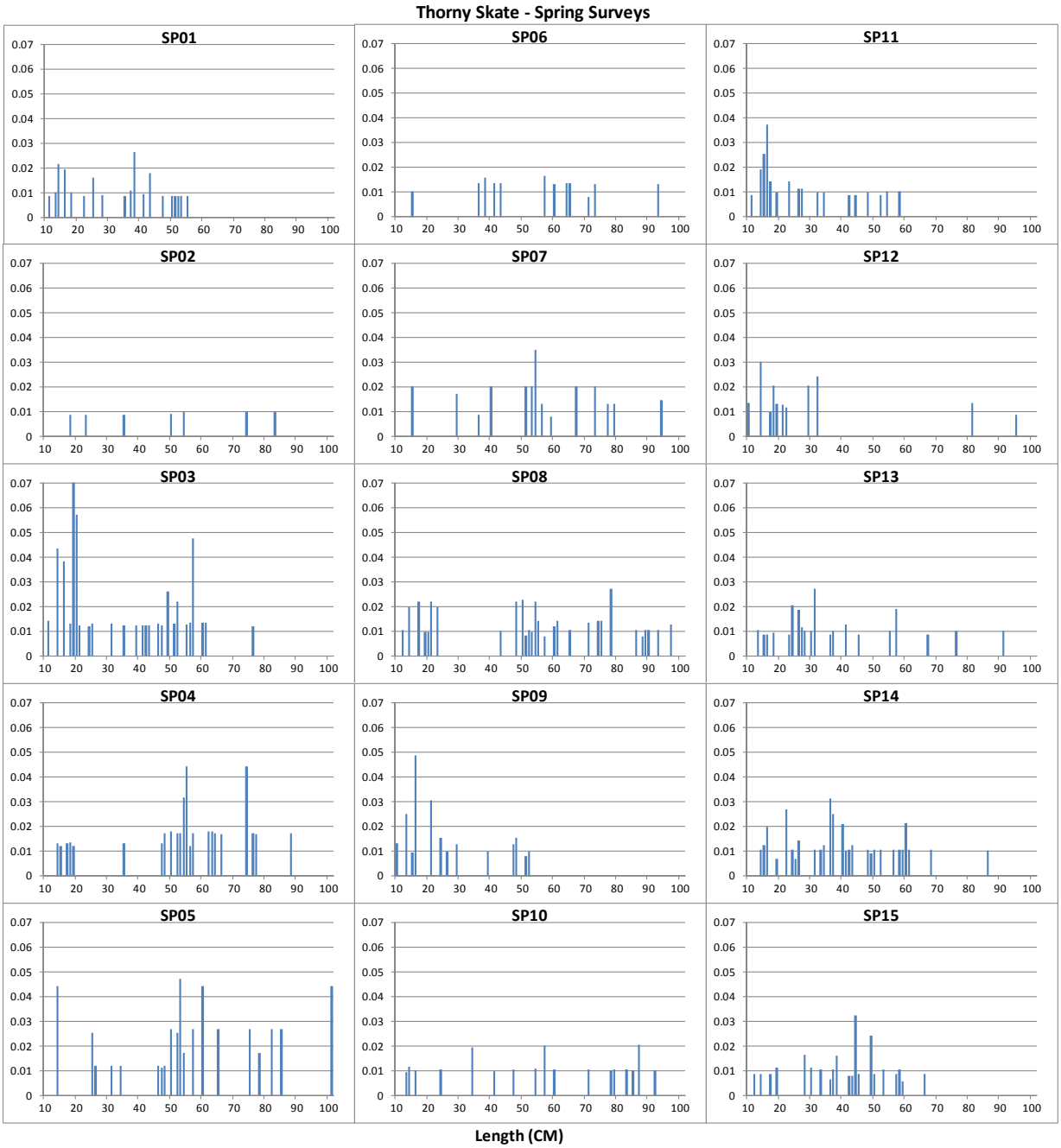

Figure 60. Length composition (stratified mean number per tow) of thorny skate (*Amblyraja radiata*) from the Maine – New Hampshire (MENH) spring survey.

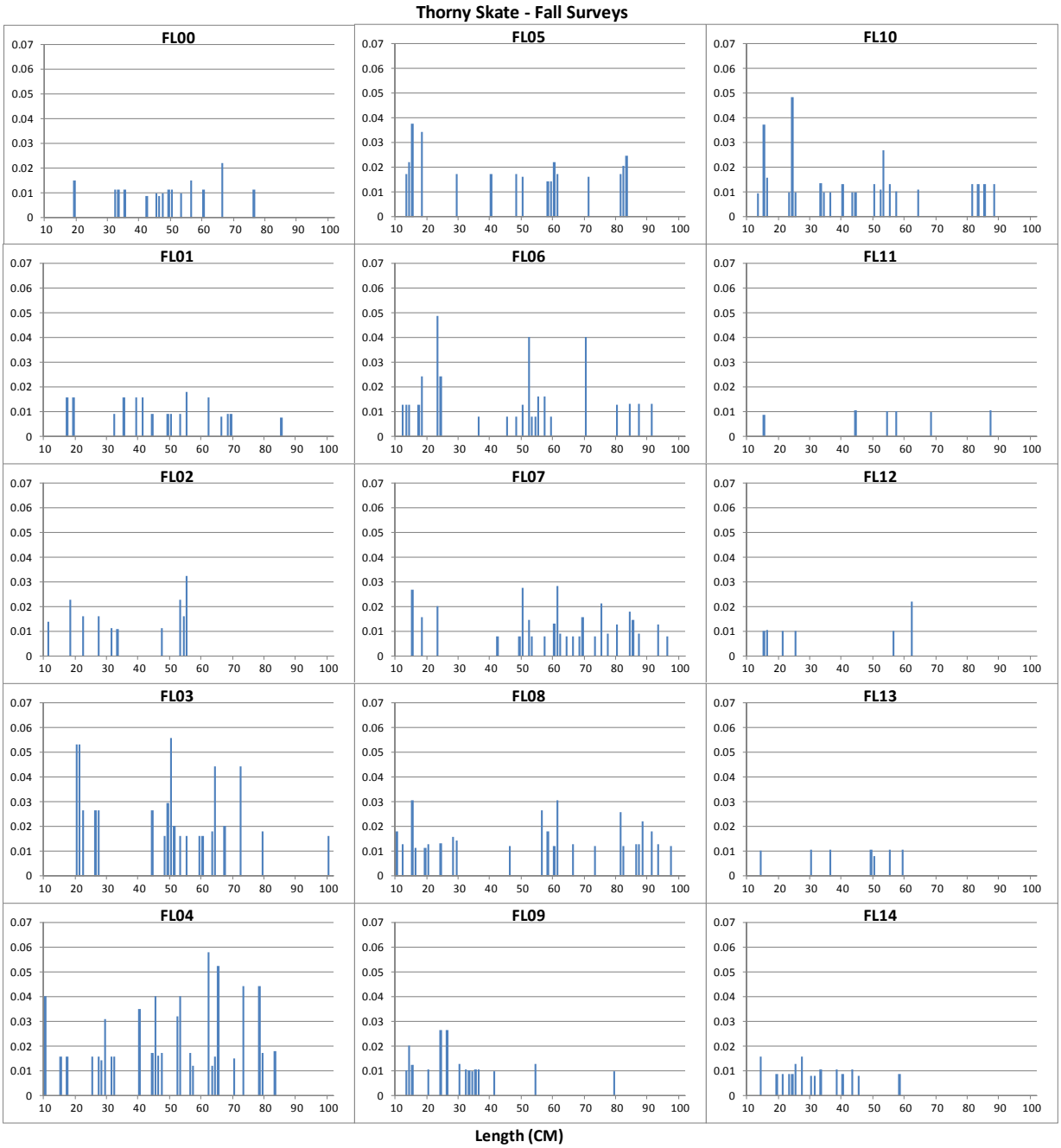

Figure 61. Length composition (stratified mean number per tow) of thorny skate (*Amblyraja radiata*) from the Maine – New Hampshire (MENH) fall survey.

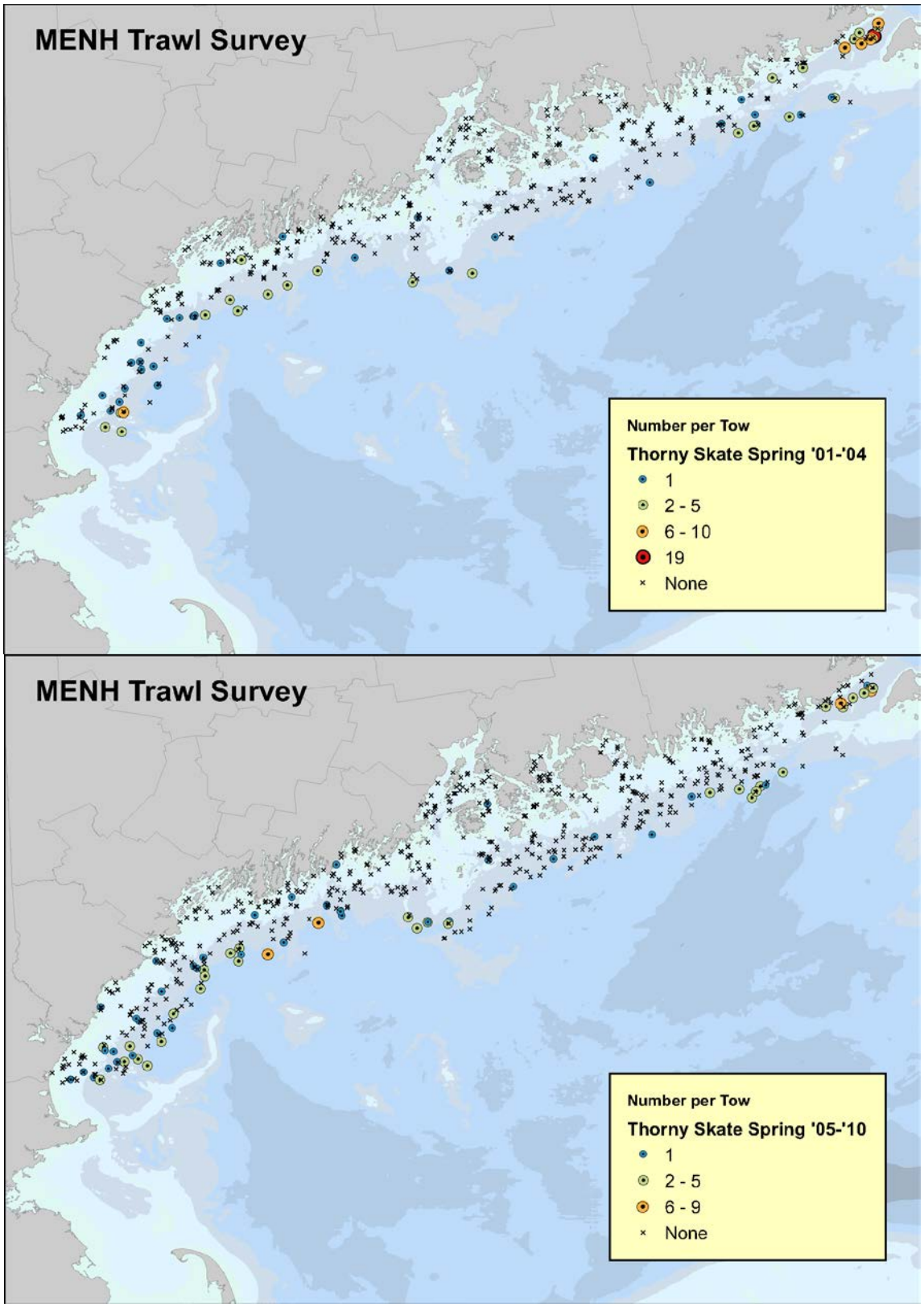

Figure 62. Distribution of thorny skate (*Amblyraja radiata*) in the Maine – New Hampshire (MENH) spring survey from 2001-2010.

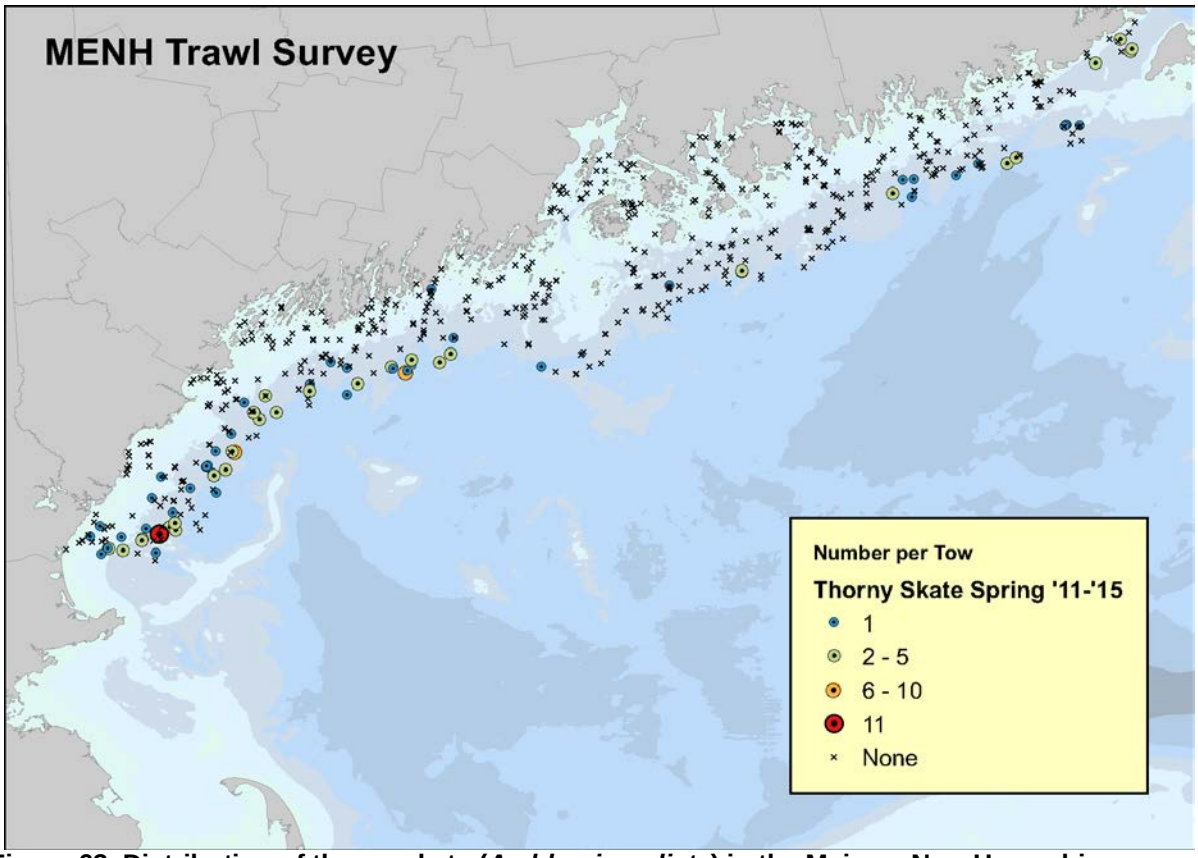

Figure 63. Distribution of thorny skate (*Amblyraja radiata*) in the Maine – New Hampshire (MENH) spring survey from 2011-2015.

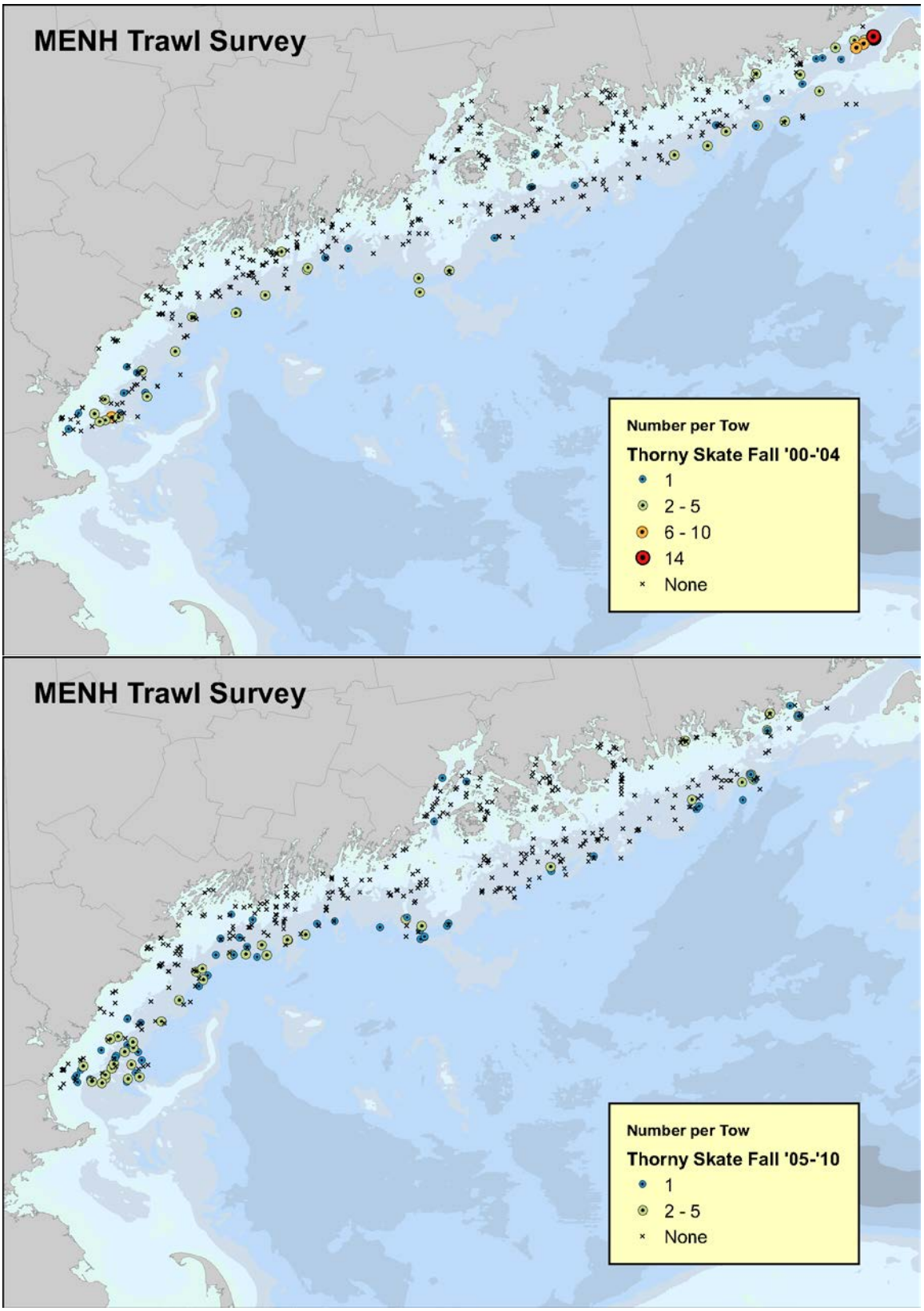

Figure 64. Distribution of thorny skate (*Amblyraja radiata*) in the Maine – New Hampshire (MENH) fall survey from 2001-2010.

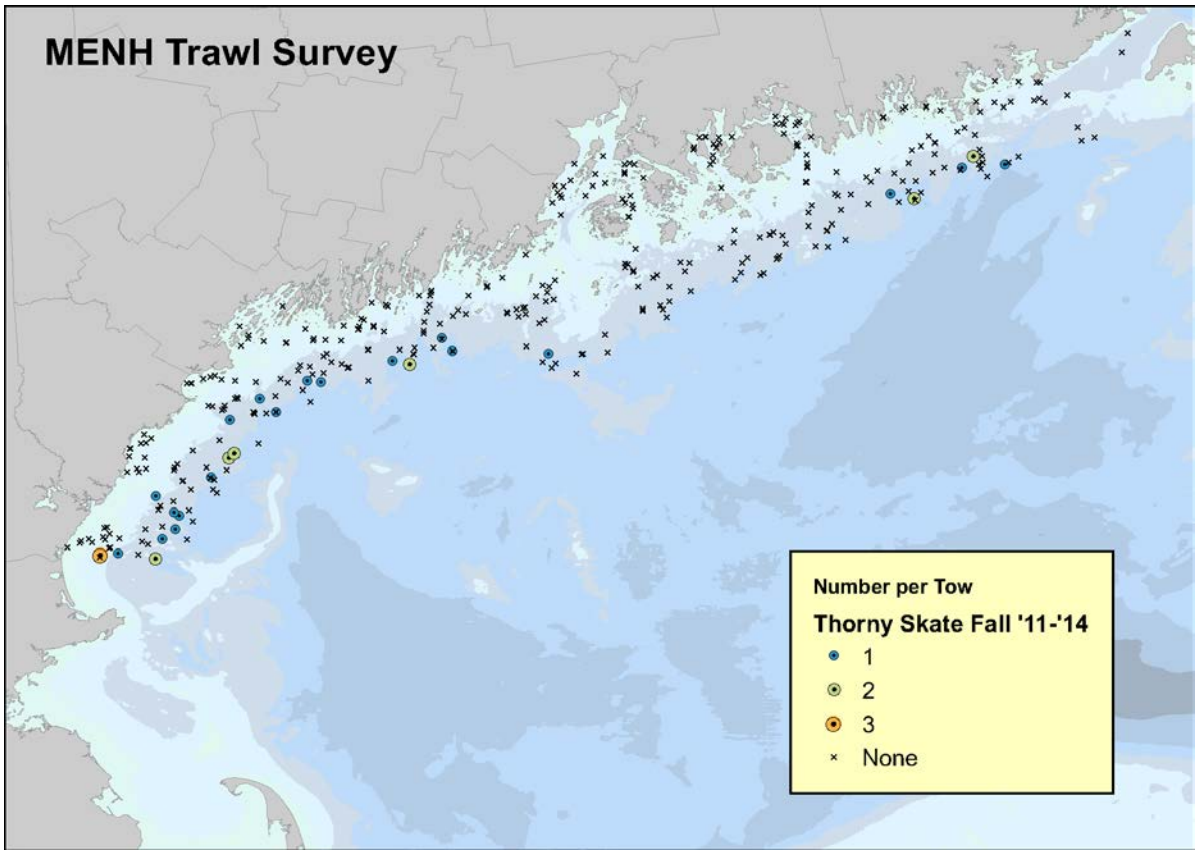

Figure 65. Distribution of thorny skate (*Amblyraja radiata*) in the Maine – New Hampshire (MENH) fall survey from 2011-2014.

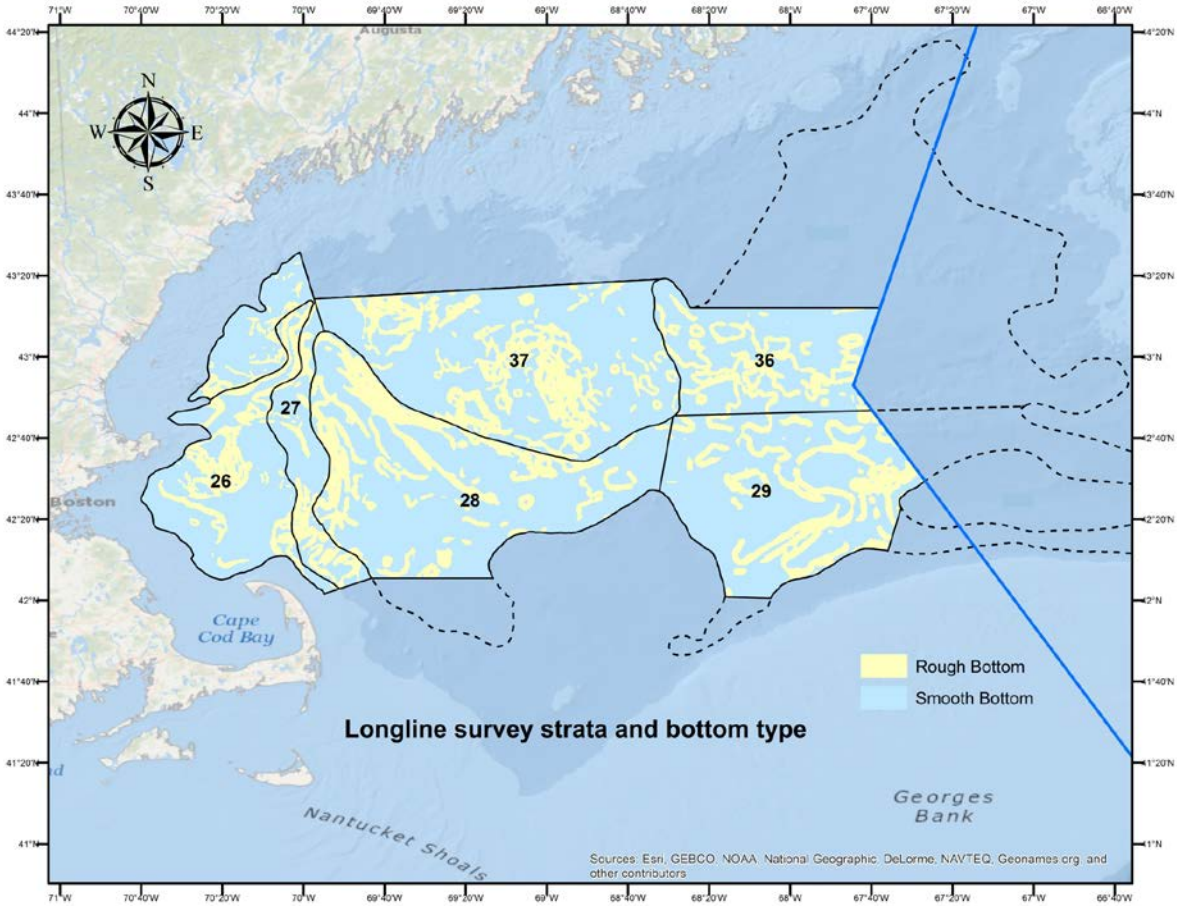

Figure 66. The Northeast Fisheries Science Center (NEFSC) Northeast Cooperative Research Program bottom longline survey strata (NEFSC offshore bottom trawl survey strata 26, 27, 28, 29, 36, 37) with rough (yellow) and smooth (blue) bottom type substrata. The dotted line designates parts of stratum areas not sampled in Canadian waters (29, 36) or those not sampled because of budget constraints (28, 29, 36).

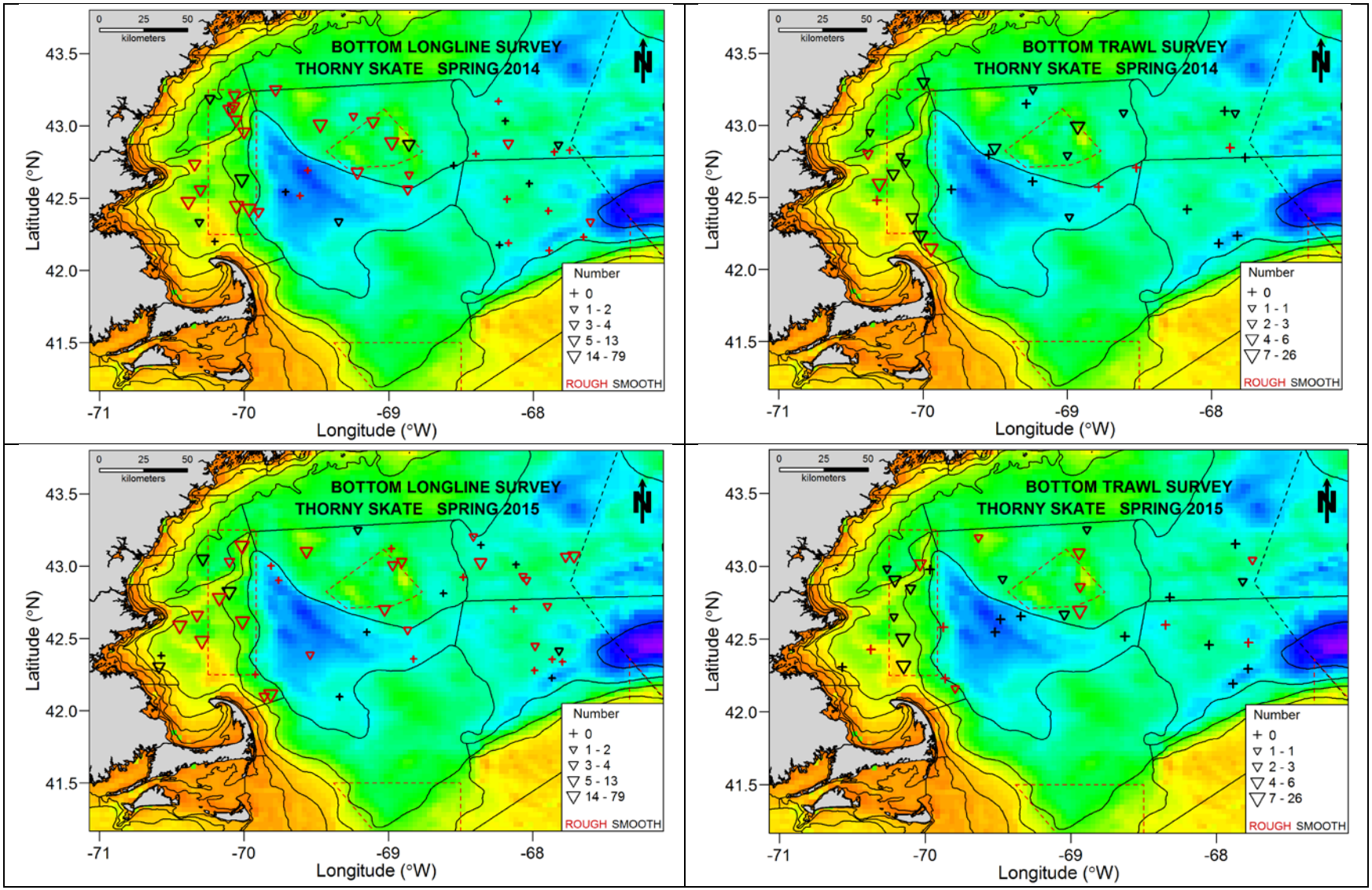

Figure 67. Distribution of thorny skate (*Amblyraja radiata*) by number from the Northeast Fisheries Science Center (NEFSC) bottom longline survey compared to the NEFSC bottom trawl survey for the spring surveys.

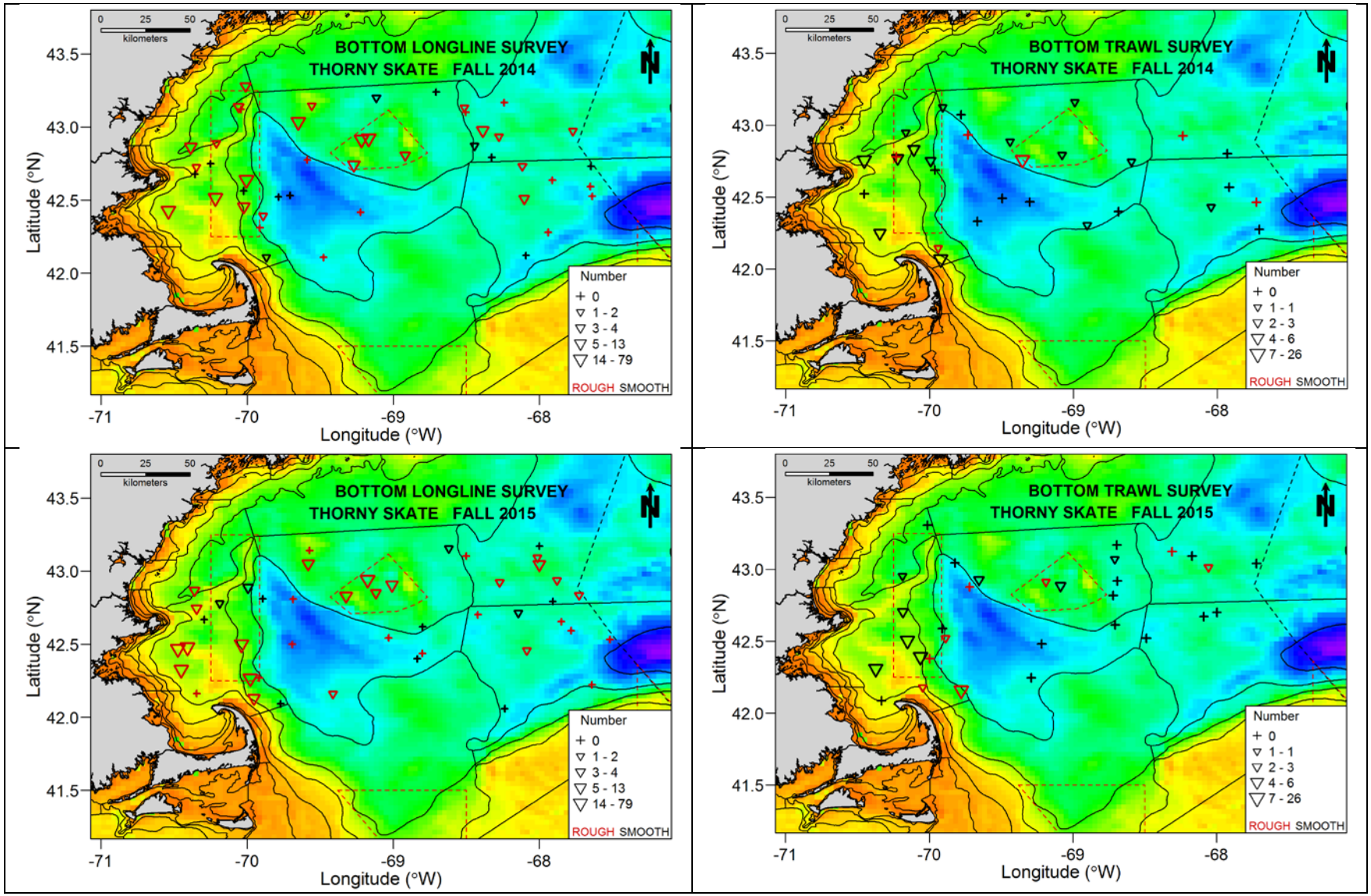

Figure 68. Distribution of thorny skate (*Amblyraja radiata*) by number from the Northeast Fisheries Science Center (NEFSC) bottom longline survey compared to the NEFSC bottom trawl survey for the fall surveys.

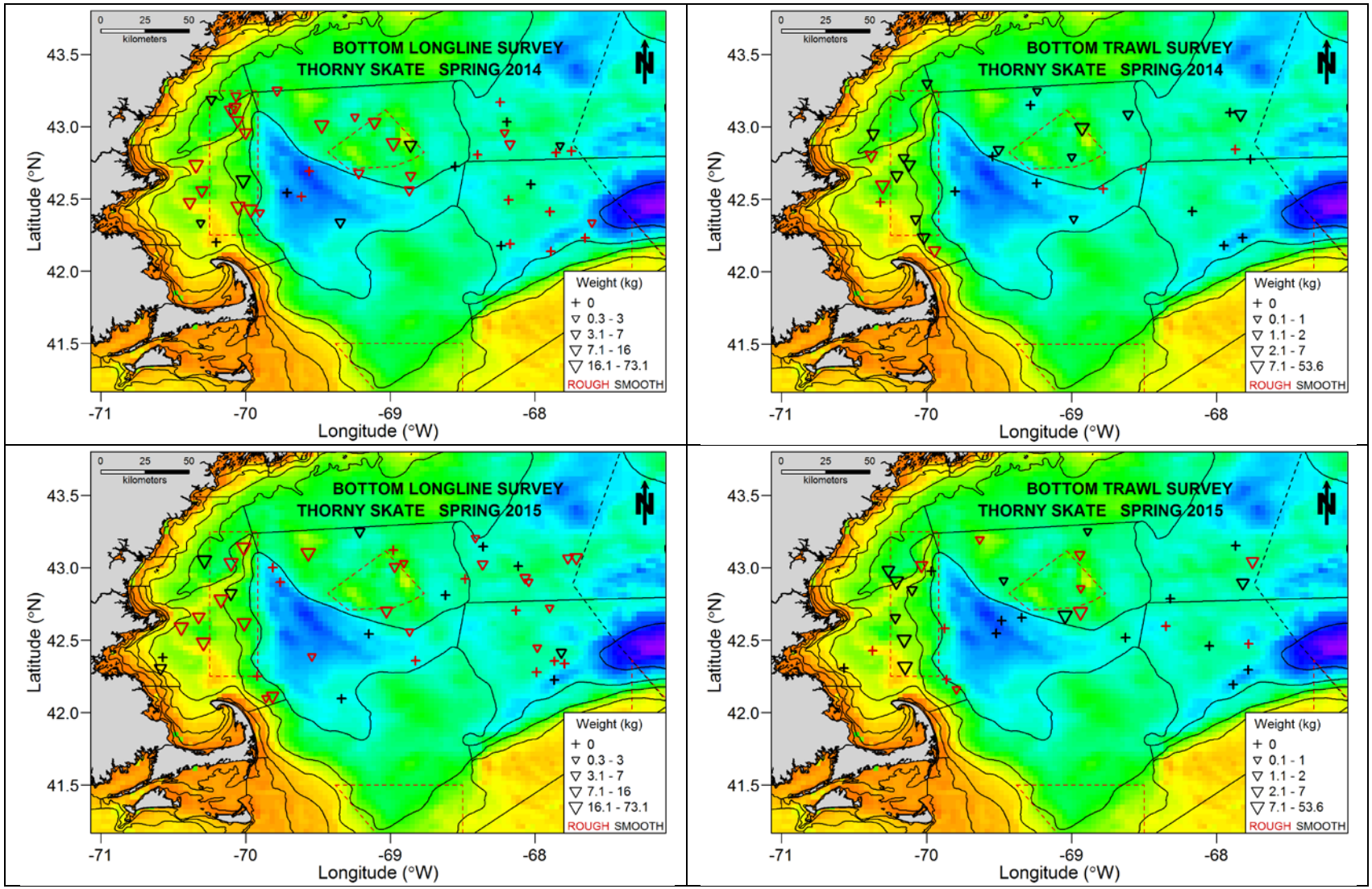

Figure 69. Distribution of thorny skate (*Amblyraja radiata*) by weight from the Northeast Fisheries Science Center (NEFSC) bottom longline survey compared to the NEFSC bottom trawl survey for the spring surveys.

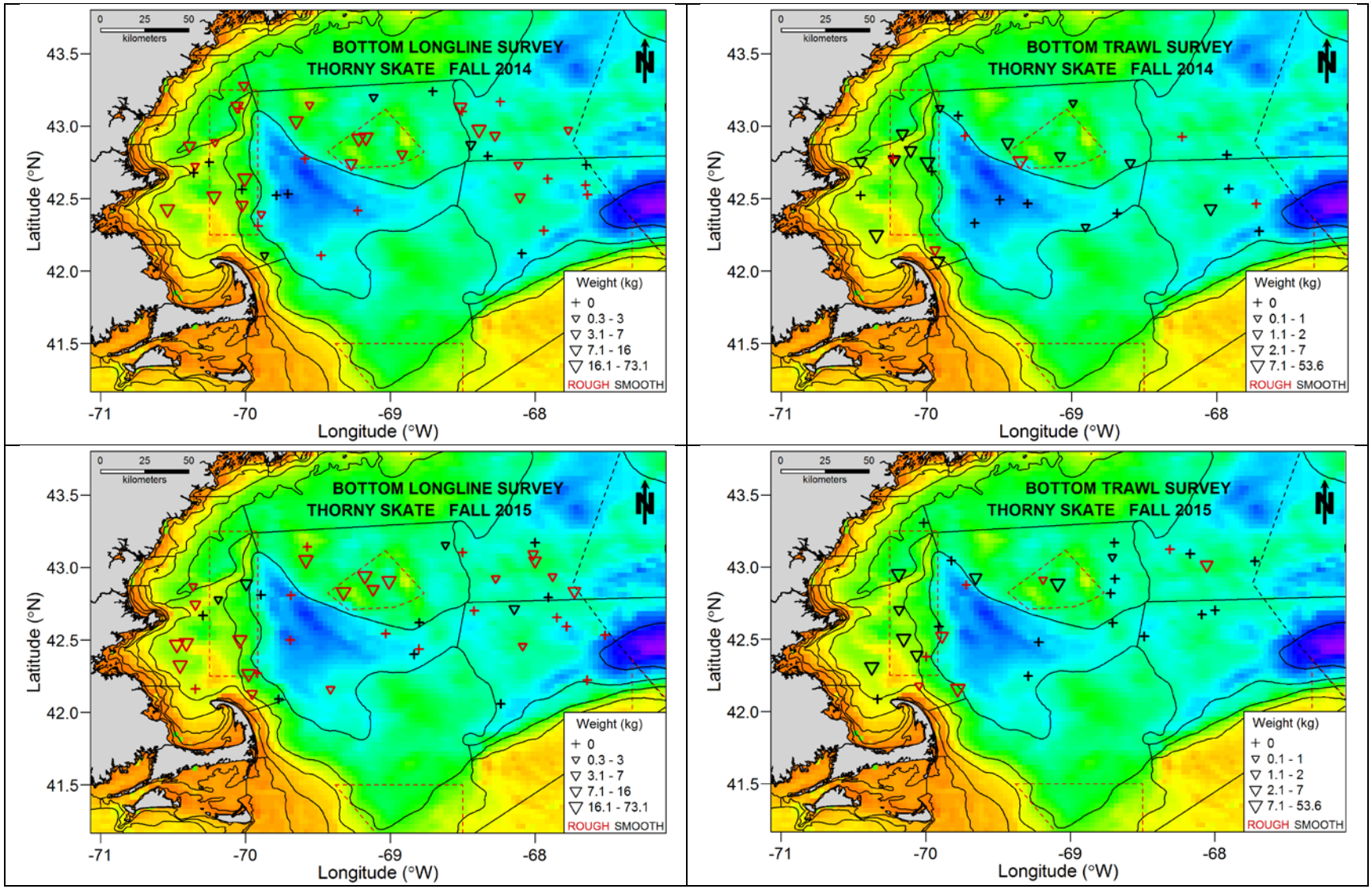

Figure 70. Distribution of thorny skate (*Amblyraja radiata*) by weight from the bottom longline survey compared to the Northeast Fisheries Science Center (NEFSC) bottom trawl survey for the fall surveys.

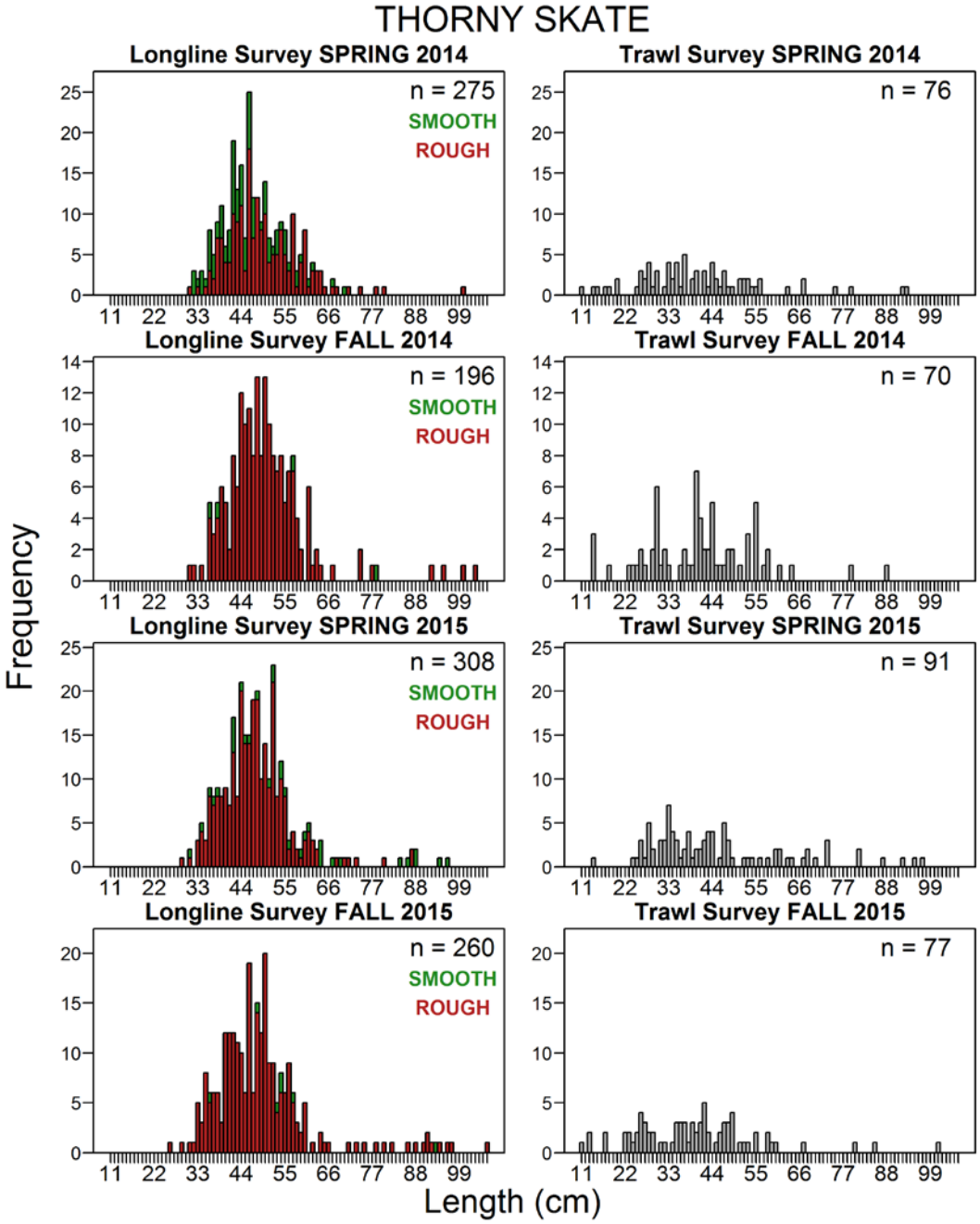

Figure 71. Length composition of thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) longline survey by smooth and rough bottom compared to the NEFSC bottom trawl survey from the same area.

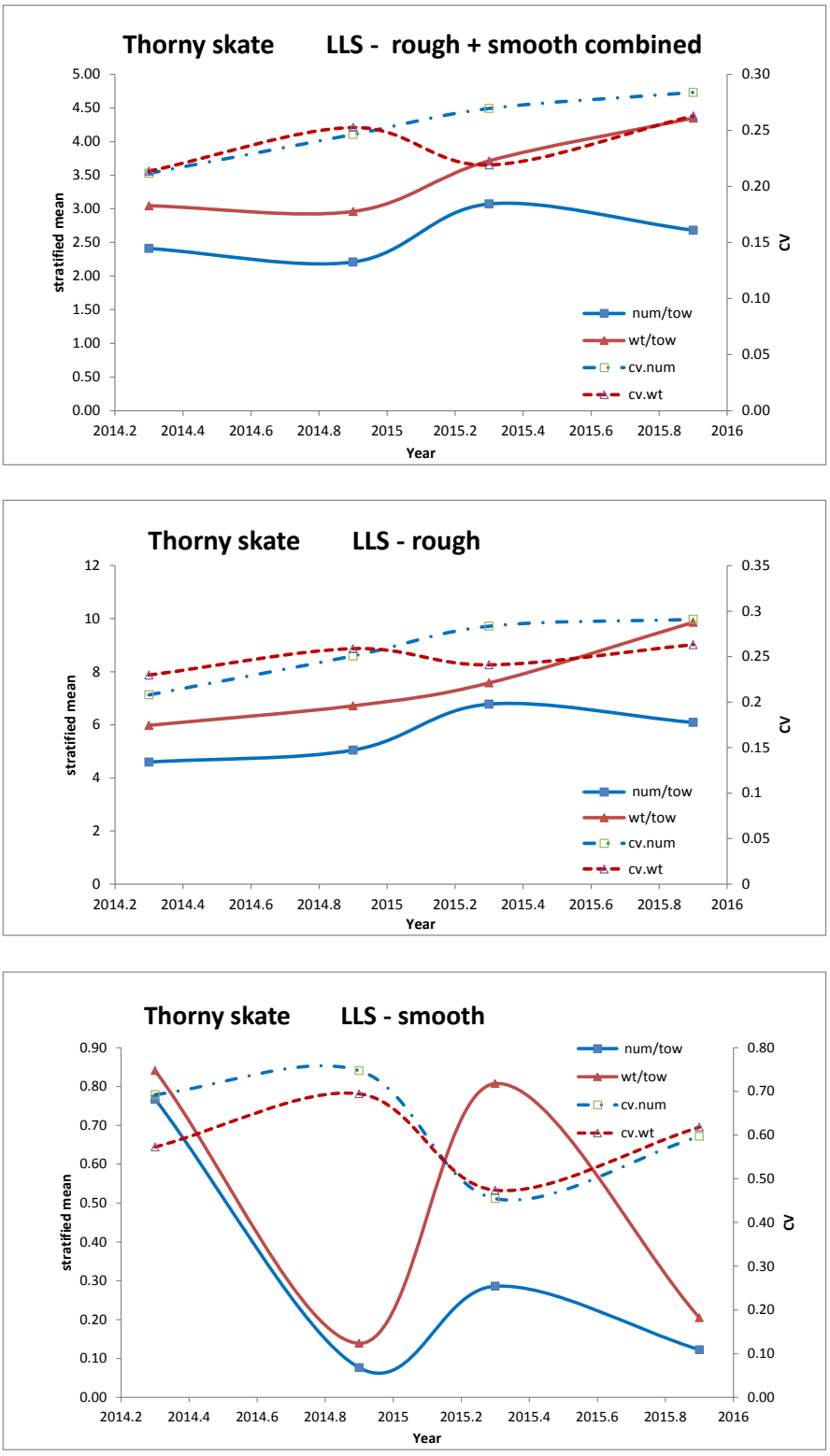

Figure 72. Stratified mean number and weight per set for thorny skate (*Amblyraja radiata*) from the Northeast Fisheries Science Center (NEFSC) bottom longline survey (LLS) for all stations (top panel), rough stations (middle panel), and smooth stations (lower panel) during spring and fall 2014-2015.

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Clearance

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The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

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