# 2016 Monkfish Operational Assessment

Northeast Fisheries Science Center

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# 2016 Monkfish Assessment Update

## Executive Summary

Assessment data for northern and southern management units of monkfish were updated with minmal changes to methodological approaches of the previous assessments (NEFSC 2013). The current assessment does not include an update to the model used previously because the method for aging monkfish failed a validation test completed in 2016, thus invalidating the growth model.

**TOR 1. Update time series of catch estimates including landings and discards, estimate size composition of catch.**

Commercial fishery statistics for monkfish were updated for 2012-2015. In the north, landings and catch have fluctuated around a steady level since 2009. In the south, landings and catch have declined slightly in recent years, but have continued to be higher than in the north. There have been no evident shifts in length composition of the catch in either management area, with the exception of high discard rates of small fish in the south in 2015, reflecting the appearance of a strong yearclass.

**TOR 2. Update time series of fishery-independent indices for monkfish, including recruitment indices and length composition of survey catches.**

All survey index time series reported in past assessments were updated through 2015.

Within the northern management area, most surveys showed an increasing trend in biomass and abundance during 2013-2015. Exploitable biomass (43+cm) in the NEFSC fall survey has increased since 2013. Survey length composition data and associated recruitment indices suggest the appearance of a strong yearclass in 2015.

In the southern management area, survey indices have generally fluctuated without trend or declined slightly, with the exception of sharply increased abundance in summer and fall surveys in 2015. Length frequency data and recruitment indices suggest a strong 2015 yearclass in this area as well as in the north. However, exploitable biomass (43+cm) in the south estimated from NEFSC fall surveys has decreased since 2012.

**TOR 3. Provide data that addresses potential biological changes such as shifts in distribution or condition of individual fish.**

Distribution plots of survey catch rates do not indicate a shift in monkfish distribution. Evaluation of physical data associated with monkfish catches also does not indicate shifts in relative depth distribution or distribution with respect to bottom temperature (fall survey data). Time series of condition factors of individual fish fluctuate without trend.

**TOR 4. Compare annual catches to ACLs to evaluate performance of the fishery.**

In both management areas, fishing year landings have remained below the annual TAL since 2009. Landings averaged 60% of the TAL in the north and 59% in the south during 2013-2014. In 2015, 70% of the TAL was landed in the north, and 53% in the south.

**TOR 5. Carry out analyses that will support the NEFMC SSC in making its ABC recommendation.**

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Calculations were carried out to support application of a model-free method previously used to derive Georges Bank cod catch limits. The method was based on calculating the proportional rate of change in smoothed survey indices over the most recent 3 years and using those rates to revise catch limits. For monkfish, the estimated proportional change in exploitable biomass during 2012-2015 ranged from 1.02-1.06 in the north (2-6% increase) and 0.80-0.87 in the south (13-20% decrease), depending on which surveys were included in the calculation.

## Introduction

### Life History

The monkfish (*Lophius americanus*), also called goosefish, is distributed in the Northwest Atlantic from the Grand Banks and northern Gulf of St. Lawrence south to Cape Hatteras, North Carolina (Collette and Klein-Macphee 2002). Monkfish may be found from inshore areas to depths of at least 900 m (500 fathoms). Seasonal onshore-offshore migrations occur and appear to be related to spawning and possibly food availability (Collette and Klein-MacPhee 2002).

Monkfish rest partially buried on soft bottom substrates and attract prey using a modified first dorsal fin ray that resembles a fishing pole and lure. Monkfish are piscivorous and can eat prey as large as themselves. Despite the behavior of monkfish as a demersal 'sit-and-wait' predator, recent information from electronic tagging suggests seasonal off-bottom movements which may be related to migration (Rountree et al. 2006).

Growth rates of monkfish are not well understood. A recent study has shown that the method currently used to age monkfish in the U.S. (counting rings on vertebrae) does not consistently identify the correct number of presumed-annual rings at the margin of the vertebra (Bank 2016), thus calling into question the growth curves used in previous assessments. In addition, it appears that first year growth may be much faster than previously understood. Growth estimated by following size modes of a strong yearclass spawned in 2015 suggests that monkfish may grow more than 20 cm during their first year (Figure 30). Even faster growth of a presumed young-of-year monkfish has been seen in the laboratory (C. Bank, UMass Dartmouth, personal communication). Because growth rates are currently highly uncertain, the assessment model used in past monkfish assessments was not updated in this assessment.

The estimated size at 50% maturity of monkfish is 41 cm for females and 37 cm for males (Richards et al. 2008). Few males are found larger than 70 cm, but females can reach sizes greater than 130 cm. Spawning takes place from spring through early autumn, progressing from south to north, with most spawning occurring during the spring and early summer (Richards et al. 2008). Females lay a buoyant mucoid egg raft or veil which can be as large as 12 m long and 1.5 m wide and only a few mm thick. The eggs are arranged in a single layer in the veil, and the larvae hatch after about 1-3 weeks, depending on water temperature. Females likely produce more than one egg veil per year (McBride et al. in prep.). The larvae and juveniles spend several months in a pelagic phase before settling to a benthic existence at a size of about 8 cm (Collette and Klein-MacPhee 2002).

### Stock Identification

The Fishery Management Plan (FMP) defines two management areas for monkfish (northern and southern), divided roughly by a line bisecting Georges Bank (Figure 1). The two assessment and management areas for monkfish were defined in the 1999 FMP based on

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differences in temporal patterns of recruitment (estimated from NEFSC surveys), perceived differences in growth patterns, and differences in the contribution of fishing gear types (mainly trawl, gill net, and dredge) to the landings. Since then, genetic studies using mitochondrial DNA have suggested a homogeneous population of monkfish off the U.S. east coast (Chikarmane et al. 2000; Johnson et al. in prep.); however research in progress using microsatellite DNA suggests a possible delination off Delaware Bay in the Mid-Atlantic Bight (Housbrouck et al. 2015).

Monkfish larvae are distributed over deep (< 300 m) offshore waters of the Mid-Atlantic Bight in March-April, and across the continental shelf (30 to 90 m) later in the year, but relatively few larvae have been sampled in the northern management area (Steimle et al. 1999). NEFSC surveys continue to indicate different recruitment patterns in the two management units in recent years; however a recruitment event appears to have occurred in both management regions in 2015.

The perceived differences in growth in the two management areas were based on studies about 10 years apart and under different stock conditions (Armstrong et al. 1992: Georges Bank to Mid-Atlantic Bight, 1982-1985; Hartley 1995: Gulf of Maine, 1992-1993). Age, growth, and maturity information from the NEFSC surveys and the 2001, 2004 and 2009 cooperative monkfish surveys indicated only minor differences in age, growth, and maturity between the areas (Richards et al., 2008; Johnson et al., 2008). However these growth studies used the vertebral aging method which is now called into question.

The southern deepwater extent of the range of American monkfish (*L. americanus*) overlaps with the northern extent of the range of blackfin monkfish (*L. gastrophysus*; Caruso 1983). These two species are morphologically similar, which may create a problem in identification of survey catches and landings from the southern extent of the range of monkfish. The potential for a problem however is believed to be small. The NEFSC closely examined winter and spring 2000 survey catches for the presence of blackfin monkfish and found none. The cooperative monkfish survey conducted in 2001 caught only eight blackfin monkfish of a total of 6,364 monkfish captured in the southern management area.

**Current Research**

Ongoing research was summarized by investigators currently funded by the monkfish Research Set-Aside (RSA) program. The following summaries were provided by the investigators.

Monkfish Age and Growth, and Tagging

*Monkfish Age Validation (C. Bank, UMass Dartmouth).* To validate the vertebral ageing protocol and to explore alternative ageing methods, we injected oxytetracycline or fluorexon into individual monkfish, kept them alive in the laboratory, and subjected them to a seasonal cycle of temperature, light, and feeding. Monkfish were also injected in the field with the same chemical markers as part of an on-going tagging study. The chemical left a visible mark on the growth ring that was forming at the time of injection. Vertebrae, otoliths, and illicia were analyzed from fish that lived six months or more after marking, from both the laboratory study and the field recaptures. Digital images were taken with an ultraviolet light to illuminate the mark and reflected light to show the growth rings. An experienced monkfish age reader determined age from vertebrae and each annulus after the chemical mark was identified. Results indicate that annuli counts on vertebrae cannot be used to accurately determine the age of monkfish, irregular

growth of the otolith prohibits its use as a reliable age structure, and age determination using illicia is the most promising.

*Monkfish Tagging (G. Sherwood (GMRI), C. Brown (GMRI), C. Bank (UMass Dartmouth), J. Grabowski (Northeastern).*

Monkfish growth is currently assumed to be linear based on age results from vertebrae. New evidence from tagging and otolith data call into question linear growth and rather support a more biologically reasonable asymptotic growth pattern. From a multi-year tagging program (6,176 releases and 282 recaptures) we were able to glean growth information from 46 individuals. Daily growth increment was found to be negatively correlated to length ($r^2 = 0.19$, $p < 0.01$) and using this information we were able to model non-linear growth curves and associated Von Bertalanffy growth function parameters. Tagging results agreed very well with another line of inquiry involving otolith microchemical signatures. Specifically, strontium/calcium ratios (Sr/Ca), which were verified to mirror the seasonal temperature cycle for monkfish (and hence annuli), also indicated a pattern of decreasing growth with age and size. While some subjectivity existed for interpreting Sr/Ca data, the real strength of this technique was in establishing the width of the first annulus which was quite large and consistent with rapid early growth in monkfish.

Tagging studies using electronic data storage tags (DSTs) have been in progress for several years. A total of 607 tags were released: 221 in the western Gulf of Maine (northern management area), 238 in southern New England (inshore and offshore), and 148 in the southern Mid-Atlantic Bight. The rate of recaptures to date is 7.6% (46 recaptures).

Very little movement across management boundaries has been observed based on release and recapture locations in either the conventional or DST tagging programs. The DST tagging data are currently being analyzed to estimate position data which will be used to construct a probabilistic path of travel for each fish.

Funding has been recently obtained to use conventional tags on small (<40 cm) monkfish caught as bycatch in small mesh gillnet fisheries (e.g. dogfish, groundfish) to obtain growth estimates for juvenile monks.

***Working Group Comments*** *- Monkfish Age and Growth, and Tagging*
*The Working Group made note that the current vertebral-based age estimates are not valid, and that previous estimates of length at age may be inaccurate at both small (< 40 cm) and large (~ 75 cm) sizes. Further work on the development of ilicia-based age and growth estimates is likely to occur over the summer of 2016, but sufficient information for peer review and incorporation into the assessment will not be available until 'a long time' subsequent. The NEFSC has collected paired samples of illicia and vertebrae (ie. from the same fish). If and when a method for determining ilicia-based ages is developed, investigators will attempt to understand the relationship between the two and possibly calibrate/correct the vertebral ages estimated in the past. The WG noted that incorporating new research results into the existing SCALE model (e.g. as part of an RSA project) should done in coordination with the SAW Monkfish WG, and not made public until vetted through an appropriate peer review process.*

*Monkfish Genetic Study using Microsatellite DNA (E. Hasbrouck (Cornell Univ), Isaac Wirgin, NYU).* In 2012 Cornell University Cooperative Extension Marine Program (CCE) received an RSA grant to help determine if the monkfish population is comprised of a single or of multiple

stocks over their coast wide distribution from Newfoundland to North Carolina. The project used a sensitive genetic approach known as microsatellite DNA analysis to evaluate the coast wide structure of the stock. Utilizing a collaborative approach, monkfish biological samples were collected and the genetic structure of the monkfish population was analyzed. For the first time, this project empirically evaluated the coast wide monkfish stock structure using sensitive DNA markers. In summary our genetic analysis indicates that there are 2 and perhaps 3 genetic stocks of monkfish along their coastwide distribution and this differentiation may result from a latitudinal gradient in genetic differentiation. The delineation between genetically different stocks does not coincide with the current management division between the northern and southern management areas. Clearly, these genetic divisions do not respect the current 2 stock model by which monkfish are managed in U.S. waters today. However, the boundaries of these genetic stocks require further delineation and the temporal stability of these units between and with years requires confirmation before this new information can be effectively employed in a management context. The project will continue under a 2016 Monkfish RSA grant awarded to Cornell Cooperative Extension and New York University.

***Working Group Comments*** *- Monkfish Genetic Study using Microsatellite DNA*
*The WG noted that the results of the genetic research should be coordinated with the DST tagging results to help understand how movements and timing of migration could affect those results. Genetic samples collected from recaptured tagged fish should be analysed using microsatellites.*

*The investigators indicated that the planned 2016 work will focus sampling on areas that will help clarify whether the 2012 results are temporally and geographically stable and will include an analysis of any blackfin monkfish that are encountered.*

*The WG noted that while the results of the 2012 RSA project are informative, questions remain:*
*-What do the results indicating genetic differentiation in areas 3D and 6 really mean – are they truly indicative of stock structure in the southern end of the range? If the differences persist, are they biologically meaningful?*
*- Sample sizes in the southern end the sampling area were small in the 2012 RSA project, especially in the offshore areas. The 2016 work will attempt to increase sample sizes in these areas, but it was also noted that it may be difficult to obtain large sample sizes in depths greater than 200 m.*
*-More information on all stages of monkfish life history from larvae to spawning adults would be helpful for developing a more targeted sampling protocol for genetic stock identification.*

**Fisheries Management**

Commercial fisheries for monkfish occur year-round using gillnets, trawls and scallop dredges. No significant recreational fishery exists. The primary monkfish products are tails, livers and whole gutted fish. Peak fishing activity occurs during November through June, and value of the catch is highest in the fall due to the high quality of livers during this season.

U.S. fisheries for monkfish are managed in the Exclusive Economic Zone (EEZ) through a joint New England Fishery Management Council - Mid-Atlantic Fishery Management Council Monkfish Fishery Management Plan (FMP). The primary goals of the Monkfish FMP are to end and prevent overfishing and to optimize yield and economic benefits to various fishing sectors

involved with the monkfish fisheries (NEFMC and MAFMC 1998; Haring and Maguire 2008). Current regulatory measures vary with type of permit but include limited access, limitations on days at sea, mesh size restrictions, trip limits, minimum size limits and annual catch limits (Tables 1 and 2).

Biological reference points for monkfish were established in the original Fishery Management Plan (FMP), but were revised after SAW 34 (NEFSC 2002), after the Data Poor Stocks Working Group (DPSWG) in 2007 (NEFSC 2007a), and after SAW 50 in 2010. The overfishing definition is $F_{max}$. Prior to 2007, $B_{threshold}$ was defined as one-half of the median of the 1965-1981 3-year average NEFSC autumn trawl survey catch (kg) per tow). After acceptance of an analytical assessment in 2007 (NEFSC 2007a), $B_{target}$ was redefined as the average of total biomass for the model time period (1980-2006) and $B_{threshold}$ as the lowest observed value in the total biomass time series from which the stock had then increased (termed "$B_{Loss}$"). According to the earlier (survey index-based) reference points, monkfish were overfished and overfishing status could not be determined (NEFSC 2005); however, with adoption of the analytical assessment in 2007, monkfish status was changed to no longer overfished and overfishing was not occurring. Assessments in 2010 and 2013 (NEFSC 2010; 2013) also concluded that both stocks were not overfished and overfishing was not occurring, while recognizing the continuing significant uncertainty in the determination.

**TOR 1. Update time series of catch estimates including landings and discards, estimate size composition of catch.**

**Landings**

Landings of monkfish tails are converted from landed weight to live weight, because a substantial fraction of the landings occur as tails only (or other parts). The conversion of landed weight of tails to live weight of monkfish in the NEFSC weigh-out database is made by multiplying landed tail weight by a factor of 3.32. In 2012, the dealer data base for 2005-2011 was corrected because some dealers were reporting 'head-on, gutted' monkfish (conversion factor of 1.14) as 'round' (no conversion). This resulted in a 1.5% overestimate of monkfish landings (live weight) during those years, (all years combined).

Early catch statistics (before ~1980) are uncertain, because much of the monkfish catch was sold outside of the dealer system or used for personal consumption until the mid-1970s. For 1964 through 1989, there are two potential sources of landings information for monkfish; the NEFSC 'weigh-out' database, which consists of fish dealer reports of landings, and the 'general canvass' database, which contains landings data collected by NMFS port agents (for ports not included in the weigh-out system) or reported by states not included in the weigh-out system (Table 3). All landings of monkfish are reported in the general canvass data as 'unclassified tails.' Consequently, some landed weight attributable to livers or whole fish in the canvass data may be inappropriately converted to live weight. This is not an issue for 1964-1981 when only tails were recorded in both databases. For 1982-1989, the weigh-out database contains market category information that allows for improved conversions from landed to live weight. The two data sources produce the same trends in landings, with general canvass landings slightly greater than weigh-out landings. It is not known which of the two measures more accurately reflects landings, but the additional data sources suggest that the general canvass is most reliable for 1964-1981 landings, whereas the availability of market category details suggests that the weigh-out database is most reliable for 1982-1989.

Beginning in 1990, most of the extra sources of landings in the general canvass database were incorporated into the NEFSC weigh-out database. However, North Carolina reported landings of monkfish to the Southeast Fisheries Science Center and until 1997 these landings were not added to the NEFSC general canvass database. Since these landings most likely come from the southern management area, they have been added to the weigh-out data for the southern management area for 1977-1997 for the landings statistics used for stock assessment.

Beginning in July 1994, the NEFSC commercial landings data collection system was redesigned to consist of vessel trip reports (VTR) and dealer weigh-out records. The VTRs include area fished for each trip which is used to apportion dealer-reported landings to statistical areas. The northern management area includes statistical areas 511-515, 521-523 and 561; and the southern management area includes areas 525-526, 562, 537-543 and 611-636 (Figure 1). Each VTR trip should have a direct match in the dealer data base, but this is not always true. VTR records with no matching dealer landings were excluded, but dealer landings with no matching VTR were included in landings statistics, apportioning the unmatched landings to management area using proportions calculated from matched trips pooled over gear, state and quarter.

Total U.S. landings (live weight) remained at low levels until the middle 1970s, increasing less than 1,000 mt to around 6,000 mt in 1978 (Table 3, Figure 2). Annual landings remained stable at between 8,000 and 10,000 mt until the late 1980s. Landings increased from the late 1980s to over 20,000 mt per year during 1992-2004, peaking at 28,500 mt in 1997. Landings declined steadily after 2003, and stabilized around an average of 8,600 mt during 2009-2015. During recent years (2008-2015 North; 2009-2015 South), fishing year landings have reamined below the TAL (Table 2).

Monkfish landings began to increase in the northern management region in the mid-1970s and in the late 1970s in the southern area. Most of the increase in landings during the late 1980s through mid-1990s was from the southern area. Historical under-reporting of landings should be considered in the interpretation of this series.

Trawls, scallop dredges and gill nets are the primary gear types that land monkfish (Table 4, Figure 3). Trawls have been the predominant gear in the north, accounting for approximately 75% of the landings on average. In the south, trawls and dredges dominated the landings before about 2002, but were subsequently replaced by gillnets as regulations changed. Gillnets now account for about 60% of the landings from the southern management area.

Until the late 1990s, total landings were dominated by landings of monkfish tails. From 1964 to 1980 landings of tails rose from 19mt to 2,302mt, and peaked at 7,191mt in 1997 (Table 5). Landings of tails declined after 1997, but are still an important component of the landings. Landings of gutted whole fish have increased steadily since the early 1990s and are now the largest market category on a landed-weight basis. On a regional basis, more tails were landed from the northern area than the southern area prior to the late 1970s (Tables 5 and 6). From 1979 to 1989, landings of tails were about equal from both areas. In the 1990's, landings of tails from the south predominated, but since 2000, landings of tails have been greater in the north.

Beginning in 1982, several market categories were added to the system (Table 5). Tails were broken down into large (> 2.0 lbs), small (0.5 to 2.0 lbs), and unclassified categories and the liver market category was added. In 1989, unclassified round fish were added, in 1991 peewee tails (<0.5 lbs) and cheeks, in 1992 belly flaps, and in 1993 whole gutted fish were added. Landings of unclassified round (whole) or gutted whole fish jumped in 1994 to 2,045 mt and 1,454 mt, respectively; landings of gutted fish continued to increase through 2003. The

tonnage of peewee tails landed increased through 1995 to 364 mt and then declined to 153 mt in 1999 and 4 mt in 2000 when the category was essentially eliminated by regulations.

**Foreign Landings**

Landings (live wt) from NAFO areas 5 and 6 by countries other than the US are shown in Table 3 and Figure 2. Reported landings were high but variable in the 1960s and 1970s with a peak in 1973 of 6,818 mt. Landings were low but variable in the 1980s, declined in the early 1990s, and have generally been below 300 mt in recent years. NAFO data for monkfish were not updated for this assessment update.

**Discard Estimates**

Catch data from the fishery observer, dealer and VTR databases were used to investigate discarding frequencies and rates using standardized bycatch reporting methodology (SBRM, Rago et al. 2005; Wigley et al. 2007). The number of trips with monkfish discards available for analysis varied widely among management areas and gear types (Tables 7, 8). As in previous monkfish assessments (NEFSC 2007a, NEFSC 2010, NEFSC 2013), monkfish discards were estimated on a gear, half-year and management area basis using observed discard-per-kept-monkfish to expanded to total discards for otter trawls and gillnets, and observed discard-per-all-kept-catch to expanded for scallop dredges and shrimp trawls. Discards for 1980-1988 (before observer sampling) were estimated by applying average discard ratios by management area and gear type (trawl, shrimp trawl, gillnet, dredge) from 1989-1991 to landings for 1980-1988 as follows:

| **Area** | **Shrimp Trawls** | **Trawls** | **Gillnets** | **Dredges** |
|---|---|---|---|---|
| **North** | | | | |
| Years included | 1989-1991 | 1989-1991 | 1989-1991 | 1992-1997 |
| Number of trips | 124 | 253 | 1191 | 54 |
| | | | | |
| **South** | | | | |
| Years included | n/a | 1989-1991 | 1991-1992 | 1991-1993 |
| Number of trips | | 334 | 177 | 32 |

The proportion of discards in the northern area catch was about 13% in the 1980s, 7% during 2002-2006, became slightly higher on average (12%) during 2007-2009, and was 14% for 2010-2015 (Table 9, Figures 4, 5). The proportion of discards in the southern area catch has generally increased since the 1980s (average 16% 1980-1989), with an annual average of 29% during 2002-2006, 24% during 2007-2009, and 27% in 2010-2015 (Table 9, Figure 4, 5). Gill nets consistently have had the lowest discard ratios. Some of the trends in discarding may reflect imposition of size limits starting in 2000 and decreased trip limits in the south starting in 2002. The most frequent discard reasons were that fish were too small for regulations or the market. In 2015, a large increase in discards of small fish was observed in the southern area dredge and trawl fisheries (Figure 7), reflecting a strong recruitment event. A similar spike was not seen in the north even though there was evidence of strong recruitment; however the recruits in the north were smaller than in the south, perhaps reflecting later birth dates. The estimates of total catch for 1980-2015 are shown in Figure 5 and Table 9.

**Size Composition of U.S. Catch**

Tail lengths were converted to total lengths using relations developed by Almeida et al. (1995). As in previous assessments, (NEFSC 2007a and later), length composition of landings and discard were estimated from fishery observer samples by management area, year, gear-type (trawls, dredges and gillnets) and catch disposition (kept or discarded). Landings in unknown gear categories were allocated proportionately to the 3 major gear types before assigning lengths. The stratification used for assigning lengths within area and gear type is shown in Table 10.

The estimated length composition of landings and discard is shown in Figures 6-9. Age composition of the catch was not estimated.

**Effort and CPUE**

Evaluating trends in effort or catch rates in the monkfish fishery is difficult for several reasons. Much of the catch is taken in multi-species fisheries, and defining targeted monkfish trips is difficult. There have been programmatic changes in data collection from port interviews (1980-1993) to logbooks (1994-2009), and comparison of effort statistics among programs is difficult. Catch rates may not reflect patterns of abundance, because they have been affected by regulatory changes (e.g., 1994 closed areas, 2000 trip limits, 2006 reductions in trip limits).

CPUE data have not been used in the assessment model for monkfish, therefore they were not examined for this assessment update.

***Working Group Comments – TOR 1***

*The WG noted that landings in the North area have recently been stable, while landings in the South have decreased since 2011. However, the number of vessels actively fishing for and landing monkfish has likely decreased in the North since 2011. Therefore, an analysis of landings and effort would likely indicate that LPUE has increased in spite of management restrictions.*

*The WG noted that the reason that landings taken by the scallop dredge gear are low (and discards high) is due to regulatory and economic disincentives to land monkfish. The WG noted that mortality rate of discarded monkfish is assumed to be 100%.*

**TOR 2. Update time series of fishery-independent indices for monkfish, including recruitment indices and length composition of survey catches.**

Resource surveys used in the 2013 assessment were updated, including NEFSC spring and autumn offshore surveys, ASMFC northern shrimp surveys (NFMA only), ME/NH spring and fall inshore surveys, and scallop dredge surveys conducted by NEFSC and Viginia Institute of Marine Science (VIMS) (SFMA only).

The NEFSC survey strata used to define the northern and southern management areas are:

| Survey | Northern Area | Southern Area |
|---|---|---|
| NEFSC offshore bottom trawl | 20-30, 34-40 | 1-19, 61-76 |
| ASMFC Shrimp | 1,3,5-8 | |

| | |
|---|---|
| Shellfish | 6,7,10,11,14,15,18,19,22-31,33-35,46,47,55,58-61,621,631 |

NEFSC spring and autumn bottom trawl survey indices for 1963-2008 were standardized to adjust for statistically significant effects of trawl type (Sissenwine and Bowman 1977) on catch rates. The trawl conversion coefficients apply only to the spring survey during 1973-1981.

Previous monkfish assessments have used delta distribution estimators for the mean and variance of stratified catch per tow because of the high proportion of zero tows in the surveys conducted using the F/V Albatross (1963-2008) (Pennington 1996). Generally the delta distribution means are very similar to arithmetic estimates (Appendix, Figures 1 and 2). However, the appearance of a very strong 2015 yearclass caused problems with the delta distribution biomass estimates because of very high within stratum variances in catch weights. The high within-stratum variance in monkfish catch weight was due to catches of very small individuals (which weighted very little) being caught in many tows. Similar problems with the delta distribution estimators has been previously documented (Syrjala 2000). Therefore estimates of arithmetic means with bootstrapped confidence intervals are provided in this assessment, along with the delta distribution estimators.

NEFSC indices derived from surveys on the FSV Henry Bigelow (starting spring 2009) were adjusted using calibration coefficients estimated during experimental work (Miller et al. 2009). The FSV *Henry B. Bigelow*, which became the main platform for NEFSC research surveys in spring 2009, has significantly different size, towing power, and fishing gear characteristics than the previous survey platform (*Albatross IV)*, resulting in different fishing power and catchability for most species. Calibration experiments to estimate these differences were conducted during 2008 (Brown 2009, NEFSC 2007b), and were peer reviewed by a Panel of three non-NMFS scientists during the summer of 2009 (Anonymous 2009). The objective was to develop specific protocols for guidance in the selection and use of appropriate estimators based on the amount of data available and the relative performance of two candidate estimators. The Panel developed general guidance on which estimator to use given sample sizes for each species. Following these guidelines, monkfish catches were converted using a simple ratio estimator without a seasonal (spring vs. fall) or length-specific correction. The low catch rates of monkfish in the Albatross series made development of more detailed coefficients infeasible. The overall coefficients for monkfish were 7.1295 for numbers and 8.0618 for biomass (kg) (Anonymous 2009; Miller et al. 2009).

Coefficients of variation and confidence intervals for survey indces are given in the tables for each survey and region discussed below.

**Northern Area**

Biomass indices from NEFSC autumn and spring research trawl surveys fluctuated without trend between 1963 and 1975, increased briefly in the late 1970's, but declined thereafter to near historic lows during the 1990's (Tables 11-14, Figures 10, 11, 13). From 2000 to 2003, indices increased, reflecting recruitment of a relatively strong 1999 yearclass. Subsequently, biomass indices declined and have remained relatively low since. In the Bigelow time series (2009-2015, Figure 11), biomass and abundance indices in the north have generally increased since 2009. Trends in the ME/NH trawl survey suggest a general decline since 2000, but a strong increase in 2015 (Figure 12).

NEFSC survey length distributions have become increasingly truncated over time (Figures 14-15). By 1990, fish greater than 60 cm long were uncommon. The minimum, median and maximum lengths in the trawl surveys declined during the 1980s and have fluctuated around smaller sizes since around 1990 (Figure 16). Despite relatively low landings and discards in recent years, there is little evidence of increased abundance of large individuals in the survey catches. Several modes potentially representing strong yearclasses have appeared in survey length distributions (Figure 14-15), most recently in 2015 (fall). Length composition of catches in the summer shrimp survey and the ME/NH surveys are shown in Figures 17 and 18.

Recruitment indices (abundance) were estimated for monkfish of lengths corresponding to presumed young-of-year (YOY, age 0) (Figure 19). The size ranges used were based on length frequencies observed for the strong 2015 yearclass, and differ from those used previously, as detailed below.

| | 2013 | | 2016 | |
|---|---|---|---|---|
| | Putative | | Putative | |
| North | age | cm range | age | cm range |
| Fall NEFSC | 1 | 11-19 | 0 | 6-18 |
| Fall ME-NH | 1 | 11-19 | 0 | 8-18 |
| | | | | |
| South | | | | |
| Spring/summer scallop | 1 | 11-19 | 0 | 7-18 |
| Fall NEFSC | 1 | 11-17 | 0 | 12-28 |

Based on the recruitment indices, the frequency of recruitment events in the northern area has increased since the late 1980s, with strong yearclasses produced in 1993, 1999 and 2015.

Additional surveys that catch monkfish in portions of the northern area include the ASMFC shrimp survey, the Massachusetts Division of Marine Fisheries fall and spring surveys, and ME/NH inshore surveys (Table 17, Figures 10, 14, 15). The shrimp survey samples the western Gulf of Maine during summer and caught more monkfish than the spring or fall surveys prior to 2009 (when the FSV Bigelow survey series began) (Table 16, Figure 10). Patterns of abundance and biomass have been relatively consistent among the NEFSC spring and fall, ME-NH, and shrimp surveys (Figure 10). The Massachusetts surveys catch few monkfish and were not considered to reflect patterns of abundance for the entire management area (NEFSC 2007a); therefore have not been used in recent assessments.

**Southern Area**

Inconsistent geographic coverage should be considered in the interpretation of southern survey indices. For example the fall survey did not sample south of Hudson Canyon until 1967. The winter survey (Tables 22-23) sampled Georges Bank inconsistently and did not sample deep strata before 1998. The NEFSC scallop survey has been limited to the southern flank of Georges Bank since 2014, and sampling intensity over the entire mid-Atlantic Bight declined starting in 2011 (Appendix Figure 3). In addition, the timing of the scallop dredge survey shifted in 2009 from mid-summer to late spring. VIMS is now conducting the scallop dredge survey in the areas south of Georges Bank (see Appendix Figure 4). NEAMAP inshore surveys in the Mid-Atlantic (http://www.vims.edu/research/departments/fisheries/programs/multispecies_fisheries_research/abundance_indices/NEAMAP/index.php) catch relatively few monkfish, so are not included here.

Biomass and abundance indices from NEFSC spring and autumn research surveys were high during the mid-1960s, fluctuated around an intermediate level during the 1970s-mid 1980s, and have been relatively low since the late 1980s (Tables 18-21, Figures 20, 22). A sharp increase in abudance was observed in the 2015 scallop and fall surveys (Tables 18, 19, 25) reflecting an apparent recruitment event. In the Bigelow time series (2009-2015, Figure 21), biomass and abundance indices in the south have declined or remained steady with the exception of the abundance index in the fall of 2015, which was more than 3 times greater than the previous high in the 7-year time Bigelow series.

Length distributions from the southern area show truncation over time but somewhat less dramatically than in the north (Figure 23). As in the northern area, fish greater than 60 cm have been rare since the 1980s, especially when compared to the 1960s. Recruitment indices (presumed YOY) (Figure 28) indicate two exceptional recruitment events in the south, occurring in 1972 and 2015. Distribution plots suggest that the 2015 recruits were broadly distributed north of about 38$^{o}$ (off northern Mayland) in the fall (Figure 29). This strong yearclass may help elucidate growth rates of young monkfish through progression of length modes in successive seasonal surveys (Figure 30).

***Working Group Comments – TOR 2***

*Delta distribution means have been used in previous monkfish assessments as the statistic of central tendency. However, some unusual patterns in the 2015 surveys (tows with many small fish that weigh very little in aggregate) resulted in large variance estimates that translated to inflated delta means.*

*The WG explored the use of arithmetic means for monkfish (which is also the usual practice in most current NEFSC assessments). The delta and arithmetic means are very similar for nearly all of the time series.*

*The WG noted that for the Bigelow surveys in 2009 and later, the proportion of zero monkfish catch tows is relatively low (~10-20%), and so the delta means may not be appropriate. The WG recommended use of the arithmetic means for the entire time series (Albatross and Bigelow survey vessels), and as the basis for the calculations in TOR 5.*

**TOR 3. Provide data that address potential biological changes such as shifts in distribution or condition of individual fish.**

Distribution shifts are a potential response to climatic changes on the northeast continental shelf, and have been seen in a number of species (e.g. Kleisner et al. 2016). Evaluation of physical data associated with monkfish catches in NEFSC fall surveys does not indicate systematic shifts in relative depth distribution or distribution with respect to bottom temperature (Figure 31, Appendix Figures 5-6). Similarly, distribution animations do not suggest a change over time in monkfish geographic range (http://www.nefsc.noaa.gov/ecosys/spatial-analyses/demersal/monkfish.html).

Time series of condition factors of individual monkfish appear to fluctuate without trend (Figure 32).

***Working Group Comments – TOR 3***

*The WG noted that there is no evidence of large scale distributional shifts in monkfish abundance in the NEFSC surveys in response to temperature. There is no evidence of any change in condition factor of the monkfish sampled in NEFSC surveys.*

**TOR 4. Compare annual catches to ACLs to evaluate performance of the fishery.**
In both management areas, fishing year landings have remained below the annual TAC/TAL since 2009 (Table 2). Landings averaged 60% of the TAL in the north and 59% in the south during 2013-2014. In 2015, 70% of the TAL was landed in the north, and 53% in the south.

***Working Group Comments – TOR 4***
*The WG noted that the fishery has only attained 50-70% of annual TALs in recent years. In the North, this is likely due to the impacts of groundfish management restrictions. In the South, market demand, price, sturgeon bycatch in gillnets, and monkfish-specific regulations have impacted the magnitude of the landings.*

**TOR 5. Carry out analyses that will support the NEFMC SSC in making its ABC recommendation.**

Exploitable biomass indices are shown in Figure 33. Relative exploitation indices calculated from landings or catch and survey indices are shown in Tables 26-28 and Figures 34-35.

A model-free method used to derive Georges Bank cod catch limits in 2015 (NEFSC 2015) was applied to monkfish in the northern and southern management areas. The method calculated the rate and direction of change in survey indices for the past 3 years using the slope of a log-linear regression during the three years. The proportional change in the indices (re-transformed slope) was applied to average cod catch in the four previous years to derive new cod catch limits.

The monkfish analysis used NEFSC fall survey exploitable biomass indices (43+ cm in both areas). The time series of exploitable biomass in each area (1980-2015) was Loess-smoothed (smoothing parameter=0.25) before being entered into a log-linear regression to estimate the proportional change during 2013-2015. The estimated proportional change for monkfish was 1.06 in the north (6% increase) and 0.80 in the south (20% decrease) (Table 29 and Figure 36).

The Working Group requested that the analysis also be carried out using the average of NEFSC fall and spring surveys rather than just the fall survey. The estimated proportional change using the combined surveys was 1.02 in the north (2% increase) and 0.87 in the south (13% decrease) (Table 29 and Figure 37). The WG noted that the spring survey may be affected more strongly than the fall survey by availability of monkfish to the gear due to timing of seasonal migrations.

***Working Group Comments – TOR 5***
*The WG noted that relative exploitation indices based on landings, catch, and survey indices have recently decreased slightly in the North, but have been increasing in the South.*

*The lead analyst initially prepared calculations (derived from the 2016 Georges Bank cod catch advice procedure) to inform future catch advice for the monkfish areas based on the NEFSC fall*

*survey, feeling that series provided the best index of monkfish biomass. Those calculations indicated the recent slope of the biomass trend in the North was 1.06 (6% increase) and in the South was 0.80 (20% decrease).*

*The WG discussed all available surveys for possible use in the catch advice calculations. The WG recommended:*

*-omission of the NEFSC winter survey for the South because it ended in 2007*
*-omission of the ME-NH survey for the North because of limited spatial coverage*
*-omission of the ASMFC shrimp survey for the North because of limited spatial coverage*
*-omission of the scallop surveys in the South because of the limited size range of monkfish captured and the lack of biomass indices from that survey*

*The WG recommended examination of survey trends in averaged NEFSC spring and fall exploitable biomass indices (43 cm and larger fish) in the catch advice calculations.*
*The revised calculations based on averaged spring and fall surveys indicated the recent slope of the biomass trend in the North was 1.02 (2% increase) and in the South was 0.87 (13% decrease).*

*The WG recommended use of the averaged NEFSC spring and fall exploitable biomass indices as the basis for advice for possible near-term adjustments to monkfish catch targets.*

*The WG notes that surveys indicate that recruitment in 2015 was strong in both management areas, which may lead both to increased discards in 2016 and an opportunity for increased landings as those fish recruit above the minimum size in 2017.*

*Given the current uncertainty about the potential size and longer term impact of the 2015 recruitment, it may be advisable to repeat the TOR 5 catch projection exercise for the 2018 and later ABCs.*

**References:**

Almeida FP, Hartley DL, Burnett J. 1995. Length-weight relationships and sexual maturity of monkfish off the northeast coast of the United States. N Am J Fish Manage. 15:14-25.

Anonymous. 2009. Independent Panel review of the NMFS Vessel Calibration analyses for FSV/ Henry B. Bigelow/ and R/V/ Albatross IV/. August 11-14, 2009. Chair's Consensus report. 10 p.

Armstrong MP, Musick JA, Colvocoresses JA. 1992. Age, growth and reproduction of the monkfish *Lophius americanus* (Pisces:Lophiiformes). Fish Bull. 90: 217-230.

Azarovitz TR. 1981. A brief historical review of the Woods Hole Laboratory trawl survey time series. Pages 62-67 in W.G. Doubleday and D. Rivard, editors. Bottom trawl surveys. Can Spec Pub Fish Aquat Sci. 58.

Bank, C. 2016. Validation of age determination methods for monkfish (*Lophius americanus*). Master of Science Thesis, School of Marine Science and Technology, Univ. Mass.

Brown R. 2009. Design and field data collection to compare the relative catchabilities of multispecies bottom trawl surveys conducted on the NOAA ship *Albatross* IV and the

FSV *Henry B. Bigelow*. NEFSC Bottom Trawl Survey Calibration Peer Review Working Paper. NEFSC, Woods Hole, MA. 19 p.

Caruso JH. 1983. The systematics and distribution of the lophiid angler fisher: II. Revision of the genera *Lophiomus* and *Lophius*. Copeia 1: 11-30.

Collette B, Klein-MacPhee G, (eds). 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine, Third edition. Smithsonian Institution Press. 748 p.

Chikarmane HM, Kuzirian A, Kozlowski R, Kuzirian M, Lee T. 2000. Population genetic structure of the monkfish, *Lophius americanus*. Biol Bull. 199: 227-228.

Cook RM. 1997.Stock trends in six North Sea stocks as revealed by an analysis of research vessel surveys. ICES J Mar Sci. 54: 924-933.

Durbin EG, Durbin AG, Langton RW, Bowman RE. 1983. Stomach contents of silver hake, *Merluccius bilinearis*, and Atlantic cod, *Gadus morhua*, and estimation of their daily rations. Fish Bull. 81: 437-454.

Eggers DM. 1977. Factors in interpreting data obtained by diel sampling of fish stomachs. J Fish Res Board Can. 34: 290-294.

Elliot JM, Persson L. 1978. The estimation of daily rates of food consumption for fish. J Anim Ecol. 47: 977-991.

Haring P, Maguire JJ, 2008. The monkfish fishery and its management in the northeastern USA. ICES J Mar Sci. 65: 1370 – 1379.

Hartley D. 1995. The population biology of the monkfish, *Lophius americanus*, in the Gulf of Maine. M. Sc. Thesis, University of Massachusetts, Amherst. 142 p.

Hasbrouck, E., J. Scotti, T. Froehlich, K. Gerbino, J. Stent, J. Costanzo, I. Wirgin. 2015. Coastwide stock structure of monkfish using microsatellite DNA analysis. Completion report, Monkfish RSA Grant NA12NMF4540095.

Johnson AK, Richards RA, Cullen DW, Sutherland SJ, 2008. Growth, reproduction, and feeding of large monkfish, *Lophius americanus*. ICES J Mar Sci. 65: 1306 – 1315.

Johnson, A.K., Allen R. Place, Belita S. Nguluwe, R. Anne Richards, Ernest Williams. In prep. Stock Discrimination of American Monkfish using a Mitochondrial DNA Marker.

Kleisner KM, Fogarty MJ, McGee S, Barnett A, Fratantoni P, Greene J, et al. (2016) The Effects of Sub-Regional Climate Velocity on the Distribution and Spatial Extent of Marine Species Assemblages. PLoS ONE 11(2): e0149220. doi:10.1371/journal.pone.0149220

Link JS, Col L, Guida V, Dow D, O'Reilly J, Green J, Overholtz W, Palka D, Legault C, Vitaliano J, Griswold C, Fogarty M, Friedland K. 2009. Response of Balanced Network Models to Large-Scale Perturbation: Implications for Evaluating the Role of Small Pelagics in the Gulf of Maine. Ecol Model. 220: 351-369.

Link J, Overholtz W, O'Reilly J, Green J, Dow D, Palka D, Legault C, Vitaliano J, Guida V, Fogarty M, Brodziak J, Methratta E, Stockhausen W, Col L, Waring G, Griswold C. 2008. An Overview of EMAX: The Northeast U.S. Continental Shelf Ecological Network. J Mar Sys. 74: 453-474.

Link JS, Griswold CA, Methratta EM, Gunnard, J. (eds). 2006. Documentation for the Energy Modeling and Analysis eXercise (EMAX). NEFSC Ref Doc. 06-15: 166 p.

Link JS, Sosebee K. 2008. Estimates and implications of Skate Consumption in the northeastern US continental shelf ecosystem. N Amer J Fish Manage. 28: 649-662.

Link JS, Idoine J. 2009. Predator Consumption Estimates of the northern shrimp *Pandalus borealis*, with Implications for Estimates of Population Biomass in the Gulf of Maine. N. Am J Fish Manage. 29:1567-1583.

DRAFT

Link JS, Garrison LP. 2002. Changes in piscivory associated with fishing induced changes to the finfish community on Georges Bank. Fish Res. 55: 71-86.

Link JS, Garrison LP, Almeida FP. 2002. Interactions between elasmobranchs and groundfish species (*Gadidae and Pleuronectidae)* on the Northeast U.S. Shelf. I: Evaluating Predation. N Am J Fish Manage. 22: 550-562.

Link JS, Almeida FP. 2000. An overview and history of the food web dynamics program of the Northeast Fisheries Science Center, Woods Hole, Massachusetts. NOAA Tech Memo. NMFS-NE-159. 60 p.

McBride, R. S, A. K. Johnson, E. K. Lindsay, H. J. Walsh, and R. Anne Richards. in prep. Goosefish *Lophius americanus* fecundity and spawning frequency, with implications for population reproductive potential.

Miller TJ, Das C, Politis P, Long A, Lucey S, Legault C, Brown R, Rago P. 2009. Estimation of */Henry B. Bigelow/* calibration factors. NEFSC Bottom Trawl Survey/ /Calibration Peer Review Working Paper. NEFSC, Woods Hole, MA. 376 p.

Moustahfid H, Tyrrell MC, Link JS. 2009a. Accounting explicitly for predation mortality in surplus production models: an application to longfin inshore squid. N Am J Fish Manage. 29: 1555-1566.

Moustahfid H, Link JS, Overholtz WJ, Tyrell MC. 2009b. The advantage of explicitly incorporating predation mortality into age-structured stock assessment models: an application for Northwest Atlantic mackerel. ICES J Mar Sci. 66: 445-454.

NEFC (Northeast Fisheries Center). 1988. An evaluation of the bottom trawl survey program of the Northeast Fisheries Center.NOAA Technical Memorandum NMFS-F/NEC52.83 pp.

NEFMC [New England Fishery Management Council] and MAFMC [Mid-Atlantic Fishery Management Council]. 1998. Monkfish Fishery Management Plan. http://www.nefmc.org/monk/index.html

NEFMC [New England Fishery Management Council] and MAFMC [Mid-Atlantic Fishery Management Council]. 2003. Framework Adjustment 2 to the Monkfish Fishery Management Plan. http://www.nefmc.org/monk/index.html

NEFSC [Northeast Fisheries Science Center]. 2002. [Report of the] 34th Northeast Regional Stock Assessment Workshop (34th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NEFSC Ref Doc. 02-06: 346p

NEFSC [Northeast Fisheries Science Center]. 2005. 40th Northeast Regional Stock Assessment Workshop (40th SAW) Assessment Report. NEFSC Ref Doc. 05-04:146 p

NEFSC [Northeast Fisheries Science Center]. 2006. 42nd Northeast Regional Stock Assessment Workshop. (42nd SAW) stock assessment report, part B: Expanded Multispecies Virtual Population Analysis (MSVPA-X) stock assessment model. NEFSC Ref Doc. 06-09b: 308 p.

NEFSC [Northeast Fisheries Science Center]. 2007a. Northeast Data Poor Stocks Working Group Monkfish assessment report for 2007. NEFSC Ref Doc. 07-21: 232 p.

NEFSC [Northeast Fisheries Science Center]. 2007b. Proposed vessel calibration studies for NOAA Ship *Henry B. Bigelow*. NEFSC Ref. Doc. 07-12: 26 p.

NEFSC [Northeast Fisheries Science Center]. 2007c. Assessment Report (45$^{th}$ SARC/SAW). Section A.10. [TOR 6]. NEFSC Ref Doc. 07-16: 13-138.

NEFSC [Northeast Fisheries Science Center]. 2007d. Assessment Report (44$^{th}$ SARC/SAW). Section B.8. [TOR 6]. NEFSC Ref Doc. 07-10: 332-344, 504-547.

DRAFT

NEFSC [Northeast Fisheries Science Center]. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007 Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. Section 2.1. NEFSC Ref Doc. 08-15: 855-865.

NEFSC [Northeast Fisheries Science Center]. 2010. Assessment Report (50th SARC/SAW). NEFSC Ref Doc. 10-17: 15-392.

NEFSC [Northeast Fisheries Science Center]. 2013. 2013 Monkfish Operational Assessment. NEFSC Ref Doc. 13-23: 116 p.

NEFSC [Northeast Fisheries Science Center]. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, Updated Through 2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p.

Overholtz WJ, Link JS. 2009. A simulation model to explore the response of the Gulf of Maine food web to large scale environmental and ecological changes. Ecol Model. 220: 2491-2502.

Overholtz WJ, Jacobson LD, Link JS. 2008. Developing an ecosystem approach for assessment advice and biological reference points for the Gulf of Maine-Georges Bank herring complex: adding the impact of predation mortality. N Am J Fish Manag. 28: 247-257.

Overholtz WJ, Link JS. 2007. Consumption impacts by marine mammals, fish, and seabirds on the Gulf of Maine-Georges Bank Atlantic Herring (*Clupea harengus*) complex during 1977-2002. ICES J Mar. Sci. 64: 83-96.

Overholtz W, Link JS, Suslowicz LE. 2000. The impact and implications of fish predation on pelagic fish and squid on the eastern USA shelf. ICES J Mar Sci. 57: 1147-1159.

Overholtz W, Link JS, Suslowicz LE. 1999. Consumption and harvest of pelagic fishes in the Gulf of Maine-Georges Bank ecosystem: Implications for fishery management. Proceedings of the 16th Lowell Wakefield Fisheries Symposium-Ecosystem Considerations in Fisheries Management. AK-SG-99-01:163-186.

Overholtz WJ, Murawski SA, Foster KL. 1991. Impact of predatory fish, marine mammals, and seabirds on the pelagic fish ecosystem of the northeastern USA. ICES Mar Sci Symposia 193: 198-208.

Pennington M. 1985. Estimating the average food consumption by fish in the field from stomach contents data. Dana 5: 81-86.

Pennington, M. 1986. Estimating the mean and variance from highly skewed marine data. Fishery Bulletin 47: 1623-1624.

Rago PJ, Wigley SE, Fogarty MJ. 2005. NEFSC bycatch estimation methodology: allocation, precision, and accuracy. NEFSC Ref Doc. 05-09: 44 p

Rago PJ, Weinberg JR, Weidman C. 2006. A spatial model to estimate gear efficiency and animal density from depletion experiments. Can J Fish Aquat Sci: 63: 2377–2388.

Raymond M, Glass C. 2006. A Project to define monkfish trawl gear and areas that reduce groundfish bycatch and to minimize the impacts of monkfish trawl gear on groundfish habitat. Final Report, NOAA NERO CRPP Contract EA-133-F-03-CN-0049.

Richards A. 2006. Goosefish (*Lophius americanus*). In Status of Fishery Resources off the Northeastern US (www.nefsc.noaa.gov/sos/spsyn/og/goose).

Richards RA, Nitschke P, Sosebee K. 2008. Population biology of monkfish *Lophius americanus*. ICES J Mar Sci. 65: 1291-1305.

DRAFT

Richards, RA, Grabowski, J and Sherwood, G. 2012. Archival Tagging Study of Monkfish, *Lophius americanus.* Final Report to Northeast Consortium, Project Award 09-042.

Rountree RA, Gröger JP, Martins D. 2006. Extraction of daily activity pattern and vertical migration behavior from the benthic fish, *Lophius americanus*, based on depth analysis from data storage tags. ICES CM 2006/Q:01.

Sissenwine MP, Bowman EW. 1977. Fishing power of two bottom trawls towed by research vessels off the northeast coast of the USA during day and night. ICES CM. 1977: B30.

Steimle FW, Morse WW, Johnson DL. 1999. Essential fish habitat source document: monkfish, *Lophius americanus*, life history and habitat characteristics. NOAA TechMemoNMFS-NE-127.

Syrjala, S. 2000. Critique on the use of the delta distribution for the analysis of trawl survey data. ICES J. Mar. Sci. 57:831-842.

Taylor MH, Bascuñán C, Manning JP. 2005. Description of the 2004 Oceanographic Conditions on the Northeast Continental Shelf. NEFSC Ref Doc. 05-03: 90 p.

Tsou TS, Collie JS. 2001a. Estimating predation mortality in the Georges Bank fish community. Can J Fish Aquat Sci. 58: 908-922.

Tsou TS, Collie JS. 2001b. Predation-mediated recruitment in the Georges Bank fish community. ICES J Mar Sci. 58: 994-1001.

Tyrrell MC, Link JS, Moustahfid H, Overholtz WJ. 2008. Evaluating the effect of predation mortality on forage species population dynamics in the Northwest Atlantic continental shelf ecosystem: an application using multispecies virtual population analysis. ICES J Mar Sci. 65: 1689-1700.

Tyrrell MC, Link JS, Moustahfid H, Smith BE. 2007. The dynamic role of goosefish (*Pollachius virens*) as a predator in the Northeast US Atlantic ecosystem: a multi-decadal perspective. J Northwest Atl Fish Sci. 38: 53-65.

Ursin E, Pennington M, Cohen EB, Grosslein MD. 1985. Stomach evacuation rates of Atlantic cod (*Gadus morhua*) estimated from stomach contents and growth rates. Dana 5: 63-80.

Wigley SE, Rago PJ, Sosebee KA, Palka DL. 2007. The Analytic Component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: Sampling Design, and Estimation of Precision and Accuracy. NEFSC Ref Doc. 07-09: 156 p

Weinberg KL, Kotwicki S. 2008. Factors influencing net width and sea floor contact of a survey bottom trawl. Fish Res. 93: 265-279.

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Table 1. Timeline of fishery management actions for monkfish.

(http://www.greateratlantic.fisheries.noaa.gov/sustainable/species/monkfish/)

**1999** – Monkfish FMP was implemented which included a limited access permit program, a DAS management system, trip limits, and minimum size limits.

**1999** – Amendment 1 (FR Notice) approved to ensure compliance with essential fish habitat requirements of the Magnuson-Stevens Act.

**2002** – Framework Adjustment 1 (FR Notice) was disapproved by NMFS. NMFS instead published an emergency rule that implemented measures based upon the best available science to temporarily suspend the restrictive Year 4 default management measures that would have become effective May 1, 2002.

**2003** –Framework Adjustment 2 (FR Notice) modified the overfishing definition and implemented annual adjustments to the management measures.

**2003 -** Final rule implemented a series of seasonal closures that prohibited the use of large mesh gillnets in Federal waters off the coast of Virginia and North Carolina to reduce the impact of the monkfish fishery on endangered and threatened species of sea turtles.

**2005 –** Amendment 2 (FR Notice) addressed essential fish habitat, bycatch concerns, and issues raised by public comments.

**2006** – Framework Adjustment 3 (FR Notice) implemented to prohibit targeting monkfish on Multispecies B-regular DAS.

**2007 –** Interim management measures Framework 4 (FR Notice) adopted in May to address overfishing while NMFS conducted a stock assessment. Framework 4 was implemented in October to establish 3-year target total allowable catches (TACs), a target TAC backstop provision, and adjustments to DAS allocations and trip limits.

**2007** – Amendment 3 (FR Notice) was implemented as an Omnibus Amendment to standardize bycatch reporting methodology for monkfish and other fisheries.

**2008** – NMFS implemented Framework 5 (FR Notice) to ensure the Monkfish FMP succeeds in keeping landings within the target total allowable catch levels. Measures include reduction in carryover DAS, reduction in bycatch or incidental catch limits, and revision in the biological reference points used to determine if the stock is overfished.

**2008** – Framework 6 (FR Notice) eliminated the backstop provision adopted in Framework Adjustment 4 to the FMP, October 2007.

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**2011** – Amendment 5 (FR Notice) implemented a suite of measures including annual catch limits and accountability measures, measures to promote efficiency and reduce waste, and bring the biological reference points into compliance.

**2011** – Framework Adjustment 7 (FR Notice) implemented measures that were disapproved in Amendment 5 due to newly available science. Specifically, DAS allocations, trip limits, and an annual catch target for the Northern Area.

**2012** – Amendment 6 is still being developed in considering a catch shares management system for the fishery. Information on Amendment 6 is located here.

**2013** - NMFS implements an emergency action (FR Notice) to suspend the monkfish possession limits in the Northern Fishery Management Area for monkfish permit categories C and D under a monkfish DAS.

**2014** - Framework Adjustment 8 (FR Notice) implemented measures to incorporate results of latest stock assessment, increase monkfish day-at-sea allocations and landing limits to better achieve optimum yield, and increase operational flexibility by allowing all limited access monkfish vessels to use an allocated monkfish-only day-at-sea at any time throughout the fishing year and Category H vessels to fish throughout the Southern Fishery Management Area.

**2016** – Framework 9 submitted. Would modify rules for at-sea DAS declarations and possession limits to reduce discarding and provide flexibility to vessels fishing in both the monkfish and NE multispecies fisheries.

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Table 2. Management measures for monkfish, fishing years 2000-2015 (note that regulations pertain to fishing years (May 1- April 30), and do not correspond to calendar year landings in Table 3.

**Northern Fishery Management Area**

| | | Trip Limits* | Trip Limits* | | | |
|---|---|---|---|---|---|---|
| Fishing Year | Target TAC/TAL | Cat. A & C | Cat. B & D | DAS Restrict | FY Landings (mt) | Percent of TAC |
| 2000 | 5,673 | n/a | n/a | 40 | 11,859 | 209% |
| 2001 | 5,673 | n/a | n/a | 40 | 14,853 | 262% |
| 2002 | 11,674 | n/a | n/a | 40 | 14,491 | 124% |
| 2003 | 17,708 | n/a | n/a | 40 | 14,155 | 80% |
| 2004 | 16,968 | n/a | n/a | 40 | 11,750 | 69% |
| 2005 | 13,160 | n/a | n/a | 40 | 9,533 | 72% |
| 2006 | 7,737 | n/a | n/a | 40 | 6,677 | 86% |
| 2007 | 5,000 | 1,250 | 470 | 31 | 5,050 | 101% |
| 2008 | 5,000 | 1,250 | 470 | 31 | 3,528 | 71% |
| 2009 | 5,000 | 1,250 | 470 | 31 | 3,344 | 67% |
| 2010 | 5,000 | 1,250 | 470 | 31 | 2,834 | 57% |
| 2011 | 5,854 | 1,250 | 600 | 40 | 3,699 | 63% |
| 2012 | 5,854 | 1,250 | 600 | 40 | 3,920 | 67% |
| 2013 | 5,854 | 1,250 | 600 | 40 | 3,596 | 61% |
| 2014 | 5,854 | 1,250 | 600 | 45 | 3,403 | 58% |
| 2015 | 5,854 | 1,250 | 600 | 45 | 4,105 | 70% |

* Trip limits in pounds tail weight per DAS

** Excluding up to 10 DAS carryover, became 4 DAS carryover in FY2007

In 2011, the target TAC became a target TAL

**Southern Fishery Management Area**

| | | Trip Limits* | Trip Limits* | | | |
|---|---|---|---|---|---|---|
| Fishing Year | Target TAC/TAL | Cat. A,C,G | Cat. B, D, H | DAS Restrict | FY Landings (mt) | Percent of TAC |
| 2000 | 6,024 | 1,500 | 1,000 | 40 | 7,960 | 132% |
| 2001 | 6,024 | 1,500 | 1,000 | 40 | 11,069 | 184% |
| 2002 | 7,921 | 550 | 450 | 40 | 7,478 | 94% |
| 2003 | 10,211 | 1,250 | 1,000 | 40 | 12,198 | 119% |
| 2004 | 6,772 | 550 | 450 | 28 | 6,223 | 92% |
| 2005 | 9,673 | 700 | 600 | 39.3 | 9,656 | 100% |
| 2006 | 3,667 | 550 | 450 | 12 | 5,909 | 161% |
| 2007 | 5,100 | 550 | 450 | 23 | 7,180 | 141% |
| 2008 | 5,100 | 550 | 450 | 23 | 6,751 | 132% |
| 2009 | 5,100 | 550 | 450 | 23 | 4,800 | 94% |
| 2010 | 5,100 | 550 | 450 | 23 | 4,484 | 88% |
| 2011 | 8,925 | 550 | 450 | 28 | 5,801 | 65% |
| 2012 | 8,925 | 550 | 450 | 28 | 5,184 | 58% |
| 2013 | 8,925 | 550 | 450 | 28 | 5,088 | 57% |
| 2014 | 8,925 | 610 | 500 | 32 | 5,415 | 61% |
| 2015 | 8,925 | 610 | 500 | 32 | 4,703 | 53% |

* Trip limits in pounds tail weight per DAS

** Excluding up to 10 DAS carryover, became 4 DAS carryover in FY2007

In 2011, the target TAC became a target TAL

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Table 3. Landings (calculated live weight, mt) of monkfish as reported in NEFSC weighout data base (1964-1993) and vessel trip reports (1994-2014) (North = SA 511-523, 561; South = SA 524-639 excluding 551-561 plus landings from North Carolina for years 1977-1995); General Canvas database (1964-1989, North = ME, NH, northern weigh out proportion of MA; South = Southern weigh out proportion of MA, RI-VA); Foreign landings from NAFO database areas 5 and 6. Shaded cells denote suggested source for landings which are used in the total column at the far right (see text for details).

| | Weigh Out Plus NC | | | General Canvas | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | US North | US South | US Total | US North | US South | US Total | Foreign | Total |
| 1964 | 45 | 19 | 64 | 45 | 61 | 106 | 0 | 106 |
| 1965 | 37 | 17 | 54 | 37 | 79 | 115 | 0 | 115 |
| 1966 | 299 | 13 | 312 | 299 | 69 | 368 | 2,397 | 2765 |
| 1967 | 539 | 8 | 547 | 540 | 59 | 598 | 11 | 609 |
| 1968 | 451 | 2 | 453 | 449 | 36 | 485 | 2,231 | 2716 |
| 1969 | 258 | 4 | 262 | 240 | 43 | 283 | 2,249 | 2532 |
| 1970 | 199 | 12 | 211 | 199 | 53 | 251 | 477 | 728 |
| 1971 | 213 | 10 | 223 | 213 | 53 | 266 | 3,659 | 3925 |
| 1972 | 437 | 24 | 461 | 437 | 65 | 502 | 4,102 | 4604 |
| 1973 | 710 | 139 | 848 | 708 | 240 | 948 | 6,818 | 7766 |
| 1974 | 1,197 | 101 | 1,297 | 1,200 | 183 | 1,383 | 727 | 2110 |
| 1975 | 1,853 | 282 | 2,134 | 1,877 | 417 | 2,294 | 2,548 | 4842 |
| 1976 | 2,236 | 428 | 2,663 | 2,256 | 608 | 2,865 | 341 | 3206 |
| 1977 | 3,137 | 830 | 3,967 | 3,167 | 1,314 | 4,481 | 275 | 4756 |
| 1978 | 3,889 | 1,384 | 5,273 | 3,976 | 2,073 | 6,049 | 38 | 6087 |
| 1979 | 4,014 | 3,534 | 7,548 | 4,068 | 4,697 | 8,765 | 70 | 8835 |
| 1980 | 3,695 | 4,232 | 7,927 | 3,623 | 6,035 | 9,658 | 132 | 9790 |
| 1981 | 3,217 | 2,380 | 5,597 | 3,171 | 4,142 | 7,313 | 381 | 7694 |
| 1982 | 3,860 | 3,722 | 7,582 | 3,757 | 4,492 | 8,249 | 310 | 7,892 |
| 1983 | 3,849 | 4,115 | 7,964 | 3,918 | 4,707 | 8,624 | 80 | 8,044 |
| 1984 | 4,202 | 3,699 | 7,901 | 4,220 | 4,171 | 8,391 | 395 | 8,296 |
| 1985 | 4,616 | 4,262 | 8,878 | 4,452 | 4,806 | 9,258 | 1,333 | 10,211 |
| 1986 | 4,327 | 4,037 | 8,364 | 4,322 | 4,264 | 8,586 | 341 | 8,705 |
| 1987 | 4,960 | 3,762 | 8,722 | 4,995 | 3,933 | 8,926 | 748 | 9,470 |
| 1988 | 5,066 | 4,595 | 9,661 | 5,033 | 4,775 | 9,809 | 909 | 10,570 |
| 1989 | 6,391 | 8,353 | 14,744 | 6,263 | 8,678 | 14,910 | 1,178 | 15,922 |
| 1990 | 5,802 | 7,204 | 13,006 | | | | 1,557 | 14,563 |
| 1991 | 5,693 | 9,865 | 15,558 | | | | 1,020 | 16,578 |
| 1992 | 6,923 | 13,942 | 20,865 | | | | 473 | 21,338 |
| 1993 | 10,645 | 15,098 | 25,743 | | | | 354 | 26,097 |
| 1994 | 10,950 | 12,126 | 23,076 | | | | 543 | 23,619 |
| 1995 | 11,970 | 14,361 | 26,331 | | | | 418 | 26,749 |
| 1996 | 10,791 | 15,715 | 26,507 | | | | 184 | 26,691 |
| 1997 | 9,709 | 18,462 | 28,172 | | | | 189 | 28,361 |
| 1998 | 7,281 | 19,337 | 26,618 | | | | 190 | 26,808 |
| 1999 | 9,128 | 16,085 | 25,213 | | | | 151 | 25,364 |
| 2000 | 10,729 | 10,147 | 20,876 | | | | 176 | 21,052 |
| 2001 | 13,341 | 9,959 | 23,301 | | | | 142 | 23,443 |
| 2002 | 14,011 | 8,884 | 22,896 | | | | 294 | 23,190 |
| 2003 | 14,991 | 11,095 | 26,086 | | | | 309 | 26,395 |
| 2004 | 13,209 | 7,978 | 21,186 | | | | 166 | 21,352 |
| 2005 | 10,140 | 9,177 | 19,317 | | | | 206 | 19,523 |
| 2006 | 6,974 | 7,980 | 14,955 | | | | 279 | 15,234 |
| 2007 | 4,953 | 7,388 | 12,341 | | | | | 12,341 |
| 2008 | 3,942 | 7,250 | 11,192 | | | | | 11,192 |
| 2009 | 3,210 | 5,532 | 8,742 | | | | | 8,742 |
| 2010 | 2,424 | 4,996 | 7,420 | | | | | 7,420 |
| 2011 | 3,227 | 5,371 | 8,599 | | | | | 8,599 |
| 2012 | 4,033 | 5,724 | 9,757 | | | | | 9,757 |
| 2013 | 3,332 | 5,253 | 8,586 | | | | | 8,586 |
| 2014 | 3,402 | 5,135 | 8,537 | | | | | 8,537 |
| 2015 | 4,027 | 4,609 | 8,636 | | | | | 8,636 |

Table 4. U.S. landings of monkfish (calculated live weight, mt) by gear type.

| | North | | | | | South | | | | | Regions Combined | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Trawl | Gill Net | Scallop Dredge | Other | Total | Trawl | Gill Net | Scallop Dredge | Other | Total | Trawl | Gill Net | Scallop Dredge | Other | Total |
| 1964 | 45 | 0 | | | 45 | 19 | | | | 19 | 64 | 0 | | | 64 |
| 1965 | 36 | 0 | | | 37 | 17 | | | | 17 | 53 | 0 | | | 53 |
| 1966 | 299 | 0 | | 0 | 299 | 13 | | | 0 | 13 | 311 | 0 | | 0 | 312 |
| 1967 | 532 | | 8 | | 539 | 8 | | | | 8 | 540 | | 8 | | 547 |
| 1968 | 447 | | 4 | | 451 | 2 | | | | 2 | 449 | | 4 | | 453 |
| 1969 | 253 | 1 | 4 | | 258 | 4 | | | | 4 | 257 | 1 | 4 | | 262 |
| 1970 | 198 | 0 | | 0 | 199 | 12 | | | | 12 | 210 | 0 | | 0 | 211 |
| 1971 | 213 | | 0 | | 213 | 10 | | | | 10 | 223 | | 0 | | 223 |
| 1972 | 426 | 8 | 1 | 2 | 437 | 24 | | | | 24 | 451 | 8 | 1 | 2 | 461 |
| 1973 | 661 | 29 | 12 | 8 | 710 | 132 | | 5 | 1 | 137 | 794 | 29 | 17 | 9 | 848 |
| 1974 | 1,060 | 105 | 7 | 25 | 1,197 | 98 | | | 0 | 98 | 1,160 | 105 | 7 | 25 | 1,297 |
| 1975 | 1,712 | 123 | 10 | 9 | 1,853 | 265 | 0 | 2 | 2 | 269 | 1,990 | 123 | 12 | 10 | 2,135 |
| 1976 | 2,031 | 143 | 47 | 15 | 2,236 | 333 | | 7 | 0 | 340 | 2,459 | 143 | 54 | 15 | 2,670 |
| 1977 | 2,737 | 230 | 142 | 28 | 3,137 | 508 | | 57 | 26 | 591 | 3,487 | 230 | 202 | 53 | 3,973 |
| 1978 | 3,255 | 368 | 212 | 54 | 3,889 | 605 | 0 | 507 | 26 | 1,138 | 4,016 | 368 | 774 | 80 | 5,238 |
| 1979 | 2,967 | 393 | 584 | 71 | 4,014 | 944 | 6 | 1,015 | 16 | 1,981 | 3,989 | 399 | 2,070 | 87 | 6,545 |
| 1980 | 2,526 | 518 | 596 | 56 | 3,696 | 1,139 | 10 | 1,274 | 7 | 2,429 | 3,723 | 528 | 2,276 | 62 | 6,589 |
| 1981 | 2,266 | 461 | 443 | 47 | 3,217 | 1,100 | 16 | 782 | 105 | 2,003 | 3,483 | 477 | 1,399 | 152 | 5,512 |
| 1982 | 3,040 | 421 | 367 | 32 | 3,860 | 1,806 | 12 | 1,507 | 27 | 3,352 | 4,998 | 433 | 2,061 | 60 | 7,551 |
| 1983 | 3,233 | 314 | 266 | 37 | 3,849 | 1,819 | 11 | 2,119 | 17 | 3,966 | 5,166 | 325 | 2,431 | 56 | 7,977 |
| 1984 | 3,648 | 315 | 196 | 43 | 4,202 | 1,714 | 15 | 1,704 | 18 | 3,452 | 5,513 | 330 | 1,968 | 61 | 7,871 |
| 1985 | 3,982 | 315 | 264 | 55 | 4,616 | 1,739 | 17 | 2,347 | 3 | 4,106 | 5,757 | 332 | 2,611 | 58 | 8,758 |
| 1986 | 3,412 | 326 | 553 | 36 | 4,327 | 1,841 | 32 | 2,068 | 12 | 3,954 | 5,318 | 358 | 2,621 | 48 | 8,345 |
| 1987 | 3,853 | 374 | 695 | 38 | 4,960 | 1,680 | 26 | 1,997 | 3 | 3,707 | 5,561 | 400 | 2,692 | 41 | 8,694 |
| 1988 | 3,554 | 304 | 1,172 | 36 | 5,066 | 1,828 | 58 | 2,594 | 3 | 4,483 | 5,399 | 363 | 3,765 | 39 | 9,567 |
| 1989 | 3,429 | 349 | 2,584 | 30 | 6,391 | 3,240 | 17 | 5,036 | 3 | 8,297 | 6,679 | 366 | 7,620 | 33 | 14,698 |
| 1990 | 3,298 | 338 | 2,141 | 25 | 5,802 | 2,361 | 32 | 4,744 | 5 | 7,142 | 5,697 | 372 | 6,885 | 30 | 12,984 |
| 1991 | 3,299 | 338 | 2,033 | 24 | 5,694 | 5,515 | 363 | 3,907 | 16 | 9,800 | 8,847 | 700 | 5,941 | 39 | 15,528 |
| 1992 | 4,330 | 359 | 2,211 | 24 | 6,923 | 6,528 | 977 | 6,409 | 11 | 13,925 | 10,860 | 1,336 | 8,619 | 35 | 20,850 |
| 1993 | 5,890 | 695 | 4,034 | 26 | 10,645 | 5,987 | 1,722 | 7,158 | 192 | 15,059 | 11,879 | 2,417 | 11,192 | 218 | 25,707 |
| 1994 | 7,574 | 1,571 | 1,808 | 86 | 11,039 | 5,233 | 2,342 | 3,995 | 556 | 12,126 | 12,707 | 3,884 | 5,759 | 638 | 22,988 |
| 1995 | 9,119 | 1,531 | 1,266 | 54 | 11,970 | 5,785 | 3,800 | 4,030 | 746 | 14,361 | 14,905 | 5,331 | 5,296 | 800 | 26,331 |
| 1996 | 8,445 | 1,389 | 913 | 45 | 10,791 | 7,141 | 4,211 | 4,330 | 33 | 15,715 | 15,586 | 5,599 | 5,243 | 78 | 26,507 |
| 1997 | 7,363 | 988 | 1,318 | 40 | 9,709 | 8,161 | 5,203 | 4,890 | 208 | 18,462 | 15,524 | 6,192 | 6,208 | 249 | 28,172 |
| 1998 | 5,421 | 885 | 948 | 27 | 7,281 | 7,815 | 6,198 | 5,190 | 134 | 19,337 | 13,236 | 7,083 | 6,138 | 161 | 26,618 |
| 1999 | 7,037 | 1,470 | 598 | 24 | 9,128 | 6,364 | 6,187 | 3,481 | 54 | 16,085 | 13,401 | 7,656 | 4,079 | 78 | 25,213 |
| 2000 | 8,234 | 2,102 | 316 | 76 | 10,729 | 4,018 | 4,005 | 1,975 | 150 | 10,147 | 12,252 | 6,107 | 2,291 | 226 | 20,876 |
| 2001 | 9,990 | 2,959 | 381 | 11 | 13,341 | 3,091 | 5,119 | 1,719 | 30 | 9,959 | 13,081 | 8,078 | 2,100 | 41 | 23,301 |
| 2002 | 10,839 | 2,978 | 181 | 13 | 14,011 | 1,584 | 5,410 | 1,847 | 43 | 8,884 | 12,423 | 8,389 | 2,028 | 56 | 22,896 |
| 2003 | 12,028 | 2,488 | 222 | 254 | 14,991 | 2,034 | 7,262 | 1,717 | 83 | 11,095 | 14,062 | 9,750 | 1,939 | 336 | 26,086 |
| 2004 | 9,918 | 2,866 | 14 | 411 | 13,209 | 1,228 | 4,605 | 671 | 1,474 | 7,978 | 11,145 | 7,471 | 685 | 1,885 | 21,186 |
| 2005 | 6,876 | 2,567 | 99 | 598 | 10,140 | 1,706 | 4,673 | 1,581 | 1,216 | 9,177 | 8,582 | 7,241 | 1,680 | 1,814 | 19,317 |
| 2006 | 5,054 | 1,573 | 185 | 162 | 6,974 | 1,457 | 3,970 | 1,532 | 1,022 | 7,980 | 6,511 | 5,542 | 1,717 | 1,184 | 14,955 |
| 2007 | 3,482 | 1,172 | 243 | 56 | 4,953 | 1,084 | 3,782 | 1,594 | 928 | 7,388 | 4,566 | 4,954 | 1,837 | 984 | 12,341 |
| 2008 | 3,055 | 802 | 52 | 34 | 3,942 | 1,041 | 4,098 | 1,370 | 741 | 7,250 | 4,095 | 4,900 | 1,422 | 775 | 11,192 |
| 2009 | 2,491 | 651 | 21 | 47 | 3,210 | 721 | 3,117 | 826 | 868 | 5,532 | 3,212 | 3,768 | 847 | 915 | 8,742 |
| 2010 | 1,947 | 460 | 12 | 6 | 2,424 | 590 | 2,738 | 579 | 1,089 | 4,996 | 2,537 | 3,198 | 590 | 1,094 | 7,420 |
| 2011 | 2,696 | 482 | 45 | 5 | 3,227 | 1,178 | 3,480 | 565 | 149 | 5,371 | 3,874 | 3,962 | 609 | 153 | 8,599 |
| 2012 | 3,551 | 347 | 134 | 1 | 4,033 | 1,144 | 3,688 | 739 | 153 | 5,724 | 4,695 | 4,035 | 873 | 154 | 9,757 |
| 2013 | 2,799 | 421 | 112 | 0 | 3,332 | 1,112 | 3,366 | 599 | 176 | 5,253 | 3,911 | 3,787 | 711 | 176 | 8,586 |
| 2014 | 2,950 | 418 | 33 | 0 | 3,402 | 1,028 | 3,142 | 879 | 86 | 5,135 | 3,978 | 3,560 | 912 | 87 | 8,537 |
| 2015 | 3,256 | 635 | 100 | 36 | 4,027 | 681 | 3,308 | 537 | 84 | 4,610 | 3,937 | 3,942 | 638 | 120 | 8,637 |

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Table 5. Landed weight (mt) of monkfish by market category for 1964-2014 for the northern management area.

| Year | Belly Flaps | Cheeks | Livers | Head on, Gutted | Round | Dressed | Heads | Tails Unc. | Tails Large | Tails Small | Tails Peewee | All Tails |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 14 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 11 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 90 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 0 | 0 | 0 | 163 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 136 | 0 | 0 | 0 | 136 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78 | 0 | 0 | 0 | 78 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 60 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 64 | 0 | 0 | 0 | 64 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 132 | 0 | 0 | 0 | 132 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 214 | 0 | 0 | 0 | 214 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 360 | 0 | 0 | 0 | 360 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 558 | 0 | 0 | 0 | 558 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 673 | 0 | 0 | 0 | 673 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 945 | 0 | 0 | 0 | 945 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,171 | 0 | 0 | 0 | 1,171 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,209 | 0 | 0 | 0 | 1,209 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,113 | 0 | 0 | 0 | 1,113 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 969 | 0 | 0 | 0 | 969 |
| 1982 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 1,146 | 15 | 2 | 0 | 1,163 |
| 1983 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 1,152 | 5 | 2 | 0 | 1,159 |
| 1984 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 1,262 | 4 | 0 | 0 | 1,266 |
| 1985 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 1,386 | 2 | 3 | 0 | 1,390 |
| 1986 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 1,303 | 0 | 0 | 0 | 1,303 |
| 1987 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 1,492 | 2 | 1 | 0 | 1,494 |
| 1988 | 0 | 0 | 47 | 0 | 0 | 0 | 0 | 1,517 | 6 | 3 | 0 | 1,526 |
| 1989 | 0 | 0 | 59 | 0 | 11 | 0 | 0 | 1,465 | 327 | 130 | 0 | 1,922 |
| 1990 | 0 | 0 | 78 | 0 | 30 | 0 | 0 | 1,174 | 411 | 154 | 0 | 1,738 |
| 1991 | 0 | 3 | 70 | 0 | 0 | 0 | 0 | 1,014 | 539 | 153 | 9 | 1,715 |
| 1992 | 0 | 1 | 83 | 0 | 0 | 0 | 0 | 911 | 590 | 505 | 79 | 2,085 |
| 1993 | 0 | 1 | 208 | 98 | 351 | 0 | 0 | 1,034 | 868 | 1,062 | 103 | 3,067 |
| 1994 | 0 | 1 | 208 | 533 | 981 | 0 | 0 | 403 | 1,206 | 1,075 | 136 | 2,820 |
| 1995 | 0 | 1 | 46 | 1,224 | 1,113 | 0 | 0 | 362 | 1,180 | 1,003 | 304 | 2,850 |
| 1996 | 0 | 0 | 65 | 1,116 | 745 | 0 | 0 | 90 | 930 | 1,399 | 224 | 2,643 |
| 1997 | 0 | 0 | 51 | 634 | 244 | 0 | 0 | 26 | 1,126 | 1,361 | 119 | 2,633 |
| 1998 | 0 | 0 | 24 | 551 | 144 | 0 | 0 | 16 | 1,055 | 810 | 79 | 1,960 |
| 1999 | 0 | 0 | 40 | 1,701 | 511 | 0 | 0 | 28 | 996 | 848 | 139 | 2,012 |
| 2000 | 0 | 0 | 94 | 3,213 | 912 | 0 | 0 | 17 | 783 | 1,050 | 3 | 1,853 |
| 2001 | 0 | 0 | 93 | 3,084 | 231 | 0 | 0 | 128 | 1,115 | 1,647 | 0 | 2,890 |
| 2002 | 0 | 0 | 75 | 3,789 | 24 | 0 | 0 | 80 | 1,055 | 1,777 | 0 | 2,912 |
| 2003 | 0 | 0 | 61 | 2,364 | 14 | 0 | 0 | 95 | 1,573 | 2,032 | 0 | 3,699 |
| 2004 | 0 | 0 | 56 | 647 | 960 | 0 | 0 | 3 | 1,883 | 1,580 | 1 | 3,467 |
| 2005 | 0 | 0 | 42 | 1,706 | 22 | 0 | 0 | 3 | 1,440 | 1,017 | 2 | 2,462 |
| 2006 | 0 | 0 | 22 | 1,622 | 20 | 0 | 0 | 9 | 899 | 627 | 3 | 1,538 |
| 2007 | 0 | 0 | 13 | 682 | 0 | 0 | 1 | 9 | 870 | 378 | 1 | 1,258 |
| 2008 | 0 | 0 | 5 | 391 | 0 | 4 | 0 | 1 | 739 | 311 | 0 | 1,051 |
| 2009 | 0 | 0 | 2 | 290 | 0 | 11 | 0 | 2 | 560 | 299 | 0 | 861 |
| 2010 | 0 | 0 | 1 | 208 | 0 | 0 | 0 | 2 | 396 | 261 | 0 | 658 |
| 2011 | 0 | 17 | 72 | 187 | 44 | 0 | 8 | 1 | 527 | 367 | 1 | 896 |
| 2012 | 0 | 24 | 89 | 142 | 0 | 0 | 3 | 1 | 609 | 556 | 2 | 1,168 |
| 2013 | 0 | 0 | 76 | 137 | 0 | 0 | 4 | 1 | 549 | 407 | 3 | 960 |
| 2014 | 0 | 0 | 71 | 117 | 0 | 0 | 25 | 2 | 560 | 423 | 4 | 988 |
| 2015 | 0 | 0 | 73 | 179 | 0 | 0 | 31 | 2 | 594 | 556 | 0 | 1,151 |

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Table 6. Landed weight (mt) of monkfish by market category for 1964-2014 for the southern management area.

| Year | Belly Flaps | Cheeks | Livers | Head on, Gutted | Round | Dressed | Heads | Tails Unc. | Tails Large | Tails Small | Tails Peewee | All Tails |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 6 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 7 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 0 | 0 | 42 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 30 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 | 0 | 0 | 0 | 85 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 129 | 0 | 0 | 0 | 129 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 250 | 0 | 0 | 0 | 250 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 403 | 0 | 0 | 0 | 403 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,016 | 0 | 0 | 0 | 1,016 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,189 | 0 | 0 | 0 | 1,189 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 685 | 0 | 0 | 0 | 685 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 912 | 138 | 51 | 0 | 1,102 |
| 1983 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 858 | 237 | 136 | 0 | 1,231 |
| 1984 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 860 | 183 | 45 | 0 | 1,087 |
| 1985 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 1,081 | 85 | 71 | 0 | 1,237 |
| 1986 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 1,063 | 76 | 52 | 0 | 1,191 |
| 1987 | 0 | 0 | 330 | 0 | 0 | 0 | 0 | 972 | 138 | 6 | 0 | 1,116 |
| 1988 | 0 | 0 | 65 | 0 | 0 | 0 | 0 | 1,129 | 190 | 32 | 0 | 1,350 |
| 1989 | 0 | 0 | 88 | 0 | 5 | 0 | 0 | 2,037 | 230 | 230 | 0 | 2,498 |
| 1990 | 0 | 0 | 102 | 0 | 187 | 0 | 0 | 1,428 | 443 | 223 | 0 | 2,095 |
| 1991 | 0 | 5 | 200 | 0 | 415 | 0 | 0 | 1,215 | 1,123 | 461 | 28 | 2,827 |
| 1992 | 0 | 3 | 239 | 0 | 386 | 0 | 0 | 1,868 | 1,318 | 788 | 104 | 4,078 |
| 1993 | 0 | 1 | 252 | 0 | 178 | 0 | 0 | 2,469 | 1,065 | 789 | 159 | 4,483 |
| 1994 | 0 | 4 | 251 | 921 | 1,064 | 0 | 0 | 854 | 1,025 | 989 | 122 | 2,989 |
| 1995 | 2 | 0 | 451 | 1,529 | 1,539 | 0 | 0 | 518 | 1,341 | 1,419 | 59 | 3,337 |
| 1996 | 0 | 0 | 504 | 2,352 | 318 | 0 | 0 | 996 | 1,160 | 1,629 | 46 | 3,830 |
| 1997 | 0 | 0 | 577 | 2,559 | 551 | 0 | 0 | 647 | 1,924 | 1,913 | 32 | 4,516 |
| 1998 | 0 | 0 | 582 | 3,036 | 438 | 0 | 0 | 842 | 1,952 | 1,840 | 16 | 4,650 |
| 1999 | 0 | 0 | 558 | 4,047 | 621 | 0 | 0 | 509 | 1,393 | 1,352 | 14 | 3,268 |
| 2000 | 0 | 4 | 530 | 3,701 | 179 | 0 | 0 | 276 | 797 | 657 | 2 | 1,732 |
| 2001 | 0 | 0 | 466 | 3,944 | 300 | 0 | 0 | 217 | 844 | 494 | 0 | 1,555 |
| 2002 | 0 | 0 | 433 | 4,013 | 551 | 0 | 0 | 167 | 629 | 336 | 0 | 1,132 |
| 2003 | 0 | 1 | 426 | 4,959 | 667 | 0 | 0 | 242 | 790 | 405 | 1 | 1,438 |
| 2004 | 0 | 2 | 355 | 2,758 | 1,066 | 8 | 0 | 186 | 671 | 274 | 0 | 1,130 |
| 2005 | 0 | 55 | 330 | 3,695 | 187 | 18 | 0 | 105 | 771 | 550 | 2 | 1,428 |
| 2006 | 0 | 108 | 293 | 3,351 | 27 | 20 | 5 | 69 | 658 | 506 | 1 | 1,233 |
| 2007 | 0 | 44 | 258 | 3,030 | 107 | 12 | 0 | 88 | 727 | 329 | 1 | 1,145 |
| 2008 | 0 | 5 | 253 | 3,008 | 44 | 13 | 1 | 61 | 768 | 300 | 0 | 1,130 |
| 2009 | 1 | 0 | 199 | 2,540 | 4 | 9 | 11 | 47 | 505 | 235 | 0 | 788 |
| 2010 | 0 | 0 | 188 | 2,117 | 9 | 4 | 27 | 61 | 476 | 235 | 0 | 772 |
| 2011 | 0 | 0 | 154 | 2,195 | 491 | 6 | 31 | 47 | 422 | 243 | 0 | 713 |
| 2012 | 0 | 0 | 110 | 2,921 | 0 | 4 | 40 | 44 | 405 | 269 | 1 | 720 |
| 2013 | 1 | 0 | 130 | 2,247 | 5 | 4 | 106 | 58 | 462 | 286 | 2 | 809 |
| 2014 | 0 | 0 | 111 | 2,049 | 2 | 14 | 116 | 45 | 540 | 250 | 3 | 837 |
| 2015 | 0 | 0 | 99 | 2,339 | 2 | 18 | 96 | 43 | 358 | 174 | 0 | 574 |

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Table 7. Estimated monkfish discards (live weight) in the northern management region. Dredge and shrimp trawl discards are based on SBRM monkfish discards relative to kept of all species; trawl and gillnet are based on monkfish discards relative to monkfish kept.

| North | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Trawl | | | | | Gillnet | | | | | Scallop Dredge | | | | | Shrimp Trawl | | | | |
| Year | Half | No. trips | D/K ratio | CV | Dlr monk (mt) | Discard (mt) | No. trips | D/K ratio | CV | Dlr monk (mt) | Discard (mt) | No. trips | D/K ratio | CV | Dlr all spp (mt) | Discard (mt) | No. trips | D/K ratio | CV | Dlr all spp (mt) | Discard (mt) |
| 1989 | 1 | 30 | 0.037 | 0.58 | 1,550 | 58 | 1 | 0.036 | | 84 | 3 | | 0.001 | | 18,213 | 17 | 31 | 0.002 | 0.33 | 3,412 | 5.5 |
| | 2 | 63 | 0.141 | 0.44 | 1,830 | 257 | 103 | 0.027 | 0.32 | 265 | 7 | | 0.008 | | 24,053 | 185 | 9 | 0.001 | 0.62 | 931 | 1.2 |
| 1990 | 1 | 16 | 0.082 | 0.60 | 1,562 | 128 | 73 | 0.036 | 0.41 | 121 | 4 | | 0.001 | | 9,864 | 9 | 27 | 0.002 | 0.34 | 4,494 | 8.1 |
| | 2 | 36 | 0.039 | 0.45 | 1,690 | 66 | 65 | 0.029 | 0.37 | 219 | 6 | | 0.008 | | 19,293 | 149 | 4 | 0.058 | 1.01 | 620 | 35.8 |
| 1991 | 1 | 27 | 0.042 | 0.45 | 1,233 | 52 | 191 | 0.030 | 0.47 | 120 | 4 | | 0.001 | | 16,608 | 16 | 46 | 0.004 | 0.19 | 3,536 | 12.8 |
| | 2 | 81 | 0.167 | 0.25 | 1,999 | 334 | 758 | 0.036 | 0.10 | 213 | 8 | 1 | 0.002 | | 21,312 | 40 | 7 | 0.046 | 0.40 | 340 | 15.7 |
| 1992 | 1 | 51 | 0.122 | 0.30 | 1,674 | 203 | 403 | 0.065 | 0.16 | 105 | 7 | 3 | 0.000 | 0.98 | 14,179 | 1 | 76 | 0.003 | 0.23 | 3,285 | 9.6 |
| | 2 | 35 | 0.224 | 0.43 | 2,624 | 587 | 618 | 0.040 | 0.24 | 248 | 10 | 6 | 0.001 | 0.41 | 20,033 | 26 | 6 | 0.003 | 0.28 | 161 | 0.4 |
| 1993 | 1 | 19 | 0.067 | 0.30 | 2,821 | 189 | 271 | 0.086 | 0.21 | 119 | 10 | 7 | 0.002 | 0.26 | 13,702 | 25 | 78 | 0.001 | 0.26 | 1,890 | 2.5 |
| | 2 | 19 | 0.084 | 0.26 | 3,032 | 254 | 338 | 0.032 | 0.24 | 560 | 18 | 4 | 0.018 | 0.45 | 12,674 | 230 | 4 | 0.001 | 0.70 | 316 | 0.3 |
| 1994 | 1 | 18 | 0.035 | 0.29 | 3,273 | 115 | 65 | 0.065 | 0.29 | 270 | 18 | 2 | 0.001 | 1.21 | 5,486 | 5 | 71 | 0.002 | 0.38 | 2,443 | 5.9 |
| | 2 | 6 | 0.024 | 0.59 | 4,385 | 107 | 44 | 0.055 | 0.19 | 779 | 43 | 5 | 0.010 | 0.38 | 6,230 | 59 | 6 | 0.001 | 0.44 | 906 | 0.7 |
| 1995 | 1 | 30 | 0.164 | 0.36 | 4,643 | 762 | 38 | 0.141 | 0.30 | 469 | 66 | 1 | 0.014 | | 2,318 | 32 | 64 | 0.000 | 0.23 | 4,452 | 1.8 |
| | 2 | 48 | 0.090 | 0.31 | 4,478 | 403 | 69 | 0.088 | 0.23 | 1,023 | 90 | 5 | 0.018 | 0.50 | 6,544 | 119 | 9 | 0.001 | 0.43 | 1,377 | 0.7 |
| 1996 | 1 | 21 | 0.190 | 0.23 | 4,294 | 814 | 28 | 0.137 | 0.43 | 340 | 47 | 8 | 0.003 | 0.94 | 5,338 | 14 | 30 | 0.000 | 0.34 | 7,580 | 0.8 |
| | 2 | 49 | 0.132 | 0.57 | 4,057 | 534 | 34 | 0.132 | 0.19 | 934 | 123 | 5 | 0.022 | 0.40 | 11,375 | 246 | 5 | 0.000 | 0.79 | 1,418 | 0.4 |
| 1997 | 1 | 13 | 0.100 | 0.49 | 3,795 | 378 | 19 | 0.036 | 0.32 | 329 | 12 | 4 | 0.004 | 0.48 | 10,567 | 42 | 17 | 0.000 | 0.61 | 5,416 | 0.9 |
| | 2 | 7 | 0.076 | 0.23 | 3,225 | 244 | 26 | 0.194 | 0.84 | 742 | 144 | 4 | 0.020 | 0.76 | 9,148 | 180 | | 0.001 | | 649 | 0.4 |
| 1998 | 1 | 7 | 0.124 | 0.37 | 3,150 | 392 | 39 | 0.028 | 0.41 | 238 | 7 | 2 | 0.004 | 0.32 | 7,482 | 28 | | 0.001 | | 3,095 | 2.7 |
| | 2 | 3 | 0.093 | 0.10 | 2,398 | 223 | 72 | 0.043 | 0.28 | 606 | 26 | 7 | 0.014 | 0.16 | 6,400 | 90 | | 0.001 | | 168 | 0.1 |
| 1999 | 1 | 3 | 0.098 | 0.04 | 3,947 | 388 | 36 | 0.067 | 0.65 | 282 | 19 | 2 | 0.004 | 0.65 | 8,347 | 29 | | 0.001 | | 1,407 | 1.2 |
| | 2 | 42 | 0.069 | 0.21 | 3,011 | 207 | 66 | 0.036 | 0.51 | 1,051 | 38 | 6 | 0.004 | 0.44 | 6,797 | 30 | | 0.001 | | 33 | 0.0 |
| 2000 | 1 | 80 | 0.069 | 0.32 | 3,916 | 271 | 58 | 0.041 | 0.30 | 501 | 21 | | 0.004 | | 6,993 | 31 | | 0.001 | | 2,068 | 1.8 |
| | 2 | 61 | 0.088 | 0.31 | 3,798 | 333 | 65 | 0.077 | 0.24 | 2,033 | 157 | 95 | 0.004 | 0.13 | 13,019 | 56 | | 0.001 | | 35 | 0.0 |
| 2001 | 1 | 61 | 0.102 | 0.20 | 5,088 | 518 | 41 | 0.061 | 0.69 | 880 | 53 | 17 | 0.003 | 0.42 | 14,926 | 41 | 3 | 0.000 | 0.14 | 813 | 0.1 |
| | 2 | 113 | 0.066 | 0.10 | 4,588 | 303 | 33 | 0.108 | 0.93 | 2,208 | 238 | | 0.005 | | 11,525 | 60 | | 0.001 | | | 0.0 |
| 2002 | 1 | 47 | 0.076 | 0.25 | 5,634 | 428 | 33 | 0.045 | 0.39 | 760 | 34 | | 0.005 | | 8,712 | 45 | | 0.001 | | 308 | 0.3 |
| | 2 | 274 | 0.100 | 0.10 | 4,532 | 455 | 67 | 0.053 | 0.27 | 2,230 | 118 | 10 | 0.008 | 0.97 | 11,533 | 88 | | 0.001 | | | 0.0 |
| 2003 | 1 | 206 | 0.101 | 0.14 | 6,642 | 671 | 112 | 0.037 | 0.24 | 628 | 23 | 5 | 0.001 | 0.89 | 16,053 | 9 | 15 | 0.000 | 1.01 | 855 | 0.0 |
| | 2 | 218 | 0.055 | 0.12 | 4,721 | 261 | 273 | 0.058 | 0.13 | 1,570 | 91 | 8 | 0.015 | 0.41 | 10,361 | 157 | | 0.001 | | | 0.0 |
| 2004 | 1 | 163 | 0.042 | 0.12 | 5,307 | 225 | 212 | 0.021 | 0.22 | 739 | 16 | 3 | 0.000 | 0.69 | 5,633 | 0 | 12 | 0.000 | 0.25 | 1,069 | 0.1 |
| | 2 | 377 | 0.036 | 0.10 | 4,039 | 147 | 728 | 0.059 | 0.09 | 1,788 | 105 | 19 | 0.096 | 0.48 | 3,705 | 355 | | 0.001 | | 44 | 0.0 |
| 2005 | 1 | 500 | 0.047 | 0.07 | 3,971 | 187 | 153 | 0.098 | 0.26 | 516 | 51 | 20 | 0.001 | 0.57 | 5,745 | 6 | 17 | 0.000 | 0.52 | 836 | 0.1 |
| | 2 | 601 | 0.057 | 0.10 | 3,038 | 174 | 660 | 0.074 | 0.12 | 1,450 | 108 | 39 | 0.008 | 0.21 | 23,131 | 184 | | 0.001 | | 40 | 0.0 |
| 2006 | 1 | 292 | 0.055 | 0.08 | 2,852 | 158 | 93 | 0.063 | 0.41 | 262 | 17 | 5 | 0.001 | 0.42 | 20,833 | 14 | 17 | 0.000 | 0.56 | 847 | 0.0 |
| | 2 | 201 | 0.071 | 0.11 | 2,285 | 162 | 80 | 0.080 | 0.17 | 1,025 | 82 | 39 | 0.021 | 0.32 | 14,291 | 305 | 3 | 0.000 | 0.10 | 449 | 0.2 |
| 2007 | 1 | 221 | 0.050 | 0.10 | 2,075 | 104 | 42 | 0.061 | 0.32 | 228 | 14 | 28 | 0.002 | 0.22 | 11,600 | 26 | 14 | 0.001 | 0.72 | 1,899 | 1.0 |
| | 2 | 303 | 0.072 | 0.10 | 1,448 | 104 | 190 | 0.062 | 0.16 | 693 | 43 | 68 | 0.021 | 0.18 | 23,644 | 487 | | 0.001 | | 333 | 0.2 |
| 2008 | 1 | 277 | 0.088 | 0.10 | 1,821 | 160 | 61 | 0.076 | 0.28 | 141 | 11 | 25 | 0.001 | 0.22 | 7,065 | 11 | 16 | 0.000 | 0.77 | 1,834 | 0.9 |
| | 2 | 383 | 0.082 | 0.10 | 1,045 | 86 | 156 | 0.051 | 0.22 | 541 | 28 | 22 | 0.011 | 0.34 | 3,696 | 42 | 3 | 0.001 | 0.90 | 167 | 0.1 |
| 2009 | 1 | 351 | 0.166 | 0.13 | 1,666 | 276 | 129 | 0.209 | 0.46 | 149 | 31 | 7 | 0.001 | 0.47 | 1,960 | 3 | 7 | 0.001 | 0.61 | 998 | 0.8 |
| | 2 | 408 | 0.079 | 0.11 | 832 | 66 | 195 | 0.119 | 0.27 | 467 | 55 | 22 | 0.003 | 0.26 | 11,642 | 34 | 5 | 0.000 | 0.92 | 347 | 0.0 |
| 2010 | 1 | 339 | 0.097 | 0.08 | 1,537 | 149 | 305 | 0.056 | 0.15 | 112 | 6 | 16 | 0.001 | 0.80 | 3,350 | 4 | 11 | 0.000 | 1.00 | 2,911 | 0.1 |
| | 2 | 671 | 0.090 | 0.07 | 857 | 77 | 1364 | 0.102 | 0.07 | 303 | 31 | 25 | 0.003 | 0.31 | 15,930 | 50 | 4 | 0.000 | 0.91 | 780 | 0.0 |
| 2011 | 1 | 671 | 0.120 | 0.07 | 1,461 | 175 | 554 | 0.050 | 0.10 | 120 | 6 | 23 | 0.002 | 0.80 | 6,660 | 16 | 1 | 0.000 | | 3,745 | 0.0 |
| | 2 | 743 | 0.058 | 0.08 | 1,174 | 69 | 1244 | 0.080 | 0.10 | 361 | 29 | 81 | 0.004 | 0.13 | 35,600 | 158 | | 0.001 | | 78 | 0.0 |
| 2012 | 1 | 739 | 0.057 | 0.06 | 1901 | 108 | 548 | 0.047 | 0.17 | 93 | 4 | 54 | 0.003 | 0.31 | 21,717 | 67 | 19 | 0.000 | 0.49 | 1,761 | 0.2 |
| | 2 | 664 | 0.078 | 0.05 | 1446 | 112 | 900 | 0.060 | 0.07 | 184 | 11 | 90 | 0.010 | 0.24 | 28,609 | 300 | | | | 132 | 0.0 |
| 2013 | 1 | 471 | 0.125 | 0.07 | 1669 | 208 | 172 | 0.044 | 0.14 | 98 | 4 | 131 | 0.003 | 0.22 | 43,664 | 118 | 24 | 0.001 | 0.79 | 195 | 0.1 |
| | 2 | 440 | 0.097 | 0.10 | 1073 | 104 | 567 | 0.083 | 0.11 | 323 | 27 | 67 | 0.010 | 0.35 | 12,980 | 128 | | | | 81 | 0.0 |
| 2014 | 1 | 405 | 0.143 | 0.07 | 1908 | 272 | 278 | 0.090 | 0.30 | 82 | 7 | 66 | 0.000 | 0.33 | 10,688 | 4 | | | | 1 | 0.0 |
| | 2 | 528 | 0.100 | 0.09 | 927 | 93 | 830 | 0.062 | 0.11 | 336 | 21 | 61 | 0.029 | 0.21 | 5,406 | 155 | | | | 21 | 0.0 |
| 2015 | 1 | 298 | 0.155 | 0.10 | 1891 | 294 | 87 | 0.056 | 0.21 | 120 | 7 | 77 | 0.002 | 0.49 | 12,517 | 28 | | | | | 0.0 |
| | 2 | 381 | 0.117 | 0.11 | 1223 | 143 | 475 | 0.063 | 0.12 | 514 | 32 | 50 | 0.020 | 0.16 | 4,916 | 97 | | | | | 0.0 |

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Table 8. Estimated monkfish discards (live weight) in the southern management region. Dredge discards are based on SBRM monkfish discards relative to kept of all species; trawl and gillnet are based on monkfish discards relative to monkfish kept.

| South | | Trawl | | | | | Gillnet | | | | | Scallop Dredge | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Half | No. trips | D/K ratio | CV | Dlr monk (mt) | Discard (mt) | No. trips | D/K ratio | CV | Dlr monk (mt) | Discard (mt) | No. trips | D/K ratio | CV | Dlr all spp (mt) | Discard (mt) |
| 1989 | 1 | 46 | 0.709 | 0.50 | 2,195 | 1,556 | | 0.031 | | 12 | 0 | | 0.010 | 0.010 | 59,696 | 577 |
| | 2 | 53 | 0.169 | 0.59 | 733 | 124 | 3 | 0.054 | | 5 | 0 | | 0.015 | 0.015 | 35,498 | 528 |
| 1990 | 1 | 50 | 0.064 | 0.26 | 1,567 | 100 | 1 | 0.031 | | 14 | 0 | | 0.010 | | 64,314 | 622 |
| | 2 | 35 | 0.118 | 0.32 | 759 | 90 | 13 | 0.054 | | 18 | 0 | | 0.015 | | 53,040 | 789 |
| 1991 | 1 | 73 | 0.258 | 0.30 | 1,257 | 324 | 3 | 0.031 | | 209 | 2 | | 0.010 | | 67,829 | 656 |
| | 2 | 77 | 0.020 | 0.39 | 3,831 | 78 | 8 | 0.000 | | 154 | 0 | 2 | 0.001 | 0.07 | 36,015 | 19 |
| 1992 | 1 | 62 | 0.061 | 0.38 | 3,947 | 239 | 94 | 0.011 | 0.31 | 786 | 8 | 7 | 0.001 | 0.69 | 48,686 | 29 |
| | 2 | 41 | 0.028 | 0.83 | 2,135 | 60 | 72 | 0.020 | 0.20 | 176 | 3 | 7 | 0.012 | 0.50 | 39,126 | 460 |
| 1993 | 1 | 40 | 0.092 | 0.68 | 2,598 | 238 | 78 | 0.034 | 0.70 | 1,306 | 44 | 12 | 0.008 | 0.30 | 23,971 | 197 |
| | 2 | 34 | 0.028 | 0.49 | 1,301 | 36 | 87 | 0.061 | 0.20 | 341 | 21 | 4 | 0.032 | 0.53 | 18,379 | 587 |
| 1994 | 1 | 43 | 0.095 | 0.29 | 2,925 | 277 | 124 | 0.079 | 0.33 | 1,565 | 124 | 10 | 0.020 | 0.26 | 26,657 | 538 |
| | 2 | 30 | 0.323 | 0.56 | 2,027 | 655 | 173 | 0.056 | 0.18 | 967 | 55 | 10 | 0.015 | 0.29 | 24,222 | 370 |
| 1995 | 1 | 61 | 0.175 | 0.55 | 2,789 | 488 | 260 | 0.044 | 0.20 | 2,758 | 121 | 14 | 0.030 | 0.17 | 34,108 | 1,011 |
| | 2 | 103 | 0.115 | 0.57 | 2,946 | 340 | 170 | 0.050 | 0.34 | 1,172 | 59 | 9 | 0.050 | 0.45 | 18,456 | 917 |
| 1996 | 1 | 56 | 0.164 | 0.36 | 3,187 | 523 | 226 | 0.077 | 0.27 | 2,615 | 202 | 19 | 0.020 | 0.23 | 27,505 | 547 |
| | 2 | 85 | 0.095 | 0.18 | 4,021 | 380 | 134 | 0.052 | 0.28 | 1,434 | 75 | 15 | 0.029 | 0.26 | 19,621 | 562 |
| 1997 | 1 | 60 | 0.025 | 0.47 | 4,130 | 102 | 238 | 0.067 | 0.34 | 3,089 | 206 | 16 | 0.028 | 0.18 | 19,067 | 543 |
| | 2 | 29 | 0.089 | 0.15 | 4,215 | 374 | 106 | 0.015 | 0.34 | 1,313 | 20 | 8 | 0.041 | 0.39 | 14,997 | 612 |
| 1998 | 1 | 31 | 0.108 | 0.33 | 3,991 | 431 | 228 | 0.070 | 0.20 | 3,606 | 252 | 8 | 0.008 | 0.24 | 17,094 | 136 |
| | 2 | 28 | 0.027 | 0.52 | 3,946 | 108 | 64 | 0.062 | 0.44 | 2,053 | 128 | 15 | 0.012 | 0.57 | 15,300 | 177 |
| 1999 | 1 | 39 | 0.045 | 0.30 | 4,370 | 195 | 52 | 0.052 | 0.34 | 4,207 | 220 | 13 | 0.010 | 0.26 | 30,059 | 291 |
| | 2 | 34 | 0.214 | 0.57 | 2,306 | 494 | 35 | 0.046 | 0.57 | 1,917 | 88 | 56 | 0.004 | 0.16 | 34,102 | 150 |
| 2000 | 1 | 67 | 0.786 | 0.32 | 2,255 | 1,773 | 60 | 0.063 | 0.30 | 2,683 | 170 | 38 | 0.014 | 0.16 | 47,847 | 666 |
| | 2 | 47 | 0.107 | 0.62 | 1,709 | 182 | 44 | 0.051 | 0.81 | 1,157 | 59 | 133 | 0.009 | 0.16 | 43,879 | 382 |
| 2001 | 1 | 61 | 0.946 | 0.47 | 1,703 | 1,611 | 57 | 0.030 | 0.42 | 2,248 | 67 | 42 | 0.015 | 0.11 | 64,029 | 972 |
| | 2 | 96 | 0.404 | 0.73 | 1,348 | 545 | 35 | 0.033 | 0.38 | 2,788 | 92 | 48 | 0.014 | 0.15 | 70,044 | 973 |
| 2002 | 1 | 50 | 0.338 | 0.38 | 1,123 | 379 | 34 | 0.017 | 0.80 | 3,590 | 61 | 34 | 0.019 | 0.09 | 83,888 | 1,571 |
| | 2 | 94 | 0.327 | 0.39 | 566 | 185 | 40 | 0.063 | 0.44 | 1,967 | 124 | 61 | 0.018 | 0.10 | 81,620 | 1,475 |
| 2003 | 1 | 120 | 0.331 | 0.36 | 1,172 | 388 | 50 | 0.016 | 0.35 | 4,452 | 69 | 46 | 0.014 | 0.15 | 82,660 | 1,192 |
| | 2 | 99 | 0.406 | 0.45 | 1,177 | 478 | 56 | 0.070 | 0.31 | 2,849 | 199 | 71 | 0.017 | 0.12 | 91,638 | 1,542 |
| 2004 | 1 | 237 | 0.240 | 0.44 | 1,012 | 243 | 78 | 0.073 | 0.22 | 3,441 | 252 | 82 | 0.014 | 0.08 | 107,728 | 1,543 |
| | 2 | 436 | 0.300 | 0.31 | 733 | 220 | 74 | 0.089 | 0.22 | 1,043 | 93 | 193 | 0.015 | 0.10 | 95,117 | 1,432 |
| 2005 | 1 | 534 | 0.175 | 0.14 | 945 | 165 | 100 | 0.104 | 0.22 | 3,217 | 334 | 108 | 0.014 | 0.18 | 99,628 | 1,419 |
| | 2 | 654 | 0.064 | 0.11 | 1,588 | 102 | 82 | 0.081 | 0.20 | 1,372 | 111 | 174 | 0.019 | 0.19 | 67,548 | 1,290 |
| 2006 | 1 | 327 | 0.180 | 0.19 | 1,008 | 181 | 43 | 0.054 | 0.19 | 2,865 | 155 | 43 | 0.009 | 0.31 | 87,842 | 767 |
| | 2 | 277 | 0.055 | 0.15 | 1,010 | 56 | 35 | 0.082 | 0.32 | 967 | 79 | 166 | 0.022 | 0.14 | 99,456 | 2,210 |
| 2007 | 1 | 335 | 0.125 | 0.25 | 741 | 93 | 59 | 0.220 | 0.37 | 2,139 | 471 | 138 | 0.010 | 0.14 | 103,992 | 1,083 |
| | 2 | 420 | 0.159 | 0.40 | 657 | 104 | 45 | 0.054 | 0.33 | 1,569 | 84 | 156 | 0.013 | 0.15 | 68,914 | 920 |
| 2008 | 1 | 343 | 0.098 | 0.19 | 744 | 73 | 54 | 0.108 | 0.25 | 2,882 | 311 | 374 | 0.006 | 0.11 | 106,134 | 686 |
| | 2 | 316 | 0.017 | 0.31 | 594 | 10 | 39 | 0.104 | 0.29 | 993 | 104 | 245 | 0.010 | 0.13 | 74,506 | 717 |
| 2009 | 1 | 414 | 0.080 | 0.30 | 646 | 52 | 62 | 0.052 | 0.19 | 2,438 | 128 | 370 | 0.006 | 0.08 | 122,576 | 725 |
| | 2 | 529 | 0.088 | 0.31 | 280 | 25 | 32 | 0.074 | 0.24 | 610 | 45 | 103 | 0.009 | 0.15 | 73,175 | 652 |
| 2010 | 1 | 569 | 0.248 | 0.24 | 474 | 118 | 114 | 0.060 | 0.21 | 2,034 | 122 | 132 | 0.010 | 0.11 | 108,617 | 1,098 |
| | 2 | 545 | 0.190 | 0.51 | 369 | 70 | 95 | 0.077 | 0.18 | 695 | 54 | 174 | 0.008 | 0.12 | 81,139 | 648 |
| 2011 | 1 | 573 | 0.123 | 0.13 | 634 | 78 | 178 | 0.078 | 0.12 | 2,357 | 185 | 156 | 0.010 | 0.13 | 107,870 | 1,132 |
| | 2 | 601 | 0.088 | 0.11 | 598 | 53 | 84 | 0.122 | 0.19 | 1,066 | 130 | 150 | 0.010 | 0.12 | 62,873 | 623 |
| 2012 | 1 | 476 | 0.147 | 0.13 | 812 | 119 | 203 | 0.051 | 0.13 | 3,015 | 153 | 205 | 0.016 | 0.08 | 98,241 | 1,545 |
| | 2 | 337 | 0.180 | 0.18 | 366 | 66 | 32 | 0.058 | 0.18 | 576 | 33 | 130 | 0.017 | 0.15 | 46,675 | 797 |
| 2013 | 1 | 594 | 0.117 | 0.24 | 720 | 84 | 60 | 0.058 | 0.15 | 2,142 | 124 | 154 | 0.017 | 0.17 | 49,832 | 864 |
| | 2 | 500 | 0.053 | 0.28 | 447 | 24 | 34 | 0.101 | 0.37 | 1,168 | 118 | 177 | 0.016 | 0.13 | 45,168 | 709 |
| 2014 | 1 | 633 | 0.171 | 0.22 | 616 | 105 | 126 | 0.056 | 0.16 | 2,249 | 127 | 174 | 0.014 | 0.09 | 62,720 | 892 |
| | 2 | 700 | 0.107 | 0.15 | 518 | 56 | 131 | 0.030 | 0.28 | 861 | 26 | 188 | 0.012 | 0.14 | 44,960 | 518 |
| 2015 | 1 | 563 | 0.179 | 0.15 | 487 | 87 | 225 | 0.022 | 0.16 | 2,403 | 52 | 227 | 0.008 | 0.12 | 56,569 | 464 |
| | 2 | 527 | 0.521 | 0.12 | 326 | 170 | 273 | 0.027 | 0.20 | 823 | 22 | 202 | 0.008 | 0.14 | 58,571 | 443 |

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Table 9. Estimated annual catch (landings plus discards) of monkfish by management region and combined.

| | North | | | South | | | Areas Combined | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Landings | Discard | Total (mt) | Landings | Discard | Total (mt) | Landings | Discard | Total (mt) | Foreign | Total (mt) |
| 1980 | 3,623 | 635 | 4,258 | 6,035 | 563 | 6,598 | 9,658 | 1,197 | 10,855 | 132 | 10,987 |
| 1981 | 3,171 | 754 | 3,925 | 4,142 | 451 | 4,593 | 7,313 | 1,204 | 8,517 | 381 | 8,898 |
| 1982 | 3,860 | 699 | 4,559 | 3,722 | 586 | 4,308 | 7,582 | 1,285 | 8,867 | 310 | 9,177 |
| 1983 | 3,849 | 664 | 4,513 | 4,115 | 659 | 4,774 | 7,964 | 1,323 | 9,287 | 80 | 9,367 |
| 1984 | 4,202 | 616 | 4,818 | 3,699 | 684 | 4,383 | 7,901 | 1,301 | 9,202 | 395 | 9,597 |
| 1985 | 4,616 | 640 | 5,256 | 4,262 | 636 | 4,898 | 8,878 | 1,276 | 10,154 | 1,333 | 11,487 |
| 1986 | 4,327 | 548 | 4,875 | 4,037 | 618 | 4,655 | 8,364 | 1,166 | 9,530 | 341 | 9,871 |
| 1987 | 4,960 | 766 | 5,726 | 3,762 | 1,039 | 4,801 | 8,722 | 1,805 | 10,527 | 748 | 11,275 |
| 1988 | 5,066 | 784 | 5,850 | 4,595 | 1,030 | 5,625 | 9,661 | 1,814 | 11,475 | 909 | 12,384 |
| 1989 | 6,391 | 534 | 6,925 | 8,353 | 2,786 | 11,139 | 14,744 | 3,320 | 18,064 | 1,178 | 19,242 |
| 1990 | 5,802 | 406 | 6,208 | 7,204 | 1,602 | 8,806 | 13,006 | 2,008 | 15,014 | 1,557 | 16,571 |
| 1991 | 5,693 | 481 | 6,174 | 9,865 | 1,080 | 10,945 | 15,558 | 1,561 | 17,119 | 1,020 | 18,139 |
| 1992 | 6,923 | 844 | 7,767 | 13,942 | 801 | 14,743 | 20,865 | 1,644 | 22,509 | 473 | 22,982 |
| 1993 | 10,645 | 730 | 11,375 | 15,098 | 1,123 | 16,221 | 25,743 | 1,853 | 27,596 | 354 | 27,950 |
| 1994 | 10,950 | 353 | 11,303 | 12,126 | 2,019 | 14,145 | 23,076 | 2,372 | 25,448 | 543 | 25,991 |
| 1995 | 11,970 | 1,475 | 13,445 | 14,361 | 2,935 | 17,297 | 26,331 | 4,410 | 30,741 | 418 | 31,159 |
| 1996 | 10,791 | 1,780 | 12,572 | 15,715 | 2,289 | 18,004 | 26,507 | 4,069 | 30,576 | 184 | 30,760 |
| 1997 | 9,709 | 1,002 | 10,712 | 18,462 | 1,856 | 20,318 | 28,172 | 2,858 | 31,030 | 189 | 31,219 |
| 1998 | 7,281 | 769 | 8,050 | 19,337 | 1,231 | 20,568 | 26,618 | 2,000 | 28,618 | 190 | 28,808 |
| 1999 | 9,128 | 713 | 9,841 | 16,085 | 1,438 | 17,523 | 25,213 | 2,151 | 27,364 | 151 | 27,515 |
| 2000 | 10,729 | 871 | 11,599 | 10,147 | 3,232 | 13,379 | 20,876 | 4,103 | 24,979 | 176 | 25,155 |
| 2001 | 13,341 | 1,213 | 14,554 | 9,959 | 4,260 | 14,219 | 23,301 | 5,473 | 28,773 | 142 | 28,915 |
| 2002 | 14,011 | 1,169 | 15,180 | 8,884 | 3,796 | 12,680 | 22,896 | 4,964 | 27,860 | 294 | 28,154 |
| 2003 | 14,991 | 1,212 | 16,203 | 11,095 | 3,869 | 14,964 | 26,086 | 5,080 | 31,167 | 309 | 31,476 |
| 2004 | 13,209 | 847 | 14,056 | 7,978 | 3,782 | 11,760 | 21,186 | 4,629 | 25,816 | 166 | 25,982 |
| 2005 | 10,140 | 711 | 10,851 | 9,177 | 3,421 | 12,597 | 19,317 | 4,132 | 23,449 | 206 | 23,655 |
| 2006 | 6,974 | 738 | 7,712 | 7,980 | 3,448 | 11,428 | 14,955 | 4,186 | 19,140 | 279 | 19,419 |
| 2007 | 4,953 | 778 | 5,732 | 7,388 | 2,755 | 10,143 | 12,341 | 3,533 | 15,875 | 8 | 15,883 |
| 2008 | 3,942 | 338 | 4,280 | 7,250 | 1,901 | 9,151 | 11,192 | 2,240 | 13,432 | 2 | 13,434 |
| 2009 | 3,210 | 465 | 3,675 | 5,532 | 1,626 | 7,158 | 8,742 | 2,092 | 10,833 | | 10,833 |
| 2010 | 2,424 | 317 | 2,741 | 4,996 | 2,109 | 7,105 | 7,420 | 2,426 | 9,846 | | 9,846 |
| 2011 | 2,362 | 452 | 2,814 | 6,344 | 2,200 | 8,545 | 8,707 | 2,652 | 11,359 | | 11,359 |
| 2012 | 4,033 | 602 | 4,635 | 5,724 | 2,714 | 8,438 | 9,757 | 3,316 | 13,073 | | 13,073 |
| 2013 | 3,332 | 589 | 3,922 | 5,253 | 1,922 | 7,176 | 8,586 | 2,512 | 11,097 | | 11,097 |
| 2014 | 3,402 | 552 | 3,954 | 5,135 | 1,724 | 6,859 | 8,537 | 2,276 | 10,813 | | 10,813 |
| 2015 | 4,027 | 601 | 4,628 | 4,609 | 1,239 | 5,848 | 8,636 | 1,840 | 10,476 | | 10,476 |

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Table 10. Temporal stratification used in expanding landings and discards to length composition of the monkfish catch. Unless otherwise indicated, sampling was expanded within gear type and area.

| | Trawl | | Gillnet | | Dredge | |
|---|---|---|---|---|---|---|
| **North** | **Kept** | **Discarded** | **Kept** | **Discarded** | **Kept** | **Discarded** |
| 1994 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 1995 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 1996 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 1997 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 1998 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 1999 | annual | annual | 1994-1999 | 1994-1999 | 1994-1999 | 1994-1999 |
| 2000 | annual | annual | annual | 2000-2002 N+S | annual N+S | annual N+S |
| 2001 | annual | annual | annual | 2000-2002 N+S | annual N+S | annual N+S |
| 2002 | annual | annual | annual | 2000-2002 N+S | annual N+S | annual N+S |
| 2003 | half-year | half-year | annual | annual N+S | annual N+S | annual N+S |
| 2004 | half-year | half-year | annual | annual N+S | annual N+S | annual N+S |
| 2005 | half-year | half-year | annual | annual N+S | annual N+S | annual N+S |
| 2006 | half-year | half-year | annual | 2006-2008 N+S | annual N+S | annual N+S |
| 2007 | half-year | half-year | annual | 2006-2008 N+S | annual N+S | annual N+S |
| 2008 | half-year | half-year | annual | 2006-2008 N+S | annual N+S | annual N+S |
| 2009 | half-year | half-year | annual | 2009-2011 N+S | annual N+S | annual N+S |
| 2010 | half-year | half-year | annual | 2009-2011 N+S | annual N+S | annual N+S |
| 2011 | half-year | half-year | annual | 2009-2011 N+S | annual N+S | annual N+S |
| 2012 | half-year | half-year | annual | 2012-2014 N+S | annual N+S | annual N+S |
| 2013 | half-year | half-year | annual | 2012-2014 N+S | annual N+S | annual N+S |
| 2014 | half-year | half-year | annual | 2012-2014 N+S | annual N+S | annual N+S |
| 2015 | annual | half-year | annual | 2015 N+S | annual N+S | annual N+S |

| | Trawl | | Gillnet | | Dredge | |
|---|---|---|---|---|---|---|
| **South** | **Kept** | **Discarded** | **Kept** | **Discarded** | **Kept** | **Discarded** |
| 1994 | annual | | annual | annual | annual | annual |
| 1995 | annual | | annual | annual | annual | annual |
| 1996 | annual | | annual | annual | annual | annual |
| 1997 | annual | | annual | annual | annual | annual |
| 1998 | annual | | annual | annual | annual | annual |
| 1999 | annual | | annual | annual | annual | annual |
| 2000 | annual N+S | annual N+S | annual | 2000-2002 N+S | annual | annual |
| 2001 | annual N+S | annual N+S | annual | 2000-2002 N+S | 2000-2002 | 2000-2002 |
| 2002 | annual N+S | annual N+S | annual | 2000-2002 N+S | 2000-2002 | 2000-2002 |
| 2003 | annual | half-year | annual | annual N+S | annual | annual |
| 2004 | annual | half-year | annual | annual N+S | annual | annual |
| 2005 | annual | half-year | annual | annual N+S | annual | annual |
| 2006 | annual | half-year | annual | 2006-2008 N+S | annual | annual |
| 2007 | annual | half-year | annual | 2006-2008 N+S | annual | annual |
| 2008 | annual | half-year | annual | 2006-2008 N+S | annual | annual |
| 2009 | annual | half-year | annual | 2009-2011 N+S | annual | annual |
| 2010 | annual | half-year | annual | 2009-2011 N+S | annual | annual |
| 2011 | annual | half-year | annual | 2009-2011 N+S | annual | annual |
| 2012 | annual | half-year | annual | 2012-2014 N+S | annual | annual |
| 2013 | annual | half-year | annual | 2012-2014 N+S | annual | annual |
| 2014 | annual | half-year | annual | 2012-2014 N+S | annual | annual |
| 2015 | annual | half-year | annual | 2015 N+S | annual | annual |

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Table 11. Survey results from NEFSC offshore autumn bottom trawl surveys in the northern management region (strata 20-30, 34-40). Indices are delta distribution stratified means.

| | Biomass Index | | | | Abundance Index | | | | Mean | Length | | | | | | of | Number | Non-zero | Proportion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | of Tows | Tows | Non-zero |
| 1963 | 3.82 | 27.3 | 2.3 | 5.3 | 0.80 | 18.4 | 0.5 | 1.1 | 4.7 | 11 | 14 | 59 | 58.3 | 103 | 111 | 86 | 90 | 39 | 0.43 |
| 1964 | 1.89 | 23.2 | 1.0 | 2.8 | 0.39 | 22.5 | 0.2 | 0.6 | 4.8 | 21 | 21 | 58 | 59.4 | 92 | 102 | 32 | 87 | 23 | 0.26 |
| 1965 | 2.54 | 22.7 | 1.4 | 3.7 | 0.35 | 17.1 | 0.2 | 0.5 | 7.3 | 28 | 36 | 70 | 71.6 | 96 | 110 | 40 | 88 | 30 | 0.34 |
| 1966 | 3.38 | 18.4 | 2.2 | 4.6 | 0.51 | 16.7 | 0.3 | 0.7 | 6.5 | 37 | 48 | 73 | 73.1 | 90 | 96 | 55 | 86 | 33 | 0.38 |
| 1967 | 1.23 | 34.2 | 0.4 | 2.0 | 0.19 | 26.7 | 0.1 | 0.3 | 6.5 | 48 | 48 | 69 | 70.3 | 91 | 92 | 18 | 86 | 14 | 0.16 |
| 1968 | 2.05 | 37.8 | 0.5 | 3.6 | 0.29 | 30.5 | 0.1 | 0.5 | 7.2 | 11 | 26 | 72 | 71.4 | 105 | 106 | 32 | 86 | 16 | 0.19 |
| 1969 | 3.76 | 26.3 | 1.8 | 5.7 | 0.42 | 17.2 | 0.3 | 0.6 | 8.8 | 13 | 41 | 78 | 78.8 | 101 | 110 | 39 | 88 | 30 | 0.34 |
| 1970 | 2.28 | 29.1 | 1.0 | 3.6 | 0.40 | 22.4 | 0.2 | 0.6 | 5.8 | 22 | 36 | 67 | 67.2 | 90 | 98 | 41 | 92 | 21 | 0.23 |
| 1971 | 2.93 | 25.9 | 1.5 | 4.4 | 0.49 | 18.6 | 0.3 | 0.7 | 5.9 | 15 | 22 | 69 | 67.0 | 97 | 101 | 44 | 94 | 27 | 0.29 |
| 1972 | 1.42 | 27.3 | 0.7 | 2.2 | 0.32 | 19.8 | 0.2 | 0.4 | 4.4 | 21 | 21 | 61 | 56.9 | 97 | 99 | 29 | 94 | 22 | 0.23 |
| 1973 | 3.18 | 26.7 | 1.8 | 4.6 | 0.51 | 19.3 | 0.3 | 0.7 | 6.0 | 16 | 16 | 58 | 65.2 | 109 | 112 | 63 | 92 | 29 | 0.32 |
| 1974 | 2.06 | 23.5 | 1.1 | 3.0 | 0.31 | 20.1 | 0.2 | 0.4 | 6.4 | 13 | 13 | 69 | 64.9 | 109 | 111 | 37 | 97 | 23 | 0.24 |
| 1975 | 1.73 | 21.1 | 1.0 | 2.4 | 0.30 | 20.5 | 0.2 | 0.4 | 5.7 | 11 | 11 | 60 | 62.9 | 97 | 102 | 40 | 106 | 27 | 0.25 |
| 1976 | 3.39 | 27.6 | 1.6 | 5.2 | 0.42 | 21.6 | 0.2 | 0.6 | 7.6 | 29 | 30 | 71 | 72.1 | 106 | 121 | 32 | 87 | 24 | 0.28 |
| 1977 | 5.57 | 19.0 | 3.5 | 7.6 | 0.63 | 13.7 | 0.5 | 0.8 | 7.2 | 21 | 35 | 73 | 71.1 | 107 | 119 | 112 | 126 | 56 | 0.44 |
| 1978 | 5.11 | 16.1 | 3.5 | 6.7 | 0.58 | 13.2 | 0.4 | 0.7 | 6.7 | 10 | 24 | 70 | 67.6 | 104 | 116 | 146 | 201 | 78 | 0.39 |
| 1979 | 5.12 | 16.9 | 3.6 | 6.7 | 0.47 | 12.0 | 0.4 | 0.6 | 8.9 | 15 | 19 | 77 | 73.5 | 103 | 115 | 125 | 211 | 78 | 0.37 |
| 1980 | 4.46 | 25.5 | 2.2 | 6.7 | 0.53 | 16.0 | 0.4 | 0.7 | 6.3 | 6 | 16 | 66 | 63.9 | 101 | 111 | 65 | 97 | 39 | 0.40 |
| 1981 | 2.00 | 27.8 | 0.3 | 1.5 | 0.41 | 15.4 | 0.1 | 0.2 | 4.4 | 9 | 13 | 55 | 57.5 | 93 | 101 | 46 | 93 | 30 | 0.32 |
| 1982 | 0.94 | 30.3 | 0.4 | 1.5 | 0.14 | 25.7 | 0.1 | 0.2 | 6.6 | 29 | 29 | 71 | 68.9 | 97 | 100 | 17 | 95 | 14 | 0.15 |
| 1983 | 1.62 | 21.8 | 0.9 | 2.3 | 0.47 | 20.2 | 0.3 | 0.7 | 3.4 | 13 | 17 | 54 | 53.0 | 88 | 96 | 38 | 82 | 27 | 0.33 |
| 1984 | 3.01 | 27.1 | 1.4 | 4.6 | 0.48 | 13.7 | 0.4 | 0.6 | 5.8 | 11 | 26 | 63 | 62.7 | 102 | 106 | 36 | 88 | 29 | 0.33 |
| 1985 | 1.44 | 36.2 | 0.4 | 2.5 | 0.37 | 24.6 | 0.2 | 0.5 | 4.0 | 12 | 15 | 55 | 53.1 | 101 | 102 | 32 | 88 | 23 | 0.26 |
| 1986 | 2.35 | 27.2 | 1.1 | 3.6 | 0.60 | 18.9 | 0.4 | 0.8 | 3.7 | 19 | 23 | 52 | 53.8 | 82 | 100 | 46 | 90 | 26 | 0.29 |
| 1987 | 0.87 | 36.1 | 0.3 | 1.5 | 0.26 | 28.6 | 0.1 | 0.4 | 3.3 | 15 | 15 | 53 | 52.2 | 92 | 96 | 22 | 87 | 15 | 0.17 |
| 1988 | 1.52 | 34.8 | 0.5 | 2.6 | 0.31 | 29.7 | 0.1 | 0.5 | 4.9 | 11 | 11 | 53 | 57.1 | 92 | 93 | 26 | 89 | 17 | 0.19 |
| 1989 | 1.40 | 40.2 | 0.5 | 2.3 | 0.43 | 19.3 | 0.3 | 0.6 | 2.6 | 9 | 9 | 39 | 40.8 | 93 | 96 | 39 | 87 | 25 | 0.29 |
| 1990 | 1.06 | 28.7 | 0.5 | 1.6 | 0.59 | 18.1 | 0.4 | 0.8 | 1.4 | 9 | 10 | 25 | 32.3 | 72 | 89 | 55 | 89 | 35 | 0.39 |
| 1991 | 1.25 | 29.4 | 0.6 | 1.9 | 0.58 | 17.1 | 0.4 | 0.8 | 1.7 | 9 | 10 | 31 | 38.3 | 83 | 95 | 62 | 88 | 33 | 0.38 |
| 1992 | 1.12 | 28.6 | 0.6 | 1.7 | 0.94 | 18.3 | 0.6 | 1.3 | 1.2 | 9 | 9 | 26 | 33.0 | 79 | 86 | 78 | 86 | 37 | 0.43 |
| 1993 | 1.13 | 44.1 | 0.5 | 1.8 | 0.99 | 15.4 | 0.7 | 1.3 | 0.9 | 6 | 9 | 20 | 27.1 | 71 | 94 | 103 | 86 | 45 | 0.52 |
| 1994 | 1.05 | 31.3 | 0.4 | 1.6 | 1.35 | 14.4 | 1.0 | 1.7 | 0.7 | 9 | 9 | 19 | 24.9 | 55 | 98 | 110 | 87 | 51 | 0.59 |
| 1995 | 1.71 | 31.2 | 0.7 | 2.8 | 0.92 | 12.9 | 0.7 | 1.2 | 1.7 | 10 | 12 | 34 | 39.6 | 84 | 91 | 87 | 93 | 40 | 0.43 |
| 1996 | 1.09 | 27.3 | 0.5 | 1.7 | 0.63 | 18.1 | 0.4 | 0.9 | 1.7 | 8 | 11 | 38 | 40.3 | 63 | 95 | 51 | 88 | 30 | 0.34 |
| 1997 | 0.75 | 26.6 | 0.4 | 1.1 | 0.50 | 19.9 | 0.3 | 0.7 | 1.3 | 8 | 9 | 35 | 35.4 | 70 | 86 | 39 | 90 | 27 | 0.30 |
| 1998 | 1.02 | 23.7 | 0.6 | 1.5 | 0.61 | 17.7 | 0.4 | 0.8 | 1.5 | 10 | 10 | 30 | 35.5 | 68 | 77 | 56 | 104 | 38 | 0.37 |
| 1999 | 0.90 | 32.2 | 0.4 | 1.4 | 1.08 | 16.3 | 0.7 | 1.4 | 0.7 | 8 | 8 | 22 | 25.7 | 58 | 81 | 111 | 106 | 44 | 0.42 |
| 2000 | 2.53 | 25.1 | 1.3 | 3.7 | 2.40 | 17.7 | 1.6 | 3.2 | 1.0 | 9 | 11 | 25 | 30.3 | 70 | 88 | 165 | 87 | 43 | 0.49 |
| 2001 | 2.07 | 23.0 | 1.1 | 3.0 | 1.62 | 12.8 | 1.2 | 2.0 | 1.1 | 8 | 12 | 31 | 34.7 | 65 | 93 | 145 | 90 | 50 | 0.56 |
| 2002 | 2.32 | 27.1 | 1.1 | 3.6 | 1.28 | 14.4 | 0.9 | 1.6 | 1.4 | 9 | 9 | 34 | 35.1 | 65 | 93 | 114 | 86 | 45 | 0.52 |
| 2003 | 2.72 | 31.3 | 1.1 | 4.4 | 1.07 | 13.8 | 0.8 | 1.4 | 1.7 | 8 | 8 | 40 | 37.8 | 73 | 88 | 90 | 88 | 39 | 0.44 |
| 2004 | 0.63 | 29.6 | 0.3 | 1.0 | 0.52 | 20.1 | 0.3 | 0.7 | 1.2 | 8 | 8 | 21 | 29.8 | 68 | 89 | 36 | 85 | 24 | 0.28 |
| 2005 | 1.62 | 46.2 | 0.2 | 3.1 | 0.59 | 20.2 | 0.4 | 0.8 | 1.7 | 8 | 8 | 24 | 34.3 | 79 | 88 | 46 | 87 | 29 | 0.33 |
| 2006 | 1.04 | 25.2 | 0.5 | 1.6 | 0.76 | 16.4 | 0.5 | 1.0 | 1.3 | 6 | 7 | 33 | 33.2 | 69 | 86 | 56 | 94 | 37 | 0.39 |
| 2007 | 1.20 | 32.7 | 0.4 | 2.0 | 0.64 | 16.5 | 0.4 | 0.8 | 1.7 | 9 | 17 | 31 | 37.5 | 77 | 81 | 63 | 90 | 32 | 0.36 |
| 2008 | 0.99 | 31.8 | 0.4 | 1.6 | 0.78 | 22.7 | 0.4 | 1.1 | 1.2 | 9 | 9 | 27 | 31.6 | 68 | 85 | 60 | 90 | 27 | 0.30 |
| 2009 | 0.44 | 20.0 | 0.3 | 0.6 | 0.40 | 14.5 | 0.3 | 0.5 | 1.3 | 9 | 9 | 31 | 35 | 68 | 93 | 205 | 70 | 48 | 0.69 |
| 2010 | 0.84 | 31.1 | 0.3 | 1.4 | 0.51 | 10.8 | 0.4 | 0.6 | 1.4 | 7 | 8 | 35 | 36 | 64 | 95 | 249 | 66 | 49 | 0.74 |
| 2011 | 0.90 | 16.8 | 0.6 | 1.2 | 0.68 | 9.0 | 0.6 | 0.8 | 1.5 | 8 | 8 | 35 | 34 | 70 | 91 | 213 | 46 | 42 | 0.91 |
| 2012 | 0.85 | 15.4 | 0.6 | 1.1 | 0.70 | 8.9 | 0.6 | 0.8 | 1.3 | 6 | 8 | 31 | 34 | 65 | 97 | 314 | 62 | 57 | 0.92 |
| 2013 | 0.83 | 28.1 | 0.4 | 1.3 | 0.74 | 7.9 | 0.6 | 0.9 | 1.0 | 7 | 8 | 29 | 30 | 61 | 90 | 385 | 63 | 58 | 0.92 |
| 2014 | 0.76 | 10.1 | 0.6 | 0.9 | 0.95 | 10.8 | 0.8 | 1.2 | 0.9 | 7 | 8 | 27 | 30 | 60 | 87 | 264 | 36 | 30 | 0.83 |
| 2015 | 2.64 | 37.5 | 0.7 | 4.6 | 1.26 | 12.4 | 1.0 | 1.6 | 1.1 | 5 | 9 | 28 | 31 | 64 | 95 | 634 | 83 | 70 | 0.84 |

Bigelow, no calibration coefficient applied:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2009 | 3.6 | 20.0 | 2.2 | 5.0 | 2.82 | 14.5 | 2.0 | 3.6 |
| 2010 | 6.8 | 31.1 | 2.7 | 11.0 | 3.66 | 10.8 | 2.9 | 4.4 |
| 2011 | 7.3 | 16.8 | 4.9 | 9.7 | 4.83 | 9.0 | 4.0 | 5.7 |
| 2012 | 6.9 | 15.4 | 4.8 | 9.0 | 4.97 | 8.9 | 4.1 | 5.8 |
| 2013 | 6.7 | 28.1 | 3.0 | 10.3 | 5.27 | 7.9 | 4.5 | 6.1 |
| 2014 | 6.1 | 10.1 | 4.9 | 7.3 | 6.81 | 10.8 | 5.4 | 8.3 |
| 2015 | 21.2 | 37.5 | 5.6 | 36.9 | 8.99 | 12.4 | 6.8 | 11.2 |

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Table 12. Survey results from NEFSC offshore autumn bottom trawl surveys in the northern management region (strata 20-30, 34-40). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Biomass Index | | | | Abundance Index | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% |
| 1963 | 3.79 | 16.3 | 2.64 | 4.99 | 0.81 | 15.7 | 0.57 | 1.05 |
| 1964 | 1.89 | 19.9 | 1.15 | 2.65 | 0.39 | 19.6 | 0.25 | 0.54 |
| 1965 | 2.52 | 19.5 | 1.67 | 3.57 | 0.35 | 15.3 | 0.24 | 0.45 |
| 1966 | 3.33 | 16.0 | 2.32 | 4.37 | 0.51 | 14.0 | 0.38 | 0.66 |
| 1967 | 1.24 | 32.8 | 0.53 | 2.08 | 0.19 | 25.3 | 0.10 | 0.28 |
| 1968 | 2.05 | 35.0 | 0.83 | 3.56 | 0.29 | 26.9 | 0.15 | 0.45 |
| 1969 | 3.69 | 22.9 | 2.17 | 5.42 | 0.42 | 15.3 | 0.29 | 0.54 |
| 1970 | 2.32 | 26.1 | 1.22 | 3.63 | 0.40 | 19.6 | 0.25 | 0.55 |
| 1971 | 2.90 | 21.7 | 1.79 | 4.25 | 0.49 | 17.2 | 0.33 | 0.66 |
| 1972 | 1.39 | 24.5 | 0.80 | 2.13 | 0.32 | 18.5 | 0.20 | 0.43 |
| 1973 | 3.19 | 21.0 | 1.94 | 4.53 | 0.53 | 19.9 | 0.34 | 0.75 |
| 1974 | 2.02 | 21.0 | 1.24 | 2.90 | 0.32 | 19.5 | 0.20 | 0.43 |
| 1975 | 1.71 | 19.0 | 1.09 | 2.42 | 0.30 | 18.8 | 0.20 | 0.42 |
| 1976 | 3.22 | 21.0 | 1.96 | 4.67 | 0.42 | 20.0 | 0.28 | 0.59 |
| 1977 | 5.43 | 17.5 | 3.72 | 7.39 | 0.76 | 12.6 | 0.58 | 0.96 |
| 1978 | 4.73 | 12.7 | 3.62 | 5.85 | 0.70 | 12.4 | 0.53 | 0.87 |
| 1979 | 4.91 | 14.4 | 3.58 | 6.21 | 0.55 | 11.6 | 0.42 | 0.68 |
| 1980 | 4.04 | 18.8 | 2.53 | 5.61 | 0.64 | 14.6 | 0.46 | 0.83 |
| 1981 | 1.98 | 17.8 | 1.34 | 2.71 | 0.45 | 14.1 | 0.33 | 0.58 |
| 1982 | 0.94 | 26.6 | 0.49 | 1.45 | 0.14 | 23.2 | 0.08 | 0.21 |
| 1983 | 1.61 | 19.0 | 1.04 | 2.18 | 0.47 | 17.9 | 0.31 | 0.63 |
| 1984 | 2.82 | 20.5 | 1.77 | 3.95 | 0.49 | 12.8 | 0.37 | 0.61 |
| 1985 | 1.48 | 33.2 | 0.61 | 2.52 | 0.37 | 22.4 | 0.22 | 0.54 |
| 1986 | 2.23 | 21.5 | 1.35 | 3.10 | 0.61 | 16.8 | 0.41 | 0.81 |
| 1987 | 0.88 | 30.9 | 0.37 | 1.45 | 0.26 | 25.0 | 0.14 | 0.40 |
| 1988 | 1.53 | 32.4 | 0.64 | 2.60 | 0.31 | 25.5 | 0.17 | 0.49 |
| 1989 | 1.32 | 28.5 | 0.68 | 2.12 | 0.51 | 16.9 | 0.36 | 0.70 |
| 1990 | 1.01 | 26.8 | 0.53 | 1.55 | 0.71 | 15.3 | 0.50 | 0.92 |
| 1991 | 1.20 | 23.5 | 0.70 | 1.78 | 0.70 | 17.2 | 0.47 | 0.93 |
| 1992 | 1.12 | 23.6 | 0.65 | 1.67 | 0.94 | 16.6 | 0.65 | 1.25 |
| 1993 | 1.10 | 33.9 | 0.53 | 1.92 | 1.23 | 15.3 | 0.89 | 1.61 |
| 1994 | 0.90 | 22.8 | 0.56 | 1.34 | 1.34 | 12.7 | 1.03 | 1.68 |
| 1995 | 1.60 | 23.1 | 0.94 | 2.34 | 0.93 | 12.0 | 0.72 | 1.16 |
| 1996 | 1.07 | 25.3 | 0.60 | 1.66 | 0.63 | 16.8 | 0.44 | 0.85 |
| 1997 | 0.67 | 21.9 | 0.40 | 0.96 | 0.50 | 17.4 | 0.33 | 0.67 |
| 1998 | 0.96 | 20.5 | 0.62 | 1.35 | 0.62 | 18.3 | 0.42 | 0.86 |
| 1999 | 0.78 | 22.3 | 0.46 | 1.14 | 1.08 | 15.1 | 0.76 | 1.42 |
| 2000 | 2.41 | 20.3 | 1.57 | 3.41 | 2.34 | 13.3 | 1.78 | 2.96 |
| 2001 | 1.84 | 15.7 | 1.31 | 2.40 | 1.61 | 11.4 | 1.24 | 1.97 |
| 2002 | 1.83 | 16.8 | 1.27 | 2.51 | 1.28 | 12.7 | 0.96 | 1.62 |
| 2003 | 1.81 | 18.0 | 1.19 | 2.46 | 1.07 | 12.3 | 0.81 | 1.33 |
| 2004 | 0.64 | 28.2 | 0.30 | 1.01 | 0.52 | 18.5 | 0.35 | 0.72 |
| 2005 | 1.01 | 21.8 | 0.61 | 1.43 | 0.60 | 18.8 | 0.39 | 0.82 |
| 2006 | 1.04 | 24.0 | 0.58 | 1.56 | 0.77 | 15.6 | 0.55 | 1.01 |
| 2007 | 1.08 | 28.1 | 0.54 | 1.73 | 0.64 | 14.6 | 0.46 | 0.83 |
| 2008 | 0.99 | 28.8 | 0.48 | 1.57 | 0.79 | 22.5 | 0.47 | 1.17 |
| 2009 | 0.44 | 17.7 | 0.30 | 0.60 | 0.39 | 9.8 | 0.31 | 0.46 |
| 2010 | 0.6 | 14.9 | 0.46 | 0.82 | 0.51 | 8.7 | 0.43 | 0.60 |
| 2011 | 0.9 | 15.2 | 0.65 | 1.16 | 0.67 | 6.5 | 0.59 | 0.75 |
| 2012 | 0.8 | 11.0 | 0.65 | 1.00 | 0.68 | 6.7 | 0.60 | 0.78 |
| 2013 | 0.6 | 11.3 | 0.49 | 0.75 | 0.73 | 6.7 | 0.64 | 0.83 |
| 2014 | 0.8 | 8.8 | 0.63 | 0.89 | 0.95 | 8.7 | 0.80 | 1.13 |
| 2015 | 1.1 | 11.4 | 0.87 | 1.39 | 1.22 | 9.1 | 1.02 | 1.44 |
| Bigelow, no calibration coefficient applied: | | | | | | | | |
| 2009 | 3.55 | 17.7 | 2.38 | 4.83 | 2.78 | 9.8 | 2.22 | 3.27 |
| 2010 | 5.13 | 14.9 | 3.69 | 6.60 | 3.65 | 8.7 | 3.07 | 4.30 |
| 2011 | 7.09 | 15.2 | 5.21 | 9.34 | 4.77 | 6.5 | 4.18 | 5.38 |
| 2012 | 6.50 | 11.0 | 5.22 | 8.02 | 4.88 | 6.7 | 4.26 | 5.53 |
| 2013 | 4.97 | 11.3 | 3.92 | 6.06 | 5.21 | 6.7 | 4.55 | 5.94 |
| 2014 | 6.11 | 8.8 | 5.09 | 7.19 | 6.79 | 8.7 | 5.71 | 8.08 |
| 2015 | 9.20 | 11.4 | 7.05 | 11.18 | 8.71 | 9.1 | 7.24 | 10.26 |

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Table 13. Survey results from NEFSC offshore spring bottom trawl surveys in the northern management region (strata 20-30, 34-40). Indices are delta distribution stratified means.

| | Biomass Index | | | | Abundance Index | | | | | Length | | | | | | Number of | Number of | Number of Nonzero | Proportion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | Tows | Tows | Non-zero |
| 1968 | 1.01 | 35.9 | 0.30 | 1.72 | 0.17 | 31.3 | 0.07 | 0.27 | 6.0 | 50 | 51 | 68 | 70.4 | 89 | 90 | 13 | 86 | 11 | 0.13 |
| 1969 | 1.34 | 44.9 | 0.16 | 2.52 | 0.18 | 38.3 | 0.05 | 0.32 | 7.5 | 33 | 33 | 71 | 71.5 | 99 | 100 | 15 | 87 | 10 | 0.11 |
| 1970 | 2.02 | 30.9 | 0.80 | 3.25 | 0.34 | 19.0 | 0.22 | 0.47 | 5.9 | 30 | 30 | 62 | 65.4 | 98 | 99 | 32 | 90 | 22 | 0.24 |
| 1971 | 1.04 | 29.4 | 0.44 | 1.64 | 0.16 | 27.9 | 0.07 | 0.24 | 6.5 | 45 | 53 | 69 | 72.6 | 99 | 100 | 20 | 96 | 15 | 0.16 |
| 1972 | 4.74 | 18.1 | 3.06 | 6.42 | 0.64 | 15.0 | 0.45 | 0.83 | 7.1 | 13 | 39 | 74 | 72.7 | 100 | 105 | 59 | 96 | 38 | 0.40 |
| 1973 | 6.39 | 25.5 | 3.20 | 9.58 | 1.07 | 29.5 | 0.45 | 1.68 | 4.3 | 17 | 26 | 68 | 65.7 | 99 | 106 | 91 | 87 | 36 | 0.41 |
| 1974 | 4.95 | 21.2 | 2.89 | 7.00 | 1.07 | 14.4 | 0.77 | 1.37 | 3.4 | 20 | 23 | 58 | 58.3 | 97 | 111 | 86 | 83 | 41 | 0.49 |
| 1975 | 3.16 | 18.6 | 2.01 | 4.31 | 0.83 | 16.7 | 0.56 | 1.10 | 2.8 | 16 | 19 | 53 | 54.0 | 87 | 109 | 73 | 87 | 36 | 0.41 |
| 1976 | 9.47 | 20.5 | 5.66 | 13.27 | 1.65 | 15.5 | 1.15 | 2.15 | 3.8 | 14 | 20 | 60 | 61.5 | 95 | 106 | 158 | 99 | 52 | 0.53 |
| 1977 | 3.39 | 22.7 | 1.89 | 4.90 | 0.64 | 19.7 | 0.39 | 0.88 | 3.6 | 10 | 31 | 66 | 63.4 | 93 | 106 | 61 | 107 | 37 | 0.35 |
| 1978 | 2.10 | 23.3 | 1.14 | 3.06 | 0.34 | 16.4 | 0.23 | 0.45 | 4.0 | 15 | 19 | 73 | 65.5 | 89 | 92 | 37 | 113 | 30 | 0.27 |
| 1979 | 3.48 | 36.8 | 0.97 | 5.98 | 0.37 | 14.5 | 0.26 | 0.47 | 4.7 | 12 | 14 | 67 | 62.5 | 100 | 118 | 48 | 139 | 40 | 0.29 |
| 1980 | 5.43 | 26.3 | 2.64 | 8.23 | 1.10 | 14.9 | 0.78 | 1.41 | 3.7 | 17 | 22 | 43 | 53.3 | 98 | 107 | 84 | 85 | 38 | 0.45 |
| 1981 | 5.84 | 24.3 | 3.06 | 8.63 | 1.11 | 12.8 | 0.83 | 1.39 | 4.4 | 11 | 21 | 52 | 57.7 | 95 | 120 | 95 | 87 | 42 | 0.48 |
| 1982 | 3.02 | 29.5 | 1.27 | 4.76 | 0.42 | 28.1 | 0.19 | 0.65 | 8.6 | 25 | 36 | 61 | 68.8 | 105 | 108 | 33 | 92 | 22 | 0.24 |
| 1983 | 1.59 | 34.0 | 0.53 | 2.64 | 0.42 | 27.7 | 0.19 | 0.64 | 3.7 | 12 | 13 | 49 | 49.9 | 96 | 112 | 34 | 90 | 22 | 0.24 |
| 1984 | 1.70 | 33.1 | 0.60 | 2.80 | 0.33 | 22.9 | 0.18 | 0.47 | 4.7 | 17 | 19 | 62 | 60.8 | 93 | 100 | 26 | 86 | 19 | 0.22 |
| 1985 | 2.11 | 24.6 | 1.09 | 3.13 | 0.35 | 21.6 | 0.20 | 0.49 | 6.1 | 13 | 13 | 68 | 66.9 | 104 | 108 | 25 | 81 | 21 | 0.26 |
| 1986 | 2.33 | 29.5 | 0.98 | 3.67 | 0.34 | 21.1 | 0.20 | 0.48 | 6.2 | 11 | 14 | 63 | 65.4 | 109 | 121 | 30 | 90 | 22 | 0.24 |
| 1987 | 1.73 | 29.6 | 0.73 | 2.73 | 0.28 | 22.1 | 0.16 | 0.40 | 7.1 | 16 | 16 | 66 | 64.2 | 99 | 100 | 21 | 83 | 16 | 0.19 |
| 1988 | 2.11 | 29.1 | 0.91 | 3.31 | 0.61 | 17.8 | 0.40 | 0.82 | 3.3 | 10 | 20 | 49 | 49.8 | 89 | 110 | 43 | 90 | 26 | 0.29 |
| 1989 | 1.64 | 32.0 | 0.61 | 2.66 | 0.75 | 24.8 | 0.39 | 1.12 | 2.6 | 10 | 11 | 40 | 43.2 | 80 | 94 | 48 | 85 | 24 | 0.28 |
| 1990 | 1.00 | 32.4 | 0.37 | 1.64 | 0.28 | 22.6 | 0.16 | 0.41 | 3.6 | 15 | 18 | 47 | 49.1 | 106 | 107 | 25 | 90 | 17 | 0.19 |
| 1991 | 1.83 | 37.7 | 0.48 | 3.18 | 0.59 | 18.8 | 0.37 | 0.81 | 2.7 | 12 | 15 | 35 | 42.3 | 78 | 100 | 48 | 86 | 28 | 0.33 |
| 1992 | 0.91 | 63.3 | -0.19 | 2.01 | 0.49 | 34.6 | 0.16 | 0.83 | 1.8 | 16 | 17 | 35 | 40.6 | 82 | 101 | 36 | 83 | 20 | 0.24 |
| 1993 | 1.20 | 22.7 | 0.74 | 1.67 | 0.68 | 15.6 | 0.48 | 0.89 | 1.7 | 10 | 11 | 44 | 41.0 | 71 | 90 | 59 | 87 | 27 | 0.31 |
| 1994 | 0.95 | 34.1 | 0.40 | 1.50 | 0.45 | 20.0 | 0.28 | 0.63 | 2.2 | 10 | 13 | 40 | 41.0 | 83 | 89 | 45 | 88 | 24 | 0.27 |
| 1995 | 1.75 | 37.7 | 0.81 | 2.70 | 0.98 | 16.7 | 0.66 | 1.31 | 1.8 | 15 | 16 | 33 | 39.9 | 73 | 97 | 83 | 88 | 39 | 0.44 |
| 1996 | 1.01 | 28.2 | 0.45 | 1.56 | 0.67 | 24.7 | 0.34 | 0.99 | 1.5 | 15 | 17 | 41 | 43.0 | 60 | 70 | 49 | 82 | 20 | 0.24 |
| 1997 | 0.56 | 37.0 | 0.17 | 0.95 | 0.34 | 27.2 | 0.16 | 0.52 | 1.6 | 9 | 9 | 36 | 39.4 | 75 | 89 | 34 | 89 | 19 | 0.21 |
| 1998 | 0.49 | 29.3 | 0.23 | 0.74 | 0.41 | 15.5 | 0.29 | 0.54 | 1.1 | 11 | 11 | 19 | 31.3 | 67 | 78 | 46 | 115 | 33 | 0.29 |
| 1999 | 1.22 | 24.5 | 0.65 | 1.80 | 0.82 | 17.2 | 0.55 | 1.10 | 1.4 | 9 | 14 | 31 | 35.5 | 71 | 97 | 62 | 87 | 33 | 0.38 |
| 2000 | 1.44 | 21.1 | 0.85 | 2.03 | 1.13 | 12.9 | 0.84 | 1.41 | 1.2 | 15 | 17 | 29 | 34.5 | 75 | 87 | 99 | 89 | 42 | 0.47 |
| 2001 | 1.97 | 33.1 | 0.69 | 3.25 | 1.69 | 14.1 | 1.22 | 2.15 | 1.1 | 9 | 11 | 24 | 31.4 | 75 | 86 | 151 | 89 | 50 | 0.56 |
| 2002 | 2.00 | 16.8 | 1.34 | 2.66 | 1.76 | 12.3 | 1.33 | 2.18 | 1.1 | 12 | 15 | 34 | 36.6 | 60 | 73 | 155 | 91 | 50 | 0.55 |
| 2003 | 2.38 | 33.5 | 0.82 | 3.95 | 0.81 | 20.9 | 0.48 | 1.14 | 2.3 | 10 | 13 | 42 | 44.2 | 69 | 95 | 79 | 86 | 30 | 0.35 |
| 2004 | 2.29 | 30.7 | 0.91 | 3.66 | 0.91 | 18.7 | 0.58 | 1.24 | 2.5 | 9 | 11 | 48 | 46.7 | 81 | 85 | 69 | 88 | 36 | 0.41 |
| 2005 | 2.06 | 38.5 | 0.51 | 3.61 | 0.71 | 15.9 | 0.49 | 0.93 | 2.1 | 11 | 13 | 48 | 45.1 | 68 | 75 | 52 | 87 | 31 | 0.36 |
| 2006 | 0.93 | 40.9 | 0.18 | 1.67 | 0.37 | 28.7 | 0.16 | 0.57 | 2.5 | 15 | 13 | 43 | 44.8 | 72 | 105 | 33 | 95 | 23 | 0.24 |
| 2007 | 1.65 | 70.1 | -0.61 | 3.91 | 0.56 | 28.3 | 0.25 | 0.86 | 1.9 | 11 | 10 | 32 | 36.8 | 78 | 85 | 43 | 86 | 19 | 0.22 |
| 2008 | 1.78 | 45.8 | 0.18 | 3.38 | 0.68 | 21.7 | 0.39 | 0.97 | 1.9 | 8 | 16 | 35 | 40.8 | 73 | 85 | 61 | 86 | 24 | 0.28 |
| 2009 | 0.51 | 19.5 | 0.31 | 0.71 | 0.34 | 13.3 | 0.43 | 0.51 | 1.6 | 11 | 13 | 36 | 38.4 | 70 | 93 | 220 | 94 | 55 | 0.59 |
| 2010 | 0.65 | 18.5 | 0.42 | 0.89 | 0.38 | 13.4 | 0.47 | 0.65 | 1.9 | 10 | 15 | 41 | 42.5 | 71 | 115 | 207 | 87 | 50 | 0.57 |
| 2011 | 0.89 | 18.1 | 0.57 | 1.20 | 0.46 | 15.9 | 0.61 | 0.89 | 2.2 | 10 | 14 | 44 | 46.1 | 78 | 91 | 185 | 54 | 40 | 0.74 |
| 2012 | 0.66 | 23.1 | 0.36 | 0.96 | 0.54 | 15.7 | 0.71 | 0.66 | 1.3 | 10 | 13 | 35 | 36.8 | 63 | 97 | 274 | 72 | 53 | 0.74 |
| 2013 | 0.67 | 20.8 | 0.40 | 0.95 | 0.55 | 8.4 | 0.65 | 0.67 | 1.2 | 8 | 9 | 29 | 32.2 | 71 | 87 | 228 | 65 | 50 | 0.77 |
| 2014 | 0.70 | 25.4 | 0.35 | 1.04 | 0.63 | 15.7 | 0.82 | 0.70 | 1.2 | 9 | 12 | 37 | 36.4 | 58 | 77 | 241 | 56 | 47 | 0.84 |
| 2015 | 0.85 | 22.7 | 0.47 | 1.23 | 0.54 | 11.1 | 0.65 | 0.85 | 1.5 | 9 | 13 | 38 | 39.3 | 66 | 94 | 336 | 103 | 70 | 0.68 |

Bigelow, no calibration coefficient applied:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2009 | 4.11 | 19.5 | 2.5 | 5.7 | 2.4 | 13.3 | 1.8 | 3.0 |
| 2010 | 5.27 | 18.5 | 3.4 | 7.2 | 2.7 | 13.4 | 2.0 | 3.4 |
| 2011 | 7.17 | 18.1 | 4.6 | 9.7 | 3.3 | 15.9 | 2.3 | 4.3 |
| 2012 | 5.34 | 23.1 | 2.9 | 7.8 | 3.9 | 15.7 | 2.7 | 5.1 |
| 2013 | 5.42 | 20.8 | 3.2 | 7.6 | 4.0 | 8.4 | 3.3 | 4.6 |
| 2014 | 5.62 | 25.4 | 2.8 | 8.4 | 4.5 | 15.7 | 3.1 | 5.8 |
| 2015 | 6.87 | 22.7 | 3.8 | 9.9 | 3.8 | 11.1 | 3.0 | 4.7 |

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Table 14. Survey results from NEFSC offshore spring bottom trawl surveys in the northern management region (strata 20-30, 34-40). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Biomass Index | | | | Abundance Index | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% |
| 1968 | 1.01 | 32.4 | 0.44 | 1.69 | 0.17 | 28.9 | 0.08 | 0.27 |
| 1969 | 1.34 | 41.2 | 0.36 | 2.46 | 0.18 | 34.8 | 0.07 | 0.31 |
| 1970 | 2.02 | 26.5 | 0.99 | 3.10 | 0.34 | 16.9 | 0.23 | 0.45 |
| 1971 | 1.05 | 28.8 | 0.51 | 1.68 | 0.16 | 28.0 | 0.08 | 0.25 |
| 1972 | 4.63 | 15.3 | 3.31 | 5.98 | 0.65 | 15.0 | 0.45 | 0.84 |
| 1973 | 6.32 | 20.9 | 3.80 | 9.06 | 1.07 | 22.2 | 0.63 | 1.54 |
| 1974 | 5.00 | 19.6 | 3.22 | 6.97 | 1.08 | 13.5 | 0.80 | 1.37 |
| 1975 | 3.15 | 16.2 | 2.21 | 4.15 | 0.84 | 15.2 | 0.59 | 1.08 |
| 1976 | 8.40 | 14.2 | 6.02 | 10.77 | 1.63 | 13.4 | 1.24 | 2.09 |
| 1977 | 3.12 | 16.7 | 2.14 | 4.12 | 0.64 | 18.3 | 0.42 | 0.87 |
| 1978 | 1.89 | 18.9 | 1.24 | 2.63 | 0.34 | 15.4 | 0.24 | 0.45 |
| 1979 | 2.25 | 21.0 | 1.40 | 3.20 | 0.37 | 13.5 | 0.27 | 0.47 |
| 1980 | 4.80 | 17.8 | 3.10 | 6.55 | 1.11 | 14.0 | 0.81 | 1.42 |
| 1981 | 5.59 | 20.2 | 3.56 | 7.85 | 1.11 | 11.3 | 0.87 | 1.36 |
| 1982 | 2.97 | 24.6 | 1.63 | 4.40 | 0.42 | 25.1 | 0.23 | 0.62 |
| 1983 | 1.53 | 30.7 | 0.76 | 2.52 | 0.42 | 24.1 | 0.24 | 0.63 |
| 1984 | 1.57 | 25.3 | 0.80 | 2.32 | 0.33 | 21.6 | 0.21 | 0.48 |
| 1985 | 2.12 | 21.2 | 1.33 | 3.03 | 0.35 | 19.4 | 0.22 | 0.48 |
| 1986 | 2.13 | 26.9 | 1.08 | 3.37 | 0.34 | 19.3 | 0.22 | 0.48 |
| 1987 | 1.73 | 27.6 | 0.80 | 2.70 | 0.28 | 20.2 | 0.18 | 0.40 |
| 1988 | 2.03 | 23.7 | 1.13 | 3.00 | 0.61 | 15.9 | 0.42 | 0.80 |
| 1989 | 1.60 | 31.5 | 0.74 | 2.70 | 0.75 | 21.6 | 0.46 | 1.09 |
| 1990 | 1.01 | 30.5 | 0.50 | 1.68 | 0.34 | 20.1 | 0.21 | 0.49 |
| 1991 | 1.61 | 24.1 | 0.89 | 2.40 | 0.71 | 16.7 | 0.47 | 0.95 |
| 1992 | 0.89 | 56.9 | 0.22 | 2.03 | 0.49 | 30.4 | 0.26 | 0.82 |
| 1993 | 1.16 | 18.4 | 0.75 | 1.57 | 0.68 | 13.3 | 0.50 | 0.86 |
| 1994 | 0.98 | 30.9 | 0.44 | 1.63 | 0.55 | 17.4 | 0.36 | 0.72 |
| 1995 | 1.84 | 29.0 | 0.91 | 2.96 | 1.01 | 17.0 | 0.72 | 1.37 |
| 1996 | 0.98 | 23.0 | 0.57 | 1.44 | 0.67 | 22.2 | 0.39 | 0.97 |
| 1997 | 0.55 | 37.6 | 0.21 | 0.98 | 0.34 | 26.1 | 0.19 | 0.53 |
| 1998 | 0.44 | 27.3 | 0.22 | 0.69 | 0.42 | 14.6 | 0.30 | 0.54 |
| 1999 | 1.15 | 19.5 | 0.73 | 1.59 | 0.83 | 15.5 | 0.58 | 1.07 |
| 2000 | 1.40 | 18.4 | 0.91 | 1.90 | 1.13 | 11.8 | 0.89 | 1.41 |
| 2001 | 1.85 | 28.1 | 0.95 | 2.97 | 1.67 | 11.8 | 1.29 | 2.05 |
| 2002 | 1.93 | 13.0 | 1.45 | 2.43 | 1.74 | 10.6 | 1.38 | 2.10 |
| 2003 | 1.87 | 21.0 | 1.13 | 2.69 | 0.98 | 19.9 | 0.63 | 1.40 |
| 2004 | 2.26 | 26.0 | 1.20 | 3.47 | 0.91 | 16.4 | 0.61 | 1.21 |
| 2005 | 1.47 | 21.1 | 0.85 | 2.08 | 0.72 | 15.3 | 0.52 | 0.95 |
| 2006 | 0.93 | 37.3 | 0.34 | 1.68 | 0.37 | 26.7 | 0.19 | 0.57 |
| 2007 | 1.05 | 43.3 | 0.28 | 2.03 | 0.55 | 23.7 | 0.31 | 0.83 |
| 2008 | 1.29 | 28.3 | 0.65 | 2.06 | 0.67 | 16.9 | 0.46 | 0.91 |
| 2009 | 0.47 | 14.3 | 0.3 | 0.6 | 0.33 | 10.0 | 0.3 | 0.4 |
| 2010 | 0.63 | 14.2 | 0.5 | 0.8 | 0.38 | 13.1 | 0.29 | 0.49 |
| 2011 | 0.89 | 15.3 | 0.63 | 1.17 | 0.46 | 13.3 | 0.35 | 0.60 |
| 2012 | 0.61 | 13.7 | 0.44 | 0.76 | 0.54 | 13.4 | 0.40 | 0.68 |
| 2013 | 0.58 | 10.8 | 0.46 | 0.71 | 0.55 | 6.8 | 0.48 | 0.63 |
| 2014 | 0.63 | 15.5 | 0.45 | 0.82 | 0.61 | 11.3 | 0.47 | 0.75 |
| 2015 | 0.73 | 15.3 | 0.53 | 0.97 | 0.54 | 9.5 | 0.44 | 0.63 |
| Bigelow, no calibration coefficient applied: | | | | | | | | |
| 2009 | 3.80 | 14.3 | 2.79 | 4.85 | 2.36 | 10.3 | 1.92 | 2.84 |
| 2010 | 5.08 | 14.2 | 3.68 | 6.54 | 2.72 | 13.4 | 2.05 | 3.51 |
| 2011 | 7.20 | 15.9 | 5.05 | 9.54 | 3.31 | 13.9 | 2.42 | 4.17 |
| 2012 | 4.90 | 13.7 | 3.64 | 6.22 | 3.83 | 13.2 | 2.93 | 4.90 |
| 2013 | 4.70 | 11.3 | 3.72 | 5.76 | 3.93 | 7.0 | 3.40 | 4.50 |
| 2014 | 5.07 | 15.6 | 3.58 | 6.55 | 4.38 | 11.9 | 3.34 | 5.42 |
| 2015 | 5.90 | 16.2 | 4.24 | 7.84 | 3.83 | 9.3 | 3.15 | 4.55 |

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Table 15. Survey results from ASMFC summer shrimp surveys in the northern management region (strata 1, 3, 5, 6-8). Indices are delta distribution stratified means.

| | Biomass Index | | | | Abundance Index | | | | | | | | Length | | | of | Number | Nonzero | Nonzero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | of Tows | Tows | Tows |
| 1991 | 1.96 | 20.6 | 1.17 | 2.75 | 2.90 | 11.2 | 2.27 | 3.54 | 0.65 | 11 | 15 | 24 | 27.5 | 59 | 96 | 125 | 43 | 39 | 0.91 |
| 1992 | 2.92 | 26.5 | 1.40 | 4.43 | 2.91 | 11.2 | 2.27 | 3.54 | 0.93 | 11 | 13 | 28 | 31.5 | 56 | 78 | 135 | 45 | 40 | 0.89 |
| 1993 | 3.34 | 31.7 | 1.39 | 5.30 | 3.76 | 14.4 | 2.70 | 4.81 | 0.83 | 7 | 9 | 23 | 27.6 | 59 | 102 | 170 | 46 | 42 | 0.91 |
| 1994 | 1.64 | 25.5 | 0.84 | 2.45 | 3.48 | 15.3 | 2.43 | 4.52 | 0.48 | 5 | 10 | 19 | 24.1 | 48 | 95 | 166 | 43 | 37 | 0.86 |
| 1995 | 1.64 | 28.3 | 0.73 | 2.54 | 2.09 | 21.3 | 1.22 | 2.96 | 0.75 | 11 | 19 | 26 | 31.2 | 67 | 76 | 83 | 35 | 24 | 0.69 |
| 1996 | 3.43 | 31.2 | 1.33 | 5.53 | 2.97 | 14.8 | 2.11 | 3.83 | 1.12 | 13 | 14 | 34 | 34.4 | 63 | 90 | 107 | 32 | 30 | 0.94 |
| 1997 | 2.08 | 25.5 | 1.04 | 3.12 | 1.58 | 16.5 | 1.07 | 2.09 | 1.32 | 11 | 16 | 32 | 37.7 | 62 | 73 | 72 | 40 | 31 | 0.78 |
| 1998 | 2.30 | 35.2 | 0.71 | 3.89 | 2.12 | 14.9 | 1.50 | 2.74 | 1.07 | 12 | 16 | 23 | 31.3 | 61 | 77 | 84 | 35 | 31 | 0.89 |
| 1999 | 6.35 | 19.8 | 4.77 | 7.93 | 7.02 | 12.4 | 5.31 | 8.73 | 0.93 | 8 | 9 | 28 | 30.9 | 65 | 82 | 301 | 42 | 39 | 0.93 |
| 2000 | 4.12 | 25.1 | 2.09 | 6.15 | 5.76 | 14.7 | 4.10 | 7.41 | 0.67 | 11 | 15 | 28 | 30.2 | 51 | 82 | 215 | 35 | 30 | 0.86 |
| 2001 | 8.55 | 24.5 | 4.44 | 12.66 | 11.12 | 12.2 | 8.46 | 13.79 | 0.67 | 11 | 13 | 26 | 29.5 | 51 | 85 | 442 | 36 | 36 | 1.00 |
| 2002 | 12.86 | 14.6 | 9.18 | 16.54 | 11.79 | 10.4 | 9.38 | 14.20 | 1.07 | 11 | 17 | 32 | 35.3 | 59 | 94 | 493 | 38 | 38 | 1.00 |
| 2003 | 8.24 | 30.2 | 4.47 | 12.02 | 5.86 | 14.6 | 4.17 | 7.54 | 1.27 | 3 | 13 | 38 | 37.4 | 63 | 87 | 236 | 37 | 36 | 0.97 |
| 2004 | 4.60 | 12.6 | 3.46 | 5.74 | 3.39 | 10.9 | 2.66 | 4.11 | 1.32 | 11 | 11 | 34 | 35.7 | 66 | 75 | 142 | 35 | 33 | 0.94 |
| 2005 | 7.60 | 16.6 | 5.13 | 10.06 | 5.25 | 10.4 | 4.19 | 6.32 | 1.38 | 9 | 14 | 34 | 37.4 | 66 | 89 | 271 | 46 | 44 | 0.96 |
| 2006 | 7.36 | 22.2 | 3.81 | 10.91 | 4.34 | 8.8 | 3.09 | 5.60 | 1.52 | 7 | 11 | 30 | 37.2 | 70 | 89 | 143 | 29 | 29 | 1.00 |
| 2007 | 5.13 | 32.7 | 1.84 | 8.42 | 4.39 | 13.0 | 3.26 | 5.51 | 0.92 | 9 | 11 | 19 | 28.2 | 64 | 79 | 218 | 43 | 36 | 0.84 |
| 2008 | 3.90 | 23.3 | 2.12 | 5.67 | 2.85 | 13.8 | 2.08 | 3.62 | 1.35 | 10 | 14 | 32 | 36.1 | 67 | 82 | 116 | 37 | 31 | 0.84 |
| 2009 | 4.23 | 32.7 | 1.5 | 6.9 | 3.10 | 12.1 | 2.4 | 3.8 | 1.03 | 11 | 11 | 28 | 32.7 | 58 | 80 | 159 | 49 | 45 | 0.92 |
| 2010 | 3.11 | 24.8 | 1.6 | 4.6 | 2.57 | 15.9 | 1.8 | 3.4 | 1.09 | 9 | 16 | 33 | 35.1 | 58 | 90 | 132 | 49 | 43 | 0.88 |
| 2011 | 2.71 | 18.5 | 1.7 | 3.7 | 2.25 | 10.3 | 1.8 | 2.7 | 1.18 | 13 | 13 | 37 | 36.2 | 59 | 77 | 124 | 47 | 38 | 0.81 |
| 2012 | 3.71 | 23.4 | 2.0 | 5.4 | 3.65 | 14.5 | 2.6 | 4.7 | 0.9 | 4 | 10 | 26 | 30.8 | 56 | 92 | 192 | 49 | 41 | 0.84 |
| 2013 | 5.18 | 32.4 | 1.9 | 8.5 | 4.19 | 16.0 | 2.9 | 5.5 | 1.0 | 11 | 12 | 24 | 30.5 | 60 | 90 | 207 | 46 | 42 | 0.91 |
| 2014 | 3.27 | 14.9 | 2.3 | 4.2 | 4.98 | 10.1 | 4.0 | 6.0 | 0.7 | 12 | 14 | 25 | 29.0 | 51 | 89 | 251 | 47 | 42 | 0.89 |
| 2015 | 1.50 | 32.2 | 0.6 | 2.4 | 2.70 | 26.9 | 1.3 | 4.1 | 0.5 | 7 | 10 | 21 | 25.4 | 47 | 62 | 93 | 30 | 26 | 0.87 |

Table 16. Survey results from ASMFC summer shrimp surveys in the northern management region (strata 1, 3, 5, 6-8). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Biomass Index | | | | Abundance Index | | | | | | | | Length | | | of | Number | Nonzero | Nonzero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | of Tows | Tows | Tows |
| 1991 | 1.88 | 16.1 | 1.34 | 2.49 | 2.88 | 9.5 | 2.33 | 3.41 | 0.65 | 11 | 15 | 24 | 27.5 | 59 | 96 | 125 | 43 | 39 | 0.91 |
| 1992 | 2.69 | 16.0 | 1.85 | 3.51 | 2.90 | 9.9 | 2.38 | 3.47 | 0.93 | 11 | 13 | 28 | 31.5 | 56 | 78 | 135 | 45 | 40 | 0.89 |
| 1993 | 3.07 | 25.5 | 1.61 | 4.72 | 3.70 | 12.7 | 2.81 | 4.70 | 0.83 | 7 | 9 | 23 | 27.6 | 59 | 102 | 170 | 46 | 42 | 0.91 |
| 1994 | 1.66 | 22.0 | 0.99 | 2.39 | 3.42 | 12.9 | 2.55 | 4.31 | 0.48 | 5 | 10 | 19 | 24.1 | 48 | 95 | 166 | 43 | 37 | 0.86 |
| 1995 | 1.55 | 23.1 | 0.83 | 2.21 | 2.08 | 18.2 | 1.34 | 2.82 | 0.75 | 11 | 19 | 26 | 31.2 | 67 | 76 | 83 | 35 | 24 | 0.69 |
| 1996 | 3.36 | 31.3 | 1.69 | 5.53 | 2.99 | 13.7 | 2.25 | 3.85 | 1.12 | 13 | 14 | 34 | 34.4 | 63 | 90 | 107 | 32 | 30 | 0.94 |
| 1997 | 2.08 | 21.5 | 1.29 | 3.00 | 1.57 | 14.1 | 1.14 | 2.00 | 1.32 | 11 | 16 | 32 | 37.7 | 62 | 73 | 72 | 40 | 31 | 0.78 |
| 1998 | 2.27 | 29.6 | 1.10 | 3.75 | 2.12 | 13.1 | 1.59 | 2.69 | 1.07 | 12 | 16 | 23 | 31.3 | 61 | 77 | 84 | 35 | 31 | 0.89 |
| 1999 | 6.26 | 10.4 | 4.95 | 7.46 | 6.75 | 9.0 | 5.53 | 7.96 | 0.93 | 8 | 9 | 28 | 30.9 | 65 | 82 | 301 | 42 | 39 | 0.93 |
| 2000 | 3.84 | 15.2 | 2.66 | 4.99 | 5.72 | 12.9 | 4.28 | 7.17 | 0.67 | 11 | 15 | 28 | 30.2 | 51 | 82 | 215 | 35 | 30 | 0.86 |
| 2001 | 7.27 | 11.0 | 5.71 | 8.87 | 10.89 | 9.3 | 8.94 | 12.84 | 0.67 | 11 | 13 | 26 | 29.5 | 51 | 85 | 442 | 36 | 36 | 1.00 |
| 2002 | 12.44 | 10.6 | 9.91 | 14.97 | 11.65 | 8.1 | 9.89 | 13.52 | 1.07 | 11 | 17 | 32 | 35.3 | 59 | 94 | 493 | 38 | 38 | 1.00 |
| 2003 | 7.36 | 16.4 | 5.19 | 10.02 | 5.80 | 12.5 | 4.38 | 7.23 | 1.27 | 3 | 13 | 38 | 37.4 | 63 | 87 | 236 | 37 | 36 | 0.97 |
| 2004 | 4.45 | 10.2 | 3.69 | 5.43 | 3.38 | 9.9 | 2.75 | 4.07 | 1.32 | 11 | 11 | 34 | 35.7 | 66 | 75 | 142 | 35 | 33 | 0.94 |
| 2005 | 7.25 | 13.7 | 5.35 | 9.25 | 5.25 | 9.7 | 4.31 | 6.24 | 1.38 | 9 | 14 | 34 | 37.4 | 66 | 89 | 271 | 46 | 44 | 0.96 |
| 2006 | 6.54 | 11.3 | 5.12 | 8.08 | 4.31 | 7.1 | 3.71 | 4.92 | 1.52 | 7 | 11 | 30 | 37.2 | 70 | 89 | 143 | 29 | 29 | 1.00 |
| 2007 | 4.10 | 21.1 | 2.55 | 5.89 | 4.46 | 13.2 | 3.41 | 5.73 | 0.92 | 9 | 11 | 19 | 28.2 | 64 | 79 | 218 | 43 | 36 | 0.84 |
| 2008 | 3.79 | 19.8 | 2.40 | 5.40 | 2.82 | 11.1 | 2.21 | 3.42 | 1.35 | 10 | 14 | 32 | 36.1 | 67 | 82 | 116 | 37 | 31 | 0.84 |
| 2009 | 3.21 | 19.3 | 2.04 | 4.49 | 3.12 | 11.0 | 2.46 | 3.78 | 1.03 | 11 | 11 | 28 | 32.7 | 58 | 80 | 159 | 49 | 45 | 0.92 |
| 2010 | 2.76 | 20.5 | 1.70 | 3.95 | 2.54 | 14.1 | 1.88 | 3.30 | 1.09 | 9 | 16 | 33 | 35.1 | 58 | 90 | 132 | 49 | 43 | 0.88 |
| 2011 | 2.66 | 15.2 | 1.92 | 3.49 | 2.25 | 9.7 | 1.81 | 2.68 | 1.18 | 13 | 13 | 37 | 36.2 | 59 | 77 | 124 | 47 | 38 | 0.81 |
| 2012 | 3.14 | 14.8 | 2.26 | 4.09 | 3.55 | 12.2 | 2.75 | 4.50 | 0.9 | 4 | 10 | 26 | 30.8 | 56 | 92 | 192 | 49 | 41 | 0.84 |
| 2013 | 4.07 | 16.0 | 2.89 | 5.41 | 4.13 | 13.3 | 3.08 | 5.21 | 1.0 | 11 | 12 | 24 | 30.5 | 60 | 90 | 207 | 46 | 42 | 0.91 |
| 2014 | 3.31 | 14.1 | 2.45 | 4.20 | 4.94 | 8.8 | 4.07 | 5.83 | 0.7 | 12 | 14 | 25 | 29.0 | 51 | 89 | 251 | 47 | 42 | 0.89 |
| 2015 | 1.45 | 24.2 | 0.78 | 2.11 | 2.76 | 20.7 | 1.59 | 3.84 | 0.5 | 7 | 10 | 21 | 25.4 | 47 | 62 | 93 | 30 | 26 | 0.87 |

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Table 17. Monkfish indices from Maine-New Hampshire inshore surveys, strata 1-4, regions 1-5.

Fall

| Year | Mean Weight | CV | L95% | U95% | Mean Number | CV | L95% | U95% |
|---|---|---|---|---|---|---|---|---|
| 2000 | 1.6 | 39.2 | 1.1 | 2.2 | 4.8 | 28.8 | 3.6 | 6.0 |
| 2001 | 4.8 | 19.8 | 3.9 | 5.6 | 10.8 | 20.8 | 8.5 | 13.0 |
| 2002 | 3.5 | 65.9 | 1.2 | 5.7 | 4.1 | 55.6 | 1.8 | 6.3 |
| 2003 | 3.6 | 38.0 | 2.0 | 5.2 | 3.7 | 30.6 | 2.4 | 5.0 |
| 2004 | 3.6 | 40.5 | 2.0 | 5.3 | 3.0 | 31.0 | 1.9 | 4.0 |
| 2005 | 2.0 | 34.5 | 1.1 | 3.0 | 1.8 | 21.8 | 1.3 | 2.3 |
| 2006 | 1.8 | 22.6 | 1.4 | 2.2 | 2.9 | 22.4 | 2.3 | 3.6 |
| 2007 | 2.1 | 32.2 | 1.4 | 2.8 | 3.1 | 26.4 | 2.3 | 4.0 |
| 2008 | 3.0 | 27.3 | 2.1 | 3.8 | 4.1 | 33.2 | 2.7 | 5.5 |
| 2009 | 1.9 | 59.3 | 0.9 | 3.0 | 2.0 | 44.7 | 1.2 | 2.8 |
| 2010 | 0.7 | 35.3 | 0.5 | 1.0 | 1.1 | 32.1 | 0.7 | 1.4 |
| 2011 | 1.1 | 38.3 | 0.7 | 1.5 | 1.0 | 36.6 | 0.6 | 1.3 |
| 2012 | 0.5 | 51.1 | 0.2 | 0.8 | 0.8 | 34.7 | 0.5 | 1.1 |
| 2013 | 0.6 | 59.2 | 0.3 | 1.0 | 0.8 | 39.2 | 0.5 | 1.1 |
| 2014 | 0.3 | 42.7 | 0.2 | 0.4 | 1.1 | 31.9 | 0.8 | 1.4 |
| 2015 | 1.6 | 30.0 | 1.2 | 2.1 | 7.1 | 32.9 | 5.0 | 9.3 |

Spring

| Year | Mean Weight | CV | L95% | U95% | Mean Number | CV | L95% | U95% |
|---|---|---|---|---|---|---|---|---|
| 2000 | | | | | | | | |
| 2001 | 1.0 | 34.7 | 0.7 | 1.3 | 6.0 | 34.6 | 4.2 | 7.8 |
| 2002 | 1.1 | 36.8 | 0.8 | 1.5 | 2.4 | 30.6 | 1.7 | 3.0 |
| 2003 | 0.6 | 52.0 | 0.3 | 1.0 | 1.0 | 25.7 | 0.7 | 1.2 |
| 2004 | 0.4 | 59.8 | 0.2 | 0.6 | 1.4 | 23.3 | 1.1 | 1.8 |
| 2005 | 0.8 | 35.5 | 0.5 | 1.1 | 1.1 | 22.0 | 0.8 | 1.5 |
| 2006 | 0.1 | 44.6 | 0.1 | 0.2 | 0.3 | 42.1 | 0.2 | 0.4 |
| 2007 | 0.4 | 49.5 | 0.2 | 0.6 | 1.1 | 30.3 | 0.8 | 1.5 |
| 2008 | 0.5 | 30.3 | 0.3 | 0.7 | 1.4 | 25.8 | 1.0 | 1.7 |
| 2009 | 0.2 | 44.0 | 0.1 | 0.3 | 0.8 | 30.9 | 0.6 | 1.0 |
| 2010 | 0.2 | 48.7 | 0.1 | 0.3 | 0.6 | 40.9 | 0.4 | 0.8 |
| 2011 | 0.2 | 69.6 | 0.1 | 0.3 | 0.3 | 35.1 | 0.2 | 0.4 |
| 2012 | 0.3 | 95.0 | 0.0 | 0.5 | 0.4 | 36.1 | 0.2 | 0.5 |
| 2013 | 0.2 | 100.9 | 0.0 | 0.3 | 0.4 | 44.5 | 0.2 | 0.5 |
| 2014 | 0.2 | 93.1 | 0.1 | 0.4 | 0.9 | 36.6 | 0.6 | 1.2 |
| 2015 | 0.2 | 32.7 | 0.1 | 0.2 | 1.1 | 28.5 | 0.8 | 1.3 |

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Table 18. Survey results from NEFSC offshore autumn bottom trawl surveys in the southern management region (strata 1-19, 61-76). Indices are delta distribution stratified means.

| | Biomass Index | | | | Abundance Index | | | | | Length | | | | | | Number of | Number of | Number of Nonzero | Proportion Nonzero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | Tows | Tows | Tows |
| 1963 | 3.83 | 26.5 | 1.8 | 5.5 | 1.20 | 19.6 | 0.7 | 1.7 | 3.0 | 7 | 17 | 53 | 50.4 | 91 | 97 | 102 | 73 | 36 | 0.49 |
| 1964 | 9.98 | 57.2 | 2.7 | 9.6 | 1.64 | 22.7 | 0.9 | 2.4 | 3.5 | 14 | 21 | 53 | 52.0 | 86 | 101 | 132 | 83 | 34 | 0.41 |
| 1965 | 5.25 | 22.8 | 2.9 | 7.3 | 1.15 | 16.4 | 0.8 | 1.5 | 4.2 | 10 | 15 | 59 | 56.3 | 91 | 104 | 83 | 85 | 39 | 0.46 |
| 1966 | 7.14 | 14.5 | 5.1 | 9.1 | 1.93 | 14.9 | 1.4 | 2.5 | 3.6 | 7 | 7 | 51 | 49.6 | 87 | 98 | 101 | 87 | 56 | 0.64 |
| 1967 | 1.25 | 26.3 | 0.6 | 1.7 | 0.52 | 19.2 | 0.3 | 0.7 | 2.2 | 14 | 19 | 31 | 40.6 | 83 | 100 | 98 | 163 | 42 | 0.26 |
| 1968 | 0.90 | 25.7 | 0.5 | 1.3 | 0.40 | 24.2 | 0.2 | 0.6 | 2.2 | 12 | 17 | 45 | 46.3 | 75 | 86 | 77 | 164 | 39 | 0.24 |
| 1969 | 1.44 | 32.3 | 0.5 | 2.2 | 0.54 | 21.8 | 0.3 | 0.8 | 2.5 | 10 | 14 | 41 | 45.4 | 88 | 96 | 101 | 163 | 43 | 0.26 |
| 1970 | 1.34 | 27.2 | 0.6 | 2.0 | 0.35 | 16.8 | 0.2 | 0.5 | 3.6 | 4 | 13 | 55 | 53.3 | 84 | 104 | 58 | 161 | 35 | 0.22 |
| 1971 | 0.73 | 32.8 | 0.3 | 1.1 | 0.28 | 23.8 | 0.2 | 0.4 | 2.8 | 5 | 8 | 39 | 42.3 | 95 | 98 | 55 | 168 | 28 | 0.17 |
| 1972 | 5.27 | 18.6 | 3.4 | 6.7 | 4.11 | 35.1 | 1.3 | 6.9 | 1.3 | 12 | 16 | 23 | 31.8 | 74 | 99 | 604 | 161 | 85 | 0.53 |
| 1973 | 2.04 | 25.5 | 1.0 | 3.0 | 1.18 | 13.8 | 0.9 | 1.5 | 1.6 | 13 | 14 | 32 | 37.7 | 77 | 93 | 280 | 154 | 70 | 0.45 |
| 1974 | 0.71 | 27.8 | 0.3 | 1.1 | 0.22 | 23.8 | 0.1 | 0.3 | 3.3 | 14 | 16 | 54 | 52.9 | 81 | 101 | 56 | 153 | 26 | 0.17 |
| 1975 | 2.05 | 17.9 | 1.3 | 2.8 | 0.65 | 17.2 | 0.4 | 0.9 | 2.7 | 8 | 17 | 45 | 46.3 | 87 | 105 | 127 | 158 | 51 | 0.32 |
| 1976 | 1.08 | 25.7 | 0.5 | 1.6 | 0.31 | 20.2 | 0.2 | 0.4 | 3.2 | 11 | 11 | 51 | 50.7 | 77 | 95 | 60 | 165 | 34 | 0.21 |
| 1977 | 1.87 | 18.5 | 1.2 | 2.6 | 0.37 | 14.6 | 0.3 | 0.5 | 4.2 | 5 | 16 | 55 | 53.1 | 95 | 106 | 94 | 172 | 50 | 0.29 |
| 1978 | 1.39 | 18.7 | 0.9 | 1.9 | 0.26 | 16.0 | 0.2 | 0.3 | 4.5 | 13 | 17 | 61 | 56.5 | 87 | 101 | 68 | 219 | 39 | 0.18 |
| 1979 | 2.28 | 22.4 | 1.3 | 3.3 | 0.69 | 15.5 | 0.5 | 0.9 | 2.3 | 7 | 16 | 34 | 40.5 | 84 | 109 | 182 | 205 | 70 | 0.34 |
| 1980 | 1.87 | 19.2 | 1.2 | 2.6 | 0.73 | 21.0 | 0.4 | 1.0 | 2.2 | 3 | 16 | 34 | 41.6 | 85 | 104 | 113 | 159 | 42 | 0.26 |
| 1981 | 2.93 | 34.5 | 0.9 | 4.8 | 0.97 | 20.4 | 0.6 | 1.4 | 2.0 | 6 | 17 | 38 | 40.7 | 71 | 99 | 176 | 146 | 59 | 0.40 |
| 1982 | 0.65 | 23.3 | 0.4 | 1.0 | 0.61 | 19.8 | 0.4 | 0.8 | 1.1 | 13 | 15 | 26 | 32.5 | 66 | 73 | 98 | 143 | 42 | 0.29 |
| 1983 | 2.15 | 34.6 | 0.7 | 3.6 | 0.78 | 20.1 | 0.5 | 1.1 | 2.3 | 7 | 16 | 45 | 44.4 | 72 | 100 | 109 | 146 | 49 | 0.34 |
| 1984 | 0.74 | 40.8 | 0.2 | 1.3 | 0.31 | 32.4 | 0.1 | 0.5 | 2.4 | 5 | 13 | 47 | 45.7 | 68 | 93 | 42 | 146 | 25 | 0.17 |
| 1985 | 1.32 | 21.9 | 0.8 | 1.9 | 0.52 | 16.5 | 0.4 | 0.7 | 2.1 | 17 | 17 | 40 | 42.0 | 72 | 96 | 100 | 145 | 46 | 0.32 |
| 1986 | 0.55 | 29.1 | 0.2 | 0.9 | 0.33 | 23.6 | 0.2 | 0.5 | 1.5 | 7 | 14 | 34 | 37.6 | 68 | 78 | 60 | 146 | 33 | 0.23 |
| 1987 | 0.27 | 29.3 | 0.1 | 0.4 | 0.48 | 18.5 | 0.3 | 0.7 | 0.6 | 12 | 13 | 20 | 25.0 | 56 | 61 | 67 | 132 | 27 | 0.20 |
| 1988 | 0.55 | 31.7 | 0.2 | 0.9 | 0.23 | 29.4 | 0.1 | 0.4 | 2.4 | 19 | 27 | 36 | 45.1 | 87 | 91 | 27 | 129 | 19 | 0.15 |
| 1989 | 0.90 | 42.0 | 0.3 | 1.0 | 0.38 | 26.7 | 0.2 | 0.6 | 1.4 | 7 | 7 | 42 | 38.0 | 57 | 77 | 57 | 129 | 23 | 0.18 |
| 1990 | 0.43 | 47.5 | 0.0 | 0.8 | 0.29 | 31.0 | 0.1 | 0.5 | 1.1 | 9 | 13 | 24 | 33.1 | 61 | 81 | 47 | 136 | 22 | 0.16 |
| 1991 | 0.79 | 35.9 | 0.2 | 1.3 | 0.69 | 32.7 | 0.2 | 1.1 | 0.9 | 14 | 15 | 23 | 30.8 | 57 | 81 | 106 | 131 | 27 | 0.21 |
| 1992 | 0.36 | 34.5 | 0.2 | 0.4 | 0.34 | 17.7 | 0.2 | 0.5 | 0.9 | 8 | 11 | 30 | 32.2 | 54 | 74 | 46 | 129 | 21 | 0.16 |
| 1993 | 0.29 | 41.2 | 0.1 | 0.5 | 0.29 | 27.0 | 0.1 | 0.4 | 0.8 | 10 | 13 | 32 | 30.4 | 52 | 68 | 46 | 130 | 24 | 0.18 |
| 1994 | 0.61 | 35.9 | 0.2 | 1.1 | 0.60 | 20.9 | 0.4 | 0.8 | 0.9 | 8 | 12 | 25 | 29.2 | 59 | 83 | 85 | 135 | 31 | 0.23 |
| 1995 | 0.39 | 29.7 | 0.2 | 0.6 | 0.49 | 24.2 | 0.3 | 0.7 | 0.8 | 11 | 13 | 25 | 29.4 | 54 | 66 | 72 | 129 | 29 | 0.22 |
| 1996 | 0.39 | 22.4 | 0.2 | 0.6 | 0.23 | 22.4 | 0.1 | 0.3 | 1.6 | 18 | 19 | 42 | 42.3 | 62 | 68 | 31 | 131 | 21 | 0.16 |
| 1997 | 0.59 | 20.5 | 0.4 | 0.8 | 0.31 | 18.2 | 0.2 | 0.4 | 1.9 | 9 | 9 | 49 | 44.6 | 70 | 71 | 43 | 131 | 24 | 0.18 |
| 1998 | 0.50 | 26.1 | 0.2 | 0.8 | 0.33 | 28.0 | 0.1 | 0.5 | 1.5 | 11 | 11 | 36 | 37.0 | 68 | 87 | 45 | 131 | 20 | 0.15 |
| 1999 | 0.30 | 18.2 | 0.2 | 0.4 | 0.45 | 14.9 | 0.3 | 0.6 | 0.7 | 12 | 14 | 27 | 29.2 | 52 | 55 | 109 | 106 | 44 | 0.42 |
| 2000 | 1.02 | 62.2 | 0.3 | 0.7 | 0.42 | 18.4 | 0.3 | 0.6 | 1.1 | 5 | 15 | 33 | 34.3 | 63 | 70 | 64 | 132 | 30 | 0.23 |
| 2001 | 0.71 | 24.3 | 0.4 | 1.1 | 0.38 | 18.8 | 0.2 | 0.5 | 1.7 | 4 | 11 | 39 | 41.7 | 70 | 80 | 51 | 130 | 30 | 0.23 |
| 2002 | 1.32 | 20.6 | 0.8 | 1.8 | 0.83 | 16.2 | 0.6 | 1.1 | 1.5 | 6 | 14 | 41 | 39.1 | 61 | 81 | 110 | 130 | 47 | 0.36 |
| 2003 | 0.83 | 17.6 | 0.5 | 1.1 | 0.95 | 17.4 | 0.6 | 1.3 | 0.9 | 6 | 7 | 18 | 28.3 | 59 | 70 | 128 | 130 | 41 | 0.32 |
| 2004 | 0.97 | 33.5 | 0.3 | 1.6 | 0.47 | 24.5 | 0.2 | 0.7 | 1.6 | 7 | 15 | 45 | 40.4 | 64 | 78 | 67 | 133 | 32 | 0.24 |
| 2005 | 0.80 | 25.0 | 0.4 | 1.2 | 0.58 | 20.9 | 0.3 | 0.8 | 1.3 | 7 | 13 | 42 | 38.5 | 57 | 67 | 76 | 123 | 34 | 0.28 |
| 2006 | 0.83 | 27.8 | 0.4 | 1.3 | 0.45 | 19.5 | 0.3 | 0.6 | 1.7 | 6 | 12 | 44 | 40.6 | 65 | 77 | 83 | 151 | 36 | 0.24 |
| 2007 | 0.51 | 26.1 | 0.2 | 0.8 | 0.20 | 23.2 | 0.1 | 0.3 | 2.6 | 25 | 25 | 51 | 50.1 | 68 | 69 | 27 | 142 | 19 | 0.13 |
| 2008 | 0.41 | 37.2 | 0.1 | 0.7 | 0.20 | 26.4 | 0.1 | 0.3 | 2.1 | 4 | 4 | 45 | 38.6 | 69 | 88 | 39 | 142 | 20 | 0.14 |
| 2009 | 0.25 | 14.9 | 0.18 | 0.32 | 0.22 | 15.4 | 0.32 | 0.29 | 1.2 | 6 | 7 | 28 | 34 | 63 | 77 | 289 | 144 | 73 | 0.51 |
| 2010 | 0.37 | 20.2 | 0.22 | 0.52 | 0.40 | 19.2 | 0.52 | 0.55 | 1.0 | 5 | 9 | 22 | 31 | 64 | 78 | 386 | 145 | 70 | 0.48 |
| 2011 | 0.32 | 18.1 | 0.21 | 0.44 | 0.62 | 15.6 | 0.44 | 0.81 | 0.6 | 6 | 8 | 19 | 25 | 52 | 76 | 482 | 99 | 66 | 0.67 |
| 2012 | 0.45 | 18.1 | 0.29 | 0.61 | 0.28 | 17.3 | 0.61 | 0.38 | 1.8 | 4 | 24 | 40 | 44 | 67 | 82 | 306 | 135 | 69 | 0.51 |
| 2013 | 0.45 | 40.5 | 0.09 | 0.80 | 0.29 | 19.1 | 0.80 | 0.39 | 1.1 | 5 | 7 | 23 | 32 | 57 | 81 | 285 | 124 | 71 | 0.57 |
| 2014 | 0.16 | 22.9 | 0.09 | 0.23 | 0.16 | 16.3 | 0.23 | 0.21 | 1.1 | 7 | 9 | 29 | 34 | 60 | 71 | 213 | 127 | 54 | 0.43 |
| 2015 | 0.36 | 20.9 | 0.21 | 0.51 | 1.87 | 28.5 | 0.51 | 2.92 | 0.2 | 5 | 13 | 19 | 21 | 26 | 69 | 1857 | 166 | 98 | 0.59 |
| Bigelow, no calibration coefficient applied: | | | | | | | | | | | | | | | | | | | |
| 2009 | 2.01 | 14.9 | 1.43 | 2.60 | 1.57 | 15.4 | 1.10 | 2.04 | | | | | | | | | | | |
| 2010 | 3.00 | 20.2 | 1.81 | 4.20 | 2.83 | 19.2 | 1.77 | 3.90 | | | | | | | | | | | |
| 2011 | 2.61 | 18.1 | 1.69 | 3.54 | 4.41 | 15.6 | 3.06 | 5.76 | | | | | | | | | | | |
| 2012 | 3.64 | 18.1 | 2.35 | 4.93 | 2.01 | 17.3 | 1.33 | 2.69 | | | | | | | | | | | |
| 2013 | 3.59 | 40.5 | 0.74 | 6.45 | 2.03 | 19.1 | 1.27 | 2.79 | | | | | | | | | | | |
| 2014 | 1.26 | 22.9 | 0.70 | 1.83 | 1.15 | 16.3 | 0.79 | 1.52 | | | | | | | | | | | |
| 2015 | 2.93 | 20.9 | 1.73 | 4.13 | 13.36 | 28.5 | 5.91 | 20.82 | | | | | | | | | | | |

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Table 19. Survey results from NEFSC offshore autumn bottom trawl surveys in the southern management region (strata 20-30, 34-40). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Biomass Index | | | | Abundance Index | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% |
| 1963 | 3.60 | 23.2 | 2.09 | 5.42 | 1.20 | 19.3 | 0.80 | 1.72 |
| 1964 | 5.50 | 17.3 | 3.75 | 7.34 | 1.64 | 15.8 | 1.09 | 2.07 |
| 1965 | 4.90 | 16.8 | 3.33 | 6.61 | 1.15 | 14.4 | 0.85 | 1.48 |
| 1966 | 7.01 | 12.9 | 5.27 | 8.81 | 1.93 | 14.5 | 1.44 | 2.53 |
| 1967 | 1.14 | 21.3 | 0.71 | 1.65 | 0.52 | 17.1 | 0.35 | 0.69 |
| 1968 | 0.89 | 23.5 | 0.52 | 1.31 | 0.40 | 21.7 | 0.25 | 0.58 |
| 1969 | 1.33 | 29.9 | 0.69 | 2.22 | 0.54 | 19.8 | 0.35 | 0.75 |
| 1970 | 1.29 | 22.2 | 0.76 | 1.85 | 0.35 | 15.9 | 0.25 | 0.47 |
| 1971 | 0.79 | 35.3 | 0.33 | 1.42 | 0.28 | 20.6 | 0.18 | 0.40 |
| 1972 | 4.89 | 14.4 | 3.52 | 6.27 | 4.11 | 23.1 | 2.30 | 5.58 |
| 1973 | 1.83 | 16.0 | 1.29 | 2.43 | 1.18 | 11.4 | 0.91 | 1.42 |
| 1974 | 0.72 | 26.8 | 0.39 | 1.13 | 0.22 | 22.2 | 0.13 | 0.32 |
| 1975 | 2.00 | 16.8 | 1.35 | 2.64 | 0.75 | 16.3 | 0.53 | 1.01 |
| 1976 | 1.00 | 17.2 | 0.66 | 1.33 | 0.31 | 19.3 | 0.22 | 0.44 |
| 1977 | 1.88 | 16.8 | 1.30 | 2.52 | 0.45 | 13.4 | 0.33 | 0.57 |
| 1978 | 1.40 | 17.0 | 0.96 | 1.87 | 0.31 | 15.9 | 0.22 | 0.42 |
| 1979 | 1.93 | 15.9 | 1.33 | 2.51 | 0.84 | 13.2 | 0.63 | 1.07 |
| 1980 | 1.85 | 16.9 | 1.32 | 2.51 | 0.87 | 15.1 | 0.59 | 1.08 |
| 1981 | 2.26 | 17.3 | 1.51 | 3.09 | 1.16 | 15.1 | 0.81 | 1.51 |
| 1982 | 0.65 | 21.3 | 0.39 | 0.94 | 0.61 | 17.3 | 0.41 | 0.83 |
| 1983 | 1.76 | 20.2 | 1.09 | 2.46 | 0.78 | 16.5 | 0.53 | 1.02 |
| 1984 | 0.77 | 41.0 | 0.26 | 1.42 | 0.31 | 32.2 | 0.14 | 0.53 |
| 1985 | 1.29 | 18.9 | 0.85 | 1.80 | 0.62 | 15.4 | 0.45 | 0.83 |
| 1986 | 0.55 | 27.6 | 0.28 | 0.89 | 0.36 | 21.5 | 0.22 | 0.52 |
| 1987 | 0.28 | 29.3 | 0.13 | 0.46 | 0.48 | 18.5 | 0.32 | 0.68 |
| 1988 | 0.55 | 29.7 | 0.25 | 0.91 | 0.23 | 26.5 | 0.13 | 0.37 |
| 1989 | 0.62 | 25.4 | 0.33 | 0.99 | 0.46 | 23.2 | 0.26 | 0.67 |
| 1990 | 0.37 | 32.0 | 0.17 | 0.63 | 0.35 | 27.6 | 0.17 | 0.55 |
| 1991 | 0.77 | 29.1 | 0.38 | 1.25 | 0.83 | 29.5 | 0.39 | 1.39 |
| 1992 | 0.32 | 20.9 | 0.21 | 0.46 | 0.34 | 16.3 | 0.24 | 0.45 |
| 1993 | 0.27 | 31.6 | 0.12 | 0.45 | 0.35 | 23.7 | 0.20 | 0.51 |
| 1994 | 0.55 | 23.1 | 0.31 | 0.82 | 0.60 | 19.4 | 0.38 | 0.85 |
| 1995 | 0.39 | 28.9 | 0.19 | 0.62 | 0.49 | 21.6 | 0.31 | 0.73 |
| 1996 | 0.39 | 20.2 | 0.24 | 0.55 | 0.23 | 20.9 | 0.15 | 0.34 |
| 1997 | 0.59 | 19.4 | 0.38 | 0.83 | 0.31 | 16.4 | 0.22 | 0.41 |
| 1998 | 0.50 | 23.7 | 0.28 | 0.75 | 0.33 | 23.0 | 0.19 | 0.48 |
| 1999 | 0.30 | 15.0 | 0.22 | 0.39 | 0.45 | 12.7 | 0.35 | 0.56 |
| 2000 | 0.47 | 19.6 | 0.29 | 0.65 | 0.42 | 16.2 | 0.29 | 0.56 |
| 2001 | 0.65 | 17.9 | 0.44 | 0.88 | 0.38 | 16.6 | 0.26 | 0.51 |
| 2002 | 1.25 | 18.7 | 0.84 | 1.74 | 0.83 | 14.9 | 0.59 | 1.07 |
| 2003 | 0.82 | 15.1 | 0.58 | 1.07 | 0.95 | 15.9 | 0.68 | 1.26 |
| 2004 | 0.74 | 18.1 | 0.50 | 1.02 | 0.47 | 19.8 | 0.30 | 0.66 |
| 2005 | 0.77 | 23.7 | 0.44 | 1.14 | 0.58 | 21.2 | 0.37 | 0.85 |
| 2006 | 0.76 | 23.4 | 0.45 | 1.13 | 0.45 | 19.0 | 0.30 | 0.64 |
| 2007 | 0.50 | 23.1 | 0.28 | 0.74 | 0.20 | 21.3 | 0.12 | 0.28 |
| 2008 | 0.41 | 34.0 | 0.17 | 0.72 | 0.20 | 24.8 | 0.11 | 0.30 |
| 2009 | 0.24 | 13.5 | 0.19 | 0.30 | 0.22 | 11.7 | 0.16 | 0.28 |
| 2010 | 0.36 | 19.2 | 0.26 | 0.50 | 0.40 | 16.6 | 0.27 | 0.58 |
| 2011 | 0.30 | 13.2 | 0.24 | 0.37 | 0.62 | 11.6 | 0.47 | 0.78 |
| 2012 | 0.43 | 13.8 | 0.33 | 0.55 | 0.28 | 13.3 | 0.21 | 0.35 |
| 2013 | 0.27 | 17.7 | 0.20 | 0.35 | 0.29 | 14.5 | 0.19 | 0.39 |
| 2014 | 0.15 | 12.3 | 0.10 | 0.20 | 0.16 | 18.2 | 0.12 | 0.20 |
| 2015 | 0.37 | 28.7 | 0.24 | 0.54 | 1.87 | 21.8 | 1.09 | 3.21 |
| Bigelow, no calibration coefficient applied: | | | | | | | | |
| 2009 | 1.92 | 12.9 | 1.42 | 2.43 | 1.56 | 14.7 | 1.07 | 2.04 |
| 2010 | 2.92 | 18.2 | 1.77 | 4.07 | 2.87 | 20.8 | 1.55 | 4.19 |
| 2011 | 2.42 | 13.3 | 1.74 | 3.10 | 4.36 | 15.1 | 2.88 | 5.84 |
| 2012 | 3.50 | 18.0 | 1.69 | 5.31 | 1.96 | 15.8 | 1.22 | 2.71 |
| 2013 | 2.19 | 17.1 | 1.39 | 2.99 | 2.07 | 18.5 | 1.27 | 2.86 |
| 2014 | 1.20 | 22.7 | 0.43 | 1.98 | 1.14 | 15.0 | 0.74 | 1.54 |
| 2015 | 2.96 | 23.4 | 1.37 | 4.55 | 13.96 | 30.9 | 3.72 | 24.20 |

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Table 20. Survey results from NEFSC offshore spring bottom trawl surveys in the southern management region (strata 1-19, 61-76). Indices are delta distribution stratified means.

| | Biomass Index | | | | Abundance Index | | | | | | | | Length | | | of | Number | Nonzero | Nonzero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | Fish | of Tows | Tows | Tows |
| 1968 | 1.16 | 26.0 | 0.57 | 1.75 | 0.21 | 20.6 | 0.13 | 0.30 | 5.4 | 21 | 23 | 63 | 62.5 | 94 | 95 | 65 | 150 | 31 | 0.21 |
| 1969 | 0.96 | 27.6 | 0.44 | 1.47 | 0.22 | 19.2 | 0.14 | 0.30 | 4.1 | 7 | 25 | 47 | 54.3 | 91 | 111 | 41 | 155 | 31 | 0.20 |
| 1970 | 1.01 | 27.6 | 0.46 | 1.55 | 0.18 | 20.9 | 0.10 | 0.25 | 5.6 | 22 | 22 | 65 | 63.9 | 102 | 108 | 40 | 166 | 31 | 0.19 |
| 1971 | 0.77 | 30.0 | 0.32 | 1.22 | 0.20 | 24.8 | 0.10 | 0.30 | 3.7 | 13 | 16 | 50 | 53.3 | 101 | 115 | 42 | 160 | 24 | 0.15 |
| 1972 | 1.89 | 19.5 | 1.17 | 2.61 | 0.36 | 13.7 | 0.27 | 0.46 | 5.2 | 14 | 22 | 59 | 59.1 | 103 | 123 | 79 | 165 | 48 | 0.29 |
| 1973 | 1.90 | 13.8 | 1.54 | 2.25 | 1.05 | 9.3 | 0.85 | 1.25 | 2.2 | 11 | 19 | 32 | 41.1 | 80 | 110 | 589 | 187 | 128 | 0.68 |
| 1974 | 1.16 | 18.1 | 0.77 | 1.56 | 0.49 | 12.3 | 0.37 | 0.60 | 3.2 | 14 | 21 | 44 | 49.1 | 93 | 117 | 201 | 132 | 70 | 0.53 |
| 1975 | 0.95 | 20.4 | 0.57 | 1.32 | 0.45 | 13.8 | 0.33 | 0.57 | 2.8 | 10 | 22 | 44 | 47.6 | 87 | 107 | 169 | 134 | 61 | 0.46 |
| 1976 | 1.21 | 15.9 | 0.83 | 1.59 | 0.40 | 12.0 | 0.31 | 0.50 | 3.3 | 13 | 22 | 48 | 51.5 | 91 | 110 | 259 | 162 | 78 | 0.48 |
| 1977 | 1.21 | 18.2 | 0.77 | 1.64 | 0.30 | 11.3 | 0.23 | 0.37 | 4.6 | 16 | 21 | 51 | 56.8 | 95 | 116 | 173 | 160 | 75 | 0.47 |
| 1978 | 0.75 | 16.9 | 0.52 | 0.97 | 0.33 | 10.7 | 0.26 | 0.40 | 3.0 | 11 | 17 | 39 | 45.9 | 90 | 104 | 196 | 161 | 66 | 0.41 |
| 1979 | 0.76 | 26.2 | 0.46 | 1.05 | 0.28 | 21.2 | 0.16 | 0.40 | 2.9 | 10 | 14 | 37 | 44.4 | 98 | 124 | 125 | 194 | 50 | 0.26 |
| 1980 | 0.80 | 19.5 | 0.49 | 1.10 | 0.45 | 10.8 | 0.35 | 0.55 | 1.9 | 18 | 21 | 34 | 40.8 | 83 | 106 | 346 | 204 | 99 | 0.49 |
| 1981 | 1.82 | 18.5 | 1.16 | 2.47 | 0.78 | 15.8 | 0.54 | 1.03 | 2.6 | 12 | 22 | 40 | 44.6 | 89 | 113 | 345 | 141 | 74 | 0.52 |
| 1982 | 2.81 | 22.2 | 1.59 | 4.03 | 0.94 | 15.4 | 0.66 | 1.23 | 2.3 | 11 | 14 | 38 | 42.4 | 89 | 104 | 251 | 150 | 68 | 0.45 |
| 1983 | 0.95 | 28.5 | 0.42 | 1.49 | 0.27 | 17.8 | 0.18 | 0.36 | 3.5 | 24 | 24 | 47 | 51.8 | 97 | 112 | 55 | 147 | 36 | 0.24 |
| 1984 | 0.75 | 35.8 | 0.22 | 1.27 | 0.18 | 25.9 | 0.09 | 0.27 | 4.1 | 21 | 21 | 47 | 50.9 | 96 | 97 | 35 | 149 | 22 | 0.15 |
| 1985 | 0.33 | 36.9 | 0.09 | 0.57 | 0.16 | 28.0 | 0.07 | 0.25 | 2.1 | 22 | 22 | 39 | 42.3 | 85 | 90 | 31 | 147 | 21 | 0.14 |
| 1986 | 0.83 | 29.7 | 0.35 | 1.31 | 0.28 | 28.5 | 0.12 | 0.44 | 2.9 | 15 | 24 | 43 | 48.7 | 90 | 102 | 65 | 149 | 36 | 0.24 |
| 1987 | 0.50 | 52.4 | -0.01 | 1.01 | 0.11 | 25.6 | 0.05 | 0.16 | 4.6 | 15 | 15 | 59 | 52.7 | 102 | 103 | 30 | 150 | 21 | 0.14 |
| 1988 | 0.43 | 15.0 | 0.30 | 0.55 | 0.44 | 17.9 | 0.29 | 0.60 | 1.0 | 17 | 18 | 30 | 34.0 | 61 | 82 | 67 | 132 | 33 | 0.25 |
| 1989 | 0.36 | 17.9 | 0.24 | 0.49 | 0.20 | 25.3 | 0.10 | 0.30 | 1.5 | 15 | 24 | 41 | 41.4 | 69 | 79 | 36 | 129 | 18 | 0.14 |
| 1990 | 1.00 | 22.3 | 0.57 | 1.44 | 0.21 | 13.2 | 0.15 | 0.26 | 4.0 | 16 | 21 | 53 | 56.5 | 86 | 93 | 39 | 128 | 23 | 0.18 |
| 1991 | 0.59 | 29.2 | 0.32 | 0.86 | 0.32 | 28.0 | 0.14 | 0.49 | 1.5 | 15 | 23 | 33 | 37.6 | 69 | 101 | 61 | 132 | 31 | 0.23 |
| 1992 | 0.21 | 34.1 | 0.07 | 0.35 | 0.18 | 25.5 | 0.09 | 0.27 | 1.2 | 14 | 19 | 28 | 35.0 | 69 | 85 | 28 | 128 | 17 | 0.13 |
| 1993 | 0.26 | 32.1 | 0.10 | 0.43 | 0.20 | 25.1 | 0.10 | 0.29 | 1.3 | 17 | 19 | 38 | 38.6 | 56 | 72 | 29 | 128 | 18 | 0.14 |
| 1994 | 0.32 | 29.1 | 0.14 | 0.50 | 0.11 | 24.9 | 0.06 | 0.17 | 2.4 | 13 | 13 | 41 | 44 | 91 | 93 | 24 | 131 | 18 | 0.14 |
| 1995 | 0.53 | 47.9 | 0.03 | 1.02 | 0.20 | 22.6 | 0.11 | 0.28 | 2.6 | 18 | 19 | 38 | 46 | 80 | 81 | 32 | 129 | 20 | 0.16 |
| 1996 | 0.29 | 25.1 | 0.15 | 0.43 | 0.14 | 22.9 | 0.07 | 0.20 | 2.1 | 9 | 9 | 44 | 44 | 80 | 81 | 27 | 143 | 20 | 0.14 |
| 1997 | 0.13 | 23.6 | 0.07 | 0.19 | 0.12 | 22.1 | 0.07 | 0.18 | 1.1 | 18 | 18 | 37 | 36 | 58 | 75 | 38 | 130 | 14 | 0.11 |
| 1998 | 0.28 | 16.7 | 0.19 | 0.37 | 0.25 | 15.9 | 0.17 | 0.33 | 1.1 | 12 | 16 | 35 | 36 | 64 | 77 | 40 | 131 | 30 | 0.23 |
| 1999 | 0.63 | 20.6 | 0.37 | 0.88 | 0.33 | 16.1 | 0.23 | 0.44 | 1.9 | 16 | 19 | 41 | 43 | 74 | 94 | 63 | 131 | 32 | 0.24 |
| 2000 | 0.29 | 19.8 | 0.18 | 0.41 | 0.24 | 18.3 | 0.15 | 0.33 | 1.2 | 14 | 14 | 38 | 38 | 61 | 78 | 32 | 131 | 25 | 0.19 |
| 2001 | 0.24 | 31.3 | 0.09 | 0.39 | 0.23 | 21.4 | 0.14 | 0.33 | 1.1 | 11 | 15 | 34 | 36 | 57 | 68 | 44 | 89 | 50 | 0.56 |
| 2002 | 0.37 | 32.8 | 0.13 | 0.62 | 0.32 | 35.6 | 0.10 | 0.54 | 1.2 | 22 | 23 | 37 | 39 | 53 | 62 | 50 | 91 | 50 | 0.55 |
| 2003 | 1.42 | 19.0 | 0.89 | 1.95 | 0.31 | 17.8 | 0.20 | 0.42 | 3.7 | 15 | 29 | 57 | 57 | 80 | 87 | 65 | 86 | 30 | 0.35 |
| 2004 | 0.19 | 34.9 | 0.06 | 0.32 | 0.12 | 27.1 | 0.05 | 0.18 | 1.6 | 22 | 21 | 37 | 40 | 61 | 62 | 24 | 88 | 36 | 0.41 |
| 2005 | 0.37 | 18.7 | 0.23 | 0.50 | 0.26 | 29.1 | 0.11 | 0.41 | 1.4 | 20 | 20 | 36 | 39 | 61 | 68 | 41 | 131 | 26 | 0.20 |
| 2006 | 0.54 | 30.6 | 0.22 | 0.86 | 0.17 | 22.3 | 0.10 | 0.25 | 3.1 | 24 | 15 | 37 | 53 | 80 | 80 | 28 | 132 | 20 | 0.15 |
| 2007 | 0.56 | 24.1 | 0.29 | 0.82 | 0.26 | 17.0 | 0.17 | 0.34 | 2.1 | 20 | 23 | 48 | 46 | 69 | 75 | 77 | 158 | 30 | 0.19 |
| 2008 | 0.39 | 32.9 | 0.14 | 0.64 | 0.19 | 31.3 | 0.07 | 0.30 | 2.1 | 17 | 17 | 41 | 46 | 64 | 84 | 32 | 140 | 19 | 0.14 |
| 2009 | 0.31 | 16.6 | 0.21 | 0.41 | 0.16 | 15.7 | 0.11 | 0.20 | 1.9 | 14 | 24 | 47 | 47.6 | 67 | 91 | 268 | 149 | 51 | 0.34 |
| 2010 | 0.23 | 26.4 | 0.11 | 0.35 | 0.16 | 26.1 | 0.08 | 0.25 | 1.3 | 15 | 17 | 38 | 40.0 | 70 | 85 | 207 | 151 | 56 | 0.37 |
| 2011 | 0.44 | 14.8 | 0.31 | 0.57 | 0.28 | 17.1 | 0.19 | 0.38 | 1.5 | 16 | 26 | 44 | 44.9 | 65 | 87 | 481 | 122 | 62 | 0.51 |
| 2012 | 0.36 | 13.0 | 0.27 | 0.45 | 0.30 | 11.0 | 0.24 | 0.37 | 1.2 | 10 | 24 | 39 | 40.8 | 61 | 88 | 517 | 142 | 84 | 0.59 |
| 2013 | 0.34 | 15.2 | 0.24 | 0.44 | 0.19 | 15.1 | 0.14 | 0.25 | 1.7 | 8 | 36 | 46 | 48.0 | 66 | 76 | 291 | 130 | 66 | 0.51 |
| 2014 | 0.25 | 24.6 | 0.13 | 0.37 | 0.15 | 16.9 | 0.10 | 0.19 | 1.7 | 28 | 27 | 39 | 45.1 | 73 | 77 | 134 | 53 | 32 | 0.60 |
| 2015 | 0.22 | 28.8 | 0.10 | 0.35 | 0.11 | 20.3 | 0.07 | 0.16 | 1.8 | 23 | 26 | 39 | 45.9 | 77 | 93 | 223 | 165 | 66 | 0.40 |

Bigelow, no calibration coefficient applied:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2009 | 2.47 | 16.6 | 1.7 | 3.3 | 1.11 | 15.7 | 0.8 | 1.5 |
| 2010 | 1.84 | 26.4 | 0.9 | 2.8 | 1.16 | 26.1 | 0.6 | 1.8 |
| 2011 | 3.55 | 14.8 | 2.5 | 4.6 | 2.03 | 17.1 | 1.3 | 2.7 |
| 2012 | 2.90 | 13.0 | 2.2 | 3.6 | 2.17 | 11.0 | 1.7 | 2.6 |
| 2013 | 2.72 | 15.2 | 1.9 | 3.5 | 1.37 | 15.1 | 1.0 | 1.8 |
| 2014 | 2.02 | 24.6 | 1.0 | 3.0 | 1.04 | 16.9 | 0.7 | 1.4 |
| 2015 | 1.79 | 28.8 | 0.8 | 2.8 | 0.79 | 20.3 | 0.5 | 1.1 |

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Table 21. Survey results from NEFSC offshore spring bottom trawl surveys in the southern management region (strata 20-30, 34-40). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Biomass Index | | | | Abundance Index | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Mean | CV | L95% | U95% |
| 1968 | 1.16 | 22.9 | 0.64 | 1.67 | 0.21 | 18.3 | 0.14 | 0.30 |
| 1969 | 0.92 | 23.5 | 0.53 | 1.39 | 0.23 | 20.5 | 0.15 | 0.32 |
| 1970 | 1.00 | 24.5 | 0.53 | 1.49 | 0.18 | 18.9 | 0.11 | 0.24 |
| 1971 | 0.76 | 26.9 | 0.40 | 1.18 | 0.21 | 24.1 | 0.12 | 0.31 |
| 1972 | 1.88 | 18.1 | 1.24 | 2.61 | 0.36 | 12.7 | 0.27 | 0.45 |
| 1973 | 1.82 | 7.8 | 1.55 | 2.10 | 1.14 | 8.0 | 0.96 | 1.32 |
| 1974 | 1.16 | 17.0 | 0.81 | 1.58 | 0.49 | 11.2 | 0.38 | 0.60 |
| 1975 | 0.91 | 14.9 | 0.65 | 1.19 | 0.44 | 12.5 | 0.34 | 0.56 |
| 1976 | 1.13 | 11.8 | 0.89 | 1.41 | 0.46 | 11.5 | 0.36 | 0.56 |
| 1977 | 1.16 | 14.5 | 0.86 | 1.52 | 0.34 | 10.3 | 0.28 | 0.42 |
| 1978 | 0.73 | 12.7 | 0.56 | 0.93 | 0.34 | 9.3 | 0.27 | 0.40 |
| 1979 | 0.70 | 16.3 | 0.48 | 0.94 | 0.33 | 15.7 | 0.23 | 0.42 |
| 1980 | 0.74 | 14.7 | 0.53 | 0.95 | 0.52 | 10.2 | 0.43 | 0.64 |
| 1981 | 1.74 | 15.1 | 1.23 | 2.24 | 0.93 | 12.1 | 0.72 | 1.15 |
| 1982 | 2.60 | 16.8 | 1.74 | 3.49 | 1.12 | 12.4 | 0.85 | 1.39 |
| 1983 | 0.95 | 26.7 | 0.52 | 1.46 | 0.27 | 15.7 | 0.19 | 0.36 |
| 1984 | 0.74 | 30.8 | 0.35 | 1.19 | 0.18 | 22.8 | 0.11 | 0.26 |
| 1985 | 0.33 | 31.4 | 0.15 | 0.57 | 0.16 | 25.9 | 0.08 | 0.25 |
| 1986 | 0.83 | 26.4 | 0.45 | 1.28 | 0.28 | 26.6 | 0.16 | 0.45 |
| 1987 | 0.50 | 48.7 | 0.15 | 1.03 | 0.11 | 23.0 | 0.06 | 0.16 |
| 1988 | 0.43 | 12.8 | 0.33 | 0.54 | 0.44 | 16.1 | 0.31 | 0.58 |
| 1989 | 0.36 | 15.5 | 0.26 | 0.48 | 0.24 | 21.5 | 0.15 | 0.35 |
| 1990 | 1.00 | 19.3 | 0.66 | 1.40 | 0.25 | 11.6 | 0.19 | 0.30 |
| 1991 | 0.58 | 24.3 | 0.32 | 0.89 | 0.39 | 24.5 | 0.23 | 0.59 |
| 1992 | 0.22 | 33.4 | 0.10 | 0.38 | 0.18 | 23.8 | 0.10 | 0.27 |
| 1993 | 0.26 | 27.2 | 0.13 | 0.41 | 0.20 | 24.2 | 0.11 | 0.29 |
| 1994 | 0.33 | 29.8 | 0.16 | 0.53 | 0.14 | 22.4 | 0.08 | 0.20 |
| 1995 | 0.52 | 39.7 | 0.17 | 0.93 | 0.20 | 20.5 | 0.12 | 0.27 |
| 1996 | 0.28 | 19.3 | 0.18 | 0.39 | 0.14 | 19.3 | 0.09 | 0.19 |
| 1997 | 0.13 | 20.5 | 0.08 | 0.19 | 0.12 | 20.4 | 0.08 | 0.18 |
| 1998 | 0.28 | 14.8 | 0.20 | 0.37 | 0.25 | 14.6 | 0.19 | 0.34 |
| 1999 | 0.64 | 19.9 | 0.41 | 0.89 | 0.34 | 14.2 | 0.25 | 0.43 |
| 2000 | 0.30 | 18.7 | 0.19 | 0.41 | 0.24 | 16.5 | 0.17 | 0.32 |
| 2001 | 0.26 | 31.9 | 0.12 | 0.44 | 0.24 | 20.1 | 0.14 | 0.33 |
| 2002 | 0.38 | 31.2 | 0.18 | 0.62 | 0.32 | 33.6 | 0.15 | 0.54 |
| 2003 | 1.38 | 15.0 | 0.99 | 1.79 | 0.37 | 15.5 | 0.26 | 0.49 |
| 2004 | 0.18 | 26.4 | 0.10 | 0.28 | 0.12 | 24.2 | 0.06 | 0.17 |
| 2005 | 0.37 | 16.6 | 0.26 | 0.50 | 0.26 | 26.6 | 0.15 | 0.41 |
| 2006 | 0.54 | 27.4 | 0.29 | 0.87 | 0.17 | 19.6 | 0.11 | 0.24 |
| 2007 | 0.55 | 22.0 | 0.35 | 0.82 | 0.26 | 15.0 | 0.19 | 0.33 |
| 2008 | 0.39 | 31.8 | 0.19 | 0.66 | 0.19 | 31.3 | 0.10 | 0.32 |
| 2009 | 0.30 | 15.3 | 0.21 | 0.40 | 0.16 | 13.9 | 0.11 | 0.20 |
| 2010 | 0.22 | 19.5 | 0.14 | 0.29 | 0.16 | 21.5 | 0.10 | 0.23 |
| 2011 | 0.42 | 11.4 | 0.34 | 0.52 | 0.28 | 13.6 | 0.21 | 0.36 |
| 2012 | 0.35 | 10.6 | 0.28 | 0.43 | 0.30 | 8.5 | 0.25 | 0.35 |
| 2013 | 0.34 | 14.4 | 0.25 | 0.44 | 0.20 | 16.5 | 0.14 | 0.27 |
| 2014 | 0.25 | 18.3 | 0.16 | 0.34 | 0.14 | 12.7 | 0.11 | 0.18 |
| 2015 | 0.20 | 18.6 | 0.13 | 0.27 | 0.11 | 15.2 | 0.08 | 0.14 |
| Bigelow, no calibration coefficient applied: | | | | | | | | |
| 2009 | 2.45 | 15.9 | 1.77 | 3.30 | 1.11 | 14.5 | 0.80 | 1.44 |
| 2010 | 1.73 | 19.0 | 1.12 | 2.41 | 1.15 | 22.1 | 0.67 | 1.68 |
| 2011 | 3.41 | 10.7 | 2.73 | 4.16 | 1.99 | 13.8 | 1.49 | 2.53 |
| 2012 | 2.86 | 10.6 | 2.26 | 3.48 | 2.14 | 8.7 | 1.77 | 2.51 |
| 2013 | 2.76 | 14.5 | 2.05 | 3.59 | 1.43 | 16.8 | 1.00 | 1.93 |
| 2014 | 2.03 | 18.6 | 1.32 | 2.75 | 1.03 | 13.3 | 0.76 | 1.28 |
| 2015 | 1.58 | 17.1 | 1.11 | 2.22 | 0.77 | 15.4 | 0.55 | 1.01 |

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Table 22. Survey results from NEFSC offshore winter bottom trawl surveys in the southern management region (strata 1-19, 61-76). Indices are delta distribution stratified means. The winter survey was discontinued after 2007.

| | Biomass Raw Index | | | Abundance Raw Index | | | | Length | | | | | | Number of Fish | Number of Tows | Number of Nonzero Tows | Proportion Nonzero Tows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | L95% | U95% | Mean | L95% | U95% | Ind wt | Min | 5% | 50% | Mean | 95% | Max | | | | |
| 1992 | 5.395 | 3.57 | 7.22 | 5.176 | 3.78 | 6.57 | 0.99 | 11 | 22 | 33 | 35.9 | 52 | 95 | 583 | 110 | 66 | 0.60 |
| 1993 | 7.954 | 4.01 | 11.90 | 5.002 | 3.95 | 6.05 | 1.19 | 9 | 21 | 36 | 37.7 | 53 | 98 | 585 | 109 | 77 | 0.71 |
| 1994 | 3.080 | 1.93 | 4.23 | 2.534 | 1.91 | 3.16 | 1.08 | 8 | 16 | 31 | 35.2 | 61 | 78 | 278 | 82 | 56 | 0.68 |
| 1995 | 3.398 | 2.32 | 4.48 | 2.738 | 1.88 | 3.59 | 1.24 | 19 | 21 | 36 | 37.8 | 57 | 101 | 390 | 123 | 76 | 0.62 |
| 1996 | 5.708 | 4.69 | 6.73 | 3.779 | 3.04 | 4.52 | 1.50 | 10 | 24 | 39 | 41.1 | 61 | 100 | 554 | 123 | 87 | 0.71 |
| 1997 | 5.472 | 4.15 | 6.79 | 3.172 | 2.57 | 3.78 | 1.67 | 10 | 20 | 43 | 42.0 | 62 | 91 | 455 | 119 | 89 | 0.75 |
| 1998 | 2.851 | 2.08 | 3.62 | 1.416 | 1.11 | 1.72 | 1.98 | 10 | 20 | 42 | 44.9 | 69 | 103 | 240 | 134 | 77 | 0.57 |
| 1999 | 3.792 | 2.92 | 4.67 | 2.803 | 2.22 | 3.38 | 1.34 | 10 | 18 | 35 | 38.3 | 61 | 87 | 459 | 138 | 83 | 0.60 |
| 2000 | 5.786 | 4.15 | 7.43 | 4.516 | 3.27 | 5.76 | 1.26 | 11 | 22 | 37 | 39.1 | 57 | 96 | 664 | 123 | 93 | 0.76 |
| 2001 | 8.227 | 4.48 | 11.97 | 4.346 | 3.13 | 5.56 | 1.45 | 8 | 19 | 37 | 40.0 | 60 | 84 | 1042 | 167 | 115 | 0.69 |
| 2002 | 7.430 | 5.74 | 9.12 | 3.978 | 3.19 | 4.77 | 1.82 | 15 | 28 | 43 | 45.2 | 65 | 86 | 737 | 153 | 113 | 0.74 |
| 2003 | 7.108 | 5.14 | 9.08 | 3.458 | 2.64 | 4.27 | 2.05 | 12 | 23 | 47 | 46.4 | 67 | 85 | 698 | 99 | 72 | 0.73 |
| 2004 | 8.074 | 5.27 | 10.87 | 4.673 | 3.16 | 6.18 | 1.67 | 13 | 22 | 40 | 42.5 | 66 | 88 | 896 | 135 | 103 | 0.76 |
| 2005 | 5.224 | 3.36 | 7.09 | 3.308 | 2.38 | 4.23 | 1.55 | 13 | 21 | 38 | 40.7 | 67 | 90 | 504 | 99 | 67 | 0.68 |
| 2006 | 7.143 | 5.39 | 8.90 | 4.046 | 3.27 | 4.82 | 1.74 | 20 | 27 | 42 | 44.2 | 64 | 92 | 1032 | 127 | 91 | 0.72 |
| 2007 | 5.291 | 4.38 | 6.20 | 2.287 | 1.96 | 2.62 | 2.28 | 12 | 24 | 50 | 49.1 | 65 | 91 | 587 | 132 | 97 | 0.73 |

Table 23. Arithmetic indices for winter survey.

| | Biomass Raw Index | | | Abundance Raw Index | | |
|---|---|---|---|---|---|---|
| | Mean | L95% | U95% | Mean | L95% | U95% |
| 1992 | 4.87 | 3.99 | 5.72 | 4.94 | 4.11 | 5.73 |
| 1993 | 5.82 | 4.84 | 6.85 | 4.90 | 4.13 | 5.72 |
| 1994 | 2.69 | 2.04 | 3.33 | 2.50 | 2.01 | 3.00 |
| 1995 | 3.58 | 2.46 | 5.03 | 2.88 | 2.04 | 3.90 |
| 1996 | 5.76 | 4.78 | 6.98 | 3.85 | 3.13 | 4.69 |
| 1997 | 5.26 | 4.21 | 6.24 | 3.15 | 2.73 | 3.61 |
| 1998 | 2.82 | 2.13 | 3.56 | 1.42 | 1.13 | 1.68 |
| 1999 | 3.80 | 3.00 | 4.65 | 2.83 | 2.26 | 3.45 |
| 2000 | 5.49 | 4.45 | 6.74 | 4.35 | 3.56 | 5.25 |
| 2001 | 6.18 | 4.92 | 7.44 | 4.26 | 3.32 | 5.33 |
| 2002 | 7.33 | 6.03 | 8.71 | 4.02 | 3.28 | 4.78 |
| 2003 | 7.14 | 5.57 | 8.93 | 3.48 | 2.82 | 4.13 |
| 2004 | 7.61 | 5.77 | 9.51 | 4.55 | 3.58 | 5.78 |
| 2005 | 5.41 | 3.65 | 7.80 | 3.49 | 2.49 | 4.86 |
| 2006 | 7.28 | 5.61 | 9.09 | 4.19 | 3.34 | 5.30 |
| 2007 | 5.24 | 4.41 | 6.08 | 2.30 | 2.03 | 2.60 |

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Table 24. Survey results from NEFSC offshore scallop dredge surveys in the southern management region (shellfish strata 6, 7, 10, 11, 14, 15, 18, 19, 22-31, 33-35, 46, 47, 55, 58-61, 621, 631). Indices are delta distribution stratified means. Biomass indices are not calculated for the dredge surveys.

| | Abundance Index | | | | Length | | | | | | Number of | Number | Number of Nonzero | Proportion Nonzero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | CV | L95% | U95% | Min | 5% | 50% | Mean | 95% | Max | Fish | of Tows | Tows | Tows |
| 1984 | 1.29 | 7.0 | 1.11 | 1.46 | 6 | 11 | 28 | 29.5 | 54 | 82 | 410 | 254 | 165 | 0.65 |
| 1985 | 1.52 | 8.9 | 1.26 | 1.79 | 7 | 9 | 25 | 28.7 | 53 | 84 | 493 | 282 | 183 | 0.65 |
| 1986 | 1.25 | 8.2 | 1.05 | 1.45 | 8 | 10 | 15 | 22.9 | 54 | 95 | 431 | 296 | 183 | 0.62 |
| 1987 | 3.15 | 6.2 | 2.77 | 3.54 | 8 | 9 | 13 | 18.6 | 51 | 90 | 1253 | 315 | 255 | 0.81 |
| 1988 | 1.67 | 8.6 | 1.39 | 1.95 | 7 | 12 | 28 | 29.8 | 49 | 97 | 572 | 316 | 187 | 0.59 |
| 1989 | 1.00 | 8.3 | 0.83 | 1.16 | 6 | 10 | 31 | 31.9 | 53 | 101 | 303 | 304 | 147 | 0.48 |
| 1990 | 1.53 | 6.5 | 1.34 | 1.73 | 6 | 10 | 18 | 24.4 | 54 | 94 | 563 | 303 | 205 | 0.68 |
| 1991 | 2.28 | 6.5 | 1.99 | 2.57 | 7 | 9 | 14 | 21.0 | 45 | 94 | 808 | 315 | 241 | 0.77 |
| 1992 | 1.94 | 7.3 | 1.66 | 2.22 | 5 | 9 | 25 | 27.3 | 52 | 97 | 644 | 316 | 235 | 0.74 |
| 1993 | 2.85 | 5.0 | 2.57 | 3.12 | 8 | 10 | 15 | 21.8 | 48 | 73 | 995 | 301 | 258 | 0.86 |
| 1994 | 3.40 | 5.9 | 3.01 | 3.80 | 8 | 10 | 15 | 22.2 | 51 | 87 | 1145 | 314 | 265 | 0.84 |
| 1995 | 2.26 | 6.6 | 1.97 | 2.56 | 7 | 9 | 27 | 29.6 | 57 | 92 | 764 | 314 | 243 | 0.77 |
| 1996 | 2.01 | 6.6 | 1.75 | 2.27 | 7 | 9 | 23 | 29.9 | 59 | 81 | 638 | 298 | 226 | 0.76 |
| 1997 | 1.11 | 7.2 | 0.95 | 1.27 | 7 | 13 | 33 | 36.7 | 65 | 76 | 388 | 313 | 196 | 0.63 |
| 1998 | 1.01 | 7.0 | 0.88 | 1.15 | 6 | 11 | 20 | 30.2 | 61 | 79 | 371 | 319 | 183 | 0.57 |
| 1999 | 2.59 | 8.5 | 2.16 | 3.02 | 6 | 10 | 16 | 23.5 | 55 | 84 | 856 | 306 | 248 | 0.81 |
| 2000 | 2.24 | 6.1 | 1.97 | 2.51 | 8 | 9 | 18 | 27.3 | 54 | 87 | 832 | 315 | 240 | 0.76 |
| 2001 | 1.71 | 6.7 | 1.48 | 1.94 | 7 | 8 | 35 | 36.0 | 64 | 77 | 549 | 334 | 233 | 0.70 |
| 2002 | 1.71 | 6.6 | 1.49 | 1.93 | 7 | 11 | 35 | 34.2 | 60 | 86 | 598 | 310 | 203 | 0.65 |
| 2003 | 2.78 | 7.1 | 2.39 | 3.17 | 6 | 9 | 15 | 24.4 | 58 | 87 | 819 | 294 | 211 | 0.72 |
| 2004 | 2.88 | 6.5 | 2.51 | 3.24 | 9 | 11 | 26 | 29.8 | 61 | 83 | 860 | 348 | 290 | 0.83 |
| 2005 | 2.01 | 6.6 | 1.75 | 2.27 | 8 | 10 | 28 | 31.3 | 56 | 83 | 859 | 344 | 265 | 0.77 |
| 2006 | 1.45 | 6.1 | 1.27 | 1.62 | 7 | 7 | 29 | 31.1 | 61 | 83 | 571 | 327 | 230 | 0.70 |
| 2007 | 0.83 | 8.2 | 0.69 | 0.96 | 7 | 12 | 39 | 40.2 | 69 | 84 | 366 | 336 | 183 | 0.54 |
| 2008 | 1.00 | 8.9 | 0.83 | 1.18 | 7 | 7 | 26 | 31.3 | 68 | 75 | 350 | 285 | 162 | 0.57 |
| 2009 | 0.79 | 9.8 | 0.63 | 0.94 | 6 | 10 | 25 | 30.9 | 65 | 80 | 248 | 269 | 133 | 0.49 |
| 2010 | 0.74 | 9.9 | 0.59 | 0.88 | 7 | 8 | 35 | 35.9 | 59 | 77 | 212 | 275 | 135 | 0.49 |
| 2011 | 0.93 | 12.5 | 0.70 | 1.16 | 8 | 10 | 29 | 32.6 | 57 | 75 | 204 | 203 | 112 | 0.55 |
| 2012 | 1.32 | 8.4 | 1.10 | 1.54 | 6 | 8 | 32 | 33.0 | 55 | 70 | 170 | 132 | 84 | 0.64 |
| 2013 | 1.10 | 12.3 | 0.84 | 1.37 | 7 | 7 | 32 | 30.0 | 61 | 68 | 125 | 113 | 68 | 0.60 |
| 2014 | 0.90 | 14.7 | 0.64 | 1.16 | 11 | 10 | 33 | 34.1 | 62 | 65 | 43 | 51 | 27 | 0.53 |
| 2015 | 2.44 | 20.5 | 1.46 | 3.42 | 1 | 7 | 11 | 19.9 | 54 | 60 | 224 | 84 | 54 | 0.64 |

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Table 25. Survey results from NEFSC offshore scallop dredge surveys in the southern management region (shellfish strata 6, 7, 10, 11, 14, 15, 18, 19, 22-31, 33-35, 46, 47, 55, 58-61, 621, 631). Indices are arithmetic stratified means with bootstrapped variance estimates.

| | Abundance Index | | | |
|---|---|---|---|---|
| | Mean | CV | L95% | U95% |
| 1984 | 1.34 | 7.4 | 1.16 | 1.53 |
| 1985 | 1.57 | 8.4 | 1.34 | 1.86 |
| 1986 | 1.29 | 8.0 | 1.08 | 1.50 |
| 1987 | 3.17 | 5.4 | 2.81 | 3.51 |
| 1988 | 1.69 | 6.8 | 1.47 | 1.93 |
| 1989 | 1.00 | 7.7 | 0.85 | 1.16 |
| 1990 | 1.53 | 5.7 | 1.37 | 1.71 |
| 1991 | 2.26 | 5.8 | 2.01 | 2.52 |
| 1992 | 1.95 | 6.7 | 1.70 | 2.21 |
| 1993 | 2.83 | 4.5 | 2.59 | 3.09 |
| 1994 | 3.33 | 4.8 | 3.01 | 3.64 |
| 1995 | 2.26 | 6.3 | 2.00 | 2.55 |
| 1996 | 2.01 | 6.4 | 1.78 | 2.28 |
| 1997 | 1.12 | 6.9 | 0.98 | 1.28 |
| 1998 | 1.03 | 7.1 | 0.89 | 1.17 |
| 1999 | 2.57 | 7.3 | 2.23 | 2.94 |
| 2000 | 2.27 | 7.2 | 1.98 | 2.61 |
| 2001 | 1.72 | 6.4 | 1.50 | 1.93 |
| 2002 | 1.69 | 5.8 | 1.49 | 1.88 |
| 2003 | 2.75 | 6.0 | 2.44 | 3.09 |
| 2004 | 2.89 | 6.5 | 2.53 | 3.27 |
| 2005 | 2.02 | 6.6 | 1.78 | 2.27 |
| 2006 | 1.44 | 6.1 | 1.29 | 1.61 |
| 2007 | 0.83 | 8.2 | 0.70 | 0.95 |
| 2008 | 1.01 | 8.9 | 0.84 | 1.17 |
| 2009 | 0.78 | 9.8 | 0.65 | 0.92 |
| 2010 | 0.74 | 9.9 | 0.61 | 0.87 |
| 2011 | 0.94 | 12.5 | 0.73 | 1.12 |
| 2012 | 1.33 | 8.4 | 1.14 | 1.52 |
| 2013 | 1.10 | 12.3 | 0.88 | 1.34 |
| 2014 | 0.90 | 14.7 | 0.68 | 1.11 |
| 2015 | 2.53 | 20.5 | 1.51 | 3.99 |

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Table 26. Area-swept estimates of minimum biomass and abundance for monkfish based on NEFSC fall surveys. Estimates assume that 100% of monkfish encountered by the trawl are captured. (A) total population, (B) exploitable biomass.

A. Total population

| North | | | South | |
|---|---|---|---|---|
| | Numbers (thousands) | Weight (mt) | Numbers (thousands) | Weight (mt) |
| 2009 | 7,490 | 9,565 | 6,402 | 7,908 |
| 2010 | 9,841 | 13,838 | 11,823 | 12,006 |
| 2011 | 12,085 | 17,958 | 17,499 | 9,721 |
| 2012 | 12,960 | 17,289 | 8,085 | 14,407 |
| 2013 | 13,860 | 13,221 | 8,470 | 8,992 |
| 2014 | 17,059 | 15,346 | 4,663 | 4,927 |
| 2015 | 23,512 | 24,814 | 57,471 | 12,197 |

B. Exploitable population (≥ 43 cm)

| North | | | South | |
|---|---|---|---|---|
| | Numbers (thousands) | Weight (mt) | Numbers (thousands) | Weight (mt) |
| 2009 | 2,803 | 8,326 | 2,121 | 6,613 |
| 2010 | 3,450 | 10,774 | 3,278 | 9,542 |
| 2011 | 5,114 | 16,238 | 2,855 | 6,682 |
| 2012 | 4,750 | 15,274 | 3,700 | 10,821 |
| 2013 | 3,108 | 10,041 | 3,147 | 8,185 |
| 2014 | 3,576 | 11,202 | 1,309 | 3,480 |
| 2015 | 5,960 | 20,020 | 1,211 | 3,194 |

Table 27. Relative exploitation indices based on numbers landed and area-swept estimates of minimum abundance of exploitable monkfish from NEFSC fall surveys. Estimates assume that 100% of monkfish encountered by the trawl are captured.

| North | Landings (millions of fish) | Relative exploitation |
|---|---|---|
| 2009 | 1.066363 | 0.38 |
| 2010 | 0.819147 | 0.24 |
| 2011 | 0.970042 | 0.19 |
| 2012 | 1.390334 | 0.29 |
| 2013 | 1.108966 | 0.36 |
| 2014 | 1.139312 | 0.32 |

| South | Landings (millions of fish) | Relative exploitation |
|---|---|---|
| 2009 | 1.282379 | 0.51 |
| 2010 | 1.094880 | 0.30 |
| 2011 | 1.235961 | 0.39 |
| 2012 | 1.438548 | 0.30 |
| 2013 | 1.398071 | 0.43 |
| 2014 | 1.243386 | 0.72 |

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Table 28. Relative exploitation indices (catch in numbers/abundance index) for monkfish based on fall, spring, shrimp and scallop surveys.

| | North | Catch (millions of fish) | Fall Survey Relative F | Spring Survey Relative F | Shrimp Survey Relative F |
|---|---|---|---|---|---|
| Albatross | 1994 | 5.602087 | 4.2 | 10.3 | 1.64 |
| | 1995 | 5.700661 | 6.1 | 5.6 | 2.74 |
| | 1996 | 7.032969 | 11.1 | 10.6 | 2.35 |
| | 1997 | 4.764853 | 9.6 | 13.9 | 3.03 |
| | 1998 | 3.792122 | 6.1 | 9.1 | 1.79 |
| | 1999 | 4.847727 | 4.5 | 5.9 | 0.72 |
| | 2000 | 3.950481 | 1.7 | 3.5 | 0.69 |
| | 2001 | 4.588402 | 2.9 | 2.7 | 0.42 |
| | 2002 | 5.207431 | 4.1 | 3.0 | 0.45 |
| | 2003 | 5.850707 | 5.5 | 6.0 | 1.01 |
| | 2004 | 4.649597 | 8.9 | 5.1 | 1.38 |
| | 2005 | 3.508406 | 5.9 | 4.9 | 0.67 |
| | 2006 | 2.572532 | 3.3 | 7.0 | 0.60 |
| | 2007 | 1.891003 | 2.9 | 3.4 | 0.42 |
| | 2008 | 1.500083 | 1.9 | 2.2 | 0.53 |
| Bigelow | 2009 | 1.559159 | 4.0 | 4.7 | 0.50 |
| | 2010 | 1.168746 | 2.3 | 3.1 | 0.46 |
| | 2011 | 1.445272 | 2.2 | 3.1 | 0.64 |
| | 2012 | 1.995398 | 2.9 | 3.7 | 0.56 |
| | 2013 | 1.724258 | 2.4 | 3.1 | 0.42 |
| | 2014 | 1.865081 | 2.0 | 3.0 | 0.38 |
| | 2015 | | | | |

| | South | Catch (millions of fish) | Fall Survey Relative F | Spring Survey Relative F | Scallop Survey Relative F |
|---|---|---|---|---|---|
| Albatross | 1994 | 8.171882 | 13.7 | 59.6 | 2.5 |
| | 1995 | 8.400046 | 17.0 | 42.8 | 3.7 |
| | 1996 | 7.117875 | 30.3 | 52.6 | 3.5 |
| | 1997 | 8.227080 | 26.7 | 66.5 | 7.4 |
| | 1998 | 7.051910 | 21.2 | 27.7 | 6.9 |
| | 1999 | 5.807313 | 12.9 | 17.3 | 2.3 |
| | 2000 | 5.645715 | 13.4 | 23.3 | 2.5 |
| | 2001 | 6.432756 | 17.0 | 27.3 | 3.7 |
| | 2002 | 5.312109 | 6.4 | 16.7 | 3.2 |
| | 2003 | 5.170862 | 5.4 | 13.9 | 1.9 |
| | 2004 | 4.252442 | 9.0 | 36.5 | 1.5 |
| | 2005 | 4.548955 | 7.9 | 17.6 | 2.3 |
| | 2006 | 3.667069 | 8.1 | 21.3 | 2.5 |
| | 2007 | 3.091468 | 15.8 | 12.0 | 3.7 |
| | 2008 | 2.627670 | 13.3 | 13.8 | 2.6 |
| Bigelow | 2009 | 2.142482 | 9.7 | 13.7 | 2.7 |
| | 2010 | 2.636741 | 6.6 | 16.4 | 3.6 |
| | 2011 | 2.659532 | 4.3 | 9.5 | 2.8 |
| | 2012 | 3.346252 | 11.8 | 11.1 | 2.5 |
| | 2013 | 2.456238 | 8.6 | 12.3 | 2.2 |
| | 2014 | 2.489241 | 15.4 | 17.3 | 2.8 |
| | 2015 | | | | |

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Table 29. Application of method used to set catch limits for Georges Bank cod applied to monkfish (described in text). (A.) based on trends in the NEFSC fall survey only, (B.) based on trends in the NEFSC fall and spring surveys averaged.

A. NEFSC fall survey indices

| Year | North ln(index) | South ln(index) |
|---|---|---|
| 2013 | -0.28 | -1.53 |
| 2014 | -0.22 | -1.72 |
| 2015 | -0.17 | -1.98 |
| % change | 106% | 80% |

B. NEFSC spring and fall surveys averaged

| Year | North ln(index) | South ln(index) |
|---|---|---|
| 2013 | -0.36 | -1.40 |
| 2014 | -0.35 | -1.52 |
| 2015 | -0.33 | -1.68 |
| % change | 102% | 87% |

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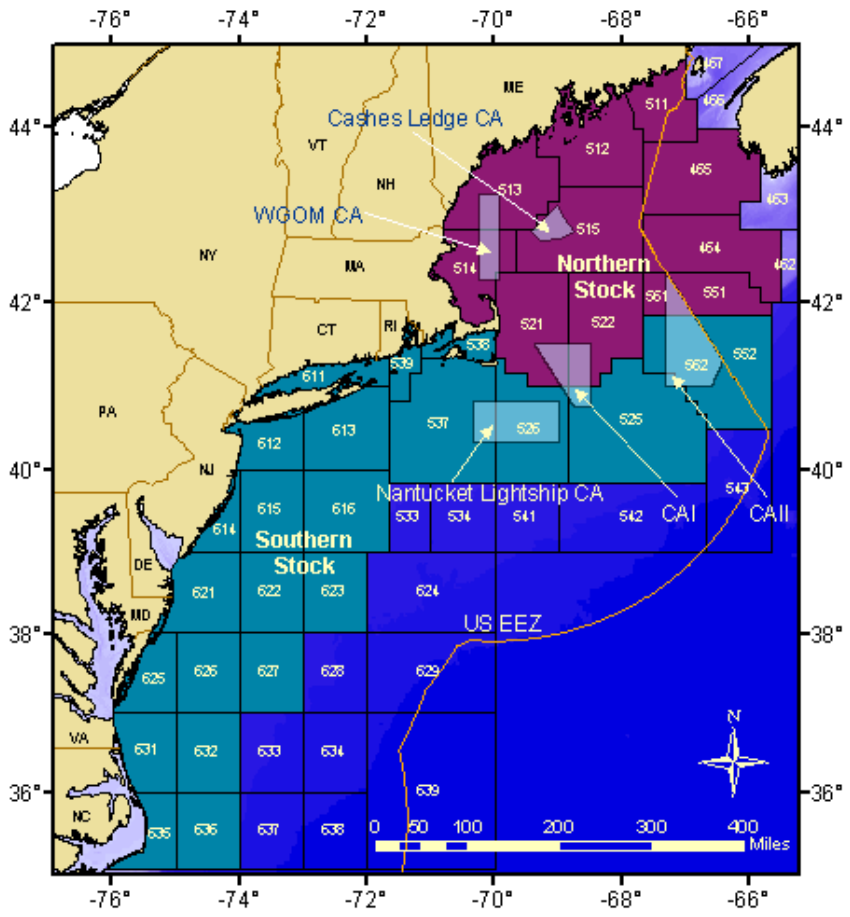


Figure 1. Fishery statistical areas used to define northern and southern monkfish management areas.

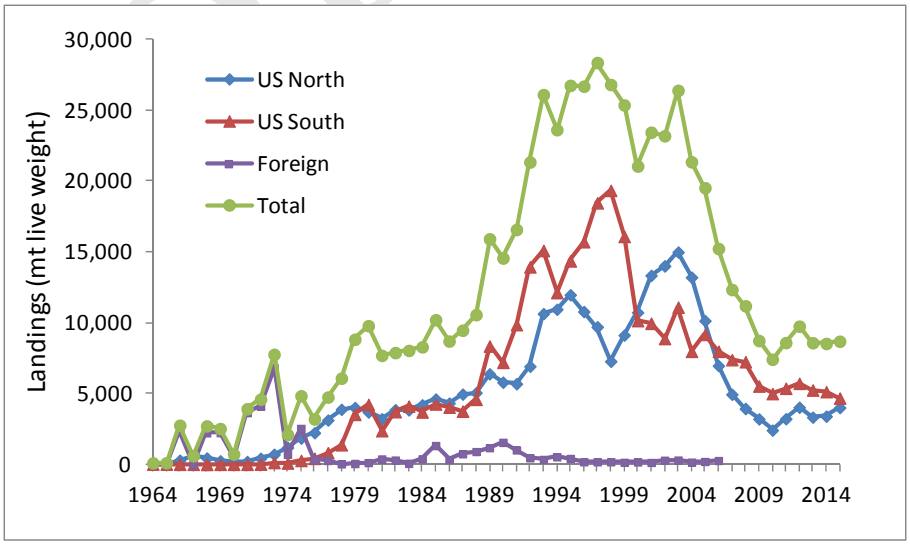


Figure 2. Monkfish landings by management area and combined areas, 1964-2015.

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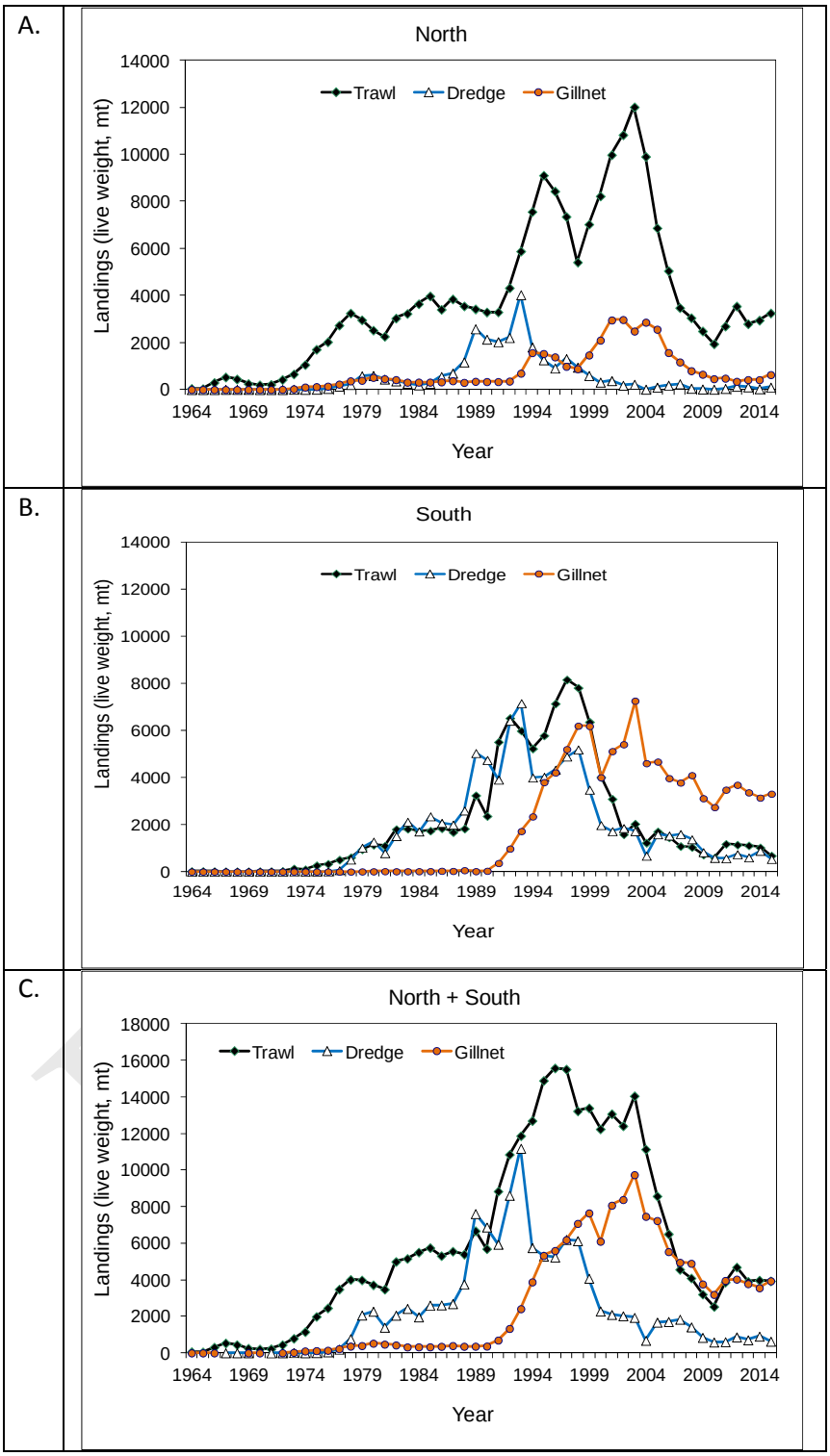


Figure 3. Commercial landings of monkfish by gear type and management area, 1964-2015. A. Northern management area, B. Southern management area, C. Management areas combined. H:\goose\assess 2016\report\tables\tables_for_2016_update.xlsx

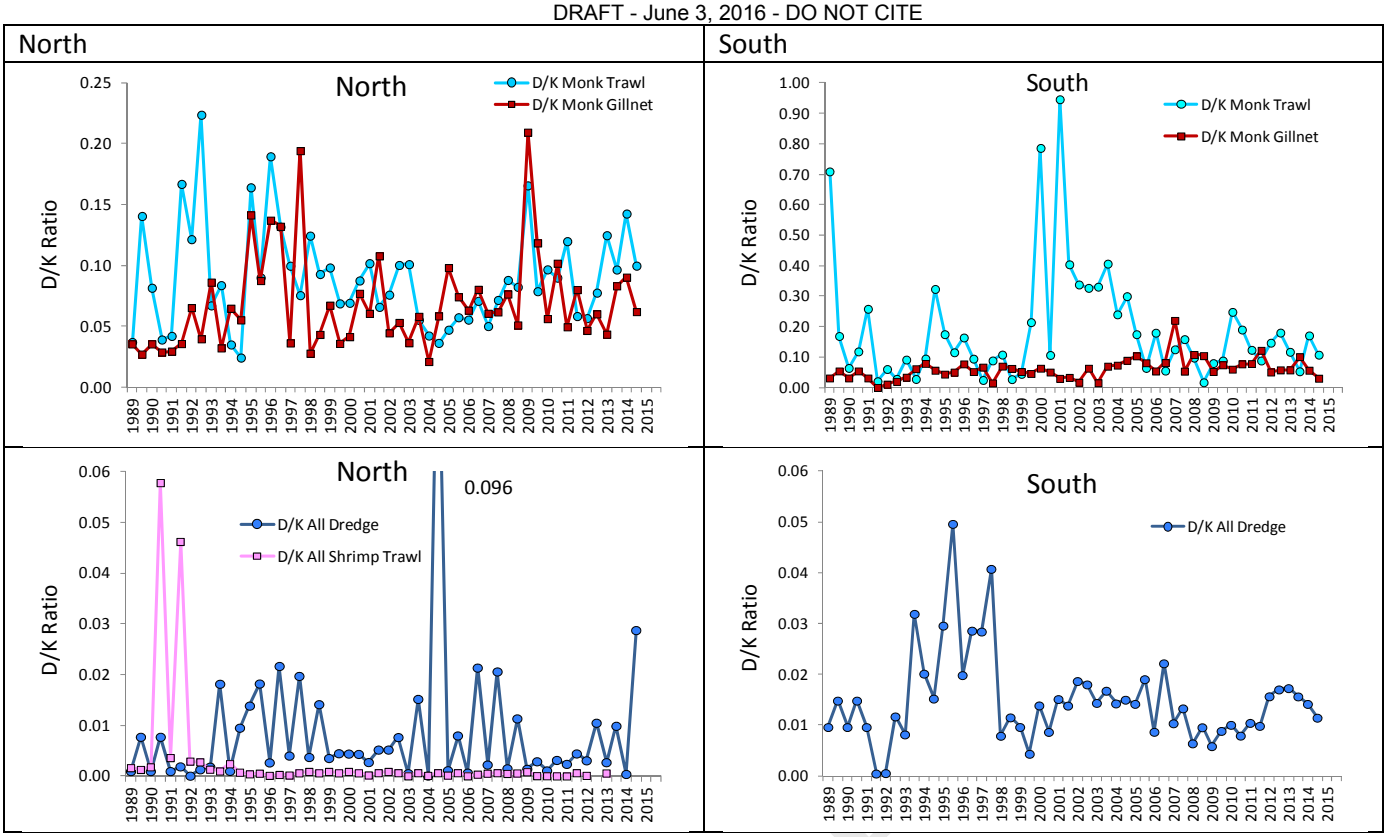


Figure 4. Discard ratios by half year for trawls and gillnets (top panels) and dredges and shrimp trawls (bottom panels) for North (left column) and South (right column). Trawls and gillnets ratios were based on kept monkfish; dredge and shrimp trawl were based on kept of all species.

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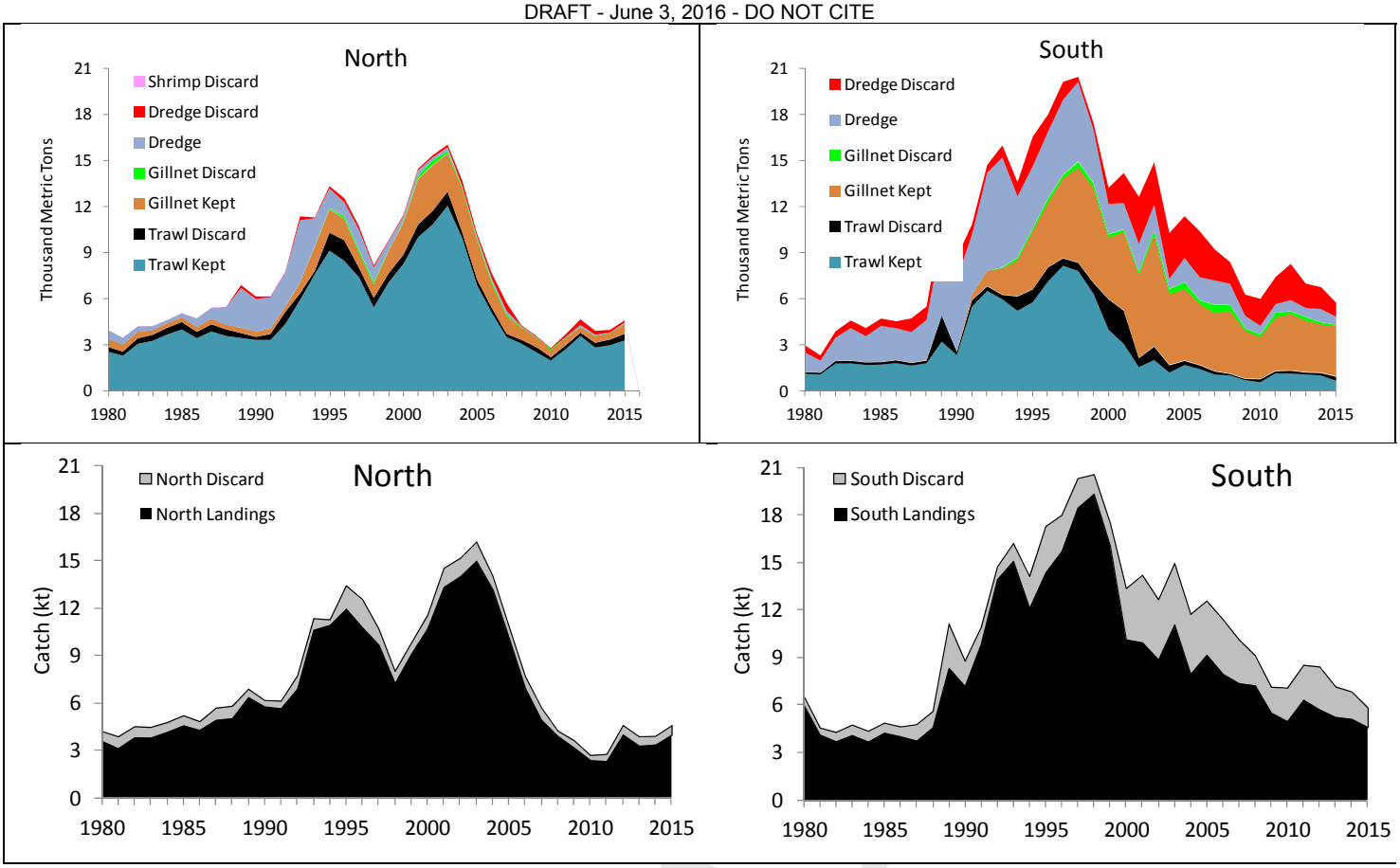


Figure 5. Monkfish landings and discard by gear type (top panels) and total (bottom panels) for North (left) and South (right).Tables_for_2016_update.xlsx / pivot N, pivot S and / annual catch

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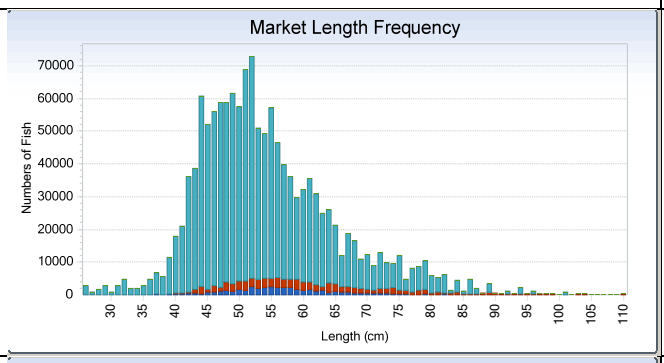
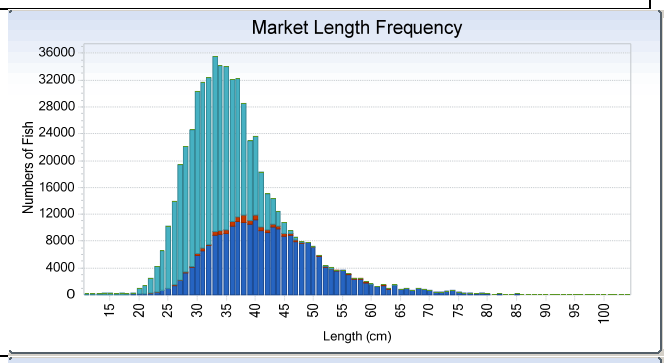
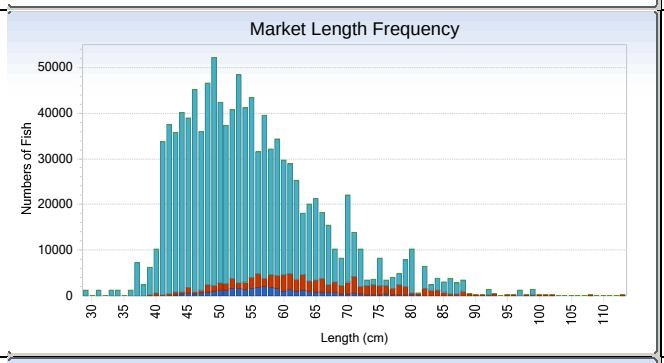
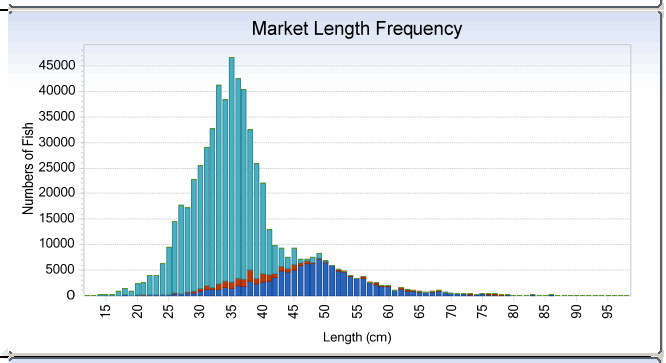
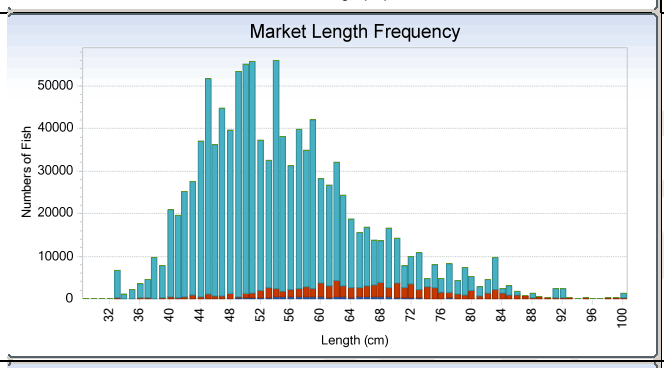
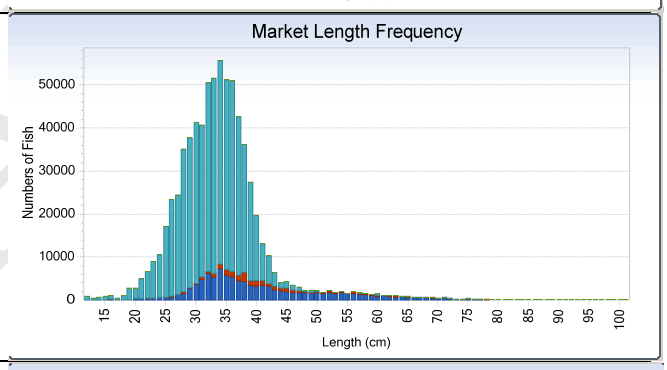
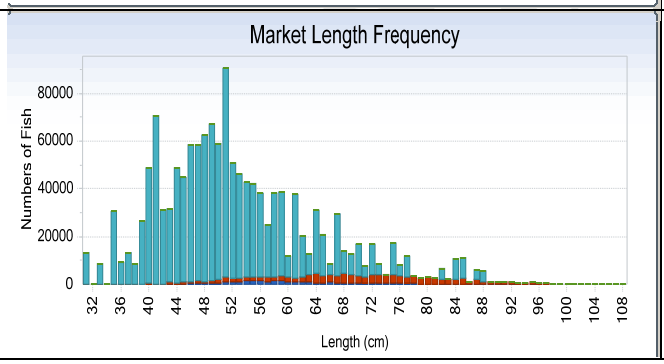
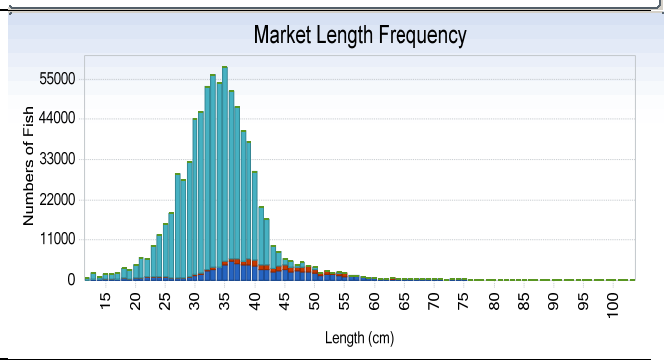
| | North - Kept | North - Discarded |
|---|---|---|
| | Note: x and y axis scales vary | Dredge Gillnet Trawl |
| 2012 |  |  |
| 2013 |  |  |
| 2014 |  |  |
| 2015 |  |  |

Figure 6. Estimated length composition of kept and discarded monkfish by gear type in the Northern Management Area.

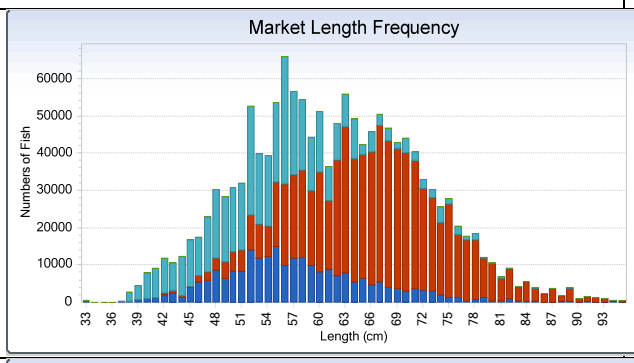
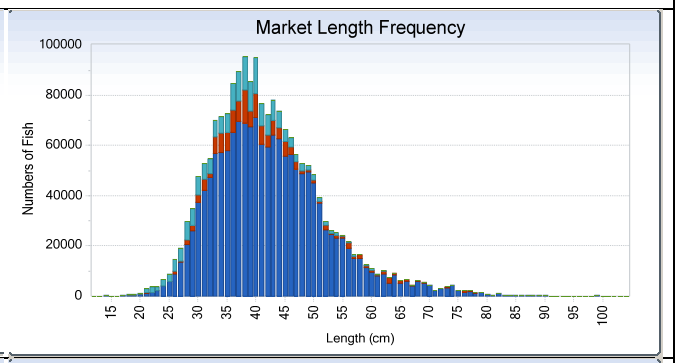
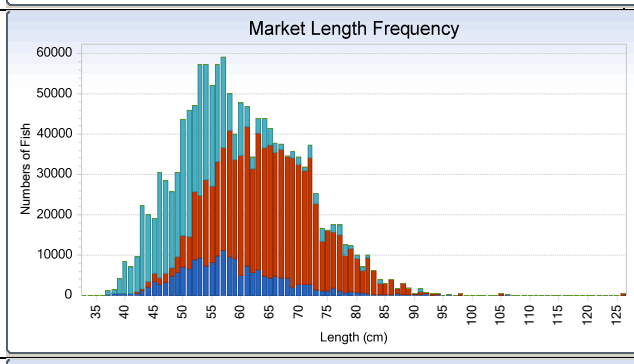
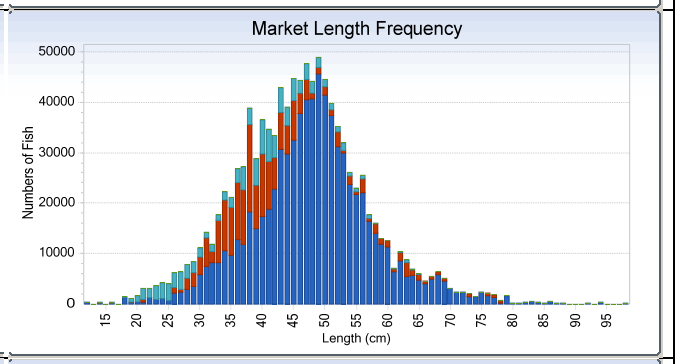
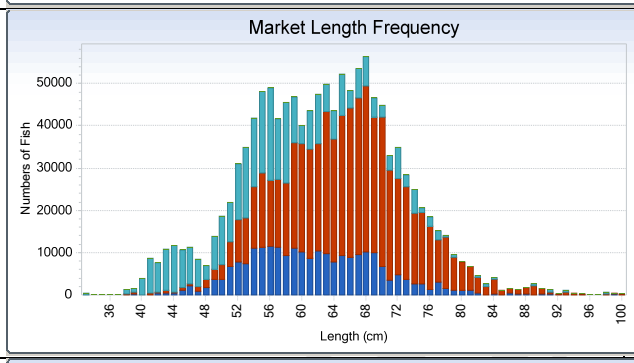
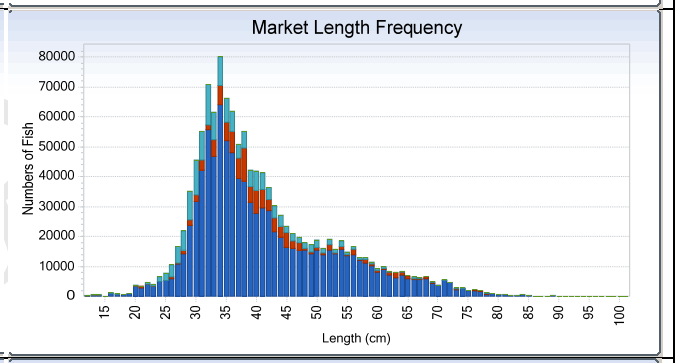
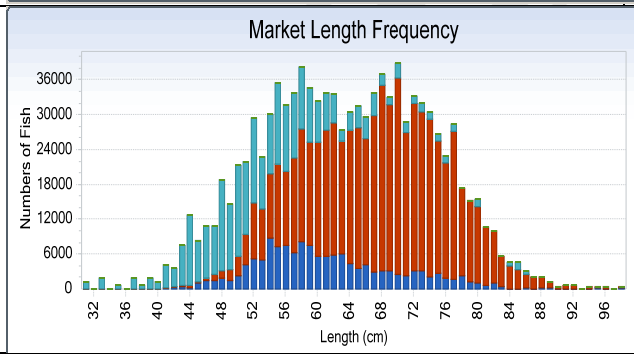
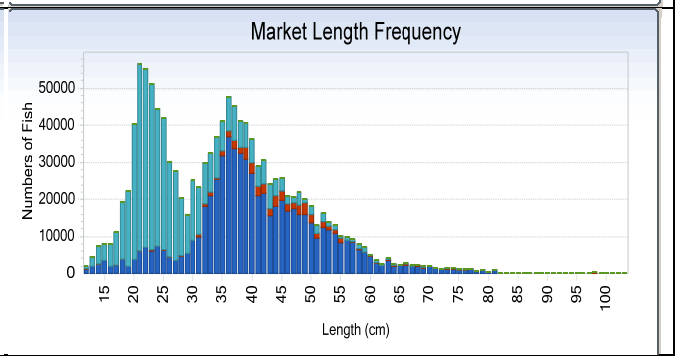
| | South - Kept | South - Discarded |
|---|---|---|
| | Note: x and y axis scales vary | Dredge Gillnet Trawl |
| 2012 |   |   |
| 2013 |   |   |
| 2014 |   |   |
| 2015 |   |   |

Figure 7. Estimated length composition of kept and discarded monkfish by gear type in the Southern Management Area.

Copy and paste from Biostat runs

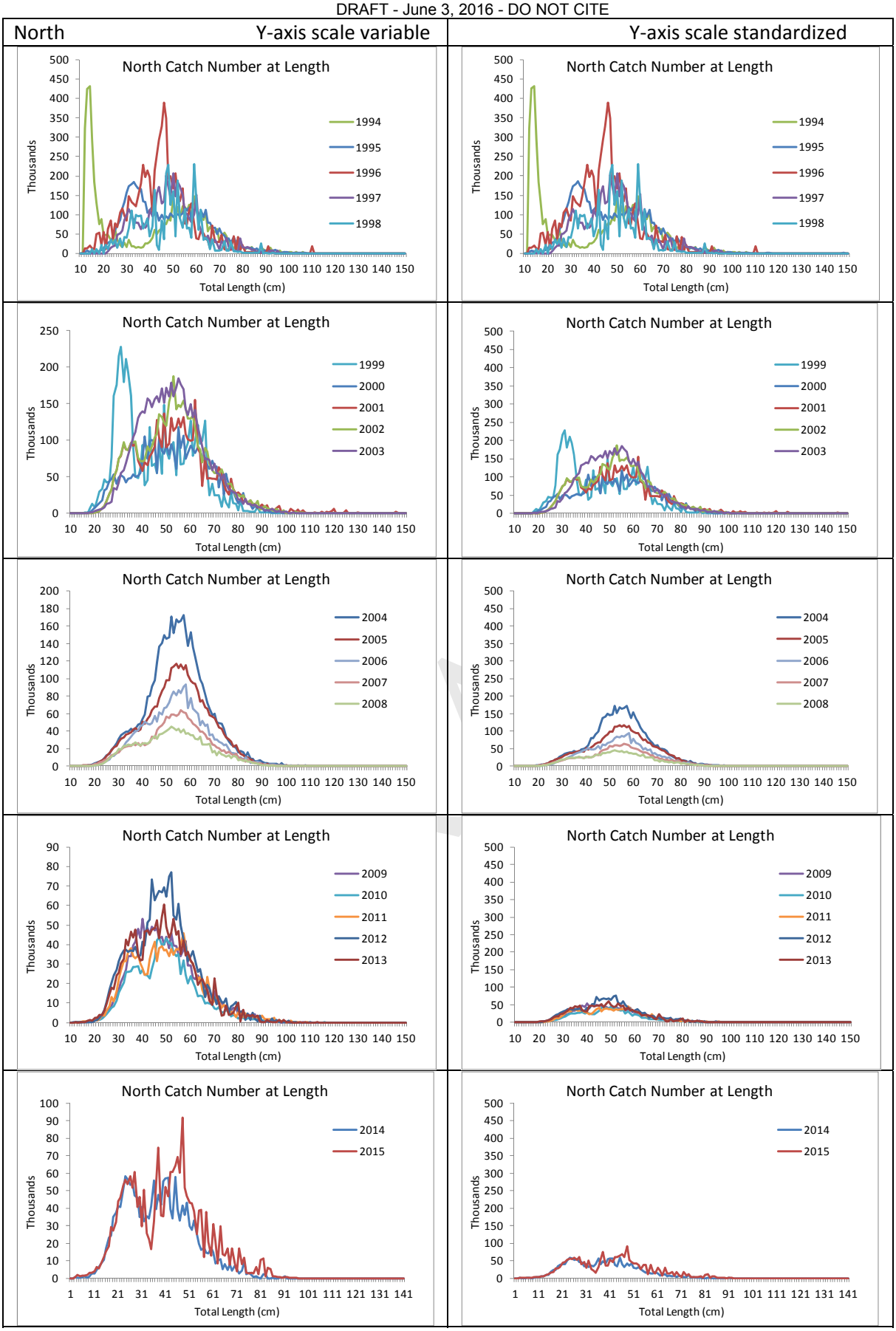



Figure 8. Estimated length composition of commercial monkfish catch, Northern Management Area.

~/comm./agelen/biostat2016/biostat_results_2016.xlsx

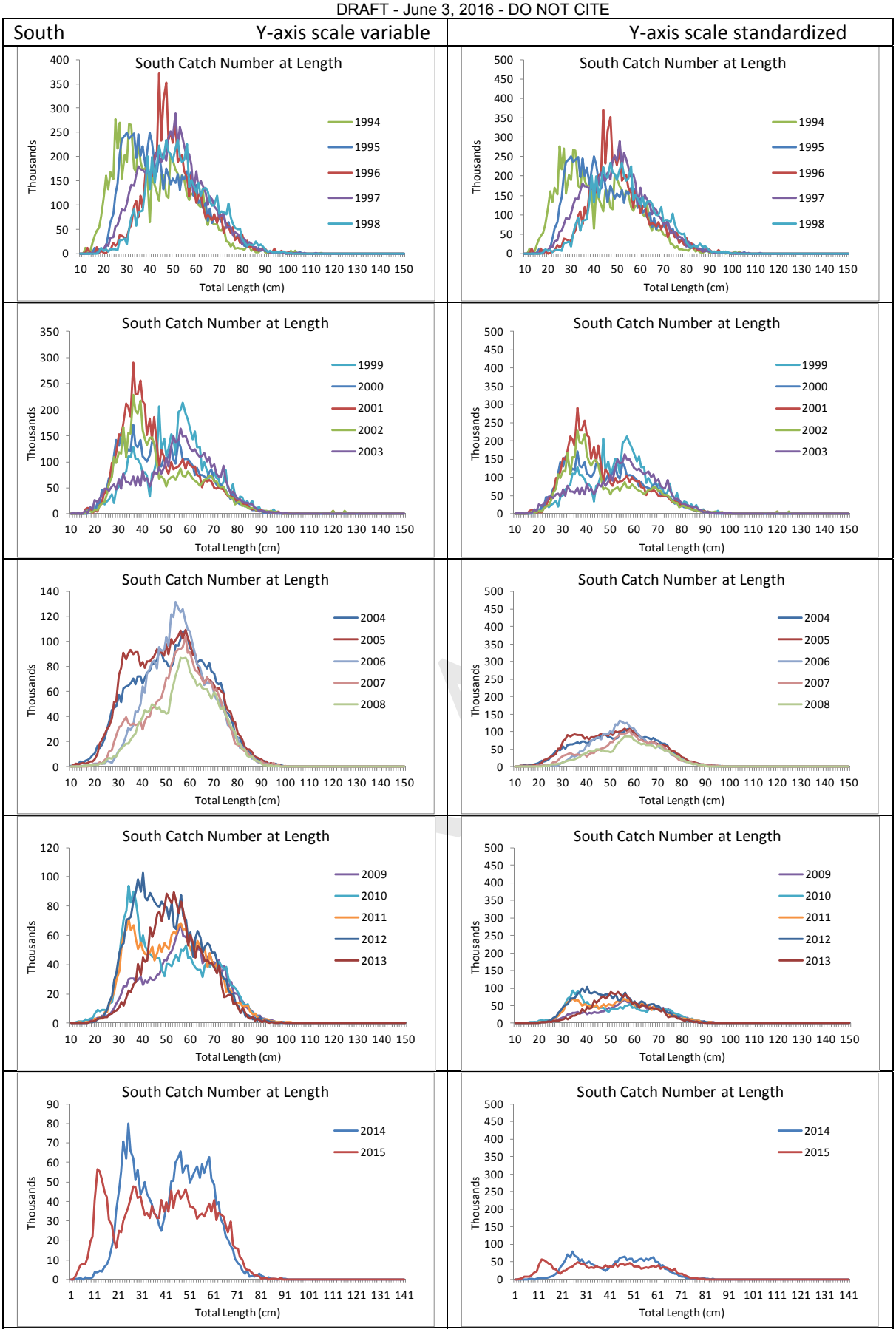



Figure 9. Length composition of monkfish commercial catch estimated using length frequency data collected by fishery observers in the Southern Management Area. ~/comm./agelen/biostat2016/biostat_results_2016.xlsx

North

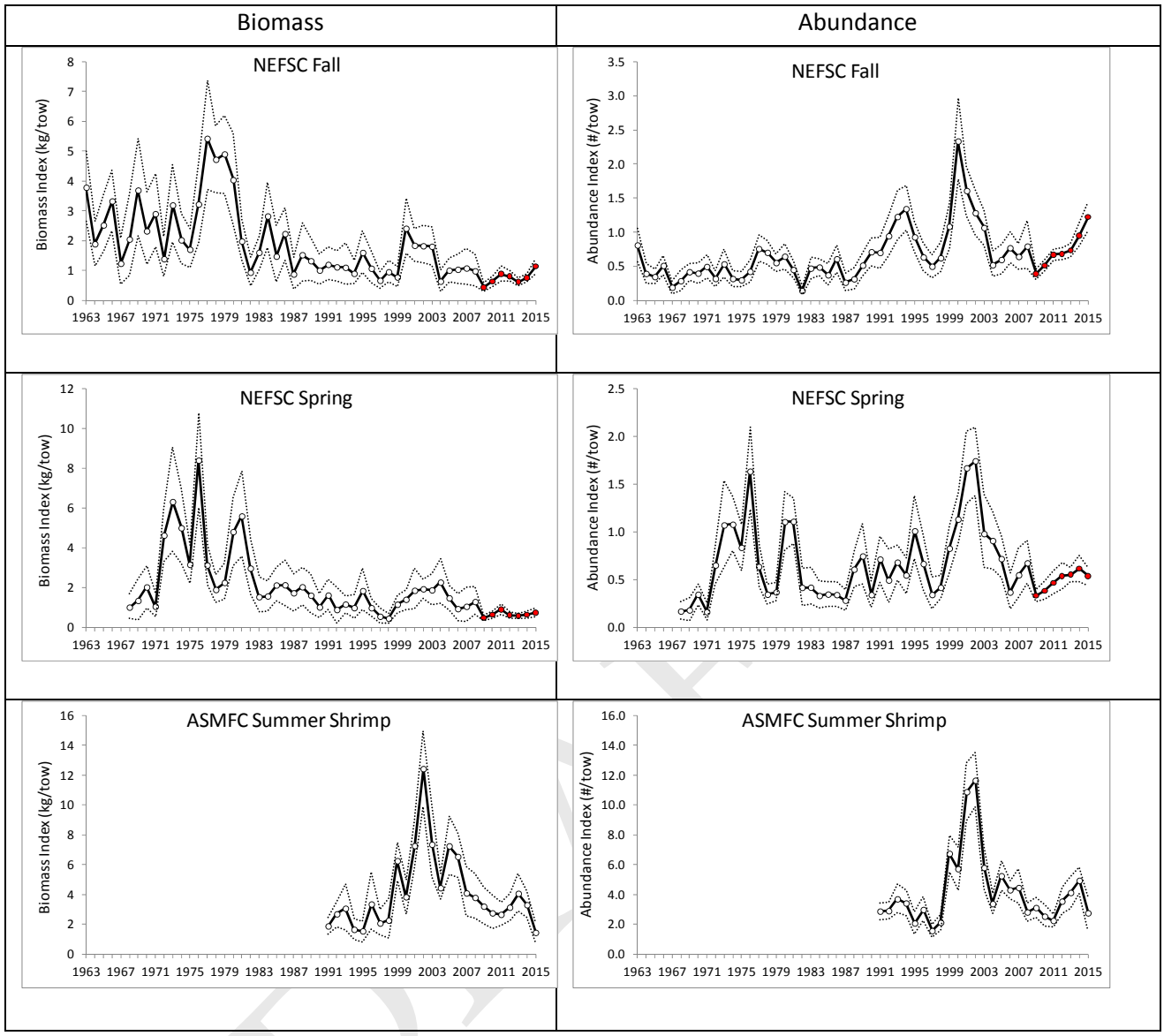



Figure 10. Survey indices for monkfish in the northern management area. Red-filled points are NEFSC surveys conducted on the FSV Bigelow (after 2008), converted to Albatross units as described in the text.Tables_for_2016_update.xlsx - arithmetic means with bootstrapped CIs

North

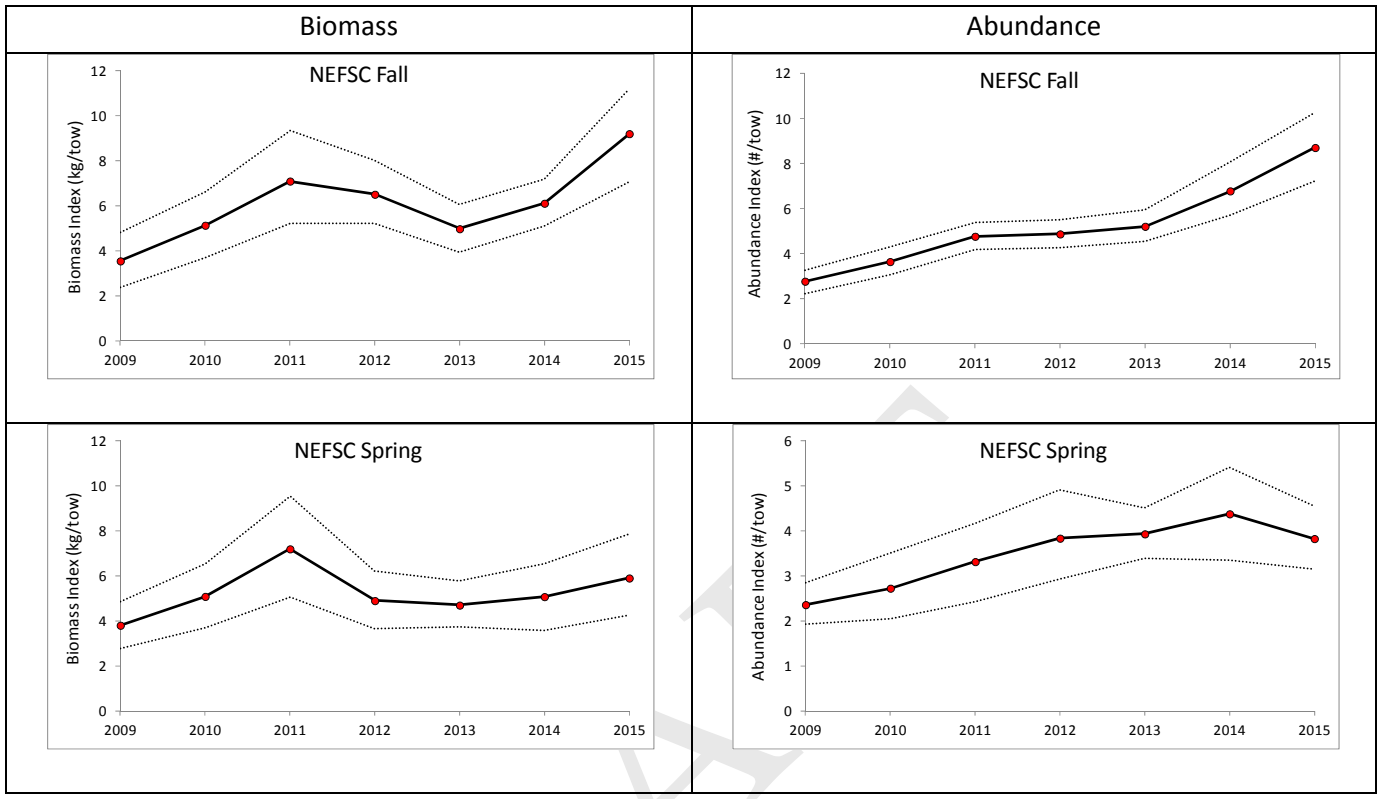



Figure 11. Survey indices from surveys conducted on the FRSV Bigelow in the northern management area, not converted to Albatross units. Note: y-axis scale varies.

North

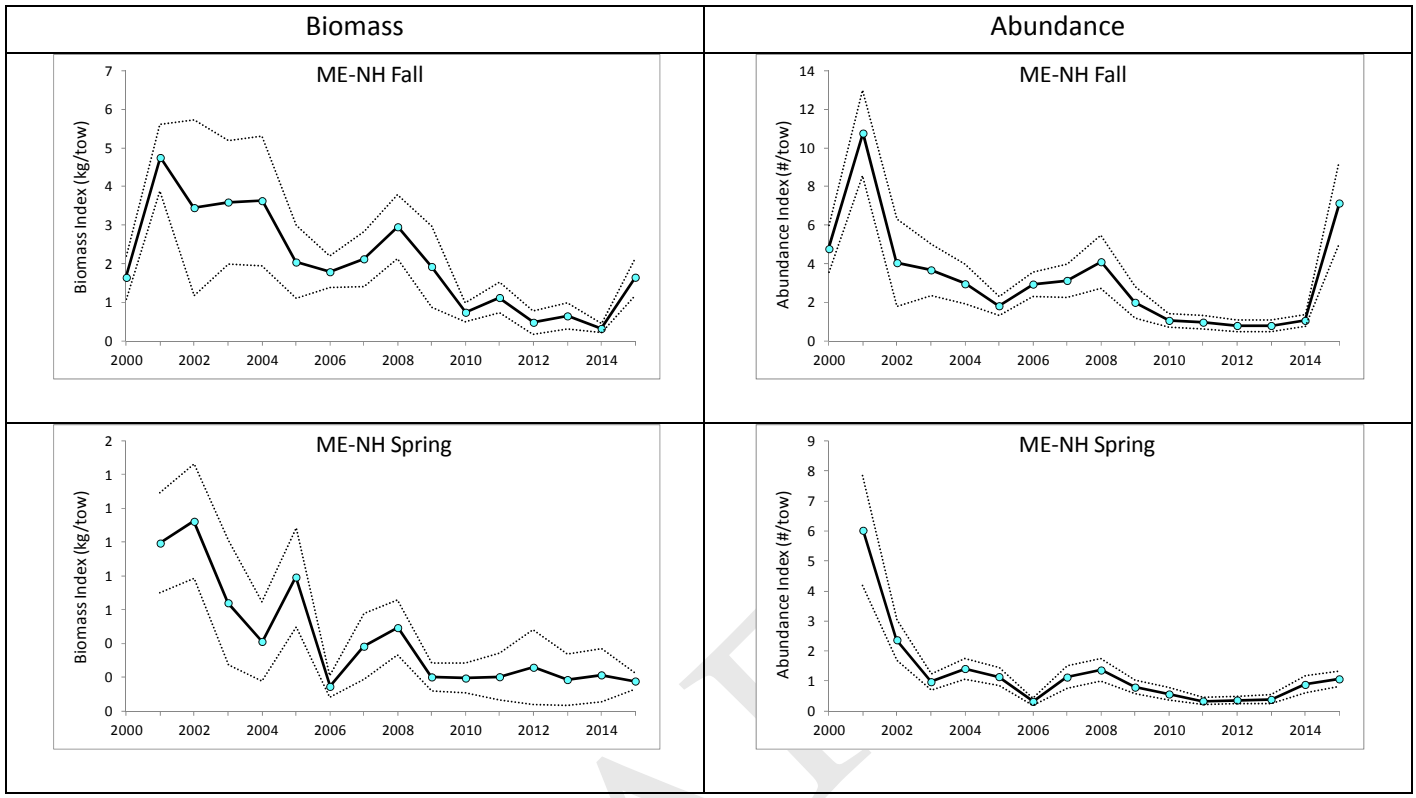



Figure 12. Survey indices for monkfish from Maine-New Hampshire inshore surveys. Data courtesy of Maine Department of Marine Resources.

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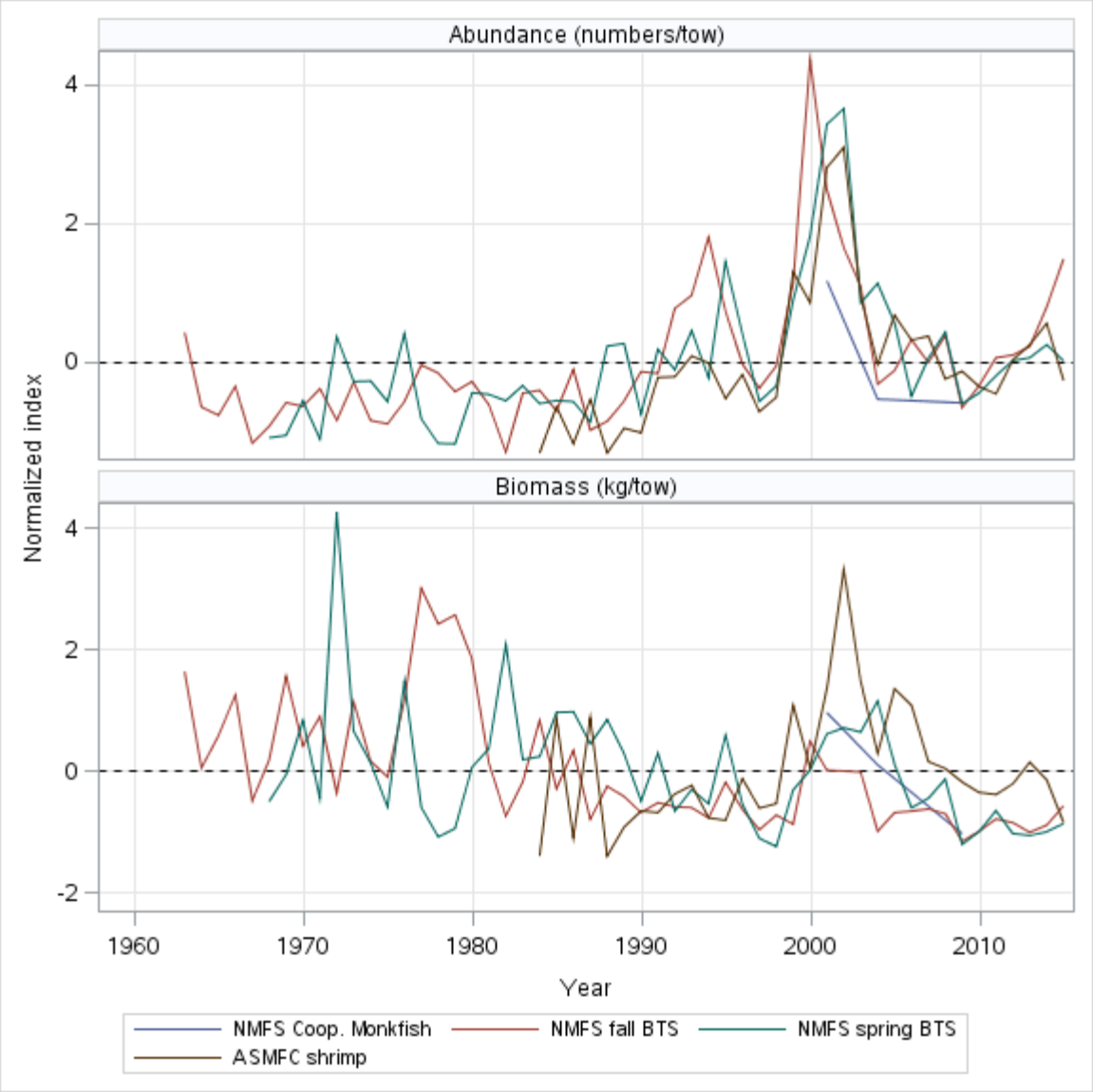



Figure 13. Normalized survey indices for monkfish in the northern management area.

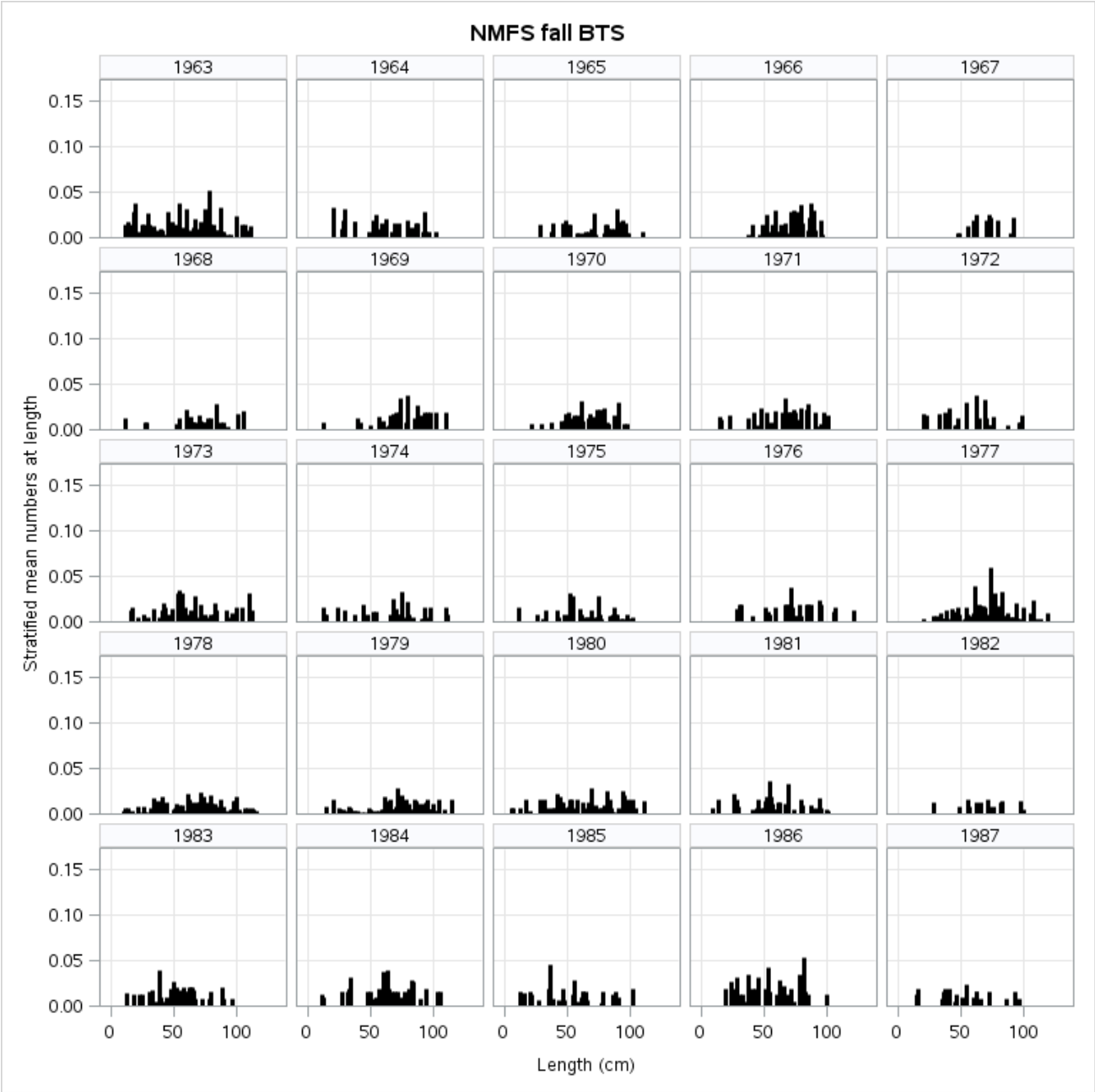



Figure 14. Abundance at length from NEFSC fall surveys in the northern management area.

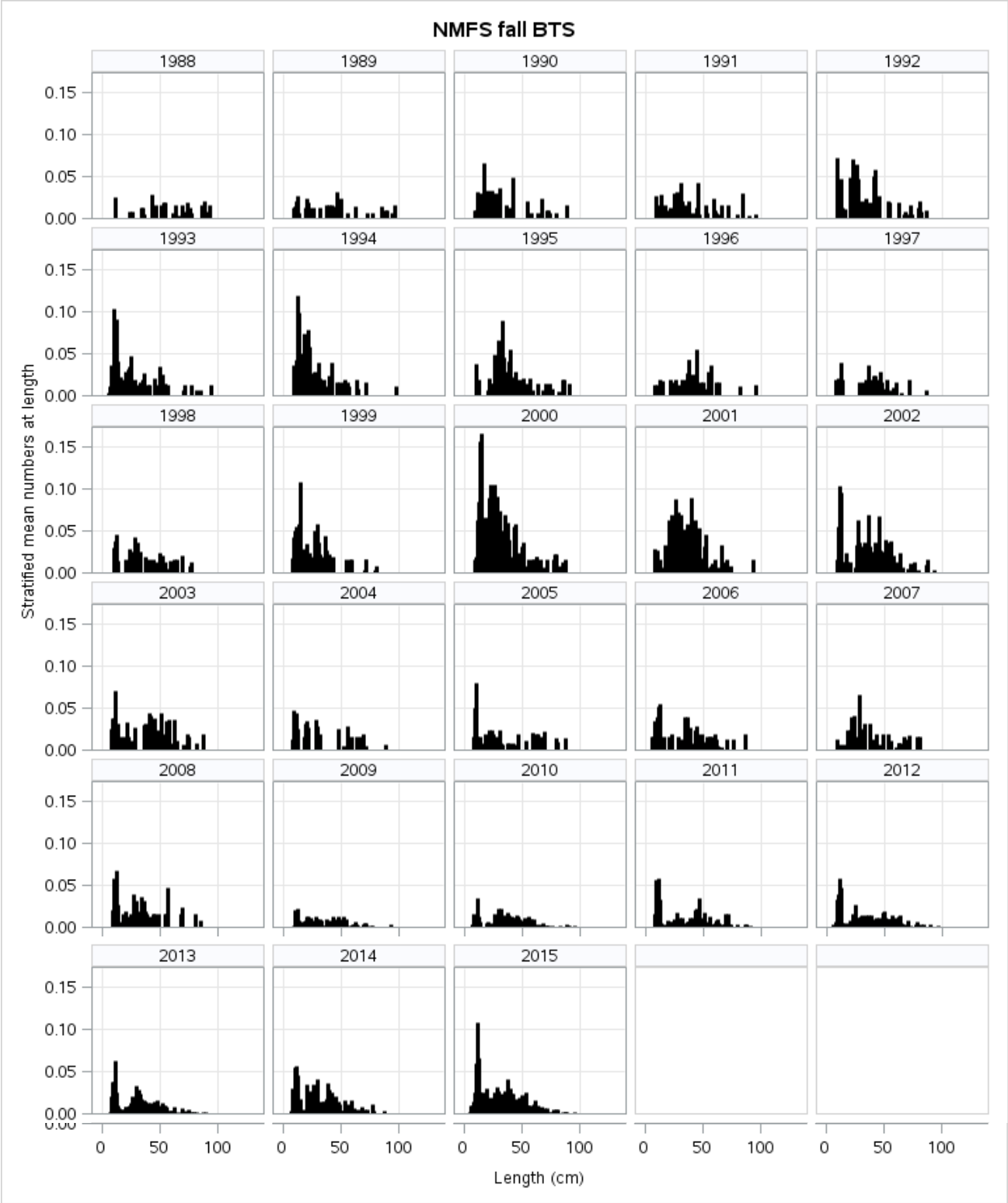



Figure 14, cont'd. (fall surveys, north)

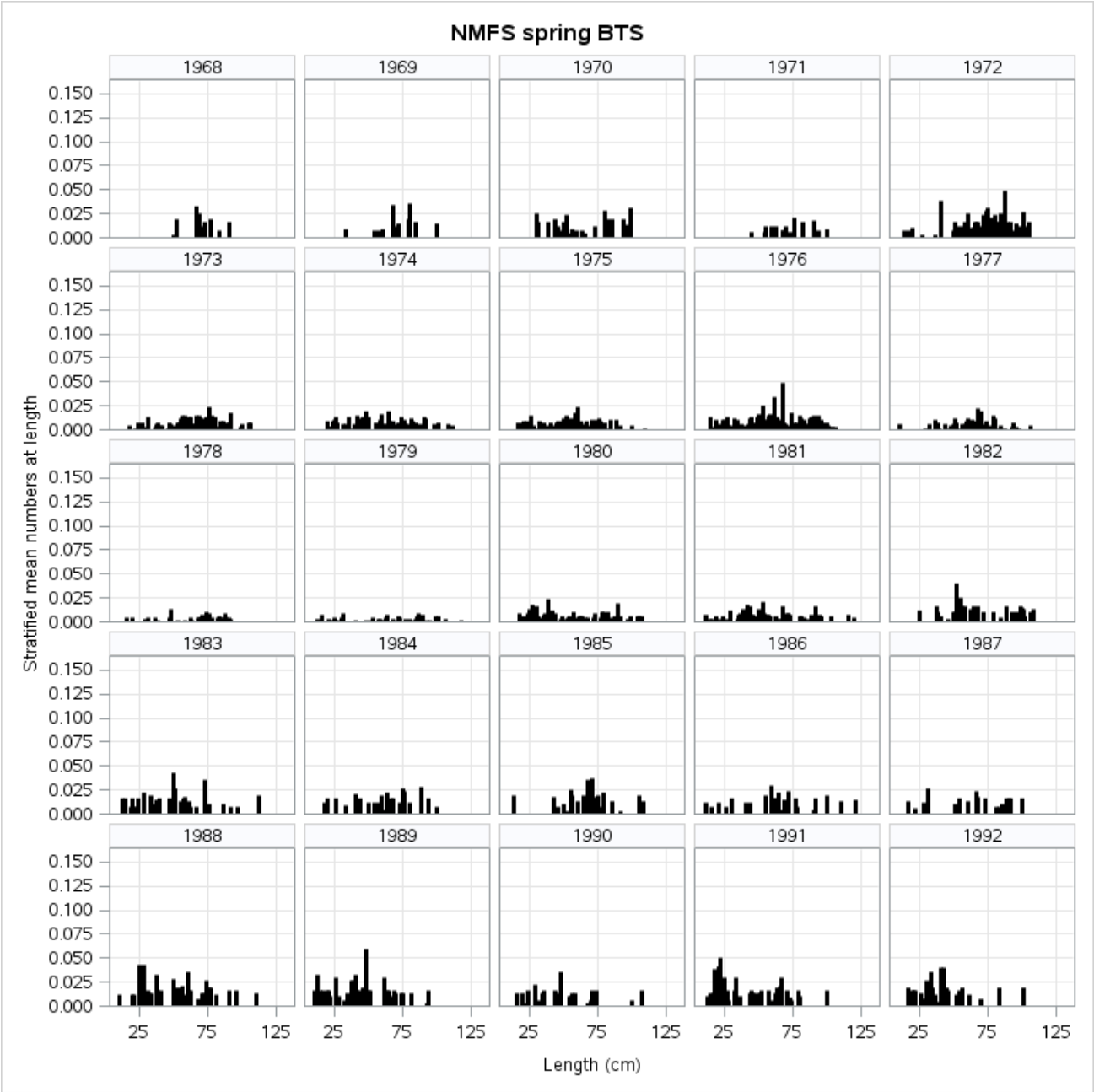



Figure 15. Abundance at length from NEFSC spring surveys in the northern management area.

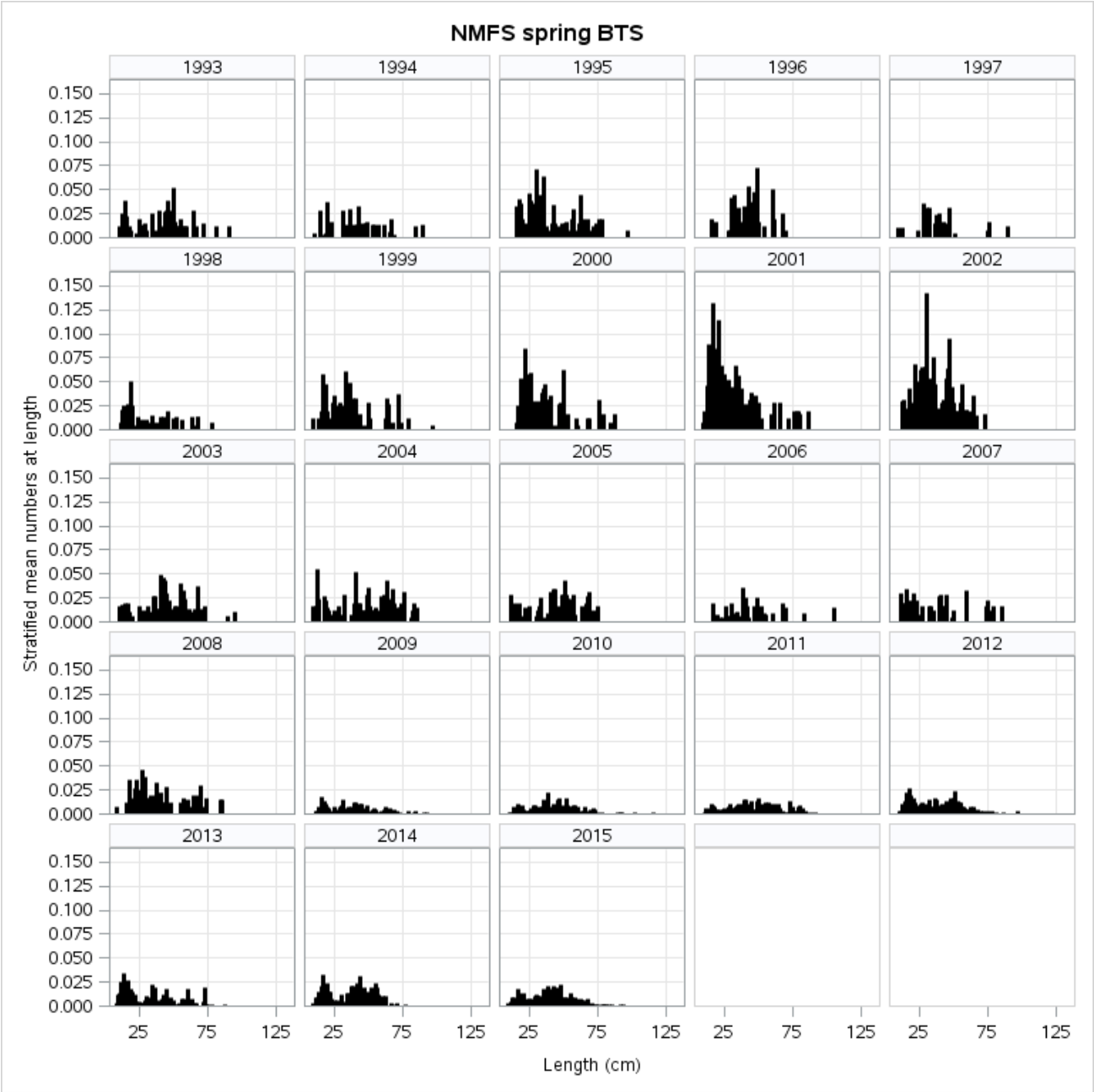



Figure 15, cont'd. (spring surveys, north)

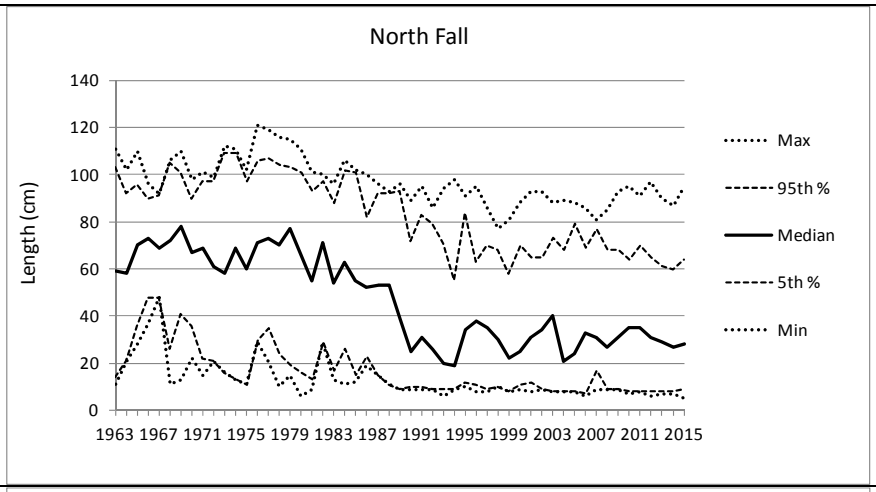
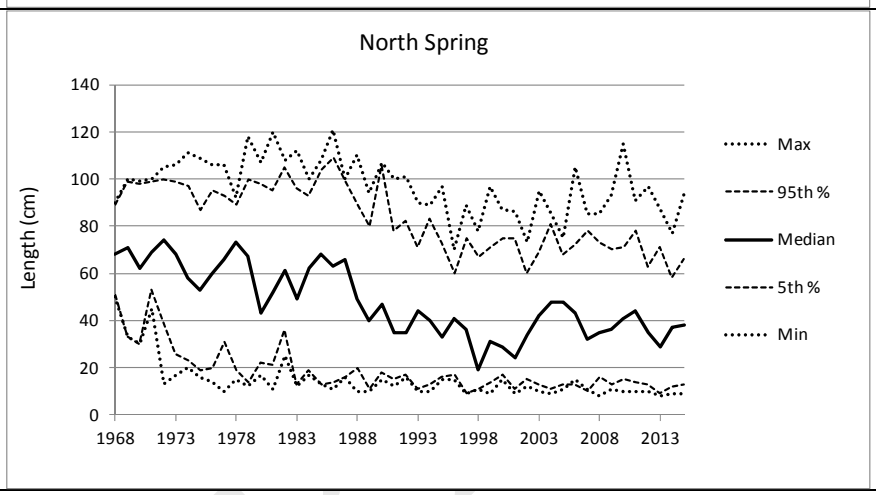
| North | |
|---|---|
| NEFSC Fall |   |
| NEFSC Spring |   |

Figure 16. Length quantiles for monkfish over time from NEFSC surveys in the northern management area.

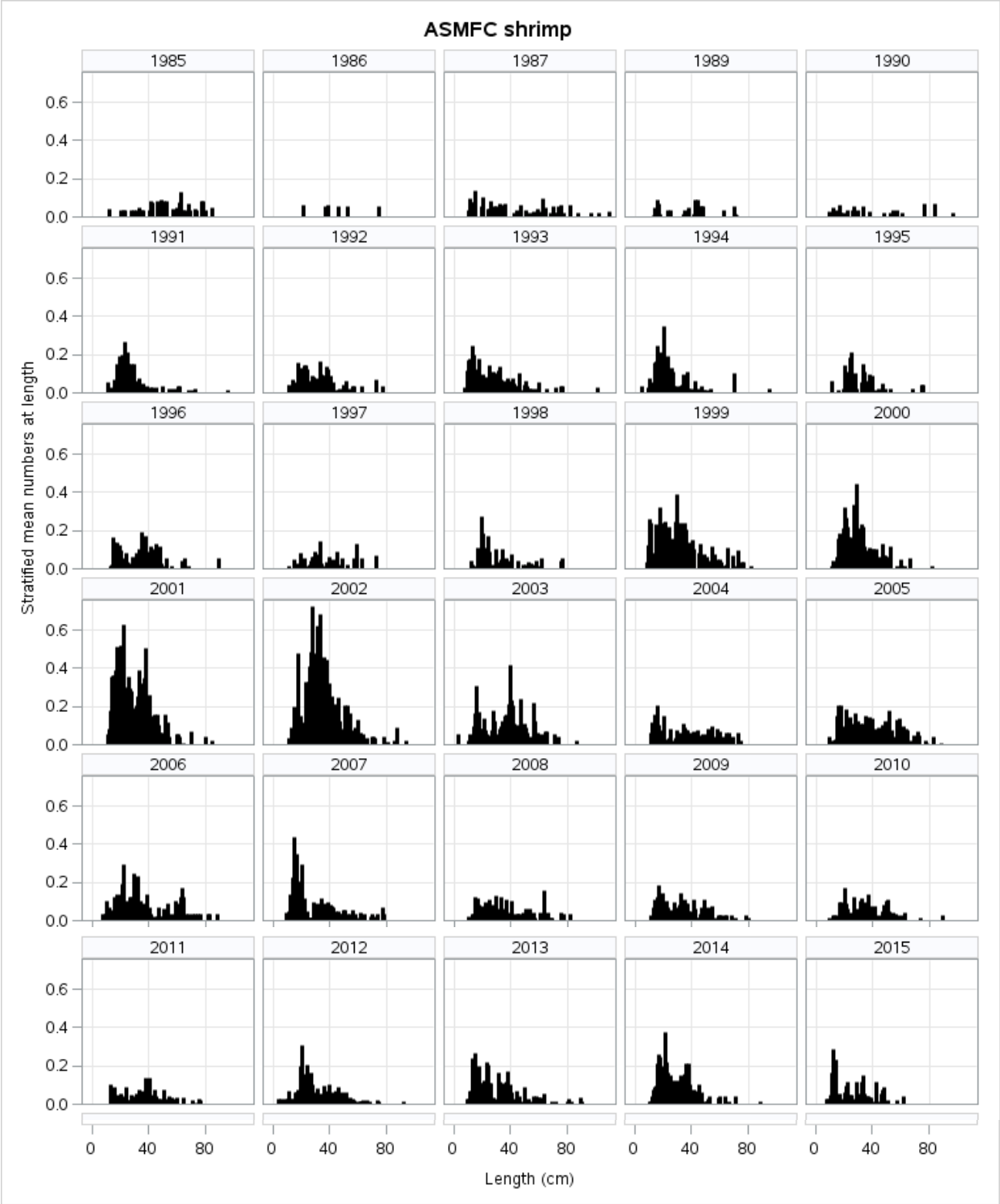
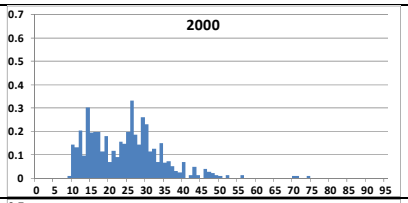
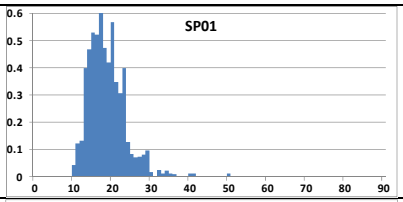
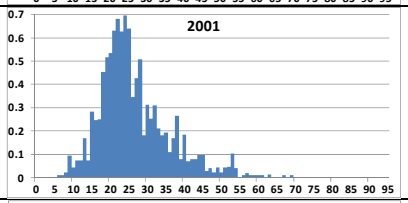
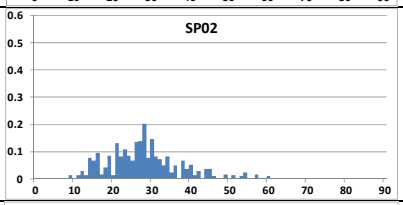
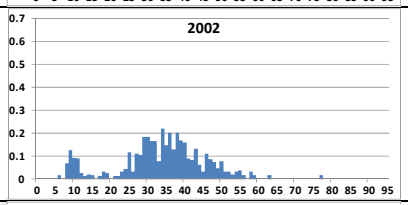
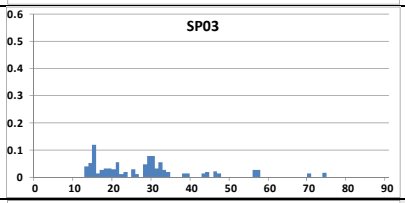
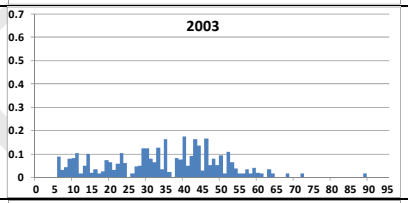
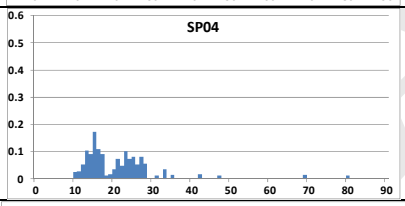
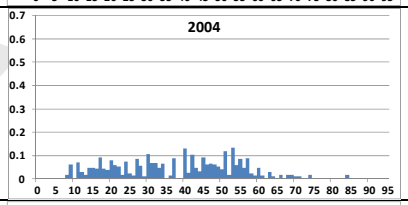
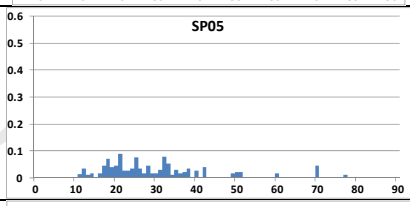
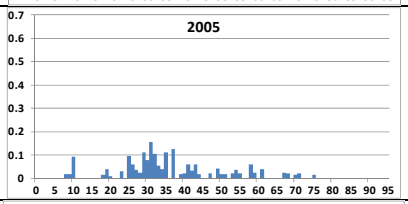
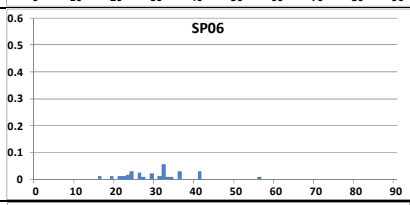
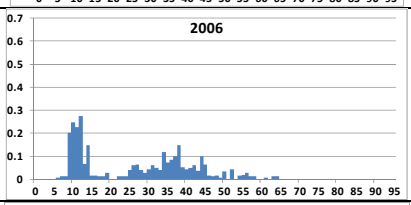
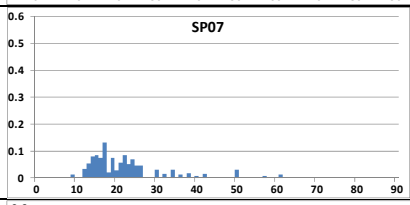
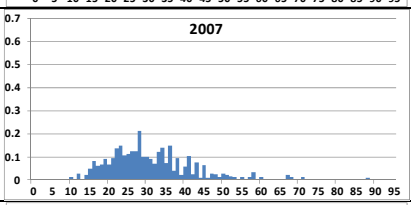
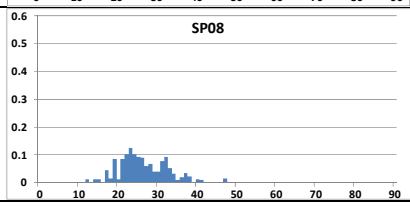
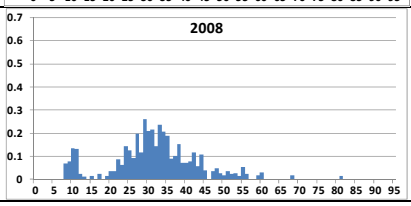



Figure 17. Abundance at length from ASMFC summer shrimp surveys in the northern management area.

| ME-NH Surveys | Spring | Fall |
|---|---|---|
| 2000 | |   |
| 2001 |   |   |
| 2002 |   |   |
| 2003 |   |   |
| 2004 |   |   |
| 2005 |   |   |
| 2006 |   |   |
| 2007 |   |   |
| 2008 |   |   |

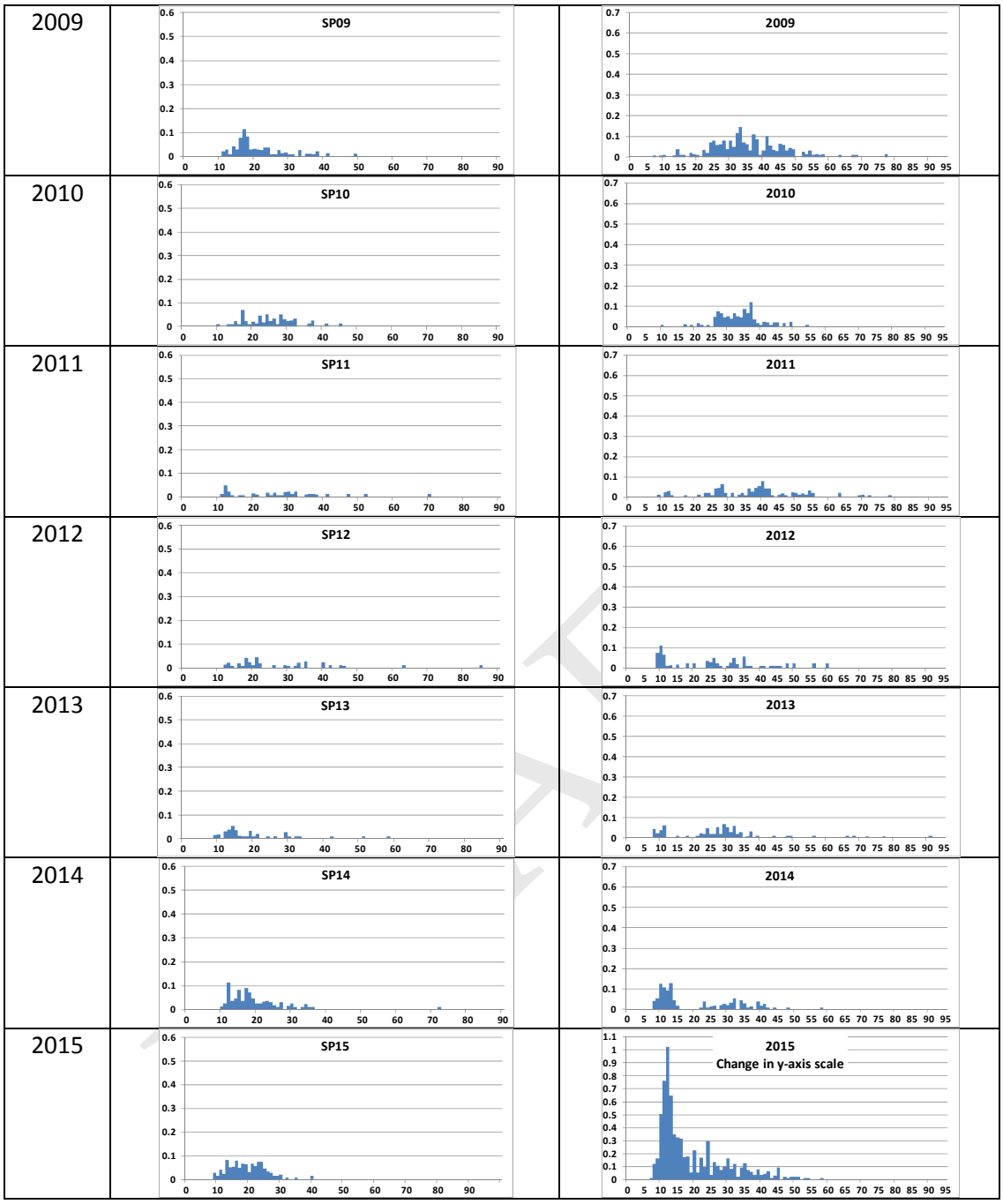



Figure 18. Abundance at length from ME/NH inshore trawl surveys in the northern management area.

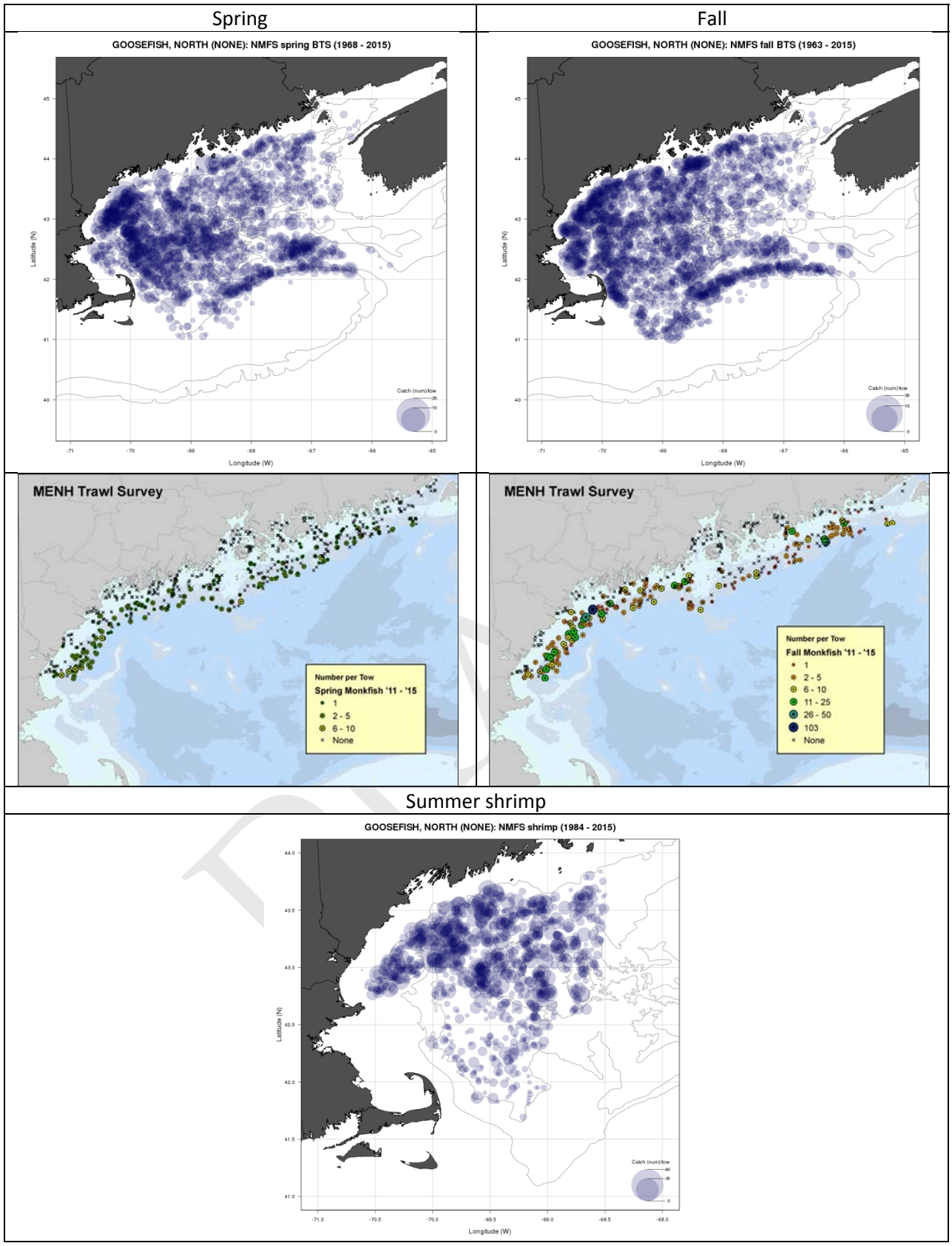



Figure 19. Distribution of monkfish in surveys in the northern management area.

South

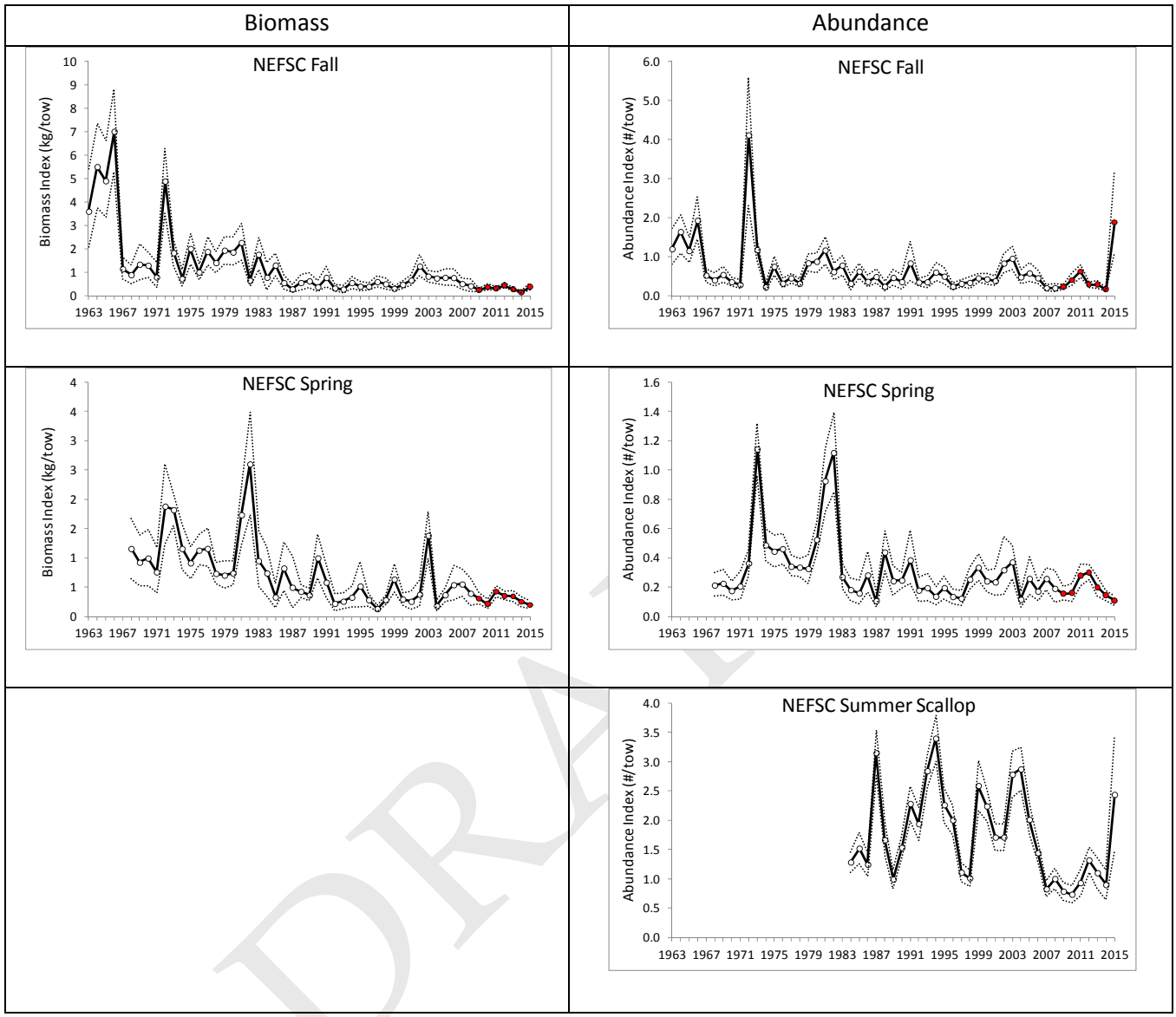



Figure 20. Survey indices for monkfish in the southern management area. Red-filled points are NEFSC surveys conducted on the FSV Bigelow (after 2008), converted to Albatross units as described in the text.Tables_for_2016_update.xlsx - arithmetic means with bootstrapped CIs

South

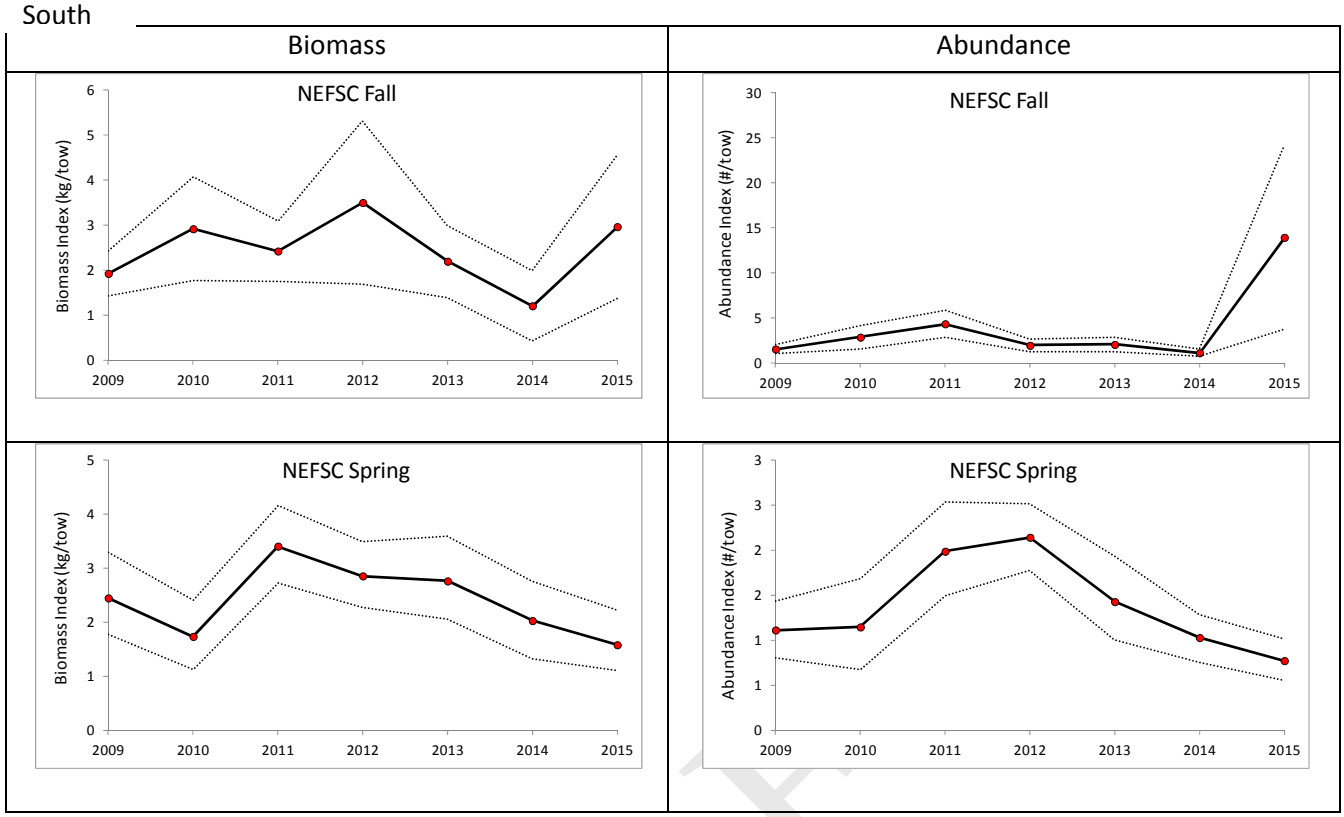



Figure 21. Survey indices from surveys conducted on the FRSV Bigelow in the southern management area, not converted to Albatross units.

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South

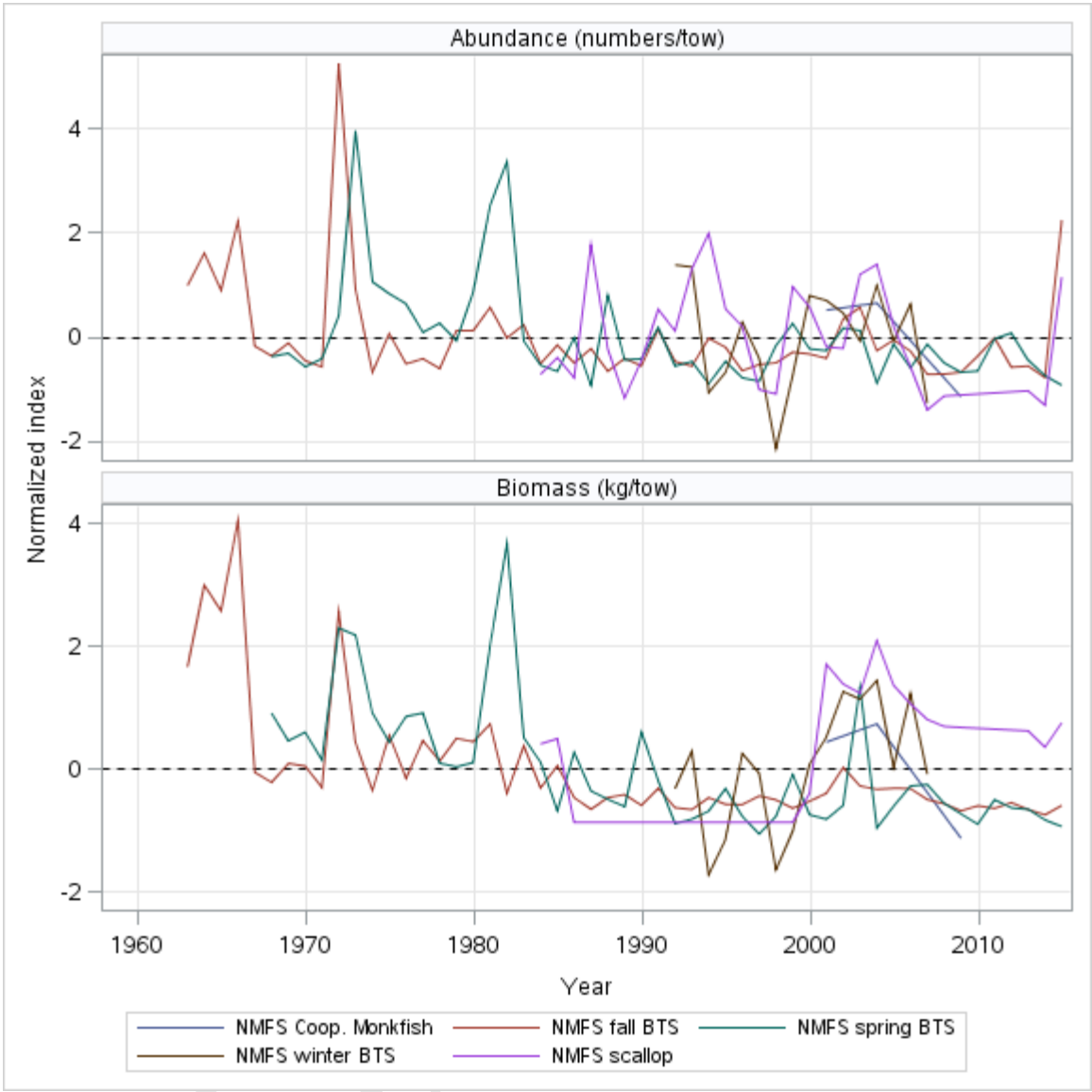



Figure 22. Normalized survey indices for monkfish in the southern management area.

South

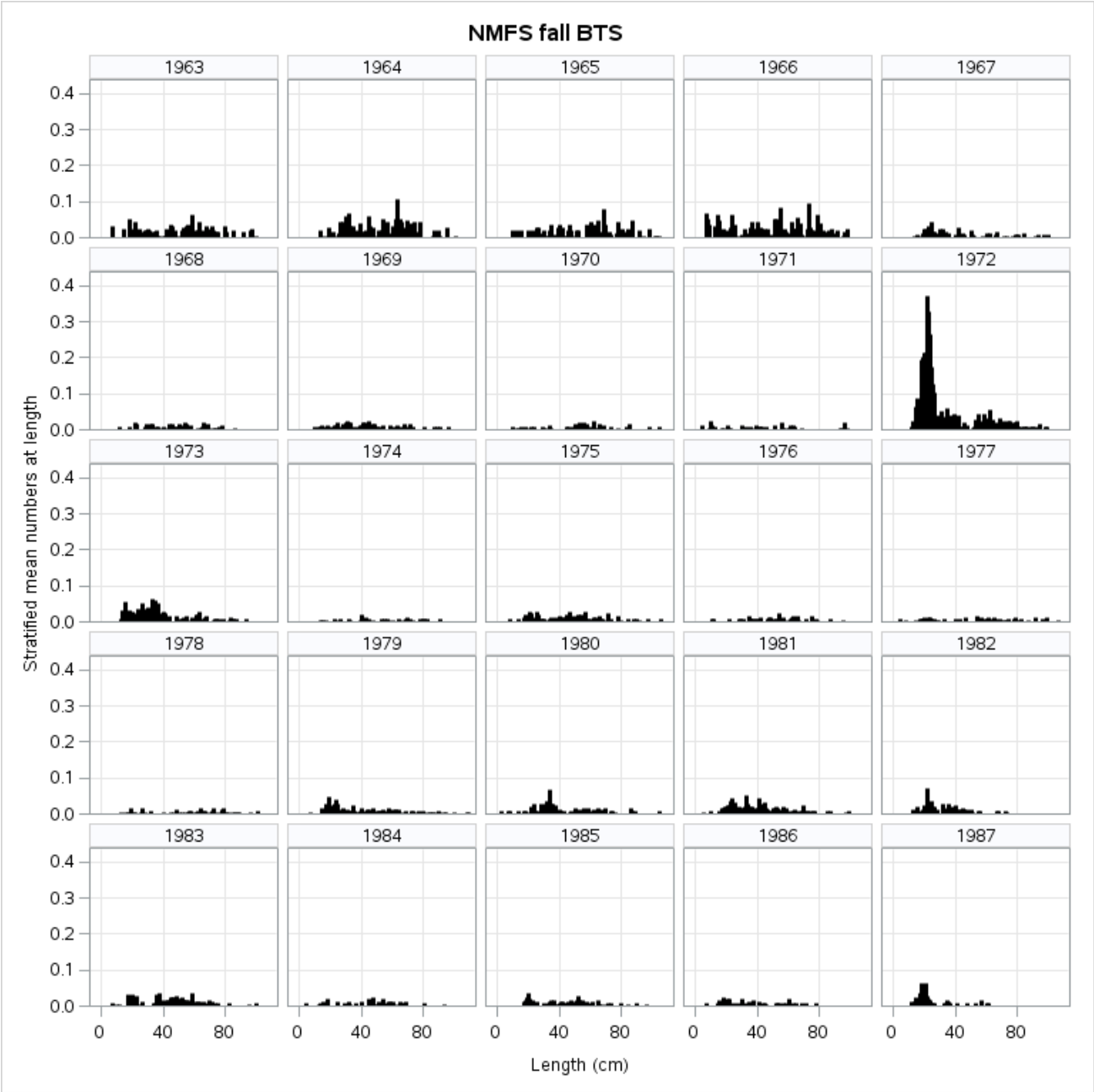



Figure 23. NEFSC fall survey indices of abundance at length, southern management area.

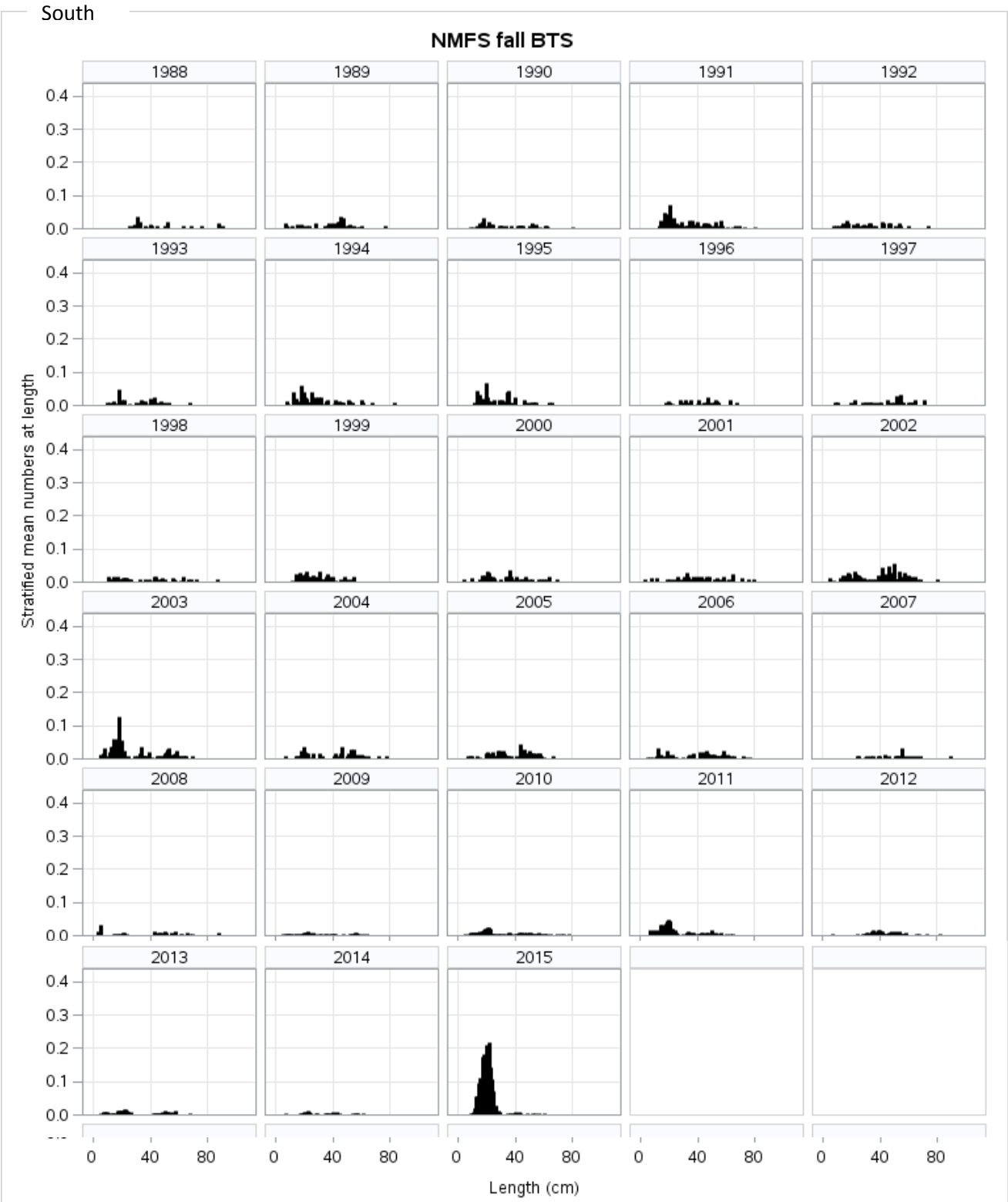



Figure 23, cont'd. (fall survey, south)

South

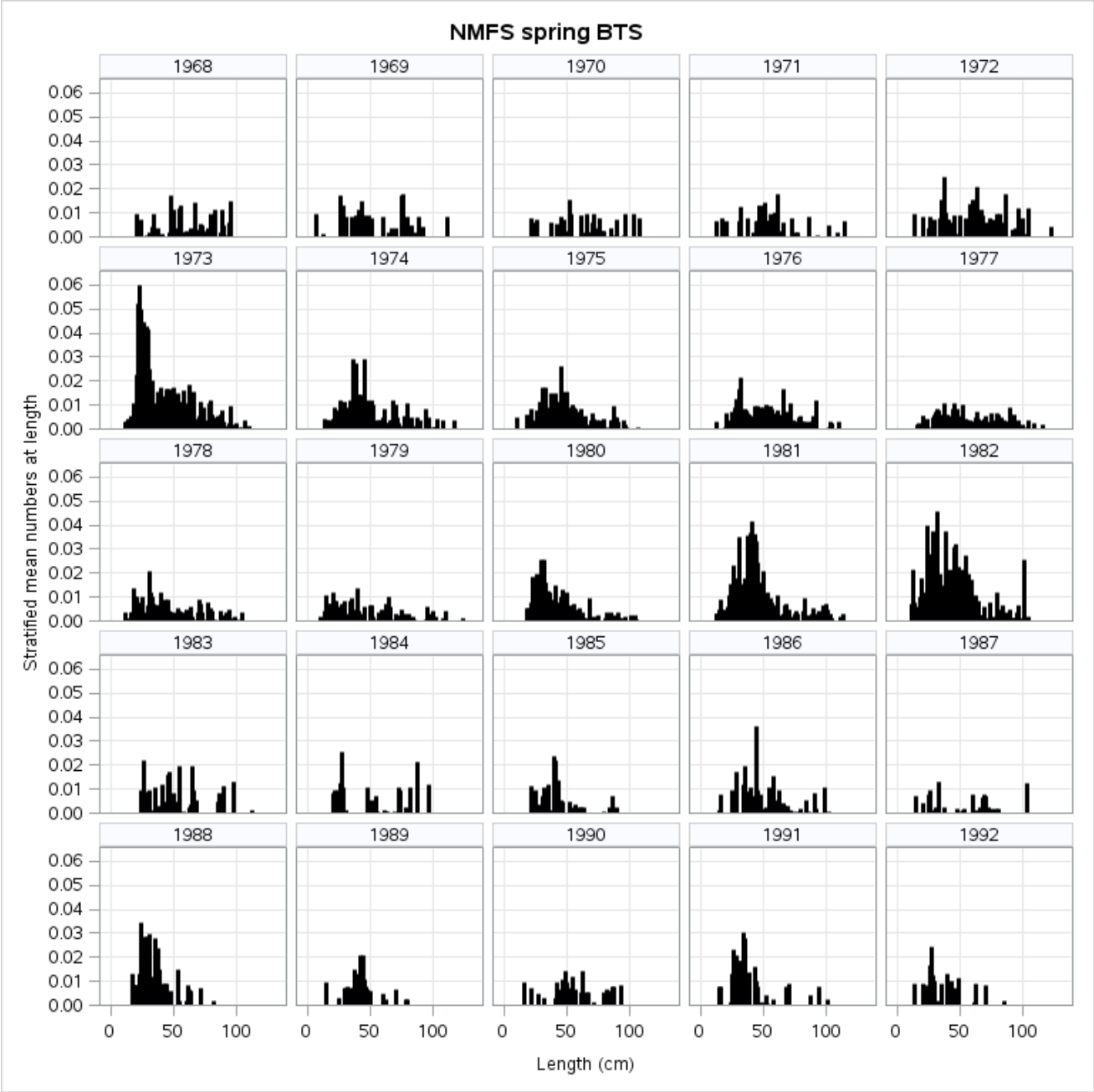



Figure 24. NEFSC spring survey indices of abundance at length, southern management area.

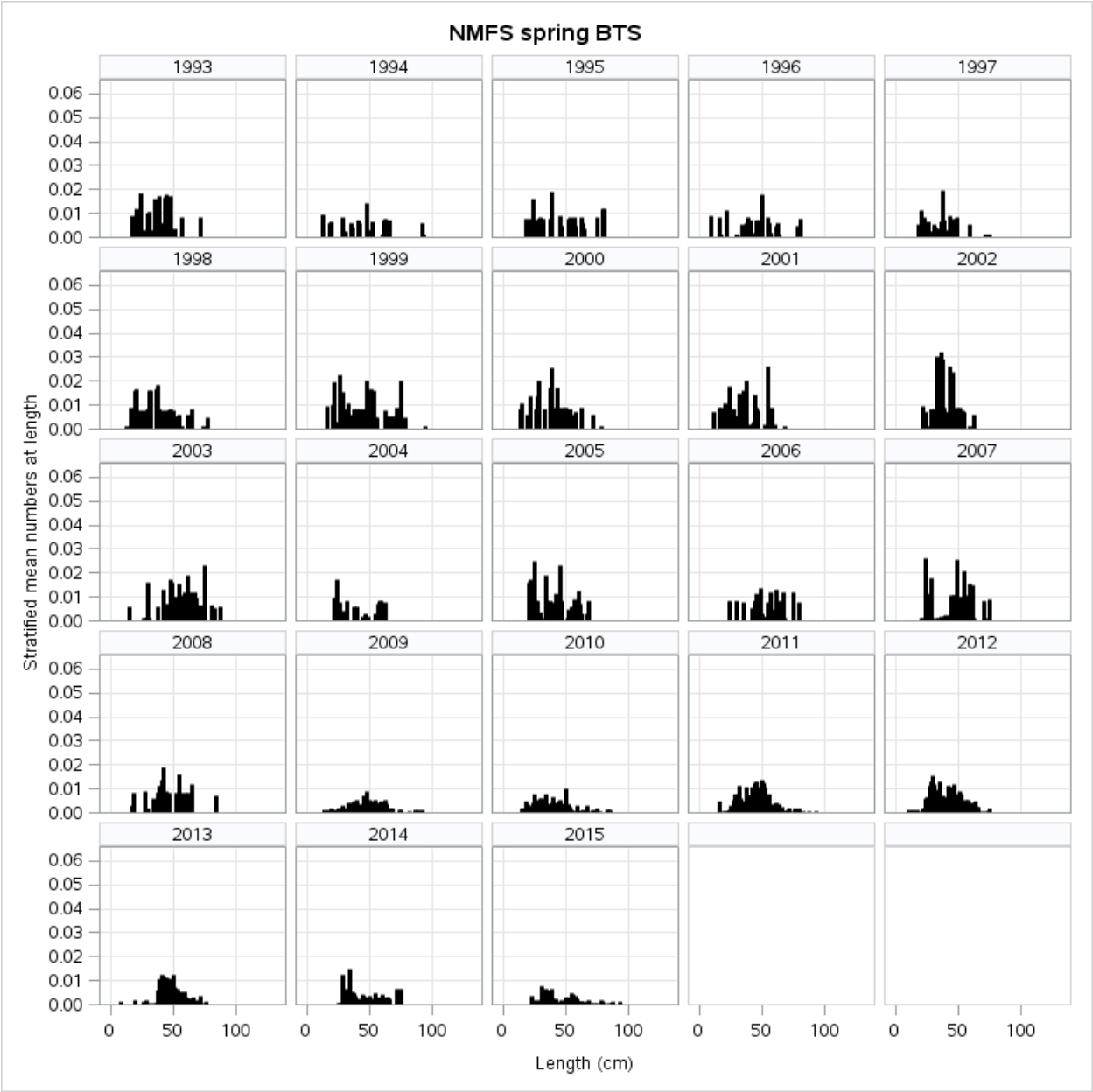



Figure 24, cont'd. (spring survey, south)

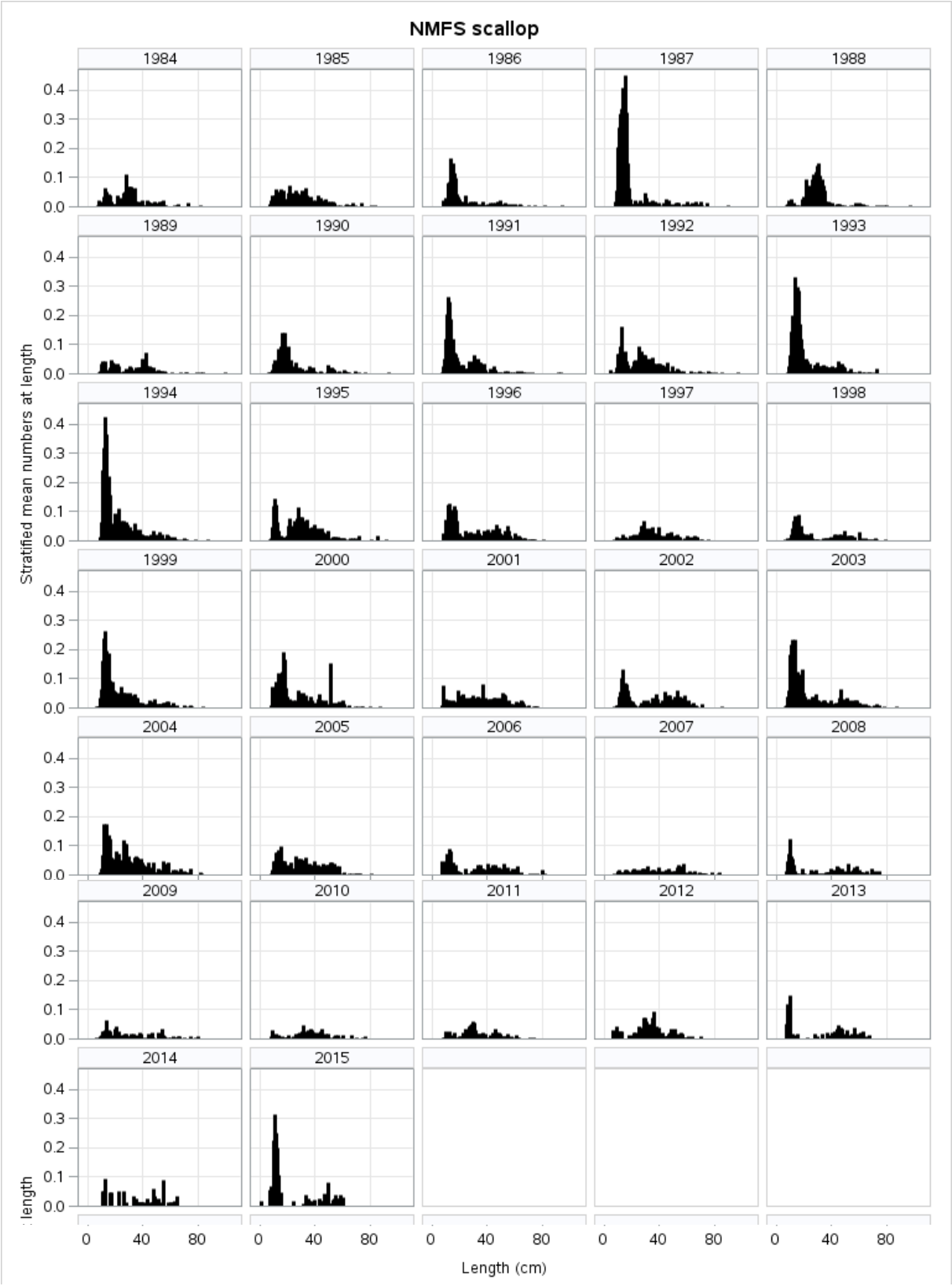



Figure 25. NEFSC spring/summer scallop surveys. Survey timing shifted from summer to spring in 2009. Data for 2014 and 2015 include only the northern portion of the survey area.

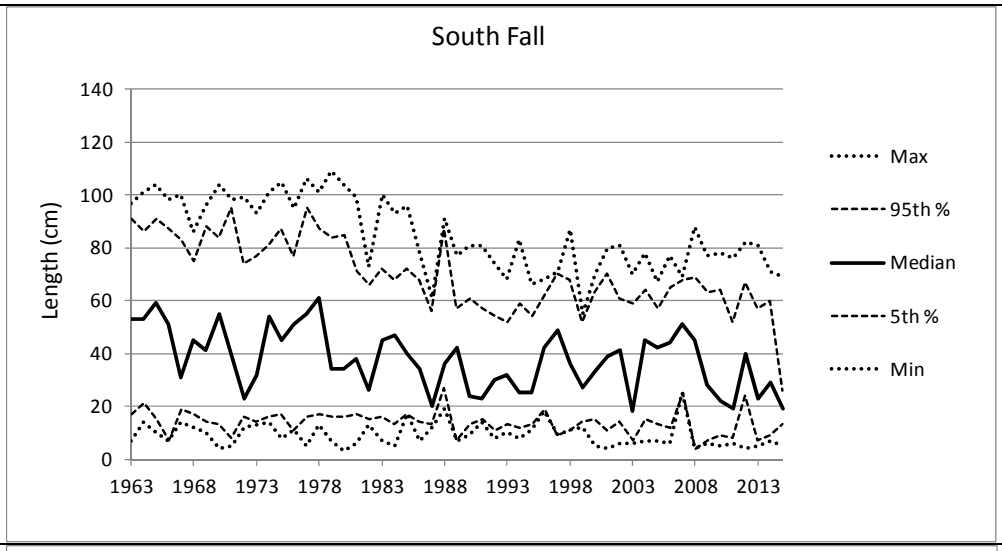
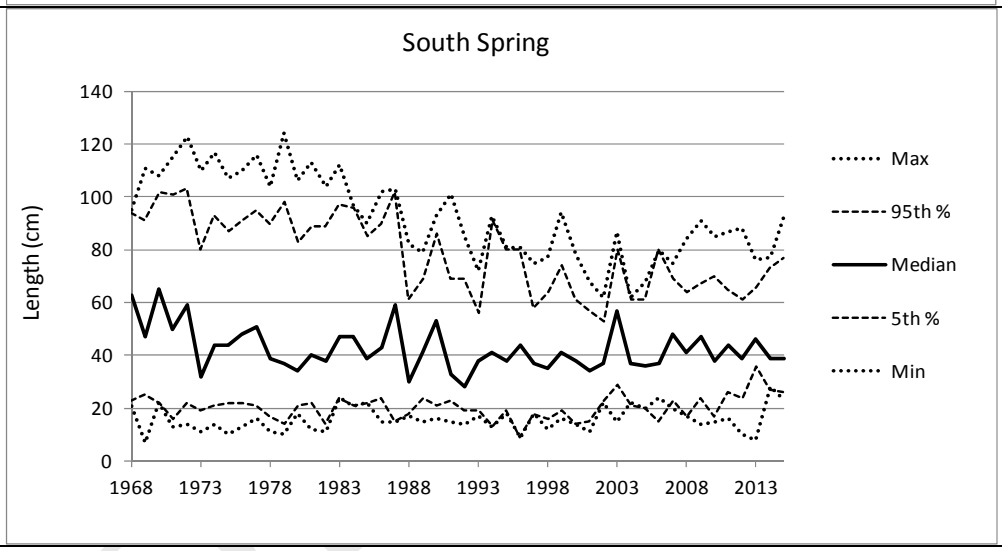
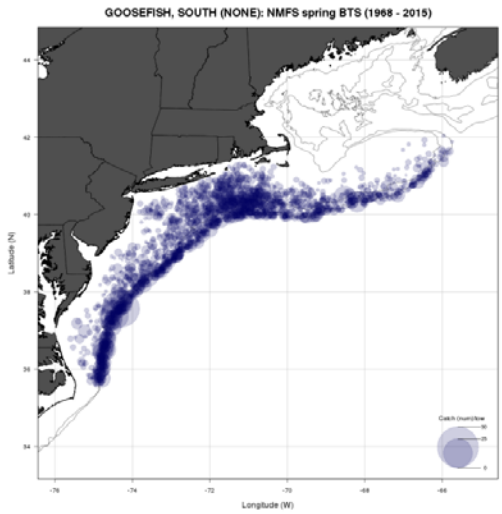
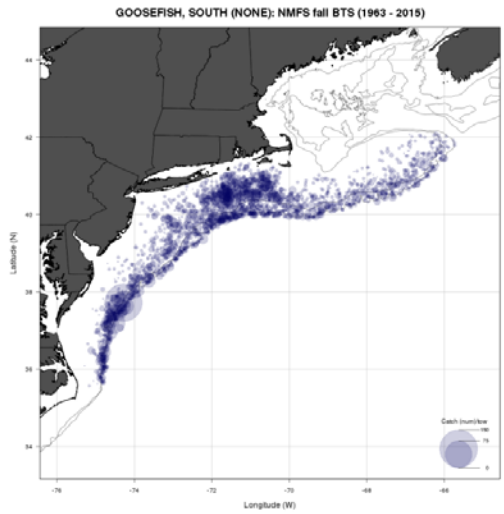
| South | |
|---|---|
| NEFSC Fall |   |
| NEFSC Spring |   |

Figure 26. Length quantiles for monkfish over time from NEFSC surveys in the southern management area.

| | Spring | Fall |
|---|---|---|
| NEFSC bottom trawl surveys |   |   |
| Spring/Summer Scallop Survey | | |

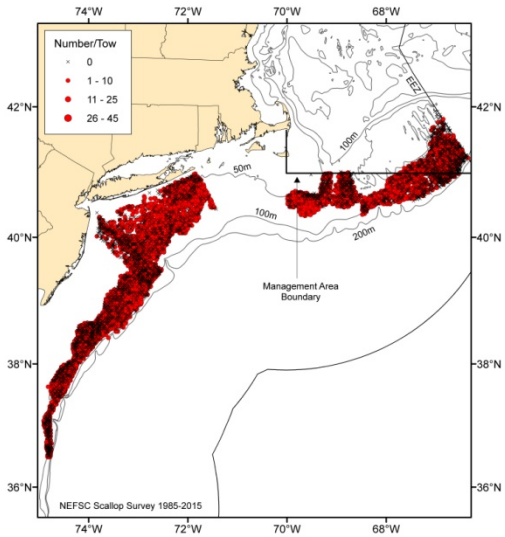



Figure 27. Distribution of monkfish in the southern management area from NEFSC spring (1968-2015) and fall (1963-2015) bottom trawl surveys and NEFSC spring/summer scallop dredge surveys (1984-2015).

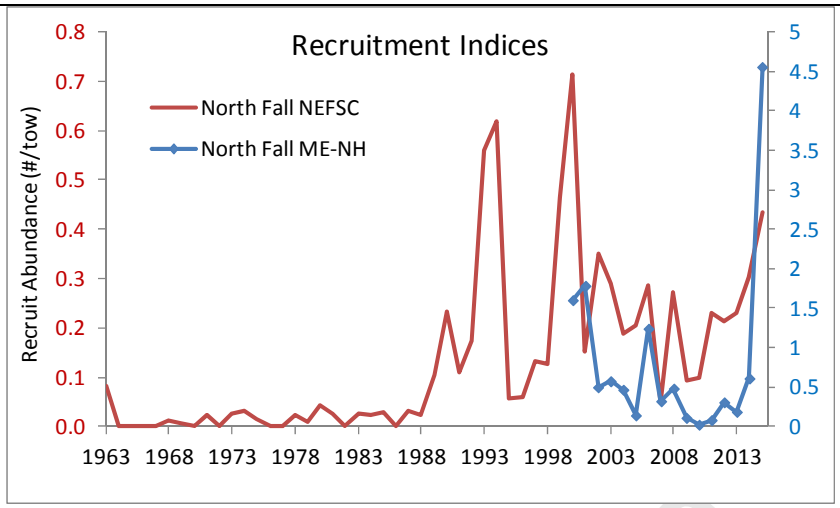
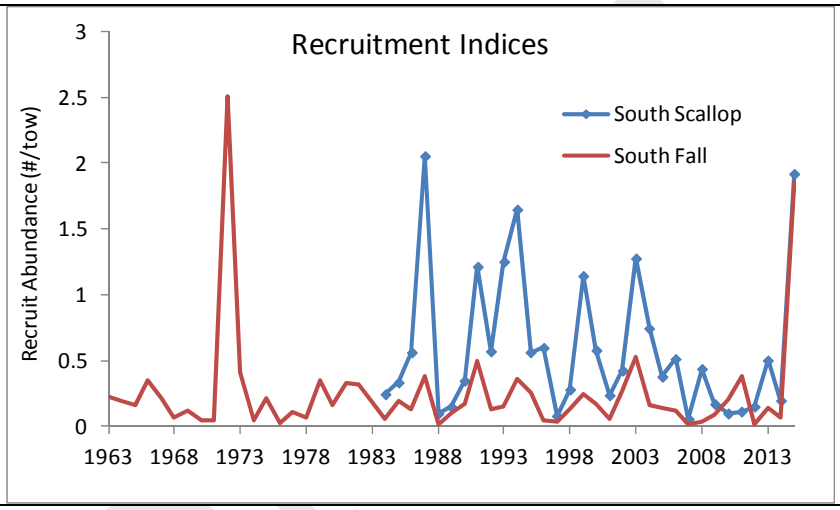
| | |
|---|---|
| North |   |
| South |   |

Figure 28. Recruitment indices for monkfish in the northern and southern management areas. Indices include monkfish in size ranges currently thought to represent young-of-year (age 0) in each area and season. Note: 2014 and 2015 scallop survey data include only the northern portion of the Mid-Atlantic Bight.

| 2015 Fall Survey | 2015 Scallop Survey |
|---|---|

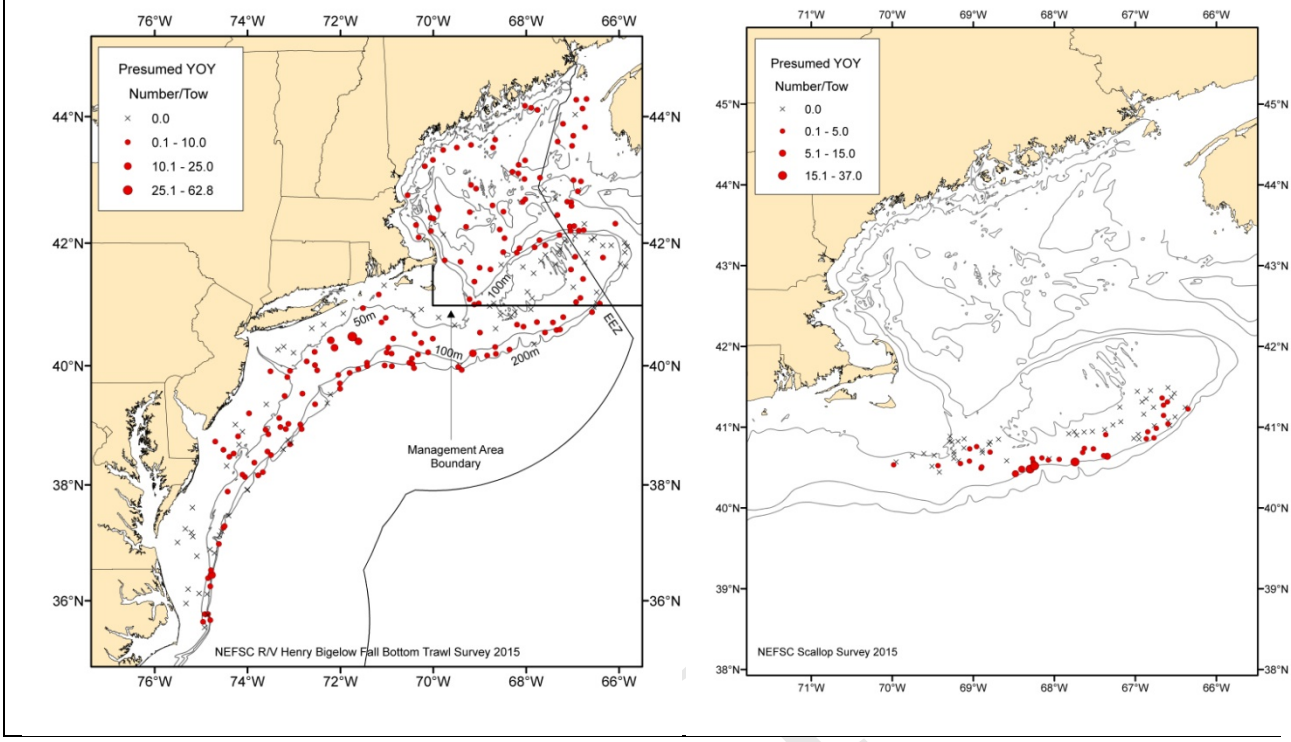



Figure 29. Distribution of presumed young-of-year monkfish in 2015 NEFSC surveys (fall trawl survey, summer scallop dredge survey). Only the northern portion of the Mid-Atlantic Bight was sampled by NEFSC in 2015.

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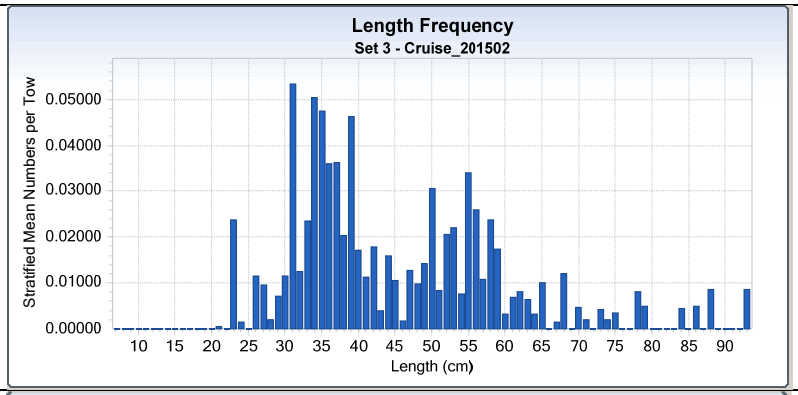
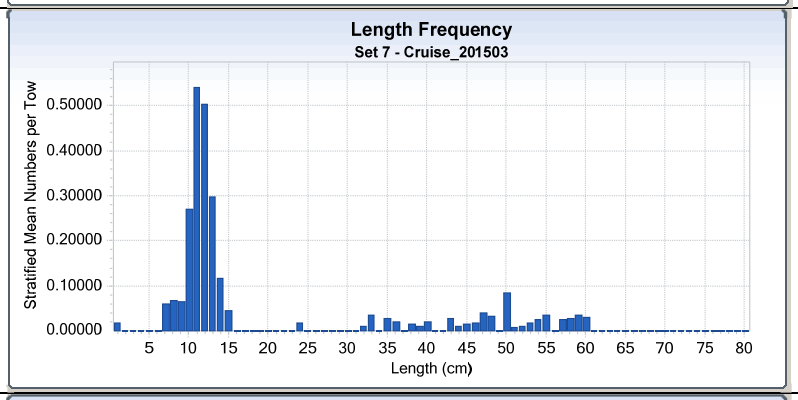
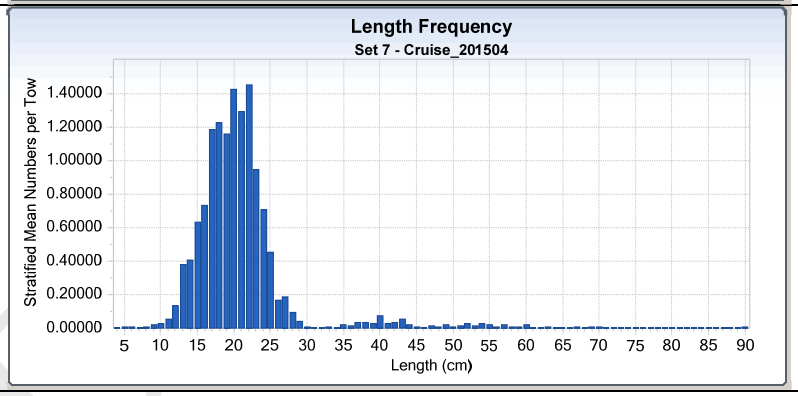
| | |
|---|---|
| South | |
| Spring 2015, average DOY= 92 |  |
| Scallop 2015, average DOY = 161 |  |
| Fall 2015, average DOY= 263 |  |

Figure 30. Length frequency distributions of monkfish from spring, summer and fall surveys in 2015 illustrating growth rates of presumed YOY monkfish. Monkfish settle to the benthos at about 8 cm.

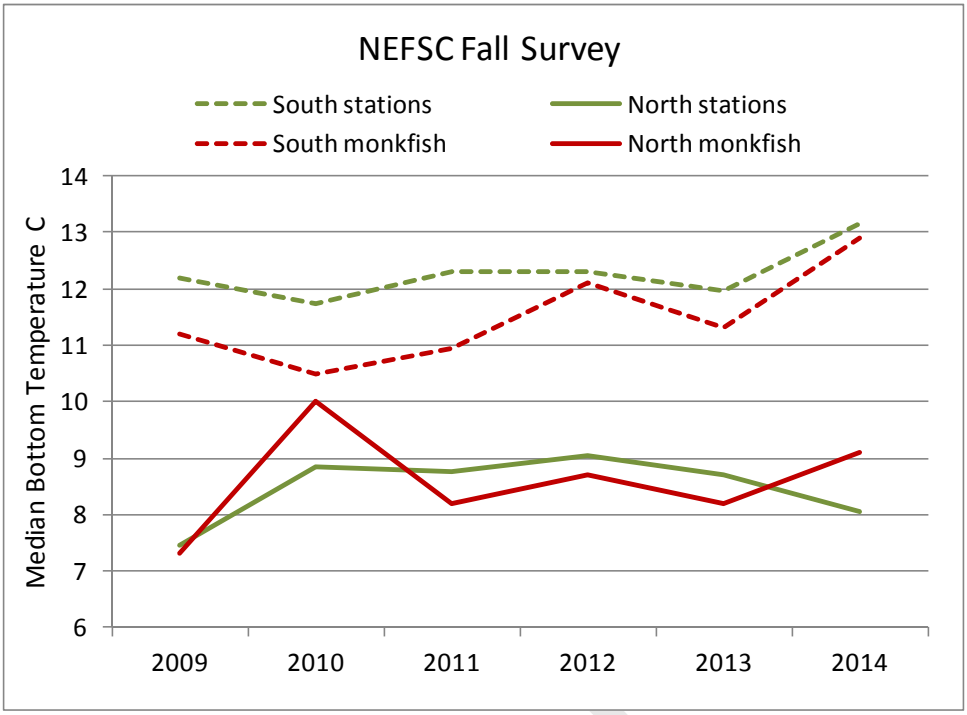



Figure 31. Median bottom temperature at all stations visited vs. bottom temperature weighted by number of monkfish at each station during NEFSC fall surveys, 2009-2014.

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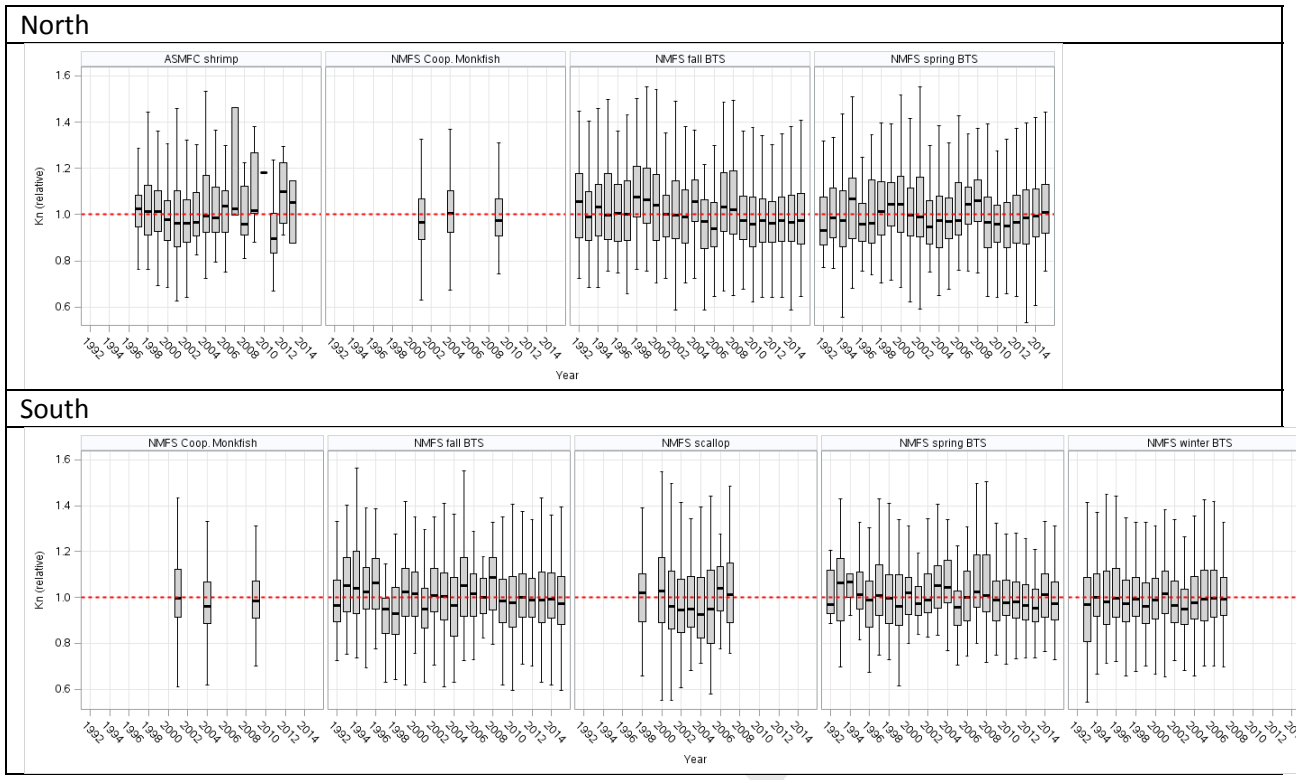


Figure 32. Condition factors (ratio of observed weight to predicted weight) for northern and southern management areas.

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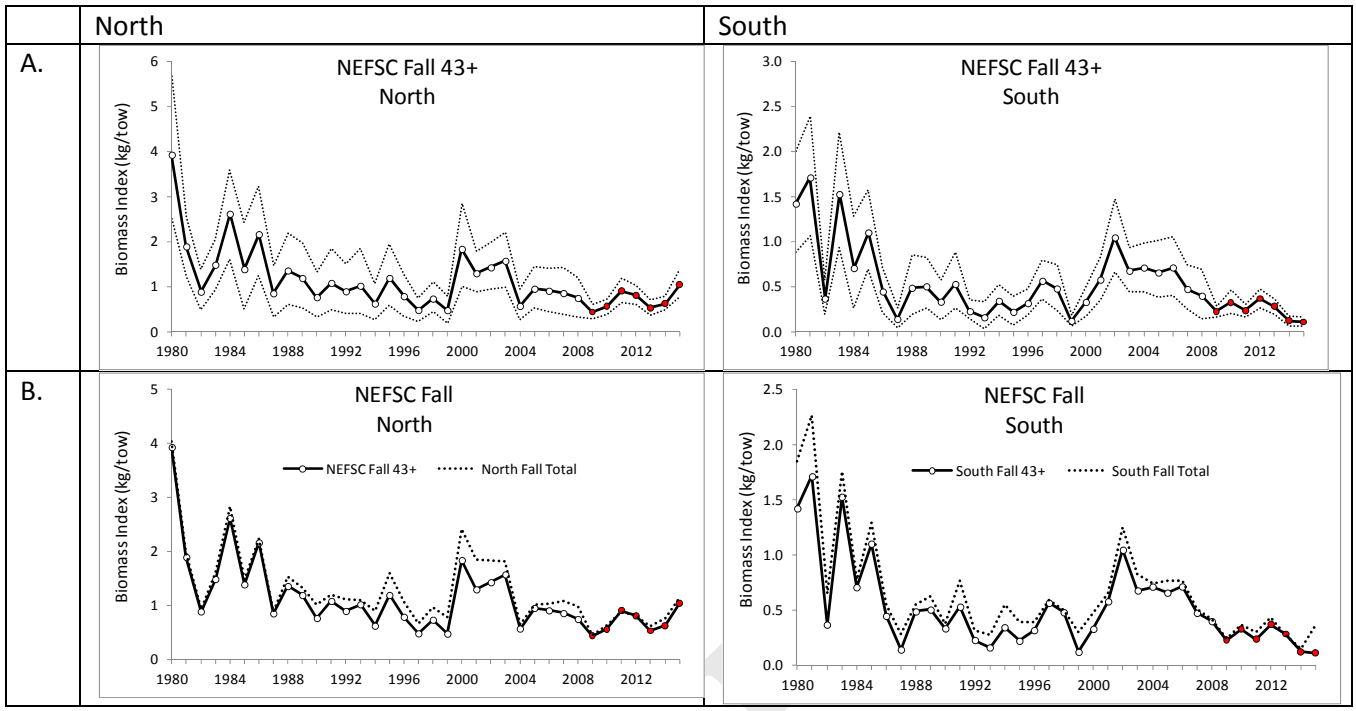


Figure 33. Exploitable biomass ( ≥ 43 cm total length) indices for monkfish in the northern and southern management areas. A. Exploitable biomass indices with 95% confidence intervals. B. Total biomass vs. exploitable biomass indices. Red points indicate years in which conversion coefficients have been applied to adjust for survey modernization (2009-2015). ~goose/assess 2016/TAC calculations/indices.xlsx

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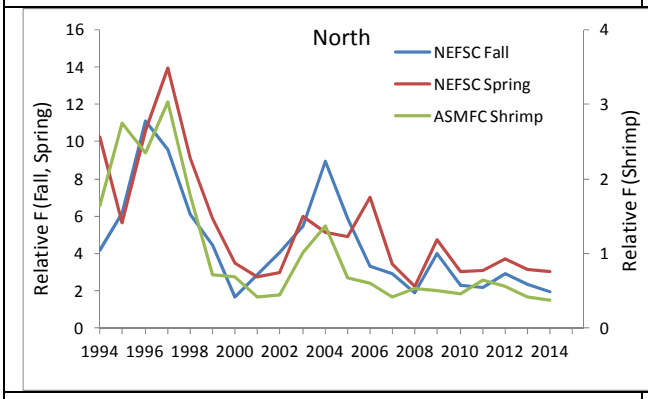
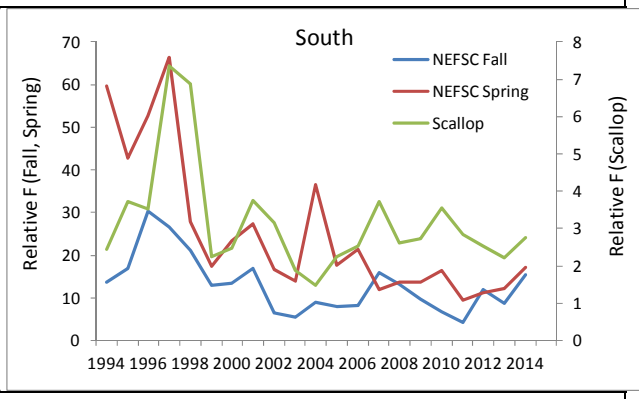
North




South




North vs. South (fall survey only)

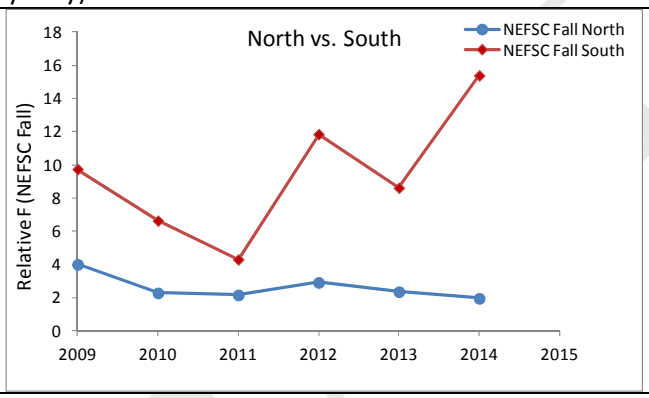
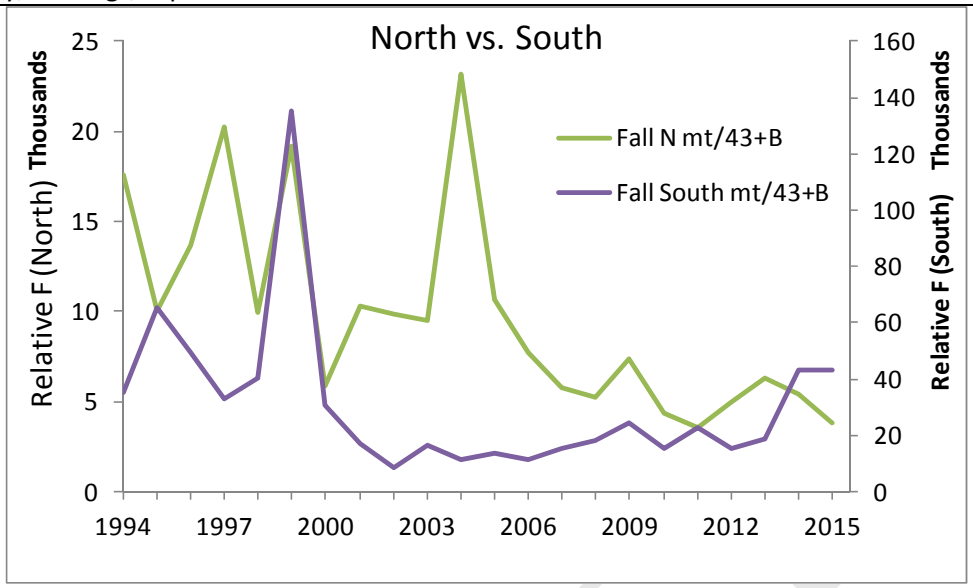



Figure 34. Relative exploitation rates (total catch in numbers/ total abundance index) of monkfish in the northern and southern management areas.

~/assess 2016/tables for 2016 update.xlsx

A. Fall survey, landings/exploitable biomass




B. Fall survey, landings (millions of fish) / exploitable abundance index (fall survey)

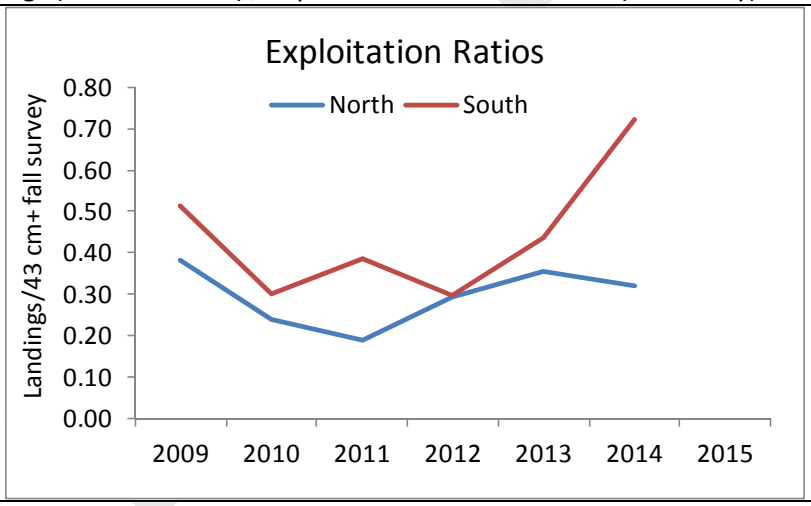



Figure 35. Relative exploitation rates based on (A.) landings (mt) / exploitable biomass index and (B.) landings (millions of fish) / area-swept minimum abundance of exploitable monkfish in the northern and southern management areas, based on NEFSC fall surveys.

~/assess 2016/tables for 2016 update.xlsx

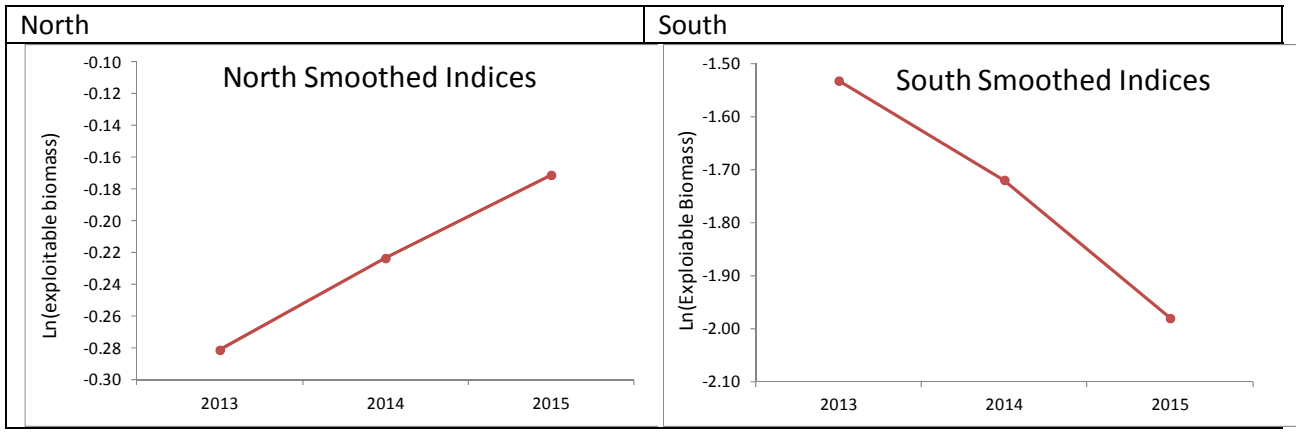



Figure 36. Trends in exploitable biomass (ln scale) indices in the northern and southern management areas based on NEFSC fall surveys only.

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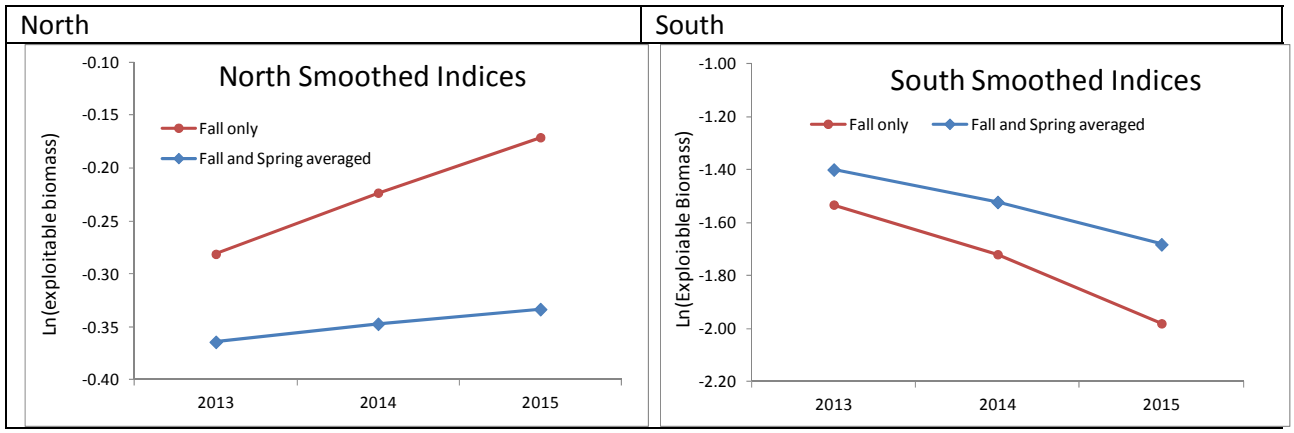


Figure 37. Trends in exploitable biomass (ln scale) indices in the northern and southern management areas based on NEFSC fall survey only (red circles) and spring and fall surveys averaged (blue diamonds).

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## Appendix

This appendix contains additional information that may be of interest to the Working Group.

Figures 1 and 2 provide a comparison of survey indices calculated using the delta distribution vs. arithmetic estimators with bootstrapped confidence intervals.

Figure 3 shows the distribution of monkfish in scallop dredge surveys conducted by NEFSC during 2009-2105. Figure 4 shows the location of sampling during the 2015 scallop dredge survey conducted by VIMS.

Figures 5 and 6 relate to habitat selection of monkfish. These figures show cumulative distribution curves for temperatures or depth at all stations vs. stations where monkfish were captured (temperature or depth at each station was weighted by the number of monkfish caught there) in NEFSC fall surveys. In the northern management area, monkfish distribution does not appear to be influenced by temperature or depth, as the curves generally overlie each other. In the south, monkfish occur at relatively cooler stations; however, there does not seem to be a trend over time (and similar results were found in Richards et al. 2008). In the south, monkfish are distributed in relatively deep water, which is consistent with distribution patterns seen previously for monkfish in the Mid-Atlantic Bight (Richards et al. 2008). No trend is evident in depth distribution in the south.

Figures 7-10 provide other indicators of distribution of monkfish. Figures 5 and 6 show the annual fraction of mean catch of monkfish in each stratum in fall surveys, and the mean catch per tow by stratum over time. Figures 7 and 8 show time series of Gini Indices calculated from several surveys over time. The Gini Index ranges between 0 and 1, with 0 indicating a perfectly even distribution, and 1 indicating a highly clumped distribution.

Figures 11 and 12 compare monkfish catch rates in day and night survey tows, along with the number of stations sampled during night and day over time. Particularly in the south, catch rates tend to be higher at night; however, in both areas, the number of day and night tows over time is roughly equal.

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Appendix

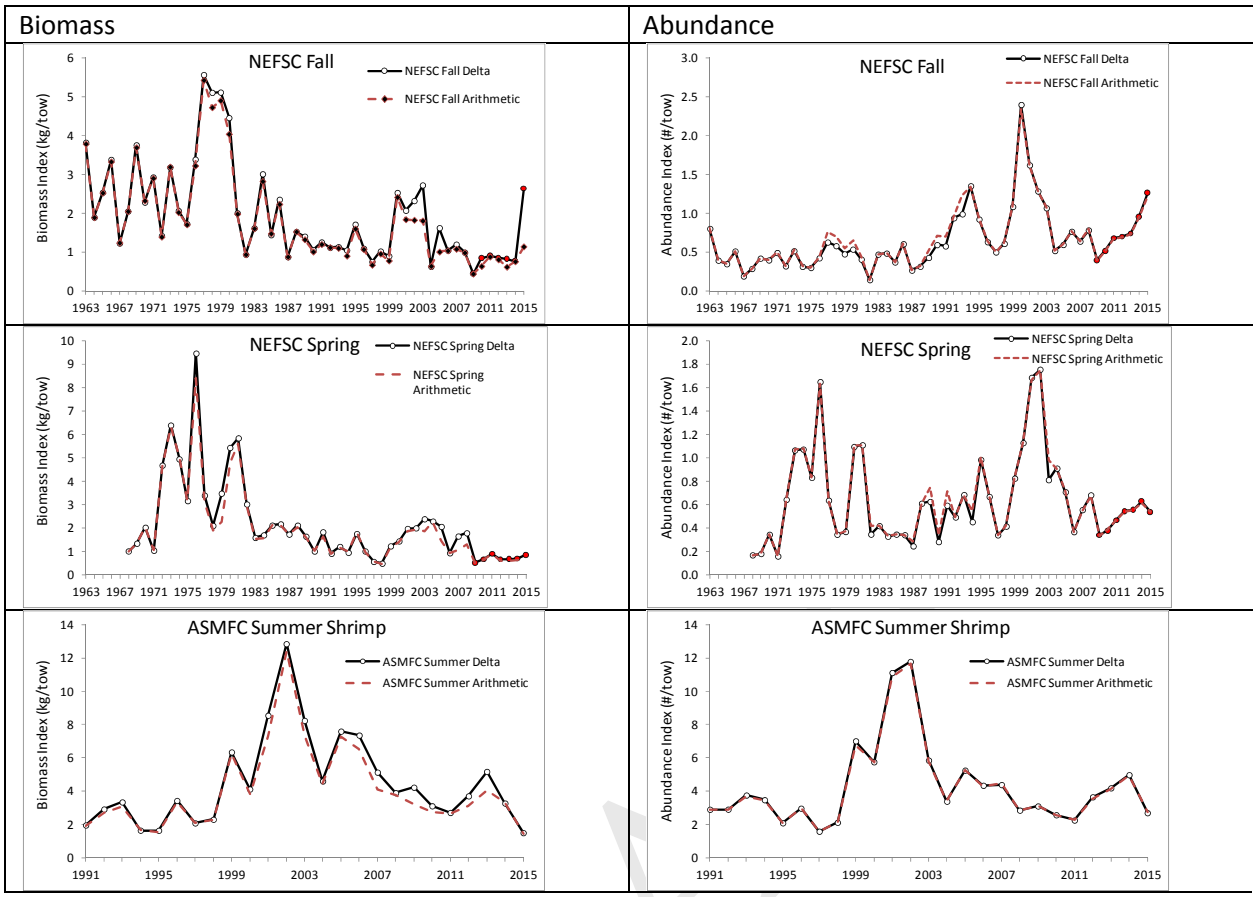



Figure A1. Comparison of delta distribution with arithmetic estimators of survey indices of abundance and biomass, northern management area. Confidence intervals for arithmetic estimators are from bootstrapping.

Appendix

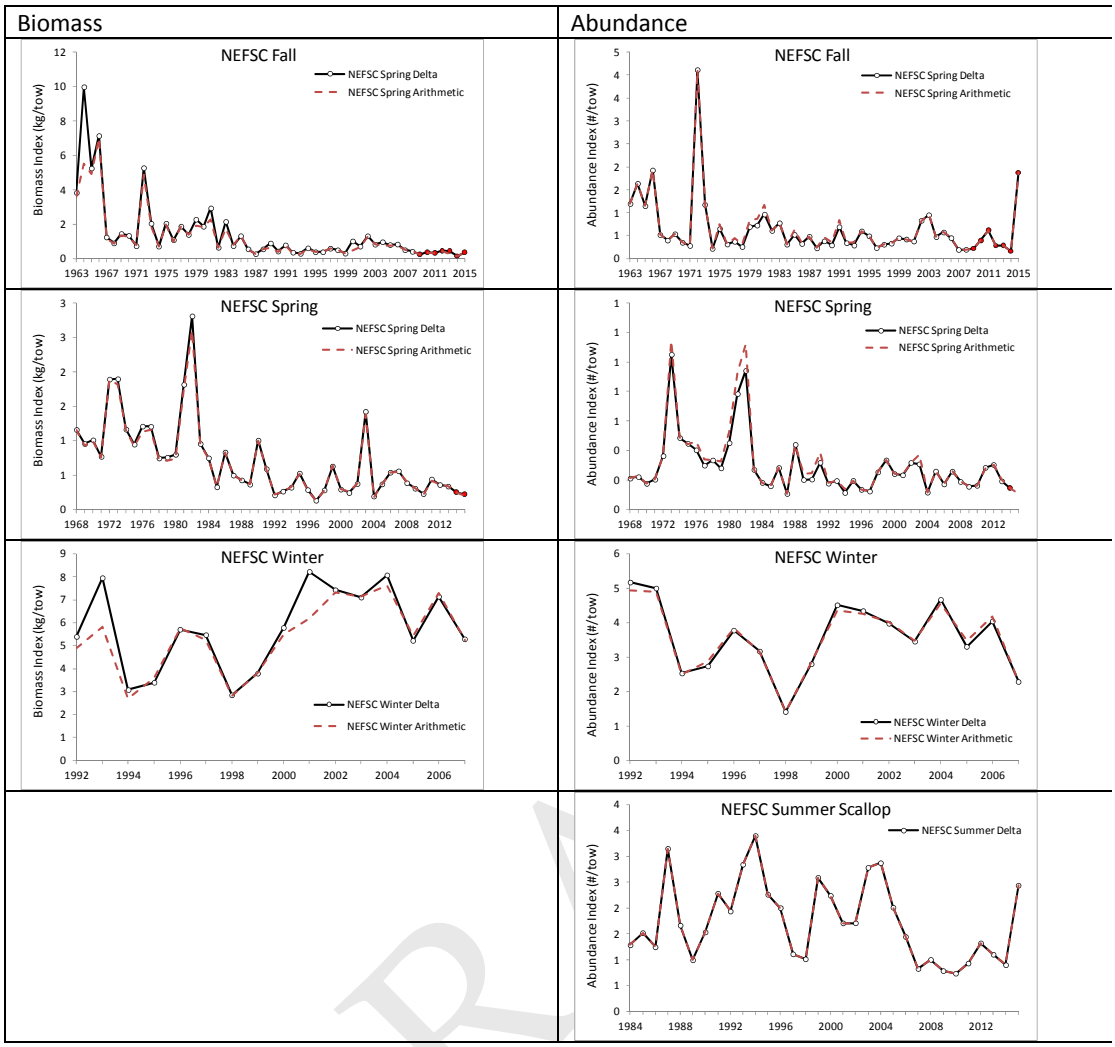
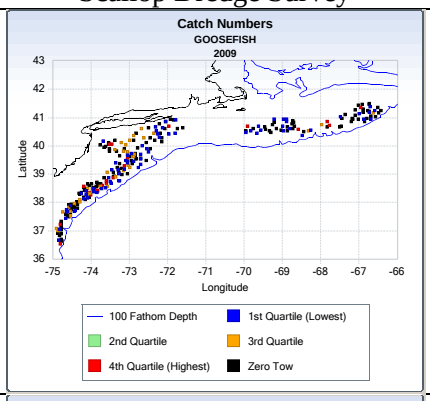
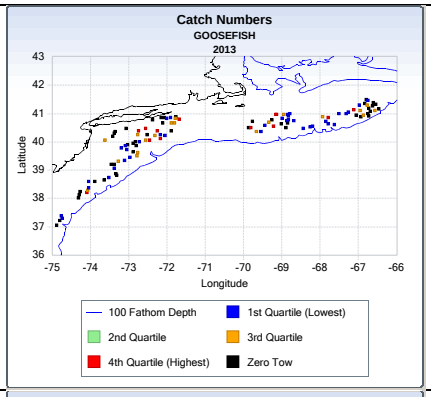


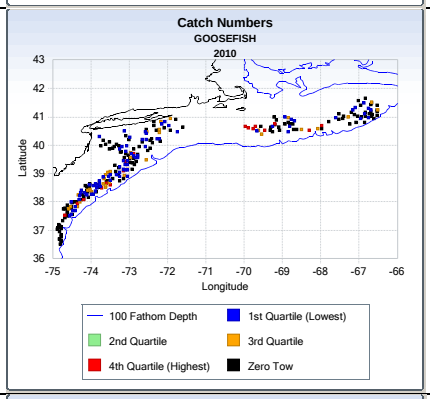

Figure A2. Comparison of delta distribution with arithmetic estimators of survey indices of abundance and biomass, southern management area. Confidence intervals for arithmetic estimators are from bootstrapping.

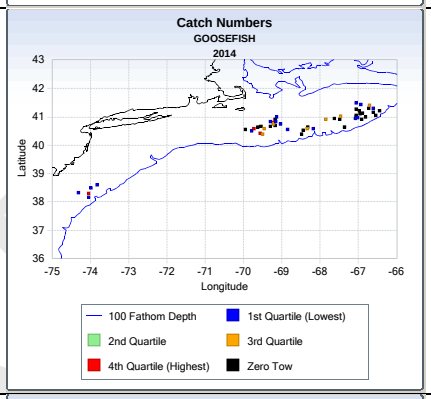
Appendix

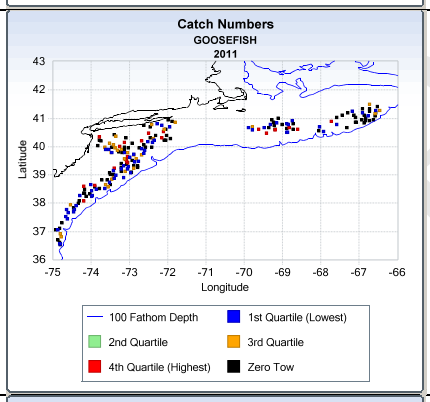
Scallop Dredge Survey

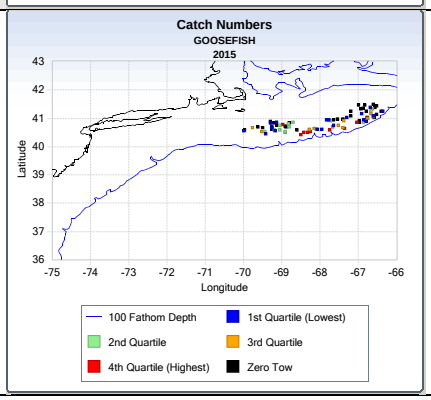


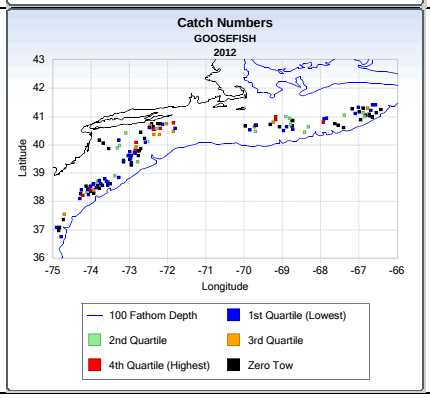




Figure A3. Distribution of monkfish in NEFSC scallop dredge surveys, 2009-2015. Survey coverage by NEFSC decreased starting in 2011 and was limited to the northern portion of the survey area in 2014 and 2015.

Appendix

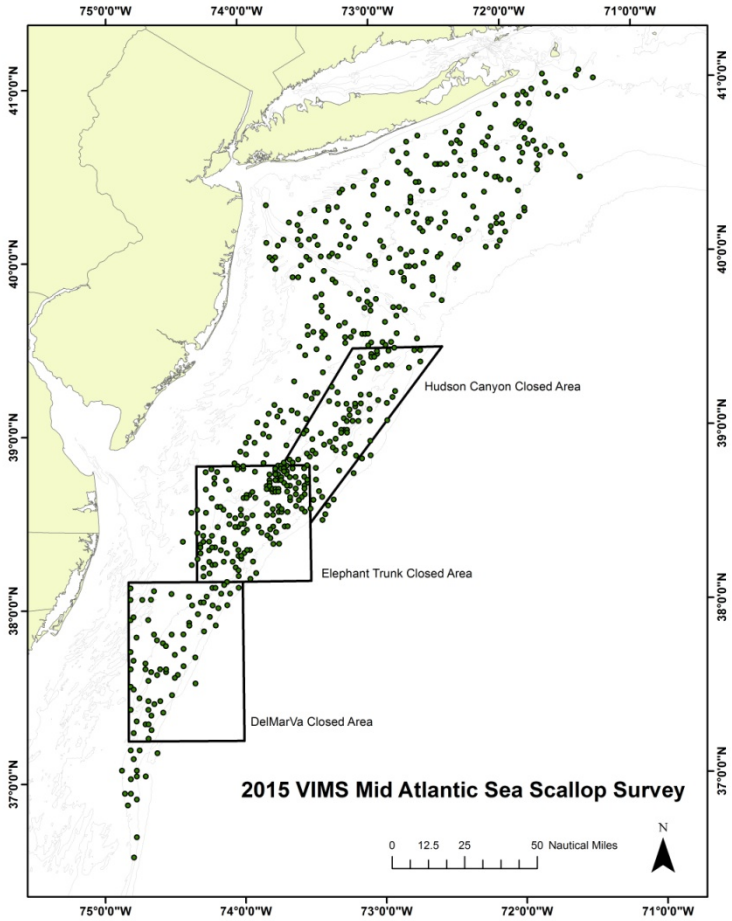



Figure A4. Sampling locations for spring scallop dredge survey conducted by VIMS in 2015.

Appendix

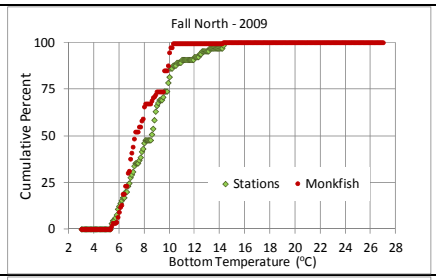
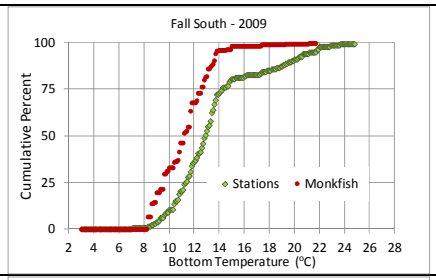
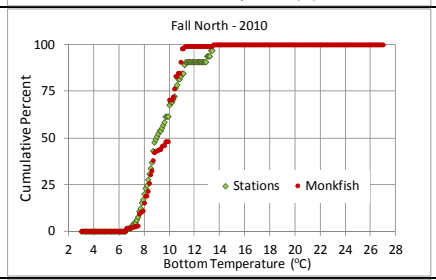
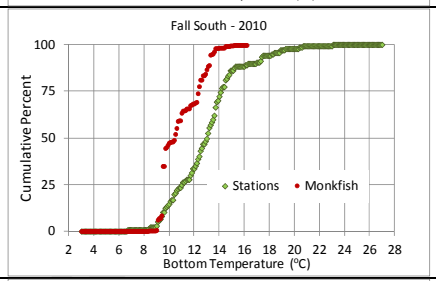
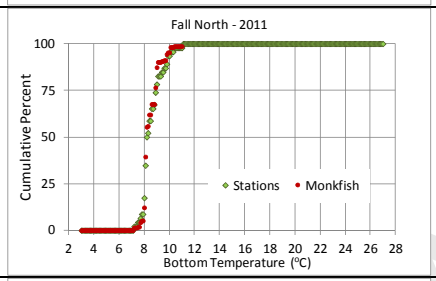
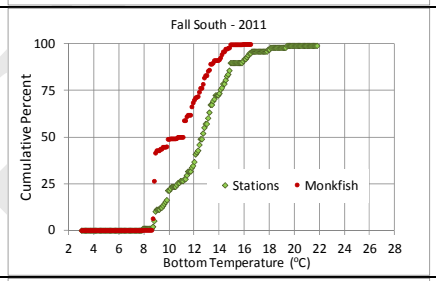
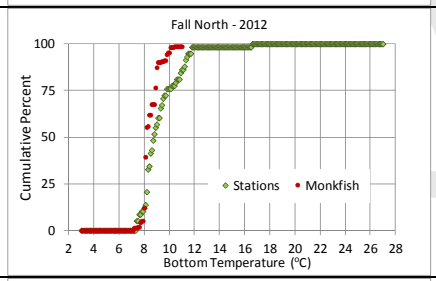
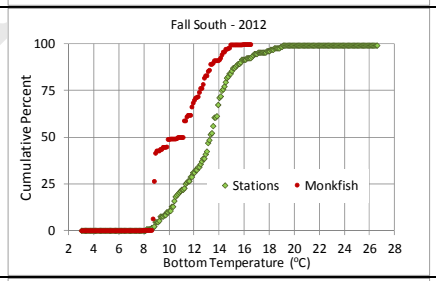
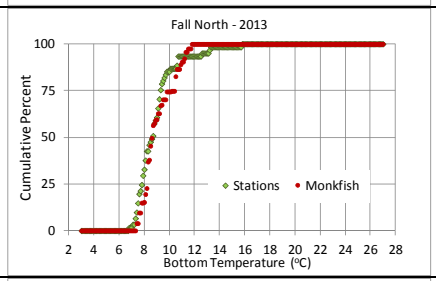
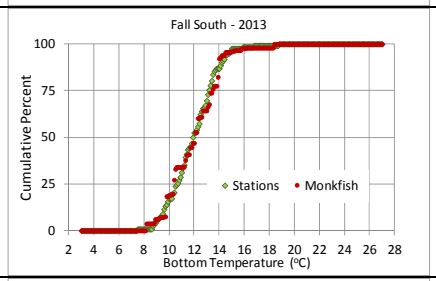
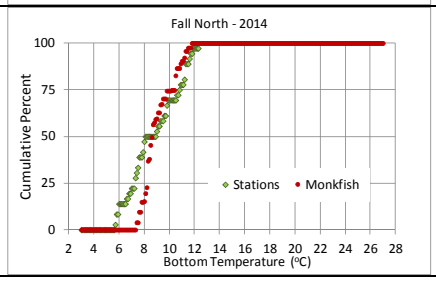
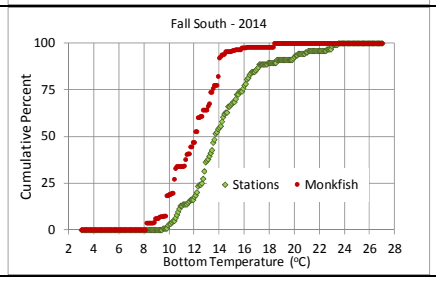
| | North | South |
|---|---|---|
| 2009 |   |   |
| 2010 |   |   |
| 2011 |   |   |
| 2012 |   |   |
| 2013 |   |   |
| 2014 |   |   |

Figure A5. Temperature selection curves for monkfish in northern and southern management regions using NEFSC fall survey data. Green shading indicates bottom temperatures at all stations visited (cumulative percent), red shading indicates temperature weighted by number of monkfish caught at each station.

Appendix

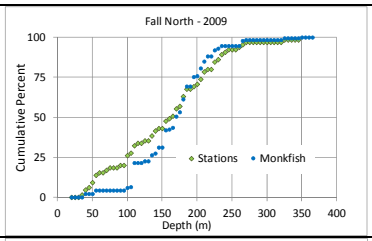
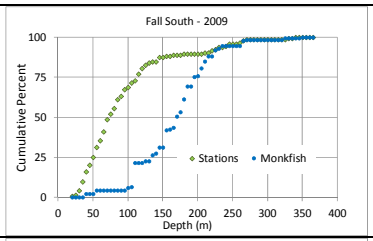
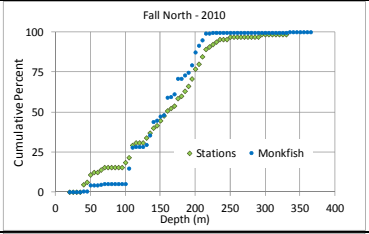
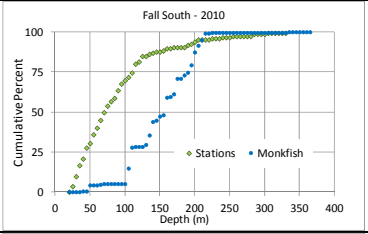
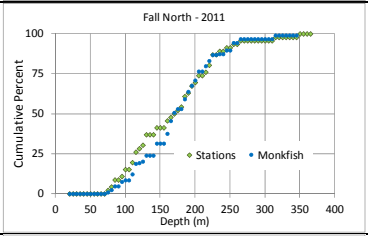
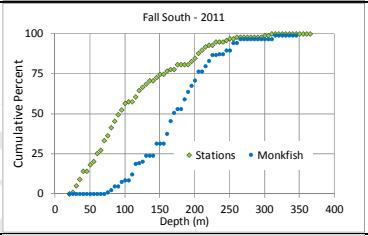
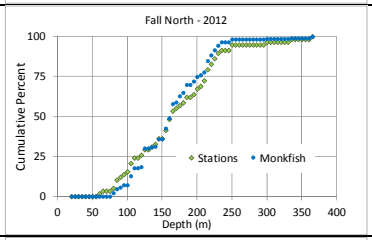
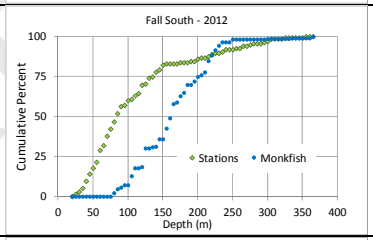
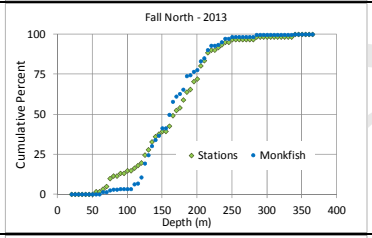
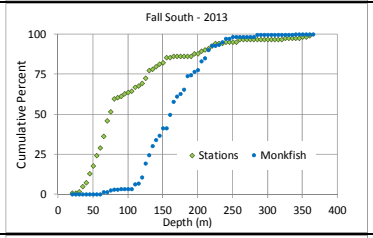
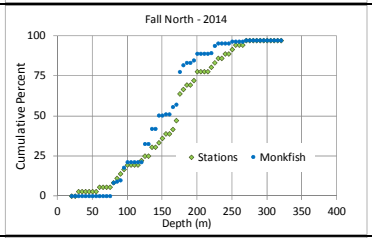
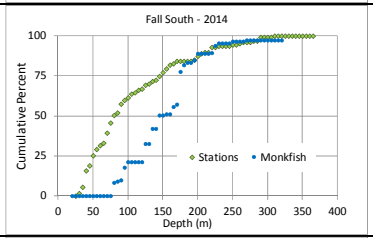
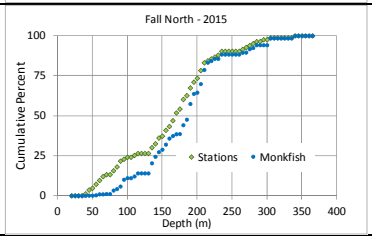
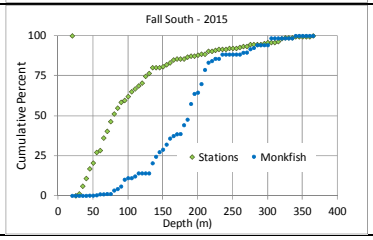
| | North | South |
|---|---|---|
| 2009 |  |  |
| 2010 |  |  |
| 2011 |  |  |
| 2012 |  |  |
| 2013 |  |  |
| 2014 |  |  |
| 2015 |  |  |

Figure A6. Depth selection curves for monkfish in northern and southern management regions using NEFSC fall survey data. Green shading indicates bottom depth at all stations visited (cumulative percent), blue shading indicates depth weighted by number of monkfish caught at each station.

Appendix

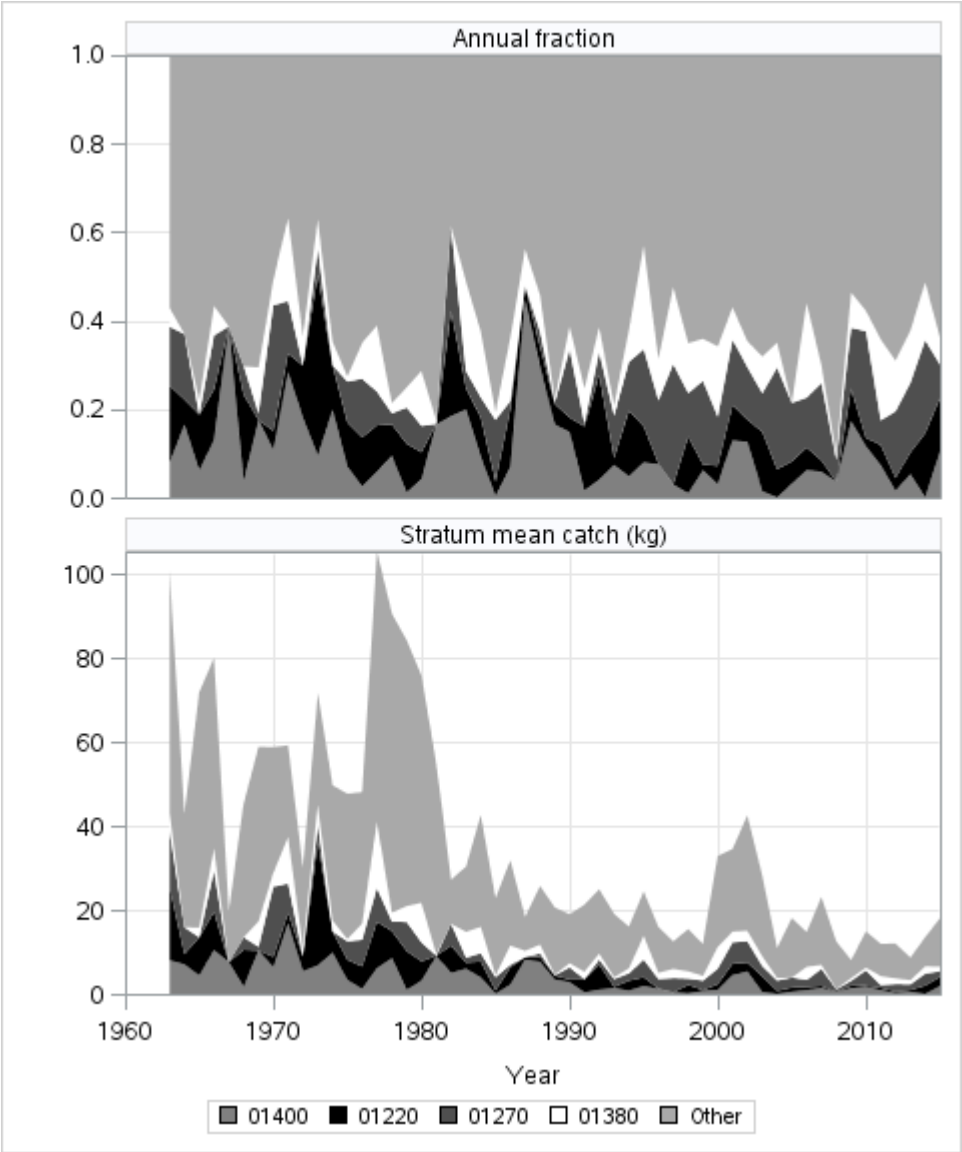



Figure A7. Top panel: Annual fraction of the mean catch in each stratum in fall surveys in the northern management area. Bottom panel: Mean catch per tow by stratum over time.

Appendix

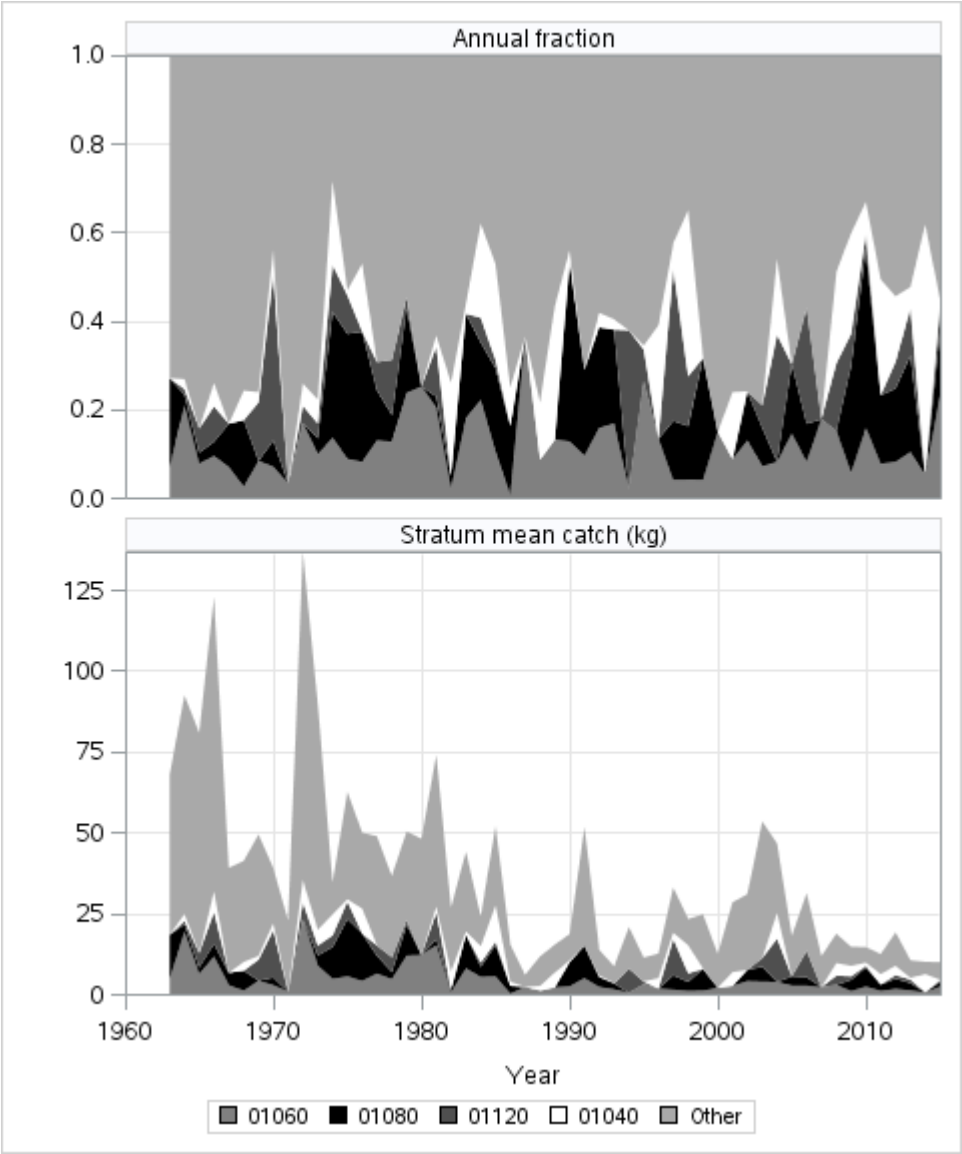



Figure A8. Top panel: Annual fraction of the mean catch in each stratum in fall surveys in the southern management area. Bottom panel: Mean catch per tow by stratum over time.

Appendix

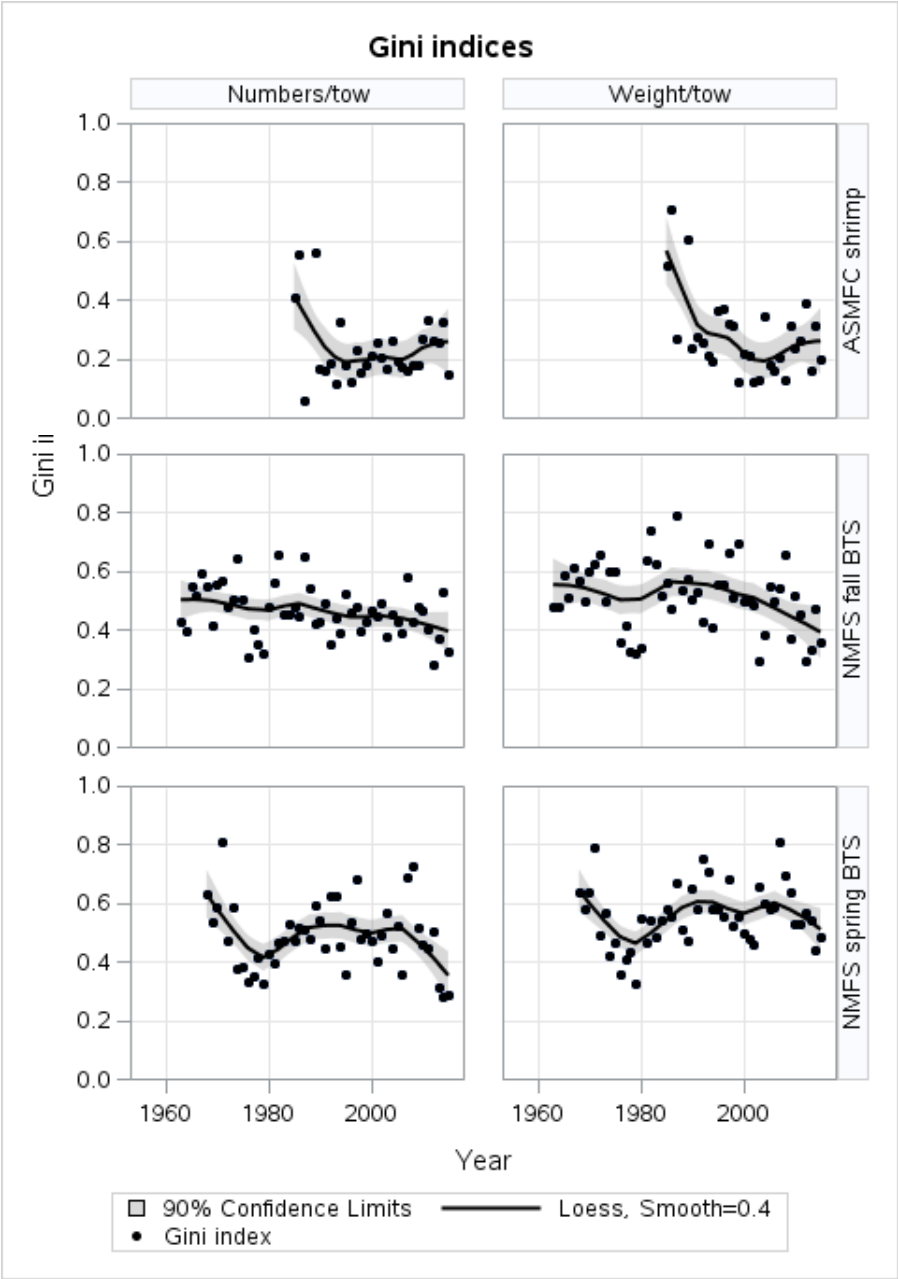



Figure A9. Gini Indices for surveys in the northern management area. The Gini Index ranges between 0 and 1, with 0 indicating a perfectly even distribution, and 1 indicating a highly clumped distribution.

Appendix

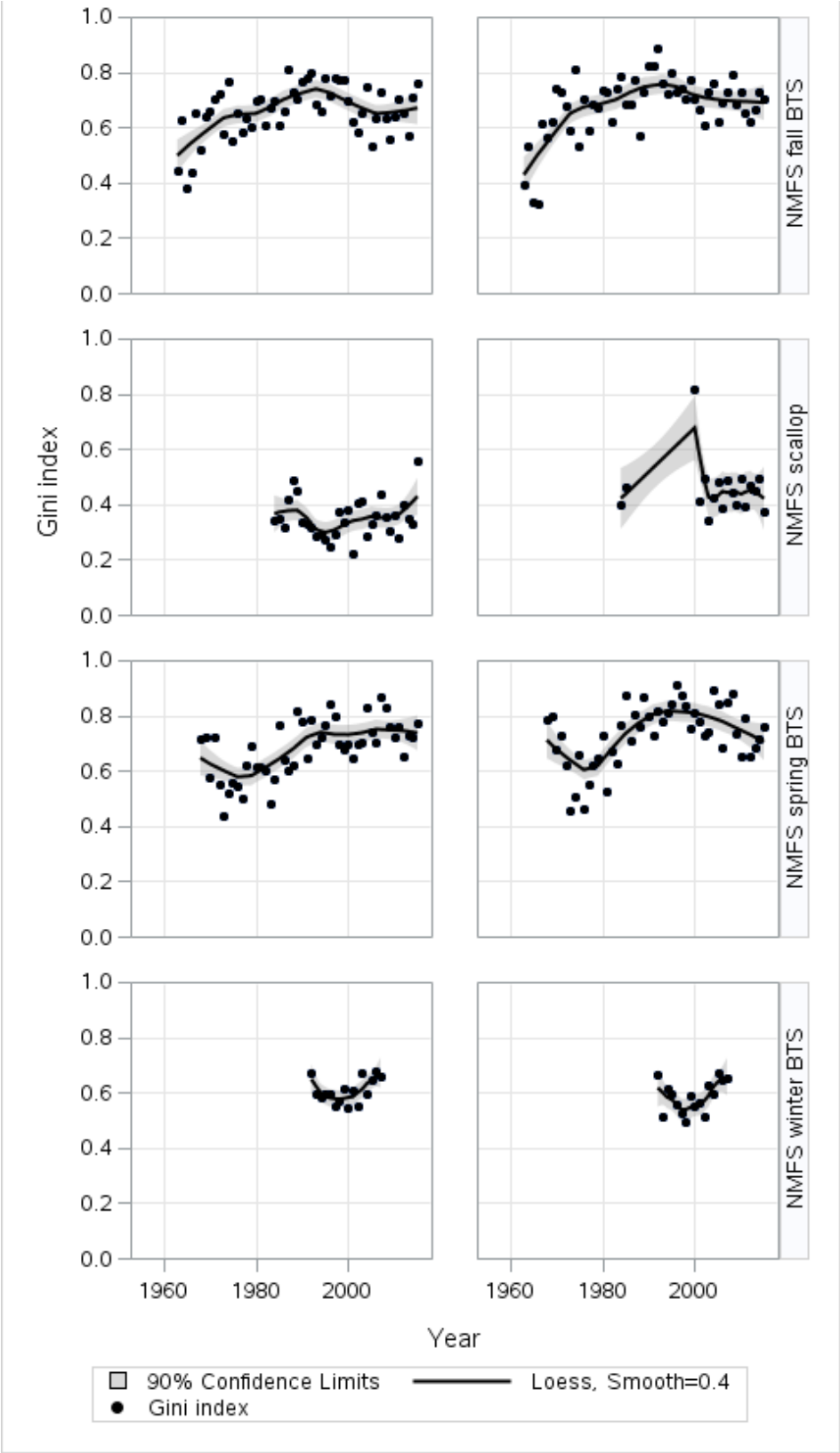
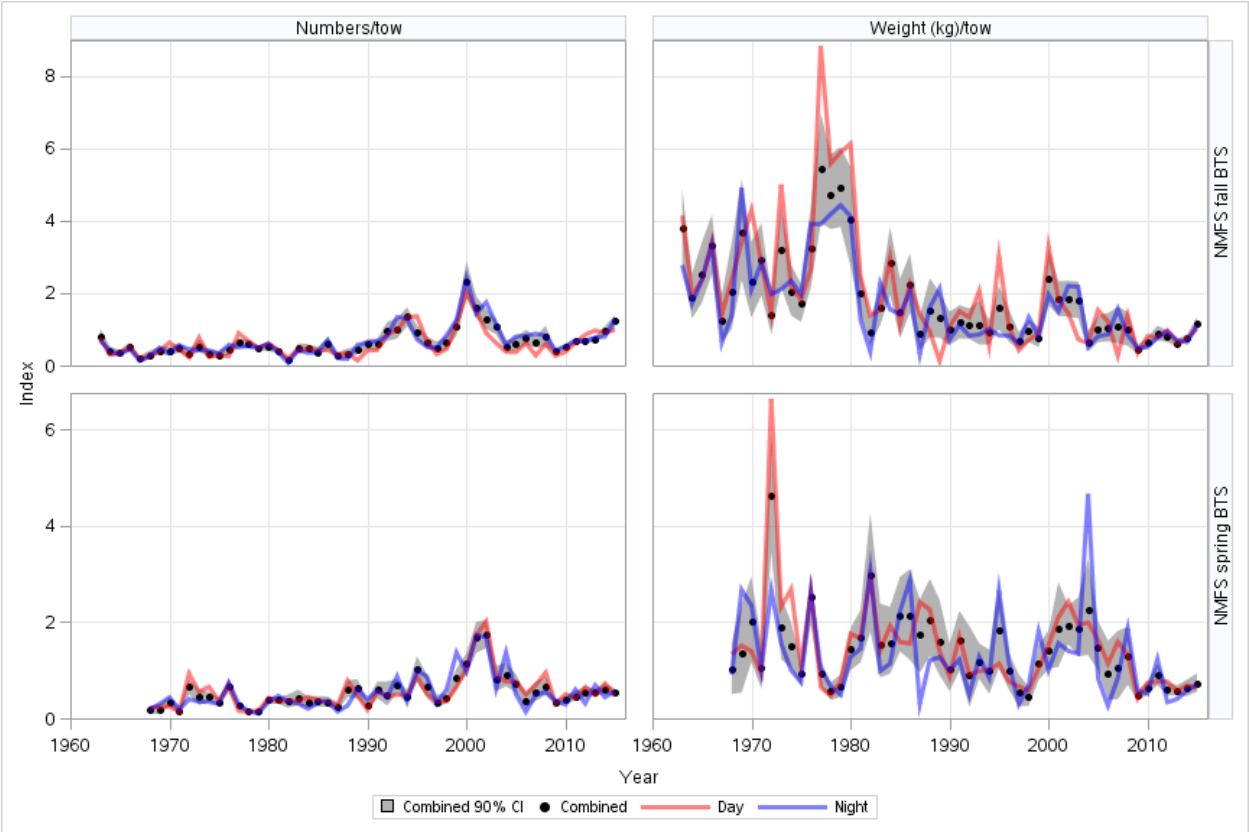



Figure A10. Gini Indices for surveys in the southern management area. The Gini Index ranges between 0 and 1, with 0 indicating a perfectly even distribution, and 1 indicating a highly clumped distribution. Left column, numbers, right column, weight.

Appendix



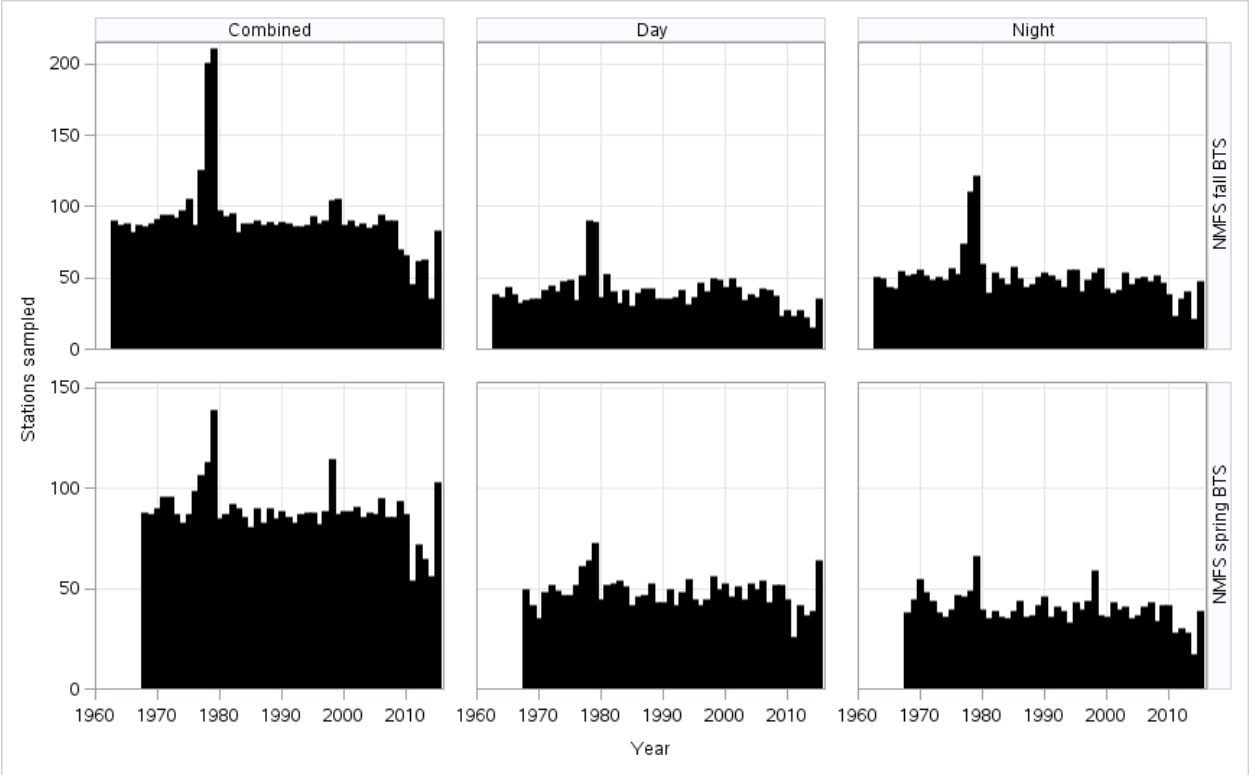
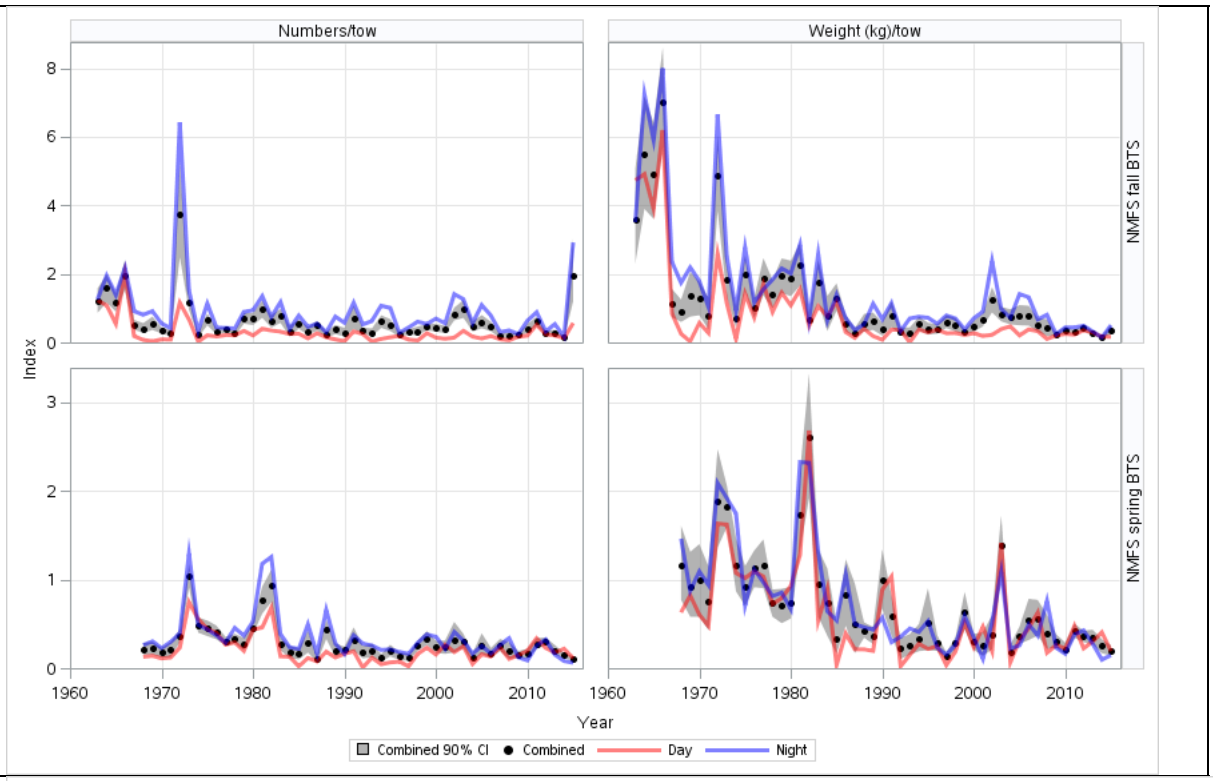




Figure A11. Northern management area. A. Comparison of monkfish catch rates in day and night survey tows. B. Number of stations sampled annually during night, day and both periods combined.

Appendix

A.




B.

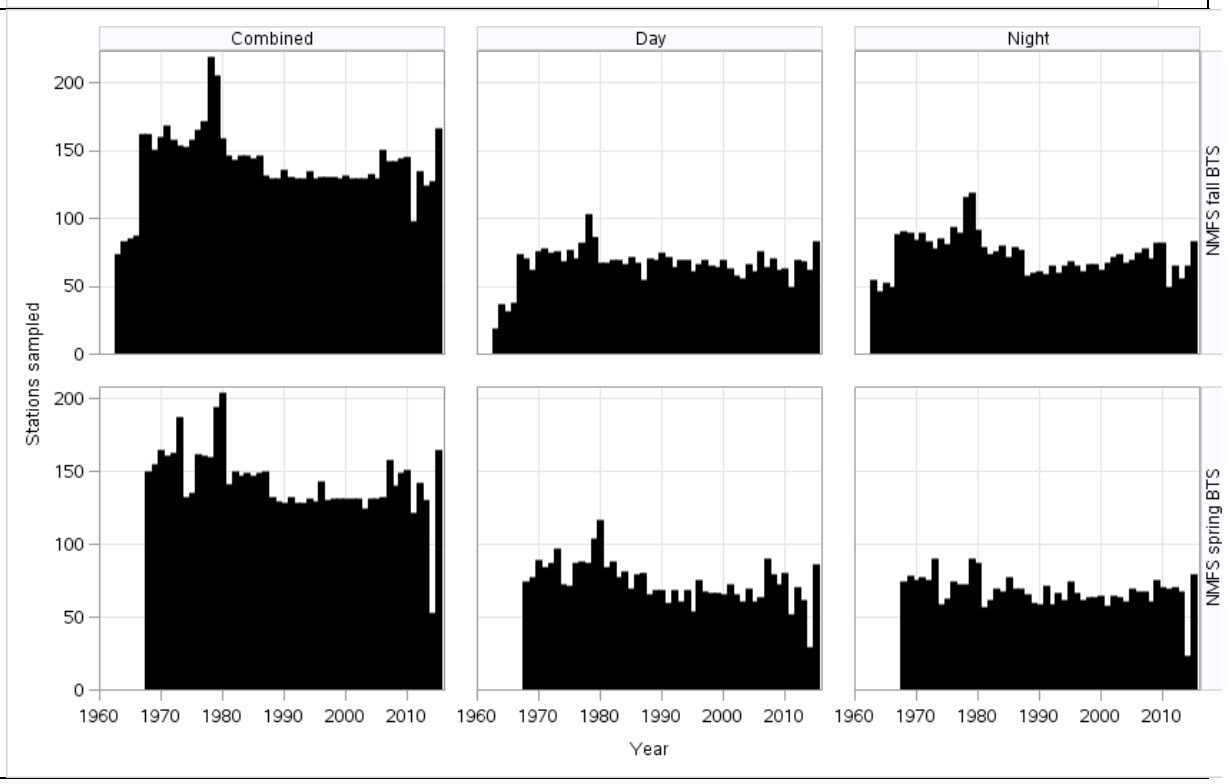



Figure A12. Southern management area. A. Comparison of monkfish catch rates in day and night survey tows. B. Number of stations sampled annually during night, day and both periods combined.