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United States Research Report for 2013

by

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A. Status of the Fisheries (Subareas 3- 6 Inclusive)

Revised sampling and protocols were implemented in the Northeast Region in 1994, in 2004, and in 2010. Auditing and allocation procedures have been used to prorate total reported landings by species among areas. However, these procedures are subject to change and the landings, by area, are therefore still considered provisional.

Most spring and autumn survey indices for 2009-2013 were converted from the FSV *Henry B. Bigelow* catches (weights) to RV *Albatross IV* catches (weights) using a single conversion factor for each species. Length-specific conversion factors may be more appropriate, but these have only been estimated for some species. Consequently, 2009-2013 survey data points should be interpreted cautiously, and these values may change in the future as new methodologies are considered. The 2009-2013 data points have been plotted separately in the figures presenting spring and fall survey data.

For the last few years, the United States has been allocated yellowtail flounder quota in Division 3N and in 2012 and 2013, a vessel fished in the area. The sections for cod, haddock, yellowtail flounder, halibut, other flounders, and skates contain the landings and the discards of these species. There were also < 1 mt of monkfish caught.

1. Atlantic Cod

USA commercial landings of Atlantic cod (*Gadus morhua*) from Subareas 5&6 in 2013 were 2,262 mt, a 53% decrease from the 2012 landings of 4,766 mt. In Div. 3N, there were 0.5 mt landed and 2.4 mt discarded.

USA cod landings from the Gulf of Maine (Div. 5Y) in 2013 were 937 mt compared to 2,848 mt in 2012. Northeast Fisheries Science Center (NEFSC) research vessel survey biomass indices in the Gulf of Maine have been generally declining over the past five years (Figure 1). The 2013 biomass indices are some of the lowest of the time series. The stock continues to experience low recruitment.

USA cod landings from Georges Bank (Div. 5Z and SA 6) in 2013 were 1,325 mt compared to 1,918 mt in 2012. The NEFSC research vessel survey biomass indices for the Georges Bank stock have been among the lowest in the time series in the last five years. The 2013 autumn survey biomass index increased slightly due to 2010 year class but was still below the long term average (Figure 2).

2. Haddock

United States commercial landings of haddock (*Melanogrammus aeglefinus*) decreased 5% from 1,967 mt in 2012 to 1,871 mt in 2013. Landings for Georges Bank (Div. 5Z) haddock increased from 1,490 mt in 2012 to 1,580 mt in 2013. Gulf of Maine (Div. 5Y) haddock landings decreased from 477 mt in 2012 to 291 mt in 2013. In Div. 3N, there were <1 mt of haddock caught.

The autumn research vessel survey biomass indices for the Gulf of Maine stock increased substantially in 2013 to 12.6 kg/tow relative to the 2012 estimate of 2.9 kg/tow (Figure 3). The recent increase in biomass is due to strong recruitment observed over the past three years. In the last decade, autumn survey biomass for Georges Bank haddock peaked at 55.8 kg/tow in 2004. Since 2004 large fluctuations have occurred in the survey index as year classes increased in weight. Mean biomass per tow was about 35 kg/tow in 2011 and 2012, and increased to 95 kg/tow in 2013, the second highest value in the time series, as the very large 2010 year class grew in length and weight (Figure 4).

3. Redfish

USA landings of Acadian redfish (*Sebastes fasciatus*) decreased by 8% from 3,848 mt in 2012 to 3,544 mt in 2013. Fall research vessel survey biomass indices generally increased from 1996 through 2012 (Figure 5), with the 2010 and 2012 indices being the highest on record. The survey biomass indices decreased by 55% from 68.39 kg/tow in 2013 to 30.47 kg/tow in 2013.

4. Pollock (USA Waters of Areas 5&6 stock)

USA landings of pollock (*Pollachius virens*) decreased from 6,742 mt in 2012 to 5,058 mt in 2013. Autumn research vessel survey indices reflected a moderate increase in pollock biomass in Subarea 5 from the mid-1990s through 2005 (Figure 6). The survey biomass index subsequently declined to a record-low of 0.22 kg/tow in 2009. Although the index increased in 2010 to 3.22 kg/tow, it has since declined to 0.67 kg/tow in 2013.

5. White Hake

Nominal USA landings of white hake (*Urophycis tenuis*) decreased by 19% from 2,769 mt in 2012 to 2,235 mt in 2013. Research vessel survey indices declined during the 1990s and increased in 2000 and 2001 due to good recruitment of the 1998 year class. The indices have been variable since 2001 (Figure 7).

6. Yellowtail Flounder

USA landings of yellowtail flounder (*Limanda ferruginea*) decreased by 12% from 2,371 mt in 2012 to 2,170 mt in 2013. Landings from US waters (NAFO subareas 5 and 6) decreased by 31% from 1,717 mt in 2012 to 1,181 mt in 2013. Landings from Div. 3N increased 38% form 654 mt n 2012 to 900 mt in 2013. In addition, 176 mt of yellowtail flounder were discarded in Div. 3N bringing the total catch of yellowtail flounder in Div. 3N in 2013 to 1,075 mt. Research survey biomass indices in 2012 increased in all three United States yellowtail flounder stocks. In the Cape Cod-Gulf of Maine stock, survey biomass indices increased from 3.55 kg/tow in 2012 to 4.80 kg/tow in 2013. In the Southern New England-Mid Atlantic stock, the survey biomass index decreased from 1.41 kg/tow in 2012 to 0.43 kg/tow in 2013. In the Georges Bank stock, the survey biomass index decreased from 2.52 kg/tow in 2012 to 0.88 kg/tow in 2013 (Figures 8-10).

7. Other Flounders

USA commercial landings of flounders (other than yellowtail flounder and Atlantic halibut) from Subareas 3-6 in 2013 totaled 10,511 mt, 4% lower than in 2012. Summer flounder (*Paralichthys dentatus*; 54%),

winter flounder (*Pseudopleuronectes americanus*; 26% comprising the Georges Bank, Southern New England, and Gulf of Maine stocks), American plaice (*Hippoglossoides platessoides*; 14%), witch flounder (*Glyptocephalus cynoglossus*; 6%), and windowpane flounder (*Scophthalmus aquosus*; <1% comprising the Northern and Southern stocks) accounted for virtually all of the 'other flounder' landings in 2013. Compared to 2012, commercial landings in 2013 were higher for winter flounder (15%), but lower for windowpane flounder (-40%), witch flounder (-34%), American plaice (-8%), and summer flounder (-5%). The American plaice landings from Div. 3N were 115 mt. In addition, 45 mt of American plaice were discarded in Div. 3N bringing the total catch of American plaice in Div. 3N in 2013 to 160 mt. Discards of witch flounder in Div. 3N were low (<1 mt).

Research vessel survey indices in 2013 remained similar to the previous year's indices for American plaice, decreased for summer flounder, witch flounder, Georges Bank winter flounder, and southern windowpane but increased for northern windowpane flounder (Figures 11-16).

8. Atlantic halibut

USA landings of Atlantic halibut (*Hippoglossus hippoglossus*) in the Gulf of Maine-Georges Bank region decreased slightly from 35 mt in 2012 to 34 mt in 2013. In addition, <1 mt of halibut were caught in NAFO Div. 3N. Research vessel survey indices have little trend and high interannual variability due to the low capture rate of Atlantic halibut (Figure 17). In some years there are no Atlantic halibut caught, indicating that abundance is close to being below the detectability level of the survey. Indices for 2009 – 2013 were converted from FSV *Henry .B. Bigelow* units to RV *Albatross IV* units using the mean calibration coefficient of other flounders.

9. Silver hake

USA landings of silver hake (*Merluccius bilinearis*) increased from 8,206 mt in 2012 to 6,167 mt in 2013. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock varied without trend between 1985 and 1997, sharply increased in 1998, and then declined through 2005. The indices then increased, with the 2012 index (20.4 kg/tow) being the highest since the mid-1990s, with a mild decline to 16.7 in 2013. Survey biomass indices for the Southern Georges Bank - Mid-Atlantic stock increased between 2007 and 2010, with the 2010 survey biomass index (2.8 kg/tow) the highest since the early 1980s (Figure 18-19). However, the survey index has since declined to 1.2 kg/tow in 2013.

10. Red Hake

USA landings of red hake (*Urophycis chuss*) decreased by 38% from 828 mt in 2012 to 517 mt in 2013. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock increased after the early 1970s, markedly declined in 2003, and have since stabilized (Figure 20). Indices for the Southern Georges Bank - Mid-Atlantic stock declined in the 1990s and remained low in the 2000s, but increased again in 2009 through 2012. There was a slight decline in 2013 (0.63 kg/tow, Figure 21).

11. Atlantic Herring

Nominal preliminary USA landings of Atlantic herring (*Clupea harengus*) increased 20% from 88,046 mt in 2012 to 106,000 mt in 2013. Spring survey indices were relatively stable during 2006-2013 and averaged 2.31 kg/tow (Figure 22). The 2013 spring survey index was 2.16 kg/tow. Based on a 2012 assessment, spawning biomass generally increased from 1982 to 1997, declined from 1998 to 2009, and increased through 2011. The 2008 year class was estimated to be the largest on record. The 2012 assessment included several features not included in previous herring assessments, including multiple fleets, time-varying maturity, and time varying-natural mortality. These features combined to produce an assessment with relatively no retrospective pattern compared to previous herring assessments.

12. Atlantic Mackerel

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) decreased 18% from 5,336 mt in 2012 to 4,376 mt in 2013 but were 721% more than 2011 landings of 533 mt. Recreational catches increased 33% from 668 mt in 2012 to 888 mt in 2013. Spring survey indices increased during the 1990s and averaged 8.6 kg/tow during the last ten years (2003-2012). The spring survey index decreased from 4.36 kg/tow in 2012 to 3.82 kg/tow in 2013 (Figure 23). Atlantic mackerel was last assessed in 2010 by the Transboundary (US and Canada) Resources Assessment Committee (TRAC). The TRAC concluded that abundance estimates were too uncertain for management purposes but that relative trends in fishing mortality and spawning stock biomass were informative.

13. Butterfish

USA landings of butterfish (*Peprilus triacanthus*) increased 64.3% from 655 mt in 2012 to 1076 mt in 2013 due to the re-establishment of a directed fishery in January 2013. Fall research vessel survey biomass indices have fluctuated substantially since the 1970s, but were generally highest in the late 1970s to early 1990s. Since 1995, annual values have typically been less than the long-term average. Biomass in 2013 was the third lowest in the time series (Figure 24). Note that biomass indices are slightly different than in previous reports due to the removal of inshore strata in the most recent benchmark assessment.

14. Squids

During 1999-2010, landings of longfin inshore squid, *Doryteuthis (Amerigo) pealeii*, gradually declined from 19,173 t in 1999 to 6,913 t in 2010, then increased again to 12,820 mt in 2012. During 2013, landings totaled 11,075 mt. Autumn survey relative abundance indices (derived using only daytime tows) declined from the third highest point in the time series during 2006 (1,778 squid/tow) to 339 squid/tow in 2011, then increased to levels above the 1975-2012 median of 740 squid/tow during 2012 (1,371 squid/tow) and 2013 (1,012 squid/tow), respectively (Figure 25).

USA landings of northern shortfin squid (*Illex illecebrosus*) declined 68% between 2012 and 2013, from 11,709 mt to 3,799 mt, respectively. Landings during 2013 were at the lowest level since 2002. Autumn survey relative abundance indices attained a record-high in 2006 (29.5 squid/tow) then steadily declined to 4.7 squid/tow in 2013, a level well below the time series median of 9.8 squid/tow (Figure 26).

15. Atlantic Sea Scallops

USA Atlantic sea scallop (*Placopecten magellanicus*) landings in 2013 were 18,659 mt (meats), the lowest landings since 2000. The 2013 landings were about 7500 mt meats less than the 2003-2012 average, but still well more than the long-term (1957-2013) mean. The ex-vessel value of the landings was $467 million, around $90 million less than in 2012. About 59% of the 2013 landings were from the Georges Bank region, 32% were from the Mid Atlantic Bight, 6% from Southern New England and 3% from Gulf of Maine. The relatively low landings and the shift of the fishery towards Georges Bank are reflective of the weak 2007-2009 year classes in the Mid-Atlantic Bight. Increases in the Mid-Atlantic Bight landings are expected in 2014-2016 as the very strong 2010 year class enters the fishery.

Stratified mean research vessel survey biomass indices decreased in 2013 on Georges Bank whereas the Mid-Atlantic increased slightly (Figures 27 and 28). Although the biomass indices have declined from their peaks in the last decade, they are still high by historical standards Recruitment (2011 year class) in both major regions was about average. Evidence of a very strong 2012 year class was observed on the southwest portions of Georges Bank.

16. Northern Shrimp

Preliminary USA commercial landings of northern shrimp (*Pandalus borealis*) from Subarea 5 in 2013

were 307 mt, about 12% of the 2012 landings and the lowest since the fishery closure in 1978. Only about half of the TAL for 2013 was landed. The average landings for 2006-2010 were 4,184 mt, and the highest annual landings of northern shrimp were 12,824 mt in 1969.

Summer shrimp survey biomass indices declined during 1985 through 2004 (Figure 29). A sharp increase occurred in 2006 reflecting a strong 2004 year class; however, the 2006 survey was considered less reliable in part due to a reduced number of tows. Biomass indices fluctuated around a lower level during 2007-2010 (average 14.4 kg/tow), but subsequently declined steadily to time series lows observed in 2012 and 2013 (2.5kg/tow, 1 kg per tow). Recruitment indices also reached record lows in 2012 and 2013, and the 2013 stock stock assessment concluded the stock has collapsed. No fishery was allowed in 2014.

17. Small Elasmobranchs

USA landings of spiny dogfish (*Squalus acanthias*) decreased 31% from 10,595 mt in 2012 to 7,276 mt in 2013. Survey indices, which are highly variable, generally declined between the early 1990s and 2005, but increased sharply in 2006 and have since remained high (Figure 30).

USA landings of skates (most species are still landed as unclassified) decreased 15% between 2012 and 2013 from 16,528 mt to 13,989 mt. The landings are sold as wings for human consumption and as bait for the lobster fishery. In addition, 11 mt of skate, likely thorny skate, were discarded in NAFO Div. 3N. Survey biomass indices for winter skate (*Leucoraja ocellata*) peaked in the mid-1980s (Figure 31) but then declined, possibly due to an increase in the directed fishery in the late 1980s and early1990s. During the mid-1990s, the indices stabilized at an intermediate level, increased through 2009, but have since declined. Little skate (*Leucoraja erinacea*) survey indices have generally fluctuated without trend (Figure 32). Survey indices for barndoor skate (*Dipturus laevis*) declined markedly in the mid-1960s, remained very low through the late-1980s, and subsequently increased to levels observed in the mid-1960s (Figure 33). Thorny skate (*Amblyraja radiata*) survey indices have declined over the entire time series, and are currently at record lows (Figure 34). Survey indices for smooth skate (*Malacoraja senta*) are highly variable, but have been generally stable for the last 20 years (Figure 35). Indices for both clearnose skate (*Raja eglanteria*) and rosette skate (*Leucoraja garmani*) generally increased over the time series (Figures 36 and 37). The indices for clearnose skate declined between 2001 and 2006, but sharply increased in both 2007 and 2008.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic Studies

A total of 1,586 CTD (conductivity, temperature, depth) profiles were collected and processed by the Northeast Fisheries Science Center (NEFSC) in 2013 over the course of 8 cruises. Of this total, 1553 CTD profiles were obtained within NAFO Subareas 4, 5, and 6. These data are archived in an oracle database. Cruise reports, annual hydrographic summaries, and data are accessible at: http://www.nefsc.noaa.gov/epd/ocean/MainPage/index.html.

Hourly bottom temperature records obtained by participants of the Environmental Monitors on Lobster Trap Project (see emolt.org) at approximately 70 fixed locations/depths around the Gulf of Maine and Southern New England Shelf indicate that 2013 was still relatively warm but not as warm as 2012. These 13-year time series of hourly bottom temperatures at many locations are now being compared to multiple ocean models and, in some cases, being assimilated into hindcast runs. Plans are underway to transmit near-realtime data of both temperature and velocity from new instruments underdevelopment. More than 100 satellite-tracked surface drifters were deployed off the coast of New England in 2013, and dozens more are planned for 2014 (see http://www.nefsc.noaa.gov/drifter). The collective archive helps resolve the transport pathways of estuarine and shelf waters. The drifter project is promoted as an educational tool where

students are involved with both the construction of the instruments and the processing, plotting, and analysis of the data.

b) Plankton Studies

During 2013, zooplankton community distribution and abundance were monitored using 657 bongo net tow samples taken on seven surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine. Additional sampling was also conducted on the winter ecosystem monitoring / pelagic survey by NASA scientists to "ground truth" satellite data with ship-based water column radiometry measurements. Data from this cooperative winter cruise was used to enhance the application of ocean color remote sensing to coastal ecosystems, and to derive region-independent ocean color algorithms for measuring primary productivity, particulate organic carbon, and dissolved organic carbon. The winter monitoring / pelagic cruise was also combined with acoustic midwater scanning at four different frequencies to locate concentrations of juvenile and adult small pelagic fish. Promising acoustic returns were "ground-truthed" with an occasional midwater trawl to capture specimens of the fish seen in the acoustic signatures. The summer ecosystem monitoring survey was a first in that it incorporated bottom mapping into the cruise plan, taking advantage of the capabilities of the NOAA vessel Okeanos Explorer to produce high resolution bottom profiles of Wilkinson and Jordan Basins and the Schoodic Ridge in the Gulf of Maine area to go along with the plankton tows made there. Three of the six cruises collected nutrient data. This was done in collaboration with the University of Maine to monitor levels of nutrients in the euphotic zone. Nitrogen stable isotope ratios of particulate matter were measured for an EPA-led study on the distribution of these isotopes across the northeastern continental shelf. Four surveys also collected additional plankton samples for the Census of Marine Zooplankton Program, based at the University of Connecticut. These samples, collected with a set of smaller bongo nets, are for genetic analysis of the plankton samples, to supplement identifications made by traditional visual taxonomic means. In addition to the research vessel surveys conducted, samples were collected by the Ship Of Opportunity Program, SOOP, using the container vessels Reykjafoss and Oleander. The Reykjafoss conducted nine monthly transects between Boston and Halifax, during 2013. The Oleander conducted eleven monthly transects across the continental shelf between New York and Bermuda, and seven monthly transects across the Sargasso Sea for 2013. Plankton samples were collected by the container vessels using a Hardy Plankton Recorder.

c) Benthic Studies

A five day cruise was conducted during June, 2013 for the purposes of training students in the NOAA Living Marine Resources Cooperative Science Center (LMRCSC) in fisheries science, including learning field sampling procedures, and in support of projects being conducted by faculty and graduate students in the LMRCSC program. Four seam otter trawl tows were made on the continental slope at depths ranging 300-500 m near Hudson Canyon (3 HC stations), between Baltimore and Washington Canyons (2 BW stations), and south of Norfolk Canyon (3 NS stations), and at single locations on the continental shelf off Maryland and New Jersey. Scientific objectives included the following:

1) Collection of biological data on deep sea red crab and monkfish stocks (partly located beyond the depth range of standard surveys)
2) Collection of benthic grab samples in support of development of habitat suitability studies for stocks of black sea bass, poorly-assessed stock utilizing untrawlable habitats off the Delmarva coast associated with impending wind energy development.
3) Collection of deepwater fauna from slope locations overlapping deep sea red crab and monkfish fisheries for characterization of habitats.

Scientific observations included the following:

- **Deep Sea Red Crab Stock Biology:** Red crabs were captured at 5 deepwater stations. Few crabs were caught at depths <300 m. The proportion of males increased from 9% at 250 m to 81% at 700-

750 m. Length frequency of sampled crabs shows that males are larger than females.

- **Monkfish Stock Biology:** Only eight monkfish (12-75 cm TL) were collected. There were five males and one female collected; sex was indeterminate for the two smallest fish. Tissue samples (gonads, liver and muscle) collected will be processed for organic contaminants.

- **Sediment Grabs – Benthic Infauna:** Triplicate grabs were successfully obtained from nine of thirteen stations from our pre-arranged grid of benthic sampling stations in the BOEM Maryland Wind Energy Area. Samples are being analyzed for grain size distribution at the NEFSC Hook Laboratory. Grain size analyses will be used to ground-truth photographic images made at the same sites using HabCam on a subsequent cruise (July 2013) aboard a Black Sea Bass Habitat cruise.

- **Other species**: Sea anemones (*Bolocera tuediae*, and *Actinauge* sp) were abundant in slope stations. A single trawl at the Mud Hole station off New Jersey produced an estimated catch of over 70,000 margined sea stars (*Astropecten americanus*) and 436 clearnose skate. A total of 75 black sea bass (*Centropristis striata*), mostly juveniles were caught at the Fingers station in 40 m of water off Maryland. Witch flounder were more common at the southern and deeper stations, blackbelly rosefish (*Helicolenus dactyloperus*) were caught primarily at the upper slope stations. Many small deep-water fish were captured, of which the most abundant were marlinspike (*Nezumia bairdi*), hatchet fish (family Sternoptychidae), various snipe eels, shortnose greeneyes (*Chlorophthalmus agassizi*), and Myctophids.
- **Oceanographic Climate**: Water column CTD profiles taken on this LMRCSC are not directly comparable with those taken other years, since GU13-03 was performed in June, rather than in the usual January-February timeslot. It was noted that thermocline-pycnocline on this cruise were shallower than in winter, covering depths of 0-25 m in the north (MH and HC stations; see Figs. 4 and 5). A dissolved oxygen (DO) peak of 100-110% saturation was seen at 10-15 m depth at these same stations, suggesting a phytoplankton bloom. A thicker thermocline layer (~0-50 m) was observed in the south (all other stations) with no strong DO peak. Temperatures below the thermocline at the MH site were remarkably cold (7.0º C) for an inshore station.

A second five day cruise was conducted during July, 2013 in order to characterize fish habitats on the continental shelf off the Atlantic coast of the Delmarva Peninsula for the purposes of two projects: a black sea bass habitat investigation funded by the NOAA Office of Habitat Restoration and an Offshore Wind investigation in advance of funding by the Bureau of Ocean Energy Management (BOEM). Scientific objectives included:

1) Collection of visual data as part of an assessment of untrawlable bottom habitats, particularly with respect to their use by the black sea bass stock. We used the HabCam IV camera vehicle currently employed for sea scallop surveys.

2) Collection of visual data for a general assessment of the distribution and use by fish of bottom habitats within the Maryland Wind Energy Area (MD WEA) using the same methods. This will serve as a demonstration of the efficacy of such methods for developing habitat models for environmental assessments to aid siting decisions for the BOEM offshore wind program.

Among the highlights of the cruise were the following:

- **Critical Black Sea Bass Habitat** – Hard bottom habitat that serves as aggregation habitat for the black sea bass (BSB) stock occurs on a small scale (single to tens of meters), distributed in non-random patterns within a complex of physical habitat types dominated by sand and shell. Previous characterizations of bottom habitat in this area have missed these in part because of their small and patchy distribution and untrawlability. Hard bottom BSB habitats were more evident in the southernmost reef polygons than in the northern ones, including those in the Maryland Wind Energy Area. Their size is often small and their distribution very patchy: easily missed by trawl and strictly visual surveys. Acoustic surveys are recommended to locate these. Detailed analysis photos and other data is proceeding at NEFSC J.J. Howard Laboratory.
- **HabCam Application** - Though designed and used, to date, largely for purposes of the NEFSC Sea Scallop Survey, HabCam IV and the SeaPics analysis system can be adapted for use for non-destructive benthic/demersal habitat studies, including surveys of untrawlable areas such as the patchy hard bottom regions off Delmarva. HabCam imagery is one of several tools being utilized for Black Sea Bass habitat definition and BOEM habitat analysis. Acoustic bottom mapping, acoustic water column survey, historical survey catch and oceanographic data, and bottom sedimentary and biological analysis were also employed.

HabCam IV can provide continuous strips of still photos of the bottom while being towed at up to 7 knots in the course of continuous (24:7) deployments lasting for several days. In the course of such deployments it generates images numbering in the millions as well as continuous CTD records and side scan sonar imagery.

· **Corals** – Both hard and soft corals as well as sponges were found to be common features of the Delmarva hard bottom patches. Their specific function in terms of habitat for structure-seeking stocks like black sea bass is unknown. As these are neither tropical (too far north) nor deep water (too shallow), they are not protected by any current mandated management scheme, but their function for fisheries is of interest to the Mid Atlantic Fisheries Management Council.

A task group called IMAG (Image Management and Analysis Group) was formed at the NEFSC J.J. Howard Laboratory (Sandy Hook Lab) during 2013 in order to assemble data for the Delmarva cruise and other benthic habitat projects into a Geographical Information System (GIS) database for retrieval, layered plotting, and analysis. With the aid of Woods Hole Oceanographic Institution IMAG staff also developed a benthic habitat retrieval and annotation system to deal with the photos generated by HabCam IV, which number in the millions.

2. Biological Studies

a) Fish Species

Flatfishes: The team of researchers at the NOAA NMFS Howard Laboratory (Highlands, New Jersey), along with collaborators within the Northeast Fisheries Science Center and in academia, are implementing an experimental approach designed to evaluate the potential effects of future ocean conditions (elevated CO_2 and water temperature) on early life-stages of marine fishes. The key elements of this broad yet adaptive approach are that it uses i) multiple species that differ in their ecologies and resource values, ii) a wide yet realistic range of environmental conditions (e.g., concurrent manipulation of CO_2 levels and water temperatures), and iii) a diverse set of response variables. The research team has grown by bringing in colleagues and collaborators with different skills with respect to the set of biotic response variables to be included in the analyses. To date, we have completed four experiments that evaluate the effects of high CO_2 oceans on the early life stages of finfish important to the NW Atlantic. Two experiments have been conducted on summer flounder, *Paralichthys dentatus*, and two on winter flounder, *Pseudopleuronectes americanus*. The first experiment on summer flounder, a one-way experimental design with CO_2 levels as the factor (at 3 levels) is complete and published (Chambers et al. 2014. *Biogeosciences*, 11, 1613-1626, doi:10.5194/bg-11-1613-2014, 2014.). The other three experiments are all two-way designs (CO_2 × water temperature) and the post-experiment response variables are currently being analyzed. In all cases our focus was on early life stages – embryos and larvae, and including effects on gametes in the later studies. The responses scored or to be scored are viability, survival, developmental rate, growth rate, histological changes, otolith allometry, and various biochemical measures of fish condition. Our results from the summer flounder one-way design showed a significant negative effect of increased CO_2 on embryo survival and on larval growth and development. Embryo mortality increases with CO_2 and larvae are initially larger, develop more quickly but metamorphose at smaller sizes at high CO_2 levels. In the coming year we will complete the analyses from the other three experiments and develop plans for follow-up work on 1) the potential for transgenerational effects on the resilience of offspring to high CO_2, and 2) intraspecific differences in resilience to high CO_2 between stocks that experience contrasting levels of environmental variance in CO_2 history.

Sturgeons: During 2014 we will be conducting multiple experiments on habitat constraints in shortnose and Atlantic sturgeons (*Acipenser brevirostrum* and *A. oxyrhynchus*, respectively) that builds upon earlier pilot eco-toxicological studies. Our earlier work evaluated the toxic responses of embryos and larvae after aqueous exposures to PCB 126 and TCDD (dioxin). Rates of uptake of radiolabelled PCB126 were also quantified. We measured viability, macro-phenotypic characters (e.g., days to hatch, morphometrics of recently hatched larvae, and starvation resistance), and molecular responses (CYP1A1). Uptake was a linear function of exposure doses, and toxicity was expressed in both species to both contaminants in lethal and sublethal responses including survival of early life-stages, the size and shape of larvae, and the

development of key organs. These results are summarized in Chambers et al. 2012 (*Environmental Toxicology and Chemistry* 31:2324-2337). Our new work, funded for two years by the Hudson River Foundation and the NOAA National Ocean Service Office, will evaluate the separate and combined effects of toxins and climate change on early life-stages of both sturgeon species. The toxins to be used are four congeners of PCBs (77, 81, 126, and 169), an Aroclor mixture, and dioxin. The thermal challenge will expose embryos to the entire thermal tolerance range of each species. We will also conduct 2-way designs (toxin × temperature) in order to evaluate the interactive effects of these co-stressors.

An experimental gillnet designed to reduce bycatch of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and sea turtles while targeting monkfish (*Lophius americanus*) and winter skate (*Leucoraja ocellata*) was tested in the inshore Mid-Atlantic region off Virginia and Maryland. The experimental gillnets were 8 meshes deep with 24" tie-downs compared with commercial gillnets (Control) that were 12 meshes deep with 48" tie-downs. Two commercial fishing vessels were contracted to do sea trials during May of 2013 with an observer on board each vessel to collect operational and biological data. The nets were fished in pairs; each pair of nets consisted of one control string (10 nets, 50 fm each net) and one experimental string of the same number and length. Each vessel completed 50 hauls, 25 hauls of Control gillnets, and 25 hauls of Experimental nets. Seven Atlantic sturgeons were captured, all from the Control nets. The Experimental net significantly reduced bycatch of Atlantic sturgeon for each vessel independently and when both vessels' data were combined. The catch efficiency of the experimental nets for monkfish was inconsistent between the two vessels. There were no significant differences between the two types of nets from "Landon Blake" ($p=0.60$, paired t-test, two-tailed, dof=25), but the Experimental nets caught significantly less monkfish on the fishing vessel "Risky Business" ($p=0.012$, paired t-test, two-tailed, dof=25) and when both vessels' data were combined. The catch differences were higher when the catch volumes were high. Length frequency and GLMM modeling indicate that the reduction in monkfish catch in "Risky Business" primarily resulted from a reduction in catch of monkfish that were less than 75 cm. There were no statistical differences in the catch of winter skate between the Control and the Experimental nets for either vessel, or when data for both vessels are combined ($p>0.05$).

b) Resource Survey Cruises

During 2013, personnel from the Ecosystems Surveys Branch (ESB) staged, staffed, and executed the spring and autumn multi-species bottom trawl surveys, the northern shrimp bottom trawl survey, the sea scallop dredge and optical survey and surfclam/ocean quahog dredge survey. In aggregate, survey staff efforts totaled 179 research and charter vessel sea days. NOAA scientific and contract staff involvement in the various cruises totaled of 1,671 person sea days, and volunteers contributed another 585 person sea days. ESB cruises occupied 1,223 stations in an area extending from Cape Hatteras, North Carolina to Nova Scotia. A total of 469,608 length measurements were recorded, representing 2,212,144 individuals from 310 species during these cruises. Ecosystem survey data are used as fishery independent inputs for 48 single species stock assessments and for several ecosystem assessment and modeling efforts.

Significant effort was also expended in 2013 to fulfill special survey sampling requests from 45 NOAA and University investigators. This sampling included 16,955 feeding ecology observations, collection of 30,913 aging structures, and acquisition of 15,697 samples/specimens to support additional shore-based research.

c) Age and Growth (http://www.nefsc.noaa.gov/fbp/)

Fishery Biology Program contributes to the basic understanding of species age and growth related demography and ecology, and integrated ecosystem research plans in the Gulf of Maine and Georges Bank area. In 2013, the Program provided ages on nearly 60,000 otoliths and other hard structures from over 15 species. In addition to Atlantic cod (7,412), haddock (6,547), and yellowtail flounder (6,001), 5,652 butterfish, 4,786 pollock, and 4,682 tilefish were aged. Age determinations for winter and summer flounder, scup, silver hake and black sea bass totaled 16,837. Most otoliths and other hard part structures are read for production ages that support age-structured stock assessments that serve as the basis for scientific advice to the NEFMC. These data provide information on age compositions, recruitment strength and growth dynamics which ultimately inform the scientific basis for determination of stock status,

biological reference points and annual catch limits.

The Program implements a set of robust QA/QC protocols to monitor and maintain 1) accuracy and 2) precision in age determinations.

1) Accuracy: Through the use of reference collections, personnel each year determine if any bias or deviation of their age estimates occurs compared to the previous years. The Fishery Biology Program also partners with other agencies by exchanging age structures. In 2012, haddock, cod, and winter flounder age structures were exchanged with age readers from the St. Andrews Biological Station (Fisheries and Oceans Canada) and the Massachusetts Department of Marine Fisheries to maintain age determination comparability among laboratories.
2) Precision: A subsample of specimens is re-aged blindly by personnel to assess deviation from 1:1 equivalence. A test of symmetry is used to detect any systematic differences between the original ages and the random test. If the coefficient of variation is under 5%, the ages are considered precise.

Related research - Research projects in 2013 included:

(1) initiated analysis to decipher population structure for cod using difference in growth patterns;
(2) initiated a partnership with Atlantic States Marine Fisheries Commission to create an aging manual that will standardize processing and aging for species of the Atlantic;
(3) continued a project on white hake life history, in partnership with the State of Maine;
(4) continued enhanced biological sampling selected fishes to examine fecundity dynamics;
(5) continued calibration of macroscopic gonad staging performed during research vessel survey cruises as validated by an independent, gonad histology method;
(6) continued analysis of environmental effects on haddock growth and reproduction;
(7) continued to investigate the feasibility of measuring bioelectrical impedance (BIA) as a predictor of fish condition and reproductive potential;
(8) continued a reproductive study of maturation, sex change, and reproductive seasonality of the migratory black sea bass population from the mid-Atlantic states and southern New England;
(9) Published results of an experiment regarding black sea bass reproductive potential (http://dx.doi.org/10.1016/j.fishres.2012.05.012)
(10) Published two papers on winter flounder reproductive maturation and fecundity (http://dx.doi.org/10.1016/j.seares.2012.04.005, http://dx.doi.org/10.1016/j.seares.2012.05.018)
(11) Published results showing reproductive dynamics before and after a period of overfishing period (http://dx.doi.org/10.7755/FB.111.2.4)
(12) Published a review, as part of the NAFO working group on reproductive potential, of the effects of energy acquisition and allocation on reproductive output (http://onlinelibrary.wiley.com/doi/10.1111/faf.12043/abstract)

d) Food Web Dynamics

The NEFSC continued studies of fish trophic dynamics based on an integrated program of long-term (since 1973) monitoring and process-oriented predation studies. Modeling and analytical efforts focused on species interactions among small pelagics, flatfish, elasmobranchs, and gadiformes.

Food habits samples were collected on the northeastern U.S. and Mid-Atlantic continental shelf during NEFSC spring and autumn surveys. Estimates of prey volume and composition were made at sea for selected species. During the 2013 spring and autumn surveys, 10,094 stomachs from 53 species, and 8,198 stomachs from 51 species were examined respectively. Diet sampling emphasized gadiformes, elasmobranchs, small pelagics, flatfishes, and lesser known species.

The 41-year time series (1973-2013) of food habits data collected during NEFSC bottom trawl surveys continued. The majority of the time series is now available for analysis, including data from over 580,000 stomach samples and over 160 predators. The processing of the 2013 bottom trawl survey food habits data is scheduled for completion in 2014.

Diet data undergo two rigorous data quality audits including initial checks at sea during sample collection and secondary checks in the lab to ensure data quality. These checks consider the various facets of prey taxonomy, predator/prey mass, predator/prey length, and prevent missing information. In 2013, stomachs from juveniles (<=12 cm) of predators routinely examined at sea were preserved for laboratory processing.

Since 2004, training workshops for identifying fish stomach contents and refreshing staff knowledge of marine invertebrate and fish taxonomy have been offered regularly throughout the year (approximately six times). These workshops continued in 2013 and provided class discussions and freshly caught specimens as aids for prey identification in association with the spring and autumn groundfish cruises.

Staff prepared several papers and reports for publication and presentations on a wide range of trophic ecology issues in the Northwest Atlantic ecosystem. Since trophic interactions are central to food web and ecosystem considerations, research continues with respect to climate, essential fish habitat, monitoring ecosystem mean trophic level, interactions with gelatinous zooplankton, incorporating fish consumption into stock assessments, and evaluating fisheries reference points.

e) Apex Predators Program

Apex Predators research focused on determining migration patterns, age and growth, feeding ecology, and reproductive biology of highly migratory species, particularly large Atlantic sharks. Members of the Cooperative Shark Tagging Program, involving over 7,000 volunteer recreational and commercial fishermen, scientists, and fisheries observers continued to tag large coastal and pelagic sharks and provide information to define essential fish habitat for shark species in US waters in 2013. Information was received on 3,200 tagged and 595 recaptured fish bringing the total numbers tagged to 244,000 sharks of more than 50 species and 14,875 sharks recaptured of 33 species. Using CSTP mark/recapture data, a University of Rhode Island MS thesis estimated survival parameters for the Blacktip Shark, *Carcharhinus limbatus* (Swinsburg 2013).

Staff participated in the SEDAR Data Workshop for the assessment of the bonnethead and Atlantic sharpnose shark populations. A working paper for each species was presented during the workshop summarizing mark/recapture data from the Cooperative Shark Tagging Program (Kohler et al. 2013). In addition, six working papers detailing multiple indices of abundance for each species that were developed using Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) survey data, as well as additional data from the South Carolina and Georgia Departments of Natural Resources and the University of North Carolina (Frazier & McCandless 2013; McCandless & Belcher 2013; McCandless & Frazier 2013; McCandless et al. 2013; Schwartz et al. 2013).

The NEFSC Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) survey continued to investigate known and putative shark nursery areas along the US east coast to describe their species composition, habitat preferences, and determine the relative abundance, distribution and migration of sharks through longline and gillnet sampling and mark-recapture data. In 2013, our COASTSPAN participants were the Massachusetts Division of Marine Fisheries (MDMF), Stony Brook University, Virginia Institute of Marine Science, North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Department of Natural Resources, and the University of North Florida. MDMF staff also conducts a survey in the U.S. Virgin Islands using coastspan gear and methods. The NEFSC staff conducts the survey in Narragansett and Delaware Bays. Over 3500 sharks of 14 species were caught during COASTSPAN surveys, more than 1500 (45%) of these sharks were tagged for migration studies.

Since 1961, recreational shark tournament sampling has been conducted annually during the summer from New Jersey to Maine. Tournaments are a primary source of biological samples used in NEFSC shark food habits, reproduction, and age/growth studies that provide biological reference points used during the ICCAT pelagic shark assessments and SEDAR process. In 2013 staff attended 8 tournaments and

examined 123 sharks. Using these historic data, information on age and growth (Gervelis & Natanson 2013) and reproductive biology (Natanson & Gervelis 2013) for the thresher shark, *Alopias vulpinus* was published in 2013.

APP staff also conducts fishery-dependent investigations of pelagic nursery grounds in conjunction with the high seas commercial longline fleet. This collaborative work involves sampling and tagging blue sharks and shortfin makos in a potential nursery area, and collecting length-frequency data and biological samples. Thus far over 3,350 sharks have been tagged and over 250 recaptured; the recaptures are primarily blue sharks recovered by commercial fishermen working in the mid-Atlantic. To date, 500 blue sharks have been double tagged using two different tag types to help evaluate tag-shedding rates, which are used in sensitivity analyses of population estimates and to estimate blue shark fishing mortality and movement rates.

A total of 201 spiny dogfish that were OTC injected during the 2011-2012 tagging study have been recaptured and 130 have been returned to the APP for age validation, with 72 of these fish in good condition to obtain measurements for reproductive studies. A study was initiated on the seasonal cycle of female spiny dogfish reproduction. Samples of mature females were collected monthly starting in July for analysis of reproductive stage of the female and the embryos. This project will continue for a total of 24 months.

f) Marine Mammals

Cetacean surveys:

In 2013, NEFSC continued work on the Atlantic Marine Assessment Program for Protected Species (AMAPPS), which is a partnership with the Bureau of Ocean Energy Management (BOEM), the US Navy, and the US Fish and Wildlife Service. As part of this program, NMFS is conducting seasonal surveys of protected species along the Atlantic coast through the next several years. The goal of the program is to provide a better understanding of the distribution and abundance of sea turtle, marine mammal, and seabird populations, and to develop a decision-support tool for use in evaluating the likely impacts of various industrial, military, and development activities within U.S. Atlantic waters.

During 1–23 July 2013 and 29 July–19 August 2013, as part of the AMAPPS project, the NEFSC conducted a shipboard abundance survey of marine mammals and sea turtles using the NOAA FSV *Henry B. Bigelow*. The ship surveyed shelf break waters off North Carolina to the southern tip of Nova Scotia, Canada, as well as some inshore areas with potential for alternative energy development. The two-independent-team method was used to collect the data. In Beaufort sea states of 4 and less, about 4,333 km of on-effort track lines were surveyed. During the on-effort track lines, 24 species or species groups and 2 identifiable sea turtles were recorded. For cetaceans, the upper team detected 792 groups (11,455 individuals) and the lower team detected 609 groups (8,458 individuals). For turtles, the upper team detected 14 groups (14 individuals) and the lower team detected 7 groups (7 individuals).

A shipboard North Atlantic right whale (*Eubalaena glacialis*) cruise was conducted during 30 April–10 May and 20–31 May aboard the NOAA R/V *Gordon Gunter*. Primary cruise activities included: (1) collecting photographs of North Atlantic right whales; (2) acoustic recording minke (*Balaenoptera acutorostrata*), sei (*Balaenoptera borealis*) and fin whales (*Balaenoptera physalus*); (3) conducting CTD casts to examine oceanographic changes; (4) conducting zooplankton sampling to examine prey sources; (5) collecting right whale fecal samples for hormone analysis; and (6) deploying marine acoustic recording units (MARUs). The primary areas of operations were the Great South Channel, Georges and Franklin Basins, Stellwagen Bank, Rhode Island Sound, extended to the Northeast Channel in Canadian EEZ waters.

The North Atlantic Right Whale Sighting Survey (NARWSS) is a NOAA Fisheries program that locates and records the seasonal distribution of North Atlantic right whales off the northeastern coast of the United States. NARWSS flights conducted in 2013 followed systematic track lines with randomized starting

locations within 11 primary survey boxes: Cashes Ledge, Franklin Basin, Georges Basin, Georges Shoal, Great South Channel, Howell Swell, Jeffreys Ledge and Wildcat Knoll, Jordan Basin and Jeffeys Bank, Lindenkohl Basin and Truxton Swell, Stellwagen Bank and Wilkinson Basin, and Rhode Island Sound (Figure 1). During 2013, NARWSS flew 185 hours over 48 surveys, including directed flights over right whales reported near Atlantis Canyon, Cultivator Shoal, Great South Channel, and Nantucket Sound. NARWSS detected 45 right whales (including possible duplicate sightings of the same individual), with 30 right whales sighted within survey blocks and 15 right whales sighted during transit to or from survey areas.

During January-March 2013, skin samples were collected from right whales on the calving grounds in the coastal region (<25 nmi from land) between Savannah, GA and St. Augustine, FL. Whales were located by aerial spotting teams, and skin and blubber samples were obtained using biopsy darts deployed by crew in an inflatable boat. DNA in right whale skin can be used to determine sex, and to create a genetic "fingerprint" for later re-identification. These samples will be added to the extensive collection of right whale DNA (obtained from approximately 300 individual right whales) maintained at Trent University in Ontario, Canada. DNA collected and archived through the project will not only help researchers identify individual whales and their paternity, but also to: (1) assess genetic variation in the population; (2) determine how many females are reproductively active; (3) monitor the health of individual animals, and (4) better understand the right whale mating system.

Cetacean bycatch and other analyses:

Incidental bycatches of cetacean, turtle, and pinniped species were estimated based on observed takes in commercial fisheries from Maine to North Carolina. Fisheries observed during 2013 included gill nets, otter trawls, mid-water otter trawls, mid-water pair trawls, scallop trawls, shrimp trawls, scallop dredges, clam dredges, purse seines, beach anchored gillnets, bottom longline, pound nets, and some pot and traps. Cetaceans observed taken included harbor porpoises (*Phocoena phocoena*), Risso's dolphins (*Grampus griseus*), short-beaked common dolphins (*Delphinus delphis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), and bottlenose dolphins (*Tursiops truncatus*). To support Atlantic Take Reduction Teams (e.g., harbor porpoise, coastal bottlenose dolphin, and Atlantic trawl teams), the observer data were analyzed to identify environmental factors, fishing practices, and gear characteristics associated with the bycatches.

Scarification analyses of right and humpback whales continued in 2013. These analyses are used to monitor interactions between whales and fishing gear. Serious injury determinations were made on non-fatal large whale fishery interactions and vessel strikes, as well as bycaught small cetaceans to determine causes and extents of injuries.

Work continued with the New England Aquarium and University of Rhode Island to update the North Atlantic Right Whale Individual ID catalogue and right whale sightings data bases.

Cetacean acoustics:

In general, NEFSC researchers have been working to: (1) elucidate the basic acoustic behavior of various marine mammal species; (2) monitor baleen whale presence using real time reporting from autonomous glider platforms; (3) improve the application of passive acoustics as a tool for monitoring and mitigation; and (4) monitoring and evaluation of ocean noise impacts. Some of these focus projects are detailed below.

Since 2007, and continuing through 2014, the NEFSC has been involved in an ocean noise project in the Stellwagen Bank National Marine Sanctuary (SBNMS). The objectives of this project are to map the ocean noise budget within the sanctuary, characterize various contributing noise sources (biological and anthropogenic), and to evaluate the noise impact on marine mammals in terms of their available communication range. Communication ranges are being modeled for four species of baleen whales (right, fin, minke, and humpback (*Megaptera novaeangliae*) whales) across six call types. The data analyses are

expected to reveal the extent of loss of communication space of these whales under present-day noise conditions.

In a NOAA wide initiative two noise reference stations are being deployed in spring 2014 in the Gulf of Maine to monitor long-term changes in ocean noise in the US EEZ.

In collaboration with the National Park Service (NPS) and SBNMS, NEFSC is initiating a pilot study to use machine-learning techniques and geospatial and sound data to develop models for predicting ocean noise on large scales. At the same time newly developed acoustic indeces will be explored for their ability to track larger scale changes in the presence of vocal marine species over varying temporal and spatial scales.

A new collaboration with Dr. Mark Baumgartner at Woods Hole Oceanographic Institution (WHOI) aims at developing adaptive, automatic detectors for baleen whale calls. These automatic detection methods (Low-frequency detection system: LFDCS) will be used to explore, passive acoustic data collected, in the SBNMS and on Georges Bank (amongst others), in order to gain a better understanding of the seasonal distribution of baleen whales in near-shore and off-shore Northeast waters.

In collaboration with various different agencies, universities and research organizations NEFSC is starting to look at right whale migration and a better description of the migration corridor using large-scale, year-long acoustic datasets from across the western North Atlantic. LFDCS detectors, described above, are going to be used for this comparison.

In an ongoing project the acoustic behavior of right whale mother-calf pairs is investigated using a variety of different methods. This research is being conducted in collaboration with Dr. Susan Parks (Syracuse University). Fieldwork in the Bay of Fundy, Cape Cod Bay, and on the calving grounds in the southeastern US involves obtaining recordings using a towed hydrophone from a small boat.

Another project has been exploring the applicability of new point-sampling and spatially-explicit capture-recapture (SECR) methods to assess right whale abundance using acoustic data collected on arrays of receivers in the SBNMS area.

In collaboration with Dr. Robert Valtierra from Boston University a new method for localizing low-frequency baleen whale calls using a single acoustic sensor has been developed.

An autonomous acoustic technology project using glider technology is underway with the Woods Hole Oceanographic Institution (WHOI) to: (1) record low and mid-frequency marine mammal vocalizations; (2) detect, classify, and remotely report vocalizations of interest; and (3) collect oceanographic data. Data from previously deployed gliders are now being analyzed in more detail. A real-time moored buoy will be developed that can be deployed and relay back detections of baleen whales throughout its deployment period.

Minke whale call characteristics are being measured and described for the Massachusetts Bay area, and a geographical comparison of minke whale calls and their seasonal occurrence across the Western North Atlantic has been completed. This work is showing seasonal migration patterns of this species along the North American shelf break, a preference for deeper waters to the east of the shelf break and confirms a possible winter habitat in the southeastern US and Caribbean region.

In collaboration with scientists from Duke University, Oregon State University, the Alfred-Wegener-Institute, Germany, University of Hannover, Germany and the Australian Antarctic Division, it was possible it was possible to solve the mystery of the bio-duck sound, which had been recorded for decades in the Southern Ocean, and was now assigned to the Antarctic minke whale.

In addition, unknown pulsed calls which may be produced by humpback or minke whales and are prevalent in the summertime in the Stellwagen Bank Sanctuary, are being described in their physical characteristics,

as well as their seasonal and spatial occurrence. Comparison with data from acoustic recording tags deployed on humpback whales might help to elucidate the source of these signals. Comparisons of tag data and data collected from bottom-mounted arrays are also conducted to better describe the social sound repertoire of humpback whales during the summer feeding season in the SBNMS.

Using data collected on line-transect surveys, the acoustic properties of a previously unrecorded beaked whale species (Sowerby's beaked whale (*Mesoplodon bidens*)) was described for the first time. A cetacean acoustic abundance estimation project is aimed at developing protocols for estimating acoustic abundance and integrating these estimates with visual abundance estimates from ship-board line-transect surveys and longer-term stationary acoustic monitoring projects. The first target species for these analyses are sperm whales; acoustic abundance estimates are being produced from data collected in 2011 and 2013. Also, a new dolphin whistle classifier has been developed for the western North Atlantic in collaboration with Dr. Julie Oswald at Biowaves. The performance of the classifier is being tested and is expected to facilitate species identification at sea using acoustic data.

Several new projects have been initiated in collaboration with the Nature Conservancy and the Department of Marine Fisheries, Massachusetts, focusing on the application of passive acoustic monitoring in detecting and describing the seasonal distribution of cod spawning aggregations. For these projects, archived long-term passive acoustic data have been used, along with new deployments of acoustic recorders in target areas selected in collaboration with local fishermen.

A large-scale database project involving several NOAA Science Centers and Scripps Oceanographic Institution in San Diego, is aimed at developing the “Tethys” database system to store passive acoustic deployment, as well as detection data information for long-term storage, data exploration and to facilitate data exchange between institutions.

Pinnipeds:

In 2013, two aerial seal surveys were conducted to monitor major gray seal (*Halichoerus grypus*) pupping colonies in Massachusetts and Maine coastal waters.

In June 2013 more than two dozen researchers collaborated on a gray seal live capture project in Chatham Harbor, Massachusetts. Partners included NEFSC's Protected Species Branch, NOAA Fisheries Northeast Regional Office, Riverhead Foundation for Marine Research and Preservation, Duke University, Canada's Department of Fisheries and Oceans, the International Fund for Animal Welfare, Woods Hole Oceanographic Institution, the Provincetown Center for Coastal Studies, Marine Mammals of Maine, National Marine Life Center, the University of New England, the US Fish and Wildlife Service and the National Park Service. Funding for PSB's work was provided by BOEM through the AMAPPS project. Twenty adult gray seals were captured and sampled and nine were fitted with GPS phone tags or satellite tags.

Work continued in 2013 on stomach content analysis of bycaught harbor (*Phoca vitulina*) and gray seals.

Bycatch estimation of harbor, gray and harp (*Pagophilus groenlandicus*) seals was conducted based on observed takes in the Mid-Atlantic Gillnet, Northeast Sink Gillnet and Northeast and mid-Atlantic bottom trawl fisheries.

g) Turtles

The NEFSC collaborated with academics, industry groups, and researchers from other NMFS science centers to (1) collect and assess data on sea turtles in U.S. Mid-Atlantic waters; and (2) reduce sea turtle bycatch in U.S. commercial fisheries in the Northwest Atlantic Ocean.

In 2013, the NEFSC continued two gear and gear-related projects investigating methods to reduce sea turtle

bycatch in fishing gear. These included: (1) a comparative study of the performance of a "topless trawl" on the targeted catch; and (2) continued refinement and investigation of the usefulness and capability of a tow time data logger to accurately record tow time in the bottom trawl fishery.

After testing the topless trawl at the flume tank at Memorial University, St John's Newfoundland, the topless trawl was reconfigured with restrictor lines to improve the shape of the bottom trawl net and to improve catch performance during previous work to reduce sea turtle bycatch while maintaining the targeted catch. The results of this evaluation indicate that the 48 meter (160 foot) headrope, 24 meter (80 foot) hanging line, topless trawl reduced the catch of summer flounder (*Paralichthys dentatus*) and skates (*Leucoraja* sp.) when compared to the traditional trawl. The mean loss of catch by F/V Darana R was 23% for summer flounder and 12% for skates, the dominant bycatch. Testing that occurred to determine sea turtle reduction, suggested that the topless trawl reduced the sea turtle bycatch by approximately 50%.

Tow time restrictions have been discussed as a viable alternative in fisheries where Turtle Excluder Devices (TEDs) are likely to significantly reduce targeted catch. Although the length of time a turtle can remain submerged in a trawl is still being evaluated, tows less than an hour are expected to result in a negligible number of sea turtle mortalities. Discussion about the feasibility of tow time restrictions often results in concerns about the feasibility of monitoring and compliance with any limit on tow times. The Protected Species Branch of the Northeast Fisheries Science Center (NEFSC) for the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) solicited a contractor to develop and construct a robust, simple, and inexpensive data logger that can be used to enforce tow-time restrictions on commercial bottom trawl fishing vessels. These loggers, which are attached to the trawl net or the trawl doors, record the amount of time the units are below a certain pre-determined depth and have a signal (light) alarm that can inform enforcement when the unit has triggered this alarm. Additionally, the units have a battery life of approximately four years and can store up to four months worth of data with the option to overwrite oldest memory. The units were tested for their ability to reliably record trawl fishing times and detect when a tow has exceeded a time threshold. The loggers have been tested on eight vessels operating in six fisheries and have held up to the abuses of the salt environment and the shock and vibration of commercial fishing practices. Additionally, because these loggers are programmable, they may have applications in other fisheries where there is a need to monitor, record, or enforce soak durations.

In 2013 the NEFSC conducted research projects related to turtle bycatch detection and assessment. These included: (1) estimating turtle mortality rates in commercial gears using serious injury guidelines; (2) publishing estimated bycatch of turtles in Mid-Atlantic gillnet gear from 2007 to 2011, and (3) beginning an analysis of turtle bycatch in bottom otter trawl and scallop trawl fisheries from 2009-2013. The NEFSC also continues to develop quantitative methods for assessing anthropogenic threats to sea turtles.

In support of AMAPPS priorities, NEFSC contributed to regional collaborations to deploy satellite tags on wild-captured loggerhead sea turtles (*Caretta caretta*) to monitor movements and behavior and to collect information on diving and surfacing times to develop correction factors for the proportion of turtles underwater during aerial surveys (and therefore not observed during these surveys). The collaboration deployed twenty satellite tags were deployed on loggerhead sea turtles collected in offshore and nearshore mid-Atlantic shelf waters.

h) Seabirds

In 2013, the NEFSC continued talks with the U.S. Fish and Wildlife Service (FWS) and the Greater Atlantic Regional Fisheries Office (GARFO) regarding implementation of the Seabird Memorandum of Understanding (MOU) between the respective agencies (66 FR 3853). Regional collaboration between organizations identified negative fisheries interactions as a potential threat to populations of red-throated loons (*Gavia stellata*), common loons (*G. immer*), great shearwaters *(Puffinus gravis)*, and northern gannets (*Morus bassanus*). Completed or continued research projects related to seabird bycatch assessments and priorities listed in the Seabird MOU include: (1) estimated bycatch of great shearwaters for New England sink gillnet gear (NESG) from 1996 to 2011; (2) identified bycatch hotspots for great shearwaters using

tagging data and commercial fishing records in collaboration with the Stellwagen Bank National Marine Sanctuary and FWS.

Dedicated seabird observers conducted observations during the summer 2013AMAPPS abundance survey aboard the NOAA R/V *Henry B. Bigelow*. A total of 5,148 birds were seen while on-effort. This consists of 45 species of birds, in addition to six unidentified species groups (e.g., unidentified jaeger, unidentified storm-petrel). Four species comprised 86% of the total birds seen. In declining order of abundance these were: great shearwater *(Puffinus gravis)*, Wilson's storm-petrel *(Oceanites oceanicus)*, Leach's storm-petrel *(Oceandroma leucorhoa)* and Cory's shearwater *(Puffinus diomedea)*. Meanwhile, others, such as Audubon's shearwater *(Puffinus lherminieri)* and bridled tern *(Onychoprion anaethetus)*, being tropical and sub-tropical species, were closely associated with habitat type; in this case, warm Gulf Stream water. Seabird occurrence and abundance data were also collected on board NOAA Fisheries ships of opportunity for 2013 in collaboration with the College of Staten Island, City University of New York for the Northeast and mid-Atlantic regions.

The NEFSC, in collaboration with the Project Puffin (National Audubon Society) and WHOI, initiated a project in 2013 to study breeding success of Atlantic puffins (*Fratercula arctica)* and Arctic terns (*Sterna paradisaea*) in relation to warming sea surface temperatures in the Gulf of Maine. To date, changes in diet compositions of 3 colonies of Atlantic puffin and Arctic tern have been analyzed. Ongoing research includes: (1) understanding forging behavior of Atlantic puffins through satellite tagging; (2) microbiological assessment of Atlantic puffin health and fitness in collaboration with the Marine Biological Laboratory (MBL) and the National Aquarium in Baltimore.

3. Studies of Fishing Operations

In 2013, NEFSC Observers were deployed on 2,626 trips aboard commercial fishing vessels. The kept and discarded catch was weighed or estimated for all observed hauls. Estimated kept weights were obtained for all unobserved hauls. Length frequencies were recorded and age structures were collected from a portion of observed hauls. NEFSC Observers recorded 131 marine mammal incidental takes, 24 sea turtle incidental takes, and 80 seabird incidental takes. For most of these animals, the information recorded included animal condition, length and other relevant body measurements, as well as species identification characteristics. Tissue samples were also collected from many of these animals, and the entire animal was collected if possible.

In addition, the Northeast Fisheries Observer Program deployed At-Sea Monitors on 1,371 trips aboard commercial fishing vessels in 2013. On these trips there were 75 marine mammal, one sea turtle, and 79 seabird incidental takes documented.

a. New England and Mid-Atlantic Sink Anchored Gillnet Fisheries

In the sink anchored gillnet fishery, 585 trips were observed with a total of 2,628 gear retrievals by Observers. There were 80 observed marine mammal takes in this fishery (37 gray seals, 15 harbor porpoises, 12 harbor seals, six common dolphins, five unidentified seals, two harp seals, one bottlenose dolphin, one Risso's dolphin). There were also three loggerhead turtles and 36 seabird takes observed in this fishery.

At-Sea Monitors observed 481 trips in the sink anchored gillnet fishery with 2,090 gear retrievals. There were 51 marine mammal (32 gray seals, 10 harbor seals, five harbor porpoises, three unidentified seals, and one common dolphin), one sea turtle (one loggerhead turtle) and 75 seabird (62 of which were greater shearwaters) incidental takes recorded in this fishery by Monitors.

b. Float Drift Gillnet Fishery

There were 14 floating drift gillnet trips with 38 gear retrievals observed in 2013. There were no marine

mammal, sea turtle, or seabird takes observed.

No Monitors deployed on float drift gillnet trips in 2013.

c. Otter Trawl Fisheries

In the bottom otter trawl fishery 1,111 trips were observed with a total of 7,913 gear retrievals recorded by Observers. In addition, there were 28 midwater trawl trips with 149 gear retrievals, 20 scallop trawl trips with 104 gear retrievals, 26 shrimp bottom otter trawl trips with 79 gear retrievals, and four twin trawl trips with 73 gear retrievals observed in 2013.

In the bottom otter trawl fishery, there were 42 observed marine mammal takes (23 common dolphins, five Risso's dolphins, four whitesided dolphins, four gray seals, two pilot whales, one harbor porpoise, one harbor seal, one unidentified dolphin, and one unidentified porpoise/dolphin). There were also 16 loggerhead turtles, two unidentified hard-shell turtles, one leatherback turtle, and nine seabird takes in this fishery. In the mid-water trawl fishery, there was one minke whale take. In the scallop trawl fishery one loggerhead turtle take was observed. No marine mammal, sea turtle or seabird takes were observed in the shrimp bottom otter trawl fishery. On twin trawl trips there were two Northern gannet takes observed.

At-Sea Monitors deployed on 843 bottom otter trawl trips with 9,500 gear retrievals and four haddock separator trawl trips with 130 gear retrievals in 2013. There were 24 marine mammal (eight pilot whales, five common dolphins, five whitesided dolphins, four gray seals, one harbor seal, and one unidentified whale) and four seabird takes recorded by Monitors in the bottom otter trawl fishery. There were no takes documented on haddock separator trawl trips in 2013.

d. Sea Scallop Dredge Fishery

In the sea scallop dredge fishery, 481 trips were observed with a total of 33,801 gear retrievals. There was one loggerhead turtle take and 13 seabird takes observed in this fishery.

No Monitors deployed in the scallop dredge fishery in 2013.

e. Scottish Seine Fishery

No Scottish seine trips were covered by Observers or Monitors in 2013.

f. Drift Sink Gillnet Fishery

In the drift sink gillnet fishery in 2013, Observers were deployed on 137 trips with a total of 980 gear retrievals. There were two marine mammal (one bottlenose dolphin and one harbor porpoise) and 19 seabird takes in this fishery.

Monitors deployed on 12 trips with a total of 138 gear retrievals. There were no takes documented by Monitors in this fishery.

g. Anchored Floating Gillnet Fishery

There were five anchored floating gillnet trips with seven gear retrievals observed in 2013. No marine mammal, sea turtle, or seabird takes were observed in this fishery.

No Monitors deployed on anchored floating gillnet trips in 2013.

h. Mid-water Pair Trawl Fishery

In 2013, there were 112 mid-water pair trawl trips observed with a total of 416 gear retrievals. Five takes (three pilot whales, one gray seal, and one unidentified shearwater) were observed in this fishery. No sea turtles were documented.

No Monitors deployed on mid-water pair trawl trips in 2013.

i. Bottom Longline Fishery

In the bottom longline fishery in 2013, eight trips were observed with a total of 39 gear retrievals. There were no marine mammal, sea turtle or seabird takes observed.

At-Sea Monitors covered a total of 28 bottom longline trips and 133 gear retrievals in 2013. There were no marine mammal, sea turtle or seabird takes observed by Monitors.

j. Beach Haul Seine Fishery

No beach haul seine trips were covered by Observers or Monitors in 2013.

k. Pound Net Fishery

No pound net trips were covered by Observers or Monitors in 2013.

l. Handline Fishery

In 2013, there were two handline trips observed with 24 gear retrievals and one auto-jig handline trip with 11 gear retrievals. No trolling trips were observed in 2013. No marine mammals, sea turtles or seabirds were taken in this fishery.

Monitors covered three handline trips and 47 gear retrievals in 2013. There were no documented takes in this fishery in 2013.

m. Herring Purse Seine Fishery

In 2013, there were 57 herring purse seine trips with 101 gear retrievals observed. There were one gray seal and one harbor seal observed in this fishery. No sea turtles or seabirds were observed.

No herring purse seine trips were covered by Monitors in 2013.

n. Menhaden Purse Seine Fishery

No menhaden purse seine trips were covered by Observers or Monitors in 2013.

o. Tuna Purse Seine Fishery

Three tuna purse seine trips with two gear retrievals were observed in 2013. There were no marine mammal, sea turtle or seabird takes observed.

No tuna purse seine trips were covered by Monitors in 2013.

p. Lobster Pot Fishery

In 2013, there were 29 lobster pot trips with 1,169 gear retrievals observed. There were no documented takes in this fishery.

No lobster pot trips were covered by Monitors in 2013.

q. Fish Pot Fishery

One fish pot trip with 33 gear retrievals was observed in 2013. No takes were documented.

r. Conch Pot Fishery

No conch pot trips were covered by Observers or Monitors in 2013.

s. Red Crab Pot Fishery

No red crab pot trips were covered by Observers or Monitors in 2013.

t. Blue Crab Pot Fishery

One blue crab pot trip with 11 gear retrievals was observed in 2013. There were no takes observed on this trip.

u. Clam Dredge Fishery

No clam dredge trips were covered by Observers or Monitors in 2013.

v. Scallop Beam Trawl Fishery

One scallop beam trawl trip with two gear retrievals was covered in 2013. There were no takes observed on this trip.

No scallop beam trawl trips were covered by Monitors in 2013.

4. Observer estimation of catch on NAFO Div 3 trips.

a. The checker pen is measured and total volume is calculated prior to the catch being dumped onboard (The F/V Titan uses varying size checker pens as they can change the size by adding or removing pen boards).

b. Once the catch is dumped the observer takes the depth of the checker pen (filled with catch) in 10 random locations within it using a measuring stick. The average depth of the fish in the checker pen is then calculated. The total volume of the catch is then calculated by multiplying the length times the width of the checker pen times the depth of the catch.

c. The observer then fills (depending on amount of catch) 1.47 cu. ft. baskets with the catch from random locations throughout the checker pen. The number of baskets varies from 8 to 15 (unless the catch is very low it could be less). The number of baskets used is then multiplied by the volume of one basket to obtain the Total Volume Subsampled. The fish are then separated by species and whether they are kept or discarded. The discard size is determined by the observer according to the legal U.S. fisheries regulations. The kept and discards of each species are weighed and recorded.

d. The kept and discarded catch weights are then calculated by the following formula:

1) A Sample Multiplier is calculated by (Total Volume (see # 2 above / total Subsample Volume (see # 3 above)

2) The weight of each species Subsampled is then multiplied by the Sample Multiplier to calculate the Estimated Total Weight for that species and catch disposition.

3) The percent Subsampled can be calculated by dividing the Total Subsample Volume by the Total Volume of the catch.

5. Population Dynamics Research

a) Stock Assessments

Population dynamics research conducted within the NEFSC supports a number of domestic and international fisheries management authorities. Within the United States Northeast Region, management plans are developed by the New England (states of Maine through Connecticut) and Mid-Atlantic (New York through North Carolina) Fishery Management Councils, and the Atlantic States Marine Fisheries Commission (ASMFC). There are about three dozen managed species; all require stock status updates as a basis for fishery management. Stock assessments are routinely reviewed in a peer review process termed the Stock Assessment Workshop (SAW). Stocks assessments conducted and reviewed through this process in 2013 include white hake, surf clam, summer flounder, and striped bass.

Not all assessments conducted by the NEFSC are vetted at the SAW. Some are developed and reviewed in the US/Canada Transboundary Resources Assessment Committee (TRAC). In 2013, stock assessments conducted and reviewed through the TRAC process included Eastern Georges Bank cod, Eastern Georges Bank haddock, and Georges Bank yellowtail flounder. Other stock assessments in 2013 vetted in regional bodies included scup, black sea bass, bluefish, spiny dogfish, striped bass, and Northern shrimp.

b) Atlantic Salmon Research

Atlantic salmon populations in eastern Maine are listed as endangered under the United States Endangered Species Act (ESA). Spawning populations have dwindled over the years, and both smolt escapement and ocean survival rates have declined. Research programs conducted by the NEFSC, in conjunction with various agencies, private partners and international collaborators, are designed to better understand the factors contributing to these declines. Research activities include a variety of projects in natal rivers, estuaries, and at sea. The data from these studies are used to provide information for local, national, and international stock assessment activities. These assessments support ESA and North Atlantic Salmon Conservation Organization (NASCO) management efforts.

Field research in 2013 focused on (1) a fish community survey within the Penobscot River estuary; (2) marine telemetry; and (3) monitoring of fishery removals on the high seas. Through the application of active (pelagic trawling) and passive (multi-frequency split-beam hydroacoustics) techniques, estimates of biomass and habitat use for various commercially important fish species (e.g. Atlantic herring, alewife, blueback herring, American shad) are being developed for the Penobscot Estuary. Documentation of American shad spawning, the presence of multiple size classes of river herring utilizing the upper estuary and the detection of significant juvenile Atlantic herring biomass in the lower estuary highlights the importance of this estuarine nursery. Telemetry studies have identified significant mortality during the transition to the marine environment for both wild and hatchery-reared smolts. Zones of increased mortality have been identified, and potential causal mechanisms (poor physiological condition, predation, etc.) and evaluation of different hatchery products are being investigated through follow-up studies. Monitoring the West Greenland fishery and collecting biological data and fishery statistics continued. These data are provided directly to ICES and are required for North American run-reconstruction modeling

and for developing catch advice for the fishery. All of these studies will contribute to recommendations for additional measures to be considered to halt the decline of USA Atlantic salmon stocks and help restore these populations.

c) Cooperative Research

The Northeast Cooperative Research Program (NCRP) partners fishermen and researchers to develop and conduct projects that make use of the specialized knowledge of each partner. The goal of this program is to promote better science and management for fisheries, as well as increase communication and collaboration among fishing professionals in the region. Projects are both internal to the NEFSC and external, usually with state or academic partners.

1. Internal Projects

The NEFSC Study Fleet, a subset of fishing vessels from which high quality, self-reported data on fishing effort, area fished, gear characteristics, catch, and biological observations are collected, was initiated with the dual objectives of: (1) assembling a "study fleet" of commercial New England vessels capable of providing high resolution self-reported data on catch, effort and environmental conditions while conducting "normal" fishing operations; and (2) developing and implementing electronic reporting hardware and software (our Electronic Logbook System) for the collection, recording, and transferring of more accurate and timely fishery-based data and continues in 2013.

A collaborative effort between the Pacific States Marine Fisheries Commission (PSMFC), Northeast Cooperative Research Program (NCRP), and NEFSC Data Management Services (DMS) was initiated to support Mid-Atlantic and Southern New England fleets to expand electronic vessel reporting and, to the extent possible, the collection of finer-scale fisheries dependent data. In 2013, 119 logbooks and associated equipment were provided by PSMFC and configured by NCRP/Study Fleet staff. FLDRS modifications were identified and requested by partner groups. Training is currently underway for partner institution technical staff to support the FLDRS software, and the equipment is being installed on vessels from New Bedford, MA to Barnegat Light, NJ. Equipment was installed and Captains trained on more than 40 vessels during 2013. For those vessels that will record tow-by-tow data beyond the sub-trip aggregate reporting required by VTRs, temperature-depth probes will be deployed to collect information that can provide valuable feedback to the fishing industry and be shared with oceanographic modelers, stock assessment scientists and other researchers to better understand associated ecosystem drivers of species distribution patterns.

Finished species identification guides, including species likely to be retained by fisheries in the Northeast, were delivered in mid-2013 and distributed to the Study Fleet and other collaborating partners under the PSMFC electronic reporting initiative.

A pilot bottom longline (fixed gear) survey in the western and central Gulf of Maine focused on areas of complex rocky habitat that are not well-sampled by mobile trawl gear was planned to addresses concerns about the catchability of specific species collected during bottom trawl surveys for important groundfish stocks, and will enhance data collection for several data poor and depleted stocks that are specifically associated with rocky habitat.

The NCRP supported a cooperative initiative to tag spiny dogfish (*Squalus acanthias*) in the Gulf of Maine, Southern New England, and Georges Bank in 2011-2012 in an effort to answer long-standing questions about stock structure, movement patterns, and life history of the species in order to update and improve dogfish stock assessments. There were 329 recaptures during 2013, demonstrating considerable movement between the three tagging areas.

A pilot cooperative flatfish trawl survey was conducted within the U.S. waters of Georges Bank in August 2013 with the goal of providing biomass, population and size composition estimates for yellowtail flounder in the survey area. The survey was developed in close collaboration with the

fishing industry, including survey design and the selection trawl gear to be used. The survey area was divided into high and low density strata based on experienced yellowtail fishermen's expertise and advice. The trawl selected based on fishermen's advice was a two-seam, two-bridle flounder net with a sweep consisting of 4" rubber cookies.

2. External Projects

There were many projects managed by states or academic partners which were initiated or continued in 2013. A Maine-New Hampshire Inshore Trawl Survey which samples inshore areas off Maine and New Hampshire was continued in 2013. The Marine Resource Education Program (MREP) is a highly successful and innovative program that has demonstrated marked success as a mechanism to inform stakeholders about marine fisheries science and management processes. During 2013, the Cooperative Institute for the North Atlantic Region (CINAR)/Rutgers on Longfin Squid Network in the Southern New England/Mid-Atlantic Region was involved thermal habitat modeling that was used to adjust the fishery independent survey time series used in the butterfish stock assessment. The University of Maine/Penobscot East Resource Center's Eastern Maine Sentinel Survey was augmented with jig stations in the shallower depths where longline and lobster gear conflicts limited sampling. This hook and line sampling was modeled after similar surveys on the west coast for Pacific rockfish and was felt to be a worthwhile addition to the program to inform future sampling design decisions. The Science Center for Marine Fisheries Science (SCeMFiS) currently is involved through academic scientists at the University of Southern Mississippi and the Virginia Institute of Marine Science and industry groups primarily in the Mid-Atlantic. Current projects involve surf clam and ocean quohog surveys and survey data processing and design questions, as well as work on survey methodologies for black sea bass. The Gear Conservation Engineering and Demonstration Network (GEARNET), led by the Gulf of Maine Research Institute, Massachusetts Division of Marine fisheries, and UMass-Dartmouth – School for Marine Science and Technology, was focused on outreach and extension services to encourage adoption of these modified gears in 2013. The REDNET group, led by the Massachusetts Division of Marine Fisheries, UMass Dartmouth – School for Marine Science and Technology, and Maine Department of Marine Resources is focused on methods to allow small redfish to escape at depth to maximize survival, outreach to the redfish industry, and exploring processing capabilities. The Squid Trawl Network (STN), led by Cornell University Cooperative Extension, developed an information exchange program to share and post gridded locations of high bycatch for scup, butterfish and river herring during 2013.

3. Research Set-Aside (RSA) Programs Cooperative Research Projects

CRP manages the review of RSA projects, the priorities of which are established through the Mid-Atlantic Fisheries Management Council's Research Set-Aside committee, RSA species oversight committees, and the Northeast Fisheries Management Council's Research Steering committee. The programs involve the scallop fishery, fluke, scup and sea bass fisheries and monkfish fisheries.

d) Stock Assessment Methods Development

Many national and international studies have concluded that stock assessments should evaluate resource status using a number of different analytical approaches. By doing so, some indication of the robustness of conclusions regarding stock status is achieved. To this end, NEFSC researchers have been collaborating with other NOAA fisheries scientists to develop a standardized suite of methods collected into a software toolbox. The NOAA Fisheries Toolbox (NFT) incorporates a wide range of methods (such as virtual population analysis, reference point estimation, surplus production and forward-projection methods) into a stable environment with tested software products. The NFT is used for many routine assessment tasks. No new methods were added to the toolbox in 2013, but several programs (SCALE, ASAP, YPR, POPSIM-A, POPSIM-L, MSE, IRATE) were updated. The complete package may be accessed at http://nft.nefsc.noaa.gov/ (note that a password is no longer required).

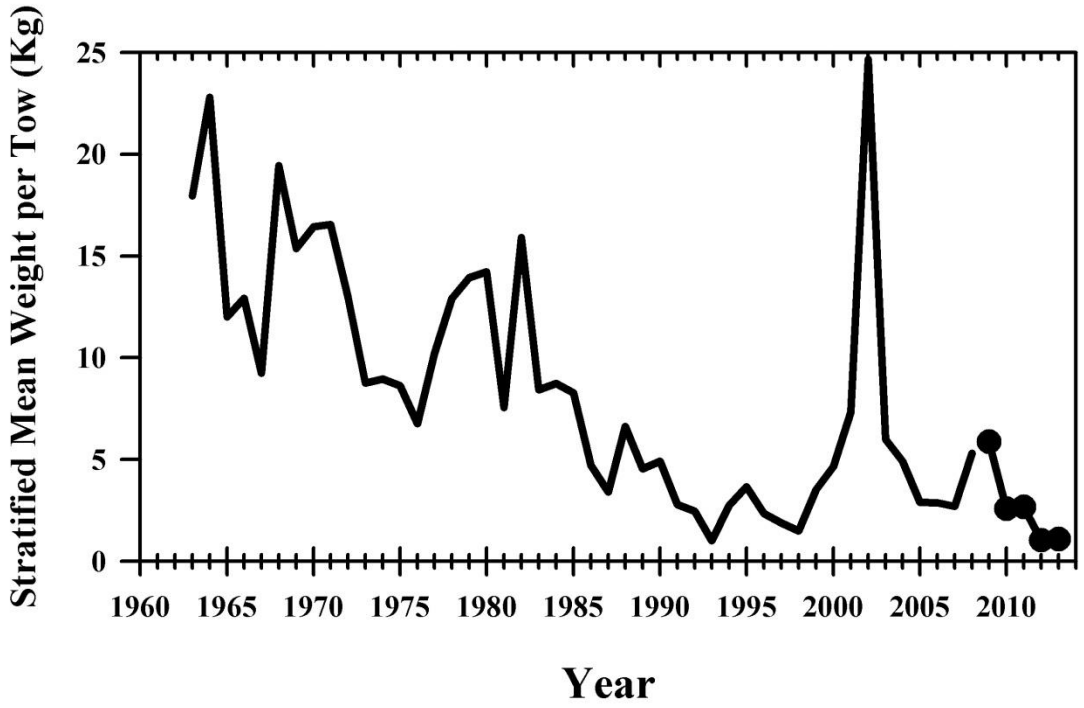

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

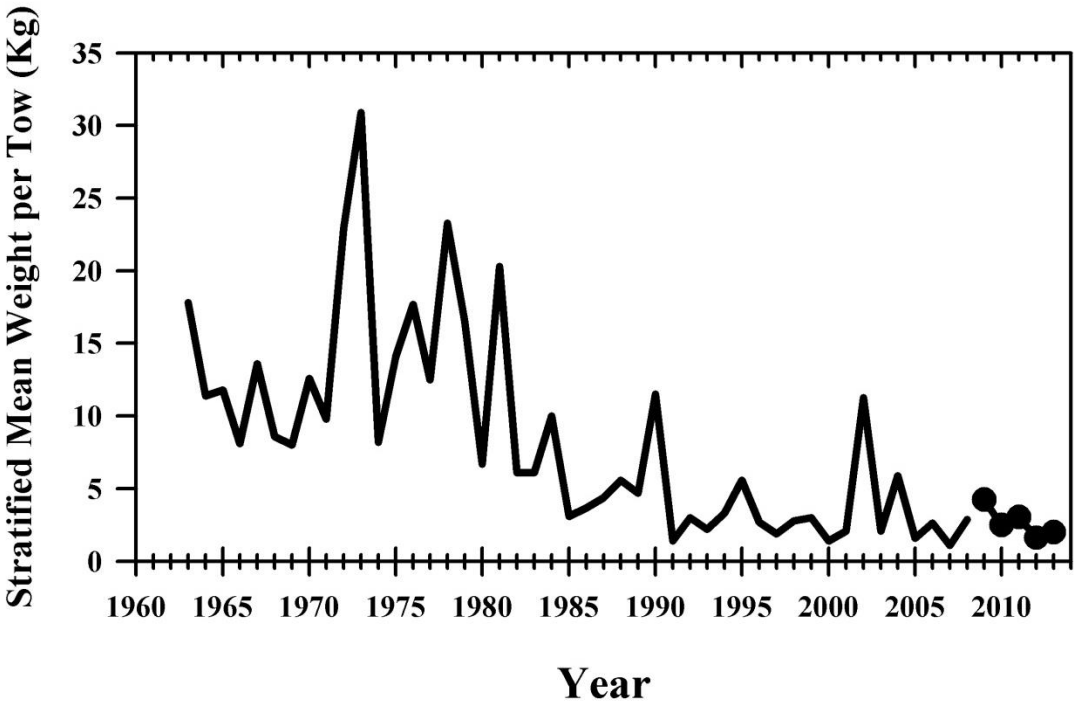

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

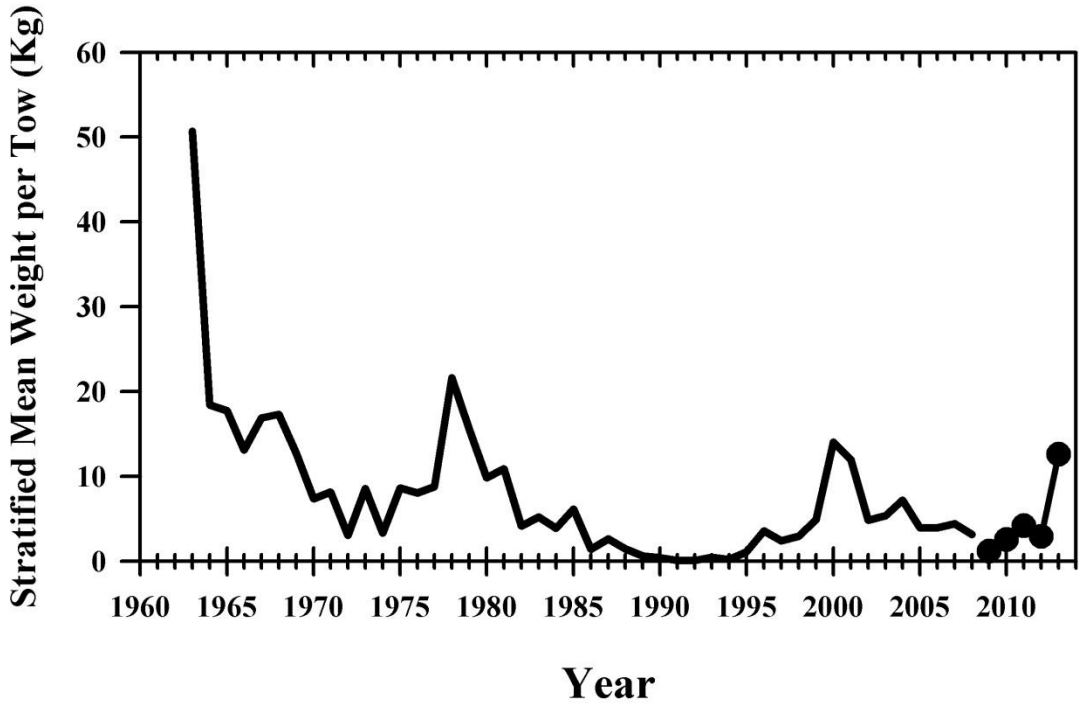

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

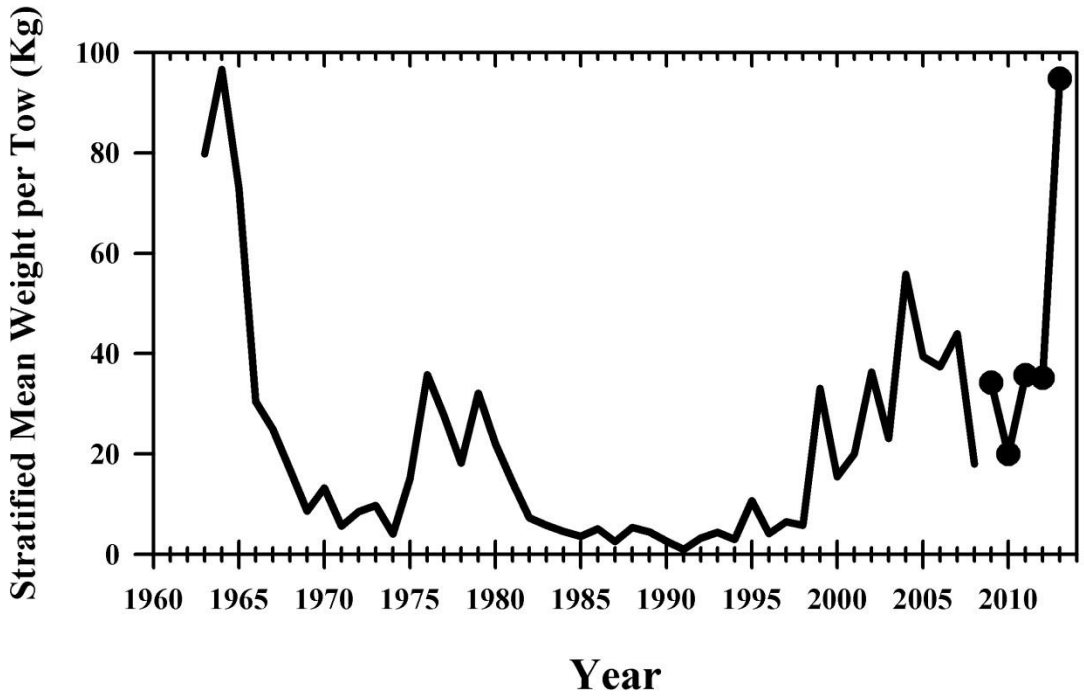

Figure 4. NEFSC autumn bottom trawl survey biomass indices for Georges Bank haddock.

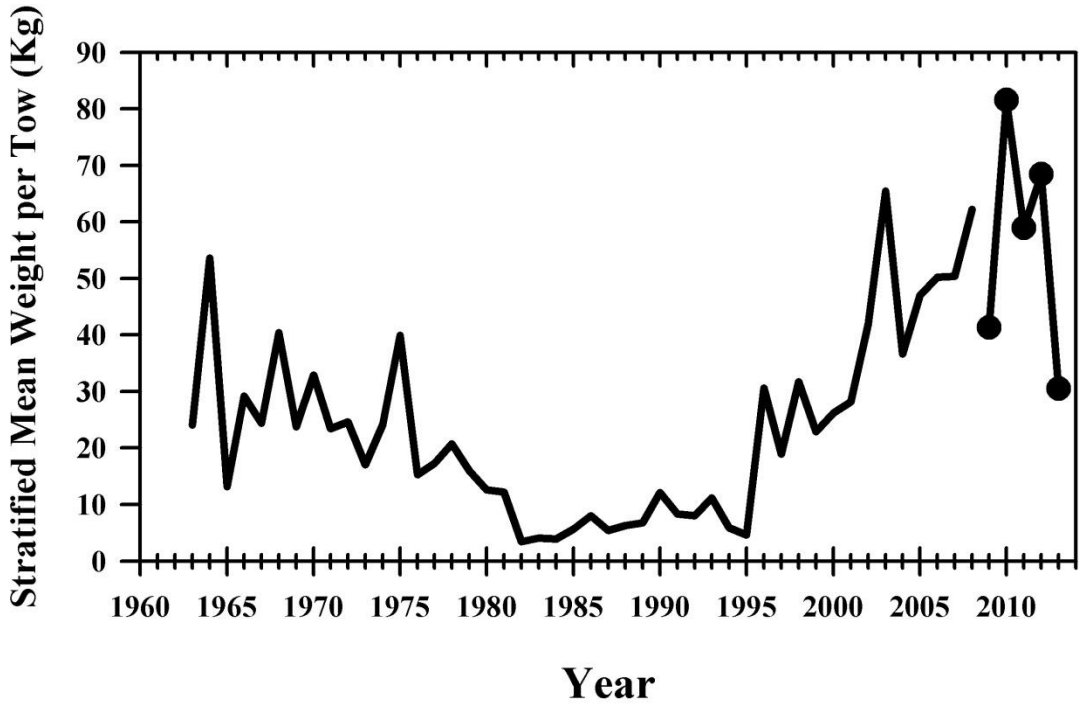

Figure 5. NEFSC autumn bottom trawl survey biomass indices for Acadian redfish.

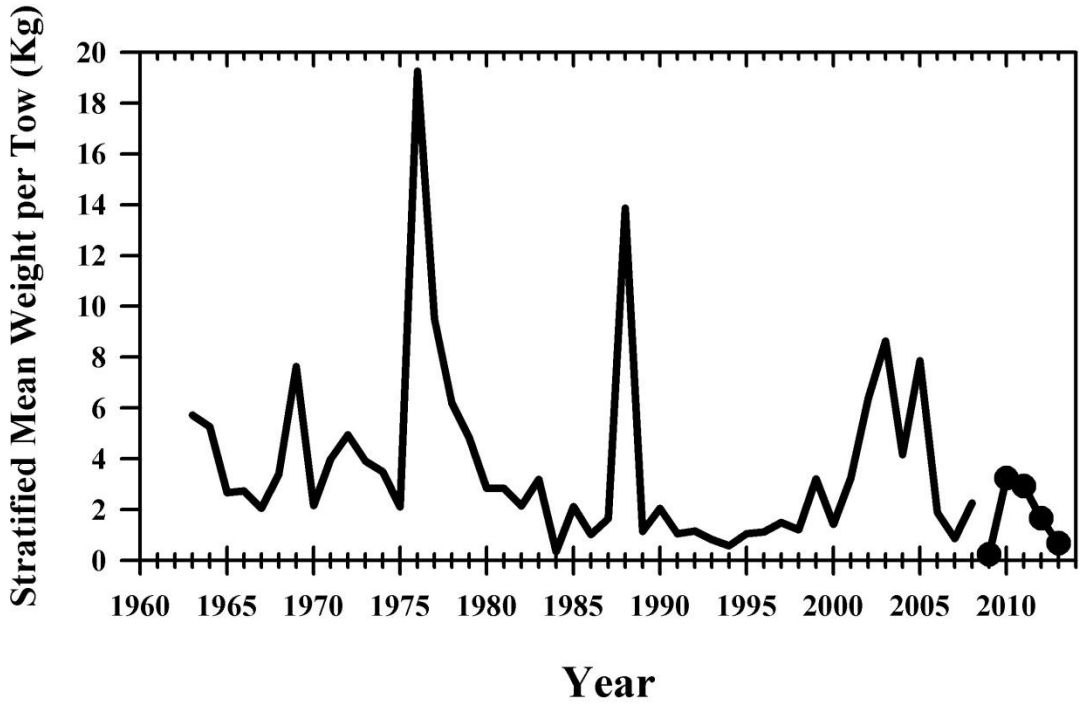

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

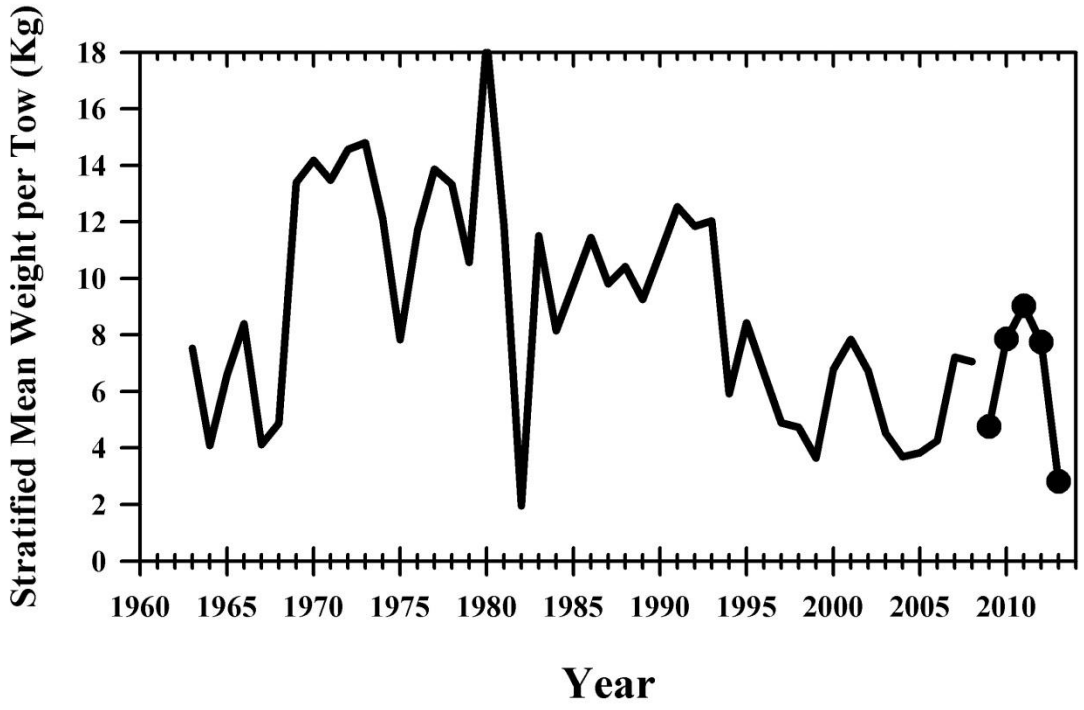

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

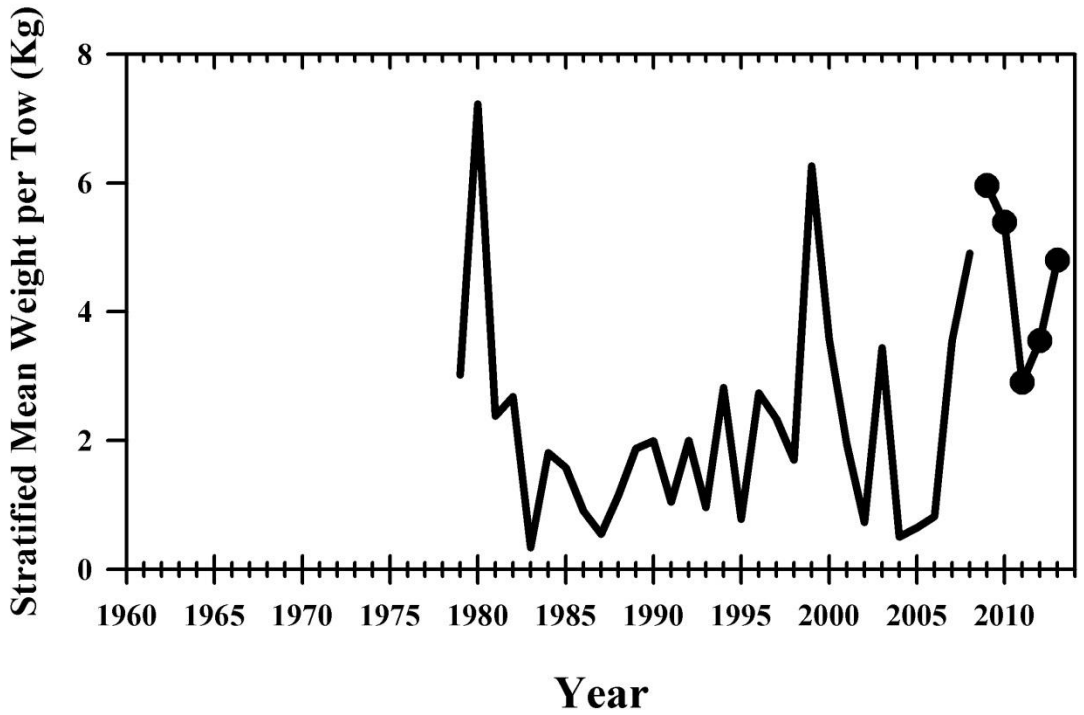

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Cape Cod-Gulf of Maine yellowtail flounder.

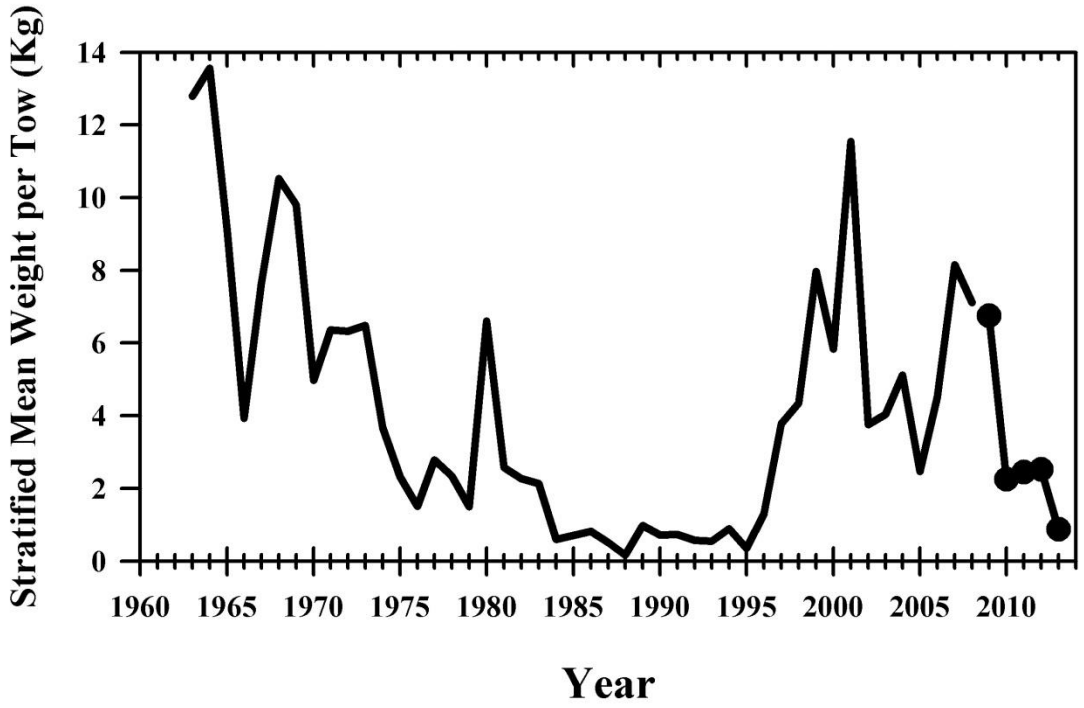

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

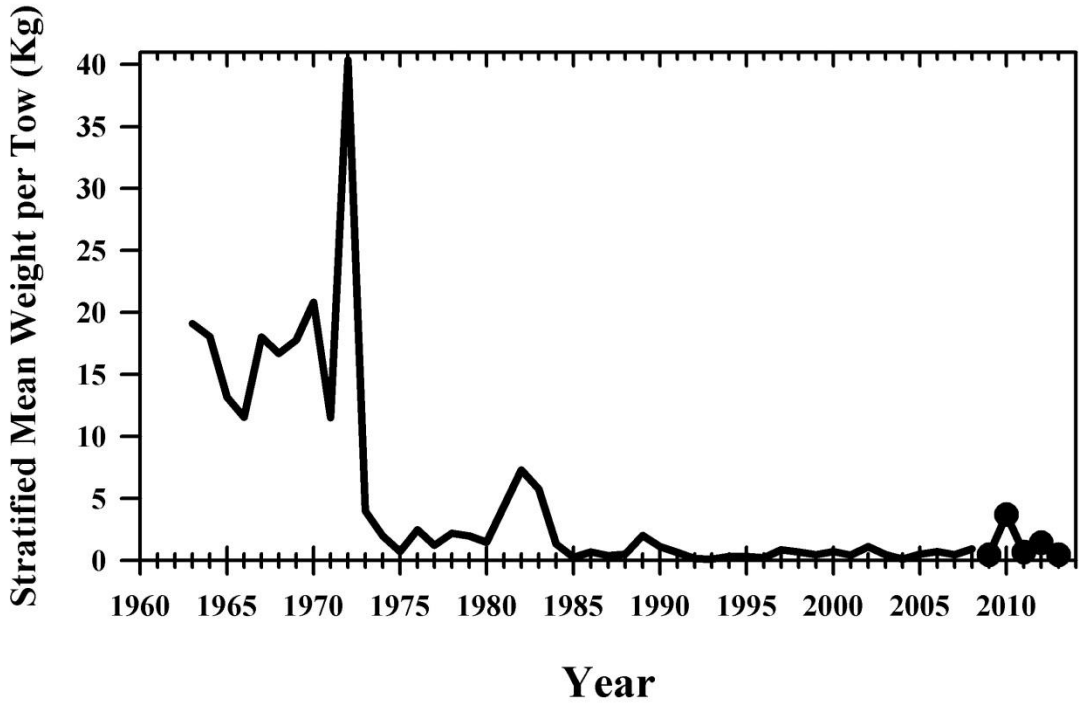

Figure 10. NEFSC autumn bottom trawl survey biomass indices for Southern New England-Mid-Atlantic yellowtail flounder.

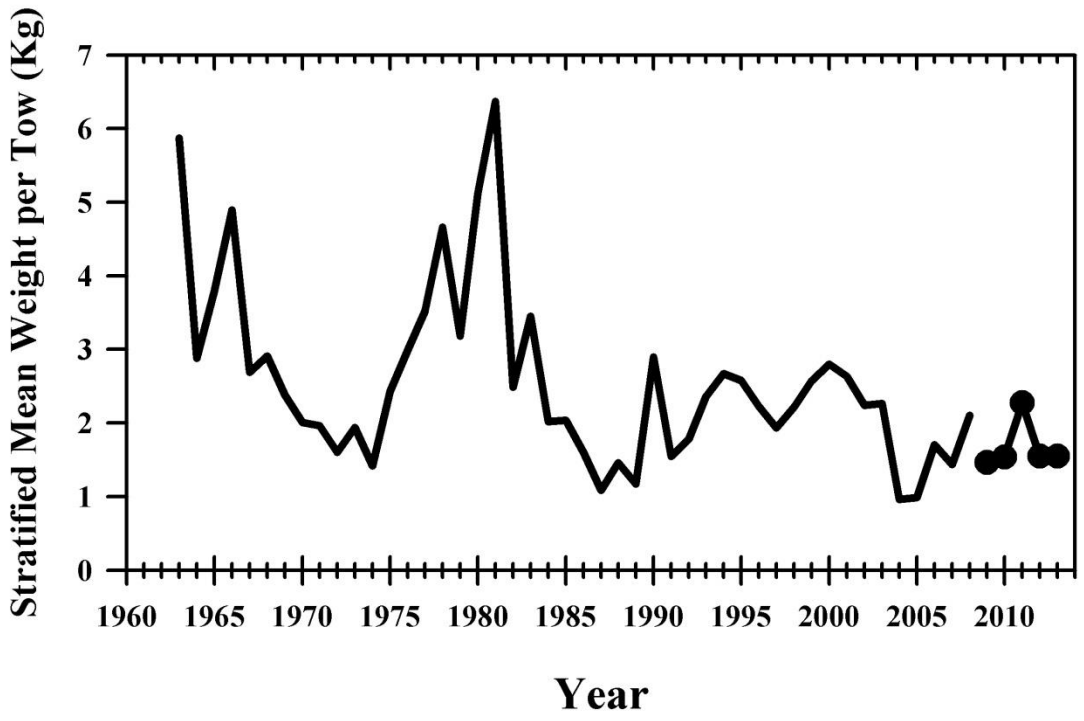

Figure 11. NEFSC autumn bottom trawl survey biomass indices for American plaice.

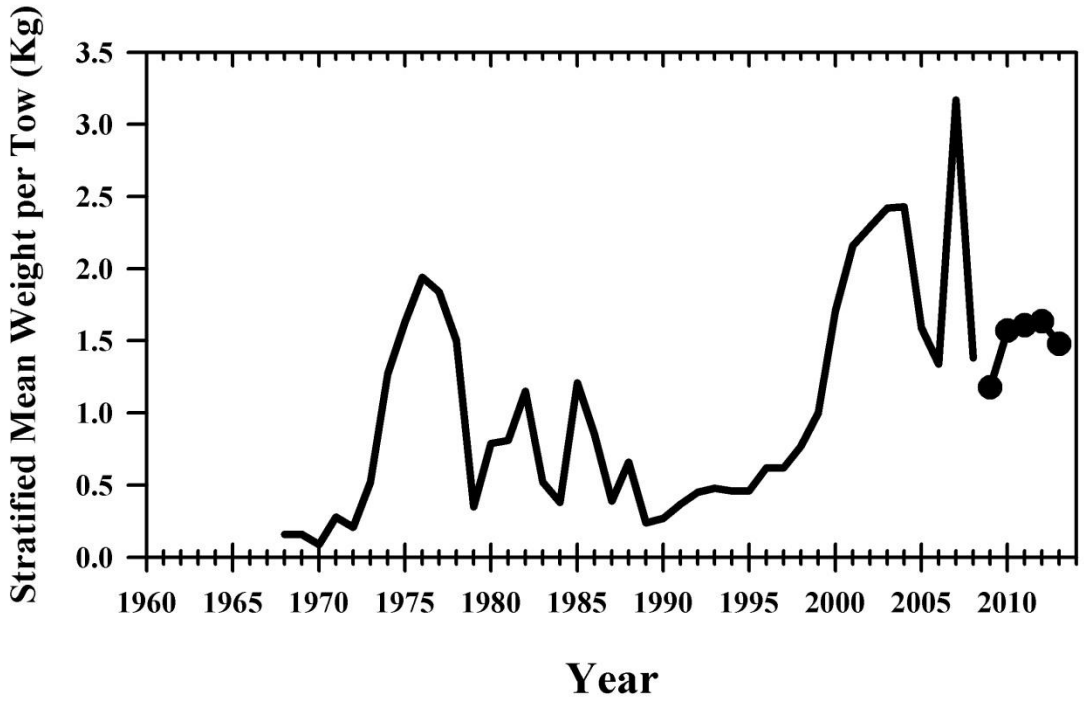

Figure 12. NEFSC spring bottom trawl survey biomass indices for summer flounder.

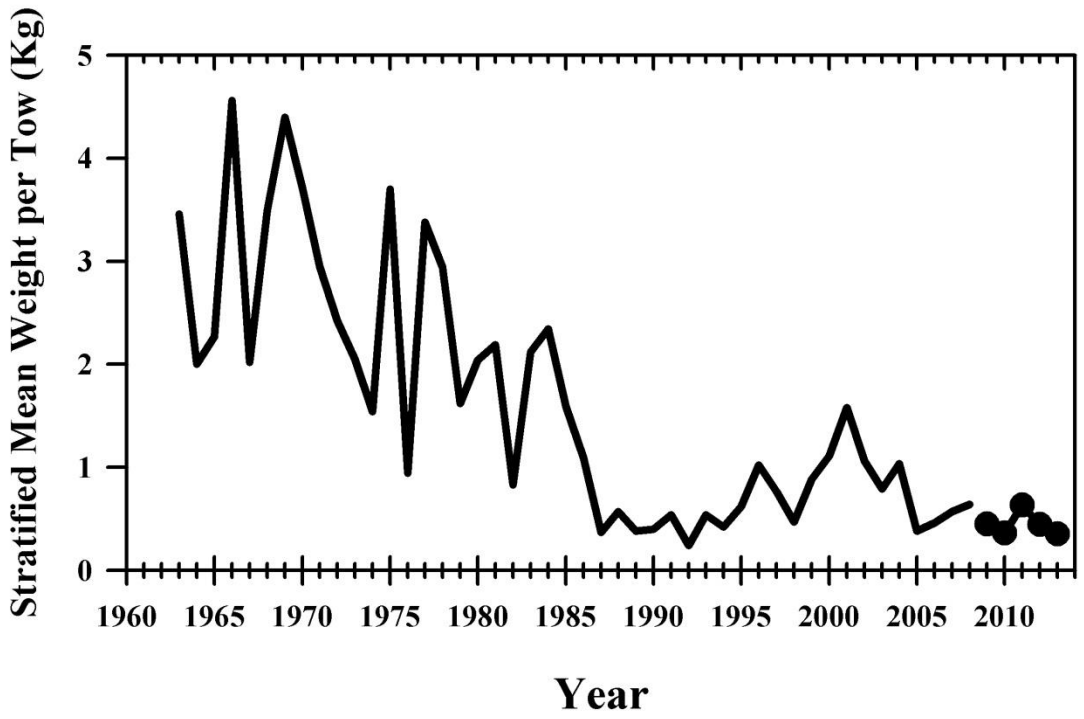

Figure 13. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

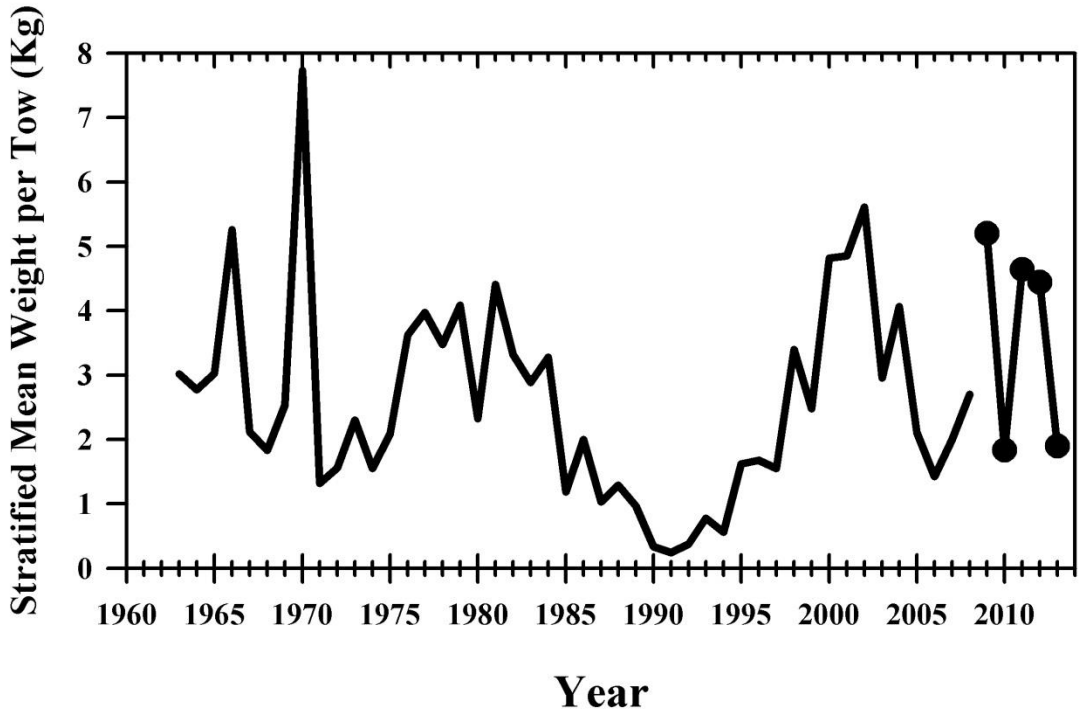

Figure 14. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

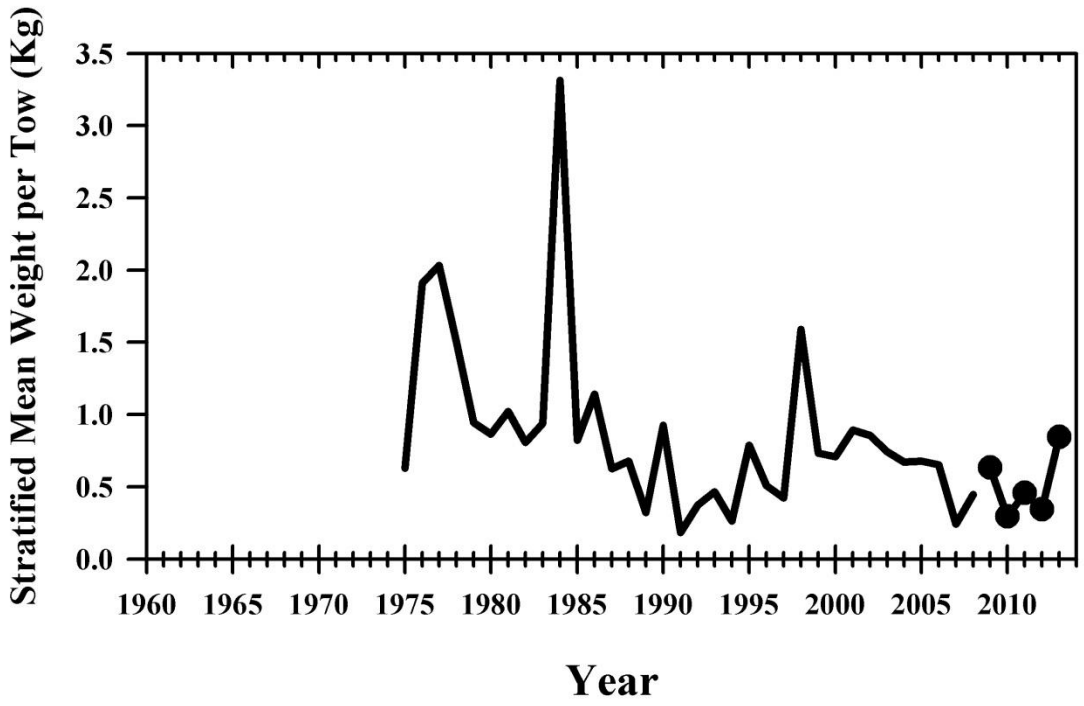

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern windowpane flounder.

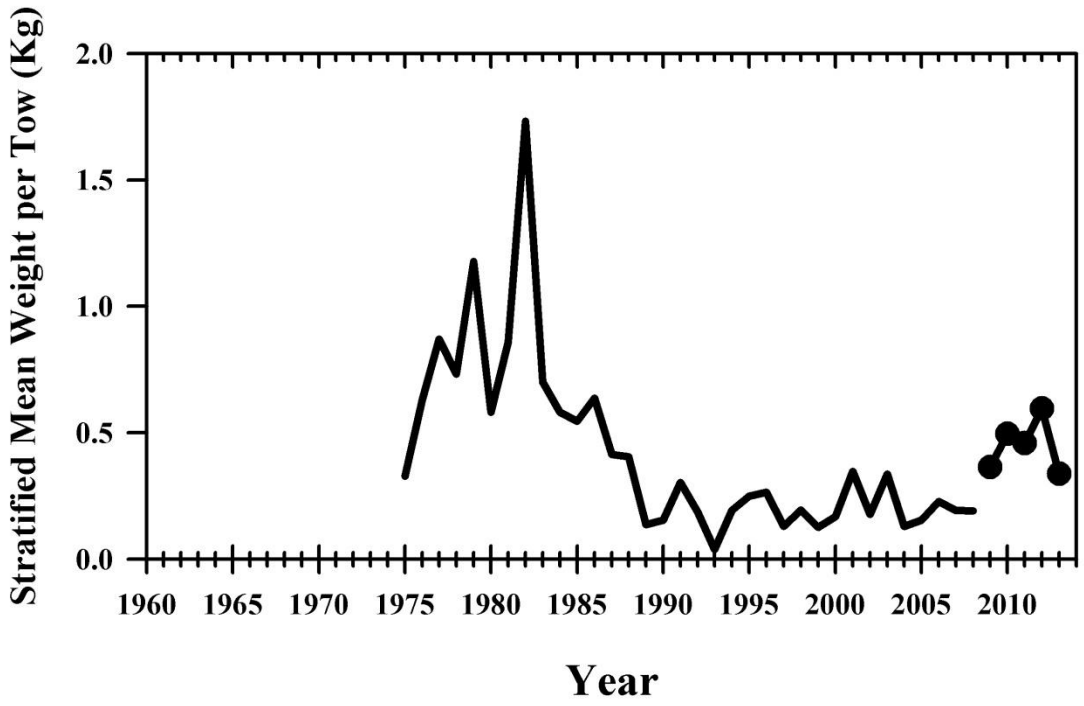

Figure 16. NEFSC autumn bottom trawl survey biomass indices for southern windowpane flounder.

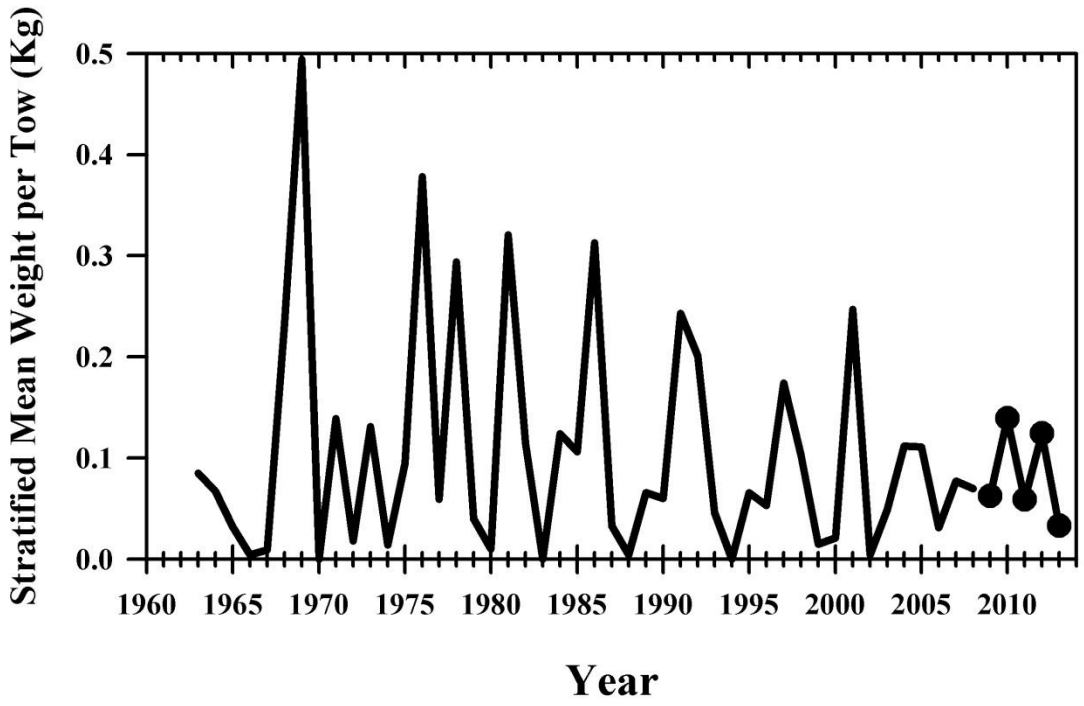

Figure 17. NEFSC autumn bottom trawl survey biomass indices for Atlantic halibut.

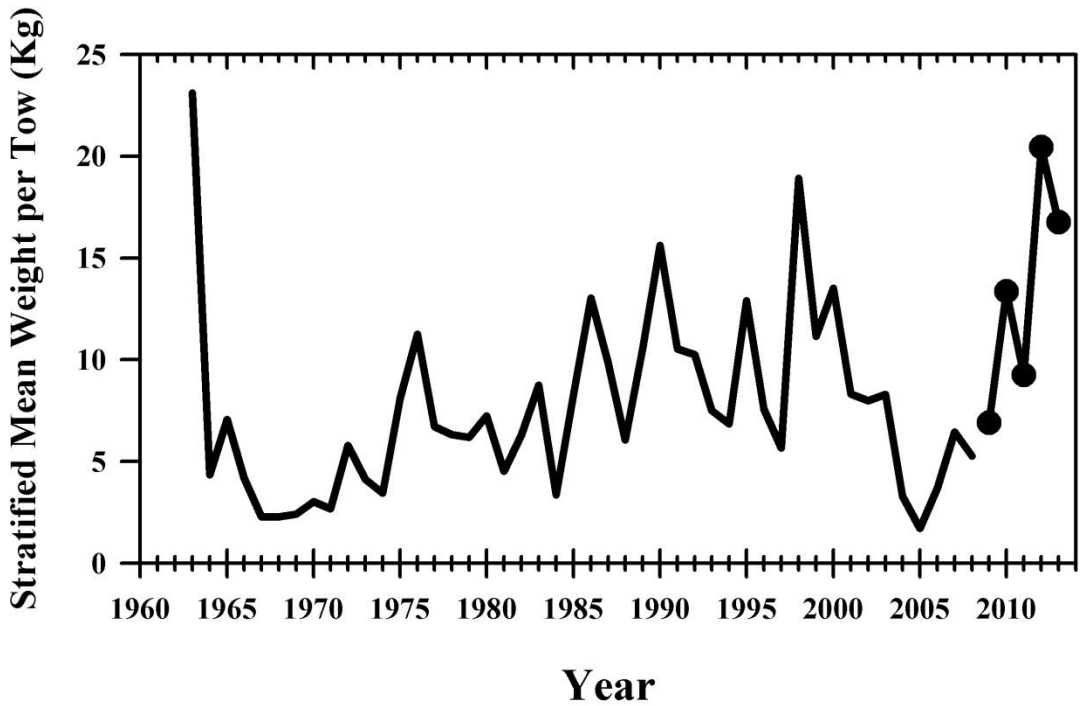

Figure 18. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

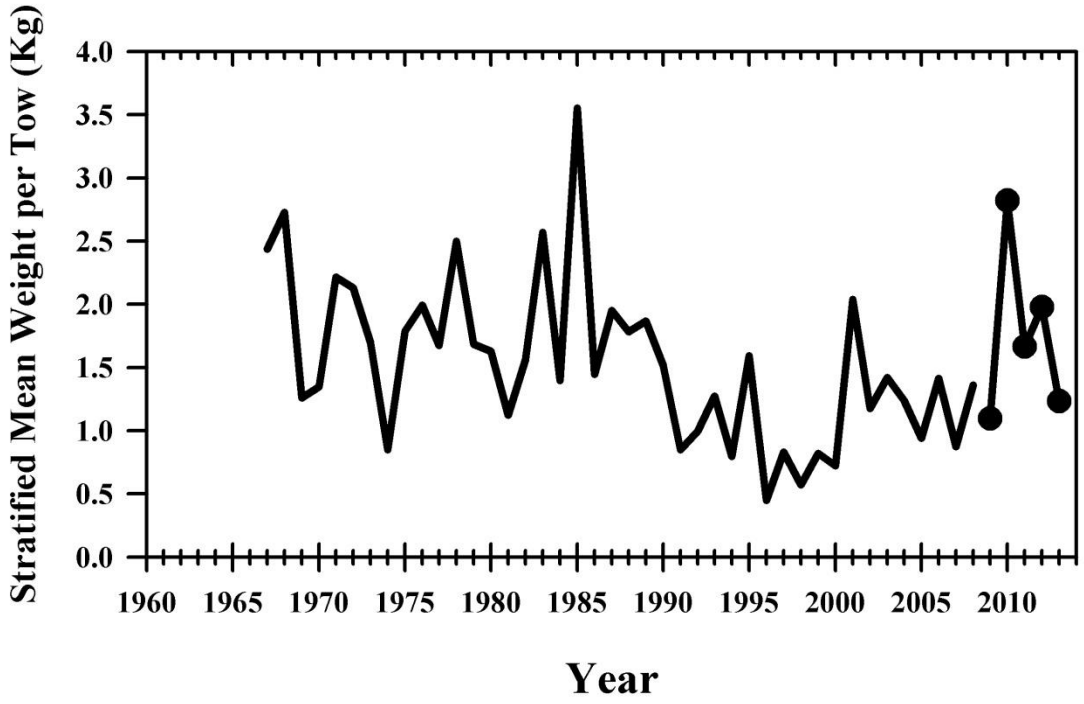

Figure 19. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

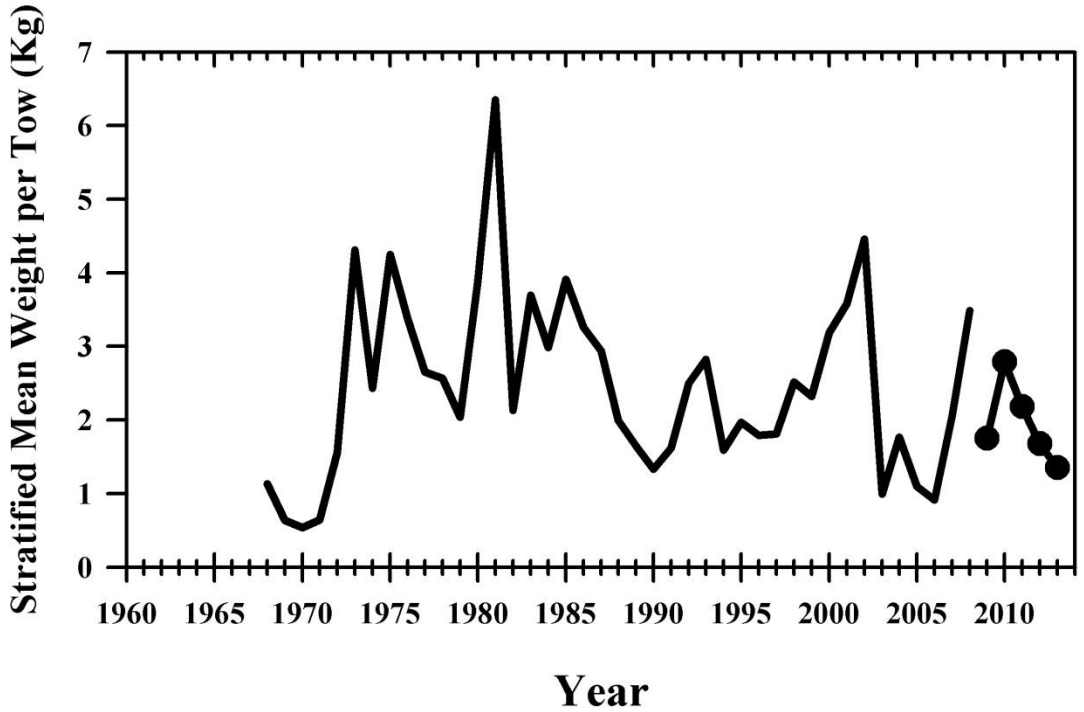

Figure 20. NEFSC spring bottom trawl survey biomass indices for northern red hake.

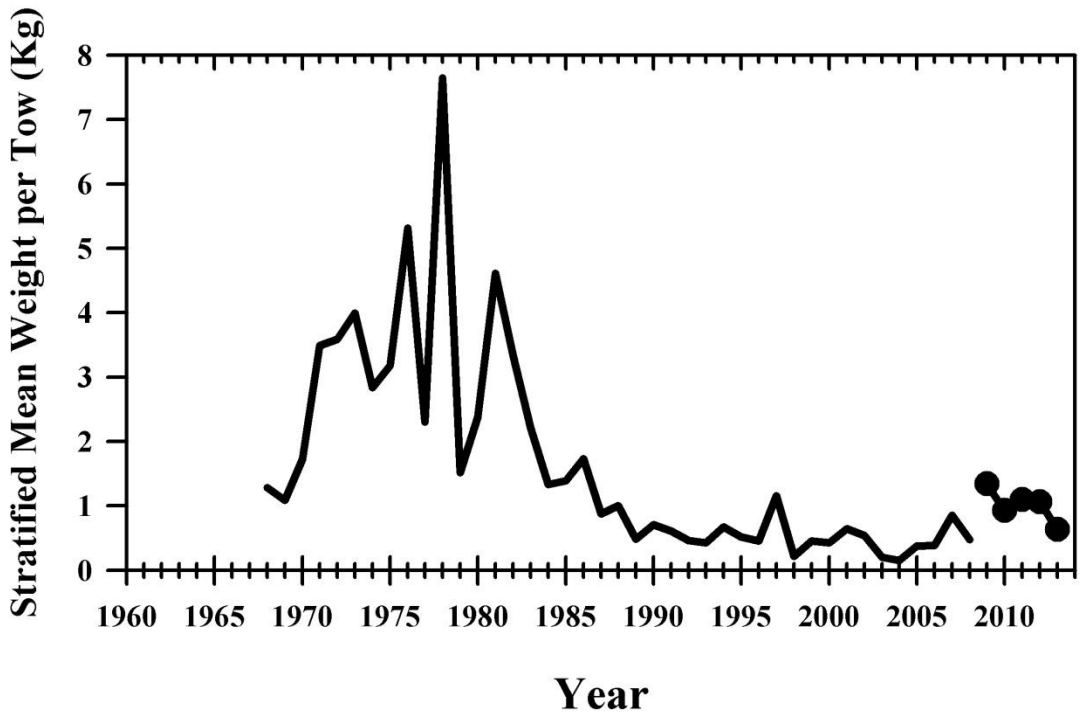

Figure 21. NEFSC spring bottom trawl survey biomass indices for southern red hake.

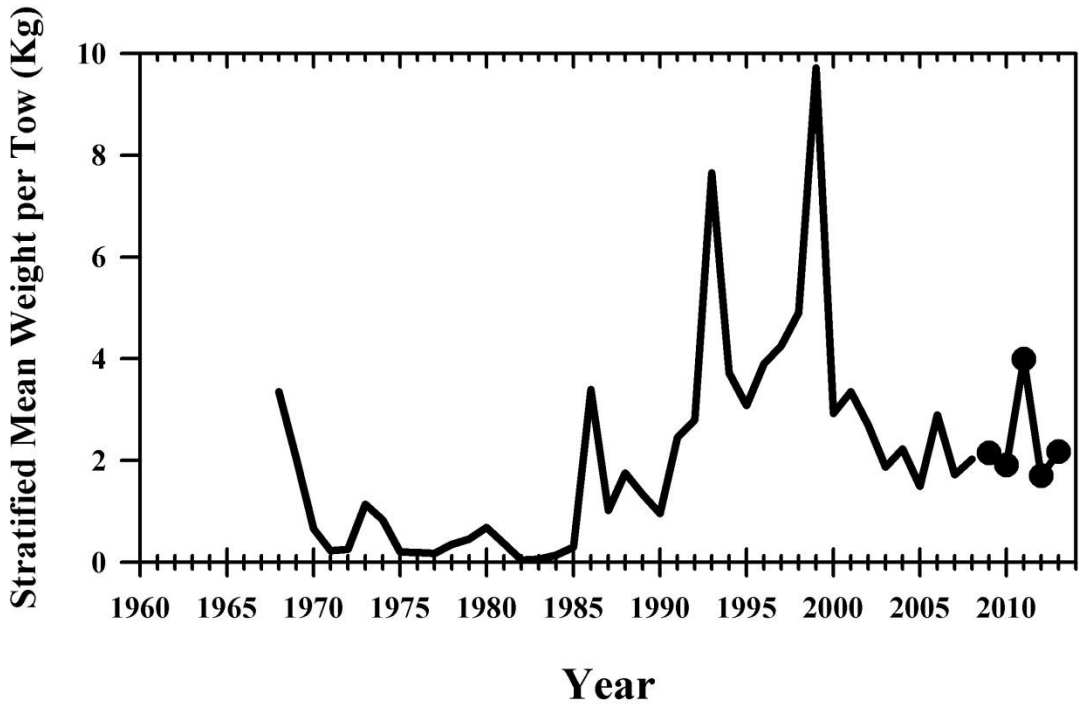

Figure 22. NEFSC spring bottom trawl survey biomass indices for Atlantic herring.

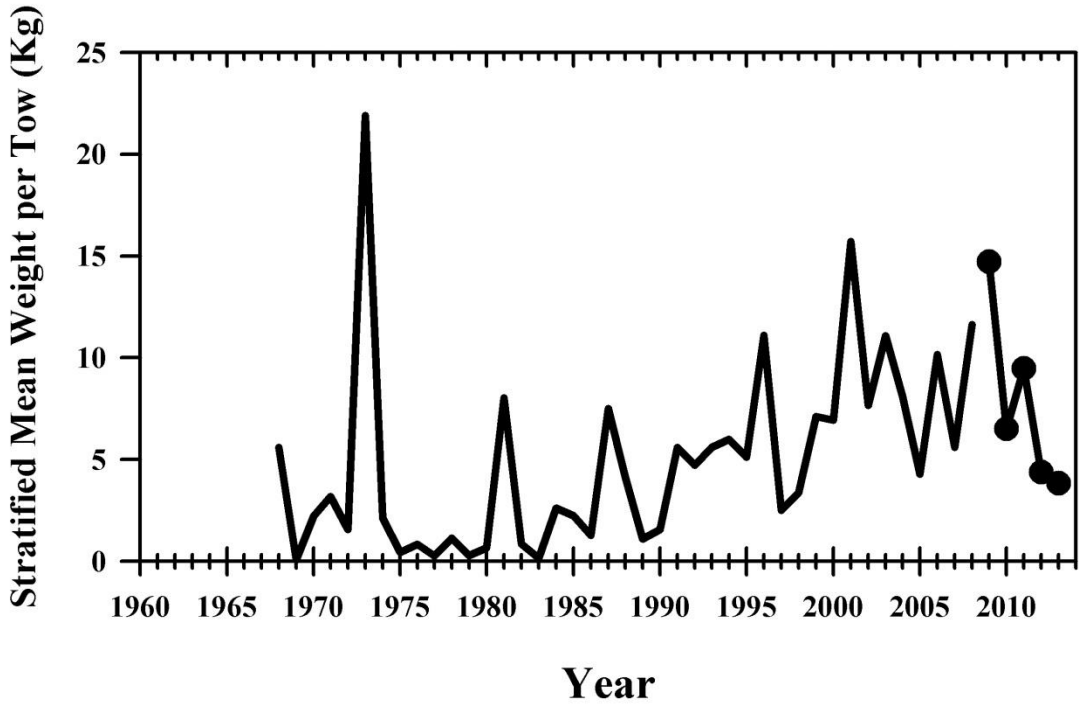

Figure 23. NEFSC spring bottom trawl survey biomass indices for Atlantic mackerel.

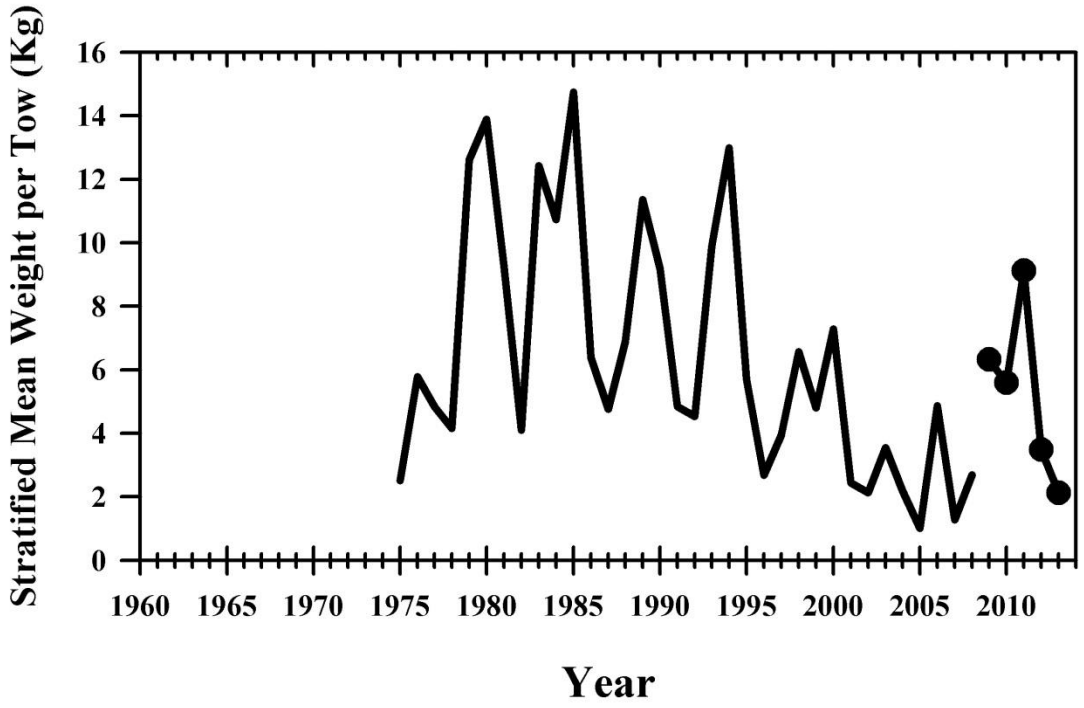

Figure 24. NEFSC autumn bottom trawl survey biomass indices for butterfish.

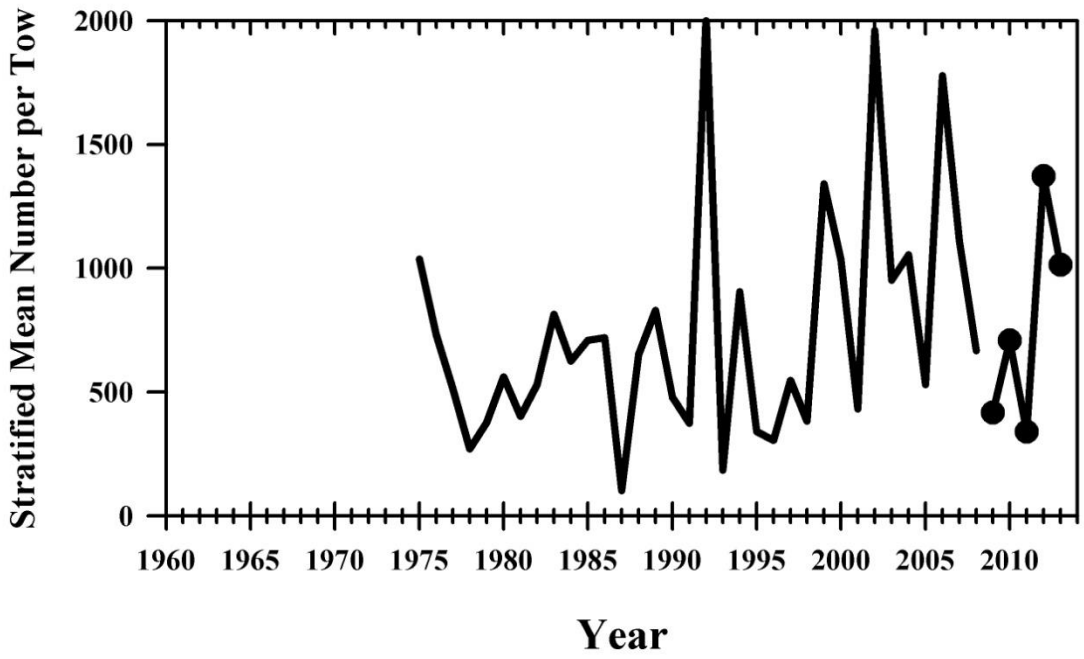

Figure 25. NEFSC autumn bottom trawl survey abundance indices for longfin inshore squid.

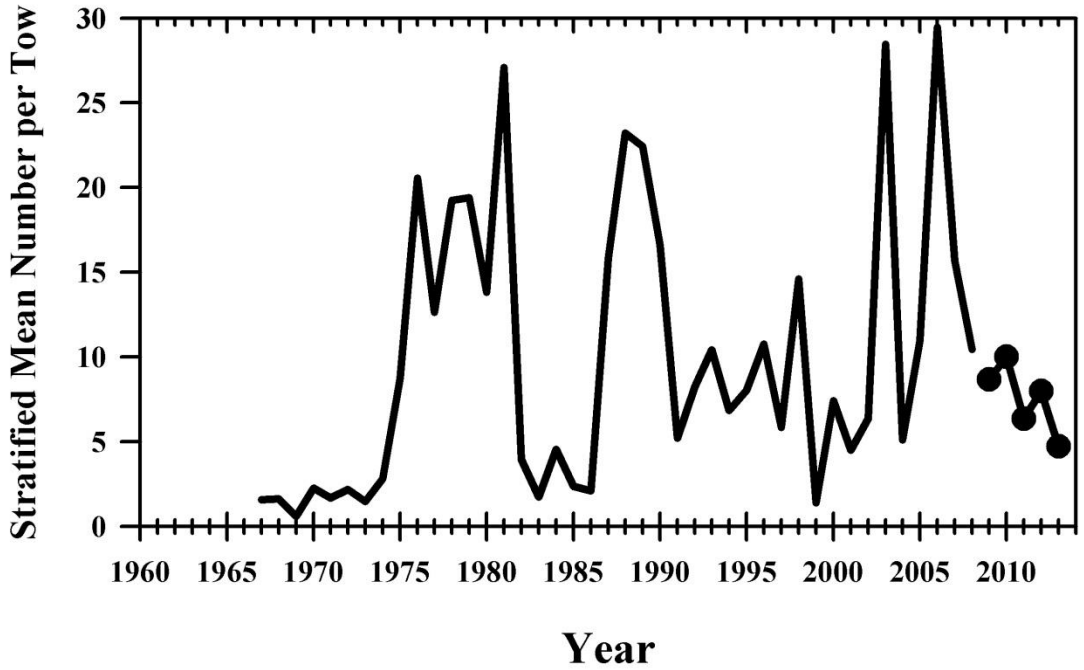

Figure 26. NEFSC autumn bottom trawl survey abundance indices for northern shortfin squid.

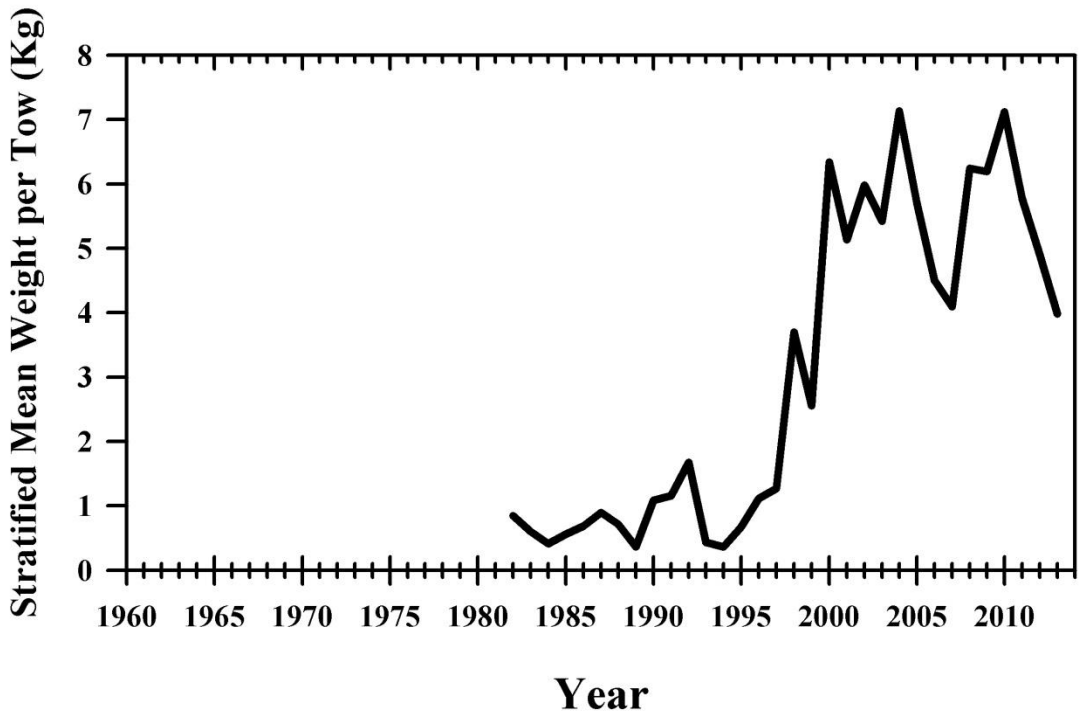

Figure 27. NEFSC scallop survey biomass indices for Georges Bank sea scallops.

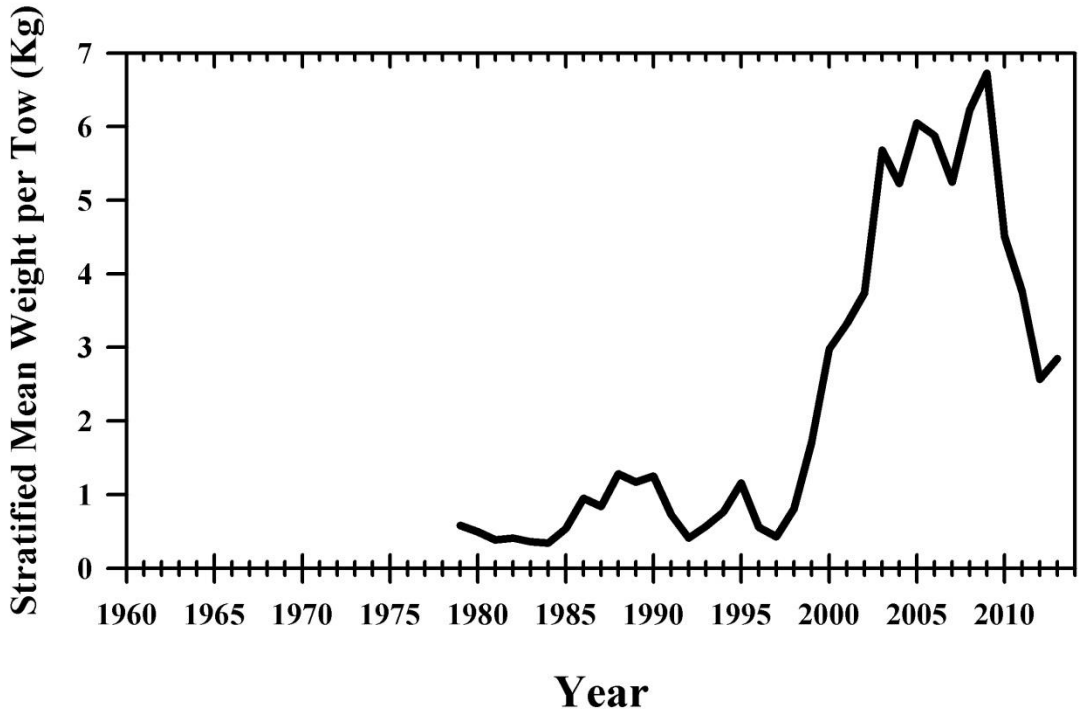

Figure 28. NEFSC scallop survey biomass indices for Mid-Atlantic Bight sea scallops.

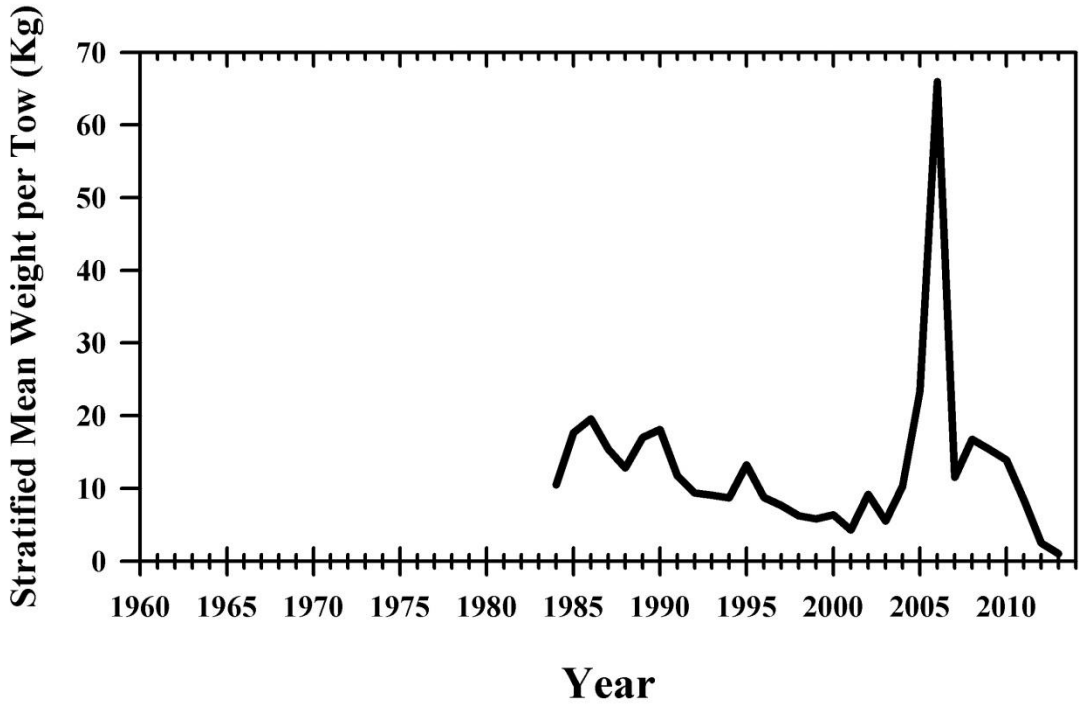

Figure 29. ASMFC summer shrimp survey biomass indices for northern shrimp.

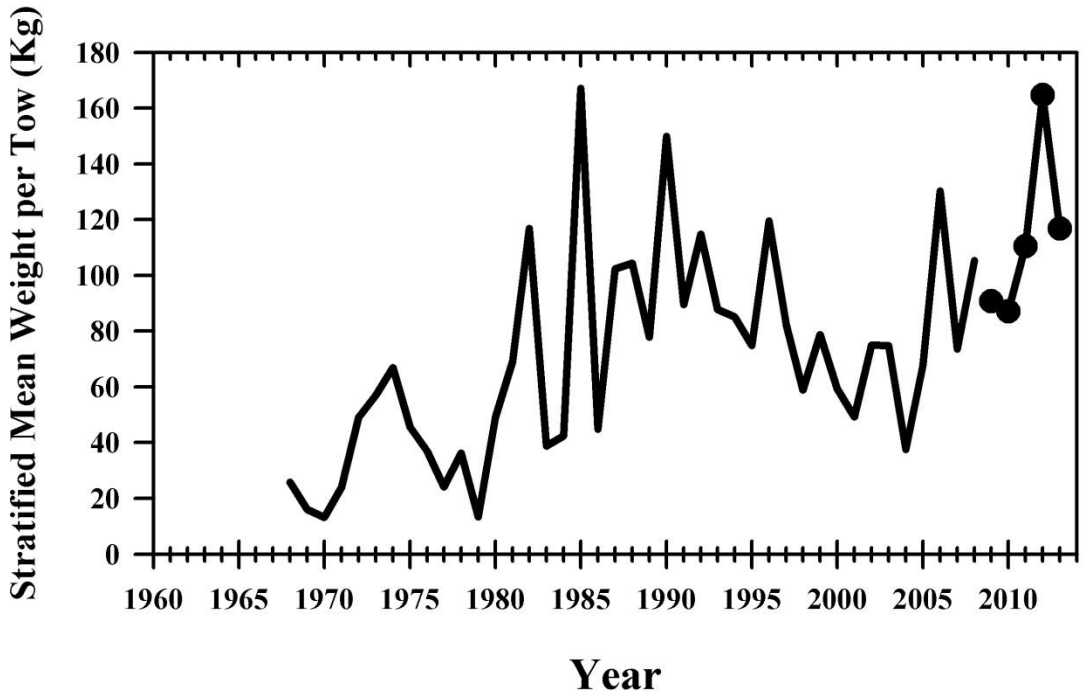

Figure 30. NEFSC spring bottom trawl survey biomass indices for spiny dogfish.

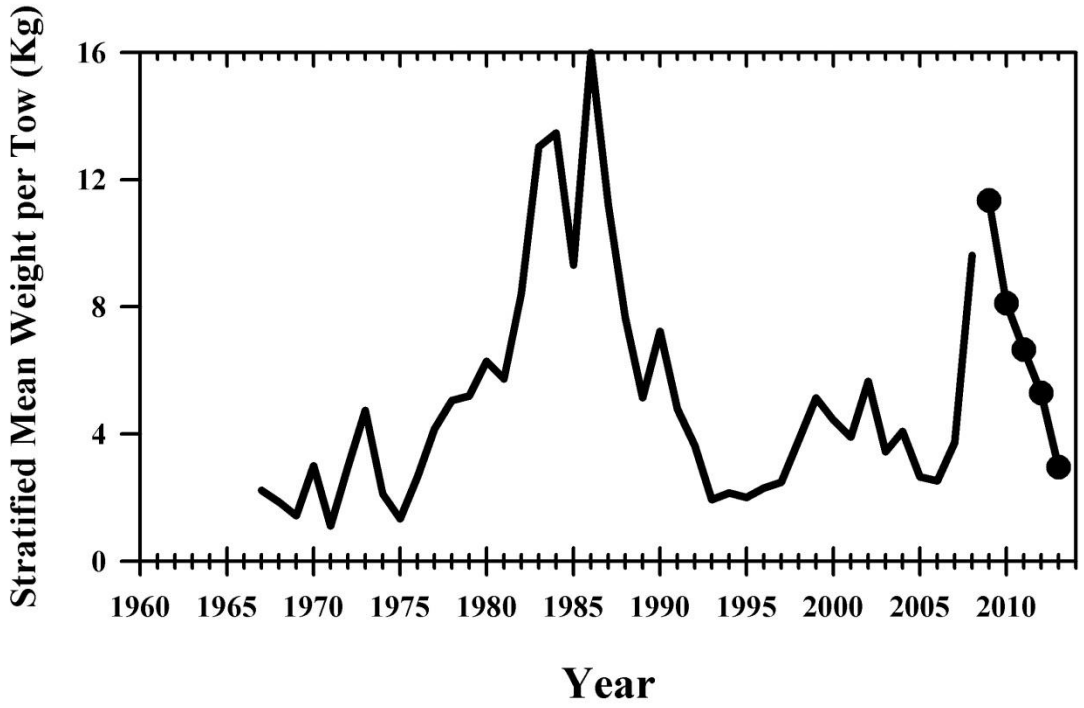

Figure 31. NEFSC autumn bottom trawl survey biomass indices for winter skate.

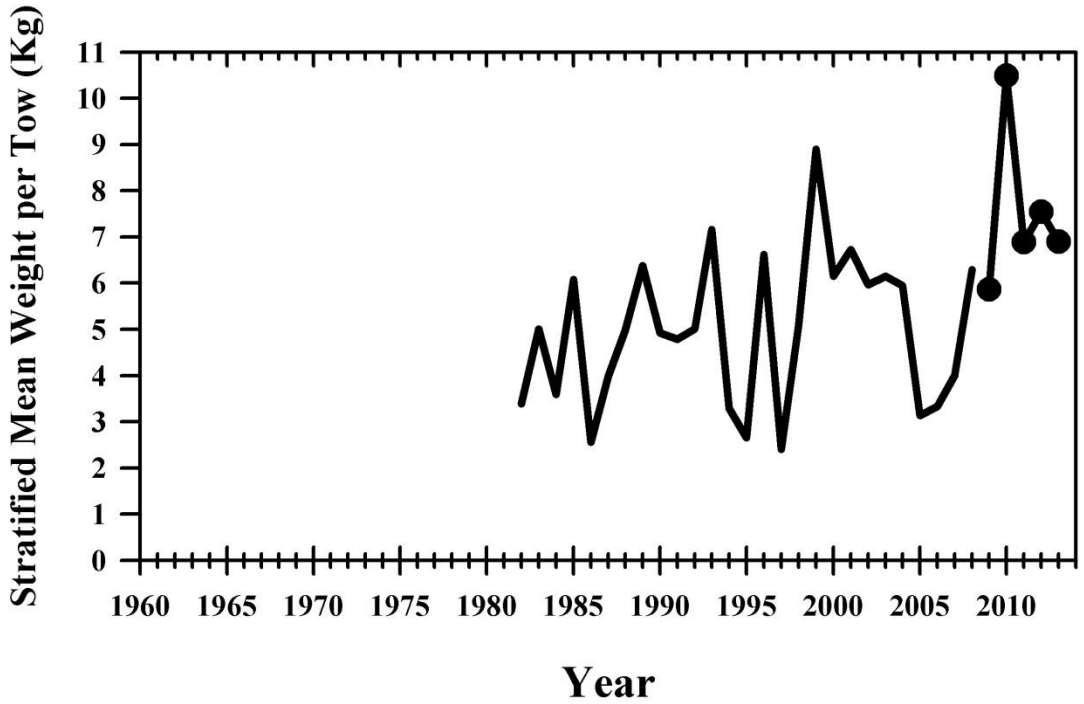

Figure 32. NEFSC spring bottom trawl survey biomass indices for little skate.

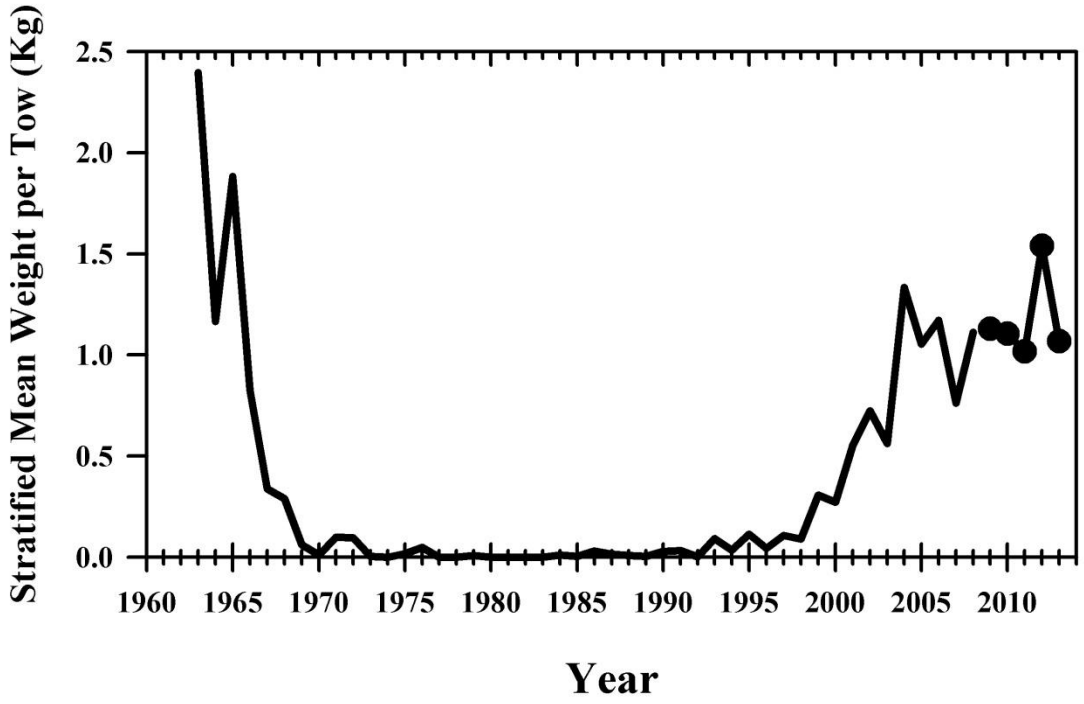

Figure 33. NEFSC autumn bottom trawl survey biomass indices for barndoor skate.

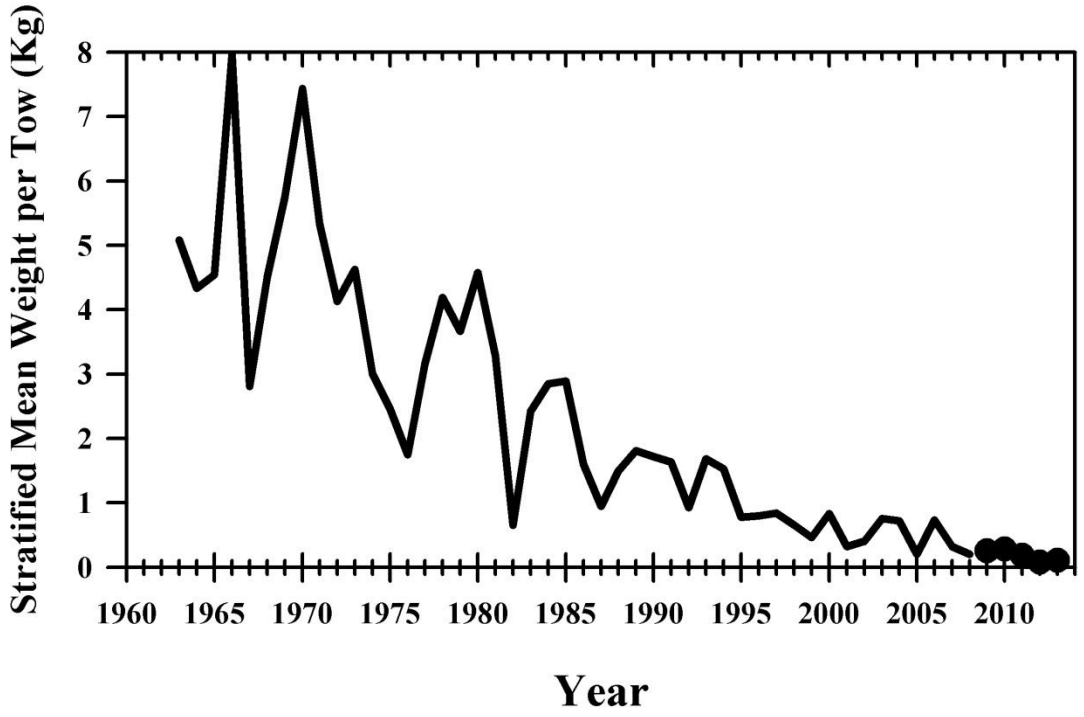

Figure 34. NEFSC autumn bottom trawl survey biomass indices for thorny skate.

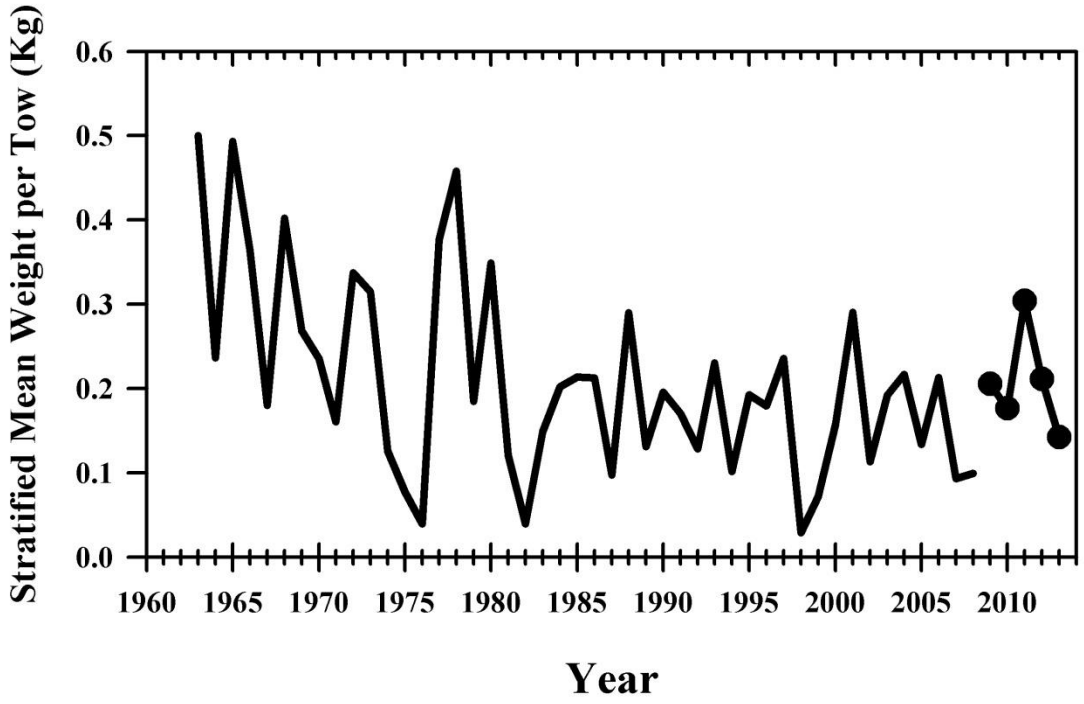

Figure 35. NEFSC autumn bottom trawl survey biomass indices for smooth skate.

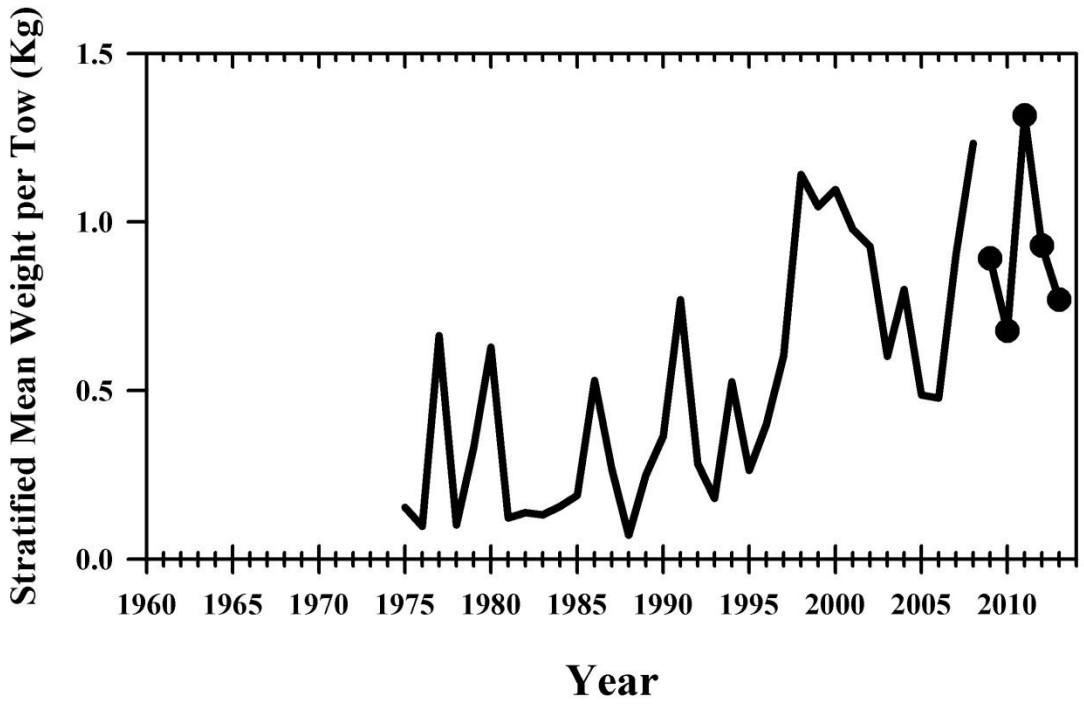

Figure 36. NEFSC autumn bottom trawl survey biomass indices for clearnose skate.

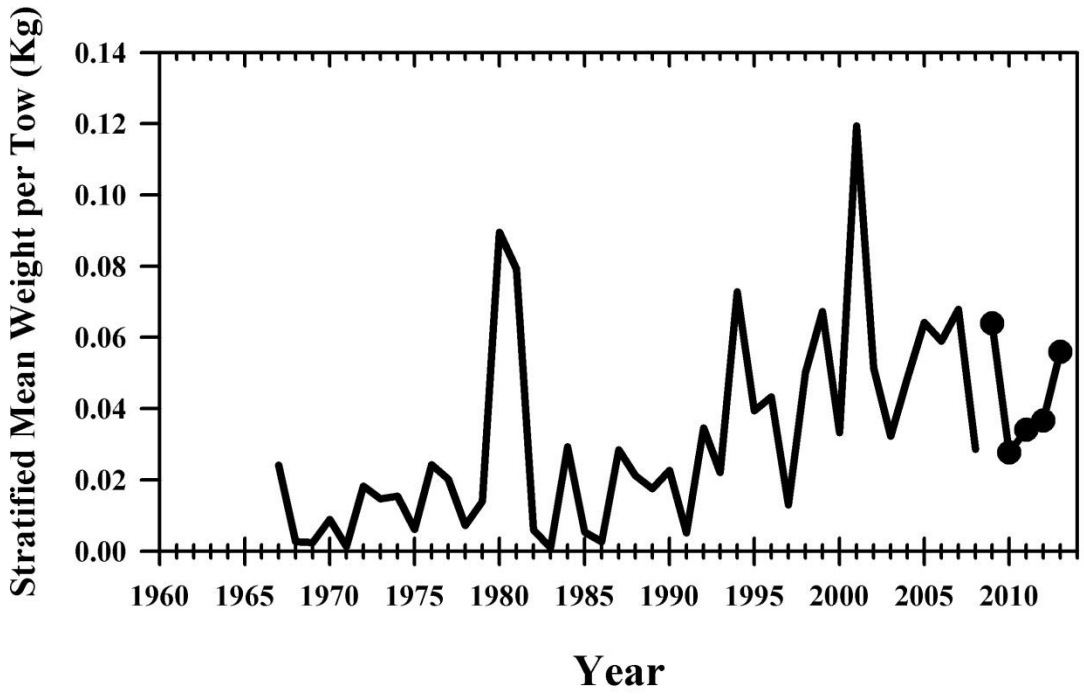

Figure 37. NEFSC autumn bottom trawl survey biomass indices for rosette skate.