Northwest Atlantic Fisheries Organization

Serial No. N6021 **NAFO SCS Doc. 12/07**

SCIENTIFIC COUNCIL MEETING – JUNE 2012

United States Research Report for 2011

by

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

Brief summaries are provided on the status of fisheries for major species of finfish and shellfish. Detailed information on these species and other species found off the northeastern coast of the United States can be found at http://www.nefsc.noaa.gov/sos/.

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

Some spring and autumn survey indices for 2009-2011 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, 2009-2011 survey data points should be interpreted cautiously, and these values may change in the future as new methodologies are considered. The 2009-2011 data points have been plotted separately in the figures presenting spring and fall survey data.

1. Atlantic Cod

USA commercial landings of Atlantic cod (*Gadus morhua*) from Subareas 5&6 in 2011 were 7,985 mt, a 1% decrease from the 2010 landings of 8,044 mt and an 11% decrease from the 2009 landings of 8,952 mt.

USA cod landings from the Gulf of Maine (Div. 5Y) in 2011 were 4,598 mt compared to 5,356 mt in 2010. Northeast Fisheries Science Center (NEFSC) research vessel survey biomass indices in the Gulf of Maine increased from 1993 through 2001. The sharp increase in the autumn 2002 index cannot be explained by the dynamics of the stock, and was largely driven by an extremely large catch at one station. Since 2000, the autumn survey biomass index has remained slightly above the low values of the 1990s (Figure 1).

USA cod landings from Georges Bank (Div. 5Z and SA 6) in 2011 were 3,387 mt compared to 2,688 mt in 2010. The NEFSC research vessel survey biomass indices for the Georges Bank stock have remained low since 1991, with the exception of an increase in the 2002 index that was due primarily to a large catch at one station. The 2011 autumn survey biomass index was below the long term average (Figure 2).

2. Haddock

United States commercial landings of haddock (*Melanogrammus aeglefinus*) decreased 42% from 9,742 mt in 2010 to 5,696 mt in 2011. Landings for Georges Bank (Div. 5Z) haddock decreased from 9,180 mt in 2010 to 5,210 mt in 2011. Gulf of Maine (Div. 5Y) haddock landings decreased from 561 mt in 2010 to 485 mt in 2011.

The autumn research vessel survey biomass indices for the Gulf of Maine stock increased in 2011 to 4.2 kg/tow from 1.3 kg/tow in 2010 (Figure 3). Gulf of Maine stock biomass has declined from a recent high in 2000 as the strong 1998 year class has experienced both natural and fishing mortality. Since 2004 large fluctuations have occurred in the survey index. Mean biomass per tow was 34.2 kg/tow in 2009, declined to 19.9 kg/tow in 2010, and increased to 35.7 kg/tow in 2011 (Figure 4).

3. Redfish

USA landings of Acadian redfish (*Sebastes fasciatus*) increased by 22% from 1,646 mt in 2010 to 2,015 mt in 2011. Fall research vessel survey biomass indices have increased since 1996 (Figure 5), and the 2010 index is the highest on record. The consistently high biomass indices reflect stock rebuilding concurrent with extremely low fishing pressure.

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

USA landings of pollock (*Pollachius virens*) increased from 5,097 mt in 2010 to 6,949 mt in 2011. The autumn research vessel survey indices have reflected a moderate increase in pollock biomass in Subarea 5 from the mid-1990s through 2005 (Figure 6). However, during 2006-2008 the fall biomass indices declined sharply to values last observed in the late 1990s. The biomass index for 2009, 0.22 kg/tow, is the lowest in the time series. The biomass index increased in 2010 to 3.22 kg/tow, and decreased slightly to 2.92 kg/tow in 2011. In addition to strong year classes that affect pollock catchability, a new vessel with new gear and new protocol has been used since 2009. Although pairwise tows were conducted for calibration, there were too few tows that caught pollock to attempt a calibration for this species.

5. White Hake

USA landings of white hake (*Urophycis tenuis*) increased by 60% from 1,808 mt in 2010 to 2,897 mt in 2011. 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*) increased by 39% from 1,313 mt in 2010 to 1,831 mt in 2011. Research survey biomass indices in 2011 suggest that both the Cape Cod-Gulf of Maine (Div. 5Y, N of Georges Bank) and the Southern New England-Mid Atlantic stocks declined in 2011. However, the index for the Georges Bank stock (Div. 5Z, E of 69W) increased from 2.2 kg/tow in 2010 to 2.5 kg/tow in 2011. In the Cape Cod-Gulf of Maine stock, survey biomass indices decreased by 46% from 5.4 kg/tow in 2010 to 2.9 kg/tow in 2011. In the Southern New England-Mid Atlantic stock, the survey biomass index decreased by 83% from 3.7 kg/tow in 2010 to 0.6 g/tow in 2011 (Figures 8-10).

7. Other Flounders

USA commercial landings of flounders (other than yellowtail flounder and Atlantic halibut) from Subareas 3-6 in 2011 totaled 11,900 mt, 23% higher than in 2010. Summer flounder (*Paralichthys dentatus*) (63%), winter flounder (*Pseudopleuronectes americanus)* (18% comprising the Georges Bank, Southern New England and Gulf of Maine stocks), American plaice (*Hippoglossoides platessoides*) (12%), witch flounder (*Glyptocephalus cynoglossus*) (7%), and windowpane flounder (*Scophthalmus aquosus*) (<1% comprising the Northern and Southern stocks) accounted for virtually all of the 'other flounder' landings in 2011. Compared to 2010, commercial landings in 2011 were higher for winter flounder (36%), summer flounder (27%) and witch flounder (15%) but lower for American plaice (-2%) and windowpane flounder (-41%). Research vessel survey indices in 2011 increased for all species (Figures 11-15).

8. Atlantic halibut

USA landings of Atlantic halibut (*Hippoglossus hippoglossus*) in the Gulf of Maine-Georges Bank region increased slightly from 20 mt in 2010 to 21 mt in 2011. Research vessel survey indices have little trend

and high interannual variability due to the low capture rate of Atlantic halibut. In some years, no Atlantic halibut are caught indicating that abundance is close to the detectability level of the survey. Indices for 2009 – 2011 were converted from *H.B. Bigelow* units to *Albatross IV* units using the mean calibration coefficient of other flounders.

9. Silver hake

USA landings of silver hake (*Merluccius bilinearis*) decreased by 4% from 8,079 mt in 2010 to 7,761 mt in 2011. 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. Subsequently the indices have increased, and in 2010 the index was 13.4 kg/tow, the highest value since the mid-1990s. Survey biomass indices for the Southern Georges Bank - Mid-Atlantic stock have increased since 2007, with the 2010 survey biomass index (2.8 kg/tow) the highest since the early 1980s (Figure 17-18). However, survey indices for both stocks declined in 2011.

10. Red Hake

USA landings of red hake (*Urophycis chuss*) remained stable at 595 mt in 2011 from 603 mt in 2010. Total landings have been low since 1980. USA landings from the Gulf of Maine - Northern Georges Bank stock of red hake increased 94% from 51 mt in 2010 to 99 mt in 2011. Landings from the Southern Georges Bank - Mid-Atlantic stock decreased 10% from 553 mt in 2010 to 495 mt in 2011. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock increased after the early 1970s, markedly declined in 2002-2003, and have since stabilized (Figure 19). Indices for the Southern Georges Bank - Mid-Atlantic stock declined in the 1980s, remained low through 2006 (Figure 20), but have since increased.

11. Atlantic Herring

Total USA landings of Atlantic herring (*Clupea harengus*) increased 18% from 68,428 mt in 2010 to 81,103 mt in 2011. Spring survey indices were relatively stable during 2004-2011 and averaged 2.30 kg/tow (Figure 21). The 2011 spring survey index was 3.98 kg/tow. Spawning biomass increased from 1982 to 1997 and has remained stable since 1998. Recent assessments, however, have been plagued by a strong retrospective pattern.

12. Atlantic Mackerel

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) decreased 95% from 9,877 mt in 2010 to 533 mt in 2011. Recreational catches increased 23% from 758 mt in 2010 to 931 mt in 2011. Spring survey indices increased during the 1990s and averaged 9.5 kg/tow during 2001-2010 (Figure 22). The spring survey index increased from 6.5 kg/tow in 2010 to 9.5 kg/tow in 2011. Results of an assessment of Atlantic mackerel were reviewed in 2010 by the Transboundary (US and Canada) Resources Assessment Committee (TRAC). The TRAC concluded that the abundance estimates were too uncertain for management purposes but that relative trends in F and SSB were informative.

13. Butterfish

USA landings of butterfish (*Peprilus triacanthus*) increased 15% from 575 mt in 2010 to 662 mt in 2011. 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, but an increasing trend is evident since 2007 (Figure 23).

14. Squids

USA landings of longfin inshore squid, *Doryteuthis (Amerigo) pealeii*, declined from 16,987 mt in 2005 to 6,750 mt in 2010 and then increased to 9,556 mt in 2011. Autumn survey abundance indices, derived using

only daytime tows, have generally declined from a near-record high of 1,778 squid/tow in 2006 to 338 squid/tow in 2011 (Figure 24).

USA landings of northern shortfin squid (*Illex illecebrosus*) in 2011 (18,000 mt) were the highest since 2004. Autumn survey abundance indices attained a record-high in 2006 (29.5 squid/tow), but declined to 7.3 squid/tow in 2011 (Figure 25).

15. Atlantic Sea Scallops

USA Atlantic sea scallop (*Placopecten magellanicus*) landings in 2011 were 26,653 mt (meats), slightly more than 2010, and more than double the long-term (1957-2009) mean. The ex-vessel value of the landings exceeded $580 million (a record-high) and represented an increase of almost $130 million from 2010. Most of the increased revenue was due to increases in price. About 31% of the 2011(?) landings were from Georges Bank, and 66% from the Mid Atlantic Bight; the remainder was taken in Southern New England and the Gulf of Maine. Since 2000, most of the annual landings have come from the Mid-Atlantic region, except in 2006. By contrast, during 1957-1999, most USA sea scallop landings were harvested from Georges Bank.

Stratified mean research vessel survey biomass indices decreased in 2011 in both the Georges Bank and Mid-Atlantic regions. However, these indices remained high by historical standards (Figures 26 and 27). Recruitment is about its median level on Georges Bank but well below average in the Mid-Atlantic.

16. Northern Shrimp

USA commercial landings of northern shrimp (*Pandalus borealis*) from Subarea 5 in 2011 were 5,944 mt, 300 mt lower than in 2010 but 42% higher than the 2006-2010 annual average of 4,184 mt. The highest annual landings of northern shrimp were 12,824 mt in 1969.

The joint state-federal summer research vessel (R/V *Gloria Michelle*) survey biomass indices declined during 1985 through 2004. 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 subsequently have fluctuated around a lower level during 2007-2011 (mean 13.2 kg/tow), and the 2011 index (8.5 kg/tow) is below the 1984-2005 average (Figure 28).

17. Small Elasmobranchs

USA landings of spiny dogfish (*Squalus acanthias*) increased 74% from 5,440 mt in 2010 to 9,480 mt in 2011. 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 29).

USA landings of skates (most species still landed as unclassified) declined 9% between 2010 and 2011 from 17,799 mt to 16,273 mt. The landings are sold as wings for human consumption and as bait for the lobster fishery. Survey biomass indices for winter skate (*Leucoraja ocellata*) peaked in the mid-1980s (Figure 30) 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, but have increased in recent years. Little skate (*Leucoraja erinacea*) survey indices have generally fluctuated without trend (Figure 31). Survey indices for barndoor skate (*Dipturus laevis*) declined precipitously in the mid-1960s, remained very low through the late-1980s, and subsequently increased to levels observed in the mid-1960s (Figure 32). Thorny skate (*Amblyraja radiata*) survey indices have declined over the entire time series and are currently at record lows (Figure 33). Survey indices for smooth skate (*Malacoraja senta*) are highly variable, but have been generally stable for the last 20 years (Figure 34). Indices for both clearnose skate (*Raja eglanteria*) and rosette skate (*Leucoraja garmani*) generally increased over the time series (Figures 35 and 36). 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 1,839 CTD (conductivity, temperature, depth) profiles were collected and processed as part of eleven Northeast Fisheries Science Center (NEFSC) cruises during 2011. Of these 1,810 were obtained in 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 temperature records obtained by participants of the Environmental Monitors on Lobster Trap Project (see emolt.org) at approximately 60 fixed locations/depths around the Gulf of Maine and Southern New England Shelf indicate that 2011 was one of the warmest years in the last decade. Early 2012 records provide evidence of even warmer conditions. Over 100 satellite-tracked surface drifters were deployed off the coast of New England in 2011, and dozens more are planned for 2012 (see http://www.nefsc.noaa.gov/drifter). The collective archive helps resolve the transport pathways of estuarine and shelf waters.

b) Plankton Studies

During 2011, zooplankton community distribution and abundance were monitored using 575 bongo net tow samples taken on five 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 done on one of these cruises by NASA and Old Dominion University scientists to "ground truth" satellite data with ship-based water column measurements. Data from this cooperative cruise will be used to enhance the application of ocean color remote sensing to coastal ecosystems, and to derive region-independent ocean color algorithms for primary productivity, particulate organic carbon, and dissolved organic carbon. Two of the five cruises also 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. The two surveys also collected additional plankton samples for the Census of Marine Zooplankton Program, based at the University of Connecticut.

c) Benthic Studies

The NEFSC's James J. Howard and Woods Hole Laboratories, U. S. Geological Service (USGS), and several collaborating academic institutions continued in 2011 to conduct field programs to develop methods for mapping, characterizing, and developing hypotheses regarding benthic habitats and their macrobenthic and demersal communities.

A 9-day cruise was conducted during January 2011 to train students in the NOAA Living Marine Resources Cooperative Science Center (LMRCSC) program, and to accomplish joint research projects with NMFS and LMRCSC faculty from the University of Maryland Eastern Shore. Trawl samples were collected with an 11m flat otter trawl and a 2m beam trawl net on the continental shelf and slope between New Jersey and Virginia at depths ranging 33-632 m. Scientific objectives included:

(1) An examination of latitudinal variation in habitat and fish assemblages; (2) An investigation of spatio-temporal patterns in demersal-megabenthic habitats on the shelf and slope around Hudson Canyon; and (3) Exploration on the continental slope to define depth limits of monkfish distribution in the vicinities of Hudson and Norfolk Canyons.

Scientific observations included the following:

- Associations are beginning to appear between newly-mapped deepwater hard bottom patches and their benthic fauna and monkfish (*Lophius americanus*) habitat in Hudson Canyon.
- A pattern is emerging on the Hudson Canyon shelf and slope in which a background of resident species appear consistently in particular habitats year-to-year while others, largely seasonal migrants, do not appear to make use of these habitats in a consistent manner, even in the same season. Data of all types from this and other cruises are being assembled into a habitat model to understand the factors governing the distribution of resource stocks around this canyon.
- Dense patches of deepwater corals (the solitary cup coral *Dasmosmilia lymani*) and sponges continue to persist around the rim of Hudson Canyon. These data are currently being incorporated into habitat suitability models for these structural species and habitat maps for the canyon.
- Juvenile black sea bass (*Centropristis striata*) habitat was again encountered in the gravelly rim of Hudson Canyon
- A protocol continues to be developed to assess year-to-year changes in biota based on a combination of sampling methods taken on a grid of fixed, geographically-widespread sites on the mid-Atlantic shelf (the Latitudinal Transects). This includes a near-synoptic assessment of hydrological climate that largely drives migratory patterns.
- For the third year (2008, 2009, 2011), substantial numbers of juvenile southern white shrimp (*Litopenaeus setiferus*) were taken on the shelf off Virginia. This northward progression will be monitored as both a possible indicator of climate change and for potential commercial importance.
- Catches of spiny dogfish (*Squalus acanthias*) during the Longitudinal Transect study were greater than in 2008 or 2009, and a larger percentage (81%) of females were ≥ 80 cm total length. This suggests that this stock has recovered from depletion of reproductive potential noted in previous years. The mature male:mature female ratio was ~ 0.95:1.
- Monkfish (*Lophius americanus*) were caught at depths ranging from 59 to 643 m in much larger numbers (153) than on any previous LMRCSC cruise. All were caught with the deepwater flat otter trawl and 2 m beam trawl nets; none were caught with the 36' rockhopper Yankee. Large deep trawl catches were associated with substantial catches of sessile anemones, suggesting association with hard bottoms. The largest beam trawl catch occurred in an area of uneven, presumably sandy bottom thought to be the result of Pleistocene iceberg scouring. This is not the first time that monkfish have been caught here. Individuals >50 cm T.L. were found largely in Hudson Canyon; Norfolk Canyon catches consisted almost entirely of smaller individuals.
- High densities of deep sea red crab (*Chaceon quinquidens*, approaching 105 individuals/km2) and witch flounder (*Glyptocephalus cynoglossus*: up to ~3000/km2) were estimated from catches in both Norfolk and Hudson Canyon areas. All deepwater trawl catches were dominated by these two species. The highest abundance of red crabs occurred between ~500-700 m, beyond the depth range of NEFSC survey trawls. As in 2009, adult-sized witch flounder were more common in Hudson than in Norfolk Canyon.
- Several species of deepwater crustaceans of possible fisheries value were caught, among them scarlet shrimp (*Aristaeopsis edwardsiana*) and royal red shrimp (*Pleoticus robustus*).

An 8-day cruise to Hudson Canyon, off the New Jersey coast, was conducted during August 2011 with collaborators from Rutgers University, Stony Brook University, the Woods Hole Oceanographic Institution, and the National Institute for Undersea Science and Technology (NIUST: Universities of Mississippi and Southern Mississippi). Scientific objectives included:

1) Perform visual ground-truthing of areas previously mapped with multibeam sonar up to 1,000 m deep in Hudson Canyon using the NIUST Seabed AUV Mola Mola. In particular, investigate craters and pockmarks mapped by Eagle Ray for vulnerable chemosynthetic communities that may include deepwater coral and sponge communities, and other areas for tilefish pueblo villages. Such vulnerable communities may be at risk due to overlap with deep sea red crab, witch flounder, tilefish and/or monkfish fisheries. The intention is to

detect and locate vulnerable communities, and to develop ground-truth relationships between habitat conditions, community types, and acoustic signatures.

2) Perform a series of CTD/rosette sampler casts down the canyon to a maximum depth of about 1,200 m in the canyon axis. This will provide a near-synoptic, 3-dimensional view of water mass interaction around Hudson Canyon and allow collection of water samples at multiple depths for dissolved methane analysis. The sampling is aimed at detecting the presence of chemosynthetic communities and locating the source(s) of methane on which they depend.

3) Perform a successful patch test with ME70 multibeam sonar with Bathymetric Option installed, and collect data to compare various configurations for mapping at various depths, possibly combined with water column detection.

Scientific observations included the following:

- While Mola Mola proved difficult to control in the apparent strong bottom currents in Hudson Canyon, we established that bottom communities in areas surveyed in the 400-500 m depth range are heavily dominated by large anemones (*Bolocera tuaediae*), regardless of substrate type or proximity to possible methane vent structures. Anemone density overall was at least 1 per m2 and frequently exceeded 5 per m2. Accompanying fauna included deep sea red crabs (*Chaceon quinquidens*), monkfish (*Lophius americanus*), witch flounder (*Glyptocephalus cynoglossus*), longfin hake (*Urophycis chesteri*), and deep sea pandalid shrimp (*Atlantopandalus propinquus*). No deep sea corals or specialized vent communities were found, but the extent of the survey was severely curtailed by AUV problems.

- Water samples throughout the water column were obtained from canyon stations at bottom depths between 260-1100 m. Dissolved methane (CH4) concentrations exceeded 100 nM largely in near-bottom water where total depth was 500±50 m, but much lower concentrations occurred further up in the water column and where total depth was shallower or deeper than 500±50 m, suggesting local sedimentary origin on the bottom in this depth stratum. Samples of dissolved methane are now being analyzed for stable carbon isotopes (12C:13C) to characterize the source of this hydrocarbon and for subsequent tracing of possible trophic pathways.
- The ME70 bathymetric mode patch test could not be performed because of a power supply failure at the beginning of the cruise. However, both a patch test and a survey were successfully conducted with ME70 in the fisheries mode, and the results suggest that the characteristic hummocky bottom terrain characteristic of areas heavily burrowed by golden tilefish (*Lopholatilus chamaeleonticeps*) extend over the shelf several kilometers southwest of the rim. A previously unknown trough-like feature, cutting across the shelf and paralleling the canyon, was also detected.

2. Biological Studies

a) Fish Species

Flatfishes: Responses of winter flounder, *Pseudopleuronectes americanus*, and summer flounder, *Paralichthys dentatus*, are being experimentally analyzed to identify the separate and joint effects of increased CO_2 and water temperature during early life-history. The effects of high CO_2 on finfish are largely unknown. The limited evidence to date suggests that these effects will differ across species, will be subtle, and will interact with other stressors. These expectations demand a carefully planned, strategic approach, and 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 cast an extensive—yet strategic— inferential net. The elements of this approach involve (i) multiple species that differ in their ecologies and resource values; (ii) a wide, realistic range of environmental conditions (i.e., concurrent manipulation of CO_2 levels and water

temperatures); and (iii) a diverse set of response variables. To date, the team has run experiments up to one month in duration on the earliest life-stages of both winter and summer flounder, including studies on gametes, embryos, and larvae. Response variables include viability, survival, developmental rate, growth rate, histological change, otolith allometry, and various biochemical measures of fish condition. Preliminary results show a significant negative effect of increased CO_2 on survival of summer flounder embryos. Further assays and new experiments will be conducted during 2012, and black sea bass, *Centropristis striata*, will be the next species to be tested.

Gadids: Field and laboratory research continues on Atlantic tomcod, *Microgadus tomcod*, a locally abundant inshore gadid of the Northeastern USA and Eastern Canada. Tomcod have a 1-yr life cycle, are important as forage, and serve as a indicator of habitat and fish community health in the Hudson River Estuary (New York / New Jersey, USA). Two concurrent projects using tomcod are underway that address ecological and toxicological themes. In the ecological study, estimates are being obtained for (1) maternal effects on offspring quality; (2) ontogenetic rates of eggs, larvae, and juveniles; (3) time of settlement, behavioral transitions with respect to habitat structure, and movement of juveniles in nature; and (4) predation risks. In the toxicological study, three tomcod populations – Hudson River, Shinnecock Bay (Long Island, New York) and Miramichi River (New Brunswick, Canada) that differ in contaminant histories are being compared relative to (1) uptake and depuration rates of dioxin and locally occurring (Hudson River) congeners of PCBs; (2) sublethal toxic responses to graded doses of local PCBs congeners using captive (F_1 and F_2) populations; and (3) interactions between environmental stressors, i.e., PCBs and high summer temperatures. The combined effects of PAHs and PCBs on ecologically relevant toxic endpoints are also being evaluated, including the toxicities of individual congeners (PCB 77, 81, 126, and 169). An assessment of nanoparticles on tomcod early life-stages is also underway to identify effects of type and dose of commonly manufactured nanoparticles. Evidence of a single-gene mutation allowing resistance to dioxin-like compounds was published in *Science* (331: 1322-1325).

Sturgeons: Several pilot eco-toxicological studies have been initiated on shortnose and Atlantic sturgeons (*Acipenser brevirostrum* and *A. oxyrhynchus*, respectively). Toxic responses of eggs and larvae are being evaluated after aqueous exposures to PCB 126 and TCDD, and rates of uptake of radio-labeled PCB126 are being quantified. Response variables include viability, macro-phenotypic characters (e.g., days to hatch, morphometrics of recently hatched larvae, and starvation resistance), and molecular effects (CYP1A1). Uptake appears to be a linear function of exposure doses, and the two contaminants induce both lethal and sub-lethal responses.

Ichthyoplankton: Adaptive ichthyoplankton sampling—guided by IOOS ocean imagery (HF radar, satellite)—was conducted in 2011 along the northern coast of New Jersey and along the southwestern coast of Long Island. Shipboard hydro-acoustic measurements were taken during transects perpendicular to coastal fronts, and periodic CTD casts made along the transects. This work is part of an investigation to assess whether oceanographic fronts (which are 3-dimensional dynamic structures of the coastal pelagic environment) are correlated with different species/stages of ichthyoplankton.

b) Resource Survey Cruises

During 2011, personnel from the Ecosystems Surveys Branch (ESB) staged, staffed, and supported the spring and fall multispecies bottom trawl survey and the northern shrimp trawl survey. Additional staff and gear support was provided for the sea scallop and surfclam/ocean quahog dredge surveys, and the Atlantic herring hydroacoustic survey. In aggregate, the survey staff efforts totaled 238 research and charter vessel sea days. NOAA scientific and contract staff involvement in the various cruises totaled of 2,267 person sea days, and volunteers contributed another 725 person sea days. ESB cruises occupied 1,759 stations in an area extending from Cape Hatteras, North Carolina to Nova Scotia. A total of 2,231,993 length measurements were recorded from 332 species during these cruises. Ecosystem survey data are used as fishery independent inputs for 48 single species stock assessments and for several ecosystem dynamics modeling efforts.

Significant effort was also expended in 2011 to fulfill special survey sampling requests from 39 NOAA and University investigators. This sampling included 17,846 feeding ecology observations, collection of 30,826 aging structures, and acquisition of 21,147 samples/specimens to support additional shore-based research.

c) Age and Growth

In 2011, approximately 102,000 age determinations for 12 species of finfish were completed by Woods Hole Laboratory staff in support of resource assessment analyses. In addition to aging Atlantic cod (23,532), haddock (11,223), and winter flounder (16,252), large numbers of silver hake (9,784), American plaice (7,153), yellowtail flounder (6,646), black seabass (6,467) and summer flounder (4,958) were also aged. Age determinations for Atlantic herring, Atlantic mackerel, scup, and witch flounder totaled 16,692.

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. Bluefish, halibut, and pollock aging workshops were also convened in 2011 to establish consistent aging protocols. Meetings with University of Massachusetts staff were held to discuss monkfish aging methods. Internal efforts to monitor and maintain accuracy and precision in age determinations continued in 2011, and are summarized and available on the Fishery Biology Program website.

Research projects that continued in 2011 included: (1) enhanced biological sampling of three species of flatfish to examine monthly aspects of diet, reproductive biology, and condition; (2) histological sampling to calibrate macroscopic gonad staging performed during research vessel survey cruises; (3) a validation study of scale and otolith aging methods for American shad; (4) analysis of results from an experimental study examining reproductive biology and condition of black sea bass at varying ration levels; (5) analysis of environmental effects on haddock growth; (6) an age validation study of Atlantic surfclams using sectioned chondrophores obtained from samples collected across the geographic range of the species; (7) a study investigating the feasibility of measuring bioelectrical impedance (BIA) as a predictor of fish condition and reproductive potential; (8) 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) an initiative to age summer flounder by sex from samples collected in both the recreational and commercial fleets; and (10) a mark-recapture study of spiny dogfish to validate the aging method using vertebrae. A new project initiated in 2011 was a calibration study to estimate individual (longitudinal) growth of haddock using scales vs. otoliths.

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 gadids.

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 2011 spring and autumn surveys, 8,057 stomachs from 54 species, and 8,128 stomachs from 55 species were examined respectively. Diet sampling emphasized gadids, elasmobranchs, small pelagics, flatfishes, and lesser known species.

The 39-year time series (1973-2011) of food habits data collected during NEFSC bottom trawl surveys continued. Most of the time series is now available for analysis, including data from over 550,000 stomach samples

Staff prepared several papers and reports for publication on a wide range of trophic ecology issues in the Northwest Atlantic ecosystem. Because trophic interactions are central to food web and ecosystem considerations, research continues on essential fish habitat, fish production, incorporating fish consumption into stock assessments, and evaluating fisheries reference points.

e) Apex Predators Program

Apex Predators research in 2011 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 2011, information was received on 4,400 tagged and 275 recaptured fish bringing the total number tagged to 228,000 sharks of more than 50 species and 13,425 sharks recaptured of 33 species.

Pelagic shark biology, movements, and abundance studies continued in 2011 with further 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 2,750 sharks have been tagged and nearly 200 recaptured; the recaptures are primarily blue sharks recovered by commercial fishermen working in the mid-Atlantic. In addition, 250 blue sharks were double tagged in 2011 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 500 sharks have now been double tagged.

The NEFSC Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) survey continued in 2011 to investigate known and putative shark nursery areas along the US east coast to describe species composition, habitat preferences, and relative abundance, distribution, and migration. In 2011, COASTSPAN participants were the Massachusetts Division of Marine Fisheries (MDMF), North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Department of Natural Resources, and the University of North Florida. NEFSC scientists conduct the survey in Narragansett and Delaware Bays. NEFSC and MDMF personnel also conduct a survey in the U.S. Virgin Islands using COASTSPAN gear and methods. A Ph.D. candidate from the University of Massachusetts School for Marine Science and Technology is finalizing a COASTSPAN supported research project in which passive acoustic telemetry in Massachusetts waters was used to study habitat utilization and essential fish habitat of juvenile sand tiger sharks.

A collaborative study on the genetic stock structure of the dusky shark, *Carcharhinus obscurus*, was published in *Endangered Species Research*. This is the first assessment of global stock structure of *C. obscure*, and was conducted by analyzing part of the mitochondrial control region in 255 specimens from 8 geographically dispersed locations. The analyses suggest that the relative contributions of US Atlantic, South Africa, and Australia dusky sharks in the Asian fin trade can be deduced using mtCR sequences.

The NEFSC Cooperative Research and Apex Predators Programs launched a new initiative in 2011 to tag spiny dogfish in the Gulf of Maine, Southern New England, and Georges Bank regions. This project aims to answer long-standing questions about stock structure, movement patterns, and life history to update and improve spiny dogfish stock assessments. Over a two-year period, dogfish will be tagged during winter and summer using three commercial vessels. Some dogfish will be double tagged for a tag retention study, while others will be injected with oxytetracycline for an age validation study.

f) Marine Mammals

In 2011, NEFSC continued work on the Atlantic Marine Assessment Program for Protected Species (AMAPPS), which is a partnership with the Bureau of Ocean Energy Management, the US Navy, and the US Fish and Wildlife Service. As part of this program, NMFS will conduct seasonal surveys during the next several years of protected species along the Atlantic coast. 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.

Small Cetaceans:

During August 7- 26, 2011, as part of the AMAPPS project the NEFSC conducted an aerial abundance survey of marine mammals and sea turtles using a chartered Twin Otter aircraft. The survey covered waters from Long Island, New York to the southern tip of Nova Scotia, Canada, and from the coast line to the 100-m depth contour. Within the study area of 199,656 km2, there were about 6,481 km of on-effort track lines, of which 5,979 km were conducted in sea states less than Beaufort 4. On these track lines, 10 cetacean species and 3 turtle species were detected.

A shipboard abundance survey was conducted between June 2 and August 1, 2011 using the NOAA survey vessel *Henry B. Bigelow*. The study area included waters south of Cape Cod (about 42°N latitude), north of North Carolina (about 36°N latitude), east of the southern tip of Nova Scotia (about 64° 30'W longitude), and west of the US coast (about 75°W longitude). The objectives of the survey were to: (1) determine the distribution and abundance of cetaceans, sea turtles, and sea birds within the study area; (2) collect vocalizations of cetaceans using passive acoustic arrays; (3) determine the distribution and relative abundance of plankton and other trophic levels; (4) collect hydrographic and meteorological data; (5) when possible, collect biopsy samples and photo-identification pictures of cetaceans; and (6) develop data entry programs to improve the collection of visual sightings data of sea birds and cetaceans. A total of 5,047 km of trackline was surveyed, 52% of which was surveyed in very good conditions of Beaufort sea state 2 or less. Sightings were made of 24 cetacean species or species groups, 2 marine turtle species, and 45 bird species.

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 2011 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*), 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. The NEFSC has been working with the gillnet fishery to reduce harbor porpoise bycatch. In 2011, a study was completed that examined the effectiveness of tie-downs in the bottom set gillnet fishery on the catch of sturgeons, marine mammals, and targeted catch. The report for this project is available at http://www.nefsc.noaa.gov/publications/reports/EA133F-10-RQ-1160.pdf.

Large Cetaceans:

The 2011 North Atlantic right whale survey DE11-04 was conducted during 29April – 26 May using the NOAA *R/V Delaware II*. Primary cruise activities included: (1) collecting biopsies and photographs of North Atlantic right whales (*Eubalaena glacialis*) on all good weather days when whales were present; (2) deploying and retrieving 10 Marine Autonomous Recording Units (MARUs) near concentrations of right whales; (3)d and retrieving underwater gliders and profiling floats; (4) transect sampling using MiniBAT tow fish; (5) collecting visual observations and oceanographic data using a vertical profiler on anchor stations; and (6) sampling zooplankton using double 70-cm diameter ring nets for oblique tows, and a single 70-cm diameter ring net for vertical tows. The area of operations was the Great South Channel, east of Cape Cod, Massachusetts, with most of the right whale work conducted between 41.5°N to 41.8°N and 69.3°W to 69.6°W.

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 2011 followed systematic track lines with randomized starting locations within 11 primary survey blocks: Cashes Ledge, Georges Basin, Georges Shoal, Great South Channel, Howell Swell, Jeffreys Ledge, Jordan Basin, Lindenkohl Basin, Rhode Island Sound, Stellwagen Bank, and the Stellwagen Bank Sanctuary. During 2011, NARWSS flights totaled 247 hours over 55 surveys, including a sawtooth survey over the Stellwagen Bank National Marine Sanctuary, a directed flight to locate a humpback whale carcass, and a directed flight to assist the *R/V Delaware II* North Atlantic

Right Whale Survey DE11-04. NARWSS flights detected 473 right whales within the survey blocks, and an additional 28 right whales were sighted during transits to or from survey areas. No flight surveys were conducted during July through October 2011.

During January-March 2011, 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.

Since 2007, and continuing through 2012, the NEFSC has been involved in an ocean noise project in the Stellwagen Bank National Marine Sanctuary. 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 in the communication area. Communication ranges are being modeled for four species of baleen whales (right, fin, minke, and humpback) across six call types. The data analyses are expected to reveal the extent of loss of communication space of these whales under present-day conditions.

NEFSC researchers have also been working to: (1) elucidate the basic acoustic behavior of various marine mammal species; (2) validate passive acoustic results with respect to other monitoring platforms; and (3) evaluate the effectiveness of passive acoustics as a tool for monitoring and mitigation. Part of the work focuses on the acoustic behavior of right whale mother-calf pairs. This research is being conducted in collaboration with Dr. Susan Parks (Penn. State University). Fieldwork in the Bay of Fundy, Cape Cod Bay, and on the Southeast calving grounds involves obtaining recordings using a towed hydrophone from a small boat. Another project is exploring variation in right whale calling activity. Patterns and behavioral ecology at different spatial and temporal scales are being analyzed. Researchers are finding high call rates for shorter bouts in the winter, and lower call rates for longer bouts in the spring. The occurrence and movement of singing humpback whales is also being examined. Movement patterns of humpbacks and right whales tracked acoustically are being compared in pre- and post-migration seasons. Minke whale call characteristics are being measured in Massachusetts Bay, and a geographical comparison of minke whale calls across the Western Atlantic has been initiated.

A cetacean acoustic abundance estimation project is aimed at developing protocols for monitoring spatial and temporal trends in relative abundance. These protocols will be used to obtain absolute acoustic abundance estimates for cetaceans, and to integrate acoustic abundance estimates with visual abundance estimates.

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. Three gliders were deployed in the Great South Channel in 2010 and 2011, with transect locations selected based on encounter rates with baleen whales during previous shipboard surveys. Data from the gliders are now being analyzed. A real-time moored buoy will be developed that can be deployed and relay back detections of baleen whales throughout its deployment period.

Scarification analyses of right and humpback whales continued in 2011. These analyses are used to monitor interactions between whales and fishing gear.

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.

Pinnipeds:

Aerial monitoring of major harbor seal (*Phoca vitulina*) and gray seal (*Halichoerus grypus*) haul-out sites in southern Massachusetts continued in 2011. Major gray seal pupping colonies in Massachusetts and Maine coastal waters were also surveyed. Nine aerial seal surveys were conducted.

Between March and May 2011, researchers from the NEFSC and several other institutions conducted harbor seal live capture, tagging, and biological sampling operations. The primary purpose of this work was to attach radio tags to seals to obtain a correction factor that could be used to account for the number of seals not hauled-out (therefore not available to be observed/counted) during aerial abundance surveys. This correction factor would then be applied to the raw seal counts obtained from NEFSC aerial surveys to estimate the total harbor seal population size. Secondary objectives were to study short-term movements of seals, and to collect health assessment and stock identification samples. Collaborating institutions included the Woods Hole Oceanographic Institution, International Fund for Animal Welfare, Riverhead Foundation for Marine Research and Preservation, Provincetown Center for Coastal Studies, University of Maine, Maine Department of Marine Resources, NOAA Northeast Regional Office, New England Aquarium and the University of New England Marine Animal Rehabilitation Center. Support for the project was provided by the AMAPPS program.

The first phase of the study took place in Chatham and Wellfleet, MA. Seals were captured using a 500 foot long gillnet. Once live captured, each seal was measured and weighed, biological samples (e.g., blood, skin, hair, morphometrics) collected, and the seal outfitted with both a flipper tag for identification and a small VHF radio tag before being released. The second phase of the study took place in Rockland, Maine, where more seals were captured and tagged. During this work, the Riverhead Foundation contributed expertise and satellite tags, which provided additional information on movement patterns and habitat use of two seals captured near Rockland. Unfortunately, aerial work was hampered by poor weather in May and the abundance survey was unable to be completed.

Bycatch estimation of harbor, gray and harp (Pagophilus groenlandicus) seals was conducted based on observed takes in the Mid-Atlantic Gillnet and Northeast Sink Gillnet 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 2011, the NEFSC undertook (or contracted) several 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" to reduce sea turtle takes; (2) a study of catch retention of summer flounder and other finfish species in the summer flounder trawl fishery using a topless trawl; and (3) an investigation of the usefulness and capability of a tow time data logger to accurately record tow time in the bottom trawl fishery.

In 2011 the NEFSC continued ongoing research into turtle bycatch detection and assessment. These efforts included: (1) predictive modeling of turtle encounter rates in the Mid-Atlantic using both fishery dependent and fishery independent data sources; (2) developing of methods to estimate sufficient levels of observer coverage to monitor turtle bycatch events; (3) estimating turtle mortality rates in commercial gears using serious injury guidelines; and (4) developing quantitative methods for assessing anthropogenic threats to sea turtles.

As part of the AMAPPS, NMFS deployed satellite tags on wild-captured loggerhead sea turtles 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). Twenty-five satellite tags were deployed on immature loggerhead sea turtles collected in offshore Mid-Atlantic shelf waters.

h) Seabirds

During June-July 2011, the NEFSC conducted a shipboard abundance survey for marine mammals, sea turtles, and seabirds in waters that were offshore of the 100m depth contour to just beyond the EEZ and off the coasts of Virginia to Massachusetts. In addition, seabird abundance data were collected in 2011 on several NEFSC fish surveys, and seabird bycatch information was collected by observers on a sample of the commercial fishing trips.

3. Studies of Fishing Operations

In 2011, NEFSC Observers were deployed on 2,785 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 241 marine mammal incidental takes, 17 sea turtle incidental takes, and 537 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 2,997 trips aboard commercial fishing vessels in 2011. On these trips there were 415 marine mammal, five sea turtle, and 1,073 seabird incidental takes documented.

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

In the sink anchored gillnet fishery, 743 trips were observed with a total of 3,175 gear retrievals by Observers. There were 111 observed marine mammal takes in this fishery (61 gray seals, 22 harbor porpoises, 17 harbor seals, three common dolphins, three unidentified seals, two unidentified porpoises/dolphins, one whitesided dolphin, one harp seal, and one unidentified marine mammal). There was also one unidentified hard-shell turtle and 280 seabird takes (248 of which were greater shearwater) observed in this fishery.

At-Sea Monitors observed 1,569 trips in the sink anchored gillnet fishery with 6,384 gear retrievals. There were 317 marine mammal (163 gray seals, 76 harbor seals, 54 harbor porpoises, seven unidentified seals, six common dolphins, four whitesided dolphins, three harp seals, three unidentified porpoises/dolphins, and one humpback whale), three sea turtles (two loggerhead turtles and one leatherback turtle) and 1,011 seabird (918 of which were greater shearwaters) incidental takes recorded in this fishery by Monitors.

b) Float Drift Gillnet Fishery

There were 15 floating drift gillnet trips with 45 gear retrievals observed in 2011. There were no marine mammal, sea turtle, or seabird takes observed.

No Monitors deployed on float drift gillnet trips in 2011.

c) Otter Trawl Fisheries

In the bottom otter trawl fishery 1,132 trips were observed with a total of 11,677 gear retrievals recorded by Observers. In addition, there were 33 midwater trawl trips with 56 gear retrievals, seven scallop trawl trips with 33 gear retrievals, one shrimp bottom otter trawl trips with three gear retrievals, eight twin trawl trips with 107 gear retrievals, 17 haddock separator trawl trips with 527 gear retrievals and two Ruhle trawl trips with 33 gear retrievals were observed in 2011.

In the bottom otter trawl fishery, there were 75 observed marine mammal takes (26 common dolphins, 22 whitesided dolphins, nine gray seals, five unidentified dolphins, five pilot whales, two bottlenose dolphins,

two Risso's dolphins, two harbor porpoises, one harbor seal and one unidentified seal). There were also 14 loggerhead turtles, one unidentified hard-shell turtle, and 37 seabird takes in this fishery. In the mid-water trawl fishery, there were no observed incidental takes. In the scallop trawl fishery, no marine mammal, sea turtle, or seabird takes were observed. As well, no marine mammal, sea turtle or seabird takes were observed in the shrimp bottom otter trawl fishery. In twin trawl trips, there were two common dolphin and five greater shearwater takes observed. On haddock separator trawl trips in 2011 there were four common dolphin, one gray seal and one pilot whale takes observed. One gray seal was documented on Ruhle trawl trips in 2011.

Monitors deployed on 1,227 bottom otter trawl trips with 12,437 gear retrievals, five Ruhle trawl trips with 149 gear retrievals and 54 haddock separator trawls with 1,197 gear retrievals in 2011. There were 80 marine mammals (34 whitesided dolphins, 15 common dolphins, ten gray seals, four harbor seals, three harbor porpoises, three unidentified dolphins, one unidentified porpoise/dolphin, one harp seal, one unidentified seal, and one unidentified marine mammal), one leatherback turtle, one unidentified hard-shell turtle, and 25 seabird takes recorded by Monitors in the bottom otter trawl fishery. Monitors also documented two unidentified dolphins on Ruhle trawl trips in 2011. On haddock separator trawl trips, there were eight common dolphins, four gray seals, two whitesided dolphins, one pilot whale, and three seabird takes documented.

d) Sea Scallop Dredge Fishery

In the sea scallop dredge fishery, 405 trips were observed with a total of 29,080 gear retrievals. There was one loggerhead turtle and five seabird takes observed in this fishery.

No Monitors deployed in the scallop dredge fishery in 2011.

e) Scottish Seine Fishery

No Scottish seine trips were covered by Observers or Monitors in 2011.

f) Sink Drift Gillnet Fishery

In the sink drift gillnet fishery in 2011, Observers were deployed on 98 trips with a total of 616 gear retrievals. There were 90 greater shearwater and eight northern fulmar takes in this fishery.

Monitors deployed on 11 trips with a total of 77 gear retrievals. There were one harbor porpoise and 19 greater shearwater takes documented in this fishery.

g) Anchored Floating Gillnet Fishery

There were five anchored floating gillnet trips with ten gear retrievals observed in 2011. No marine mammal, sea turtle, or seabird takes were observed in this fishery.

No Monitors deployed on anchored floating gillnet trips in 2011.

h) Mid-water Pair Trawl Fishery

In the mid-water pair trawl fishery in 2011, 193 trips were observed with a total of 501 gear retrievals. One pilot whale, 31 greater shearwaters, and two unidentified birds were observed in this fishery. No sea turtles were documented.

No Monitors deployed on mid-water pair trawl trips in 2011.

i) Bottom Longline Fishery

In the bottom longline fishery in 2011, 18 trips were observed with a total of 106 gear retrievals. There were eight greater shearwater observed in this fishery. No marine mammal or sea turtle takes were observed.

At-Sea Monitors covered a total of 95 bottom longline trips and 510 gear retrievals in 2011. In 2011, there were 15 greater shearwater takes documented in this fishery. No marine mammal or sea turtle takes were observed in this fishery in 2011.

j) Beach Haul Seine Fishery

No beach haul seine trips were covered by Observers or Monitors in 2011.

k) Pound Net Fishery

No pound net trips were covered by Observers or Monitors in 2011.

l) Handline Fishery

In 2011, there were eight handline trips observed and 148 gear retrievals and three auto-jig handline trips with 12 gear retrievals. No trolling trips were observed in 2011. No marine mammal, sea turtle, or seabird takes were observed in these fisheries.

Monitors covered 33 handline trips and 439 gear retrievals and three auto-jig handline trips and 73 gear retrievals in 2011. There were no documented takes in this fishery in 2011.

m) Herring Purse Seine Fishery

In 2011, there were 97 herring purse seine trips with 166 gear retrievals observed. There were 34 gray seals, eight unidentified seals, three harbor seals, 59 greater shearwaters, 12 unidentified birds, and two unidentified shearwaters observed in this fishery. No sea turtles were observed in this fishery.

No herring purse seine trips were covered by Monitors in 2011.

n) Menhaden Purse Seine Fishery

No menhaden purse seine trips were covered by Observers or Monitors in 2011.

o) Lobster Pot Fishery

No lobster pot trips were covered by Observers or Monitors in 2011.

p) Fish Pot Fishery

No fish pot trips were covered by Observers or Monitors in 2011.

q) Conch Pot Fishery

No conch pot trips were covered by Observers or Monitors in 2011.

r) Red Crab Pot Fishery

No red crab pot trips were covered by Observers or Monitors in 2011.

s) Clam Dredge Fishery

No clam dredge trips were covered by Observers or Monitors in 2011.

t) Scallop Beam Trawl Fishery

No scallop beam trawl trips were covered by Observers or Monitors in 2011.

4. 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 2011 include Gulf of Maine cod, black sea bass and three winter flounder stocks.

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 2011, 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 2011 vetted in regional bodies included summer flounder, scup, black sea bass, bluefish, spiny dogfish, striped bass, and Northern shrimp.

b) Atlantic Salmon Research

Atlantic salmon populations in eastern Maine have been formally listed as endangered under the United States Endangered Species Act. 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 agency and private partners, are designed to better understand the factors contributing to these declines. Research activities include a variety of field projects in natal rivers, estuaries, and at sea. The data from these studies are used to support ICES stock assessment activities, and in the management activities of the North Atlantic Salmon Conservation Organization (NASCO).

Field research in 2011 focused on (1) obtaining smolt production estimates; (2) marine telemetry; and (3) monitoring of fishery removals on the high seas. Smolt production in various rivers is monitored through the use of in-river traps. Trapping programs either generate population estimates via mark-recapture techniques, or provide qualitative estimates via index monitoring. A large hatchery smolt tagging program has provided information useful in characterizing both smolt emigration and adult returns in relation to stocking practices. Results from these studies indicate differential migration success in relation to stocking location and time. 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 in 2011. 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

During 2011, eight projects were conducted through the conservation engineering and information technology network. The network groups bring together over 80 fishing industry, academic, and government partners to develop multi-disciplinary approaches to fisheries research. Studies focus on fish distribution, environmental factors, real-time information exchange, and gear designs to help fishermen target specific species while avoiding others. Coordination of these network activities is being facilitated by NCRP staff members who provide technical and administrative support for network activities. Researchers, working with fisherman, net builders, and industry advisors to provide ideas and expertise, are currently focusing their efforts on small and large mesh fisheries in Southern New England, the Gulf of Maine, and the Mid-Atlantic where bycatch is a major concern.

An extensive network group, the Northeast Groundfish Gear Conservation Engineering & Demonstration Network (GEARNET), is developing gear-based solutions to groundfish fishery bycatch. Principal investigators from the Gulf of Maine Research Institute (GMRI), Massachusetts Division of Marine Fisheries (MADMF), SMAST, Superior Trawl, and industry consulted with groundfish sectors and fishermen in the common pool. More than 17 pilot projects are underway including an evaluation of a topless flounder net, cod end selectivity and catch sensors, and a fisherman-designed detachable codend. Additional projects are working to increase fishing fuel efficiency by replacing netting in groundfish trawls with fine-diameter Sapphire and Dyneema twine. For additional information, visit http://gearnet.org/.

Network groups focusing on bycatch reduction in the *Loligo* squid fisheries include scientists from Cornell Cooperative Extension (CCE), University of Massachusetts-Dartmouth School of Marine Science & Technology (SMAST), and the University of Rhode Island who are evaluating potential gear solutions, such as large mesh belly panels and drop-chains. Additional efforts will help determine the distribution of target and non-target species in time and space, and encourage real-time data collection and communication to avoid bycatch hotspots. The Squid Trawl Network (STN) website http://squidtrawlnetwork.squarespace.com/ has been developed to inform stakeholders of network progress and direction.

Another team, involving the Garden State Seafood Association, Rutgers University, University of Delaware, University of New Hampshire, and CCE is developing ecologically-informed models to reduce butterfish bycatch in the squid fishery. Using fishermen's input, the team is refining Integrated Ocean Observing System (IOOS) habitat models to predict where the two species do not overlap for cleaner catches. The team is also investigating the diet of squid to improve ecosystem-based management of *Loligo*, and is also synthesizing the results of habitat modeling, diet studies, and gear modifications to determine the impacts of different bycatch reduction strategies.

Two network groups are focusing on solutions to groundfish fishery bycatch that rely on real-time information about the distribution of fish species. One team, headed by the Cape Cod Commercial Hook Fishermen's Association, Duke University, and Island Institute, is developing temporal-spatial information for the Sector Manager Tool currently used by some sectors. Another network segment led by GMRI, SMAST, Ocean Data Products and the University of Maine is developing a more generalized data collection and communication system to deliver near real-time information to fishermen to help avoid non-target species.

The REDNET network, including MADMF, Maine Department of Natural Resources, SMAST, Trawlworks, Superior Trawl, Reidar's Manufacturing Inc., and Associated Fisheries of Maine, aims to redevelop a sustainable redfish (*Sebastes fasciatus*) fishery in the Gulf of Maine, and collaborators from the University of Rhode Island, Rhode Island Department of Environmental Management, and MADMF are working with stakeholders to develop an expanded pot survey for scup and black sea bass to fill in gaps in seasonal NEFSC trawl surveys.

In 2010, a two-year cooperative trawl sweep comparison study was completed that evaluated the performance of cookie and rockhopper sweeps as they relate to catch efficiency of skates and flatfish (including winter, summer and yellowtail flounder). In 2011, this work focused on analysis of sweep study

data. Catch comparisons were produced by sweep type for 13 species in the three areas and two seasons resulting in 61 test cases. Differences in sweep catch efficiency vary by species, and calibration factors will be developed for many species/area combinations. This information is expected to inform discussions on the need for a dedicated flatfish survey in the future, and will also be considered in the assessments of additional species.

Fiscal year 2011 NCRP funds were also used to continue the support required for three commercial vessels to complete a two year cooperative spiny dogfish (*Squalus acanthias*) tagging study in the Gulf of Maine, Southern New England, and Georges Bank regions. This project will provide information on stock structure, movement patterns, and life history of the species to update and improve the stock assessment. Over a two year period, approximately 33,000 dogfish are to be tagged during the winter and summer seasons, with some fish double tagged (as part of a tag retention study) and/or injected with oxytetracycline for age validation.

Cooperative Research continues to support the Electronic Logbook/Study Fleet Program, which focuses on using electronic reporting mechanisms for recording haul-based data (including temperature and depth profiles), and providing direct assistance to industry partners. In 2011, vessel solicitations continued to recruit Study Fleet vessels, and the program currently has more than 25 vessels operating in the groundfish, squid, and Southern New England yellowtail fisheries. Currently, the Study Fleet electronic logbook is the only fishery-dependent reporting system providing near real time tow-by-tow data to the NEFSC (often within 48 hours of a vessel completing a trip). Cooperative Research is seeking additional opportunities to expand the use of the Study Fleet Electronic Logbook system, known as FLDRS (Fisheries Logbook and Data Recording Software), in other cooperative studies and sectors. Data collected from the logbooks will be used to investigate precision in discard estimates, as well as to identify patterns in fishery dependent catch per unit effort.

Continued funding in 2011 for the Environmental Monitors on Lobster Traps, or eMOLT program, was provided by Cooperative Research funds through the Northeast Consortium. This partnership, involving NOAA, the State of Maine, the Commonwealth of Massachusetts, the Downeast and Atlantic Offshore Lobstermen's Associations, the Gulf of Maine Lobster Foundation, and the Marine Science Department at Southern Maine Community College (SMCC) in South Portland, Maine, facilitates environmental monitoring using a combination of temperature and current meter probes on lobster pots, as well as a series of GPS drifter deployments. The project continues to collect hourly bottom temperatures from nearly 100 fixed locations around the Gulf of Maine and the Southern New England Shelf. For more information and data access, see: http://emolt.org.

The Research Set-Aside (RSA) programs held 2011 grant competitions for Sea Scallops, Monkfish, and Mid Atlantic multispecies. Nineteen projects were awarded. Scallop RSA awards included support for resource assessments of rotational management areas, continuation of a real-time electronic bycatch reporting study, and testing of a turtle excluder dredge and twine-top mesh and configuration studies for bycatch reduction. Awards under the Monkfish RSA supported projects on the movement, growth, and stock structure of monkfish. Mid-Atlantic RSA awards included the Northeast Area Monitoring and Assessment Program (NEAMAP), a fishery independent survey of scup on hard bottom areas in Southern New England, and a project to understand effects of fishing on size, age, and sex distribution of black sea bass.

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 2011, but several programs (ASPIC, ASAP, SS3, AGEPRO

AIM, DCAC, and POPSIM) were updated. The complete package may be accessed at http://nft.nefsc.noaa.gov/ (note that a password is no longer required).

e) Bigelow-Albatross Calibration

Work continued on calibrating the catches between the two vessels. Length-based calibrations were evaluated for winter flounder and herring. Different methods were used, depending on the data available for specific species.

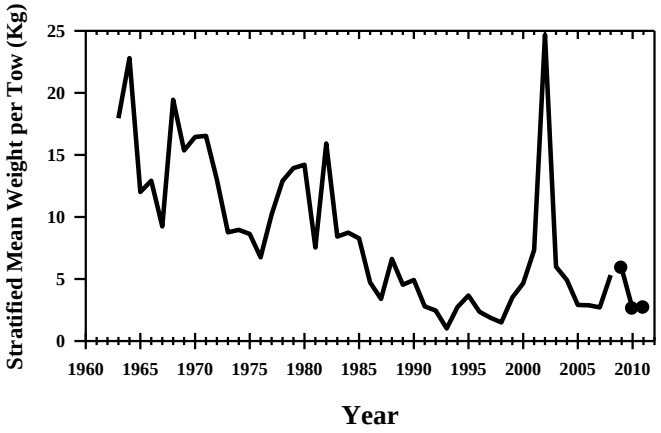

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

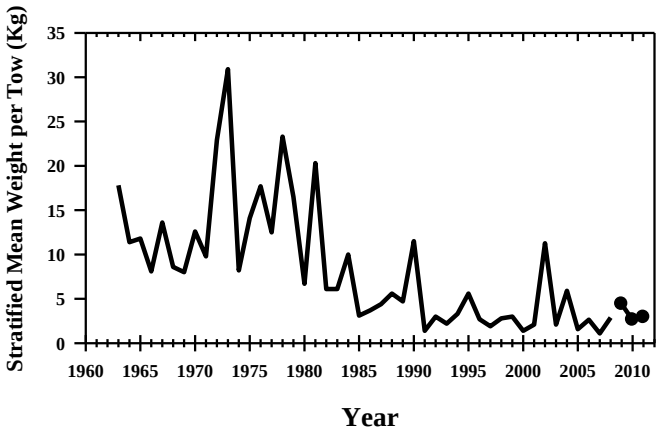

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

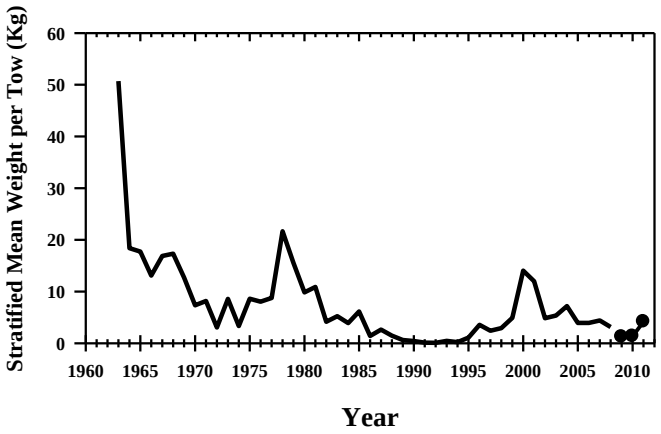

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

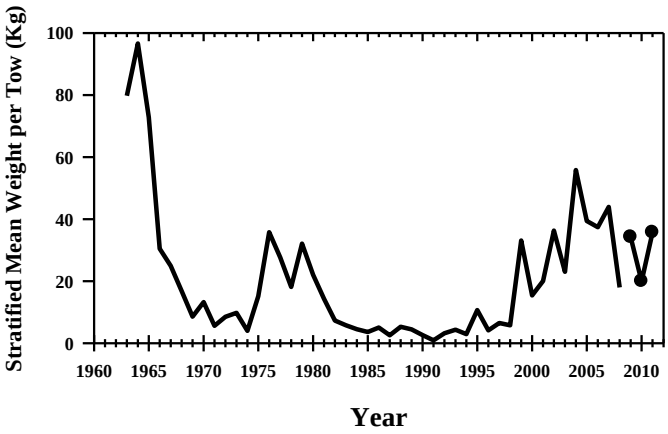

Figure 4. NEFSC autumn bottom trawl survey biomass indices for Georges Bank haddock.

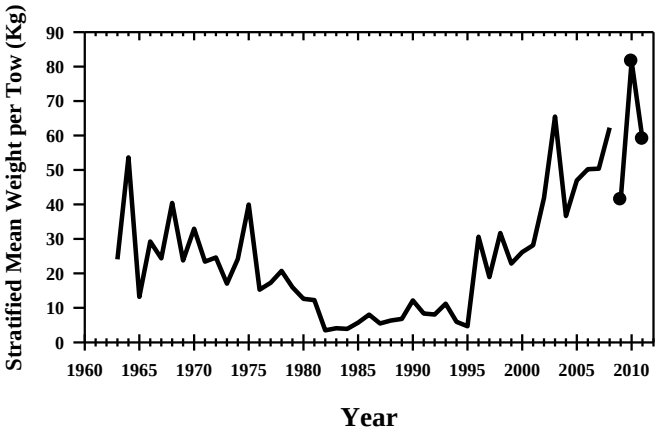

Figure 5. NEFSC autumn bottom trawl survey biomass indices for Acadian redfish.

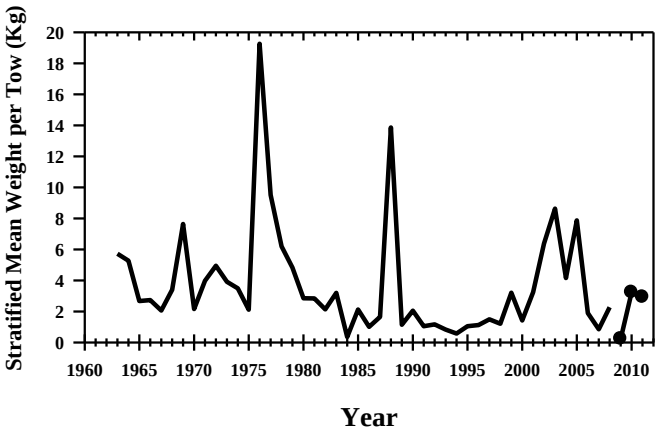

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

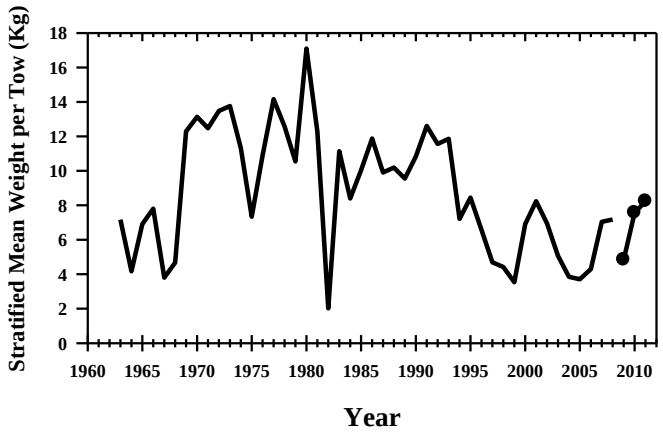

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

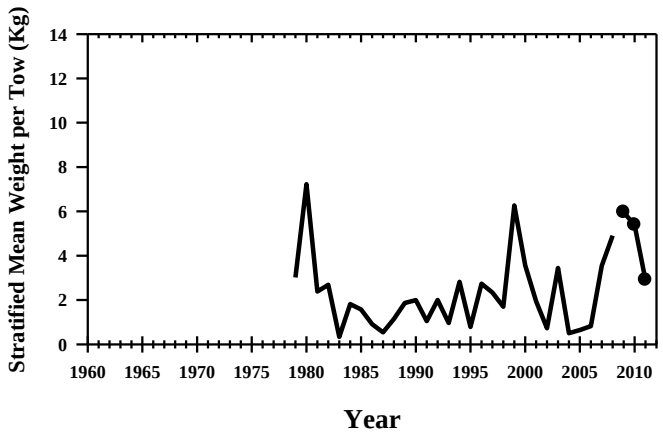

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Cape Cod-Gulf of Maine yellowtail flounder.

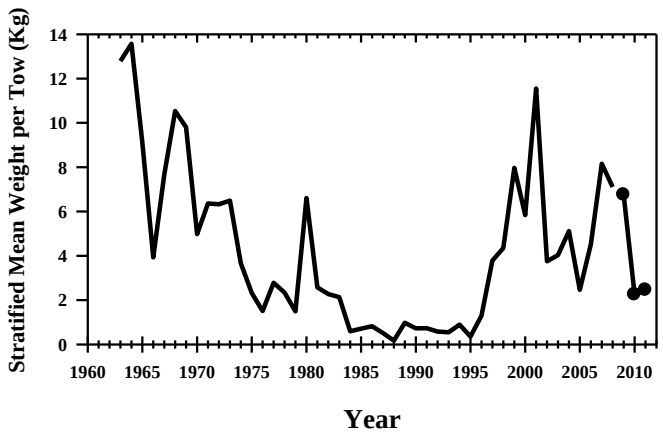

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

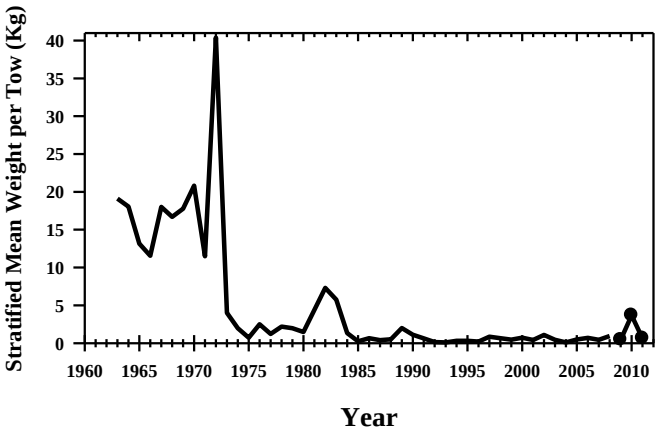

Figure 10. NEFSC autumn bottom trawl survey biomass indices for Southern New England-Mid-Atlantic yellowtail flounder.

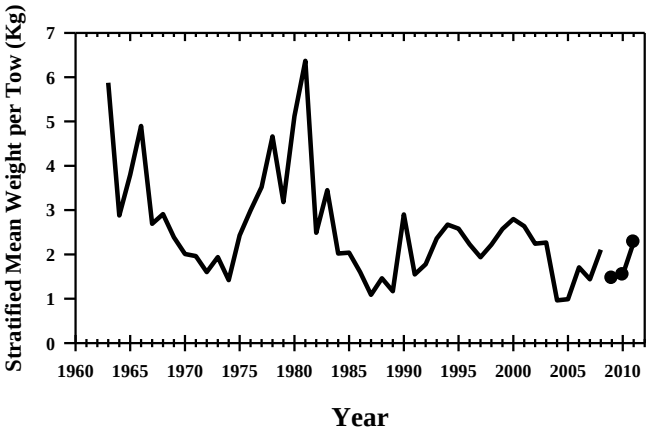

Figure 11. NEFSC autumn bottom trawl survey biomass indices for American plaice.

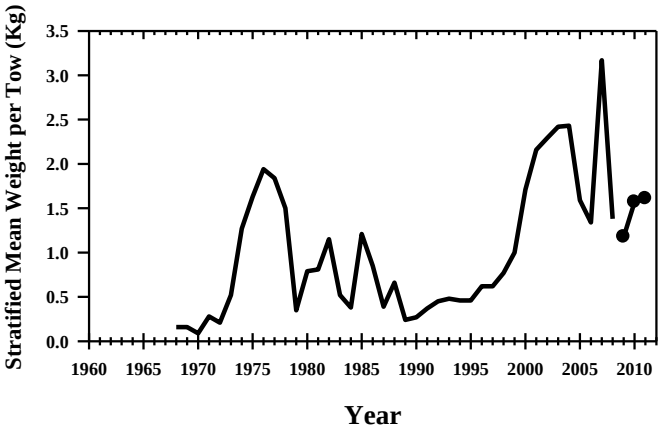

Figure 12. NEFSC spring bottom trawl survey biomass indices for summer flounder.

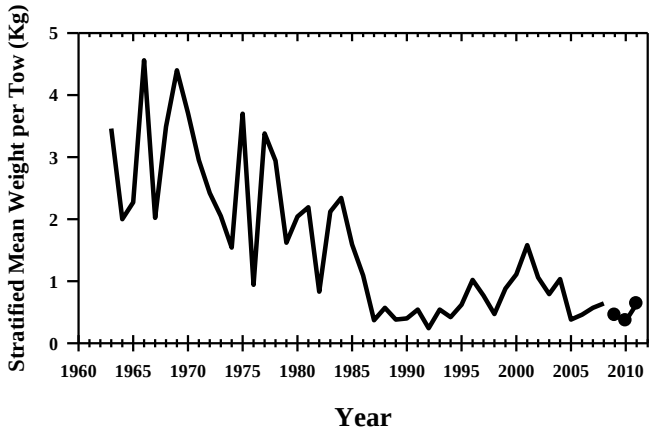

Figure 13. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

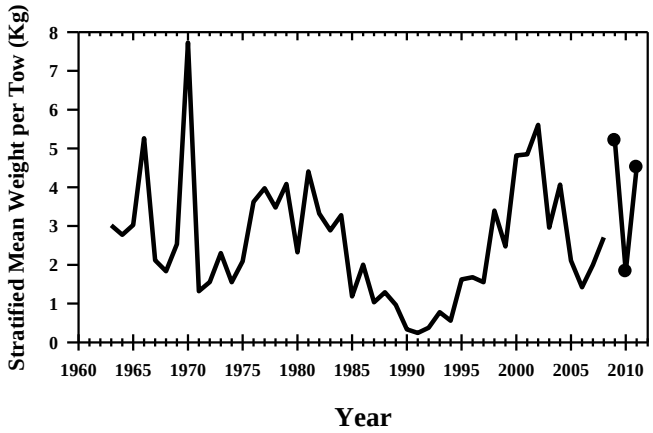

Figure 14. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

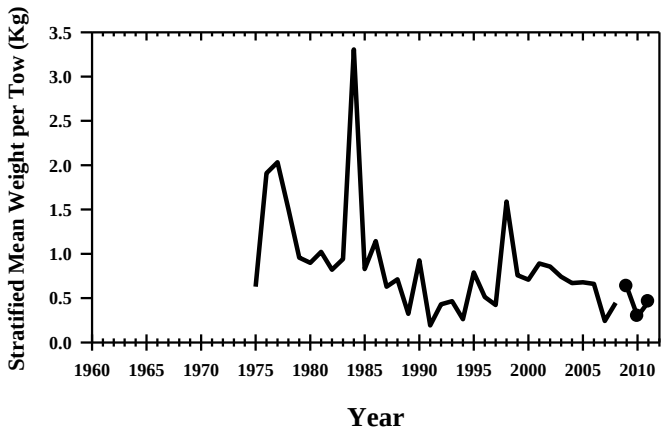

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern windowpane flounder.

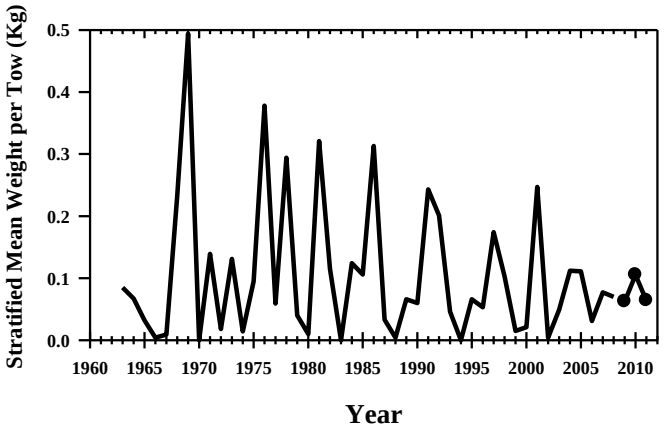

Figure 16. NEFSC autumn bottom trawl survey biomass indices for Atlantic halibut.

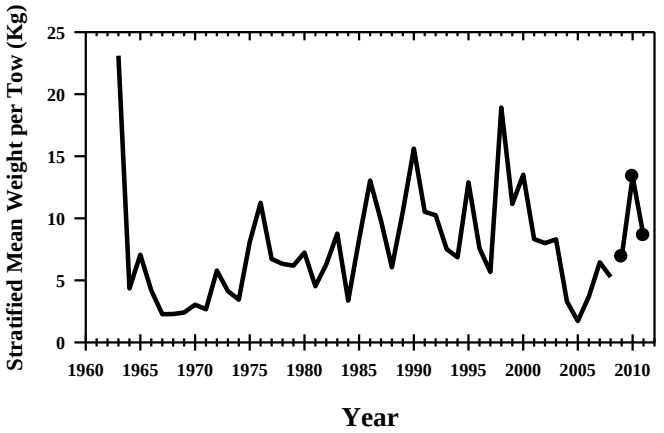

Figure 17. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

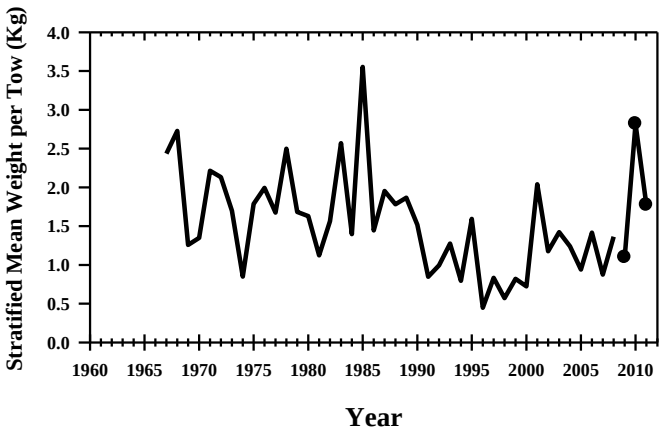

Figure 18. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

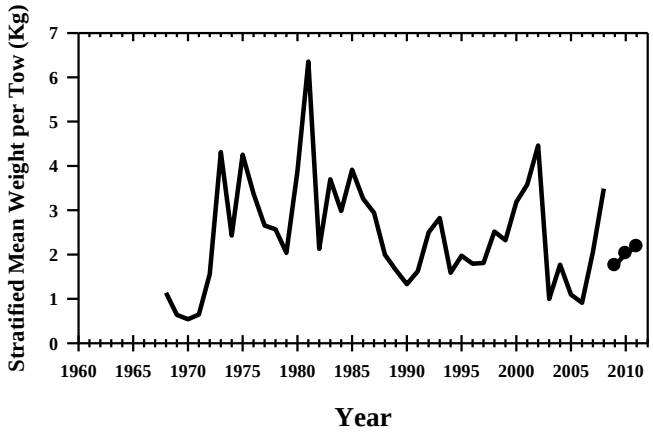

Figure 19. NEFSC spring bottom trawl survey biomass indices for northern red hake.

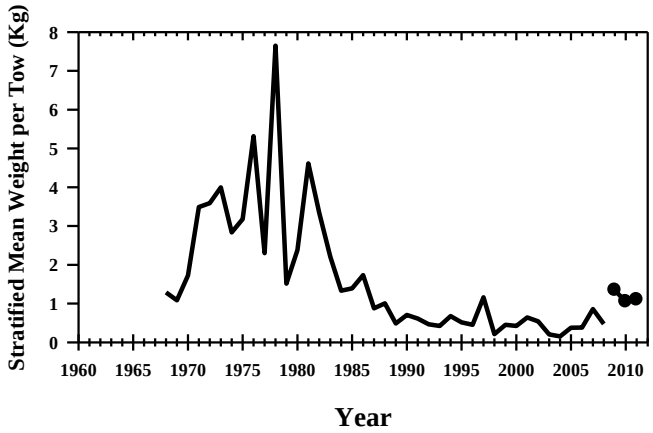

Figure 20. NEFSC spring bottom trawl survey biomass indices for southern red hake.

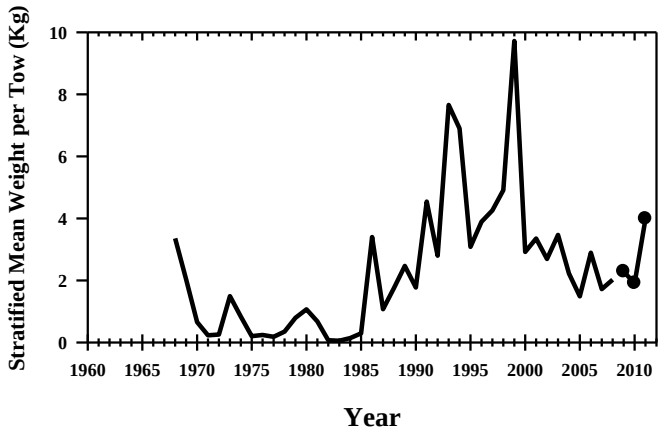

Figure 21. NEFSC spring bottom trawl survey biomass indices for Atlantic herring.

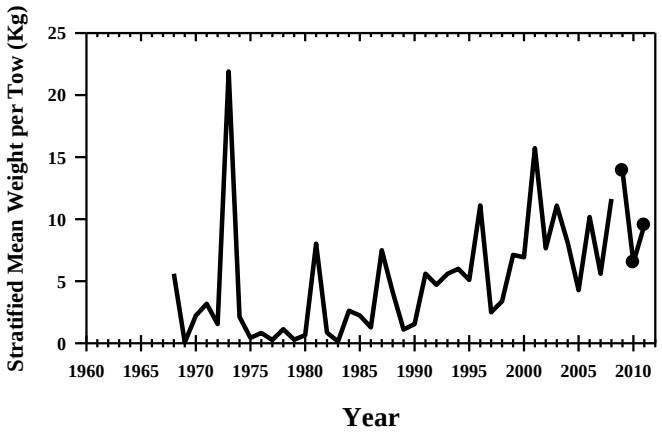

Figure 22. NEFSC spring bottom trawl survey biomass indices for Atlantic mackerel.

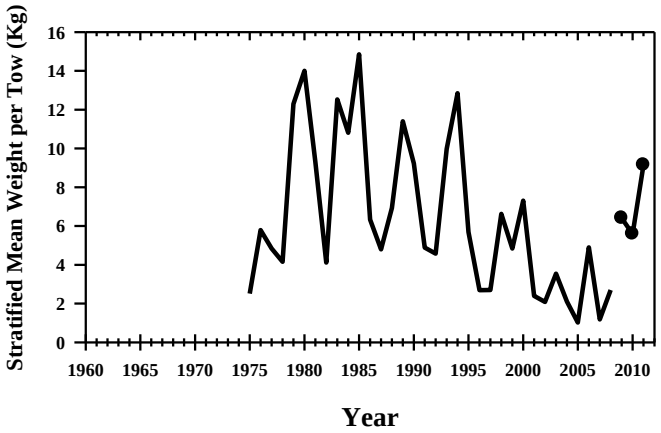

Figure 23. NEFSC autumn bottom trawl survey biomass indices for butterfish.

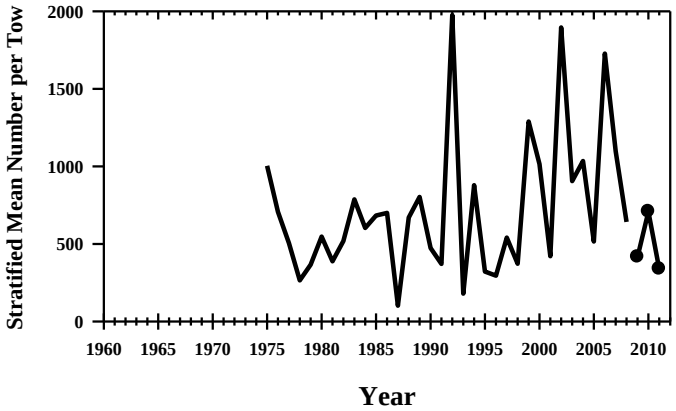

Figure 24. NEFSC autumn bottom trawl survey abundance indices for longfin inshore squid.

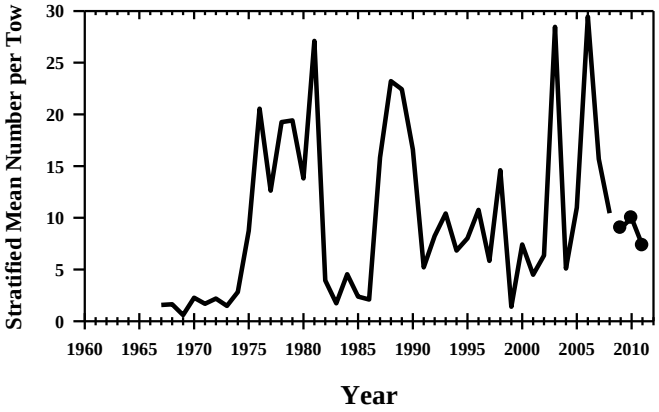

Figure 25. NEFSC autumn bottom trawl survey abundance indices for northern shortfin squid.

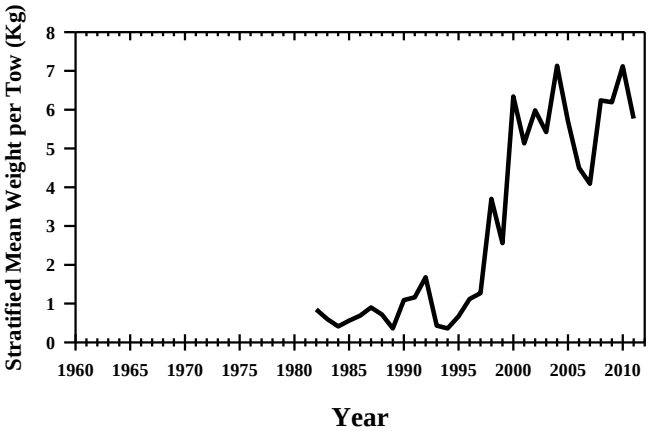

Figure 26. NEFSC scallop survey biomass indices for Georges Bank sea scallops.

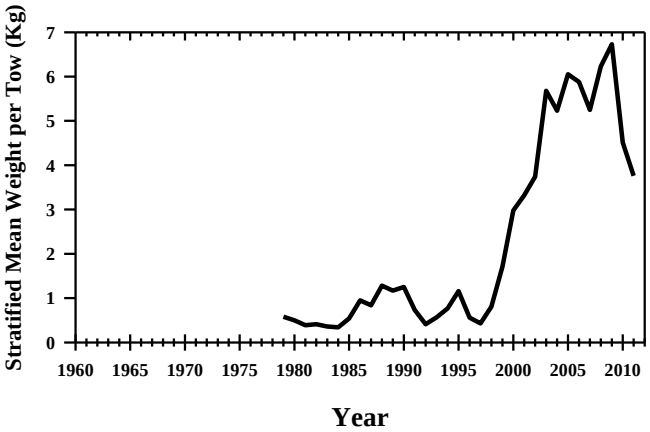

Figure 27. NEFSC scallop survey biomass indices for Mid-Atlantic Bight sea scallops.

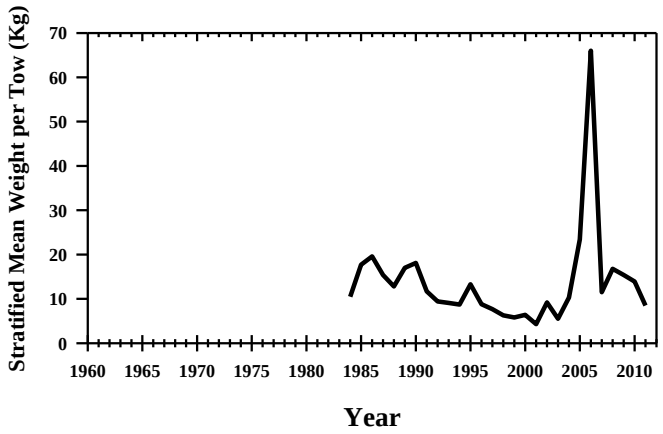

Figure 28. ASMFC summer shrimp survey biomass indices for northern shrimp.

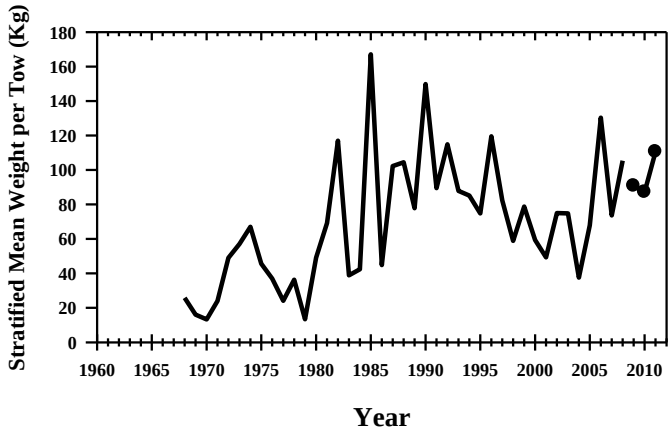

Figure 29. NEFSC spring survey biomass indices for spiny dogfish.

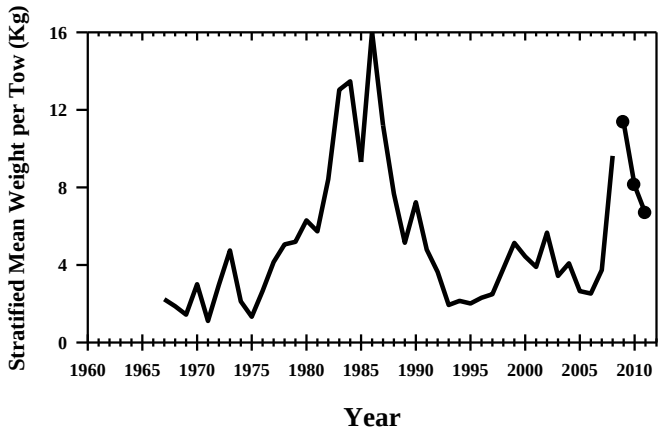

Figure 30. NEFSC autumn survey biomass indices for winter skate.

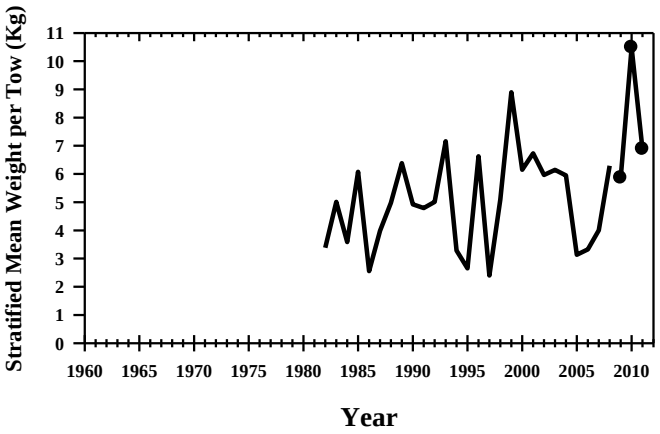

Figure 31. NEFSC spring survey biomass indices for little skate.

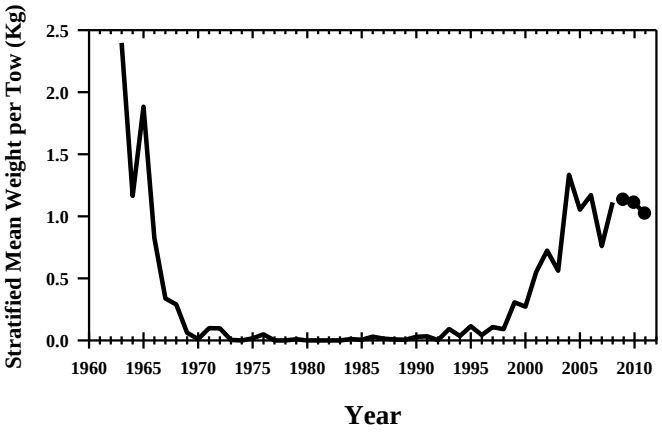

Figure 32. NEFSC autumn survey biomass indices for barndoor skate.

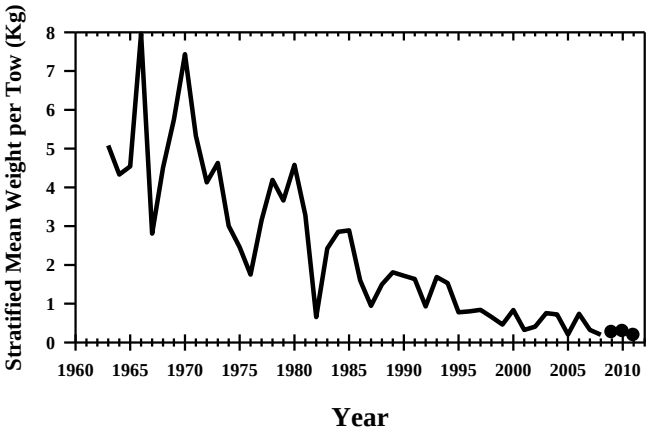

Figure 33. NEFSC autumn survey biomass indices for thorny skate.

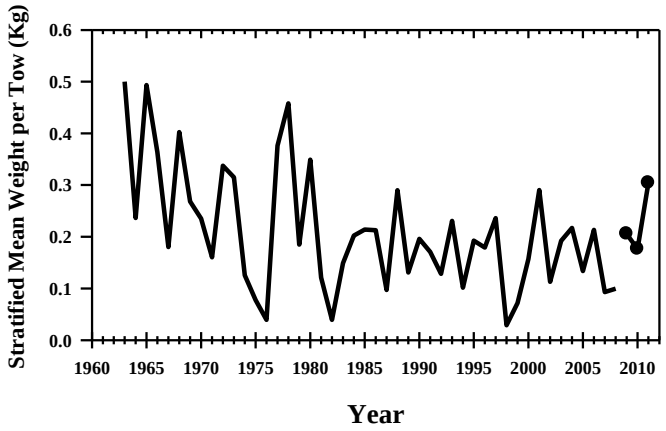

Figure 34. NEFSC autumn survey biomass indices for smooth skate.

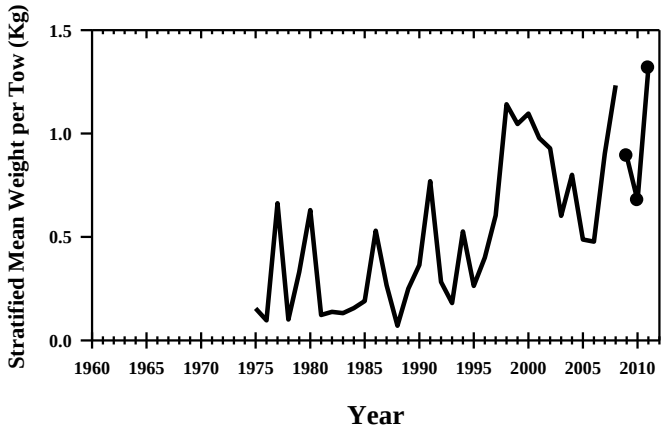

Figure 35. NEFSC autumn survey biomass indices for clearnose skate.

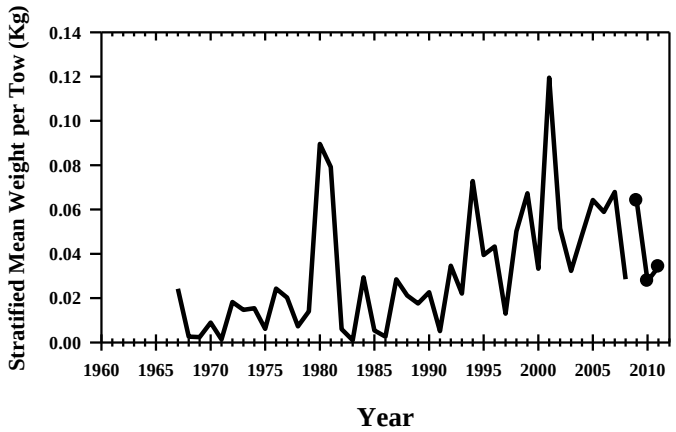

Figure 36. NEFSC autumn survey biomass indices for rosette skate.