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United States Research Report for 2005

by

K.A. Sosebee

NOAA/NMFS, Northeast Fisheries Science Center
Woods Hole, MA 02543, USA
Katherine.Sosebee@noaa.gov

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.

Revised sampling and reporting protocols were implemented in the Northeast Region in 1994 and then again revised in 2004. Auditing and allocation procedures have continued to be 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.

1. **Atlantic Cod**

USA commercial landings of Atlantic cod (*Gadus morhua*) from Subareas 5-6 in 2005 were 6 327 mt, a 13% decrease from 2004 landings of 7 287 mt and a 41% decrease from the 10 692 mt landed in 2003.

USA cod landings from the Gulf of Maine (Div. 5Y) in 2005 were 3 909 mt, a 3% decrease from 3 798 mt landed in 2004. Although discards remain a source of substantial additional mortality on this stock due to the imposition of relatively low trip limits beginning in 1999, discards declined in 2004 coincident with a relaxation of the trip limit. Northeast Fisheries Science Center (NEFSC) research vessel survey biomass indices gradually increased through 2001 following the 1993 record low. 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. The autumn survey index declined in 2005 and is among the lowest in the survey series at about the level of the early 1990s (Fig. 1).

USA cod landings from Georges Bank (Div. 5Z and SA 6) in 2005 were 2 418 mt, a 30% decrease from 3 470 mt landed in 2004 and a 64% decrease from 6 645 mt landed in 2003. The NEFSC research vessel survey biomass indices remained near record-low levels during 1991-2004, with the exception of an increase in the 2002 index, due primarily to a large catch at one station and an increase in the 2004 index as a result of three large tows in three separate strata. The index in 2005 was very near the record-low observed in both 1991 and 2000 (Fig. 2).

2. **Haddock**

USA haddock (*Melanogrammus aeglefinus*) landings decreased 8% from 8 200 mt in 2004 to 7 542 mt in 2005. Georges Bank (Div. 5Z) haddock landings decreased 17% from 6 802 mt in 2004 to 5 617 mt in 2005. Gulf of Maine (Div. 5Y) haddock landings increased by 37% between 2004 and 2005 from 967 mt to 1 320 mt. Landings of both stocks are below historical yields.

Research vessel survey biomass indices increased in 2004 for both the Gulf of Maine and Georges Bank stocks (Fig. 3 and 4). Spawning stock biomass of Georges Bank haddock increased in 2004 and is expected to increase further due to relatively low fishing mortality rates and recruitment of the strong 2003 year-class.

3. **Redfish**

USA landings of Acadian redfish (*Sebastes fasciatus*) increased by 42% from 398 mt in 2004 to 564 mt in 2005. Research vessel survey biomass indices have continued to increase since 1996 (Fig. 5) and remain at levels comparable to the 1960s. The initial increase in abundance first detected in 1996 was due to improved survival of fish from the 1991 and 1992 year-classes. By 2004, the population age structure had broadened to include abundant year-classes from 1992 through 2000 (ages 4 through 12). Stock biomass has remained high due to growth and survival of these year-classes, as well as the 1984, 1985 and 1986 cohorts.

4. **Pollock (4VWX + 5 stock)**

USA landings of pollock (*Pollachius virens*) increased by 29% from 5 070 mt in 2004 to 6 529 mt in 2005. Research vessel survey indices continue to reflect a moderate increase in pollock biomass in Subarea 5 due to improved recruitment (Fig. 6).

5. **White Hake**

USA landings of white hake (*Urophycis tenuis*) decreased by 24% from 3 510 mt in 2004 to 2 661 mt in 2004. Research vessel survey indices declined during the 1990s, increased in 2000 and 2001 due to good recruitment of the 1998 year-class, and have since declined (Fig. 7).

6. **Yellowtail Flounder**

USA landings of yellowtail flounder (*Limanda ferruginea*) decreased 43% from 7 202 mt in 2004 to 4 118 mt in 2005. Research vessel survey indices suggest that the Georges Bank stock (Div. 5Z, E of 69E) is at a moderate biomass level, while the Southern New England-Mid Atlantic stock (Div. 5Z W of 69E and SA 6) remains at an historic low (Fig. 8 and 9).

7. **Other Flounders**

USA commercial landings of flounders (other than yellowtail flounder) from Subareas 3-6 in 2005 totaled 15 525 mt, 11% lower than in 2004. Summer flounder (*Paralichthys dentatus*) (50%), winter flounder (*Pseudopleuronectes americanus*) (24%), witch flounder (*Glyptocephalus cynoglossus*) (17%), American plaice (*Hippoglossoides platessoides*) (9%), and windowpane flounder (*Scophthalmus aquosus*) (<1%) accounted for virtually all of the 'other flounder' landings in 2004. Compared to 2004, commercial landings in 2005 were higher for windowpane flounder (4%) but lower for winter flounder (-25%), American plaice (-21%), witch flounder (-9%) and summer flounder (-1%). Research vessel survey indices in 2005 increased for windowpane, decreased for summer flounder and witch flounder and remained relatively constant for winter flounder and American plaice (Fig. 10-14).

8. **Silver hake**

USA landings of silver hake (*Merluccius bilinearis*) decreased by 21% from 8 573 mt in 2004 to 6 808 mt in 2005. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock varied without trend during 1990-1997, sharply increased in 1998 and have since declined to a record low level during 2005 (Fig. 15). Survey indices for the Southern Georges Bank - Mid-Atlantic stock declined between 1989 and 1996, remained very low during 1997-2000, increased slightly and have been stable for the last couple of years (Fig. 16).

9. **Red Hake**

USA landings of red hake (*Urophycis chuss*) declined 53% from 674 mt in 2004 to 315 mt in 2005. Landings have remained low since 1980. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock increased steadily after the early 1970s, but markedly declined in 2004-2005 (Fig. 17). Indices for the Southern Georges Bank - Mid-Atlantic stock, however, continue to remain at record-low levels (Fig. 18) despite low landings.

10. **Atlantic Herring**

Total USA landings of Atlantic herring (*Clupea harengus*) decreased slightly (2%) from 94 439 mt in 2004 to 92 259 mt in 2005. Commercial landings from Georges Bank increased 50% from 8 952 mt in 2004 to 13 397 mt in 2005. Spawning biomass of the coastal stock complex has increased since 1982 and is currently stable at about 1 million mt. Stock size has increased due to both strong recruitment and reduced fishing mortality on both adult and juvenile herring.

11. **Atlantic Mackerel**

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) declined 23% from 53 724 mt in 2004 to 41 234 mt in 2005. Recreational catch increased 102% from 515 mt in 2004 to 1 042 mt in 2005. Spawning stock biomass in 2005 was estimated at 2.5 million mt. Stock rebuilding since 1981 has resulted from very low fishing mortality rates and the recruitment of several good year-classes (1982, 1999, and 2003).

12. **Butterfish**

USA landings of butterfish (*Peprilus triacanthus*) decreased 21% from 488 mt in 2004 to 386 mt in 2005, most likely due to reduced market demand. Research vessel survey biomass indices increased during the late 1970s, fluctuated during the 1980s, and were presently below the long-term average.

13. Squids

Following a record-high of 26 087 mt in 2004, USA landings of northern shortfin squid (*Illex illecebrosus*) declined by 54% (11 976 mt) in 2005. The NEFSC autumn survey relative abundance indices during 2004 and 2005 (5.1 and 11.0 squid per tow, respectively) were similar to the levels observed during 1991-2002 (Fig. 19). The average weight of individual squid caught during the 2005 autumn survey remained low (67 g) and within the range observed since 2001.

USA landings of longfin inshore squid (*Loligo pealeii*) during 2005 were 16 813 mt, 23% higher than in 2004 (13 712 mt). The NEFSC autumn survey biomass index has fluctuated without long-term trend (Fig. 20).

14. **Sea Scallops**

USA sea scallop (*Placopecten magellanicus*) landings in 2005 were 25 500 mt (meats), a 15% decline from the record 2004 landings (29 260 mt meats), but still well above historical norms. A majority of the 2005 landings (62%) was harvested from the Mid-Atlantic region, but landings on Georges Bank were the highest (9 800 mt meats) since 1990, in part due to limited reopenings of portions of the groundfish closed areas to scallop fishing.

Research vessel surveys in 2005 indicated continued high biomass in both the Georges Bank and Mid-Atlantic regions (Fig. 21 and 22). A substantial portion of the sea scallop biomass in the Georges Bank region was located in the three groundfish closed areas that have been closed to scallop fishing for most of the time since December, 1994. Similarly, a majority of the Mid-Atlantic biomass is in a rotational area off of New Jersey and Delaware that was closed in 2004, where there have been several strong recent year-

classes. Very high densities of scallops were observed in this area in the 2003-2005 surveys, which is planned to be reopened to limited fishing in 2007. Recruitment in 2005 was strong in the southern portions of the Mid-Atlantic, but weak in the northern Mid-Atlantic and on the U.S. portions of Georges Bank.

15. Small Elasmobranchs

USA landings of spiny dogfish (*Squalus acanthias*) increased by 17% from 981 mt in 2004 to 1 150 mt in 2005. Survey indices are highly variable but have generally declined since the early 1990s (Fig. 23).

USA landings of skates (80% landed as unclassified) declined by 15% between 2004 and 2005 from 15,003 mt to 11 355 mt. The landings are sold as wings for human consumption and as bait for the lobster fishery. Research survey biomass indices for winter skate (*Leucoraja ocellata*) peaked in the mid-1980s (Fig. 24) and subsequently declined possibly due to an increase in the directed fishery in the 1990s. During the 1990s, the indices were stable at an intermediate level, but have declined slightly in the last few years. Little skate (*Leucoraja erinacea*) survey indices have generally fluctuated without trend (Fig. 25). Survey indices for barndoor skate (*Dipturus laevis*) declined precipitously in the mid-1960s, remained very low through the late 1980s, and have since increased to about the same magnitude as in the mid-1960s (Fig. 26). Thorny skate (*Amblyraja radiata*) survey indices have declined over the entire time series and are currently near record lows (Fig. 27). Survey indices for smooth skate (*Malacoraja senta*) are highly variable but exhibited a decline in the early part of the time series and have been generally stable for the last 20 years (Fig. 28). Indices for both clearnose skate (*Raja eglanteria*) and rosette skate (*Leucoraja garmani*) have generally increased over the time series with clearnose skate declining in the last couple of years (Fig. 29 and 30).

B. Special Research Studies

1. Environmental Studies

a) Hydrographic Studies

A total of 1996 CTD (conductivity, temperature, depth) profiles were made on NEFSC cruises during 2005. The data were processed and made available via an anonymous FTP site. Data access and reports of the oceanographic conditions indicated by these observations are available at ftp://ftp.nefsc.noaa.gov/pub/hydro/cruise_rpts/2005/. Similar reports have been issued each year since 1991.

b) Plankton Studies

During 2005, zooplankton community distribution and abundance were monitored using 673 bongo net tows taken on seven surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine. The Ship Of Opportunity Program (SOOP), completed twelve transects across the Gulf of Maine from Cape Sable, NS to Boston and twelve transects across the mid-Atlantic Bight from New York to the Gulf Stream during the same time period.

c) Benthic Studies

The NEFSC's James J. Howard and Woods Hole laboratories, working with the U. S. Geological Survey and University of Rhode Island, continued studies (begun in 1999, with some aspects earlier) to describe habitats and determine habitat effects of mobile fishing gears in New England and Mid-Atlantic waters. The objectives of an August 2005 cruise were:

1) Continuation of a long-term study of fishing gear effects in which previously sampled gravel habitats on northern Georges Bank were revisited. The closed area continued to have high abundances of taxa that are sensitive to bottom fishing disturbance, including sea urchins and horse mussels. Emergent epifauna such as sponges and bryozoans were still present but, as seen

in the prior August's cruise, they were less abundant than in the years immediately following the closure. Sites outside the closed area continued to appear heavily disturbed, and the bottom remained mostly bare gravel. 2) Documentation of increased abundance of an invasive tunicate, *Didemnum* sp., over at least 61 square miles of gravel substrate in an area open to fishing on northern Georges Bank, and 21 sq. mi. in an adjacent area closed to fishing. These gravel beds are considered highly productive for fish and scallops, and the tunicate infestation is thought to be unique, the only known occurrence of this magnitude in a major offshore fishing ground. The tunicate species had been present in the area prior to 2002, but had not been noticed. Analysis of seabed video and still photos indicated that in fall 2002 the species occupied at most 10% of the bottom in a few areas, while in 2003 in some places it covered up to 90% of the bottom, over at least a 6.5 square mile area. In August 2004 the tunicate was present over at least 40 sq. mi., again completely covering the bottom at some sites. The increases over time in documented distribution of the species do not necessarily mean its distribution has been increasing, since the more recent cruises have sampled more areas. In 2005 abundance, in terms of size of the tunicate colonies, decreased; we found few areas where it covered all or most of the bottom. There is some evidence that benthic community composition is changing in areas where the tunicate is abundant.

Inshore studies of habitat requirements of resource species and fishing gear effects on habitat were continued. In an area with a winter dredge fishery for blue crabs, *Callinectes sapidus*, effects of a commercial crab rake on beds of amphipod tubes and other habitat features are being documented. The dredging removes the tubes, but the amphipod population is reestablished fairly rapidly. A cooperative project to restore oyster reefs in local estuaries and determine functional value of the reefs to resource species is underway. A Biological Review Team assembled information for determining whether the eastern oyster, *Crassostrea virginica*, should be listed as a threatened or endangered species. However, the petition to list the oyster was later withdrawn. Other ongoing projects are to 1) examine relationships between springtime weather patterns and success of bivalve recruitment over the past two decades, and 2) synthesize information on biology, ecology and fisheries for the bay scallop, *Argopecten irradians*.

2. **Biological Studies**

a) **Fish Species**

Flatfishes: Five themes are being addressed on studies of summer flounder, *Paralichthys dentatus*: 1) the effects of winter temperature regimes on growth, developmental, and mortality rates of eggs, larvae, and juveniles; 2) the role of time and location of spawning on the winter survival of larvae and the spring-summer growth of juveniles; 3) mortality risks of recently settled juveniles due to predation by bay shrimp (*Crangon septemspinosa*), blue crab (*Callinectes sapidus*), and larger summer flounder juveniles; 4) rates of change of stable isotope ratios as indicators of prey consumed, and the potential of these ratios for evaluation of fish habitat usage; and 5) evidence of paternal, maternal and thermal influences and their interactions on early life history traits from embryonic development through larval life and into juvenile life stage, culminating with gender expression.

Gadids: Field and laboratory research continues on Atlantic tomcod *Microgadus tomcod*, a locally abundant inshore gadid. Tomcod has a 1-yr life cycle, is an important forage fish, and serves as a sentry of habitat and fish community health in the Hudson River Estuary (New York, USA). Two concurrent projects on tomcod are underway that address ecological and toxicological themes. Regarding the ecological theme, 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) risk of predation. Regarding the toxicological theme, three source populations – Hudson River, Shinnecock Bay (Long Island, New York) and Miramichi River (New Brunswick, Canada) that differ in contaminant histories are being compared with respect to: 1) uptake and depuration rate 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) tomcod populations; and 3) interactions between environmental stressors, i.e., PCBs and high summer temperatures. The toxicological work in 2006 will include

assessing the combined effects of PAHs and PCBs on ecologically relevant toxic endpoints. Collaborations in 2006-07 with colleagues at New York University include evaluating the incidence of tumors in laboratory-reared F_2 juvenile exposed as embryos and larvae / juveniles to combinations of PAHs and PCBs, and pilot assessments of effects of nanoparticles on tomcod early life stages.

Goosefish: Three themes are being investigated in studies of goosefish, *Lophius americanus*: 1) seasonal and inter-annual patterns of variation in body components with emphasis on the relationship between gonad size (reproductive effort) and liver size in the previous year; 2) temperature-dependent growth, developmental, and survival rates of the early life-stage goosefish from captive-spawned egg veils; and 3) movement, feeding, and spawning behavior of captive, wild-caught adult goosefish.

Weakfish: Field collections and laboratory processing are continuing in a recruitment study of weakfish, *Cynoscion regalis*. The thrust of this work is to 1) describe the demographic structure of spawners in the local system (Hudson River estuary and nearby coastal waters); 2) investigate the pattern of mortality of young-of-the-year based on hatching dates and growth rates derived from otolith microstructure; and 3) evaluate whether differences in survival are related to maternal sources of variation in the timing spawning and the quality of eggs. Juvenile weakfish are being evaluated for evidence of selective mortality during their first season of growth.

Hudson River Estuary Ecosystem: Field and laboratory evaluations of patterns of abundances of the ichthyofauna of the Hudson River Estuary Ecosystem and processes that affect these abundances are ongoing. Regular (monthly) sampling of the estuary from April through October has been conducted since 1999. These data, along with others from earlier federal projects and with ongoing surveys by state and private concerns, are being analyzed for community wide patterns in general, and the association between target species and habitat variables in particular.

b) **Resource Surveys Cruises**

During 2005, personnel from the Ecosystems Surveys Branch (ESB) staged, staffed and supported the winter, spring and fall bottom trawl surveys, northern shrimp, surf clam, sea scallop, hydroacoustic, and gear experiment surveys for a total of 229 research vessel sea days and and 2 674 scientific staff sea days with an additional 33 ESB staff sea days spent on non-ESB surveys and 142 ESB staff sea days on cooperative research surveys and projects. 1865 ESB stations were occupied in an area extending from Cape Hatteras, North Carolina to Nova Scotia including the Gulf of Maine. A total of 115 720 length frequencies were taken from 333 species during these cruises.

Significant sampling effort was also expended to fulfill requests from 55 NMFS and University investigators for samples or observations made during the various survey cruises. These included 14 675 feeding ecology observations, 20 306 aging structures collected, and 23 362 samples or individual specimens collected.

Major progress was made in cooperation with leading industry and commercial stakeholders to determine the final net configuration and door type of the trawling gear that will be used aboard the new research vessel, Henry B. Bigelow. A new electronic clam measuring board device was developed and successfully implemented during the surf clam survey which minimized processing time. A grant to develop an imaging system to measure scallops was accepted and a prototype continues to be tested.

c) **Age and Growth**

Approximately 65 000 age determinations for 14 species of finfish and shellfish were completed in 2005 by Woods Hole Laboratory staff in support of resource assessment analyses. In addition to Atlantic cod (8 780), haddock (5 182), and yellowtail flounder (5 514), 9 805 winter flounder, 6 483 summer flounder, 6 003 American plaice, 6 986 silver hake, and 6 046 Atlantic mackerel were aged. Age determinations for witch flounder, Acadian redfish, Atlantic herring, pollock, scup, and Atlantic surf clam totaled 10 480.

Cod and haddock age structures were exchanged with age readers from Canada's Department of Fisheries & Oceans St. Andrews Biological Station in a continuing effort to maintain comparability of age determinations between laboratories. The Woods Hole Laboratory convened an Atlantic surfclam Aging Workshop in November 2005 to standardize ageing methodologies among agencies and institutions ageing surf clams and to discuss generic surfclam ageing research issues.

Research projects completed in 2005 included the development of a template to calculate age reader accuracy, precision, and bias statistics and its implementation into production ageing and reference collection protocols.

d) **Food Web Dynamics**

The NEFSC continued studies of 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 and Mid-Atlantic continental shelf during NEFSC winter, spring, and autumn surveys. Estimates of prey volume and composition were made at sea for selected species. During the 2005 winter survey, 2 791 stomachs from 43 species were examined, while 5 218 stomachs from 50 species, and 6 286 stomachs from 58 species were examined during the spring and autumn 2005 surveys, respectively. Diet sampling emphasized small pelagics, elasmobranchs, gadids, flatfishes, and lesser known species.

The 33 year time series (1973-2005) 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 500 000 stomach samples. The processing of the 2005 and 2006 bottom trawl survey food habits data is scheduled for completion in 2006.

Staff published several papers and reports on a wide range of trophic ecology issues in the Northwest Atlantic ecosystem. Other published papers addressed the theoretical and practical implications and implementation of ecosystem-based fisheries management. Since trophic interactions are central to food web and ecosystem considerations, research continues with respect to fish production, fisheries reference points, system-wide productivity, and essential fish habitat.

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 (CSTP), 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 2005. Information was received on over 5 000 tagged and 400 recaptured fish bringing the total numbers tagged to 194 000 sharks of more than 50 species and 11 600 sharks recaptured of 33 species.

A comprehensive aging and validation study for the shortfin mako, *Isurus oxyrinchus*, in conjunction with scientists at Moss Landing Marine Laboratories, California using bomb carbon techniques was concluded. The two papers resulting from this work were presented at the American Elasmobranch Society meetings in July 2005 and submitted to the symposium to be published in the journal Environmental Biology of Fishes. Aging studies of the thresher shark, *Alopias vulpinus*, have been concluded and were presented at the AES meeting, and a manuscript is being formatted for publication. Radiocarbon validation studies were continued on the sandbar shark, *Carcharhinus plumbeus*, though this species does not appear suitable for this technique. Validation of aging techniques for the tiger shark, *Galeocerdo cuvier* was concluded (with scientists at the University of New Hampshire) and a manuscript is being finalized for publication.

In 2005, landings information and biological samples for age and growth, feeding ecology, and reproductive studies and catch data for pelagic sharks were collected at recreational fishing

tournaments in the Northeastern United States. The collection and analysis of these data are critical for input into species and age specific population and demographic models for shark management.

Reproductive dynamics and nursery ground studies also continued, focusing on the identification and characterization of mating, pupping, and nursery areas of small and large coastal sharks along the Atlantic coast of the US. An ongoing project to study the diet, gastric evacuation, and feeding ecology of elasmobranchs in the Delaware Bay nursery found that sandbar and smooth dogfish sharks contained 54% and 98% food, respectively. Gastric evacuation experiments have been initiated in 2005. Random stratified sampling based on depth and geographic location continued towards developing a time series to estimate and monitor the relative abundance and population size of sandbar sharks in Delaware Bay throughout the nursery season and from year to year.

A collaborative program to examine the biology and population dynamics of the blue shark, *Prionace glauca*, and shortfin mako, *Isurus oxyrinchus*, in the North Atlantic continued in 2005. Research on the food and feeding ecology of these two shark species is being conducted cooperatively with University of Rhode Island staff with additional samples collected through the 2004-2005 field season. A detailed reexamination of the reproductive parameters of the blue shark continued with collection of additional biological samples to determine if any changes have occurred since the 1970s. A manuscript is in press on blue shark stock structure based on tagging data detailing size composition and movements between Atlantic regions. Progress continued on a population dynamic study for the blue shark and shortfin mako in the North Atlantic with the objectives of constructing a time series of blue shark catch rates (CPUE) from research surveys, and estimation of migration and survival rates. This study is critical for use in stock assessment and is being conducted in collaboration with scientists at the School of Aquatic and Fishery Sciences, University of Washington and the Graduate School of Oceanography, University of Rhode Island.

f) **Marine Mammals**

Small Cetaceans: During 5-25 July 2005, the NOAA R/V *Delaware II* was used to biopsy and photograph pilot whales (*Globicephala* spp.) from the southern portion of Georges Bank to Cape Hatteras, North Carolina concentrating off the US continental shelf. This overlapped similar work prosecuted by the SEFSC off the R/V *Gordon Gunter* that concentrated on the slope edge. Collected tissues will be used to determine the distribution and geographic overlap of long-finned (*Globicephala melas*) and short-finned pilot whales (*G. macrorhynchus*) during the summer survey period. A secondary objective was to collect biopsy samples of other cetaceans for which additional stock identification data would be useful [e.g. sperm whales (*Physeter macrocephalus*) and striped dolphins (*Stenella* spp.)].

Incidental by-catches of cetacean, turtle, and seal species that were observed taken in commercial fisheries from Maine to North Carolina were estimated. Fisheries observed during 2005 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, hand-line, troll line, and some pot and traps. Cetaceans observed taken included: harbor porpoises, bottlenose dolphins, common dolphins, white-sided dolphins, Risso's dolphins, pilot whales, and a minke whale. In addition, incidental fishery takes of harbor seals, grey seals, harp seals, hooded seals, loggerhead turtles, green turtles, Kemps Ridley turtles, and leatherback turtles were observed.

Large Cetaceans: During 13 January-17 March 2005, NEFSC and SEFSC staff conducted the second field season of a biopsy and photo-id survey of humpback whales on Silver Bank off the Dominican Republic using the R/V *Gordon Gunter*. Silver Bank is an important breeding and calving area for much of the North Atlantic humpback whale population and the survey was designed to estimate the size of that West Indies breeding population.

Using R/V *Albatross IV*, the NEFSC, in conjunction with the Woods Hole Oceanographic Institution, conducted a habitat sampling and tagging study to better understand right whale foraging behavior in the Great South Channel area off Massachusetts, USA. Conducted during four weeks in May 2005, this

was the second such survey; a third survey will be performed during May 2006. In August, oceanographic sampling was conducted in primary right whale foraging areas in the Bay of Fundy and Roseway Basin, off the coasts of Nova Scotia, Canada.

During all months of 2005, the NEFSC conducted aerial sighting surveys for right whales in the Great South Channel, Gulf of Maine, and Georges Bank areas. These surveys included directed surveys, as well as broad-scale tracks designed to assess both presence and absence of right whales (and other cetaceans) over the entire Gulf of Maine region. The NEFSC also conducted a four-week right whale habitat research cruise in the Gulf of Maine and Bay of Fundy regions in August 2005 as part of continuing evaluation of right whale critical habitat and predictive modeling ventures.

Scarification analyses of right and humpback whales continued in 2005. These analyses are used to monitor interactions between whales and fishing gear.

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

Pinnipeds: A total of seventeen aerial surveys were conducted in 2005. Nine flights focused on gray seal pupping sites (Muskeget Island and Monomoy National Wildlife Refuge in Nantucket Sound; Seal and Green Islands in eastern Maine). Eight surveys covered sections of the Massachusetts coast between Plymouth and Noman's Island to monitor harbor seal and gray seal trends at major haul out sites.

Research partners at University of Massachusetts, Boston and University of Maine captured and satellite tagged a weaned gray seal pup "Stephanie" in eastern Maine in February 2005. The animal traveled along portions of the Maine and Massachusetts coasts, Georges Bank and the western Scotian Shelf. Details are available at: http://whale.wheelock.edu/whalenet

g) **Turtles**

The NEFSC collaborated with several academic and industry groups to assess and reduce sea turtle by-catch in domestic commercial fisheries in the Northwest Atlantic Ocean. The three main fisheries dealt with in 2005 were the Atlantic sea scallop fishery, the Atlantic bottom trawl fisheries, and the Chesapeake Bay pound net fishery.

In the Atlantic sea scallop fishery, NEFSC undertook both by-catch analysis and gear research. Observed turtle interactions with commercial vessels in the 2004 U.S. sea scallop dredge fishery were used to estimate by-catch of sea turtles from June through November 2004 in the Mid-Atlantic region. The study identified environmental factors that influence by-catch rates of sea turtles. A gear research team examined a modified scallop dredge frame in an experimental setting and later completed preliminarily field trials to examine changes in target catch when the modified dredge was used in the fishery. Video projects recorded information about how the dredge fishes, but were not able to capture any turtle/gear interactions. The NEFSC is continuing to work with scallop fishing industry participants to better observe, analyze, and mitigate turtle-dredge interactions.

NEFSC also undertook both by-catch analysis and gear research in the Atlantic bottom trawl fisheries. NEFSC assembled datasets for by-catch analysis and completed a preliminary estimate of the magnitude of sea turtle by-catch during the last decade in bottom trawl fisheries. A cooperative effort between the National Marine Fisheries Service, the New England and Mid-Atlantic trawl fishing industry, and the University of Rhode Island resulted in a workshop to explore potential gear modifications to reduce turtle by-catch in bottom trawl fisheries.

Final field testing of a modified pound net leader occurred in the Chesapeake Bay during the summer of 2005. In May and June 2005, a 56-day study was conducted to test a pound net leader which had been modified to reduce the likelihood of sea turtle interactions. During the study, both standard leaders and modified leaders were fished in close proximity, and sea turtle and fish catch were

recorded. Several sea turtles were observed in the traditional leader, but none were observed in the modified leader. The success of the modified leader in retaining target catch and reducing sea turtle by-catch led to the promulgation of a proposed rule to allow fishing to continue if the modified leader is used.

3. **Studies of Fishing Operations**

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

The NEFSC deployed observers on 1 254 commercial fishing trips with a total of 5 397 gear retrievals in the New England and Mid-Atlantic gillnet fisheries. Primary objectives were to monitor the incidental by-catch of marine mammals and sea turtles. A total of 177 marine mammals were caught, including (in order of highest occurrence) harbor porpoises, harbor seals, and gray seals. Two turtles were taken (one green turtle and one loggerhead turtle). From most of the animals, biological samples were collected including body weight measurements, tissue samples, or collection of the entire animal. A total of 44 seabirds were also caught.

b) **Float Drift Gillnet Fisheries**

The closure of the pelagic swordfish drift gillnet fishery continued in 2005. Eleven trips were observed with a total of 36 gear retrievals. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish. No protected species, endangered species or seabird takes occurred in this fishery.

c) **Otter Trawl Fisheries**

A total of 1 935 bottom otter trawl trips were observed with a total of 26 695 gear retrievals. In addition, there were 49 midwater trawl trips with 148 gear retrievals, 139 scallop trawl trips with 480 gear retrievals and 19 shrimp bottom otter trawl trips with 63 gear retrievals. Kept and discarded catches were weighed or estimated. Length frequencies and age structures were obtained for age and growth studies. A total of 164 marine mammals, two loggerhead turtles and one unidentified turtle and 10 seabirds were incidentally caught in the otter trawl fisheries. No protected species were caught in the midwater trawl fishery. Five loggerhead turtles were observed taken in the scallop bottom otter trawl fishery. Three greater shearwater and one herring gull were caught in the shrimp bottom otter trawl fishery.

d) Sea Scallop Fisheries

In 2005, 343 trips were observed with a total of 21 713 gear retrievals. The scallop catches were measured and weighed. The finfish by-catch was also weighed, and size frequency and age structure data collected from a portion of the hauls. One unidentified dolphin, two loggerhead turtles and one Kemp's Ridley turtle were caught. Three seabirds (two great black back gulls and one common loon) were taken.

e) **Conch Pot Fishery**

One conch pot trip with 14 gear retrievals was observed in 2005. No protected species were incidentally caught in this fishery.

f) **Scottish Seine Fishery**

No Scottish seine trips were observed in 2005.

g) **Sink Drift Gillnet**

NEFSC observers covered 318 trips with a total of 1 550 gear retrievals in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. Twenty-nine marine mammals were observed taken in this fishery. Seven seabirds (three sooty shearwater, three unidentified shearwaters, and one greater shearwater) were caught in this fishery.

h) **Anchored Floating Gillnet**

Twelve anchored floating gillnet trips with a total of 24 gear retrievals were observed in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. One unidentified dolphin was observed taken in this fishery.

i) **Midwater Pair Trawl**

A total of 131 pair trawl trips with 352 gear retrievals were observed in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. Eight Atlantic whitesided dolphins and 16 northern gannets were incidentally caught in this fishery.

j) **Bottom Longline Fishery**

In 2005, observers were deployed on 299 bottom longline trips with a total of 1 497 gear retrievals. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. No protected or endangered species were observed to be taken in this fishery. Twenty-six seabirds were caught.

k) **Beach Haul Seine**

Twenty-nine beach anchored gillnet trips were observed in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. No protected or endangered species were observed to be taken in this fishery.

l) **Pound Net**

One pound net trip with one gear retrieval was observed in 2005.

m) Handline

No handline trips were observed in 2005. However, there were 44 gear retrievals on trips with a different primary gear (i.e. gillnet, trawl, etc.). There were four trips using troll line gear with a total of 22 gear retrievals. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. No protected or endangered species were observed to be taken in these fisheries.

n) Herring Purse Seine

Fifty-four trips with a total of 102 gear retrievals were observed in this fishery in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. Twenty-five seals were caught in this fishery (19 gray seals, four harbor seals and two unidentified seals).

o) **Lobster Pot**

Five trips with a total of 203 gear retrievals were observed in this fishery in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. No protected or endangered species were observed to be taken in this fishery.

p) **Fish Pot**

Six trips with a total of 33 gear retrievals were observed in this fishery in 2005. Kept and discarded finfish were weighed or estimated for a portion of the observed sets. Length frequencies and age structures were also obtained from the finfish catch. No protected or endangered species were observed to be taken in this fishery.

q) **Clam Dredge**

A total of 38 clam dredge trips were observed in 2005. The clam catches were measured and weighed. The finfish by-catch was also weighed, and size frequency and age structure data collected from a portion of the hauls. No protected species takes occurred in this fishery.

4. **Population Dynamics Research**

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; many require annual 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). Two such workshops are conducted annually, with the focus of the workshops being the review of Abenchmark@ assessments (e.g., those using new analytical approaches, or for species that have never been assessed quantitatively or for which peer reviewed assessments have not occurred for several years). The SAW reviews about 10 stock assessments each year. However, not all assessments conducted by the NEFSC are vetted at the SAW. Some are reviewed in international fora (e.g. US/Canada Transboundary Resources Assessment Committee [TRAC]; ICES; etc), while others are vetted in regional bodies (e.g., ASMFC science boards; Management Council Plan Development Teams, etc). Apart from stock assessment research for management purposes, population dynamics research in 2005 focused on a number of other management and scientific issues. Five such areas are highlighted:

a) **Atlantic Salmon Research**

Atlantic salmon in eight rivers of Maine have been formally listed as endangered under the United States Endangered Species Act, and a biological review is being conducted on the remaining Atlantic salmon populations in the State. 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, in estuaries, and at sea. These data are used extensively in support of ICES/NASCO stock assessment activities.

Field research in 2005 focused on obtaining smolt production estimates, telemetry studies of emigrating hatchery and wild smolts, fishery-independent sampling through marine smolt trawling surveys and 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 smolt emigration and adult

returns in relation to stocking practices. Preliminary analysis of the data from these studies has identified differential migration success in relation to stocking location and time. The effect that stocking location and time has on marine survival will also be evaluated via subsequent adult returns of marked hatchery fish. 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) are being further investigated through follow-up studies. A fishery-independent trawl survey, incorporating a modified Norwegian designed trawl net with a hard cod-end aquarium for live capture and release capabilities, has allowed researchers to obtain specimens from the marine environment. Samples obtained from this survey will be used to evaluate the effects that stocking time and location have on survival in the nearshore environment as well as evaluate the physiological health and condition of these fish. Monitoring the West Greenland fishery and collecting biological data and statistic continued as well. These data are provided directly to ICES and are required for North American run-reconstruction modeling and catch advice generation for this fishery. All of these studies will contribute to recommendations for additional measures to be considered to halt the decline and restore the resource.

b) **Study Fleet**

Phase II of the Study Fleet program was completed in May 2005. The two primary program objectives were to: 1) assemble a "study fleet" of commercial vessels from the southern New England and Gulf of Maine region capable of providing high resolution (temporal and spatial) self-reported data on catch, effort and environmental conditions while conducting "normal" fishing operations; and 2) develop and implement an electronic reporting system for the collection, recording, and transferring of more accurate and timely fishery-based data. An electronic logbook system (ELB) had been developed capable of collecting detailed information on individual fishing efforts (hauls, tows, sets, etc.) such as gear characteristics, effort timing and location, catch and discard (species and weight on an individual effort basis), and environmental factors (temperature). The logbook was deployed on 33 different fishing vessels over a two and half year period resulting in the recording of over 1100 fishing trips and 5600 individual efforts.

Data analyses of Phases I and II data have been completed and Phase III of the program is currently being planned. Phase III will focus on improving the ELB technology, collecting finer information on gear characteristics, improving discard estimation and increasing the amount of environmental information captured. Phase III fleet deployment will be concentrate on small (<20 vessels) data-poor fisheries which lack sufficient observer coverage in an attempt to improve estimates of fishing effort.

c) **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. This provides some indication of the robustness of conclusions regarding stock status. To this end, NEFSC researchers have been collaborating with other NOAA fisheries scientists to develop a standardized suite of methods collected into a software Atoolbox@. The NOAA Fisheries Toolbox (NFT) incorporates classical methods such as ADAPT -VPA, reference point estimation, surplus production and forward-projection methods into a stable environment with tested software products. The NFT will be used for most routine assessment tasks. Work on the package continues to incorporate more modules, to test software for reliability and to make the NFT more user friendly. A total of 14 packages are now included in the toolbox. Additional modules are under development. The population simulator has been enhanced to allow for model testing with multiple stochastic realizations of simulated datasets. No additional programming is required by the user to test performance of several models to recover the true underlying parameters. The complete package may be accessed at http:/nft.nefsc.noaa.gov (username: nft, password: nifty).

In 2005 the NFT introduced new versions of the ASPIC, ASAP, STATCAM, POPSIM, CSA and VPA/ADAPT models. The ASPIC, ASAP and POPSIM models were major upgrades to previous

versions including improved graphics and enhanced calculation capabilities. The population simulator model, POPSIM now includes the capability of generating a synthetic population using length based as well as aged based input. STATCAM and VPA/ADAPT were upgraded to improve the user interface. The new CSA model calculation engine incorporates an exact solution of the catch equation in addition to Pope's approximation previously available. In 2006 it is anticipated that the Stock Synthesis-2 model will be added to NFT Toolbox as well as continuing enhancements to other models.

d) **Biological Studies**

Ongoing sea scallop research at NEFSC includes investigations into the effects of predators on sea scallop recruitment, analyses of spatial management measures including both rotational and long-term closures, verification of shell aging techniques, photographic methods of enumerating scallops and other benthic invertebrates, and dynamic length-based stock assessment models.

e) **Ecosystem Studies**

Energy Modeling and Analysis eXercise (EMAX) is a focused ecosystem study being conducted by the NEFSC. It is a network analysis food web model (aka a more nuanced energy budget). It includes the entire NE US continental shelf, broken into 4 subregions with 34 network "nodes" or biomass state variables across a broad range of biology. The emphasis is on the role of small pelagics, with some pseudo-dynamic scenarios executed. Interactions among targeted and protected species are explicitly included. This work is highly interdisciplinary and involves personnel from most of the Center's Divisions.

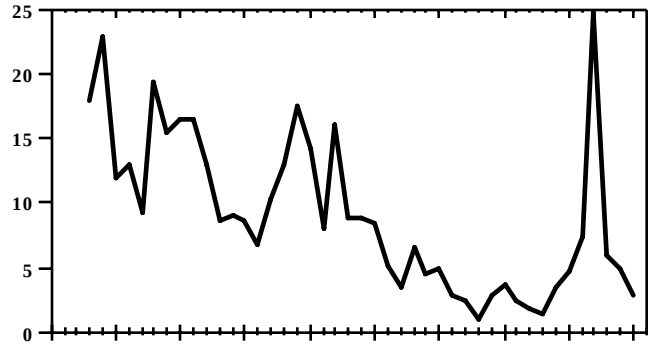

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

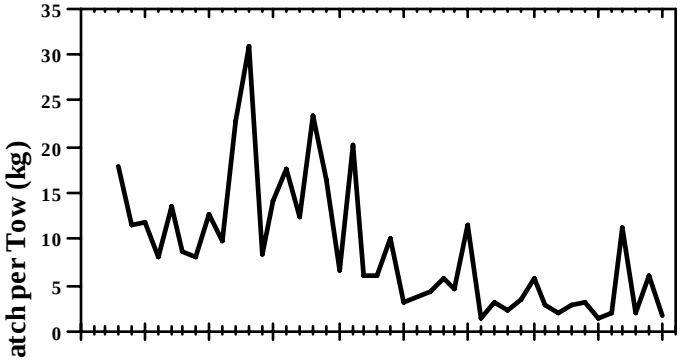

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

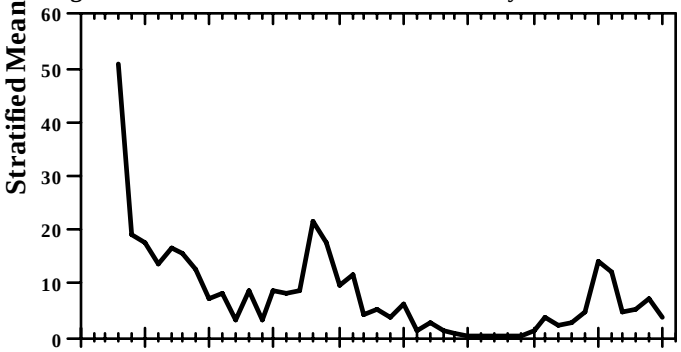

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

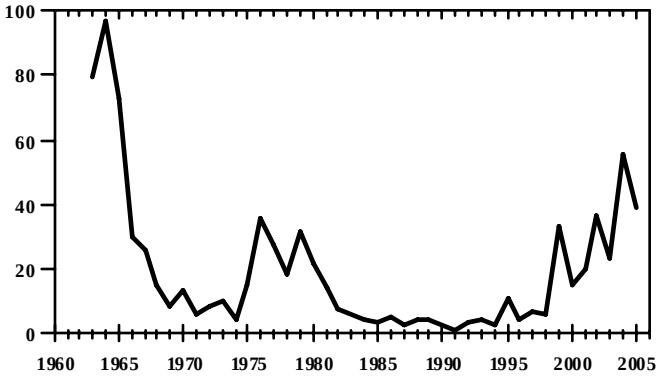

Figure 4. NEFSC autumn bottom trawl survey biomass indices for Georges Bank haddock.

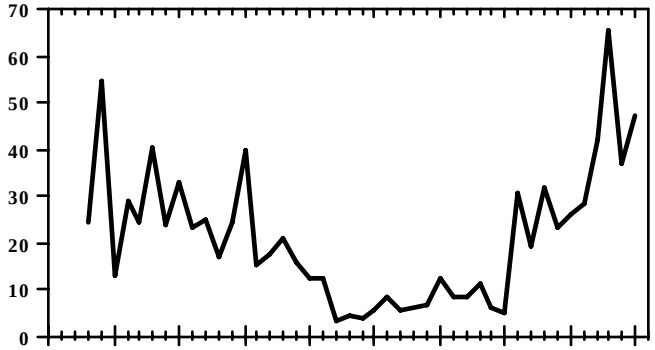

Figure 5. NEFSC autumn bottom trawl survey biomass indices for redfish.

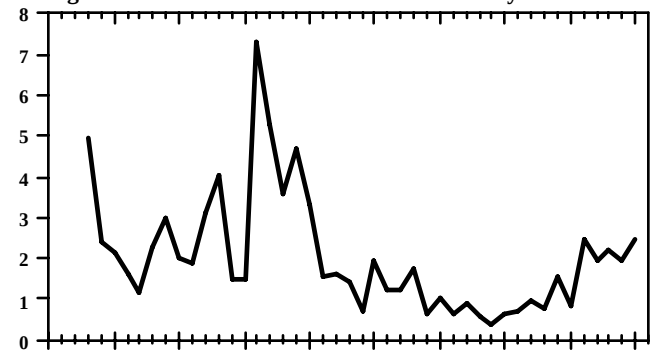

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

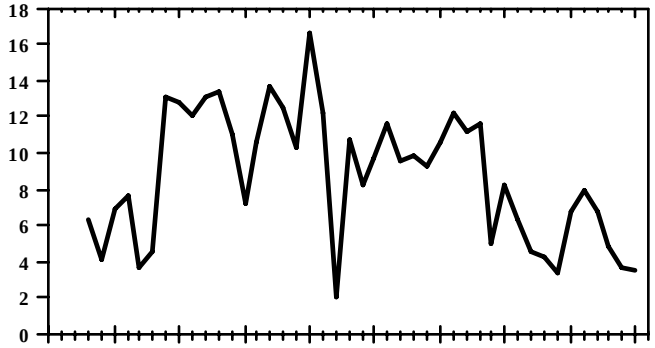

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

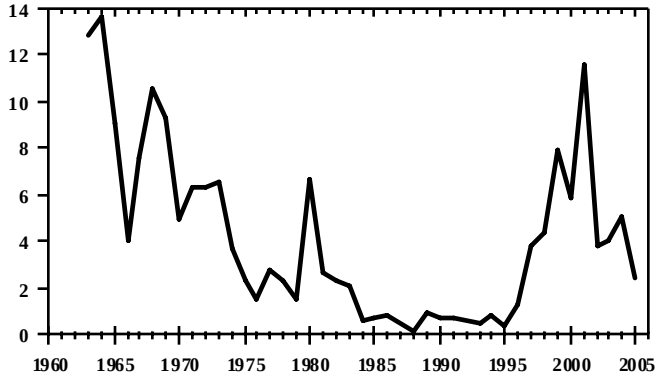

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

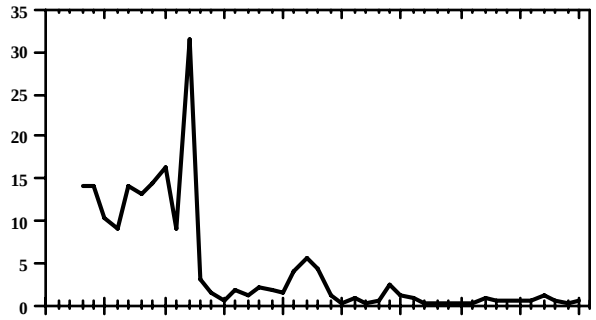

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Southern New England-Mid-Atlantic yellowtail flounder.

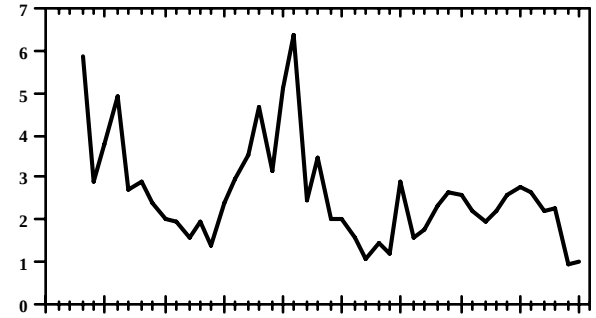

Figure 10. NEFSC autumn bottom trawl survey biomass indices for American plaice.

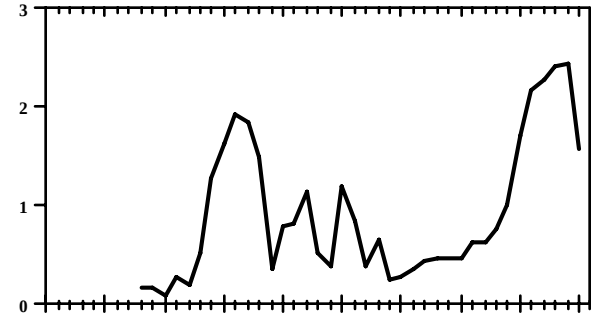

Figure 11. NEFSC spring bottom trawl survey biomass indices for summer flounder.

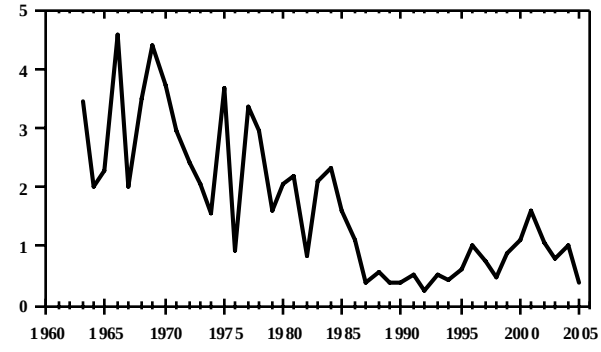

Figure 12. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

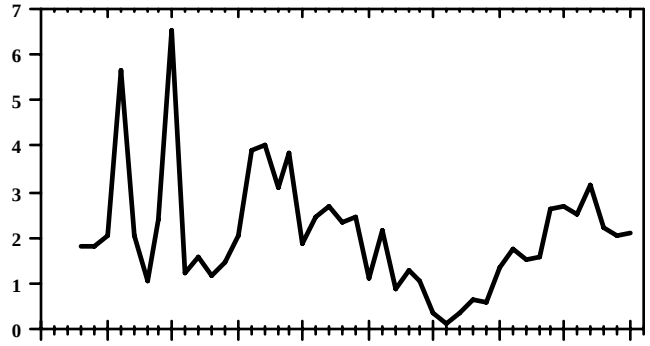

Figure 13. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

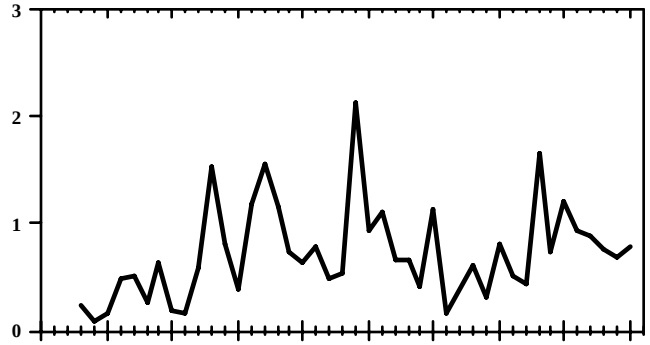

Figure 14. NEFSC autumn bottom trawl survey biomass indices for northern windowpane flounder.

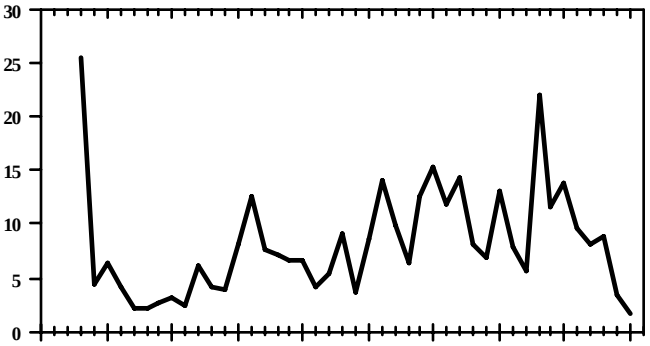

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

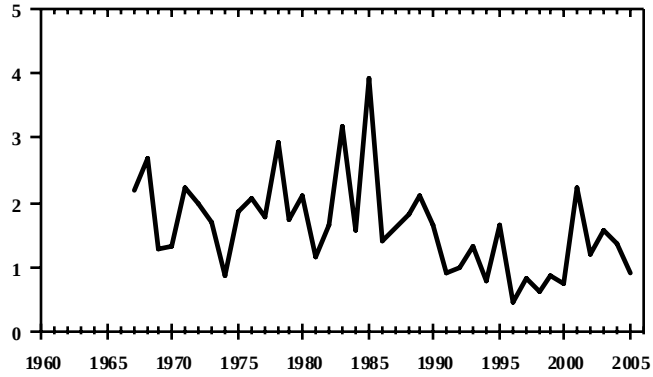

Figure 16. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

Stratified Mean Catch per Tow (kg)

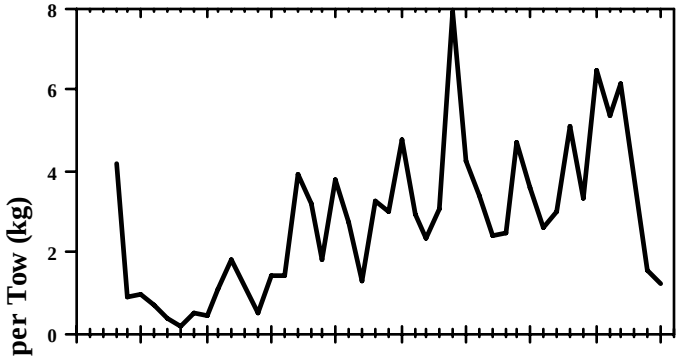

Figure 17. NEFSC autumn bottom trawl survey biomass indices for northern red hake.

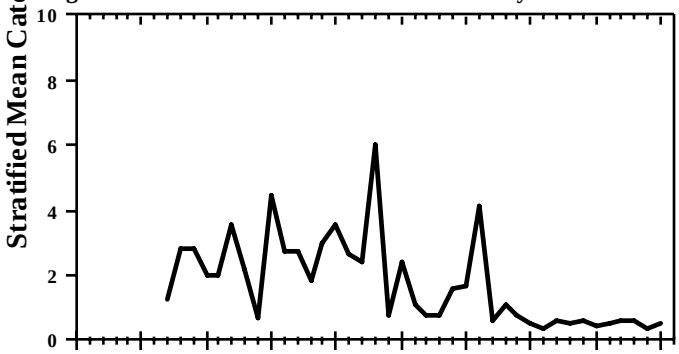

Figure 18. NEFSC autumn bottom trawl survey biomass indices for southern red hake.

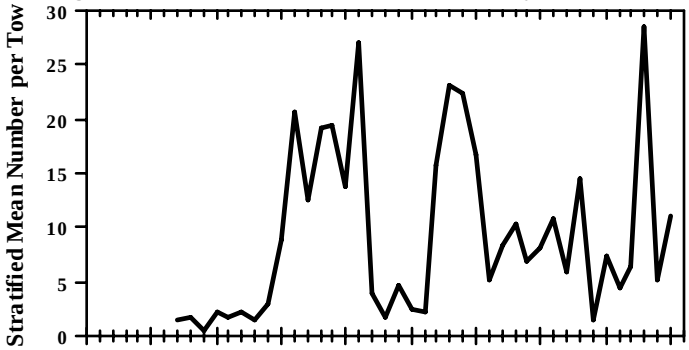

Figure 19. NEFSC autumn bottom trawl survey abundance indices for *Illex*.

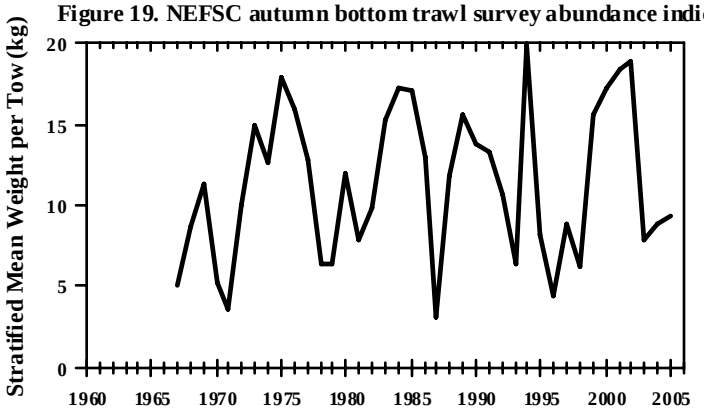

Figure 20. NEFSC autumn bottom trawl survey biomass indices for *Loligo*.

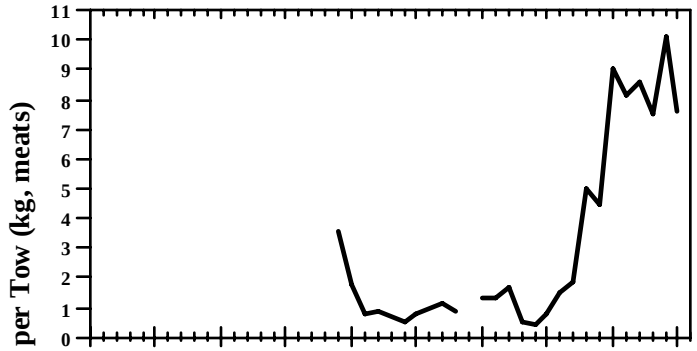

Figure 21. NEFSC scallop survey biomass indices for Georges Bank sea scallops.

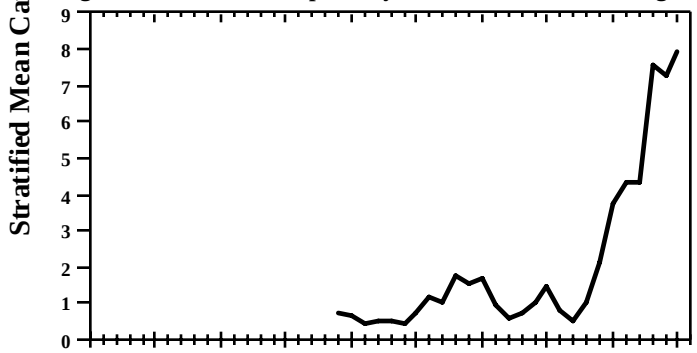

Figure 22. NEFSC scallop survey biomass indices for Mid-Atlantic Bight sea scallops.

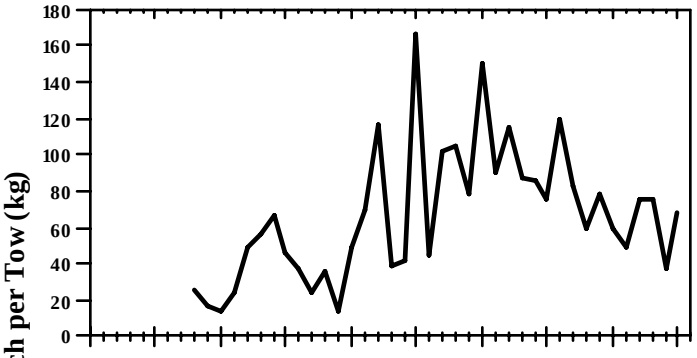

Figure 23. NEFSC spring survey biomass indices for spiny dogfish.

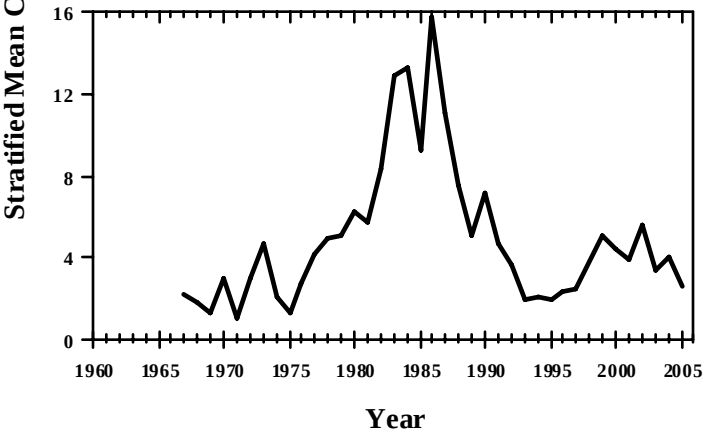

Figure 24. NEFSC autumn survey biomass indices for winter skate.

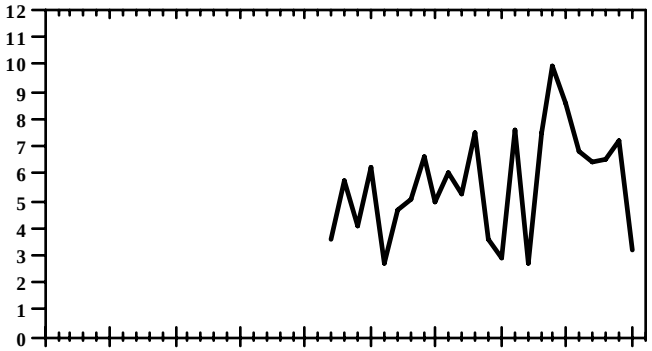

Figure 25. NEFSC spring survey biomass indices for little skate.

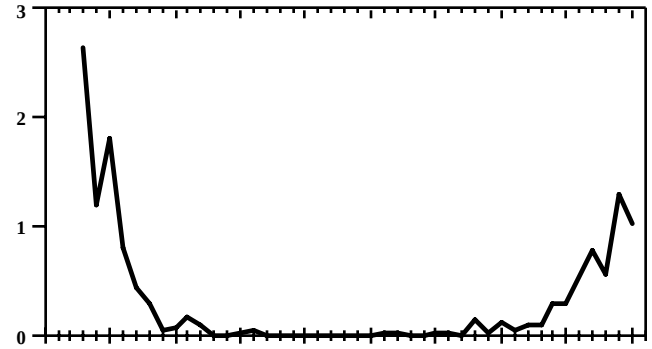

Figure 26. NEFSC autumn survey biomass indices for barndoor skate.

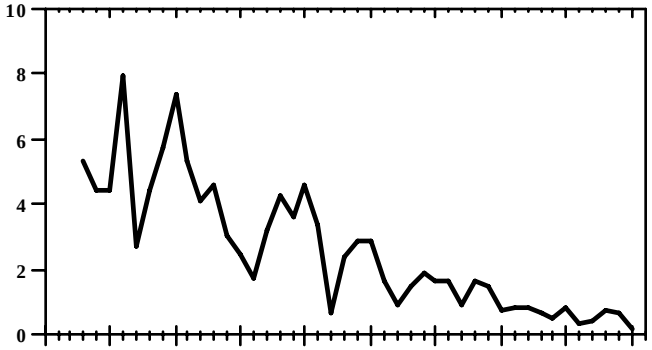

Figure 27. NEFSC autumn survey biomass indices for thorny skate.

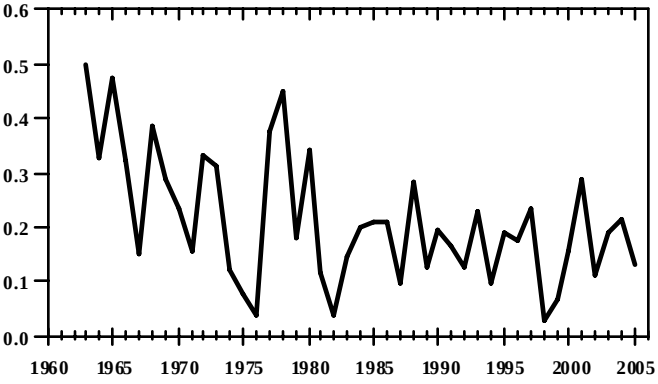

Figure 28. NEFSC autumn survey biomass indices for smooth skate.

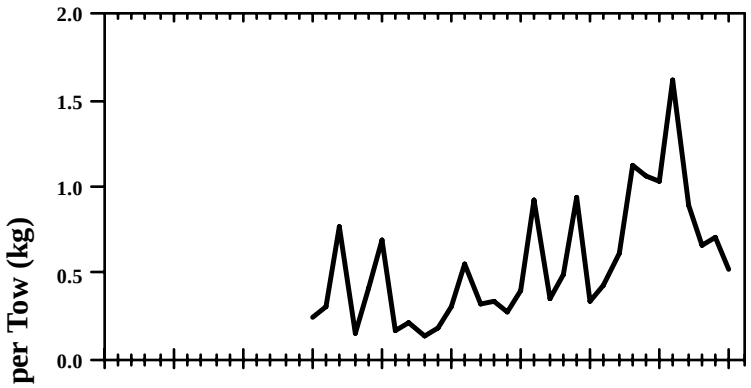

Figure 29. NEFSC autumn survey biomass indices for clearnose skate.

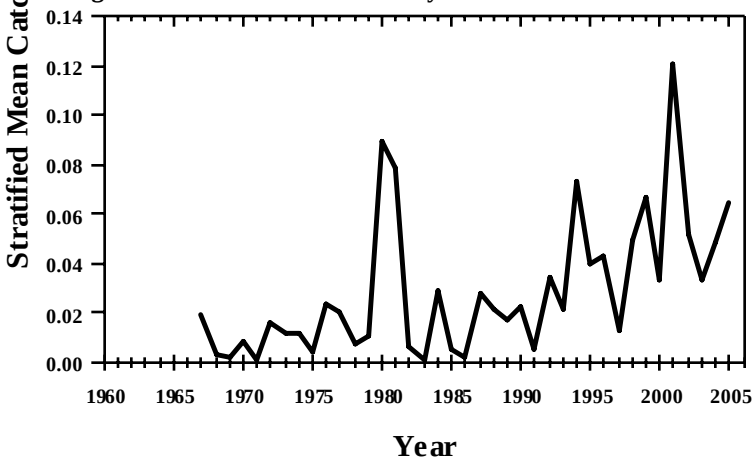

Figure 30. NEFSC autumn survey biomass indices for rosette skate.