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United States Research Report for 2003

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.

Revised sampling and reporting protocols were implemented in the Northeast Region in 1994. 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*) in 2003 were 10,625 mt, a 19% decrease from 2002 landings of 13,096 mt.

USA cod landings from the Gulf of Maine (Div. 5Y) in 2003 were 4,043 mt, a 1% decrease from 4,096 mt landed in 2002. Discards remain a source of substantial additional mortality on this stock due to the continuation of relatively low trip limits in 2003. Northeast Fisheries Science Center (NEFSC) research vessel survey biomass indices have shown a gradual increase through 2001 following the 1993 record low. The sharp increase in the autumn 2002 index cannot be explained by the dynamics of this stock, and was largely driven by an extremely large catch at one station. The autumn 2003 index declined to about the same level as in 2001 (Fig. 1).

USA cod landings from Georges Bank (Div. 5Z and SA 6) in 2003 were 6,582 mt, a 27% decrease from 9,000 mt landed in 2002. The NEFSC research vessel survey biomass indices have remained near record low levels during 1991-2002, with the exception of the sharp increase observed in the 2002 index primarily due to a large catch at one station (Fig. 2). The 2003 index remains near the record low.

2. Haddock

USA landings of haddock (*Melanogrammus aeglefinus*) decreased 16% from 8,011 mt in 2002 to 6,741 mt in 2003. Georges Bank (Div. 5Z) landings decreased 17% from 6,421 mt in 2002 to 5,309 mt in 2003, while Gulf of Maine (Div. 5Y) landings decreased by 10% from 1,590 mt in 2002 to 1,432 mt in 2003. Landings of both stocks are below historical yields.

Research vessel survey biomass indices have remained stable in recent years for both the Gulf of Maine and Georges Bank stocks but remain below historic levels (Fig. 3 and 4). Spawning stock biomass of

Georges Bank haddock increased in 2003 and is expected to remain stable or increase further due to relatively low fishing mortality rates and recruitment of the relatively strong 2000 year-class.

3. Redfish

USA landings of Acadian redfish (*Sebastes fasciatus*) increased by 13% from 368 mt in 2002 to 416 mt in 2003. Research vessel survey biomass indices have continued to increase since 1996 (Fig. 5) and are now at record high levels. The initial increase in abundance first detected in 1996 was due to improved survival of fish from the 1991 and 1992 year-classes, and stock biomass has since 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 31% from 3,580 mt in 2002 to 4,680 mt in 2003. 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*) increased by 30% from 3,259 mt in 2002 to 4,232 mt in 2003. 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 3% from 5,507 mt in 2002 to 5,327 mt in 2003. Research vessel survey indices suggest that the Georges Bank stock (Div. 5Z, E of 69E) is at a moderate to high biomass level, while the Southern New England-Mid Atlantic stock (Div. 5Z W of 69E and Div. 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 2003 totaled 17,866 mt, 7% lower than in 2002. Summer flounder (*Paralichthys dentatus*) (36%), winter flounder (*Pseudopleuronectes americanus*) (33%), witch flounder (*Glyptocephalus cynoglossus*) (17%), American plaice (*Hippoglossoides platessoides*) (14%), and windowpane flounder (*Scophthalmus aquosus*) (<1%) accounted for virtually all of the 'other flounder' landings in 2003. Compared to 2002, commercial landings in 2003 were lower for witch flounder (-2%), summer flounder (-3%), American plaice (-29%), and windowpane flounder (-35%) and remained unchanged for winter flounder (0%). Research vessel survey indices in 2003 increased for summer flounder, decreased for witch flounder, winter flounder, and windowpane and remained relatively constant for American plaice (Fig. 10-14).

8. Silver hake

USA landings of silver hake (*Merluccius bilinearis*) increased 11% from 7,434 mt in 2002 to 8,223 mt in 2003. 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 (Fig. 15). Survey indices for the Southern Georges Bank - Mid-Atlantic stock declined between 1989 and 1996, remained very low during 1997-2000, and have since increased (Fig. 16).

9. Red Hake

USA landings of red hake (*Urophycis chuss*) declined 27% from 908 mt in 2002 to 662 mt in 2003. Landings have remained low since 1980. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock have increased since the early 1970s, and are presently near record high

levels despite a slight decline in 2003 (Fig. 17). Indices for the Southern Georges Bank - Mid-Atlantic stock, however, continue to remain at record-low levels (Figure 18) despite low landings.

10. Atlantic herring

Total USA landings of Atlantic herring (*Clupea harengus*) increased 11% from 91,275 mt in 2002 to 101,000 mt in 2003. Spawning biomass of the coastal stock complex has increased since 1982 and is currently well above the high levels observed in the late 1960s. Stock size has increased due to both strong recruitment and reduced fishing mortality on both adult and juvenile herring. There is strong evidence of stock recovery on Georges Bank (Div. 5Ze) based on research vessel abundance indices. Commercial landings from Georges Bank increased 37% from 15,217 mt in 2002 to 20,876 mt in 2003.

11. Atlantic Mackerel

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) increased 15% from 26,452 mt in 2002 to 30,375 mt in 2003. Recreational catch declined 44% from 1,286 mt in 2002 to 724 mt in 2003. Based on research vessel survey indices, total stock biomass remains large Stock rebuilding since 1981 has resulted from very low fishing mortality rates and the recruitment of several good year-classes (1982, 1987, 1988, 1991, and most year-classes from 1993 to present).

12. Butterfish

USA landings of butterfish (*Peprilus triacanthus*) decreased 59% from 824 mt in 2002 to 339 mt in 2003, most likely due to reduced market demand. Research vessel survey biomass indices increased during the late 1970s, fluctuated during the 1980s, and are presently near the long-term average.

13. Squids

USA landings of longfin inshore squid (*Loligo pealii*) during 2003 were 11,626 mt, 30% lower than in 2002 (16,706 mt). The survey biomass index in 2003 (corrected for day-night changes in catchability) declined steeply from 2002 (Fig. 20).

USA landings of northern shortfin squid (*Illex illecebrosus*) increased 132% between 2002 and 2003, from 2,750 to 6,389 mt, respectively, but remained below the 1982-2002 average of 11,511 mt. The autumn survey abundance index markedly increased between 2002 and 2003 (Figure 19), due primarily to a large catch at one station in southern New England. The average weight of individual squid in 2003 remained at a low level, 69 g, similar to that observed since 2001.

14. Sea Scallops

USA sea scallop (*Placopecten magellanicus*) landings in 2003 were a record-high 25,062 mt (meats), 7% above the previous record-high attained in 2002 (23,320 mt). The bulk of the 2003 landings (79% or 19,782 mt) was harvested from the Mid-Atlantic region, where landings reached a new record level for the fourth consecutive year. The high landings are due to a combination of good recruitment and reduced fishing mortality that improved yield-per-recruit.

Research vessel surveys in 2003 indicated continued high biomass in both the Georges Bank and Mid-Atlantic regions (Fig. 21 and 22). A substantial portion of the scallop biomass is located in the three groundfish closed areas on Georges Bank and Nantucket Shoals, and in one of the Mid-Atlantic areas that was closed to scalloping between April 1998 and April 2001. However, increases in biomass outside these areas have also been observed, especially in the Mid-Atlantic. Recruitment in 2003 was very strong throughout the Mid-Atlantic and average on Georges Bank.

15. Small Elasmobranchs

USA landings of spiny dogfish (*Squalus acanthias*) declined by 50% from 2,199 mt in 2002 to 1,127 mt in

2003. This decline is largely due to spiny dogfish landings restrictions. Survey indices are highly variable but have generally declined since the early 1990s (Fig. 23).

USA landings of skates (virtually all unclassified) increased by 13% from 13,004 mt in 2002 to 14,642 mt in 2003. 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. Since the mid-1990s, the indices have been stable at an intermediate level. 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 (Fig. 26). Thorny skate (*Amblyraja radiata*) survey indices have declined over the entire time series and are currently at or 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. 27). Indices for both clearnose skate (*Raja eglanteria*) and rosette skate (*Leucoraja garmani*) have generally increased over the time series (Fig. 29 and 30).

B. Special Research Studies

1. Environmental Studies

a) Hydrographic Studies

During 2003 over 1300 CTD (conductivity, temperature, depth) profiles were made on NEFSC cruises. The data were processed and made available via an anonymous FTP site. A report on the oceanographic conditions indicated by these observations is being prepared and will be available via the NEFSC website (http://www.nefsc.noaa.gov/nefsc/publications/crd) by the summer of 2004. Similar reports have been issued each year since 1991.

b) Plankton Studies

During 2003, zooplankton community distribution and abundance was monitored using 480 bongo net tows taken on six surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine.

The Georges Bank GLOBEC program is now in a synthesis phase in which the results from the various components of the program will be integrated to provide a greater understanding of how environmental variability influences the Bank=s ecosystem, particularly the plankton populations. A number of studies are in progress focusing on both the zooplankton populations and the early life stages of the cod and haddock stocks on the Bank.

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 (initiated in 1999, with some aspects earlier) to describe habitats and determine habitat effects of mobile fishing gears in New England and Mid-Atlantic waters. Three research objectives were addressed on a November 2003 cruise. First, gravel habitats on northern Georges Bank, sampled numerous times since one portion of the area was closed to fishing in 1994, were revisited. In the closed area, emergent epifauna such as hydroids and bryozoans continue to recover, while in the fished area the bottom is mostly bare gravel. Productivity measurements indicate overall productivity is considerably higher in the unfished area. Second, samples were taken inside and outside the boundaries of the Nantucket Lightship Closed Area (southeast of Cape Cod), to study effects on substrates and benthos of fishing activities as well as the relationship between habitat features (e.g., sand ridges vs. swales) and benthic assemblages. Finally, the spread of an invasive tunicate, *Didemnum lahillei*, on northern Georges Bank was documented. 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, but in 2003 in some places it covered up to 90% of the bottom, over at least a 6.5 square mile area.

Inshore studies of habitat requirements of resource species were continued as well as studies of fishing gear effects on habitat. The commercially important hard clam, *Mercenaria mercenaria*, is abundant in Raritan Bay (NY/NJ), especially where amphipod tubes (*Ampelisca* spp.) are a dominant feature of the bottom. The extent of the tubes over space and time were examined, attempting to determine whether settling of larval hard clams and other benthos is related to whether the tubes are recently formed or are older. In an area with a winter dredge fishery for blue crabs, *Callinectes sapidus*, effects of a commercial crab rake on the tube beds and other habitat features are being documented. A cooperative study to restore oyster reefs in local estuaries and to determine functional value of the reefs to resource species is also underway.

d) Other Environmental Studies

Mortality and Increased Susceptibility to Predation of Juvenile Demersal Fish Exposed to Chesapeake Bay Sediments: In studies of the effect of Chesapeake Bay sediments on young-of-year (YOY) winter flounder (*Pseudopleuronectes americanus*), it was found that fish held on sediment from the Elizabeth River suffered significantly higher direct mortality and higher predation by bay shrimp (*Crangon septemspinosa*) than fish held on York River sediment. The mortality pattern paralleled previous toxicity results for winter flounder held on Newark Bay, New Jersey sediments, suggesting that the observed effects on juvenile demersal fish were the result of transdermally absorbed sediment components, most likely PAHs, which have been documented in the Elizabeth River. Preliminary measurements suggest that respiration was lower in fish held on Elizabeth River sediment, providing a mechanism for the observed reduction in escape capability.

Essential Fish Habitat Projects: A project is underway to study settlement and early-life history of fishes that use a hard-substrate rock reef in Long Island Sound as habitat. Minnow traps have been successfully used to sample settling young-of-the-year tautog, cunner, and black sea bass. On-reef and off-reef sites were sampled concurrently and settling fishes are clearly associated with the reef. Food habits of young fish and their predators are also being investigated. In cooperation with University of Connecticut, acoustic Doppler profile data was recorded to measure current patterns on the study site. Site characterization data will be employed in GIS mapping of this habitat. The reef appears to be an important habitat, supporting a large abundance and diversity of fishes and invertebrates.

Sampling of young-of-the-year fishes continues in a nursery area in the shallow waters of Morris Cove in New Haven, Connecticut to build a multi-year data set. Differential use of specific habitat types by different fish species has been established, and attempts will be made to link annual abundance of young-of-the-year fishes to adult species abundance in Long Island Sound. Effort to sample winter flounder eggs in coastal waters was recently initiated and spawning areas will potentially be identified and egg abundance associated with habitat-type.

2. Biological Studies

a) Fish Species

Flatfishes: Analyses and report writing continue on studies of summer flounder, *Paralichthys dentatus*. Four themes are being addressed: 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; and 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.

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 themes, 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 themes, 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.

Goosefish: Analyses and report writing continues on studies of goosefish, *Lophius americanus*. Three themes are being investigated: 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.

Aquaculture Projects: Adult broodstock black sea bass were conditioned to spawn outside of their normal season. Over the winter, seawater temperatures were gradually increased, as was photoperiod. The fish were recently cannulized to determine gonad ripeness. All males gave sperm and all females showed developing oocytes. Results are not yet conclusive, but some evidence of precocious development was evident. A group of hatchery-produced black sea bass spawned at Milford Laboratory two years ago have grown to approximately 180 mm in a temperature controlled recirculating-seawater system and have produced viable gametes, thus completing the life-cycle under culture conditions.

b) Age and Growth

Approximately 35,000 age determinations were completed in 2003 by Woods Hole Laboratory staff for 11 species of finfish in support of resource assessment analyses and other research. In addition to Atlantic cod (7,109), haddock (2,655), and yellowtail flounder (8,030), 2,552 scup, 1,628 Atlantic herring, 5,256 summer flounder, and 3,030 butterfish were aged.

Cod, haddock, and pollock age structures were exchanged with Canadian age readers in preparation for a Gadid Ageing Workshop (held in St. Andrews, NB, January 2004), and ageing materials for Atlantic herring and scup were exchanged with readers from USA state laboratories in a continuing effort to maintain comparability of age determinations between laboratories.

Research projects initiated or continued in 2003 included: (1) compilation of information related to stock reproductive potential; (2) a study of the biology and origin of witch flounder *Glyptocephalus cynoglossus* in deep water habitats; (3) a study of the biology of offshore populations of cunner *Tautogolabrus adspersus*; (4) development of an indirect age estimation method based on otolith weight for butterfish *Peprilus triacanthus*; and (5) completion of otolith reference collections for cod and haddock, including annotated digital images. The NEFSC hosted a meeting of the NAFO Working Group on Reproductive Potential in October, 2003.

c) 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 flatfish, elasmobranchs, larval gadids, and principal pelagics.

Food habits samples were collected during NEFSC winter, spring, and autumn surveys on the northeastern and Mid-Atlantic continental shelf. Estimates of prey volume and composition were made at sea for selected species. During the 2003 winter survey, 2,893 stomachs from 38 species were examined, while 6,445 stomachs from 46 species, and 6,879 stomachs from 49 species were examined during the spring and autumn 2003 surveys, respectively. Diet sampling emphasized small pelagics, elasmobranchs, gadids, flatfishes, and lesser known species.

The 31 year time series (1973-2003) 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 420,000 stomach samples. The processing of the 2002 and 2003 bottom trawl survey food habits data is scheduled for completion in 2004.

A study examining of cod trophic ecology in cooperation with the commercial industry continued in 2002-2003. This study emphasizes meso-scale localized sampling, three times per month, year-round. During 2003, 87 trips were completed and a total of 2318 stomachs collected. Additional sampling for ovaries, livers, blood, and tissue was also accomplished.

Staff published several papers and reports on a wide range of trophic ecology issues in the NW 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.

d) 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 6,500 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 2003. These efforts formed the basis for NMFS essential fish habitat designations in the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks, and in 2003, EFH was re-designated for 5 species of shark.

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. Staff initiated a project to study the diet, gastric evacuation, and feeding ecology of elasmobranchs in the Delaware Bay nursery. This research will quantify the food and feeding characteristics of juvenile sandbar sharks, *Carcharhinus plumbeus*, and smooth dogfish, *Mustelus canis*, and document ontogenetic changes within both species and dietary overlap between the two species. Random stratified sampling based on depth and geographic location continued towards developing a time series used to estimate and monitor the relative abundance and population size of sandbar sharks within Delaware Bay throughout the nursery season and from year to year. A report summarizing Atlantic and Gulf of Mexico coastal shark nursery ground and habitat studies has been finalized and a paper on the shark nursery areas is in press.

Biological research on pelagic shark species in 2003 included age studies of both the white shark, *Carcharodon carcharias* and thresher shark, *Alopias vulpinus* and re-examination of the age and growth of the shortfin mako, *Isurus oxyrinchus*. Vertebrae, length-frequency data, and tag/recapture

data collected between 1962 and 2002 for these species are being analyzed to obtain growth function parameters. In conjunction with staff at the Moss Landing Marine Laboratory, NEFSC staff are using bomb radiocarbon dating techniques to validate band periodicity. Predator-prey research continued in 2003 on the shortfin mako and other shark species, as well as biological studies on the thresher shark.

A collaborative program to examine the biology and population dynamics of the blue shark, *Prionace glauca*, in the North Atlantic continued in 2003. A manuscript describing age and growth was published and a manuscript on stock structure based on tagging data was submitted for publication. Population dynamics research continued towards constructing a time series of blue shark catch rates (CPUE) from research surveys, estimating migration and survival rates, and developing an integrated tagging and population dynamics model for use in stock assessment.

e) Marine Mammals

Small Cetaceans: During 2003 there were no field studies directed to study only small cetaceans. However, small cetacean sightings were recorded during the aerial sighting surveys for right whales and the sperm whale tagging survey. See details of these two projects in the Large Cetacean section below.

A contract to Woods Hole Oceanographic Institution is currently underway to determine the stomach contents of stranded small cetaceans.

Large Cetaceans: During July 2003, the NEFSC conducted a sperm whale dive study in the Atlantic, where there is little seismic activity. This study was on the *R/V Delaware* and conducted in cooperation with Woods Hole Oceanographic Institution and Mineral Management Service. During this study scientists simultaneously conducted line-transect marine mammal visual, passive acoustic, oceanographic, and plankton surveys, collected satellite data on ocean color and sea surface temperature, and attached DTAGs to sperm whales. The DTAGs provided information on dive depths and the orientation of the animal during its dive. These dive data will be compared to sperm whale dive data in the Gulf of Mexico, where there is seismic activity, and the data will also be used to correct Atlantic sperm whale abundance estimates because some sperm whales were not available to be counted visually when they were diving. Twelve sperm whales were tagged.

During March-July 2003, 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 conducted a three-week biopsy and photo-id research cruise in the Gulf of Maine and Scotian Shelf region in August 2003 as part of a large-scale assessment of North Atlantic humpback whales.

Scarification analyses of right and humpback whales continued in 2003. These analyses are useful in monitoring interactions between whales and fishing gear.

The North Atlantic Right Whale Individual ID catalogue and database (NE Aquarium and URI) were updated through December 2003.

Scientists at the Woods Hole Oceanographic Institution continued to investigate the reactions of right whales to ships. Acoustic tags were used to record acoustical stimuli and to archive data on dive behavior and water column orientation of right whales. Results indicate that right whales show little reaction to vessels as close as 100m. Reactions of tagged right whales to artificially generated alarm stimuli were also monitored. Results of this work indicate that most whales responded by coming to the surface, while one tagged animal exhibited no response at all. The preliminary conclusion of this study is that alarms either have no impact or cause whales to engage in behaviors that significantly increase their chances of being struck.

Pinnipeds: On 8 January 2003 a reconnaissance boat trip was conducted to Muskeget Island to assess the distribution and abundance of gray seal mother/pup pairs and weaned pups in preparation for the January-February 2003 field studies to conduct live capture, biological sampling, and tagging of weaned gray seal pups.

On 21 April 2003 a reconnaissance boat trip was conducted to Monomoy Island to assess the distribution and abundance of gray seals and to assess options for scat collecting trips.

In support of the NOAA Oil Spill Response Team, the NEFSC conducted a survey in along the Elizabeth Islands (Woods Hole to Cuttyhunk Is., including Nomans Is.) on 29 April 2003 to look for oiled seals. The survey was conducted using the NOAA Twin Otter at an altitude of 600 ft and no oiled seals were detected. A total of 363 seals were counted of which 343 were harbor seals and 20 were gray seals.

Seal monitoring surveys were conducted on 26 February 2003 and 20 October 2003. The February flight was conducted in a Cessna Skymaster at an altitude of 500 ft and covered the region from the Isle of Shoals to Cape Cod. A total of 1,112 harbor seals were counted. The survey was curtailed at Cape Cod due to inclement weather. The October flight was conducted in a NOAA Twin Otter at altitudes between 500 and 900 feet and covered the region from Isle of Shoals to Cape Cod. A total of 3,091 seals were counted, of which 1,072 were harbor seals and 2,019 were gray seals.

One flight was conducted on 25 January 2003 to monitor gray seals. The survey was conducted in a Cessna Skymaster at an altitude of 500 ft and covered Monomoy Is. and Muskeget Is. A total of 1645 adults and 512 pups were counted on Muskeget Is. and adjacent shoals, and 532 seals (mixed harbor and gray) were counted on Monomoy.

A pilot study to radio tag and track harbor seals was conducted from 18-22 November in Woods Hole, MA. Seals were not present in adequate numbers to successfully capture and tag, however the following attempts were made: 18 November - 3 sets made, 25 seals flushed; 21 November - 0 sets made, 5 seals flushed; 22 November - 2 sets made, 20 seals flushed

On 6 February, NEFSC scientific staff along with researchers from a variety of institutions and universities, participated in the live capture, biological sampling, and tagging of weaned gray seal pups on Muskeget Island, located in eastern Nantucket Sound. Twenty-five weaned pups were captured and biological sampling included: weight (kg), length (cm), sex, and flipper tagged using ALLFLEX tags imprinted with a unique identifier and contact information. The tissue samples obtained when attaching the flipper tag were kept for genetic analysis. Pups were kept in the nets during weighing, then transferred to a seal carrier for subsequent sampling and tag attachment.

In October 2002, the NEFSC let a contract to the Woods Hole Oceanographic Institution to process stomachs obtained from seals that are bycaught in the New England sink gillnet fisheries. Since then, 50 seal stomachs, 49 harbour seals, *Phoca vitulina*, and one grey seal, *Halichoerus grypus* have been analyzed. Six of the harbour seal stomachs were deemed unusable. All the seals caught were immature, mostly yearlings, and most were caught in the western Gulf of Maine. The 43 harbor seal stomachs contained ~ 1200 otoliths of at least eleven taxa of fishes. Ninety-four percent of the otoliths were from five species: silver hake, *Merluccius bilinearis*, red hake, *Urophycis chuss*, Acadian redfish, *Sebastes fasciatus*, pollock, *Pollachius virens*, and Atlantic herring, *Clupea harengus*. Silver hake otoliths comprised 67% (n=824) of the total. The single grey seal stomach contained mostly redfish otoliths.

f) Marine Turtles

In 2003, the NEFSC extended its monitoring plan to observe pound net leaders in the Chesapeake Bay. In 2003 NMFS performed over 800 surveys of fishing gear and documented 17 interactions between sea turtles and pound net gear. Four turtles were found dead, 12 were alive, and the status of 1 was undetermined. Five were entangled, and 12 were impinged. Twelve were loggerheads, 4 were

Kemp's ridley, and 1 was unknown. Eleven were caught with 11.5" mesh, and 6 with 8" mesh. Fifteen were found in the Eastern Bay, and two in Western Bay.

In an effort to reduce the number of interactions between pound net leaders and sea turtles, NEFSC has designed an experiment to test the effectiveness of a modified pound net leader. The proposed research represents NMFS' effort to develop gear modifications that simultaneously reduce turtle by-catch and preserve targeted catch. Specifically, the plan is to test a leader of eight inch mesh no higher than 1/3rd the water depth with 3/8" ropes attached to the headline every two feet.

The NMFS has funded gear modification research in the scallop dredge fishery. Virginia Institute of Marine Science and Coonamessett Farm conducted research on catch and by-catch rates in an unmodified control scallop dredge verses a scallop dredge equipped with a chain mat turtle excluding device.

A Generalized Linear Model (GLM) was used to examine environmental factors and gear characteristics to estimate sea turtle mortality during May to December in 2001 and 2002 in the scallop dredge fishery in the Hudson Canyon and Virginia Beach Closed Areas. The total estimated by-catch of sea turtles in the Hudson Canyon and Virginia Beach Closed Areas during these time periods combined was 169 animals (C.V.=55.3). This includes 74 turtles taken from May-December in 2001, and 95 turtles from this time period in 2002.

3. Studies of Fishing Operations

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

The NEFSC deployed observers on 802 commercial fishing trips with a total of 3,282 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 32 marine mammals were caught, including (in order of highest occurrence) harbor seals, harbor porpoises, gray seals, and unidentified seals. From most of the animals, biological samples were collected including body weight measurements, tissue samples, or collection of the entire animal. A total of 79 seabirds was also caught, which included northern gannets (5), greater shearwaters (8), common loons (7), sooty shearwater (1), red-throated loons (45), loon (unknown) (3), thick billed murres (2), eider (1), double crested cormorants (3), bufflehead (1), merganser (1), brown pelican (1), black legged kittiwake (1). Three unidentified turtles were also taken.

b) Float Drift Gillnet Fisheries

The closure of the pelagic swordfish drift gillnet fishery continued in 2003. Twenty-seven trips were observed with a total of 143 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 or endangered species, or seabirds, were observed taken in this fishery.

c) Otter Trawl Fisheries

A total of 611 trips were observed with a total of 7,248 gear retrievals. Kept and discarded catches were weighed or estimated. Length frequencies and age structures were obtained for age and growth studies. Seventeen marine mammals and 4 loggerhead turtles were incidentally caught in the otter trawl fisheries. The marine mammals were 15 whitesided dolphins, 1 bottlenose dolphin and 1 unidentified dolphin. There were also 6 seabirds taken (1 unidentified gull, 1 double crested cormorant, 2 greater shearwaters, and 2 northern gannets).

d) Sea Scallop Fisheries

In 2003, 127 trips were observed with a total of 16,371 gear retrievals. Seventeen loggerhead turtles and 10 unidentified sea turtles were caught. Nine seabirds were taken (1 greater black backed gull, 7 unidentified gulls and 1 northern gannet). 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.

e) Conch Pot Fishery

One trip was observed with a total of 6 gear retrievals in this fishery. No takes of marine mammals or seabirds were reported. Finfish were measured and weighed. Finfish by-catch and discard was documented.

f) Scottish Seine Fishery

Observers covered six trips with a total of 23 gear retrievals in the Scottish seine fishery in 2003. Kept and discarded finfish were weighed or estimated for a portion of the observed set. Length frequencies and age structures from the finfish catch were also obtained. No protected or endangered species were observed to be taken in this fishery.

g) Sink Drift Gillnet

NEFSC observers covered 12 trips with a total of 552 gear retrievals in 2003. Two harbor porpoises and 7 harbor seals were observed taken. One leatherback and 1 loggerhead turtle were also observed taken. Six northern gannets were caught. 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.

h) Midwater Pair Trawl

Twenty-nine trips with a total of 82 gear retrievals were observed in 2003. Seventeen northern gannets were caught. 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.

i) Bottom Longline Fishery

Twenty trips with a total of 77 gear retrievals were observed in 2003. 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.

j) Beach Haul Seine

Thirteen trips with a total of 23 gear retrievals were observed in this fishery in 2003. 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.

k) Pound Net

Two trips with a total of 9 gear retrievals were observed in this fishery in 2003. 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 loggerhead turtle was observed to be taken in this fishery.

l) Handline

Two trips with a total of 19 gear retrievals were observed in this fishery in 2003. 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.

m) Herring Purse Seine

Two trips with a total of 2 gear retrievals were observed in this fishery in 2003. 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.

n) Lobster Pot

Two trips with a total of 34 gear retrievals were observed in this fishery in 2003. 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.

o) Fish Pot

Seven trips with a total of 116 gear retrievals were observed in this fishery in 2003. 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.

4. Population Dynamics Research

Population dynamics research conducted within the Northeast Fisheries Science Center 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; most require annual stock status updates as a basis for fishery management. Stock assessments are routinely reviewed in a domestic 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 2003 focused on a number of other management and scientific issues. Four 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 Atlantic salmon in one additional river system. 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 assessments.

Field research has emphasized smolt production estimates, telemetry studies of emigrating smolts, monitoring of fishery removals on the high seas, and fishery-independent sampling through marine

smolt trawling surveys. In addition, a large smolt tagging program has provided information useful in characterizing smolt emigration and adult returns. Analysis of the data from these studies has identified significant smolt mortality during the transition to the marine environment. Potential sources of this mortality (poor physiological condition, predation) are being evaluated through follow-up studies. These studies will contribute to recommendations for additional measures to be considered to halt the decline and restore the resource.

b) Cooperative Research with the Fishing Industry

A cooperative research program is on-going to develop modern Astudy fleets@ to collect high-quality fishery-dependent data for scientific applications. Reporting procedures and database structures are under development, and various hardware and software applications are being field-tested aboard fifteen vessels from various fleet sectors. A critical element of this pilot project is to eliminate, to the extent possible, the recording of data in paper form. These efforts should allow greater spatial resolution of data, and near-real time evaluation of fishery trends.

The Cooperative Black Sea Bass Tagging Project was designed to examine the population size, exploitation rate and seasonal movements of the northern Atlantic coast population of black sea bass, *Centropristis striata*. This project is conducted in collaboration with state fishery agencies, and with commercial and recreational fishermen. Since autumn 2002, federal and state fishery employees have tagged and released 9,541 black sea bass from Cape Cod, MA to Cape Henry, VA with recaptures exceeding 1,240 fish. In addition, sea bass have been released with data storage tags to examine depth and temperature experienced during seasonal migrations.

In 2003, during cooperative field work with yellowtail flounder fishermen, approximately 10,000 yellowtail were tagged from the Gulf of Maine to the Mid Atlantic, 186 of which were tagged with data-storage tags. As of December 1 2003, tags have been returned from 369 recaptured fish. Preliminary results indicate a low frequency of movement between the Cape Cod grounds and Georges Bank. Six data-storage tags have been returned, indicating distinct off-bottom movements.

c) Stock Assessment Methods Development

Many national and international studies have concluded that stock assessments should consider evaluating 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 on 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. The package may be accessed at http:/nft.nefsc.noaa.gov (username: nft, password: nifty).

d) Other Research

Members of the Population Dynamics Branch have been collaborating with oceanographers from NEFSC and Rutgers University to estimate the extent of larval transport between various scallop grounds. Additional research is being conducted on scallop growth, using stable isotopes and other techniques, in collaboration with faculty at the Coast Guard Academy, and on predation of juvenile scallops by the sea star *Astropecten americanus*, in collaboration with Boston University.

Studies on the age, growth and maturity of skates continued in 2003. Vertebrae have been collected for seven species of skates. Both traditional maturity stages and morphometric measurements were collected to estimate maturity and validate the morphometric method. A study investigating changes in maturity and fecundity of spiny dogfish also continued in 2003. Age samples (spines) were collected to evaluate changes in age composition.

ACKNOWLEDGMENTS

The assistance of several members of the Resource Evaluation and Assessment Division, the Fisheries and Ecosystems Monitoring and Analysis Division, the Ecosystems Processes Division and the Aquaculture and Enhancement Division of the NEFSC in the preparation of this report is gratefully acknowledged by the authors.

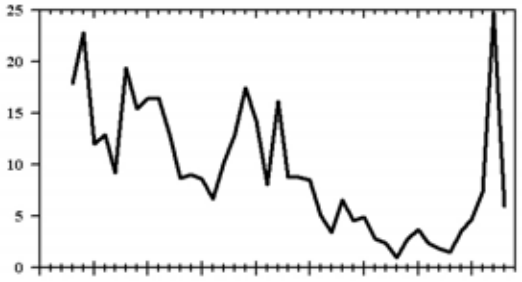

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

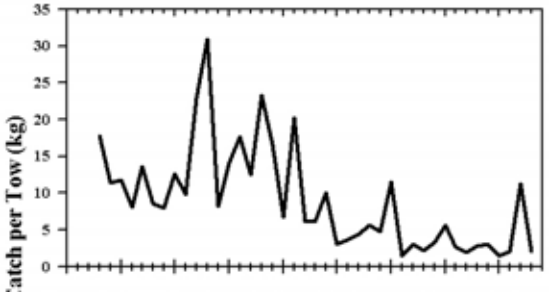

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

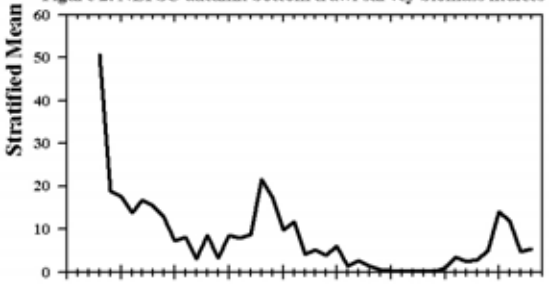

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

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

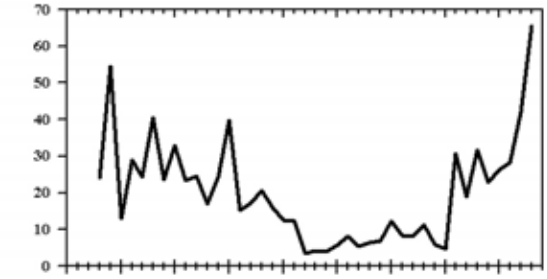

Figure 5. NEFSC autumn bottom trawl survey biomass indices for redfish.

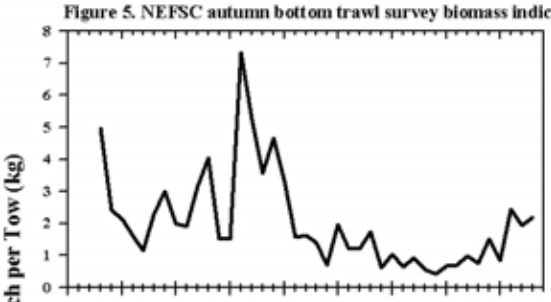

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

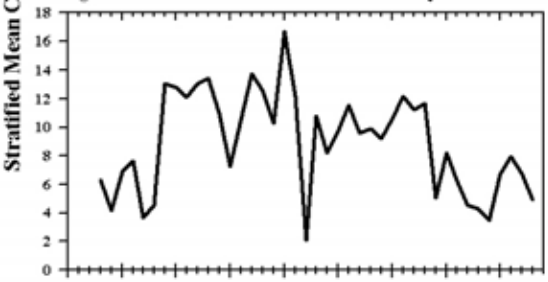

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

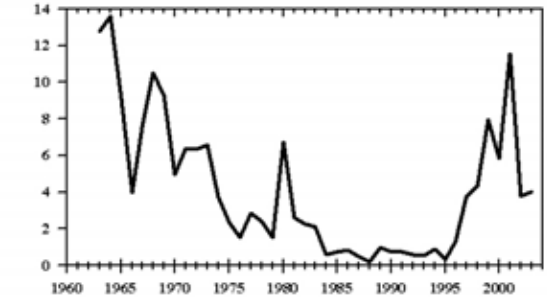

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

Stratified Mean Catch per Tow (kg)

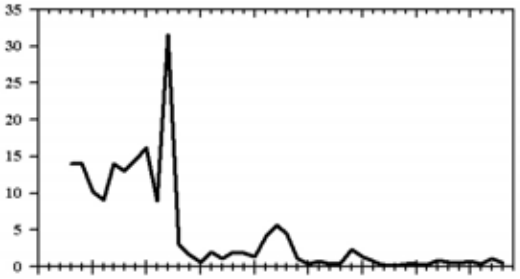

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Southern New England-Mid-Atlantic yellowtail flounder.

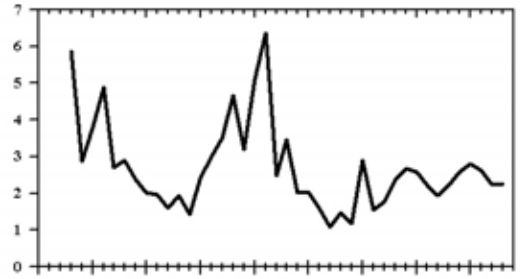

Figure 10. NEFSC autumn bottom trawl survey biomass indices for American plaice.

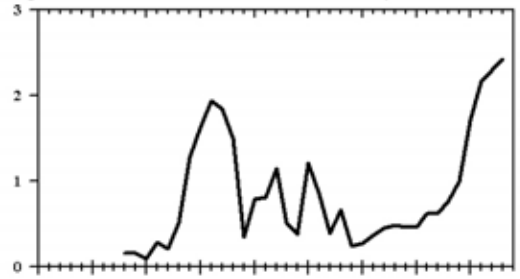

Figure 11. NEFSC spring bottom trawl survey biomass indices for summer flounder.

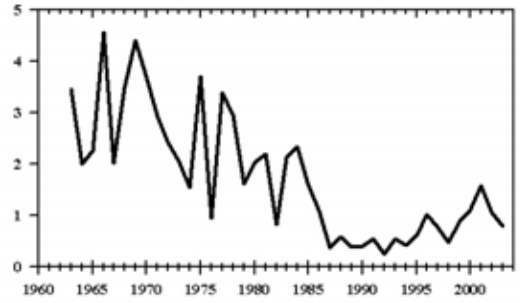

Figure 12. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

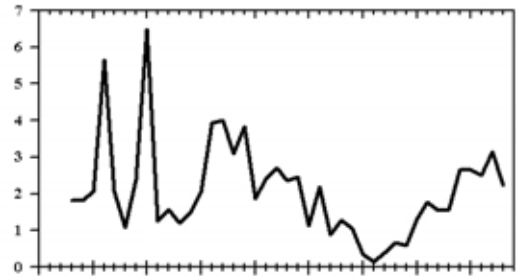

Figure 13. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

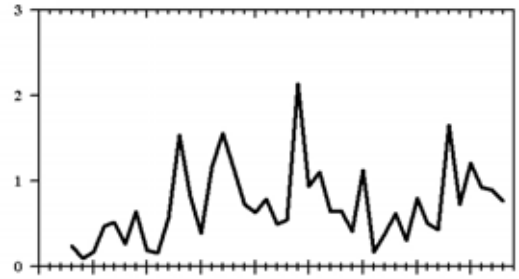

Figure 14. NEFSC autumn bottom trawl survey biomass indices for northern windowpane flounder.

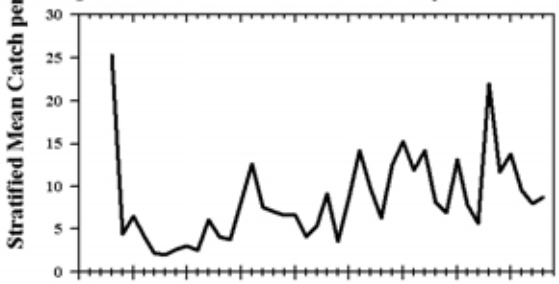

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

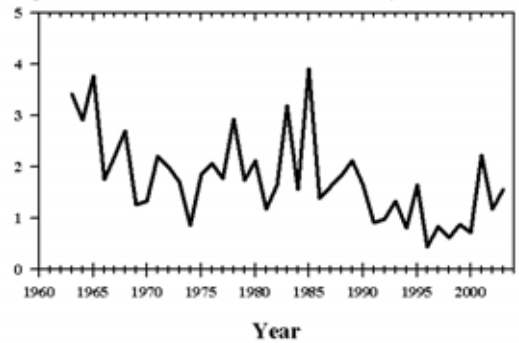

Figure 16. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

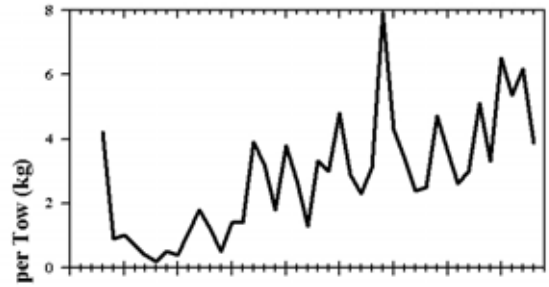

Figure 17. NEFSC autumn bottom trawl survey biomass indices for northern red hake.

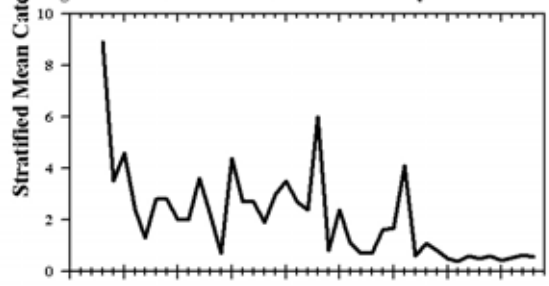

Figure 18. NEFSC autumn bottom trawl survey biomass indices for southern red hake.

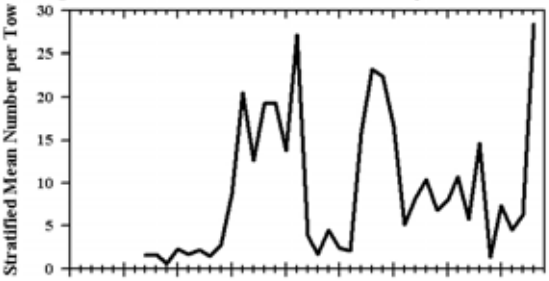

Figure 19. NEFSC autumn bottom trawl survey abundance indices for *Illex*.

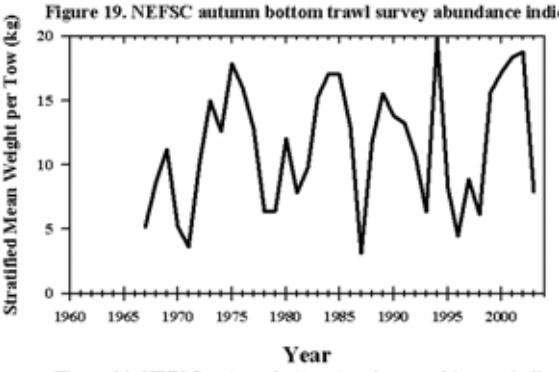

Figure 20. NEFSC autumn bottom trawl survey biomass indices for *Loligo*.

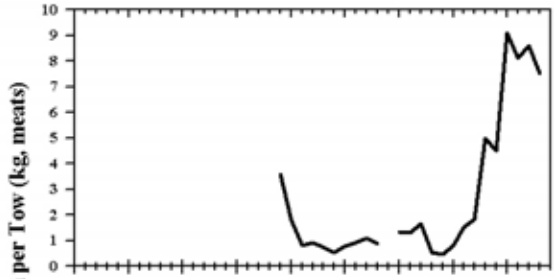

Figure 21. NEFSC scallop survey biomass indices for Georges Bank sea scallops.

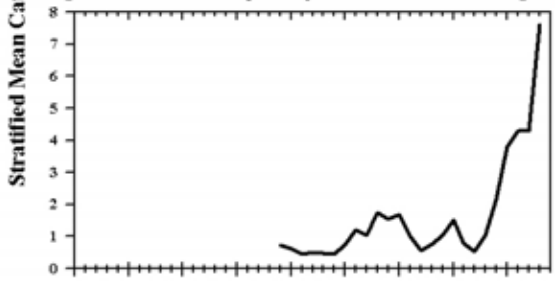

Figure 22. NEFSC scallop survey biomass indices for Mid-Atlantic Bight sea scallops.

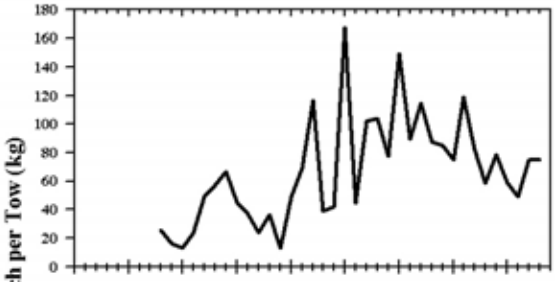

Figure 23. NEFSC spring survey biomass indices for spiny dogfish.

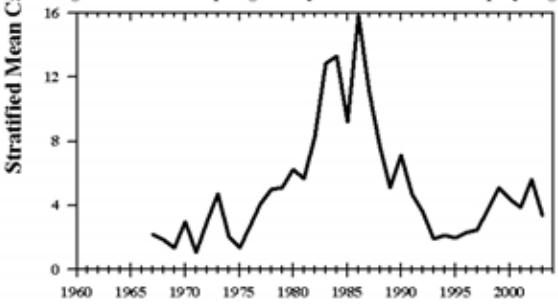

Figure 24. NEFSC autumn survey biomass indices for winter skate.

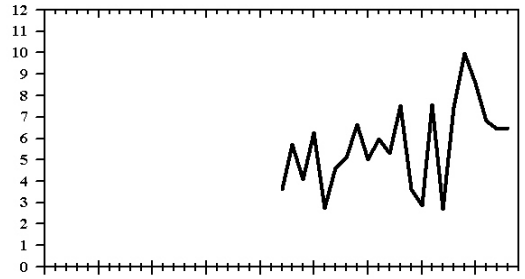

Figure 25. NEFSC spring survey biomass indices for little skate.

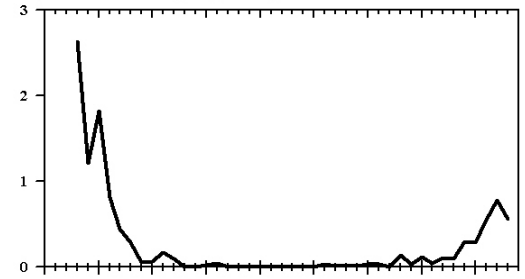

Figure 26. NEFSC autumn survey biomass indices for barndoor skate.

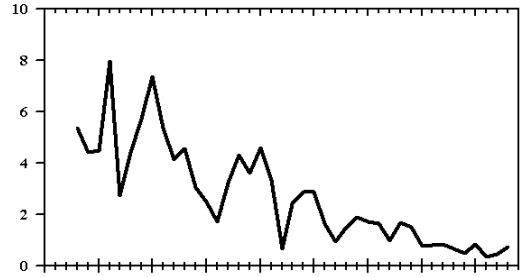

Figure 27. NEFSC autumn survey biomass indices for thorny skate.

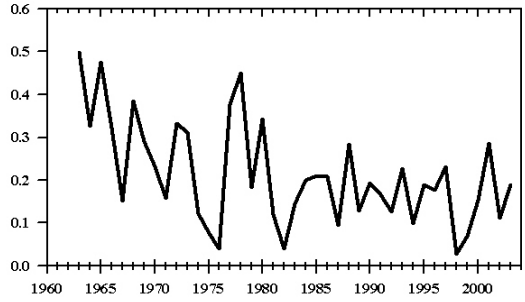

Figure 28. NEFSC autumn survey biomass indices for smooth skate.

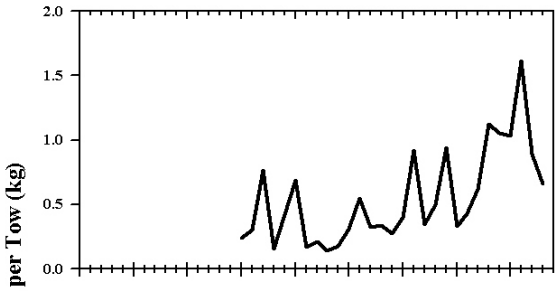

Figure 29. NEFSC autumn survey biomass indices for clearnose skate.

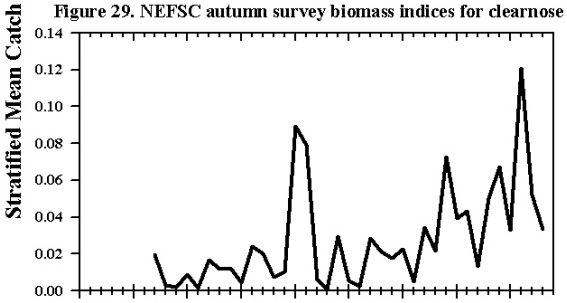

Figure 30. NEFSC autumn survey biomass indices for rosette skate.