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United States Research Report for 2000

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. New auditing and allocation procedures have been developed to prorate total reported landings by species among areas.

1. Atlantic Cod

USA commercial landings of Atlantic cod (*Gadus morhua*) in 2000 were 11,347 mt, a 17% increase over 1999 landings of 9,697 mt. The 2000 landings are still among the lowest since 1960.

USA cod landings from the Gulf of Maine (Div.5Y) in 2000 were 3,730 mt, a 128% increase from 1,636 mt landed in 1999. It is likely that the very sharp decline in landings which occurred in 1999 and the subsequent increase in 2000 landings reflect 1999 management measures (low trip limits) which may have promoted high discarding. Fishing mortality on this stock has remained high since the early 1980s, averaging about 1.0 between 1983 and 1997. Fishing mortality declined slightly in 1998 and may have decreased further in 1999. Spawning biomass declined from over 26,000 mt in 1989 to about 8,900 mt in 1998 but has since begun to slowly increase. Northeast Fisheries Science Center (NEFSC) research vessel survey biomass indices have increased slightly since the 1993 record low, but continue to remain low compared to earlier periods. (Figure 1).

USA cod landings from Georges Bank (Div.5Z and SA 6) in 2000 were 7,617 mt, a 6% decrease from 8,061 mt landed in 1999. Fishing mortality reached a record high of 1.5 in 1994 and has subsequently declined to a record low of 0.22 in 2000. Spawning stock biomass in 2000 (29,000 mt) was about 6% higher than in 1999 (27,400 mt) and 51% higher than the record low in 1994 (19,233 mt). NEFSC research vessel survey biomass indices reached a record low in 1991, increased slightly through 1995, but have since declined to the 1991 level (Figure 2).

2. Haddock

USA landings of haddock (*Melanogrammus aeglefinus*) increased 18% from 3,443 mt in 1999 to 4,065 mt in 2000. Georges Bank (Div. 5Z) landings increased 21% from 2,775 mt in 1999 to 3,366 mt in 2000, while Gulf of Maine (Div. 5Y) landings increased by 5% from 668 mt in 1999 to 699 mt in 2000. Landings from both stocks remain below historical levels and continue to be constrained by management measures.

Research vessel survey biomass indices have increased in recent years for both the Gulf of Maine and Georges Bank stocks but remain below historical levels (Figures 3 and 4). Spawning stock biomass of Georges Bank haddock continued to increase in 2000 and is expected to increase further due to recruitment of the relatively strong 1998 and 2000 year classes.

3. Redfish

USA landings of redfish (*Sebastes* spp.) decreased by 10% from 353 mt in 1999 to 319 mt in 2000. Research vessel survey biomass indices increased in 1996 and have continued to remain relatively high from 1997 through 2000 compared to those observed during the 1980s (Figure 5). The initial increase in abundance first detected in 1996 is due to improved survival of fish from the 1991 and 1992 year classes, and the continuation of relatively high biomass through 2000 can be attributed to growth and survival of these year classes and those from 1984, 1985 and 1986.

4. Pollock (4VWX + 5 stock)

USA landings of pollock (*Pollachius virens*) decreased by 12% from 4,595 mt in 1999 to 4,045 mt in 2000. Spawning stock biomass increased from 89,000 mt to 204,000 mt between 1974 and 1985, but declined to 125,000 mt in 1992. Spawning biomass is estimated to have increased in 1993/1994 to about 146,000 mt as a result of modest recruitment from the 1987 and 1988 year classes. Research vessel survey indices suggest that pollock biomass in Subarea 5 has increased over the past 5-6 years but continues to remain low relative to earlier periods (Figure 6). There has been no evidence of recruitment of any moderate or strong year classes since the late 1980s.

5. White Hake

USA landings of white hake (*Urophycis tenuis*) increased 14% from 2,624 mt in 1999 to 2,990 mt in 2000. The stock has declined considerably from the relatively stable levels seen in the 1980s. Research vessel survey indices for 1997-1999 were among the lowest in the time series, but the value for 2000 increased somewhat (Figure 7).

6. Yellowtail Flounder

USA landings of yellowtail flounder (*Limanda ferruginea*) increased 59% from 4,432 mt in 1999 to 7,056 mt in 2000. Research vessel survey indices suggest that the Georges Bank stock (Div. 5Z, E of 69?) is at a high biomass level, while the Southern New England stock (Div. 5Z, W of 69?) remains at an historic low (Figures 8 and 9).

7. Other Flounders

USA commercial landings of flounders (other than yellowtail flounder) from Subareas 3-6 in 2000 totaled 17,895 mt, 20% higher than in 1999. Summer flounder (*Paralichthys dentatus*) (28%), winter flounder (*Pseudopleuronectes americanus*) (33%), American plaice (*Hippoglossoides platessoides*) (24%) witch flounder (*Glyptocephalus cynoglossus*) (14%), and windowpane flounder (*Scophthalmus aquosus*) (1%) accounted for virtually all of the "other flounder" landings in 2000. Compared to 1999, commercial landings in 2000 were higher for winter flounder (+6%), summer flounder (+26%), American plaice (+35%), windowpane flounder (+63%), and witch flounder (+15%). Research vessel survey indices in 2000 increased for summer flounder, witch flounder and windowpane flounder, and remained relatively constant for winter flounder and American plaice (Figures 10 - 14).

8. Silver hake

USA landings of silver hake (*Merluccius bilinearis*) decreased 15% from 14,100 mt in 1999 to 11,919 mt in 2000. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock increased throughout the 1980s and varied without trend during 1990-2000; the 2000 index value was above average (Figure 15). Indices for the Southern Georges Bank - Mid-Atlantic stock have decreased since the mid-1980s and have been below average throughout the 1990s (Figure 16).

9. Red Hake

USA landings of red hake (*Urophycis chuss*) decreased 3% from 1,558 mt in 1999 to 1,510 mt in 2000. Landings have remained low since 1980. Research vessel survey biomass indices for the Gulf of Maine - Northern Georges Bank stock have increased steadily since the early 1970s, and stock biomass is currently above the long-term average. Indices for the Southern Georges Bank - Mid-Atlantic stock, however, continue to remain depressed despite low fishing mortality (Figures 17 and 18).

10. Atlantic herring

Total USA landings of Atlantic herring (*Clupea harengus*) increased 8% from 94,803 mt in 1999 to 102,460 mt in 2000. Spawning biomass of the coastal stock complex has increased continuously 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 trawl catches and larval survey indices. Commercial landings from Georges Bank increased from 4,477 mt in 1999 to 16,486 mt in 2000. Hydroacoustic surveys of the Georges Bank component in Autumn 1999 and 2000 indicate a high biomass level.

11. Atlantic Mackerel

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) declined 53% from 12,040 mt in 1999 to 5,643 mt in 2000. The stock (Subareas 2-6) is currently underexploited, and total biomass remains high. Stock rebuilding since 1981 has resulted from very low fishing mortality rates and the recruitment of several very good year classes (1982, 1987, 1988, 1991, and most year classes from 1993 to present).

12. Butterfish

USA landings of butterfish (*Peprilus triacanthus*) decreased from 2,105 mt in 1999 to 1,418 mt in 2000. Research vessel survey biomass indices increased during the late 1970s, fluctuated during the 1980s, and are presently at the long-term average.

13. Squids

USA landings of northern shortfin squid (*Illex illecebrosus)* during 1999 (7,388 mt) and 2000 (9,008 mt) were considerably below the 1998 peak of 23,597 mt. The autumn 2000 survey biomass index (7.4 kg/tow) was higher than the 1999 biomass index (1.4 kg/tow), which was one of the lowest values observed since 1967 (Figure 19).

USA landings of longfin inshore squid (*Loligo pealeii*) decreased 9% from 18,560 mt in 1999 to 16,976 mt in 2000. Survey indices for this stock, which have varied considerably, are now at a high level (Figure 20).

14. Sea Scallops

USA landings of sea scallops (*Placopecten magellanicus*) in 2000 totaled 14,478 mt (meats), up sharply from 1999 (10,146 mt), and 1998 (5,565 mt). Most of the 2000 increase came from the Mid-Atlantic Bight region, where landings reached record levels (9,691 mt). Portions of the three groundfish closed areas on Georges Bank were open to limited fishing in 2000; landings from these areas were about 2,391 mt.

Research vessel surveys in 2000 indicated continued increases in biomass in both the Georges Bank and Mid-Atlantic regions; dredge survey indices in 2000 were 9.1 kg/tow (meats) for Georges Bank (Figure 21), and 3.8 kg/tow for the Mid-Atlantic (Figure 22). Both of these values were at all-time highs for the survey time series. Much of the biomass was in the groundfish closed areas on Georges Bank, and in the two Mid-Atlantic areas closed to scallop fishing since April 1998. However, increases in biomass outside

the closed areas have also been observed. Recruitment for Georges Bank in 2000 appeared to be extremely high, while recruitment in the Mid-Atlantic Bight was slightly above average.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic Studies

Ecosystems monitoring work accomplished by the NEFSC Narragansett Laboratory during 2000 included (1) the 6 standard seasonal cruises to measure temperature, salinity, chlorophyll-a and zooplankton on the continental shelf covering Cape Hatteras through the Gulf of Maine (excluding January 2000 Gulf of Maine coverage), and (2) monthly sampling along transects between Boston, Massachusetts, and Cape Sable, Nova Scotia, and between New York and Bermuda on ships of opportunity to measure temperature, salinity, acoustic doppler current profiling, phytoplankton and zooplankton. Studies of historical variation in temperature and salinity in the Gulf of Maine and the Middle Atlantic Bight from 1991 through 2000 are currently in review and scheduled for publication in late 2001. Several manuscripts on historical variation in zooplankton abundance and species composition are in preparation or review. Considerable progress was also made in preparing manuals describing standard ecosystem survey and ship of opportunity (SOOP) sampling designs, equipment and sampling procedures. These are currently scheduled for publication in late 2001 or early 2002.

b) Plankton Studies

Field operations in the Georges Bank GLOBEC Program were completed in 1999 and data analysis is underway. Cod and haddock larval growth and mortality rates have been calculated for the first two years of the program (1995 and 1996), and are in large part comparable to values in the literature. Mortality during the egg stage for both species, however, appears higher than observed previously. Preliminary results for 1998, which produced a good haddock year class, indicate that egg production was not particularly high, but larval abundance was substantially higher than in other years of the program. This suggests higher survival during the larval stage as compared to other years. Cod larval abundance also was high in 1998, although a good year class for cod did not develop. Comparing the development of the cod and haddock year classes, particularly during 1998, will be an interesting aspect of GLOBEC data analysis.

c) Benthic Studies

Staff of the NEFSC James J. Howard and Woods Hole laboratories continued studies of the effects of mobile fishing gear on benthic habitats on Georges Bank. Cruises were conducted in June and November, 2000 to further characterize and compare 1) areas open to otter trawling and scallop dredging, 2) an area which has been closed to mobile gear since 1994, and 3) areas closed from 1994 until recently reopened to scallop dredging. Some results became available from a June 1999 survey of an area which had been closed for 4½ years, and surrounding open areas: 1) species composition, species diversity and richness of trawl-caught organisms inside the closed area were similar to those immediately outside the area; 2) numbers and biomass of haddock and yellowtail flounder were greater inside; 3) most other groundfish species had similar abundances inside and outside, but some were slightly more abundant outside; 4) size distributions of fish and mega-invertebrates were similar inside and outside, with the exception of sea scallops (significantly larger inside); and 5) total organic carbon in sediments was generally higher inside, and was related to sediment grain size. From analysis of videotapes and still photographs, greater abundance of emergent sponges inside the closed area was the only significant difference in microhabitat resources attributable to gear effects. The lack of major differences inside vs. outside the closed area was probably due to the area's sandy habitat type. Additional cruises to study gear effects on benthic habitats are scheduled for June and October 2001.

d) Other Environmental Studies

Habitat Relations of Estuarine Species: The Navesink River/Sandy Hook Bay estuarine system in New Jersey serves as a nursery ground for important coastal species such as winter flounder, summer flounder, and blue crabs (*Callinectes sapidus*). The system, which has been surveyed three times each year since 1997, provides key information on habitat associations of estuarine species and allows researchers to test hypotheses about habitat effects on distribution, growth, and survival. Habitat features such as bathymetry, sediment characteristics, submerged vegetation, and shoreline development have been mapped and will be related to abundance of estuarine species. Staff at the NEFSC James J. Howard Laboratory are currently exploring the role habitat features, and other factors such as water quality, may play in the distribution and abundance of various life stages. For example, settlement of winter flounder occurs about two weeks earlier in the River than in the Bay and is related to water temperature. Although abundance of newly settled winter flounder was similar in the Bay and River, abundance of juvenile winter flounder was higher in the River. The loss of young winter flounder from the Bay may be due to higher predation rates or movement out of the Bay. Surveys planned for 2001 will help us determine predation pressure on young winter flounder throughout the system.

Habitat effects on growth of young-of-the-year winter flounder were studied in a two-year caging experiment in three estuaries along the mid-Atlantic coast: Great Bay-Little Egg Harbor (New Jersey), Navesink River (New Jersey), and Hammonasset River (Connecticut). Of the habitat types studied – macroalgae, eelgrass, tidal creeks, and unvegetated areas adjacent to vegetation – none consistently supported higher growth rates of winter flounder. Growth rates in the Hammonasset River did not differ among habitat types. Winter flounder growth rates were highest in areas of macroalgae in Great Bay-Little Egg Harbor; in the Navesink River, growth rates were highest in eelgrass habitats. Other characteristics which were not measured in this study (e.g., dissolved oxygen or food supply), may have contributed to the lack of consistency in habitat effects on growth rates. These studies also indicated that nominal habitat designations might not be sufficient to define habitat requirements of estuarine-dependent species.

The distribution of blue crabs in the Navesink River/Sandy Hook Bay, New Jersey, was determined from seasonal surveys. Juvenile blue crabs recruit to the adult population in the fall, and abundance of blue crabs at this time is highest. Cannibalism was detected in this species, but we found no evidence for size-related differences in distribution within the system. Likewise, environmental characteristics (such as sediment grain size, temperature, and depth) did not affect the distribution of life stages. Male crabs tended to be associated with the head of the Navesink River and were less common in the Bay. Spatial modeling of crab abundance and environmental variables indicated that overall crab abundance was higher in habitats associated with fine-grained sediments and warmer temperatures.

Ecology of Estuarine-Phase Bluefish: Gillnet surveys have been conducted since 1998 for bluefish (*Pomatomus saltatrix*) in the Navesink River/Sandy Hook Bay, New Jersey. These bi-weekly collections have provided information on habitat features of importance to bluefish, and current work focuses on analysis of diet data (for age-0 and age-1 fish). In 2000, staff at the James J. Howard Laboratory began cooperative studies with Rutgers University on bluefish movements and distribution. Physical characteristics of the system such as tidal fronts, turbidity maxima, distance from shore, and abundance of prey are important determinants of habitat use and movement.

Tautog Stock Enhancement: Studies of a natural tautog (*Tautoga onitis*) population in Morris Cove in New Haven Harbor on Long Island Sound have identified a significant young-of-the-year (YOY) nursery area. Physical habitat characteristics have been mapped spatially and distribution and abundance of YOY tautog have been quantified. Marking studies with wire-coded tags are in progress to estimate movement, growth, and changes in population size. Research in the past year has produced new information on the diets of young tautog and species assemblages of other fish species, associated with different habitat types.

Lobster Mortality: In 1998 and 1999, significant lobster mortalities occurred in western Long Island Sound (LIS), and increasing prevalence of shell disease was reported in lobsters of eastern LIS. The environmental causes of these conditions are unknown. These problems were reviewed at a Long Island Sound Lobster Health Symposium in April, 2000, and pooled observations and research ideas were developed into work plans to address research needs. Two of the seven objectives recommended in the Pathology/Toxicology Section of the LIS Lobster Work Plan are (1) to conduct controlled laboratory studies to determine whether known environmental stressors can increase susceptibility to microbial pathogens, and (2) to develop tools/indices to define immunological, reproductive, and metabolic health in lobsters. A project now beginning at the NEFSC Milford and James J. Howard Laboratories directly addresses these objectives. The study will examine the effects of four interrelated habitat quality variables (hypoxia, sulfide, ammonia, and temperature) in reducing the resistance of lobsters to bacterial diseases caused by *Aerococcus viridans* var *homari* and *Vibrio fluvialis*. It will also examine the effects of the four variables on several immunological indices in lobster (phagocytosis, cell cytotoxicity, serum bactericidal capacity, and serum bacterial agglutinins). The selected habitat quality variables are associated with cultural eutrophication, which is most intense in the western portion of LIS. Individually, each variable has the potential to cause mortality directly and it is hypothesized that at sublethal concentrations the four variables increase the susceptibility of lobsters to microbial infections through immune system suppression.

2. Biological Studies

a) Fish Species

Studies on life history and ecology of marine and estuarine fishes continue at the James J. Howard Laboratory with a primary focus on variations in reproduction and in the growth, development, and survival of offspring during their first year of life.

Flatfish: Studies are continuing on winter and summer flounder to evaluate the effects of temperature on growth, developmental, and mortality rates of eggs, larvae, and juveniles. Experimental designs generally include multiple temperatures (10 temperatures for embryonic period, 4 to 6 temperatures for larval period) and several replicate populations within a temperature. Data are providing insights into developmental, morphometric, and meristic traits, and their relationships to environmental factors. Survival of winter flounder from hatching to metamorphosis has been surprisingly high, exceeding 95% at the warmer temperatures. Summer flounder experiments were designed to evaluate the role of time and location of spawning, and therefore the thermal environments experienced by eggs and larvae. In addition, late larvae and early juvenile summer flounder are being subjected to water temperatures typical of inshore and bay habitats during mid-winter, which is the season of ingress of summer flounder.

Evaluation of mortality risks to recently settled juvenile flatfish is continuing, using winter and summer flounder as prey and bay shrimp, *Crangon septemspinosa*, blue crab, *Callinectes sapidus*, and summer flounder as predators. Size-specific risks of predation have been estimated for various sizes of prey and predators. The role of water temperatures in affecting the duration of time that juvenile summer flounder are vulnerable to these size-limited predators is being evaluated.

Results of laboratory tests on growth of newly settled winter flounder have revealed that under constant temperature conditions, growth rates of late settlers may differ from those of earlier cohorts. In 2001, we plan to investigate the effect of food quality on growth of newly settled winter flounder in central New Jersey estuaries. Early settlers appear to rely on a mix of species, but feed mainly on crustacean and polychaete larvae. Late settlers may rely on a different mix of species that provides a different nutritive value, thus contributing to observed differences in growth rates. In addition, Laboratory staff investigated the feeding behavior of newly settled winter flounder in tests with two co-occurring calanoid copepods and found that fish select *Eurytemora affinis* over *Acartia hudsonica*, even though catch efficiencies of *E. affinis* were lower. This selection was also observed in field-captured specimens during times when *A. hudsonica* was more abundant than *E. affinis.*

Gadids: Research efforts that began in 1998-1999 on Atlantic tomcod, *Microgadus tomcod,* are continuing. This species is of local interest as a sentry of habitat and fish community health and because it is an important forage fish in estuarine systems in the New Jersey - New York area. It is of particular interest because it attains reproductive maturity within 1 year in New Jersey-New York waters. Tomcod is also a focal species in studies of early life-stage exposures to PCB congeners.

Goosefish: Research on goosefish or monkfish, *Lophius americanus,* is proceeding along three lines. First, adults are being collected and processed on a monthly basis during the fishing season (May to August, and November to February). Fish age, gender and maturity stage, and length as well as weights of body (gutted), liver, and gonadal tissue are being determined. Seasonal and interannual patterns of variation in body components are also being evaluated, with emphasis on the inverse relationship between gonad size (reproductive effort) and liver size in the previous year. Second, growth, development, and survival of the early life stages are being evaluated in the laboratory. Cooperating fishermen are providing egg veil fragments which are a source of larvae. Otolith-based age validation studies are planned for 2001. Third, captive adult goosefish will be observed for movement, feeding, and spawning behaviors.

Bluefin Tuna: Elemental analysis of juvenile (age 1) Atlantic bluefin tuna (*Thunnus thynnus*) otoliths indicated that the concentration of certain elements vary among putative nursery grounds in the Atlantic Ocean. Further, trace element fingerprints from each nursery ground are distinct and vary sufficiently to distinguish individuals from different regions with moderate confidence. Overall correct classification rates for a simulated test set were 68% and 81% between two analytical laboratories, despite small sample size (9 Mediterranean v. 19 Western Atlantic tunas). Thus, use of elemental fingerprints as tracers of nursery origin appears promising. This work was done in collaboration with the University of Maryland Center for Environmental Science, the Bedford Institute of Oceanography, the National Research Council Canada, and Texas A&M University.

b) Age and Growth

Approximately 39,550 age determinations were completed by Woods Hole Laboratory staff for 17 species of finfish and shellfish in support of resource assessment analyses and other research in 2000. In addition to Atlantic cod, haddock, and yellowtail flounder, 4,990 summer flounder, 6,264 silver hake, 1,911 white hake and 582 monkfish were aged.

Cod, haddock, and yellowtail flounder age structures were exchanged with Canadian age readers; and Atlantic herring structures were exchanged with readers from USA state laboratories in a continuing effort to maintain comparability of age determinations between laboratories aging these species. A workshop on the aging of yellowtail flounder was held in collaboration with Canadian scientists in St. John's, Newfoundland.

Research projects initiated or continued in 2000 were: 1) a study to validate the aging of monkfish; 2) a study of juvenile cod and haddock otoliths in collaboration with the University of Rhode Island; 3) verification of cunner aging; and 4) a study of the biology of witch flounder in deep water habitats.

c) Food Web Dynamics

Fish Species: The NEFSC continued studies of trophic dynamics based on an integrated program of long-term (since 1963) monitoring and process-oriented predation studies. Modeling and analytical efforts focused on species interactions among flatfish, elasmobranchs, 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 winter survey, 3,262 stomachs from 33 species were examined, while 6,176 stomachs from 51 species, and 4,553 stomachs from 50 species were examined during the spring and autumn surveys, respectively. Diet sampling emphasized gadids, flatfishes, small pelagics, and elasmobranchs.

Revisions to the 27 year (1973-99) time series 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 250,000 stomach samples. The processing of all the 1999 and 2000 bottom trawl survey food habits data is scheduled for completion in 2001.

Macroinvertebrates: Staff at the NEFSC James J. Howard Laboratory studied the distribution and feeding preferences of three species of crabs (blue crabs; lady crabs, *Ovalipes ocellatus*; and Atlantic rock crabs, *Cancer irroratus*) in the Hudson-Raritan estuary of New York and New Jersey. Most of the blue and lady crabs were collected in warmer months, whereas Atlantic rock crabs were most numerous in cooler months. Sex ratios of rock crabs were highly skewed indicating that male rock crabs use the estuary more than female rock crabs. The dominant prey items for all three species crabs were mollusks and crustaceans, but the diet of each species depended mainly on location of capture in the estuary. These results support previous proposals that the three species are opportunistic feeders. Areas of high abundance have been delineated and this information could be used in the planning of habitat alterations, e.g. dredging or filling.

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. The Cooperative Shark Tagging Program (CSTP) involving over 6,500 volunteer recreational and commercial fishermen, scientists and fisheries observers (conducted since 1962) continued to tag large coastal sharks and provided information to define essential fish habitat for shark species in USA waters.

A cooperative USA/Canadian research program on the biology of the porbeagle shark, *Lamna nasus*, continued. An age and growth study has been completed and a manuscript detailing the results was prepared and submitted. Reproductive sampling continued in 2000; final maturity estimates were generated and a draft manuscript prepared. Tagging was continued for migration studies.

Reproductive dynamics and shark nursery ground studies also continued, focusing on identification and characterization of mating, pupping, and nursery areas of small and large coastal sharks along the USA Atlantic and Gulf coasts. Studies in 2000 involved the continuation of a post-release survivorship study and in conjunction with biologists from five coastal states, mapping and collecting baseline catch and relative abundance data for shark species utilizing the coastal zone. In addition, an overview and synthesis of ongoing and recent shark nursery grounds studies was initiated in 2000 with 14 researchers in 12 coastal states contributing summaries and data.

e) Marine Mammals:

Small Cetaceans: An abundance estimate was completed for harbor porpoise (*Phocoena phocoena*) based on a 1999 survey. Results of this survey indicate that abundance of the Gulf of Maine/Bay of Fundy stock is higher than previously estimated. The main reason for this change is that harbor porpoises were found in areas not previously surveyed.

Additional harbor porpoise genetic materials have been provided to the Southeast Fisheries Science Center (SEFSC) and are currently being analyzed. These represent animals taken in the Mid-Atlantic and Gulf of Maine gillnet fisheries.

A database is being developed on the spatial position and size of recorded vocalizing harbor porpoise groups detected by a hydrophone. Software was developed to process the raw acoustic data files. Positions of automatic porpoise clicks (N=102) were determined, together with times, durations, and bearings from the hydrophone. The data are also being analyzed manually to verify and refine the findings from the software.

Research is ongoing to develop and test a method to estimate abundance of harbor porpoise using visual sighting and acoustical data. This will be an extension of the double-team survey method in which teams search separate regions to reduce the correlation between the two teams' sighting availability. Uncertainty in duplicate identification is likely to be a major component of estimator variance and it will be a central feature of the statistical methodology.

Large Cetaceans: A cooperative research cruise between the SEFSC and the NEFSC was held during winter 1999-2000 to evaluate abundance of humpback whales (*Megaptera novaeangliae*) in the Leeward Islands.

Preliminary matching of data for humpback whales from the Scotian Shelf suggests limited exchange with the Gulf of Maine stock, thus potentially establishing population boundaries for stock assessment purposes.

Scarification analyses for humpback whales initiated in 1999 have been expanded to include right whales (*Eubalaena glacialis*), and will be extended for a minimum of three more years. It is anticipated that these analyses will provide a key tool for meeting the goals of the Atlantic Large Whale Take Reduction Plan.

NEFSC developed a Critical Sightings Program (CRISP) placard that outlines vital information to be collected from sightings of right whales, or dead or entangled whales of any species. The placard will be distributed to the U.S. Coast Guard, state agencies and Navy installations to facilitate timely and more accurate reporting of marine mammal sightings.

The NEFSC and the NMFS Northeast Regional Office (NERO) continued aerial sighting surveys for right whales in the Great South Channel, Gulf of Maine, and Georges Bank areas during April - July 2000. In August, the NEFSC conducted aerial surveys in the Bay of Fundy to obtain photogrammetric length measurements for use in determining health and condition of individual whales, employing aerial photogrammetry camera systems of military design with forward motion compensation.

The North Atlantic Right Whale Individual ID catalogue and database (URI and NE Aquarium) have been updated through December 2000.

DNA extraction, sexing, sequencing and genotyping of individual right whales continued. Additional microsatellite loci were used, resulting in further paternity assignments. MtDNA analyses continue to identify only five haplotypes in the modern right whale population, one of which is very rare. Analysis of haplotype frequencies and of microsatellite loci continue to indicate genetic substructuring in the population. Studies of historical variability have been greatly enhanced by successful extraction of DNA from 16th century right whale bones from a Basque whaling site in Labrador; additional mtDNA haplotypes have been found, reinforcing the belief that most genetic variation was lost prior to the 20th century. Worldwide genetic comparisons indicate that North Atlantic, North Pacific and southern hemisphere right whales are three separate species.

Right whale reproduction has declined significantly in recent years, and an NEFSC-hosted workshop on this topic developed a research plan to investigate this phenomenon. Reproduction-related work funded in 2000 included steroid hormone analysis, health assessment, body condition studies, and continued assessments of population status.

A joint NEFSC - Oregon State University cruise in July/August 2000 placed satellite-monitored tags on 16 right whales, and time - depth recorders on many more; extensive oceanographic sampling was also conducted for habitat profiling in association with the tagging work.

Assessments of blubber thickness using ultrasound suggest that North Atlantic right whales are significantly thinner than southern right whales.

NEFSC has also funded a postdoctoral fellow to continue studies of the reactions of right whales to ships. This work is based upon an acoustic tag which records acoustical stimuli as well as data on orientation in the water column and dive behavior. Twenty right whales were tagged in August, and playback experiments were conducted.

Pinnipeds . Surveys were conducted from the southern Gulf of Maine to southern New England and eastern Long Island to obtain counts of harbor seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) at major haul-out sites, and to obtain baseline data for developing seasonal abundance indices. Also, scat collecting trips were conducted in the Cape Cod region. A total of 213 samples were collected, which included 174 harbor seal and 39 grey seal scats. Preliminary analyses of the harbor seal scats indicate sand lance (*Ammodytes* sp.) to be the most important prey with frequency of occurrence at 83%.

Tissue samples were collected from six harbor seal pup carcasses found on several ledges in Penobscot Bay. These were sent to SEFSC, Charleston, SC for DNA studies.

f) Marine Turtles

NEFSC and NER staff developed the first five-year research and management plan for the Northeast Region. The objectives of this plan are to prioritize, support and direct future research on sea turtles to assess the status of sea turtle stocks and to reduce bycatch. The plan addresses stock assessment, sources of anthropogenic mortality, habitat assessment, the Sea Turtle Stranding and Salvage Network (STSSN), recovery and conservation research and ongoing NEFSC activities that involve sea turtles. NEFSC and NER staff also worked cooperatively with other NMFS units to formulate a response plan to reduce sea turtle mortality in the Mid-Atlantic during spring. This plan includes increased observer coverage, management triggers, aerial surveys, alternative platform work, improved STSSN coverage and biopsies from observed and stranded animals.

NEFSC staff were actively involved in issues related to the pelagic longline fishery on the Grand Banks, including reviews of biological opinions and analyses, technical workshops and development of a proposal to investigate movements and behavior of loggerhead turtles (*Caretta caretta*) on the Grand Banks via satellite telemetry. NEFSC staff also met with Canadian DFO staff to assist with development of a sea turtle protection program in Canadian waters. It is expected that this dialogue will facilitate a cooperative approach to research and bycatch reduction in the Northwest Atlantic. Other activities included a pilot aerial survey in the Mid-Atlantic in July, 2000 to investigate applicability of line transect methodology for estimating marine turtle abundance, and a November workshop to review the major cold stun event in 1999 and to develop protocols to improve future cold stun response and treatment.

3. Studies of Fishing Operations

The NEFSC placed observers aboard fishing vessels in 8 different fishery categories in 2000. All of these fisheries operated in NAFO Subareas 5 and/or 6.

a) New England and Mid-Atlantic Sink Gillnet Fisheries

The NEFSC deployed observers on 1,283 trips covering 1,398 sea days in New England and Mid-Atlantic sink gillnet fisheries. The primary objective was to estimate incidental catch rates of harbor porpoise and other marine mammals. A total of 63 marine mammals were caught, including (in order of highest occurrence) harbor seals, harbor porpoises, bottlenose dolphins, gray seals, unidentified seals, harp seals, white-sided dolphins and Risso's dolphins. Biological samples were collected from these animals including body measurements, entire carcasses and tissue samples. Kept and discarded finfish catches were weighed or estimated for a portion of the observed sets. Eleven sea turtles were also caught, including 4 unidentified turtles, 4 loggerheads, 2 Kemp's ridleys and 1 green turtle. Length frequencies and age structures were also obtained from finfish. A total of 146 sea birds were caught, including (in order of highest occurrence) unidentified cormorants, unidentified loons, red-

throated loons, common loons, northern gannets, double-crested cormorants, greater cormorants, pelicans, unidentified sea birds, and greater and Manx shearwaters.

b) Drift Gillnet Fisheries

The closure of the pelagic swordfish drift gillnet fishery continued in 2000. Fifty-three trips were made aboard coastal drift gillnet vessels, for a total of 53 days of coverage. One harbor porpoise was caught. Four unidentified seabirds, 5 unidentified cormorants and 18 red-throated loons were caught.

c) Otter Trawl Fisheries

A total of 272 trips were made, totalling 776 days of coverage. Observed fisheries included: New England multispecies groundfish; summer flounder; *Illex; Loligo*; Atlantic mackerel; and Atlantic herring. Kept and discarded catches were weighed or estimated for a portion of the observed tows. Length frequencies and age structures were also obtained for age and growth studies. The following marine mammals were caught: Six saddleback dolphins, 1 harbor seal, 1 unidentified dolphin, 1 unidentified pilot whale and 1 longfin pilot whale. Two unidentified sea turtles and 1 unidentified cormorant were also caught.

d) Pair Trawl Fisheries

One trip was made aboard a pelagic pair trawl vessel for 2 days of coverage. Kept and discarded catches were weighed or estimated for a portion of the observed tows. Length frequencies and age structures were also obtained. No incidental takes were observed.

e) Sea Scallop Dredge Fishery

Thirty trips were conducted, with a total of 216 days of coverage. Additionally, three areas, previously closed to fishing, were opened to dredge scalloping in 2000 and 1,913 days of coverage were accomplished in these areas. Coverage in the closed areas was used for monitoring of yellowtail bycatch rates. Individual measurements were collected from kept and discarded sea scallops. Kept and discarded catches were weighed or estimated for a portion of the observed tows. Length frequencies and age structures were also obtained. No marine mammals, sea turtles or sea birds were taken.

f) Lobster Pot Fishery

Two trips were conducted on lobster pot vessels for a total of 15 days of coverage. Kept and discarded catches were weighed or estimated for a portion of the observed hauls. Length frequencies and age structures were also obtained. Lobsters were measured individually. No marine mammals, sea turtles or sea birds were observed in this fishery.

g) Purse Seine Fishery

Five trips were made aboard purse seine vessels for 18 days of coverage. Kept and discarded catches were weighed or estimated for a portion of the observed sets. Individual weights and measurements were collected from targeted giant bluefin tuna. No marine mammals, sea turtles or sea birds were observed in this fishery.

h) Pelagic Longline Fishery

Six trips were covered in the longline fishery for a total of 25 days. Kept and discarded catches were weighed or estimated for a portion of the observed sets. Individual length and weights were obtained from pelagic species. No marine mammals, sea turtles or sea birds were observed.

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.

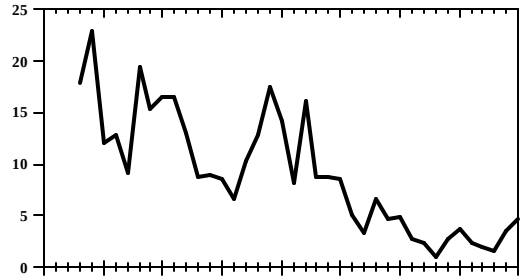

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

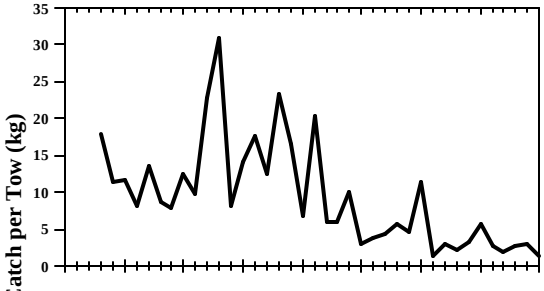

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

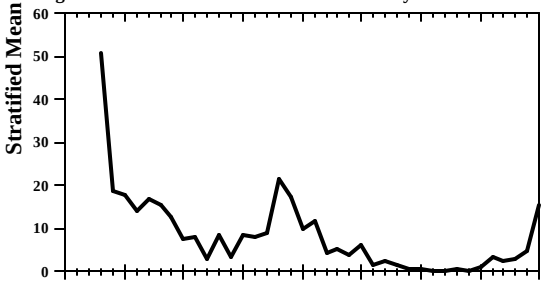

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

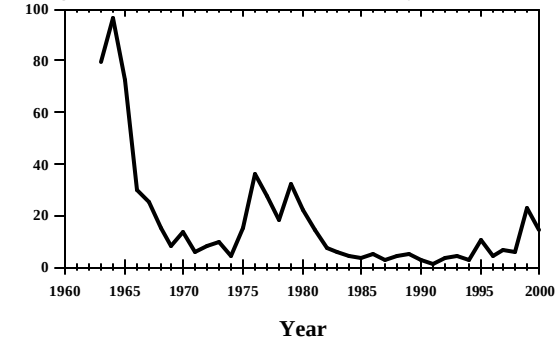

Figure 4. NEFSC autumn bottom trawl survey biomass indices for Georges Bank haddock.

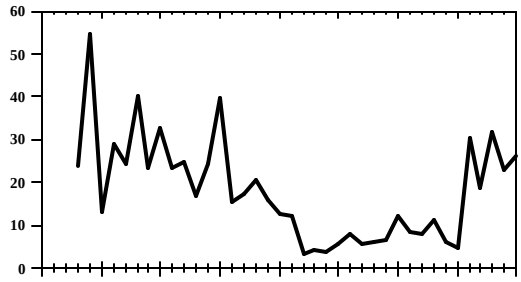

Figure 5. NEFSC autumn bottom trawl survey biomass indices for redfish.

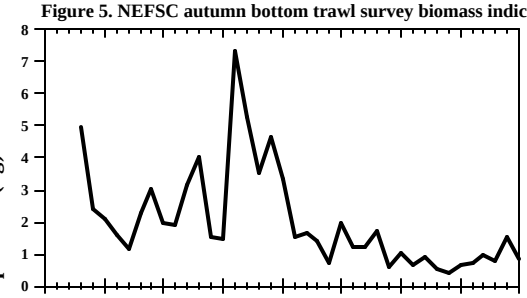

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

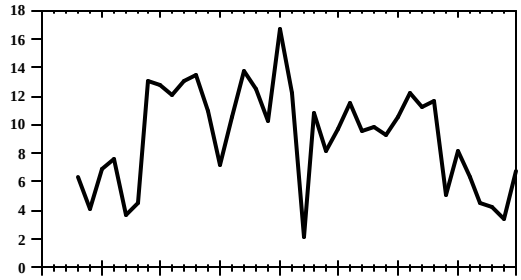

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

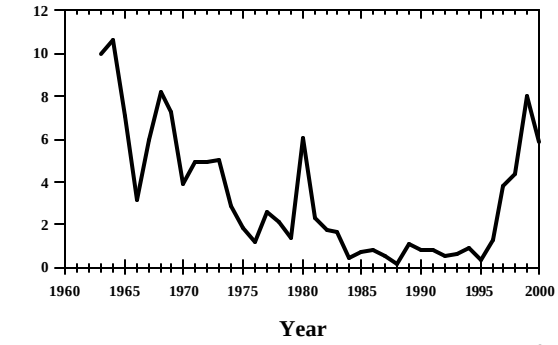

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

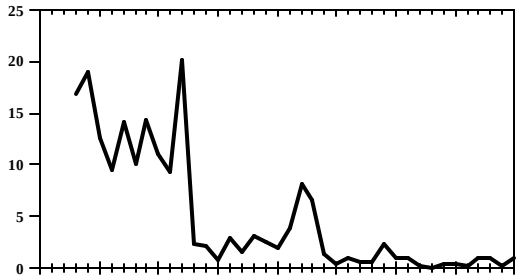

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Southern New England yellowtail flounder.

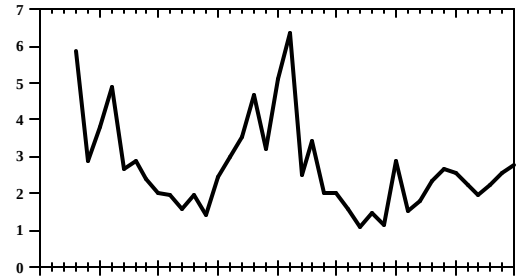

Figure 10. NEFSC autumn bottom trawl survey biomass indices for American plaice.

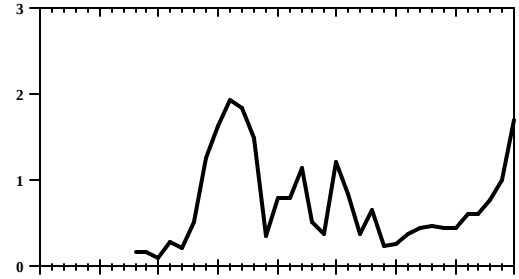

Figure 11. NEFSC spring bottom trawl survey biomass indices for summer flounder.

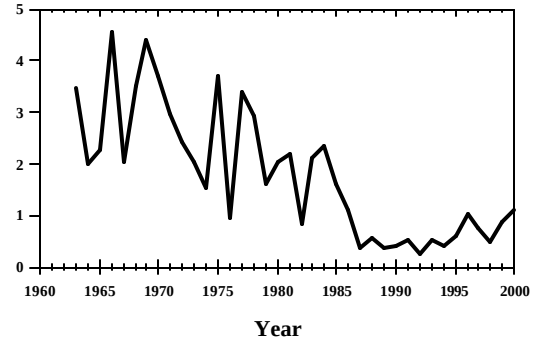

Figure 12. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

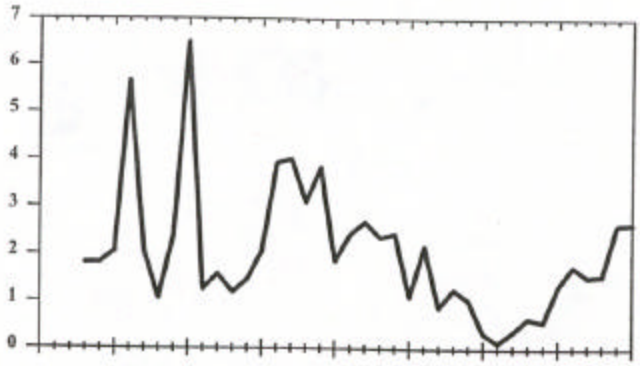

Figure 13. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

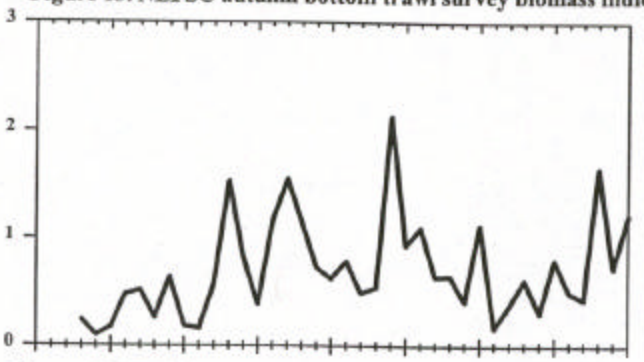

Figure 14. NEFSC autumn bottom trawl survey biomass indices for northern windowpane flounder.

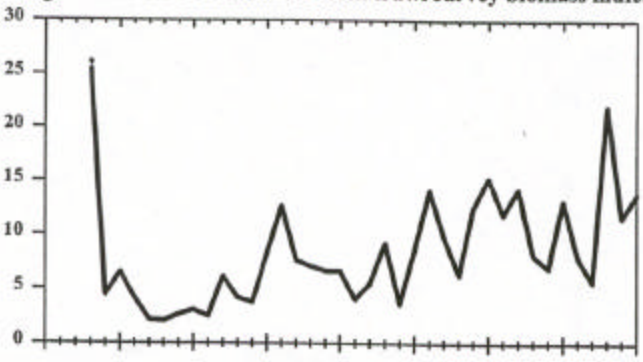

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

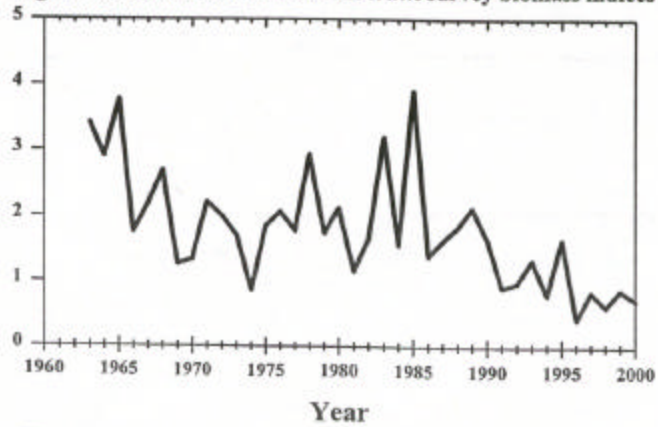

Figure 16. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

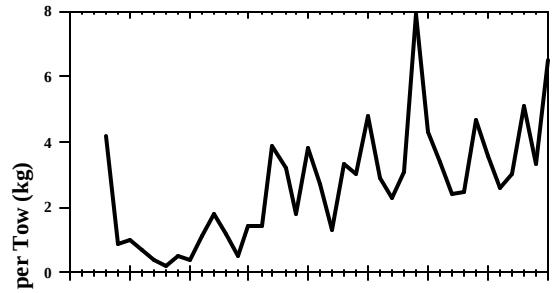

Figure 17. NEFSC autumn bottom trawl survey biomass indices for northern red hake.

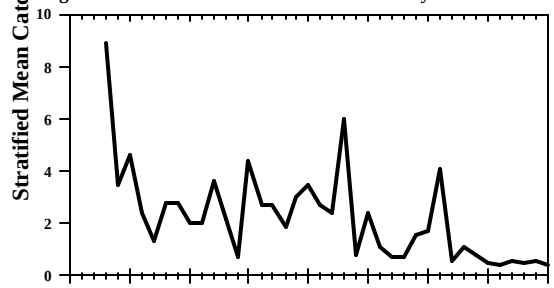

Figure 18. NEFSC autumn bottom trawl survey biomass indices for southern red hake.

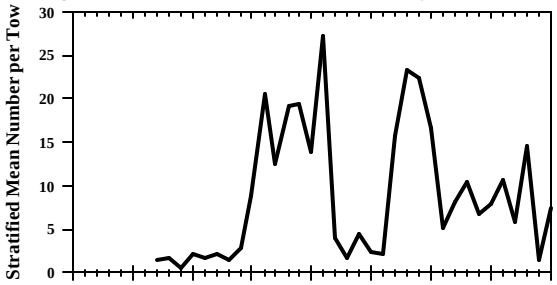

Figure 19. NEFSC autumn bottom trawl survey abundance indices for *Illex*.

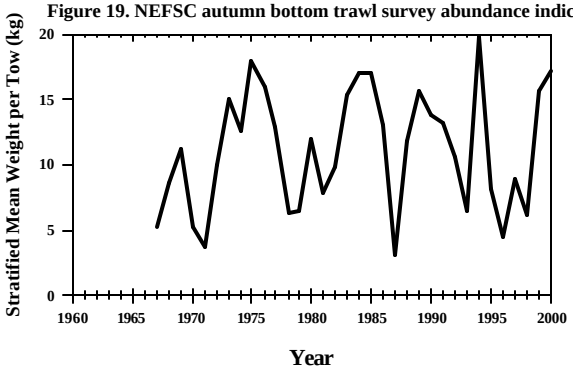

Figure 20. NEFSC autumn bottom trawl survey biomass indices for *Loligo*.

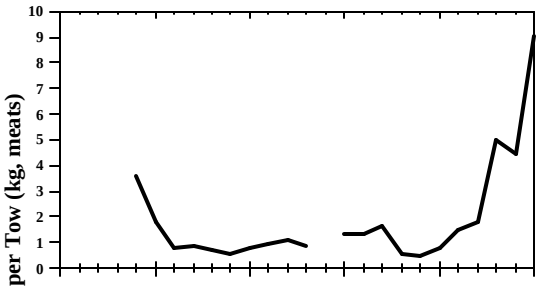

Figure 21. NEFSC scallop survey biomass indices for Georges Bank sea scallops.

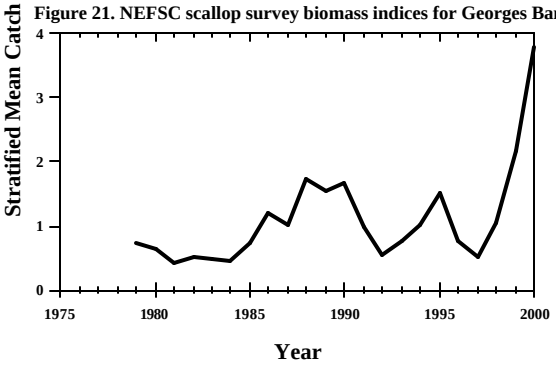

Figure 22. NEFSC scallop survey biomass indices for Mid-Atlantic Bight sea scallops.