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United States Research Report for 1996

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*) increased 5% from 13,557 mt in 1995 to 14,214 mt in 1996, but 1996 landings remain among the lowest since 1960.

USA cod landings from the Gulf of Maine (Div. 5Y) in 1996 were 7,194 mt, a 6% increase from 6,798 mt landed in 1995. Fishing mortality on this stock has remained high over the past decade, averaging about 1.1 in 1995 and 1996. Spawning biomass has declined from over 30,000 mt in 1989 to about 11,000 mt in 1996. Stratified mean biomass indices have increased slightly since the 1991 record low, but continue to remain among the lowest in the series (Figure 1).

Landings from the Georges Bank stock (Div. 5Z and SA 6) in 1996 were 7,020 mt, a 4% increase from 6,759 mt landed in 1995. Fishing mortality in 1996 declined to a record low of 0.18, following a record high of 1.07 in 1994. Spawning stock biomass in 1996 (41,150 mt) was 20% higher than in 1995 (34,300 mt) and 30% higher than the record low in 1994 (31,300 mt). Stratified mean biomass indices from research surveys indicate that total stock biomass declined slightly in 1996 and remains near historic low levels (Figure 2).

2. Haddock

USA landings of haddock (*Melanogrammus aeglefinus*) increased 39% from 410 mt in 1995 to 570 mt in 1996, but remained well below levels extracted from historically larger stocks. Georges Bank (Div. 5Z) landings increased 44% from 218 mt in 1995 to 313 mt in 1996, while Gulf of Maine (Div. 5Y) landings increased 34% from 192 mt in 1995 to 257 mt in 1996. Landings from both stocks remained at less than 10% of historical levels and were constrained by restrictive management measures.

Research vessel survey indices in 1996 indicated some increase in stock levels, but the survey indices for both the Gulf of Maine and Georges Bank stocks remained well below historical levels (Figures 3 and 4). Spawning biomass of the Georges Bank stock increased in 1996 due to continued recruitment and growth of a moderate 1992 year class, but spawning biomass is expected to stabilize in the near future due to weak recruitment after 1992.

3. Redfish

USA landings of redfish (*Sebastes* spp.) remained declined 27% from 440 mt in 1995 to 322 mt in 1996. Research vessel survey indices indicate that stock biomass increased substantially in 1996 (Figure 5) due to somatic growth of a relatively strong recruiting year class produced in the early 1990s. Redfish from this year class should recruit to the fishery in the next 2-3 years.

4. Pollock (4VWX + 5 stock)

USA landings of pollock (*Pollachius virens*) declined 10% from 3,358 mt in 1995 to 2,963 mt in 1996, the lowest annual catch ever recorded. 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 indices suggest that pollock biomass in Subarea 5 continues to remain near a record low (Figure 6).

5. White Hake

USA landings of white hake (*Urophycis tenuis*) decreased 24% from 4,316 mt in 1995 to 3,264 mt in 1996, the lowest annual catch since 1973. Research vessel survey indices indicate that the stock has declined from the stable level of the 1980s to one of the lowest points in the survey series (Figure 7).

6. Yellowtail Flounder

USA landings of yellowtail flounder (*Pleuronectes ferrugineus*) increased 21% from a record low of 1,916 mt in 1995 to 2,343 mt in 1996. Research vessel survey indices suggest that the Georges Bank stock (Div. 5Z, E of 69°) biomass has begun to increase, but remains low relative to that observed in the 1960s, while biomass of the Southern New England stock (Div. 5Z, W of 69°) remains at an historic low (Figures 8 and 9). Virtual population analysis indicates that both stocks are beginning to rebuild due to moderate recruitment and improved survival.

7. Other Flounders

USA commercial landings of flounders (other than yellowtail flounder) from Subareas 3-6 in 1996 totaled 18,014 mt, 3% lower than in 1995. American plaice (*Hippoglossoides platessoides*) (24%), summer flounder (*Paralichthys dentatus*) (32%), winter flounder (*Pseudopleuronectes americanus*) (26%), witch flounder (*Glyptocephalus cynoglossus*) (12%), and windowpane flounder (*Scophthalmus aquosus*) (5%) accounted for virtually all of the 'other flounder' landings in 1996. Compared to 1995, commercial landings in 1996 were lower for American plaice (-5%), summer flounder (-17%), and witch flounder (-6%), but higher for winter flounder (+18%) and windowpane flounder 1970s; stock biomass is currently well above the long-term average. Biomass indices for the Southern Georges Bank - Mid-Atlantic stock, however, continue to remain depressed despite low fishing mortality (Figures 17 and 18).

8. Silver Hake

USA landings of silver hake (*Merluccius bilinearis*) increased 10% from 14,727 mt in 1995 to 16,200 mt in 1996. Research survey biomass indices for the Gulf of Maine - Northern Georges Bank stock, which increased throughout the 1980s, have been quite variable since 1990. Biomass indices for the Southern Georges Bank - Mid-Atlantic stock have declined in recent years and are now at historically low levels (Figures 15 and 16). In both stocks, discards of juvenile fish have been relatively high.

9. Red Hake

USA landings of red hake (*Urophycis chuss*) decreased 31% from 1,599 mt in 1995 to 1,097 mt in 1996. Landings continue to remain at or near record low levels. Research vessel biomass indices for the Gulf of Maine - Northern Georges Bank stock have increased steadily since the early

1970s; stock biomass is currently well above the long-term average. Biomass 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

USA landings of Atlantic herring (*Clupea harengus*) increased 34% from 76,135 mt in 1995 to 101,847m t in 1996. Spawning stock biomass of the coastal stock complex of herring 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, particularly on juvenile herring. Although there has been no directed fishery for herring on Georges Bank (Div. 5Ze) since the stock collapsed in 1977, there is strong evidence of stock recovery based on research vessel trawl (Figure 19) and larval survey results and incidental commercial catches.

11. Atlantic Mackerel

USA commercial landings of Atlantic mackerel (*Scomber scombrus*) increased from 8,492 mt in 1995 to 15,752 mt in 1996. Recreational landings increased from 1,249 mt in 1995 to 1,335 mt in 1996. The stock (Subareas 2-6) is currently underexploited, and total biomass remains at record high levels in excess of 2 million mt. Stock rebuilding since 1981, documented by research survey indices (Figure 20), has resulted from very low fishing mortality rates and the recruitment of several very good year classes (1982, 1987, 1988, 1991, and possibly 1993 cohorts).

12. Butterfish

USA landings of butterfish (*Peprilus triacanthus*) increased 65% from 2,154 mt in 1995 to 3,564 mt in 1996. Research survey biomass indices increased during the late 1970s, fluctuated during the 1980s, and are presently above the long-term average. Recent recruitment has been good and both the 1992 and 1993 year classes appear strong.

13. Squids

USA landings of long-finned squid (*Loligo pealei*) decreased 33% from 18,531 mt in 1995 to 12,459 mt in 1996. Minimum biomass estimates suggest that the stock is at low levels.

USA landings of short-finned squid (*Illex illecebrosus*) increased 21% from 14,058 mt in 1995 to 16,969 mt in 1996, but remained well below the record high 1994 level. Stock biomass estimates have remained relatively stable since 1991.

14. Sea Scallops

USA commercial landings of sea scallops (*Placopecten magellanicus*) in 1996 were 7,892 mt (meats), 1% less than in 1995 (8,001 mt). Results from the 1996 sea scallop survey indicate that the abundance of exploitable-sized scallops in the USA Georges Bank region has increased moderately from near record low levels, while in the Mid-Atlantic region, exploitable stock abundance has declined sharply from near record high levels. The 1990 and 1991 year classes, which were relatively strong in the Mid-Atlantic region, have now been fished out. Recent recruitment has been below average on Georges Bank and extremely poor in the Mid-Atlantic region.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic Studies

A report describing surface and bottom temperatures and surface salinities in the Mid-Atlantic Bight and Gulf of Maine in 1996 was submitted as NAFO SCS Doc. 97/06.

b) Plankton Studies

USA GLOBEC Georges Bank Study: The USA GLOBEC Georges Bank study completed its second year of field work in 1996. Six monthly surveys of the Bank (January-June) were conducted which measured the hydrography (temperature, salinity, and fluorescence) and currents (by ADCP) and collected samples to determine the distribution and abundance of zooplankton and the ichthyoplankton of cod and haddock. Approximately 75 stations were occupied on each survey cruise. These observations are part of a planned 5-year study. The hydrographic observations indicated a continued lowering of the salinity of the Bank region that was observed in 1995. Comparison with other data sets showed that this low salinity phenomenon occurred throughout the Gulf of Maine/Georges Bank system. No significant intrusions of offshore slope water or water directly from the Scotian Shelf were observed in 1996, unlike the conditions in 1995 when intrusions of both origins were seen. The plankton data from 1996 are being sorted and processed.

c) Aquaculture

The NEFSC Milford Laboratory has reestablished a major program in shellfish and finfish aquaculture. Two new land-based culture systems have been constructed for the culture of bay scallops (*Argopecten irradians*) and tautog. These systems are designed to identify and communicate practical operational parameters of closed, recirculating, land-based culture systems and to evaluate the economic costs and returns associated with the operational features and potential economic viability of such ventures. Linked to the new culture systems is a recently constructed greenhouse designed to apply industrial process-control technology to phytoplankton culture for aquaculture feeds.

Bay scallop morphometric data such as shell height, rib number, and convexity were found to coincide with earlier allozyme electrophoresis studies conducted at the Milford Laboratory on genetic differences among bay scallop populations. Additional improvements in identification of scallop stocks through collaborative work on DNA analysis with the University of Connecticut are expected to aid in stock enhancement and restoration efforts.

d) Other Environmental Studies

Seasonal collections are being made with beam and otter trawls by NEFSC staff from the James J. Howard Laboratory in Highlands, NJ at 84 fixed stations in the Navesink River/ Sandy Hook Bay, NJ estuarine system in a multidisciplinary study of juvenile habitat requirements for fishes and macroinvertebrates. Habitat associations of economically significant species such as winter flounder (*Pleuronectes americanus*), summer flounder (*Paralichthys dentatus*), and blue crab (*Callinectes sapidus*) are being examined with canonical correspondence analysis. Distributions of the sediment characteristics, macrophyte biomass, major food organisms, and hydrography and basic physical-chemical characteristics of the estuary are being entered into a GIS. A combination of multivariate statistics and GIS is being used to describe habitats critical to recruitment of the subject species. The role of predator and prey species will be considered in the analysis along with all of the above environmental characteristics. Summer and fall collections were made in 1996. Dietary studies are being conducted with the economically significant species. Seasonal collecting will continue through 1997 with the addition of surveys for benthic infauna.

The final year of field work was completed in the 3-year cooperative study with Rutgers University to determine habitat-use patterns for juvenile fishes in three estuaries: Great Bay-Little Egg Harbor and the Hudson-Raritan systems in New Jersey and the Connecticut side of Long Island Sound. In addition to determining distribution and abundance of young fish, transplant experiments with winter flounder (*Pleuronectes americanus*) and tautog (*Tautoga onitis*) were conducted in 1996 as experimental tests of habitat quality for juvenile fishes in bare sand, seagrass beds, and beds of the green macroalga *Ulva lactuca*. Growth and survivorship were monitored, and fish tissues were analyzed for RNA/protein ratios. Stable isotope analyses of sediment, vegetation, and tissues were made to inves-

tigate trophic linkages. Other laboratory experiments were conducted to test for habitat preferences in winter flounder and tautog.

Field surveys in the Kill Van Kull area of New York were undertaken in continuing cooperative studies with Rutgers University to evaluate the function of various structures (i.e., piers, derelict vessels, and pilings) as habitat for juvenile fishes. Results will be used by the US Corps of Engineers in their program to remove potential drift material which can pose a hazard to shipping in New York Harbor.

A study was begun in the Arthur Kill section of New York Harbor to compare the functioning of salt marshes replanted after an oil spill to oiled but unreplanted marshes and unoiled (reference) marshes. Aspects of the study include sediment biogeochemistry, benthic meio- and macrofauna, growth and contamination of ribbed mussels, stable isotope ratio analysis of marsh food webs, and food habits of the mummichog (*Fundulus heteroclitus*), an important prey for larger fish.

A monthly bottom trawl survey of the lower Hudson-Raritan Estuary (New York/New Jersey) was continued for the sixth year. Manuscripts are being prepared on overall results of the survey, the distribution/abundance of skates, diets of crabs, and differences in catches between channel and non-channel areas.

Nutritional studies of *Aureococcus anophagefferens*, picoplankter responsible for catastrophic "brown tides" in the northeast region since 1985, were continued. Preparatory to elimination of bacterial contaminants from the culture, marked *A. anophagefferens* growth improvement in artificial sea water was obtained through enhanced formulation of macro and micro constituents.

2. Biological Studies

a) Fish Species

Bluefish: A year-long analysis of feeding, growth, and locomotion of 0-year class bluefish (*Pomatomus saltatrix*) was conducted under simulated natural conditions of light and temperature in the research aquarium at the Howard Laboratory in 1996. The data are currently under analysis.

Winter flounder: Studies of the rates of growth, development, and survival during the early life history of winter flounder (*Pleuronectes americanus*) were initiated at the Howard Laboratory. These vital rates are often poorly known even for the best studied species and usually require laboratory experimentation to achieve baseline estimates. A new facility was designed, constructed, and used to evaluate vital rates during the embryonic, larval, and early juvenile periods of winter flounder. The effects of temperature on duration of life periods, growth rates, and sizes at transitions between life periods were estimated based on replicated populations reared at multiple temperatures (10 temperatures for embryonic period, 5 temperatures for larval period). These data are currently being analyzed. An analogous study will be conducted in the autumn of 1997 on vital rates of summer flounder (*Paralichthys dentatus*).

b) Invertebrate Species

A mathematical relationship was established between carapace length and surface area of female lobsters (*Homarus americanus*) over a broad range of sizes. This was used to calculate surface areas of 15,000 USA Northeast coast lobsters which were examined previously for evidence of shell disease. Comparison of lesion size with surface area is expected to give a more accurate index of disease intensity.

c) Age and Growth

Approximately 48,200 age determinations were completed for 19 species of finfish and shellfish in support of resource assessment analyses and other research in 1996.

Cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), winter flounder (*Pleuronectes americanus*), and goosefish (*Lophius americanus*) age structures were exchanged with Canadian age readers, and Atlantic herring (*Clupea harengus*) and summer flounder (*Paralychthys dentatus*) structures were exchanged with readers from USA state laboratories in a continuing effort to maintain comparability of age determinations among the laboratories ageing these species.

The processing and ageing of larval cod otoliths in order to examine daily growth rates continued in 1996. Research to examine the variability in juvenile winter flounder growth and survival in three habitats (Milford, CT, Sandy Hook, NJ, and Tuckerton, NJ) utilizing laboratory studies and analyses of juvenile otoliths was initiated.

A cooperative study between USA and Canadian biologists analyzing migration and distribution patterns of Atlantic cod utilizing data from fish tagged during 1979-1994 continued in 1996. The results of this analysis are expected to be published in 1997.

Research to develop indices of maturity and egg quality in Atlantic cod and summer flounder were initiated. These studies are designed to develop biochemical and histological methods for accurately determining maturation schedules for these important species and validate the macroscopic methods for determining maturation during standard trawl surveys.

d) Food Chain Studies

Studies of trophic dynamics based on an integrated program of long-term (since 1963) monitoring and process-oriented predation studies were continued in 1996. In addition to standard research vessel survey sample collection, a series of process-oriented studies has been in progress since 1994 with funding from the NOAA Coastal Ocean Program (NCOP).

Food habits samples were collected during NEFSC survey activities conducted during the winter, spring, and fall on the Northeastern and Mid-Atlantic continental shelf. Volumetric estimates of prey composition were made at sea for selected species. During winter, 6,264 stomachs from 26 species were examined, while 7,500 stomachs from 29 species and 7,828 stomachs from 35 species were examined during the spring and fall, respectively. Sampling emphasis was placed primarily on elasmobranchs (spiny dogfish, smooth dogfish, and various skates), gadids, and flatfishes.

Process-oriented predation studies were conducted during the spring and summer on Georges Bank to quantify the role of predation in fish community dynamics. This work was designed to complement predation-process studies conducted under the USA GLOBEC Northwest Atlantic/Georges Bank Program. Three NCOP predation cruises were carried out from which 3,973 stomach samples from 20 species were examined at sea or preserved for laboratory analysis.

Revision of the 33-year time series of food habits data collected during NEFSC bottom trawl surveys continued. An 18-year subset of this time series is now available for analysis including data from over 120,000 stomach samples collected during 1973-1990.

e) Apex Predators

Apex predator research is focused on determining migration patterns, age and growth, food chain dynamics, and reproductive biology of highly migratory species, particularly large Atlantic sharks. To delineate shark migratory patterns and stock structure, a multi-

decadal cooperative tagging program involving 6,500 volunteer recreational fishermen, scientists, and fisheries observers has been conducted since 1962 along the North American and European coasts. Data utilized to monitor changes in abundance and biological samples required for studying age and growth, food habits, and reproductive biology are obtained regularly at sportfishing tournaments, from commercial longline vessels, and from domestic and foreign research vessels. Resource surveys are also conducted to assess and monitor species composition and abundance of coastal shark species, tag and release individuals, collect essential biological information, and link distribution patterns with environmental parameters using oceanographic and remotely sensed data.

In 1996, members of the Cooperative Shark Tagging Program tagged and released 9,376 fish, including 36 species of sharks and 15 species of teleosts. The principal shark species tagged were blue (65%), sandbar (15%), tiger (5%), blacktip (3%), and dusky (2%). Information was also received on 602 recaptured fish representing 16 species of sharks and 3 species of teleosts. Blue (420), sandbar (52), shortfin mako (35), tiger (18), and porbeagle (13) sharks were the predominant species recaptured. The addition of the 1996 data brings the total number of sharks tagged to 138,315 and recaptures to 6,812.

A cooperative USA/Canada research program to examine the age and growth of the porbeagle shark (*Lamna nasus*) was begun in 1996. In September, a cruise was conducted which targeted porbeagles off the coast of Maine and Canada to tag and inject individual sharks with oxytetracycline to validate the periodicity of vertebral column banding. Distribution information and biological samples were taken for ongoing migration, food habits, and reproductive biology studies.

In addition, the reproductive dynamics of nurse sharks and sandbar sharks are being investigated. This research is focusing on identifying the mating areas of nurse sharks in the waters off Florida utilizing ultrasonic telemetry and fidelity of sandbar sharks to summer nursery areas using tag/recapture data from young-of-the-year and juvenile sandbars.

f) Marine Mammals

Harbor Porpoise

A new method called "adaptive cluster sampling" was field tested for comparison to traditional line transect methods for estimating the abundance of harbor porpoise.

Fine-scale spatial patterns of harbor porpoises were correlated with the fine-scale pattern of biological and physical features of the Gulf of Maine during August and November. Biological features included zooplankton collected in bongo tows and potential harbor porpoise prey and competitor species collected from bottom trawl tows on the same track lines of a marine mammal survey. Physical features included water surface temperature, bottom temperature, salinity, and depth.

The abundance of Gulf of Maine/Bay of Fundy harbor porpoises was estimated as 74,000 (95% CI = 40,900 - 109,100; CV = 20%) from a sighting survey conducted August 1995.

Aerial surveys were conducted during October - December 1996 to document large-scale distribution patterns and seasonal movements of harbor porpoise and record environmental and biological factors.

A 6-day necropsy session on 44 harbor porpoise which stranded south of Cape Cod during winter 1994 was conducted at the Smithsonian Institution's National Museum of Natural History in Washington, DC in December 1995. All stranded carcasses were yearlings and considered to be in poor physical condition. Also, life history studies were conducted on 18 harbor porpoises from Grand Manan Island in the Bay of Fundy. Another necropsy session on winter-stranded harbor porpoise was conducted October 6 - 15, 1996 at the Smithsonian Institution during which time 66 carcasses were necropsied.

Data were received until March 20, 1996 from a harbor porpoise that was satellite-tagged and released in August 1995. This period of contact represents the longest successful deployment of a satellite-linked transmitter on a cetacean (212 days). A rehabilitated harbor porpoise at the National Aquarium in Baltimore was equipped with a satellite-linked transmitter on April 29, 1996 and released off Ocean City, MD. Scientists monitored its movements during its northern migration. The animal was tracked for 6 weeks via satellite and the last transmission was received east of Montauk Pt., NY. In July and August 1996, attempts to tag harbor porpoise in Grand Manan were unsuccessful due to an unusual absence of animals in that area which previously had been a highly populated region.

During spring 1996, experimental fisheries were continued in closed areas south of Cape Cod, in Massachusetts Bay, and in the mid-coast area off New Hampshire. No harbor porpoise were taken in the southern areas during these experimental trips, however, nine harbor porpoise were taken in the mid-coast area in April.

A short field collection period was completed in August to obtain baseline acoustic measurements of the background noise levels and spectra in the Gulf of Maine study site and collect harbor porpoise echo-location signals for calibrating equipment and developing the tracking program over the winter of 1996-1997. Over 19 tape recordings of various forms of harbor porpoise vocalizations, echo-locations, and whistles were collected representing nearly a terabyte of data to be directly linked to the shore-based observations and to help describe underwater activities. A rough draft version of a tracking program was used for testing and verifying its performance while at the research station.

Right Whales

Right whale research and management is based on two principal program components: infrastructure and studies. The infrastructure consists of the photo-identification catalog of identified individuals (archived at the New England Aquarium - NEA), a centralized database (maintained at the University of Rhode Island), and a strandings and human-impacts response effort (coordinated by the New England Aquarium). Much of the science and management is based on the photographic mark and recapture of identified right whales and the associated database. This has led to descriptions of population status, trends, distribution, abundance, movements, and habitats. The studies program includes satellite tagging, genetics, and foraging/prey species projects.

The North Atlantic Right Whale Catalog currently consists of 9,631 photographed and identified sightings of 357 individual right whales between 1935 and June 1996. Of these animals, 179 are considered adults (reproductive females, animals of known age 10 or more years old, or animals of unknown age with sighting histories spanning 10 or more years), 28 are of unknown age, 72 are between ages 1 and 9, nine are known dead, and 69 are presumed dead (after five years with no sightings). The gender of 80% of the catalogued animals is known: 39.5% (n = 141) male, 40% (n = 143) female, and 20.5% (n = 73) unknown gender.

From January 1 to June 30, 1996, photographs from nine organizations/individuals, as well as the NEA, were analyzed and nearly 2,000 photo-identified sightings were entered into the catalog database. At least 21 calves were born to the population in 1996, ten of which have been photo-identified in northern waters to date. The addition of these animals was offset by a number of deaths:two whales were known to have died in 1995, and six in 1996.

Of the 46 adult females considered to be available for calving in the 1995/1996 season, only 10 were documented to have calved. The remaining 11 mothers were first observed with calves this year. Three of these were 10 years old or younger, two were 9 years old, and six were of unknown age. In 1995/1996, more mothers gave birth after a 5-year interval than in previous years, suggesting that the calving interval was increasing. An up-

dated analysis of calving interval through the 1995/1996 season suggests that the calving interval is increasing ($P < 0.001$).

A small offshore survey in February 1996 reported three sightings in waters east of NE Florida and SE Georgia: a mother/calf pair, a single individual, and a group of four juveniles. These sightings suggest a distribution further offshore than previously reported, and suggest that the characterization of the SE USA habitat, as well as the Critical Habitat, may need to be revisited.

Genetic analysis of tissue samples is providing insights to stock definition. Researchers previously have suggested that western North Atlantic right whales probably represent a single breeding population based on three matrilines. To date, skin biopsy sampling has resulted in the compilation of a DNA library of 205 North Atlantic right whales. When work is completed (December 1998), a genetic profile will be established for each individual and an assessment provided on the level of genetic variation in the population, the number of reproductive individuals, reproductive fitness, the basis for associations and social units in each habitat area, and the mating system. Tissue analysis has also aided in sex identification: the sex ratio of the photo-identified and catalogued population (357 through December 1995, of which approximately 300 are thought to be alive) is 137 females and 132 males (1.04:1), not significantly different from unity ($P < 0.001$). Analysis based on sighting histories of photographically identified individuals also suggests that, in addition to the Bay of Fundy, there exists an additional and undescribed summer nursery area utilized by approximately one-third of the population. As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more major wintering and summering grounds have yet to be described.

While several tags have been successfully attached and tracked for whales moving from coastal waters off the southeastern USA (separate project under contract with the SEFSC), no successful tags to date have resulted from work in the Northeast. Two right whales tagged in southeastern USA coastal waters in February 1996 were successfully tracked on their northern migration, arriving in New England waters in April.

The present focus for right whale science and management, which is likely to continue for the foreseeable future, is recovery plan implementation and mitigation of human impacts. The mitigation efforts involve principally ship-strike mitigation and reduction of net entanglement and fishery interactions.

Harbor and Grey Seals

An aerial abundance survey was postponed due to a delay in funding, but is scheduled to be conducted in spring 1997.

3. Studies of Fishing Operations

The NEFSC placed observers aboard fishing vessels in 12 different fisheries in 1996. All of the fisheries operated in the NAFO Subareas 5 and/or 6.

a) New England and Mid-Atlantic Gillnet Fisheries

The NEFSC deployed observers on 1,310 trips in these fisheries which occur year around. The primary emphasis of the studies was to estimate incidental catch rates of harbor porpoise and other marine mammals. A total of 134 marine mammals were caught, including (in order of highest occurrence) harbor porpoise, harbor seal, harp seal, grey seal, saddleback dolphin, white sided dolphin, and bottlenose dolphin. Sampling of 85 of the animals included the taking of measurements, entire carcass collection, or tissue sampling. Kept and discarded finfish catches were weighed or estimated for a portion of the observed tows. Length frequencies and age structures were also obtained for finfish and forwarded for age and growth studies. A total of 37 sea birds were caught, including (in

order of highest occurrence) greater shearwater, northern gannet, cormorant, common loon, thin-billed murre, great blackback gull, and sooty shearwater. Four loggerhead turtles were caught, two of which were released alive.

b) Swordfish Drift Gillnet

Observers were placed aboard six different domestic drift gillnet vessels which were targeting swordfish, tuna, and sharks. The fishery operates with a small swordfish quota and limited seasons. A total of 13 trips, covering 140 days, were made by observers on these vessels representing 81% of the total 16 trips made in the fishery. Swordfish, bigeye tuna, yellowfin tuna, albacore, blackfin tuna, mako sharks, and thresher sharks were caught and marketed. Bycatch from this fishery included bluefin tuna, little tunny, skipjack tuna, other sharks, rays, and ocean sunfish which were mostly discarded. Bycatch also included incidental takes of 100 marine mammals, only two of which were released alive. Ninety-three animals were sampled. Species caught (in order of highest occurrence) included: saddleback dolphin, beaked whales, striped dolphin, pilot whale, and spotted dolphin. Seven sea turtles were caught, of which six were sampled and six were released alive. These species were (in order of highest occurrence) loggerhead turtles and leatherback turtles.

c) Otter Trawl Fisheries

The otter trawl fisheries which were covered included 650 days aboard vessels in the northern shrimp, New England multispecies groundfish, summer flounder, *Illex* squid, *Loligo* squid, and Atlantic mackerel fisheries. Actual and estimated weights were collected for retained and discarded finfish, crustacean, and squid catches. Biological samples, including length frequencies and ageing structures, were collected and forwarded for age and growth studies. Incidental catches of marine mammals, sea turtles, and sea birds were recorded. Six marine mammals including saddleback dolphins and pilot whales were caught, all dead, only one of which was sampled. Eight loggerhead turtles were caught, of which seven were released alive.

d) Sea Scallop Dredge Fisheries

Observers were deployed for 38 trips, consisting of 485 days aboard 31 different scallop vessels. Individual measurements were collected from kept and discarded sea scallops. Biological samples, including length frequencies and ageing structures, were collected from kept and discarded finfish. These were forwarded for age and growth studies. Actual or estimated weights of catches were collected for each gear set. No incidental catches of marine mammals, sea turtles, and sea birds were recorded from the observed hauls. Bycatch included monkfish, cod, winter flounder, summer flounder, yellowtail flounder, witch flounder, American plaice, haddock, red hake, white hake, spotted hake, silver hake, scup, herring, mackerel, skates, dogfish, lobster, crabs, clams, and squid.

e) Giant Bluefin Tuna Purse Seine

Observer coverage was conducted for the first time in this fishery, which consists of five vessels each possessing individual quotas of 75 mt. Fishing activity occurred from August 15 through October 28, with observer coverage on 43 of 45 trips for a total of 136 days. Incidental takes of marine mammals, sea turtles, and sea birds were recorded, including the encirclement of six pilot whales, one minke whale, and one humpback whale, all of which were released alive without injury. Individual weights were collected from each bluefin tuna. Ageing structures including otoliths and vertebrae were collected from tuna which had been previously tagged and released.

f) Lobster Pot Fisheries

The offshore lobster pot fishery was observed during eight trips aboard six different vessels for a total of 71 days. Bycatch consisted of Jonah crabs (predominantly), white hake,

cusk, and red hake. Estimated or actual weights of catches were collected from all hauls. Individual carapace measurements were collected from lobsters and some crabs. No incidental catches of marine mammals, sea turtles, and sea birds were observed, although one severely decomposed white-sided dolphin was caught.

The assistance of a number of individuals in the Conservation and Utilization Division and Environmental Processes Division of the NEFSC in the preparation of this report is gratefully acknowledged by the authors.

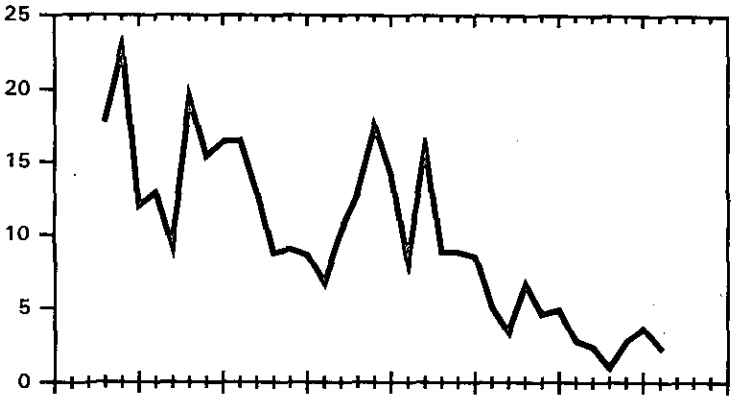

Figure 1. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine cod.

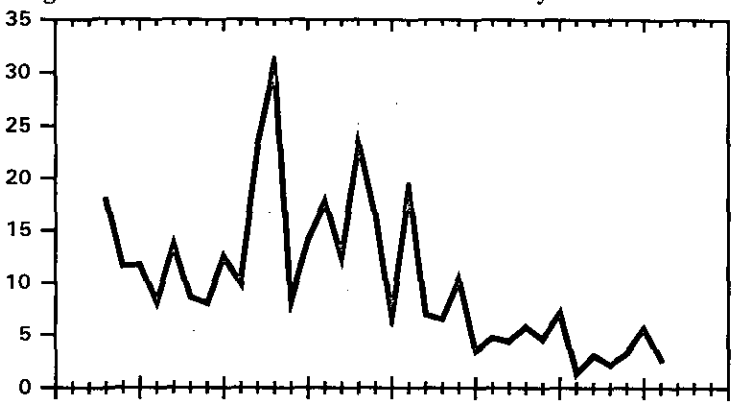

Figure 2. NEFSC autumn bottom trawl survey biomass indices for Georges Bank cod.

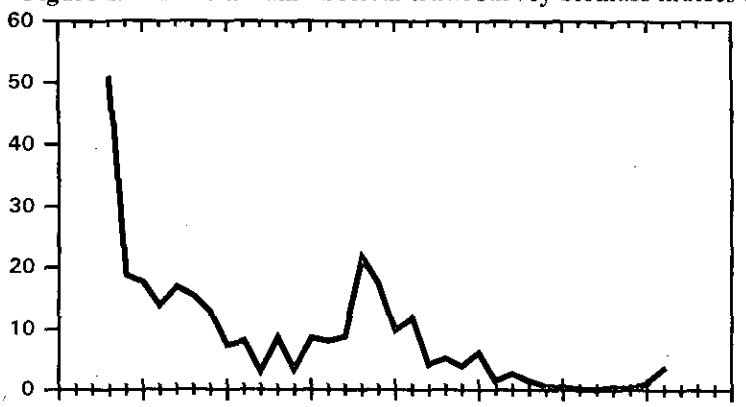

Figure 3. NEFSC autumn bottom trawl survey biomass indices for Gulf of Maine haddock.

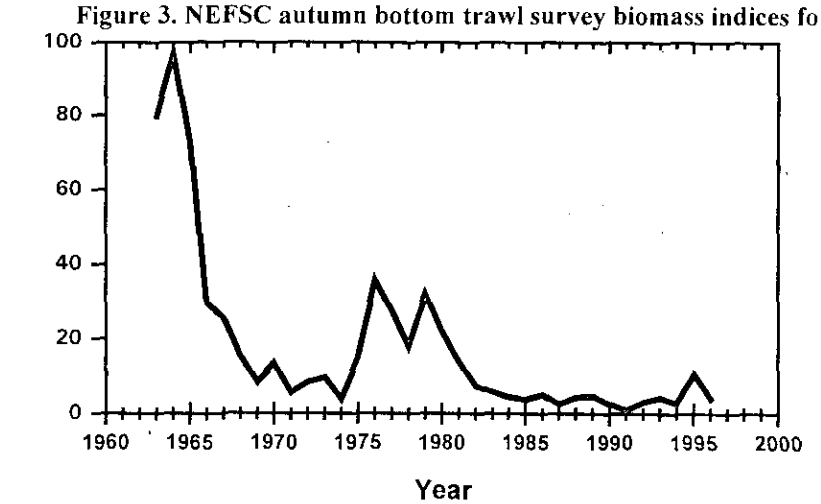

Figure 4. NEFSC autumn bottom trawl survey biomass indices for Georges Bank haddock.

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

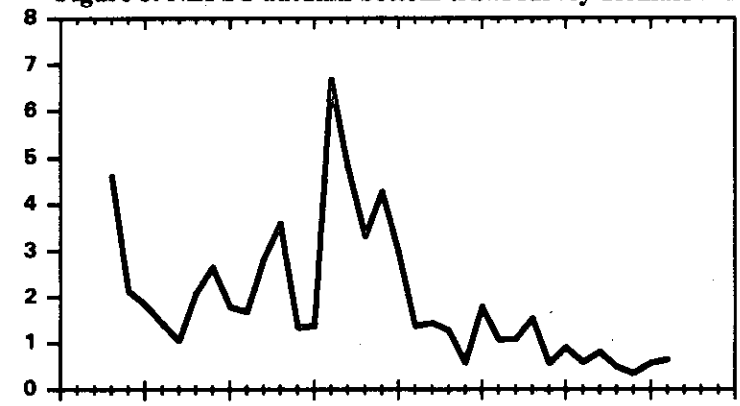

Figure 6. NEFSC autumn bottom trawl survey biomass indices for pollock.

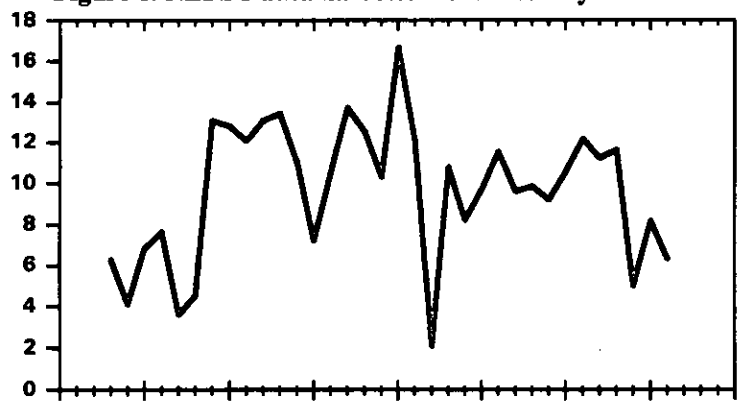

Figure 7. NEFSC autumn bottom trawl survey biomass indices for white hake.

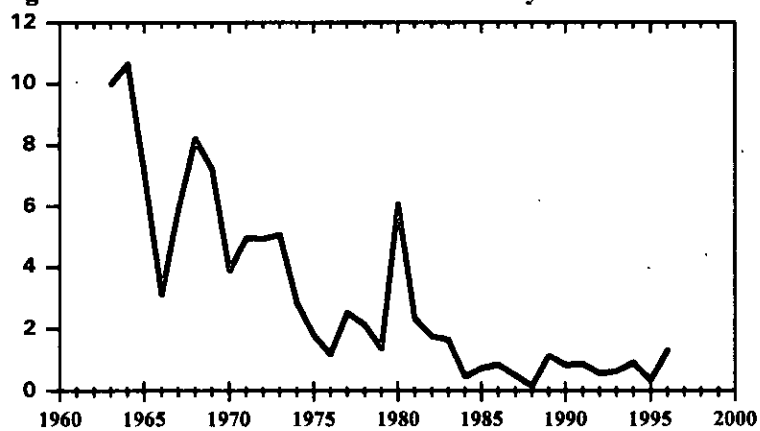

Figure 8. NEFSC autumn bottom trawl survey biomass indices for Georges Bank yellowtail flounder.

NEFSC Stratified Mean Weight per Tow (Kg)

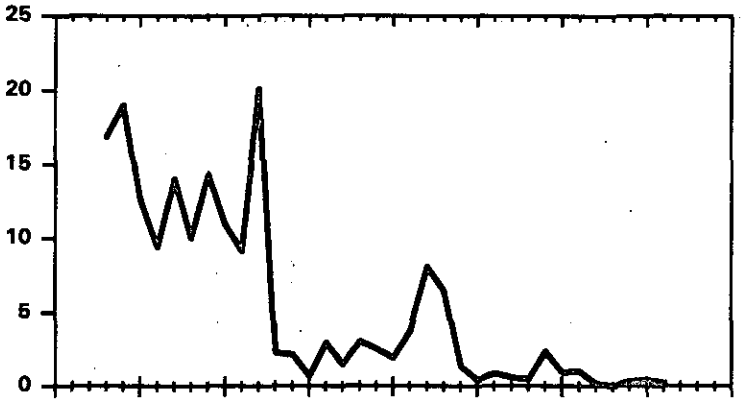

Figure 9. NEFSC autumn bottom trawl survey biomass indices for Southern New England yellowtail flounder.

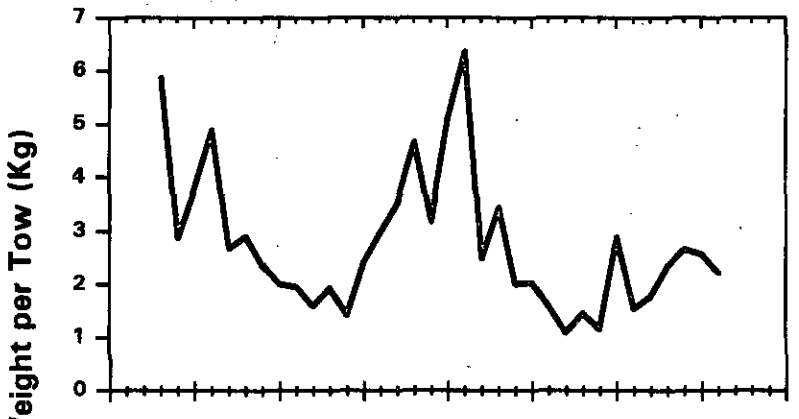

Figure 10. NEFSC autumn bottom trawl survey biomass indices for American plaice.

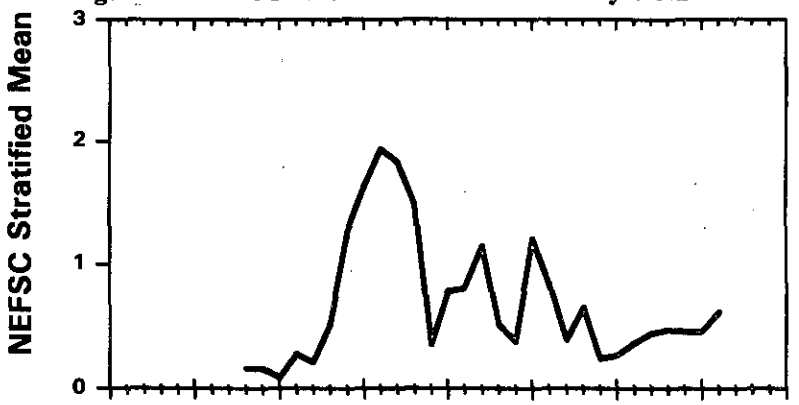

Figure 11. NEFSC spring bottom trawl survey biomass indices for summer flounder.

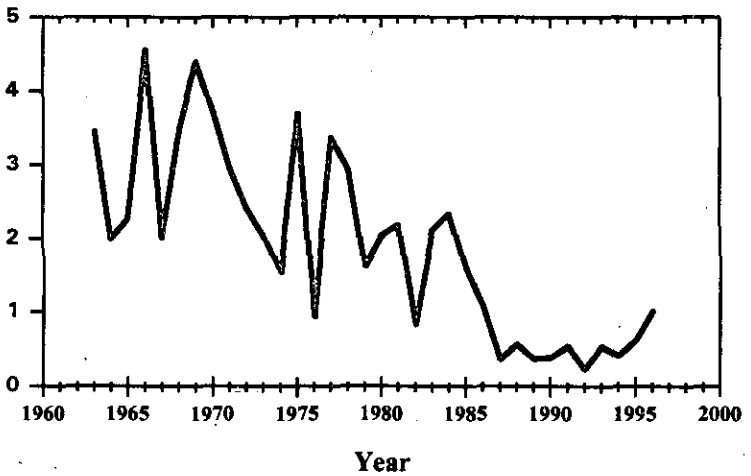

Figure 12. NEFSC autumn bottom trawl survey biomass indices for witch flounder.

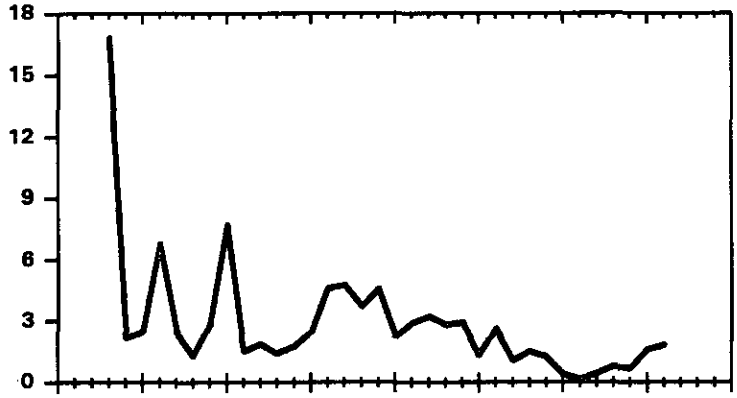

Figure 13. NEFSC autumn bottom trawl survey biomass indices for Georges Bank winter flounder.

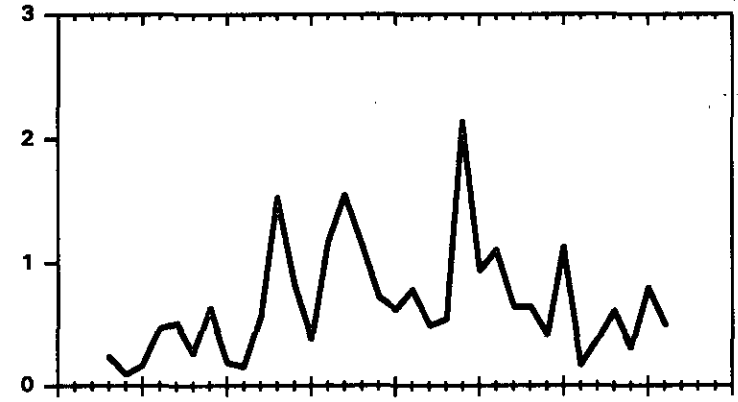

Figure 14. NEFSC autumn bottom trawl survey biomass indices for windowpane flounder.

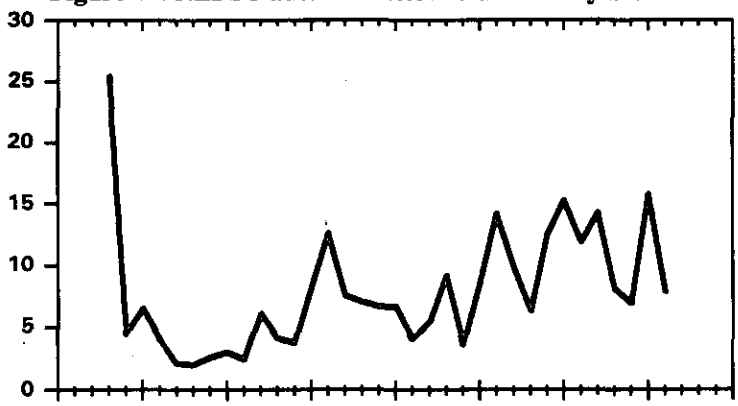

Figure 15. NEFSC autumn bottom trawl survey biomass indices for northern silver hake.

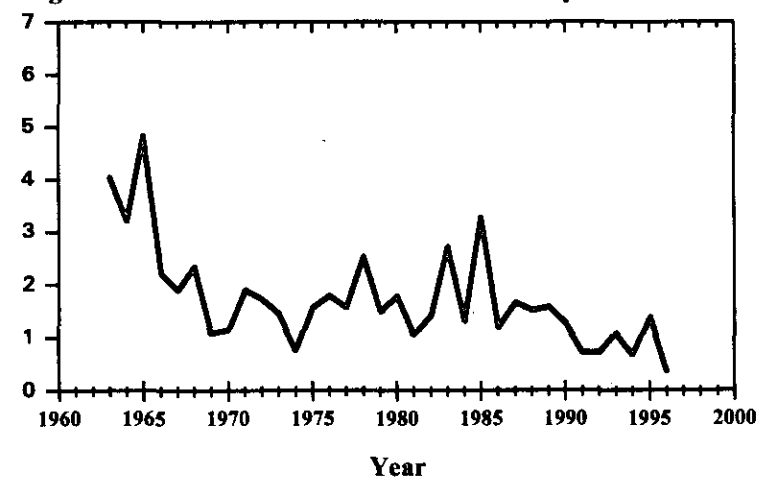

Figure 16. NEFSC autumn bottom trawl survey biomass indices for southern silver hake.

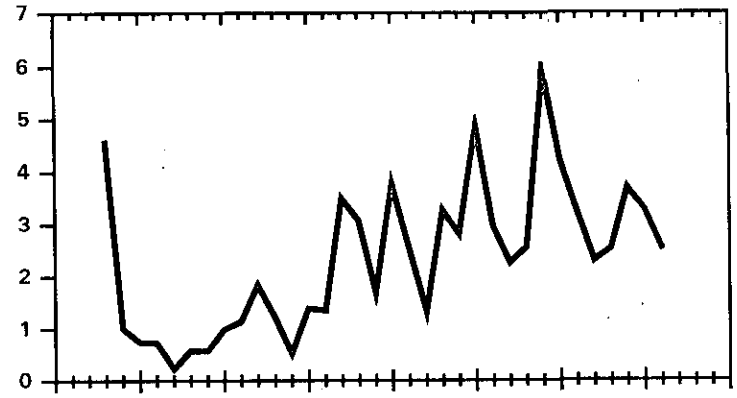

Figure 17. NEFSC autumn bottom trawl survey biomass indices for northern red hake.

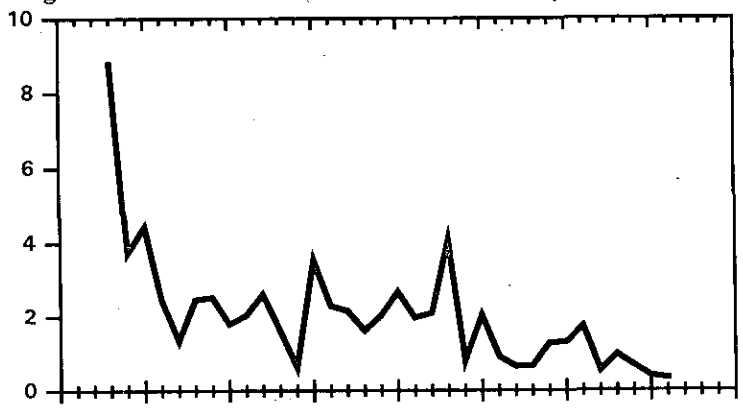

Figure 18. NEFSC autumn bottom trawl survey biomass indices for southern red hake.

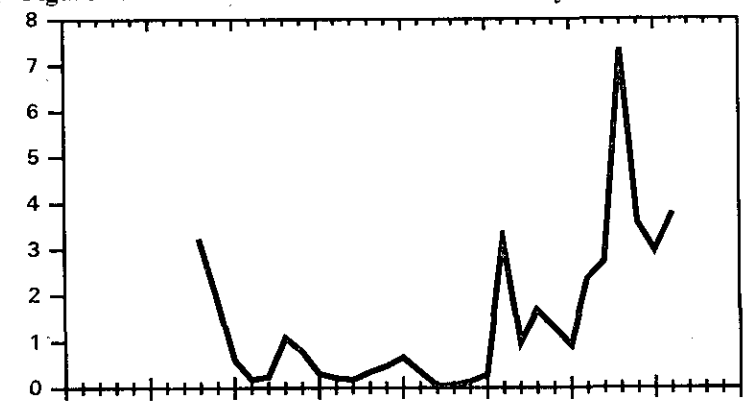

Figure 19. NEFSC spring bottom trawl survey biomass indices for Atlantic herring.

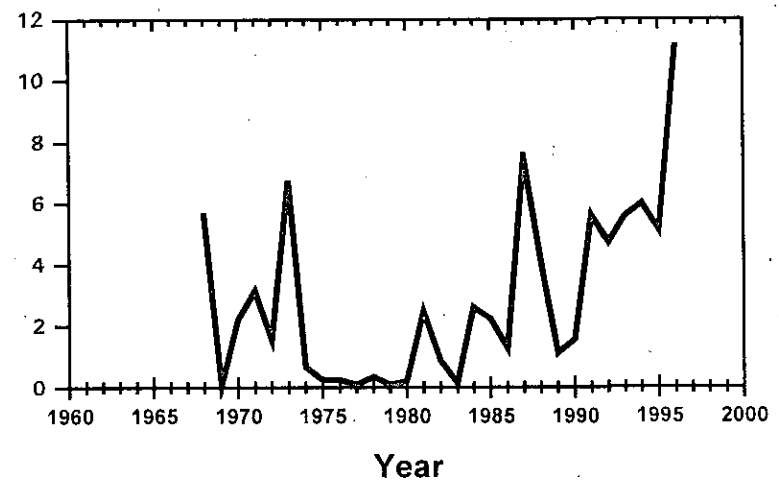

Figure 20. NEFSC spring bottom trawl survey biomass indices for Atlantic mackerel.