

Northwest Atlantic



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**United States Research Report for 1993**

by

**F. M. Serchuk and M. D. Grosslein**

NOAA/NMFS, Northeast Fisheries Science Center  
Woods Hole, MA 02543, USA

**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. More detailed information on these and other species is included in a report entitled "Status of the Fishery Resources off the Northeastern United States for 1993" prepared by the Northeast Fisheries Science Center of the National Marine Fisheries Service (NMFS), and in "Our Living Oceans: Report on the Status of U.S. Living Marine Resources 1993", a report prepared by NMFS Headquarters in Silver Spring, Maryland.

**1. Atlantic Cod**

USA commercial landings declined 18% from 27,775 t in 1992 to 22,873 t in 1993. Total cod landings in 1993 were the lowest in 20 years (i.e., since 1973). None of the 1993 landings were taken from Subareas 3 and 4.

Landings in 1993 from the Georges Bank fishery [Div. 5Z + 6] totalled 14,594 t, 13% lower than in 1992 (16,855 t). Total and spawning stock biomass of Georges Bank cod declined to a record-low level in 1993, and is expected to decline further in 1994 and 1995 due to poor recruitment and high fishing mortality rates.

Gulf of Maine [Div. 5Y] landings in 1993 were 8,279 t, 24% lower than in 1992 (10,915 t). Spawning stock biomass of Gulf of Maine cod peaked in 1990 due to strong recruitment from the 1987 year class, but has since declined to record-low levels. Further declines in stock biomass are expected in 1994.

**2. Haddock**

USA landings in 1993 declined to a record-low of 878 t. Landings from Georges Bank [Subdiv. 5Ze] totalled only 686 t, 66% less than in 1992. Abundance of the Georges Bank stock continues to remain at a record-low level. Landings from the Gulf of Maine [Div. 5Y] haddock stock in 1993 were 192 t, 120 t less than in 1992. Commercial CPUE and research vessel indices indicate that Gulf of Maine stock abundance remains at an historically-low level.

**3. Redfish**

*Subarea 4*

No USA landings of redfish were taken from Division 4X in 1993. In 1992, only 3 t were landed.

*Subareas 5 and 6*

USA landings of redfish from Subareas 5 and 6 declined 6% between 1992 and 1993 (844 t vs 796 t). Redfish are taken primarily as by-catch in the Gulf of Maine mixed species otter trawl fishery. Stock biomass remains low, although slight increases have occurred since 1990 due to some modest recruitment from year classes produced in the mid 1980s. Unless recruitment improves in the future, stock biomass and yield levels are not expected to substantially increase.

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

*Subarea 4*

No USA landings of pollock were taken from Division 4X in 1993. In 1992, 56 t were landed.

*Subareas 5 and 6*

USA landings in 1993 were 5,672 t, 20% less than in 1992 (7,127 t), and the lowest annual catch since 1972. Spawning stock biomass, which increased from 89,000 t in 1974 to a peak of 204,000 t in 1985, declined to 125,000 t in 1992. Recruitment of the 1987 and 1988 year classes is strong, however, and moderate increases in stock biomass are expected during the next few years.

5. Yellowtail Flounder

*Subarea 3*

USA landings from Subarea 3 in 1993 were 68 t. In 1992, no landings occurred from Subarea 3.

*Subareas 5 and 6*

USA landings in 1993 were 3,535 t, a record-low, and 37% less than in 1992 (7,127 t). Landings from the Georges Bank stock declined 27% from 2,859 t in 1992 to 2,089 t in 1993. Landings from the Southern New England stock declined by 67% to an historic low of 479 t. Abundance of both stocks is at record low levels and recent recruitment has been poor. The Southern New England stock is considered to have collapsed.

6. Other Flounders

USA landings of flounders [other than yellowtail flounder] from Subareas 3 - 6 in 1993 totalled 19,784 t, 15% lower than in 1992. Compared to 1992, landings from Subarea 3 increased from zero to 96 t [84 t, American plaice; 12 t, witch flounder], landings from Subarea 5 declined by 13% (15,675 t vs 18,118 t) and landings from Subarea 6 declined by 22% (4,013 t vs 5,154 t). American plaice (29% of total), winter flounder (26%), summer flounder (23%), witch flounder (13%) and windowpane flounder (8%) accounted for 99% of the 'other flounder' landings. Landings of each species declined in 1993 [American plaice: -13%; winter flounder: -14%; summer flounder: -27%; windowpane flounder: -23%] except for witch flounder (+17%). Recent survey abundance indices for windowpane flounder, winter flounder, and witch flounder have been at record-low levels, while survey indices for American plaice and summer flounder have been increasing.

7. Silver Hake

USA commercial landings from Subareas 5 and 6 in 1993 were 16,875 t, 8% higher than in 1992 (15,591 t). Landings from the Gulf of Maine - Northern Georges Bank stock declined to 4,360 t (-18% from 1992 and the second lowest ever), while landings from the Southern Georges Bank - Middle Atlantic stock increased to 16,875 t (64% higher than in 1992). Recent recruitment in both stocks has been above average. Stock abundance appears to be increasing in the northern stock but declining in the southern stock.

8. Red Hake

USA 1993 commercial landings from Subareas 5 and 6 were 1,661 t, 18% less than in 1992, and near the record-low 1989-1991 levels. Landings from the Gulf of Maine - Northern Georges Bank stock in 1993 were 768 t (-16% from 1992), while landings from the Southern Georges Bank - Middle Atlantic stock totalled 893 t (-20% from 1992). In both stocks, fishing mortality is low and substantially higher catches could be supported.

9. Atlantic Herring

USA landings from Subarea 5 in 1993 were 47,696 t, 7% lower than in 1992 (51,419 t). Spawning stock biomass of the coastal stock complex of herring has increased continuously since 1982 and is currently at or above the high SSB levels observed in the late 1960s. Stock size has increased due to strong recruitment and reduced fishing mortality rates, particularly on juvenile herring. Landings from Division 5Z in 1993 were 1,823 t, primarily from Subdivision 5Zw (1,755 t). There has been no directed herring fishery in Subdivision 5Ze since the collapse of the fishery in 1977. There is evidence of continuing recovery of the Georges Bank population based on research vessel survey results and reports of incidental catches by commercial vessels. Herring landings in Subarea 6 in 1993 were 1,496 t, 65% lower than in 1992 (4,257 t).

10. Atlantic Mackerel

USA commercial landings in 1993 from Subareas 5 and 6 totalled 4,652 t, 60% less than in 1992 (11,737 t). Total stock biomass (Subareas 2-6) has been increasing since 1981 and is presently at record-high levels (> 2.5 million t). Rebuilding of the stock has resulted from low fishing mortality rates coupled with outstanding recruitment from the 1982 year class and relatively strong recruitment from the 1984-1988 cohorts.

11. Butterfish

USA landings in 1993 from Subareas 5 and 6 were 4,599 t, 72% higher than in 1992 (2,678 t). Nearly two-thirds (62%) of the 1993 catch was taken in Subarea 5 (2,873 t), while 38% was taken in Subarea 6 (1,726 t). Research vessel survey indices indicate that although recruitment has been high since 1987 spawning stock biomass has declined since 1989 and is currently below average.

12. Squid

USA landings in 1993 of long-finned squid, *Loligo pealei*, from Subareas 5 and 6 were 22,101 t, 22% higher than in 1992 (18,172 t), and the second highest annual catch. Of the 1993 USA total, 24% was from Subarea 5 (5,402 t) and 76% from Subarea 6 (16,699 t). Survey abundance indices indicate that stock abundance declined in 1993 to below the long-term average, despite record-high recruitment from the 1992 cohort.

USA landings of short-finned squid, *Illex illecebrosus*, from Subareas 5 and 6 in 1993 totalled 18,083 t, a record-high, and 1% greater than in 1992 (17,829 t). Of the 1993 USA total, 16% was from Subarea 5 (2,912 t) and 84% from Subarea 6 (15,171). Survey indices indicate that the *Illex* stock is at a medium biomass level.

### 13. Sea Scallops

USA commercial landings from Subareas 5 and 6 in 1993 were 7,352 t (meats), 48% lower than in 1992 (14,152 t). Compared to 1992, Gulf of Maine [Div. 5Y] landings (797 t) increased by 10%, Georges Bank [Div. 5Z] landings (3,745 t) declined by 56%, and Mid-Atlantic [Subarea 6] landings (2,810 t) declined by 43%.

Abundance indices from the USA 1993 sea scallop survey indicate that the abundance of adult scallops in the USA Georges Bank and Mid-Atlantic resources is at or near record-low levels. Recruitment of the 1990 year class was poor on Georges Bank but extremely high in the Mid-Atlantic region. Due to this disparity, fishing effort in 1994 is expected to be focused in the Mid-Atlantic area.

#### B. Special Research Studies

##### 1. Environmental Studies

###### a) Hydrographic Studies

Hydrographic surveys of the Georges Bank region were conducted in January, November and December in conjunction with a study of the recovery of the herring stock on Georges Bank. Additional hydrographic surveys of the entire shelf region from Cape Hatteras to the Gulf of Maine were conducted in spring (March-April) and fall (September-October) in connection with bottom trawl surveys of the fish stocks.

A document was prepared summarizing the water column thermal structure and surface salinity in the New York Bight and the Gulf of Maine from the MARMAP/Ship of Opportunity program, 1978-1992. Monthly sampling in this program was continued in 1993; Results from the 28 cruises, averaged for the year, showed surface and bottom temperatures and surface salinities in 1993 all below the baselines for both of these transects.

###### b) Plankton Studies

The Plankton Ecology Investigation has undertaken studies of fine scale distributions of zooplankton on Georges Bank under funding from the NOAA Climate and Global Change Program. A TRACOR Acoustic Profiling System (TAPS) was deployed along with a CTD in late May '93 aboard the *R/V Columbus Iselin* to compare zooplankton distributions in stratified and well mixed areas of Georges Bank. TAPS was used to acoustically measure volume backscattering at 4 frequencies (2.9 MHz, 1.1 MHz, 418 KHz and 267 KHz) at very short ranges from the transducer mount, thereby enabling fine scale measurements of zooplankton distribution. Continuous profiling casts with the CTD and TAPS were accompanied by plankton pump sampling at selected depths to provide information on species composition. These studies indicate significant spatial variability in adult copepod size zooplankton at horizontal scales of 10-100 m and vertical scales of 5-10 m. Significantly higher levels of backscattering were observed in the well mixed water column of the Central Bank compared to early season weakly stratified water to the south.

During 1993 three ecosystems surveys were conducted on the northeast shelf using the modified (since 1991) MARMAP survey design of a series of transects. In addition to the standard double oblique bongo tows and T/S profile to 200 m at each station, the new protocol includes between-station sampling with a towed-body (CTD), fluorometer, and Hardy plankton recorder at a fixed depth of 10 m. Plankton samples continue to be analyzed in Poland, but most of the other variables are initially captured in digital form. In addition piggyback zooplankton Bongo sampling was conducted during two trawl surveys of the northeast shelf.

A test cruise using the undulating oceanographic recorder, the "Aquashuttle" was conducted in the western Gulf of Maine. All systems performed satisfactorily. Plans were completed and materials fabricated to permit the installation of Hardy plankton recorders in this towed instrument. Eventually this instrument is intended for use on ecosystem monitoring surveys in the top 100 m of the water column.

###### c) Benthic Studies

Interdisciplinary data analysis continued in a study of recovery of the inner New York Bight sewage sludge dumpsite, which closed in 1987. Semiannual sampling of sediment chemistry, microbiology and benthic macrofauna also continued in order to examine longer-term responses of the dumpsite.

###### d) Other Environmental Studies

A two-year pilot study of habitat use by juvenile fish in the Hudson-Raritan Estuary was completed. The study compared abundance and growth of juvenile winter flounder, *Pleuronectes americanus*, and tautog, *Tautoga onitis*, among different shallow-water habitats (eelgrass beds, macroalgae, sand and mud bottoms). Statistical analysis of data is still underway, but it appears that flounder was more abundant, and tautog grew faster, in vegetated areas. Preparations were made for an expanded 3-year study of growth and abundance of the same species in the same habitats (plus marsh creeks) in three Middle Atlantic estuaries (Hudson-Raritan, Long Island Sound, and Great Bay in southern New Jersey). A related study examined abundance and growth of winter flounder and tautog under large piling-supported piers in the Hudson River, as compared to abandoned pile fields and interpier areas. Preliminary results from the first summer of the two-year study suggested the pile fields and interpier areas had greater abundance and diversity of fish than under pier areas, and that growth of caged fish was slowest under the piers. No firm conclusions can be drawn until the studies are repeated in summer 1994.

The Environmental Assessment Group continued a bottom trawl survey of the Raritan/Lower/Sandy Hook Bay system. Major habitat types in this stressed estuary are being characterized in terms of their value to commercial and recreational species. There are areas of mud, shell and sand as well as natural and dredged channels. The trawl survey uses a stratified random sampling scheme and is designed to determine the functional value of the various habitats to finfish.

and megainvertebrate communities throughout the year. The Bay system serves as a nursery region for a number of inshore fishes, as well as a feeding and spawning area for many species. The survey efforts will result in species data from about 480 stations per year and will provide a basis for determining biomass and community change by comparison to historical surveys.

An adjunct study is designed to determine the seasonal variations in feeding habits of blue, rock and lady crabs (decapod crustaceans which dominate the invertebrate fraction of the catches).

A one year study of Newark Bay was begun. Contracted by the US Army Corps of Engineers, the effort characterized seasonal utilization of an area heavily impacted by industrial use below the confluence of the Hackensack and Passaic Rivers. The water quality and finfish/megainvertebrate data will be used in management decisions for minimizing impact resulting from a proposed large-scale storm water drainage into the head of the Bay. The area appears to be an important nursery for striped bass, winter flounder and tomcod.

Surveys were conducted in 1990 and 1991 to determine whether chemical contaminants related to sewage sludge dumping were present in mid-water fish, plankton or sediment from the area around the 106-Mile Dumpsite. Findings were presented at a symposium in October 1993. Results showed that certain metals, organic compounds and bacteria were present in significantly higher concentration in samples collected near the dumpsite than in samples collected elsewhere. Geographic patterns of elevated concentrations suggested that sewage sludge dumping was responsible for the pollution. Thus, sludge dumping can provide a source of contaminants to the otherwise pristine offshore food web.

In conjunction with the US Environmental Protection Agency and Army Corps of Engineers, a survey was conducted in Fall 1993 in the apex of the New York Bight to collect fish species important in the local recreational fishery. When completed, the study will provide current benchmark measurements of metal and organic contaminant levels in edible filets of these species.

A 45-chapter report on the history of molluscan shellfishing in North America and Europe neared completion. The report is based on a 1992 symposium in which participants from the various regions and countries presented papers on shellfishing history in their areas.

## **Biological Studies**

### **a) Herring/Sand Lance**

The Northeast Fisheries Science Center completed the final year of a study to document the changing status of Atlantic herring and investigate density-dependent population regulation between herring and sand lance in the Georges Bank area. During the course of the six-year study (1988/89-1993/94), Center personnel conducted 34 surveys and occupied 3,560 stations in the 72,000 km<sup>2</sup> Nantucket Shoals/Georges Bank/Massachusetts Bay study area. Fecundity estimates were initiated in 1989 and continued annually thereafter. This study was the first to recognize that a full scale recovery of herring was underway in the Georges Bank area. Since the mid 1980s, larval abundance has increased nearly 30-fold with the principal spawning beds located on Nantucket Shoals. The historically significant spawning grounds on the Northeast Peak of Georges Bank were re-occupied in 1992 after lying dormant for 15 years. Larval sand lance remained at consistent levels of abundance until 1992 when a steep decline was observed.

A report was prepared describing the age and growth of larval Atlantic herring, *Clupea harengus*, collected from the Nantucket Shoals-Georges Bank region during 1976-77 and compared with samples from 1988-92 growing seasons, by enumerating daily growth increments of sagittal otoliths. A general model of larval growth was also completed.

### **b) Cod and Haddock**

The second year of sampling was accomplished in the study of stratification on larval cod and haddock growth and survival on Georges Bank. This study is supported by the NOAA Climate and Global Change Program and is a pilot study to the U.S. GLOBEC Northwest Atlantic study which begins in the spring of 1994. Observations of the relation between larval cod and haddock, their prey, and water column density structure were made during May 1993 in stratified and well-mixed regions on the southern flank of Georges Bank.

### **c) Lobster**

A two-year study of shell disease was completed on 15,004 lobsters from offshore stocks residing in canyons along the continental-shelf margin between southern Georges Bank and northern Virginia. A statistically significant increase in disease prevalence was found in female (but not male) lobsters residing within the "potential area of influence" of a sewage-sludge dump site 106 nautical miles offshore. However, association of shell disease with this dumpsite could not be proved because of an equally strong statistical association of disease with proximity to an older dumpsite 12 nautical miles offshore. The region with the highest disease prevalence was adjacent to coastal areas with riverine systems carrying high anthropogenic pollutant loads.

### **d) Winter Flounder**

Field and laboratory data collections are nearly complete for a winter flounder life history model. This multi-stage model is based on egg, larval, juvenile, and adult flounder stages. The objective of this study is to examine and predict the possible joint effects of harvesting and contaminants on the dynamics of winter flounder populations. The present analysis differs in several important ways from previous studies: (1) the model is based on life history stage and/or size rather than age, (2) the potential impact of pollutants is not limited to direct effects on survivorship but includes effects on stage duration and reproductive output at several life stages, and (3) the implications of density-dependent processes are considered.

A joint study by the University of Connecticut and the Milford Laboratory NEFSC, has shown that winter flounder kidney tissues actively transport certain herbicides and insecticides from the blood into the urine. Such transport would limit retention time and thus the toxicity of these compounds. Although the potential for a toxic compound to be transported from blood to urine cannot, by itself, be used to predict the full effects of a compound on fish health, knowledge of this potential may be useful in anticipating the likelihood of any effects.

e) Age and Growth

Approximately 36,500 age determinations were completed for 14 species of finfish and shellfish in support of assessment studies. In addition cod and haddock otoliths and scales were exchanged and an ageing workshop was held with Canadian biologists in a continuing effort to maintain comparability of age determinations between the two countries.

A monthly sampling program was conducted in 1993 to collect biological samples from demersal finfish in the inshore region of the Gulf of Maine. The data will be used to develop or refine basic biological parameter estimates (e.g., growth rates, length-weight relationships, maturity ogives) needed for assessments and to monitor seasonal changes in the parameters as well as species composition and abundance.

A report was completed describing length - weight relationships and maturity analyses for goosefish, *Lophius americanus*, landed "tails only" in U.S. commercial fisheries; the size composition and sexual maturity of the landed portion of the catch was estimated.

A report was prepared comparing growth rate estimates of American plaice, *Hippoglossoides platessoides*, using data collected during NEFSC bottom trawl surveys and samples from the U.S. commercial fishery.

An age validation study was completed utilizing scales and otoliths of black sea bass, *Centropristis striata*, inhabiting Mid-Atlantic and Southern New England waters. Oxytetracycline marked laboratory-held individuals and scale marginal increment analyses were used.

f) Food Chain Studies

At-sea examination of 21,000 fish stomachs was accomplished during quarterly bottom trawl surveys during 1993. In addition to the standard spring and fall surveys which covered the region from Cape Hatteras to the Gulf of Maine, a winter survey was carried out from Cape Hatteras to southern New England, and a summer survey was conducted in the Gulf of Maine. Principal focus of stomach sampling on the trawl surveys continued to be on piscivorous species and estimation of predator-prey interactions among adult and juvenile components of the fish communities - for input into multispecies models of fish production.

A new research initiative under the NOAA Coastal Ocean Program (COP) was begun in 1993 to evaluate the joint effects of harvesting and predator-prey interactions on the composition and production potential of Georges Bank. This initiative will augment ongoing NEFSC food chain studies by examining predation on larval stages of fish by major pelagic species such as mackerel and herring, and by evaluating competition and predation between juvenile and adult stages of elasmobranchs and principal groundfish and flounders. Two special food habits cruises were conducted at four sites on Georges Bank in July and August 1993 and involved examination of 3,800 stomachs at sea and preservation of 4,900 stomachs for lab analysis of fish and invertebrate prey. Quantitative bottom grab samples of benthic invertebrate fauna were also taken for comparison with fish stomach contents. Retrospective analysis of historical food habits data going back to the late 1960s and the new data from the COP initiative will be integrated within the context of multispecies models. The COP information on predation on early life stages of cod and haddock represents a critical component of the data base needed for the study of gadid recruitment processes by the U.S. GLOBEC/NW Atlantic Program on Georges Bank.

g) Marine Mammals

**Harbor Porpoise.** In 1993, the NEFSC conducted studies to determine the population size, distribution and habitat preferences, by-catch, life history parameter values, food habits, and population growth rate of harbor porpoise. Food habits, age of first reproduction, age and sex distribution, and pregnancy rate were estimated during a necropsy session in January 1993 of harbor porpoise caught incidentally in the sink gillnet fishery.

Abundance of the Gulf of Maine harbor porpoise population was estimated to be 47,200 animals (95% confidence interval of 39,500 to 70,600) using data from ship-based assessment surveys conducted in 1991 and 1992. An experimental survey was conducted in 1993 to test ship-based survey methodology and to evaluate a newly-designed computerized data entry system. Aerial surveys were performed during December 1992 and in February, April, November and December 1993 to investigate seasonal distribution patterns. In addition, during both 1992 and 1993, observers on NEFSC groundfish surveys performed dedicated marine mammal sighting surveys. Habitat studies were also conducted during April, May, and June 1992 and in September 1993 in Penobscot and Blue Hill Bays, Maine.

An estimate of harbor porpoise by-catch in the sink gillnet fishery was presented at a February 1993 Harbor Porpoise Workshop conducted by NEFSC. Problems with the estimation procedure were discovered and an algorithm developed to correct for a systematic bias. A new estimate of total by-catch will be available in June 1994. NEFSC also investigated by-catch reduction methods and net modifications that might make gillnets less likely to entangle harbor porpoise. In May 1993, the NEFSC assisted in the design of a field experiment to test how various sounds affect the behavior of harbor porpoise; the experiment was sponsored by the New England Aquarium and the University of New Hampshire. NEFSC staff also assisted in the design, execution and analysis of an experiment to evaluate the effect of acoustic alarms on gillnets in the Gulf of Maine. This study was sponsored by the Memorial University of Newfoundland, The New Hampshire Gillnetters Association, and the NEFSC.

**Pilot Whales** A contract was let to refine information on the reproductive rates of Northeast Atlantic pilot whales. This work focused on available life history data from the directed harvest of pilot whales in the Faroe Islands; these data are presently being integrated into a population model for the species. Studies of the trophic role of pilot whales using stable isotope techniques were supported through the University of Massachusetts. Results of this research suggest that (1) pilot whales killed incidentally in the mackerel trawl fishery prey on a mixture of both squid and mackerel, and (2) pilot whales in the eastern and western Atlantic have different diet histories. These results and other pilot whale information was presented to the ICES Study Group on North Atlantic Pilot Whales in August 1993.

**Pelagic Delphinids** A pelagic delphinid survey was conducted along the shelf edge and slope waters from southern Georges Bank to the Scotian Shelf. The survey investigated the fine-scale distribution of beaked whales and pelagic delphinids in shelf edge and Gulf Stream warm-core ring waters, and evaluated the distributions of these species relative to the U.S.- Canada boundary line. Line transect survey data was collected and photoidentification studies were done using a rigid-hulled inflatable boat. A total of 494 marine mammal sightings were recorded.

**Pinnipeds** The NEFSC funded the University of Maine (UMO) to conduct aerial surveys during May-June 1993 to obtain population abundance and recruitment indices of harbor seals during the peak abundance/pupping period in coastal Maine waters. These data will be compared to UMO data collected in the 1980s to determine population trends.

**Humpback Whales** Principal NEFSC involvement with humpback whale research was through participation in the Years of the North Atlantic Humpback (YONAH) Project. YONAH is a large-scale international effort that uses photographic identification and molecular genetics to study humpback whales (*Megaptera novaeangliae*) across their entire known North Atlantic range - from the West Indies to the Arctic. At the end of 1993 (the second and final year of field work), YONAH had photographically identified approximately 4,000 humpback whales and biopsied more than 2,500. While matches between areas (notably breeding and feeding grounds) will reduce these totals, these sample sizes are unprecedented for a marine mammal study.

**Right Whales** Since the mid-1980s, the NEFSC has administered an integrated research program on north Atlantic right whales. The population is currently estimated to be between 300-350 individuals and is believed to be recovering at three to four percent annually. The population is, however, threatened by human impacts - principally by ship strikes and gear entanglements. In both 1992 and 1993, the NEFSC participated in a multi-investigator, multi-agency mitigation effort. This program included an assessment of vessel traffic, education of mariners, development of an early warning network to alert vessel operators on the presence of right whales in and near shipping areas, and research on right whale distribution, behavior, and habitat. The states of Florida (Department of Environmental Protection) and Georgia (Department of Natural Resources) were major participants. Building on work from the 1992 and 1993 wintering seasons, a Southeastern U.S. Implementation Team for the Recovery of the Northern Right Whale was formed in August 1993. An upgraded and refined mitigation program for coastal waters of the southeastern U.S. has been implemented for the 1993-94 season.

**Satellite Tagging of Small Cetaceans** NEFSC, working jointly with the Office of Naval Research, supported contract studies to develop and test application of satellite tags for small cetaceans. These studies addressed the biocompatibility of attachment materials, hydrodynamic aspects of tag design, and dorsal fin morphology and its role in the regulation of body temperature.

#### **h) PSP Toxins in Shellfish and Mackerel**

In 1989, paralytic toxins were observed in all important molluscan shellfish species on Georges Bank resulting in the closure of the Georges Bank surf clam fishery, and issuance of an advisory to fishermen concerning potential toxicity of scallop roe (roe-on product) and of various mollusk species taken as by-catch. While the source of this widespread toxicity has yet to be identified, it is assumed to have been derived from toxic phytoplankton blooms occurring on the Bank. The neurotoxic compound, domoic acid, has recently been detected at low levels in these offshore areas. Through 1993, Georges Bank surf clams continue to be toxic (780 ug/100 g). A protocol for a dockside testing program has been designed and is now under consideration.

In more than three years of sampling, toxins continue to be found in the livers of mackerel throughout range of this species in the Northwest Atlantic. Toxins have not been detected, however, in the edible muscle or gonad tissues. High performance liquid chromatography (HPLC) and bioassay methods are routinely used to examine patterns of toxicity in mackerel. Toxin profiles as revealed by HPLC have now been characterized.

#### **i) Oyster Disease Studies**

Cooperative efforts continue with the Maryland Department of Natural Resources in assessing the extent that the disease agents MSX (*Haplosporidium nelsoni*) and DERM ( *Perkinsus marinus*) have had in affecting oyster populations in the Chesapeake Bay. DERM has most severely affected the oysters remaining in the Maryland portion of the Chesapeake Bay. In the 1993/94 fishing season, oyster harvests reached an all-time low of less than 100,000 bushels.

A survey of oysters conducted between 1989-1994 documented the spread of DERM (*P. marinus*) to oysters in New York, Connecticut, and Massachusetts. Previous reports of the disease north of Delaware Bay were anecdotal and not documented.

Studies were conducted on the distribution of oyster diseases along the U.S. East and Gulf coasts, and to determine the cause of Juvenile Oyster Disease (JOD) recently reported in hatchery-produced oysters from the northeast United States. Mortalities of juvenile oysters exhibiting specific signs of the JOD occurred only in New England oysters and were more frequent in oysters less than 30 mm in length. The prevalence and intensity of JOD appears to increase at higher salinities and temperatures. Along with other specific gross signs of JOD, small intracellular bodies have been identified in the mantle lesions which suggest a possible association with ciliates.

Other studies of JOD were conducted on a series of cultured juvenile oysters spawned in January through May 1993. Both live and dead specimens oysters were analyzed weekly for mortality, size, and the presence of conchiolin. As well, the mantle and internal shell surfaces were cultured for ciliates. Intracellular organisms were found in the mantle tissues, characterized ultrastructurally by the presence of tubular cristae, vesicles, and dense bodies not consistent with oyster cell organelles. The effects of salinity and selected standard saltwater aquarium medications on transmission and treatment of JOD were also evaluated. Experimental oysters were cultured for presence of bacteria that may be associated with the disease. Although several bacterial types were identified, no association of a specific bacterium and JOD infections could be made.

j) Blue Crab Disease Research

A study of diseases in the blue crab, *Callinectes sapidus*, was completed in cooperation with the Maryland Department of Natural Resources. The study provided first-time information on the health status of overwintering blue crabs. A new ciliate was detected, cultured, and identified as a new *Mesanoophrys* sp.

A survey of coastal bays in Maryland and Virginia determined the prevalence of a parasitic dinoflagellate, *Hematodinium perezii*, in the blood of adult and juvenile blue crabs. The survey documented the prevalence of *H. perezii* in up to 100% of early juvenile crabs (5-29 mm), in 75% of juvenile crabs (30-89 mm), and in 77% of adult crabs (90-180 mm). Experiments showed a slight increase in the mean intensity of the disease in crabs held in a flow-through seawater tank. Mortality (putatively caused by *H. perezii*) and mean parasite intensity were higher in small crabs than in larger crabs.

3. Gear and Selectivity Studies (Including Survey Operations)

a) Winter/Summer Trawl Surveys

Two new trawl surveys have been initiated recently; a summer survey (late July-early August) in the Gulf of Maine, and a winter survey (late January-early February) in the mid-Atlantic and southern New England. The summer survey began in 1991 and concentrates on inshore waters along the Maine and New Hampshire coasts, although some limited sampling in the central Gulf of Maine is also performed. Emphasis in the survey is placed on collecting biological samples, especially of juveniles. The "Yankee 36" trawl - used in NEFSC spring and fall surveys - is also used in the summer survey. The winter survey, which began in 1992, targets summer flounder and yellowtail flounder in offshore waters (55-365 m) between the Virginia capes and western Georges Bank. A New Bedford type flounder trawl is used in this survey.

b) Pen-based Computer Data Entry

A major effort to automate data collection and processing during finfish and shellfish resource surveys was initiated in 1993. The upgrading of capabilities is focused on the use of pen-based computers to eliminate the need for initially recording data on paper logs and subsequently hand keying data to create computer files. Entry of data from handwritten logs - either during the cruise or thereafter - has proven to be the major source of errors detected during post-cruise laboratory audits. It is envisaged that a final working system will (1) incorporate wireless communications between computers; (2) integrate data from electronic measuring boards and scales; and (3) provide immediate audit checks thereby significantly reducing post-cruise audit requirements. A prototype system was tested in 1993 during the sea scallop survey. During the 1994 scallop survey, an automated working system will be used in parallel with the old written log system to evaluate the new system. It is anticipated that a prototype system for finfish surveys will be ready for testing in early 1995.