
NOAA Technical Memorandum NMFS-F/NEC-63

# Status of the Fishery Resources Off the Northeastern United States for 1988

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts

October 1988

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NOAA Technical Memorandum NMFS-F/NEC-63



# Status of the Fishery Resources Off the Northeastern United States for 1988

Conservation and Utilization Division, Northeast Fisheries Center

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October 1988

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# INTRODUCTION

The Conservation and Utilization Division of the Northeast Fisheries Center (NEFC), with headquarters in Woods Hole, Massachusetts, annually updates its assessments of finfish and shellfish resources off the northeast coast of the United States, and presents detailed information as needed to administrators, managers, the fishing industries, and the public. This report is based on those assessments and summarizes the general status of the major finfish and shellfish resources off the northeast coast of the United States from Cape Hatteras to Nova Scotia through 1987.

Many of the assessments relied on here are described in Laboratory Reference Documents at the Woods Hole Laboratory, which may be obtained upon request. The most recent complete assessment for each stock is cited in the appropriate species synopsis section. Additionally, in recent years NEFC has initiated a new procedure of reviewing assessments of selected species-stocks in workshops. The reports of those workshops are cited in the species synopses sections for those species which were reviewed.

The assessment information contained in the present report varies among the species-stocks because of differences in available data and in the need for assessment information. Some species (such as mackerel, Georges Bank herring, silver hake, red hake, butterfish, and squid) were fished most heavily in the past by foreign distant water fleets. Before 1977, biological and catch-effort data provided most of the basic fishery information used for assessing the status of these stocks. Since implementation of the Magnuson Fishery Conservation and Management Act of 1976, the levels of foreign fishing have been greatly reduced. Assessments of the status of these stocks during this period has increasingly been based on research vessel survey information rather than fishery-generated information. This is because fishing effort by the United States was lower in the late 1970s than that of the distant water fleets that they were replacing.

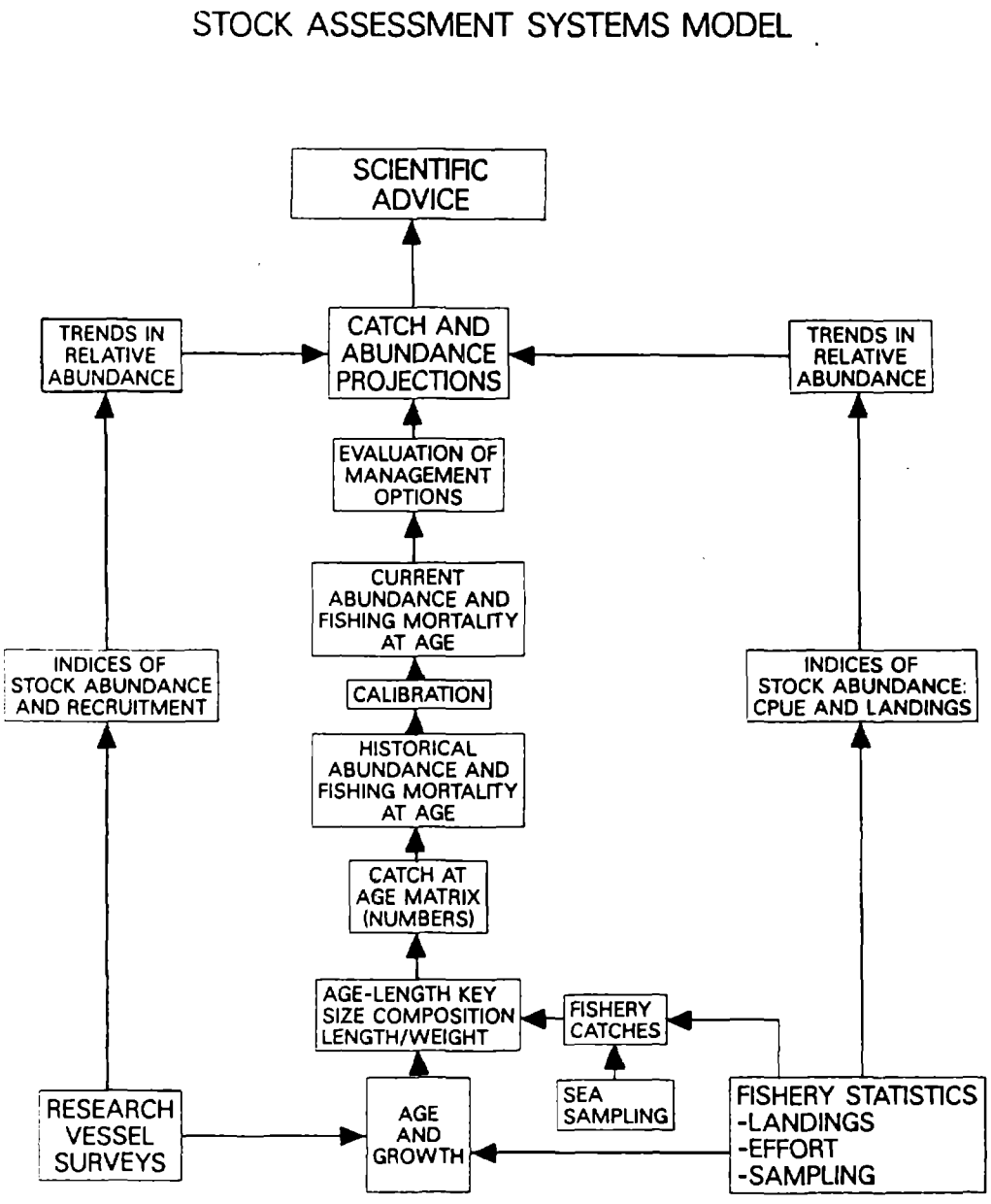
For some fisheries (such as yellowtail flounder and butterfish), the mortality of discarded small fish is a very significant proportion of the total mortality of the stock. The ability to estimate quantities discarded in these fisheries is crucial for the production of accurate assessments. Recently there has been an acceptance in the market of smaller fish of some species. The definitions of market categories have changed in many ports in response. Since sampling of landings for length and age composition is based on these categories to a large extent, this change in market definition has also produced problems in maintaining continuity in the assessments. The need to improve sampling aboard commercial vessels has been identified.

Fishing pressure on some species-stocks comes almost entirely from recreational fishermen, and a great many other species receive substantial but lesser proportions of fishing pressure from such fishermen. Catch and effort information has been especially poor for the recreational fisherman, although significant progress in collecting this information has now been made.

Depending on the nature of the fishery, the type and amount of fishery-generated data, and the information required for management, the assessment information reported here may be generated in several different ways. Figure A[1] is a diagram of several ways in which catch and survey data in the lower left and right boxes respectively, can be combined to provide assessment advice, illustrated at the top of the diagram. (1) The simplest approach is when **catch data** are used to generate indices of

[1]Tables and figures in this section are lettered, to distinguish them from the numbered tables and figures in the Species Synopses section.

Figure A. Diagram of alternate ways in which fishery-generated data and research data (lower right and left boxes, respectively) are combined to provide scientific advice on the status of stocks (top box).



abundance, as seen by moving vertically along the right side of Figure A. A more complex approach (2) is when the catch data from approach (1) is combined with **trawl survey data** to generate indices of abundance, as seen by moving vertically along the left side of Figure A. Both of these approaches are frequently supplemented with knowledge of the life history generated from biological data from sampling the commercial and survey catches. A third approach (3) is to utilize the information about total stock size and population productivity generated under approaches (1) and (2) to determine the relationship between productivity and stock size, termed **production models**. Finally, for those species where the age composition of the catch or of the survey samples can be determined reliably, (4) more complex **analytic assessments** can be developed that use the information in the age structure of the population and the catches to determine productivity as seen by moving vertically along the center of Figure A.

The status of information pertaining to the various elements in Figure A is diagrammed in Table A. The great differences in availability of different types of information (columns) for the several species of interest in this region (rows) suggests why assessments of different species involve different paths in Figure A. Although research on some of the species has been underway for many years, some of the items are still not known. As fisheries become more intense, more of the categories will need to be filled to evaluate the effects of fishing on the resource.

Both Figure A and Table A reflect information about each species separately, as if they had no interactions with each other. Similarly, the assessments in this report are presented individually, with little indication of the biological interactions among species or of the technical interactions due to the mixed species nature of many of the fisheries. These interactions have implications for how assessment information is generated, and for the impact of management of fisheries on one species-stock on other species and other fisheries. The need for assessment information that better accounts for these interactions has been identified.

## Definition of Technical Terms

Certain assessment terms used throughout this document may not be familiar to all. A brief explanation of some of these follows.

**Nominal Catch**: The sum of catches that have been reported as live weight or equivalent of the landings. Nominal catches do not include unreported discards or unidentified young fish put into fish meal.

**Sustainable Yield**: The number or weight of fish in a stock that can be taken by fishing without reducing the stock's biomass from year to year, assuming that environmental conditions remain the same.

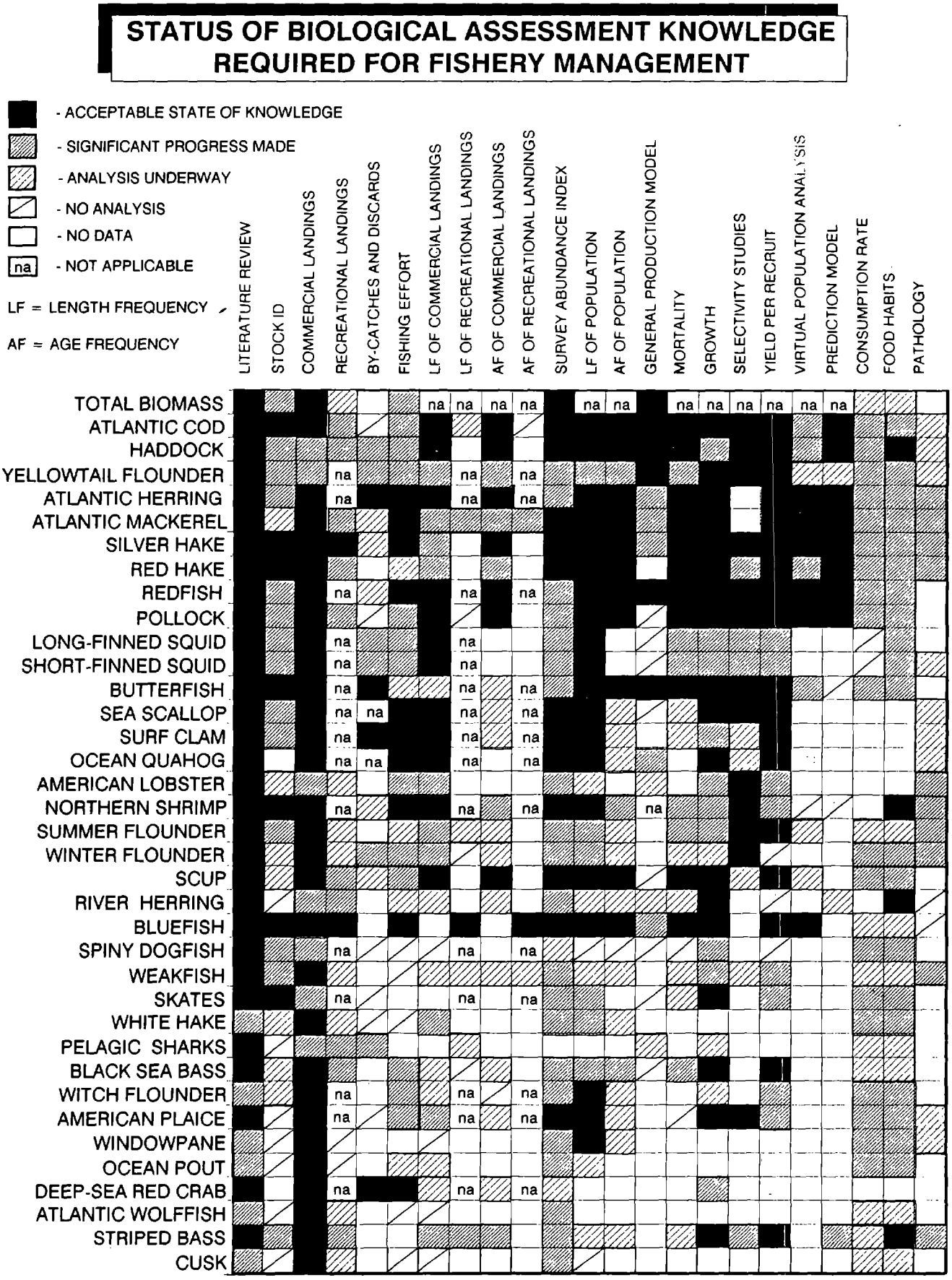
**TAC**: Total allowable catch is the total regulated catch from a stock in a given time period, usually a year.

**Quota**: A portion of a TAC allocated to an operating unit, such as a size class of vessels or a country.

**Year Class (or Cohort)**: Fish of the same stock born in the same year. For example, the 1987 year class of cod includes all cod born in 1987, and they would be age 1 in 1988. Occasionally a stock produces a very small or very large year class and this group of fish is followed closely by assessment scientists since it can be pivotal in determining the number of fish in successive years.

**Exploitation rate**: The proportion of a population at the beginning of a given time period that is caught during that time period (usually expressed on a yearly basis). For example, if 720,000 fish were caught during the year from a population of 1 million fish present

TABLE A


STATUS OF BIOLOGICAL ASSESSMENT KNOWLEDGE REQUIRED FOR FISHERY MANAGEMENT
- ACCEPTABLE STATE OF KNOWLEDGE
- SIGNIFICANT PROGRESS MADE
- ANALYSIS UNDERWAY
- NO ANALYSIS
- NO DATA
na - NOT APPLICABLE
LF = LENGTH FREQUENCY
AF = AGE FREQUENCY
LITERATURE REVIEW
STOCK ID
COMMERCIAL LANDINGS
RECREATIONAL LANDINGS
BY-CATCHES AND DISCARDS
FISHING EFFORT
LF OF COMMERCIAL LANDINGS
LF OF RECREATIONAL LANDINGS
AF OF COMMERCIAL LANDINGS
AF OF RECREATIONAL LANDINGS
SURVEY ABUNDANCE INDEX
LF OF POPULATION
AF OF POPULATION
GENERAL PRODUCTION MODEL
MORTALITY
GROWTH
SELECTIVITY STUDIES
YIELD PER RECRUIT
VIRTUAL POPULATION ANALYSIS
PREDICTION MODEL
CONSUMPTION RATE
FOOD HABITS
PATHOLOGY
TOTAL BIOMASS
ATLANTIC COD
HADDOCK
YELLOWTAIL FLOUNDER
ATLANTIC HERRING
ATLANTIC MACKEREL
SILVER HAKE
RED HAKE
REDFISH
POLLOCK
LONG-FINNED SQUID
SHORT-FINNED SQUID
BUTTERFISH
SEA SCALLOP
SURF CLAM
OCEAN QUAHOG
AMERICAN LOBSTER
NORTHERN SHRIMP
SUMMER FLOUNDER
WINTER FLOUNDER
SCUP
RIVER HERRING
BLUEFISH
SPINY DOGFISH
WEAKFISH
SKATES
WHITE HAKE
PELAGIC SHARKS
BLACK SEA BASS
WITCH FLOUNDER
AMERICAN PLAICE
WINDOWPANE
OCEAN POUT
DEEP-SEA RED CRAB
ATLANTIC WOLFFISH
STRIPED BASS
CUSK

at the beginning of the year, the annual exploitation rate would be 0.72.

**Mortality rate**: The rate at which fish die from natural causes (disease, predation, old age) or fishing. Mortality rates can be described in several ways. Conceptually the easiest way is the total annual mortality rate, the fraction of the fish alive at the beginning of a year that die during the year. For example, a total annual mortality rate of 0.50 means that 50% of the population of fish died for whatever reason during the year. In general, annual mortality rates can range from 0 to 1.0, that is 0% to 100% mortality.

Annual rates are easy to understand, but difficult to use when describing the relative contribution of different types of mortality, such as fishing and natural causes, to the total mortality of fish during a year. One way to describe mortality and overcome this limitation of annual rates is by using instantaneous rates, although this approach is conceptually more difficult. An instantaneous mortality rate is the fraction of the population of fish that dies in each very short period of time.

The derivation of instantaneous rates is mathematically complex, but there is a relatively simple connection between them and the simpler annual rates. Any particular instantaneous mortality rate, often denoted by Z, is equivalent to one specific annual rate A, according to the formula:

$$A = 1 - e^{-Z}$$

That is, the annual rate is equal to 1 - e, (this is the number 2.718, the base of the natural logarithms) raised to the negative power of the instantaneous rate. For example, the instantaneous mortality rate of 1.1 is equivalent to an annual mortality rate of 0.67, or 67%. In practice, instantaneous rates range from 0 to values as high as 1.5 or 2.0, but theoretically could take on any large value. Because instantaneous rates make comparing the relative importance of different sources of mortality very easy, as discussed next, they are frequently used by fishery biologists, and are used throughout this report. To aid in interpretation, the following explanation of correspondence between the simpler annual rates and the more useful instantaneous rates may be helpful:

**Relationship between instantaneous mortality rate, annual mortality rate, and annual percentage mortality.**

| Instantaneous Annual Mortality Rate | Annual Mortality Rate | Percentage Mortality |
|---|---|---|
| 0 | 0 | 0% |
| 0.10 | 0.10 | 10% |
| 0.20 | 0.18 | 18% |
| 0.30 | 0.26 | 26% |
| 0.40 | 0.33 | 33% |
| 0.50 | 0.39 | 39% |
| 0.60 | 0.45 | 45% |
| 0.70 | 0.50 | 50% |
| 0.80 | 0.55 | 55% |
| 0.90 | 0.59 | 59% |
| 1.00 | 0.63 | 63% |
| 1.50 | 0.78 | 78% |
| 2.00 | 0.86 | 86% |

Instantaneous rates seem to be confusing, but are used in assessments because they are mathematically easy to use (e.g., they can be added directly while percentages cannot be). If a year is divided into a large number (n) of equal time intervals, Z/n is the proportion of the population which dies during each time interval. For example, if Z = 1.7 and a day represents the time interval, then approximately 1.7/365 or 0.466% of the population is dying daily, but the instantaneous rate is constant. (Actually 0.465% of the population dies each day instead of 0.466% because a day only approximates an instantaneous time period. If hours were used, the approximation would be even closer.) During the first day of the year, about 4,660 fish will die and 995,340 will survive out of a population of 1 million. The survival rate over the year is $e^{-1.7}$ (where e = 2.71828) or 0.1827. Multiplying 0.1827 by the number of fish alive at the beginning of the year (1 million) gives 182,684 fish that survive to the beginning of the next year. The proportion that actually dies during the year is, therefore, $1-e^{-1.7}$ or 0.8173. This is called the annual mortality rate (A) which, of course, can never exceed 1.0.

**Fishing Mortality Rate**: The part of the total mortality rate applying to a fish population that is caused by man's harvesting. Fishing mortality is usually expressed as an instantaneous rate, as discussed under **Mortality Rate**, and can range from 0 for no fishing to very high values such as 1.5 or 2.0. The corresponding annual fishing mortality rate can be computed in the same manner as total mortality rates. Fishing mortality rates are estimated using a variety of techniques, depending on the available data for a species or stock.

For example, if F = 1.5, then approximately 1.5/365 or 0.411% of the population dies each day from fishing. If fishing were the only cause of death, then the number of fish that survive the fishery over the year from a population of 1 million alive at the beginning of the year is 1 million multiplied by $e^{-1.5}$ or 223,130 fish. During fishing, there are other causes of death that also act on the population of fish, and must be considered in calculating the number that die from fishing. The number that die from fishing is the proportion of the total mortality that is caused by fishing, multiplied by the number that die from all causes [i.e., F/Z multiplied by $[1-e^{-Z}]$ multiplied by 1 million.] If the total mortality rate is 1.7, as given above, then this calculation is:

$$\frac{1.5}{1.7}\,(1-e^{1.7})\,(1{,}000{,}000)$$

or (0.8824) (0.8173) (1,000,000)

or 721,186 fish that die from fishing.

**Natural Mortality Rate:** The part of the total mortality rate applying to a fish population attributed to natural causes, usually assumed to mean all causes other than fishing. These many causes of death are normally lumped together for convenience since they usually account for much less mortality than fishing in adult fish, and are therefore of less immediate interest. Natural mortality is usually expressed as an instantaneous rate, as discussed under **Mortality Rate**, and can range from 0 to very high values, such as 0.5 or 1.0. The corresponding annual mortality due to natural causes acting alone can be computed in the same manner shown for total mortality rates. The most important causes are predation, disease, cannibalism, and perhaps increasingly, environmental degradation such as pollution. When particular mortality factors are of interest, a separate instantaneous mortality term is often defined. Natural mortality rates have proven very difficult to estimate, and often values are assumed, based on the general life history of a particular fish. For example, for many demersal round fish, natural mortality is assumed to be 0.2, or 18% annual mortality.

Following the examples given earlier, instantaneous natural mortality rate (M) is equal to Z-F or 1.7-1.5 = 0.2. The number of fish that die during the year from natural causes

is, therefore the proportion of total mortality (Z) due to natural causes multiplied by the proportion that actually die multiplied by the population alive at the beginning of the year:

$$\frac{M}{Z}\ (1\text{-}e^{-Z})\ (1{,}000{,}000)$$

or $\quad (0.1176)\ (0.8173)\ (1{,}000{,}000)$

Therefore, 96,114 fish or 9.6% of the population die from natural causes during the year when the fishing mortality rate is 1.5. If fishing mortality were less, more fish would die from natural causes because some fish are caught by the fishery before they die from natural causes. For example, if the fishery did not exist, an M of 0.2 applied over the year to 1 million fish would cause a mortality of $(1\text{-}e^{-0.2})$ multiplied by 1 million or 181,269 fish and 18.1% of the beginning population.

**Total Mortality Rate**: The combined effect of all sources of mortality acting on a fish population. This is conveniently expressed in terms of instantaneous mortality rates because the total instantaneous mortality rate is simply the sum of the instantaneous fishing and natural mortality rates. For example, the total instantaneous mortality rate that is occurring when the instantaneous fishing mortality rate is 0.5 and the natural mortality rate is 0.2 would be 0.7, which is equivalent to an annual rate of 50%.

The total mortality could be calculated in annual rates, but would be more complicated. In this example, the annual fishing mortality rate corresponding to an instantaneous rate of 0.5 would be 0.39, and the annual natural mortality rate corresponding to an instantaneous rate of 0.2 would be 0.18. The total mortality rate would be computed as the sum of these two annual rates, less their product, or:

$$0.39 + 0.18 - (0.39)(.018) = 0.50.$$

This is the same value obtained from the instantaneous rate calculation, because the instantaneous rate of 0.7 corresponds to an annual rate of 50%.

**Recruitment**: The amount of fish, in numbers or weight, that reach a certain size or age in a specific year. For example, the weight or number of fish that grow to become vulnerable to the fishing gear in one year would be the recruitment to the fishable population in that year. This term is also used in referring to the number or weight of fish from a year class reaching a certain age. For example, all fish reaching their second year would be age 2 recruits. This is often used to describe the strength of a year class.

**$F_{max}$**: The rate of fishing mortality for a given method of fishing that maximizes the harvest in weight taken from a single year class of fish over its entire lifespan.

**$F_{0.1}$**: A fishing mortality rate less than $F_{max}$ that reflects the diminishing returns in terms of yield per recruited fish from increasing fishing mortality.

Both $F_{max}$ and $F_{0.1}$ can be technically defined in terms of the increase in yield from a year class over its lifespan as fishing mortality increases. When no fish are taken, there is no yield from the year class. As fishing increases, the yield increases, but at a decreasing rate. $F_{max}$ is the point at which the increased yield for additional effort is zero; that is, additional fishing mortality will not increase yield, but in fact, will decrease it as fish are caught before they have grown enough. $F_{0.1}$ is a point at which the increase in yield for increased effort is 10 percent of what it was when fishing mortality was very low.

**Virtual Population Analysis (or Cohort Analysis)**: An analysis of the catches from a given year class over its life in the fishery. If 10 fish were caught each year from the 1968 year class for 10 successive years from 1970 to 1979 (age 2 to age 11), then 100 fish would have been caught from the 1968 year class during its life in the fishery. Since 10 fish were caught during 1979, then 10 fish must have been alive at the beginning of that year. At the beginning of 1978, there must have been at least 20 fish alive because 10 were caught in 1978 and 10 more were caught in 1979. By working backward year by year, one can be virtually certain that at least 100 fish were alive at the beginning of 1970. A virtual population analysis goes a step further and calculates the number of fish that must have been alive if some fish also died from causes other than fishing. For example, if the instantaneous natural mortality rate was known in addition to the 10 fish caught per year in the fishery, then a virtual population analysis calculates the number that must have been alive each year to produce a catch of 10 fish each year in addition to those that died from natural causes.

If one knows the fishing mortality rate during the last year for which catch data are available (in this case 1979), then the exact abundance of the year class can be determined in each and every year. If the fishery removes a large proportion of the stock each year so that the population declines quite rapidly over time, then an approximate fishing mortality rate can be used in the last year (1979), and by calculating backward year by year for the year class, a very precise estimate of the abundance can be determined for the previous three or four years (1976 or 1975). Accuracy depends on the rate of population decline and the correctness of the starting value of the fishing mortality rate (in the most recent year). This technique is used extensively in fishery assessments since the conditions for its use are so common: many fisheries are heavily exploited, the annual catches for a year class can be easily determined, and the natural mortality rate is known within a fairly small range and is low compared with the fishing mortality rate.

**Spawning Stock Biomass (SSB)**: The total weight of all sexually mature fish in the population. This quantity changes naturally depending on the size of new year classes, the growth rate of the young fish, the age at onset of sexual maturity, the growth and natural mortality rate of older fish, and the magnitude of fishing mortality.

**Spawning Stock Biomass Per Recruit (SSBR)**: The spawning stock biomass divided by the number of fish recruited to age 2. This number is in units of weight (kg) and measures the average or expected contribution of any one young fish to the spawning stock biomass over its lifetime. It can be calculated based on the actual growth and mortality rates experienced by a group of young fish as they age, or based on what such fish would likely experience under prevailing growth and fishing mortality rates.

A useful reference point is the level of SSBR that would be obtained if there were no fishing. This is a maximum value for SSBR, and levels of SSBR under different fishing patterns can be compared to it. For example, the maximum SSBR for Georges Bank haddock is approximately 9 kg.

**Projected Spawning Stock Biomass Per Recruit (PSSBR)**: The spawning stock biomass per recruit that would be achieved from an individual fish from a year class, if the fishing mortality and age specific pattern were to hold throughout the life span of the fish. For example, PSSBR for Georges Bank haddock is currently about 1.6 kg per fish recruited at age 2, only 18% of the maximum of 9 kg per fish recruited at age 2.

**Maintenance Spawning Stock Biomass Per Recruit (MSSBR)**: An estimate of the spawning stock biomass per recruit required to maintain spawning stock biomass, based on the observed success of spawning in recent years. Fishing patterns that result in a SSBR below this level will cause the spawning stock biomass to decline in the long term. Such values have been adopted in the New England Fishery Management Council's Multispecies Fishery Management Plan (FMP) as management targets. If the projected

spawning stock biomass per recruit (PSSBR) is less than the maintenance spawning stock biomass per recruit (MSSBR), then the spawning stock biomass wil likely decline. For example, MSSBR is approximately 2.7 kg per fish recruited at age 2, some 30% of the maximum SSBR. The PSSBR at about 1.6 kg is less than the MSSBR, implying that fishing intensity is too high as defined by the management targets.

**Status of Exploitation**: An appraisal of the status of exploitation is found at the bottom of each table in the species synopsis section, using the terms unknown, protected, not exploited, under exploited, moderately exploited, fully exploited, and over exploited. These terms are used to describe the effect of current fishing effort on each stock, and represent the assessment scientist's educated opinion based on current data and the knowledge of the stocks over time.

**Long-term Potential Catch:** The largest annual harvest in weight which could be removed from a fish stock year after year, under existing environmental conditions. This can be estimated in a variety of ways, ranging from maximum values from production models to average observed catches over a suitable period of years.

## COMMERCIAL FISHERY TRENDS

### Total Commercial Catch

The total international (USA and foreign) commercial nominal catch of all species off the northeastern United States (Gulf of Maine to Cape Hatteras, North Carolina) increased 5% from 1986 to 1987. The total catch increased from 1.24 million mt in 1986 to 1.30 mt in 1987. The catch of other pelagics increased 35% and the catch for other groundfish increased by 29% (Table B).

### Groundfish

Total groundfish commercial catches decreased 1% from 1986 to 1987. Catches of principal groundfish (cod, haddock, redfish, red hake, silver hake, and pollock) decreased 5% from 94,983 mt in 1986 to 89,883 mt in 1987. Haddock, redfish, silver hake, and pollock catches decreased 9%, 37%, 14%, and 11% respectively. Cod catches increased 7%.

Flounder catches decreased 3,267 mt from 1986 to 1987 (8%). Winter flounder and summer flounder catches increased by 1,029 mt (13%) and 546 mt (5%) respectively. Yellowtail flounder catch decreased 22% (1,763 mt).

### Pelagics

Total catches of the principal pelagic species, herring and mackerel, increased 14% from 1986 (67,083 mt) to 1987 (76,524 mt). The USA herring catch increased 24%, 7,764 mt, and the USA mackerel catch increased by 33%. However, the foreign catch for mackerel catches decreased 9% from 1986 (25,651 mt) to 1987 (24,145 mt).

The catch of other pelagic species increased by 35%, largely due to a 37% increase in menhaden catches between 1986 (231,657 mt) and 1987 (316,998 mt). Bluefish landings increased by 17%.

### Other Finfish

The catch of other finfish decreased 5% from 1986 (29,475 mt) to 1987 (27,973 mt). There was a 35% decrease in river herring catches and an 18% increase in skate catches.

### Other Invertebrates

The total USA and foreign catch of invertebrates decreased 4% from 743,247 mt in 1986 to 709,823 mt in 1987. Foreign catches increased 30% due to a 45% increase in sea scallop catches. USA catches of sea scallops increased 55%. Foreign vessels caught no squid in 1987. USA squid catches increased 8% from 1986 (11,996 mt) to 1987 (21,670 mt).

Table B. USA commercial and foreign nominal catches (mt) from the marine finfish and invertebrates resources off the northeastern United States (Gulf of Maine to Cape Hatteras, North Carolina Mid-Atlantic) in 1986 and 1987. All catches are expressed in live weight. 1987 catches are provisional, and recreational catches are not included.

| Species | Foreign | | USA | | Commercial Total | |
|---|---|---|---|---|---|---|
| | 1986 | 1987 | 1986 | 1987 | 1986 | 1987 |
| **Principal Groundfish** | **15,646** | **20,448** | **79,337** | **69,435** | **94,983** | **89,883** |
| Cod | 9,308 | 12,345 | 27,155 | 26,560 | 36,463 | 38,905 |
| Haddock | 3,640 | 4,793 | 4,929 | 3,007 | 8,569 | 7,800 |
| Redfish | 139 | 74 | 2,913 | 1,859 | 3,052 | 1,933 |
| Silver hake | 362 | 2 | 17,977 | 15,710 | 18,339 | 15,712 |
| Red hake | 6 | 0 | 2,219 | 2,009 | 2,135 | 2,009 |
| Pollock | 2,191 | 3,234 | 24,234 | 20,290 | 26,425 | 23,524 |
| **Flounders** | **499** | **318** | **39,520** | **36,434** | **40,019** | **36,752** |
| American plaice | 34 | 48 | 4,480 | 3,800 | 4,514 | 3,848 |
| Witch flounder | 67 | 25 | 4,535 | 3,435 | 4,602 | 3,460 |
| Yellowtail flounder | 27 | 57 | 7,818 | 6,025 | 7,845 | 6,082 |
| Greenland halibut | 0 | 0 | 0 | 0 | 0 | 0 |
| Atlantic halibut | 32 | 23 | 33 | 26 | 65 | 49 |
| Winter flounder | 25 | 34 | 7,990 | 9,010 | 8,015 | 9,044 |
| Summer flounder | 0 | 0 | 11,090 | 11,636 | 11,090 | 11,636 |
| Windowpane flounder | 0 | 0 | 3,223 | 2,280 | 3,223 | 2,280 |
| Flatfishes (not specified) | 314 | 131 | 351 | 222 | 665 | 353 |
| **Other Groundfish** | **1,551** | **1,792** | **20,906** | **27,289** | **22,457** | **29,081** |
| Cusk | 126 | 261 | 1,843 | 1,373 | 1,969 | 1,634 |
| Scup | 16 | 0 | 6,850 | 6,058 | 6,866 | 6,058 |
| White hake | 956 | 659 | 5,300 | 5,519 | 6,256 | 6,178 |
| Atlantic wolfish | 0 | 80 | 858 | 717 | 858 | 797 |
| Groundfish (not specified) | 453 | 792 | 6,055 | 13,622 | 6,508 | 14,414 |
| **Principal Pelagics** | **25,652** | **24,175** | **41,431** | **52,349** | **67,083** | **76,524** |
| Atlantic herring | 1 | 30 | 31,993 | 39,757 | 31,994 | 39,787 |
| Atlantic mackerel | 25,651 | 24,145 | 9,438 | 12,592 | 35,089 | 36,737 |
| **Other Pelagics** | **361** | **276** | **244,410** | **331,266** | **244,771** | **331,542** |
| Bluefish | 0 | 2 | 4,647 | 5,436 | 4,647 | 5,438 |
| Atlantic butterfish | 127 | 0 | 4,593 | 4,701 | 4,720 | 4,701 |
| Atlantic menhaden | 18 | 3 | 231,639 | 316,995 | 231,657 | 316,998 |
| Pelagic (not specified) | 216 | 271 | 3,531 | 4,134 | 3,747 | 4,405 |
| **Other Finfish** | **940** | **135** | **28,535** | **27,838** | **29,475** | **27,973** |
| River herring | 62 | 48 | 4,071 | 2,616 | 4,133 | 2,664 |
| Spiny dogfish | 13 | 0 | 2,629 | 2,645 | 2,642 | 2,645 |
| Skates | 106 | 27 | 4,225 | 5,093 | 4,331 | 5,120 |
| Finfish (not specified) | 759 | 60 | 17,610 | 17,484 | 18,369 | 17,544 |
| **Invertebrates** | **43,860** | **56,783** | **699,387** | **653,040** | **743,247** | **709,823** |
| Illex | 213 | 0 | 13,577 | 10,244 | 13,790 | 10,244 |
| Loligo | 4,317 | 0 | 6,419 | 11,426 | 10,736 | 11,426 |
| American Lobster | 275 | 263 | 20,791 | 20,629 | 21,066 | 20,892 |
| Shrimp (Pandalid) | 0 | 0 | 4,693 | 5,029 | 4,693 | 5,029 |
| Crab (not specified) | 2 | 1 | 47,681 | 37,337 | 47,683 | 37,338 |
| Surf clams | 0 | 0 | 189,149 | 144,379 | 189,149 | 144,379 |
| Ocean quahog | 0 | 0 | 169,830 | 189,280 | 169,830 | 189,280 |
| Sea scallop | 39,050 | 56,518 | 72,144 | 111,965 | 111,194 | 168,483 |
| Invertebrates | 3 | 1 | 175,103 | 122,751 | 175,106 | 122,752 |
| **Total** | **88,509** | **103,927** | **1,153,526** | **1,197,651** | **1,242,035** | **1,301,578** |

# RECREATIONAL FISHERY TRENDS

Recreational landings of many species of fish and shellfish harvested in marine waters off the northeastern United States equal or exceed the commercial landings. Notable examples are mackerel, striped bass, bluefish, weakfish, white marlin, and pelagic sharks. In addition, recreational landings are a significant part of the total catch of numerous other species.

Between 1960 and the mid-1970s, NMFS and the NEFC conducted a variety of surveys to obtain catch and other information about the recreational fishery. Because of considerable uncertainty about the data from these surveys, NMFS implemented the Marine Recreational Fishery Statistics Survey (MRFSS) in 1979. It consists of two complementary surveys: a telephone survey of households and a direct-intercept creel census. Since 1979 the recreational fisheries of the Atlantic and Gulf coasts have been surveyed annually as part of the MRFSS. Since the MRFSS methodology represents a radical change from previous methodologies, data from the MRFSS is not directly comparable to the results of the earlier surveys. Data from the MRFSS are reported in the species synopsis sections of this report; data from earlier surveys are not used here.

Recreational fishery data are an important factor in determining the status of many stocks, and results from the MRFSS have been incorporated into some of the assessments summarized in this report. However, obtaining detailed records on the recreational catch is a formidable task. Recreational fishermen make between 25 and 35 million fishing trips annually in marine waters off the northeastern U.S. The trips are made at all hours of the day to virtually every coastal river, bay, and sound of the region, as well as in the open ocean. Marine anglers fish from private boats, rental boats, party and charter boats, the shore, and from man-made structures such as piers, bridges, and jetties.

Although significant progress is being made in collecting reliable recreational catch-and-effort information, the use of recreational survey data to monitor the status of fish stocks should be done with caution and with other indices of stock abundance, such as prerecruit survey data or total adult biomass indices.

## Total Recreational Catch

The estimated total number of fish caught by recreational fishermen in marine waters off the northeastern United States (Maine through Virginia) declined approximately 26% from 1986 to 1987. The total recreational catch declined from an estimated 220 million fish in 1986 to 162 million fish in 1987 (Table C).

The estimate of the proportion of the total catch released alive by marine anglers increased slightly, from 33% in 1986 to 35% of the catch in 1987. In 1985, an estimated 29% of the recreational catch was released alive.

## Principal Recreational Species

The recreational fishery off the northeast coast includes more than 50 species of finfish. A number of species not commonly thought of as principal game fish or food fish species are caught by recreational fishermen in large numbers. Examples of such species and the numbers caught in 1987 are: sea robins (5.9 million), cunner (3.1 million), toadfish (2.9 million), dogfish (1.6 million), and skates and rays (1.2 million). Since the catch of such species contributes to the success or enjoyment of the fishing trip for large numbers of recreationalists, they are an important part of the recreational fishery resource base.

Among the principal recreational species catches of scup and black sea bass, which had increased dramatically in 1986, declined in 1987 nearly to their 1985 catch

Table C. Principal species and total numbers caught (millions of fish) by recreational fishermen in marine waters off the northeastern United States in 1986 and 1987.

| | 1986 | | 1987 | | Total | |
|---|---|---|---|---|---|---|
| Species | New England | Mid-Atlantic | New England | Mid-Atlantic | 1986 | 1987 |
| Scup | 21.6 | 10.8 | 11.0 | 3.3 | 32.4 | 14.3 |
| Black sea bass | 1.0 | 30.3 | 0.4 | 5.6 | 31.3 | 6.1 |
| Bluefish | 10.7 | 18.4 | 8.1 | 20.5 | 29.4 | 28.6 |
| Summer flounder | 4.3 | 18.4 | 1.2 | 23.4 | 22.7 | 24.6 |
| Spot | 0 | 15.7 | 0 | 12.5 | 15.7 | 12.5 |
| Atlantic croaker | 0 | 13.0 | 0 | 7.8 | 13.0 | 7.8 |
| Weakfish | -[1] | 11.1 | - | 7.0 | 11.1 | 7.0 |
| Winter flounder | 5.4 | 5.0 | 6.6 | 7.8 | 10.4 | 14.4 |
| Tautog | 4.2 | 5.0 | 1.6 | 4 0 | 9.2 | 5.6 |
| Atlantic mackerel | 1.2 | 4.6 | 3.7 | 5.1 | 5.9 | 8.7 |
| Atlantic cod | 1.5 | 0.1 | 1.9 | 0.2 | 1.6 | 2.1 |
| Striped bass | 0.7 | 0.7 | 0.4 | 0.5 | 1.4 | 0.9 |
| Pollock | 0.4 | - | 0.7 | - | 0.5 | 0.7 |
| Whiting | - | 0.2 | 0 | 0.2 | 0.2 | 0.2 |

[1] Denotes less than 30,000 reported

levels. The catch of scup, which ranked first among the principal recreational species in 1986 at 32.4 million fish, declined by 18.1 million fish (56%), from 1986 to 1987. Similarly, the catch of black sea bass, which ranked second in 1986 at 31.3 million fish, declined by 25.2 million fish (81%) from 1986 to 1987. Other recreational catches that declined substantially from 1986 to 1987 are Atlantic croaker (5.2 million fish, or 40%), tautog (3.6 million fish, or 39%), weakfish (4.0 million fish, or 20%), and spot (3.2 million fish, or 20%). As with scup and black sea bass, catches of the four species declined in 1987 to near the numbers caught in 1985.

The catch of bluefish, which showed a substantial increase of 34% in 1986, changed relatively little from 1986 to 1987 (3% decline), and ranked first in 1987 with a catch of 28.6 million fish. The catch of winter flounder, which had declined 66% from 1985 to 1986, increased by 4 million fish, or 28%, from 1986 to 1987. Other principal species that showed a substantial increase in catch from 1986 to 1987 are Atlantic mackerel (2.8 million fish, or 32%), summer flounder (1.9 million fish, or 8%), Atlantic cod (0.5 million fish, or 24%), and pollock (0.2 million fish, or 29%).

## Recreational Fishing Effort

Recreational fishermen made an estimated 26.1 million fishing trips in marine waters off the northeastern United States in 1987. The number of trips in 1987 is below the 27.5 million mean of the annual estimates for 1979 to 1986, and represents a decline of 2.8 million trips, or 10% from 1986 to 1987.

## Reference

Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1986. Current Fishery Statistics Number 8392. National Marine Fisheries Service, Washington, D.C. September, 1987.

# COMMERCIAL FISHERY ECONOMIC TRENDS

## Northeast Region

The Northeast region's commercial oceanic and estuarine fisheries produced domestic landings worth $801 million in 1987, an increase in value of $107 million over that of 1986 landings. Excluding the industrial fisheries (menhaden for example), the total yield of all food fisheries was down 5,000 mt, with most of the reduction occurring in finfish landings which were off by 3%. Ex vessel payments for the 228 million metric tons of finfish, however, increased 20% to $291 million. Shellfish landings increased slightly to 169,000 mt bringing in $478 million, a 12 % increase in revenue for the year.

A total of 1,978 vessels of 5 or more gross registered tons (GRT) participated in one or more of the various ocean fisheries in the region, an increase of seventy vessels from 1986. The performance of vessels, grouped by predominant gear type, for the New England and Mid-Atlantic-Chesapeake areas is discussed next.

## New England

In 1987, otter trawl vessel landings were valued at $204.8 million, a 9% increase over the previous year (Table D). This is based on landings of 141,400 mt, a 4% decrease from 1986. The trend initiated in 1986 of decreasing revenues offset by increasing value maintained itself in 1987. Revenue per vessel rose 7% for the 927 vessels participating in the fishery. Landings per vessel continued to drop due to declining overall landings concurrent with the addition of 31 more participants using this gear (Table D). In 1987, sixty-six more vessels fished in the smallest class (5 to 50 GRT). The intermediate (51 to 150 GRT) and large (151 + GRT) classes had 21 and 14 fewer vessels, respectively (Figure B).

In the scallop dredge fishery, both revenues and landings increased over 1986 levels: revenues by 23% to $92.1 million, and landings by 56% to 81,200 mt. Reversing the established trend of decreasing fleet size, 17 more vessels joined the fleet in 1987. The revenue per vessel increased for all 3 vessel classes (Figure C).

The total of operating, maintenance and repair, labor and other fixed costs was relatively stable between 1986 and 1987, rising approximately four percent. Ex-vessel prices rose, in general, except for scallop meats (Table E), resulting in increased revenues per day at sea, even for vessels whose catches declined. Continuing the trend established in 1986, the financial picture was slightly better for the average otter trawler than in 1987, and considerably better for the average scallop dredge than it had been a year ago.

With the exception of sea scallops, ex-vessel prices and, consequently, consumer prices for the most important shellfish and finfish species in New England increased in 1987. Scallop meat prices exhibited a 16% decline, in part due to the very strong 56% increase in landings from 1986 to 1987 (Table E).

For the majority of the species, the revenues generated increased from 1986 to 1987, as price increases outweighed the decline in landings. The exceptions were yellowtail, haddock and redfish.

## Imports

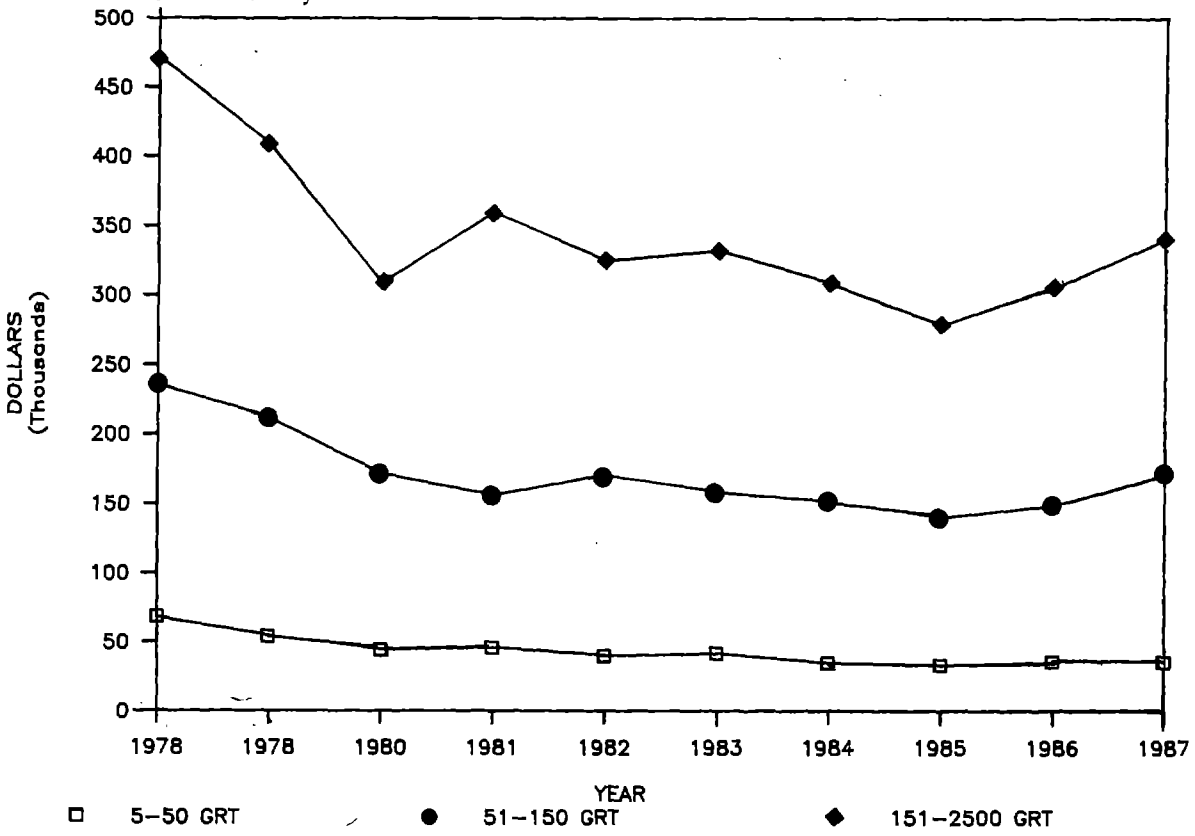
Imports of all forms of finfish (as expressed in live weight equivalent) to New England from Canada and all other sources increased 10% from 978 to 1,071 thousand mt in 1987 (Table F). Cod products (45%) dominated these finfish imports and Canadian cod accounted for 64% of that species' imports. The live weight equivalent of Canadian cod products sent to New England was roughly eleven times the live weight equivalent of New England cod landings. Imports of scallop meats increased slightly from both Canada and other sources to 8.6 thousand mt in 1987.

Table D. New England fleet landings and revenue 1978-1987: vessels of 5 gross tons or more. [1]

| Year | Number of Vessels | Total Revenue All Trips (millions of dollars) | Total Revenue All Trips (millions of dollars) (Deflated) | Total Landings All trips (1,000 mt) | Landings Per Vessel Primary Gear Only (mt) |
|---|---|---|---|---|---|
| | | **All Gears** | | | |
| 1978 | 919 | $161.5 | $161.5 | 285.0 | |
| 1979 | 1,153 | $194.9 | $175.2 | 294.2 | |
| 1980 | 1,316 | $212.0 | $167.9 | 328.2 | |
| 1981 | 1,364 | $242.9 | $174.2 | 317.1 | |
| 1982 | 1,377 | $261.7 | $176.8 | 380.8 | |
| 1983 | 1,624 | $314.4 | $205.9 | 378.0 | |
| 1984 | 1,425 | $286.6 | $180.0 | 355.7 | |
| 1985 | 1,362 | $264.8 | $160.3 | 302.3 | |
| 1986 | 1,255 | $285.3 | $169.8 | 275.3 | |
| 1987 | 1,334 | $324.2 | $186.2 | 277.6 | |
| | | **Otter Trawl** | | | |
| 1978 | 650 | $106.4 | $106.4 | 191.7 | 228.7 |
| 1979 | 779 | $121.5 | $109.3 | 193.5 | 199.4 |
| 1980 | 902 | $136.2 | $107.8 | 215.7 | 189.4 |
| 1981 | 922 | $156.5 | $112.3 | 209.5 | 181.4 |
| 1982 | 1,011 | $188.7 | $127.5 | 257.3 | 188.4 |
| 1983 | 997 | $200.4 | $131.2 | 230.9 | 187.7 |
| 1984 | 1,023 | $192.2 | $120.7 | 216.6 | 166.7 |
| 1985 | 973 | $180.6 | $109.3 | 177.9 | 148.1 |
| 1986 | 897 | $185.7 | $110.6 | 147.1 | 146.4 |
| 1987 | 927 | $204.8 | $117.6 | 141.4 | 120.9 |
| | | **Scallop Dredge Vessels** | | | |
| 1978 | 132 | $ 46.5 | $ 46.5 | 68.4 | 477.0 |
| 1979 | 201 | $ 61.6 | $ 55.4 | 71.5 | 322.0 |
| 1980 | 273 | $ 69.0 | $ 54.6 | 71.0 | 229.3 |
| 1981 | 292 | $ 91.1 | $ 65.3 | 94.7 | 252.2 |
| 1982 | 192 | $ 72.7 | $ 49.1 | 79.2 | 316.1 |
| 1983 | 221 | $ 99.2 | $ 65.0 | 76.6 | 264.3 |
| 1984 | 214 | $ 80.2 | $ 50.4 | 57.8 | 229.4 |
| 1985 | 171 | $ 61.1 | $ 37.0 | 47.7 | 260.2 |
| 1986 | 137 | $ 71.2 | $ 42.4 | 51.7 | 378.1 |
| 1987 | 154 | $ 92.1 | $ 52.9 | 81.2 | 508.4 |

[1] Landings and revenue figures are total annual amounts, regardless of port of sale, for all vessels of 5 GRT or more that sold at least one trip's catch in Maine, New Hampshire (1982 onward), Massachusetts, or Rhode Island. The deflated figures are used to compare revenue over several years and are expressed in 1978 dollars (CPI 1978 = 100).

Figure B. Deflated (adjusted) gross revenue per vessel by tonnage class or those vessels using otter trawl gear and landing the catch in a New England port at least once during the year. All revenue is included, regardless of gear used or where catches were sold. Revenue adjusted by the Consumer Price Index (CPI) with 1978 as the base year.




Total edible fishery products coming into New England from Canada were worth $996 million in 1987, an increase of $204 million over the 1986 figure. This accounted for 63% of the $1.6 billion of total New England imports in this category. The value of these Canadian imports was composed of finfish products worth $701 million (70%), lobster products worth $177 million (18%), scallop products valued at $73 million (7%), crab products at $29 million (3%), and other fish products (2%) worth $16 million.

The Northeast region as a whole imported a record $2.8 billion worth of edible fish products in 1987. The principal sources of these imports were Canada, $1,045 million (37%); Iceland, $233 million (8%); the European Economic Community, $282 million (10%); Norway, $166 million (6%); Japan, $88 million (3%); and South Korea, $110 million (4%).

Thirty six percent of the region's expenditures on edible fish imports was spent on shellfish products. Of significance to the region's fisheries were imports of 52,774 mt (live weight equivalent) of lobster worth $338 million, 5.8 thousand tons (live weight equivalent) of clam products worth $11.1 million and 15,509 mt (live weight equivalent) of crab products worth $45.5 million (Table G).

## Mid-Atlantic and Chesapeake

As in New England, the Mid-Atlantic and Chesapeake shellfish fisheries were responsible for a greater percentage of industry revenue than were those producing finfish. Finfish landings increased 14% between 1986 and 1987 to 40,000 mt, excluding menhaden. Their value increased 32% to $66 million. In contrast, shellfish landings remained relatively constant at 110,000 mts, but generated an additional $20 million above 1986's $171.4 million.

The most important ocean fisheries are carried out by vessels using surf clam and ocean quahog dredges, otter trawl nets and scallop dredges. There is also a small, but by volume of landings, significant menhaden fishery. Seasonal gear switching between otter trawl nets, scallop dredge gear and other gears is common on vessels in this area.

All vessels taken together experienced an increase in gross income of nearly 7%. Revenues increased in the otter trawl and scallop dredge fleets and dropped in the ocean quahog and surf clam fleet (Table H). The scallop dredge fleet generated the highest revenue in the area, followed by the otter trawl and surf clam and ocean quahog fleets, reversing previously established orders of importance.

Otter trawl receipts rose an average of 5% per vessel over the past year (Table H). Landings per vessel, however, continued their decline with a 9% drop. Landings and revenue generated by the scallop dredge fleet increased sharply (Table H) rising by 66% and 40% respectively over 1986 levels (Table I).

The decline in revenue in the surf clam and ocean quahog fishery continued. Revenues dropped 19% to $39.3 million, whereas landings remained approximately constant at 310,400 mt. The decline in revenue was mainly due to a 19% drop in the price of surf clam meats in the Chesapeake and New Jersey areas (Table J). All three vessel classes were equally affected (Figure D).

Surf clam and ocean quahog value, and nominal and deflated prices for the Northeast region are listed in Table J. Ocean quahog prices increased slightly in the Northern part of the region with very low revenue levels being generated. In the Southern part of the region prices and revenue remained approximately constant. Surf clam prices dropped moderately in the New England and New York areas and more substantially in the Chesapeake and New Jersey areas.

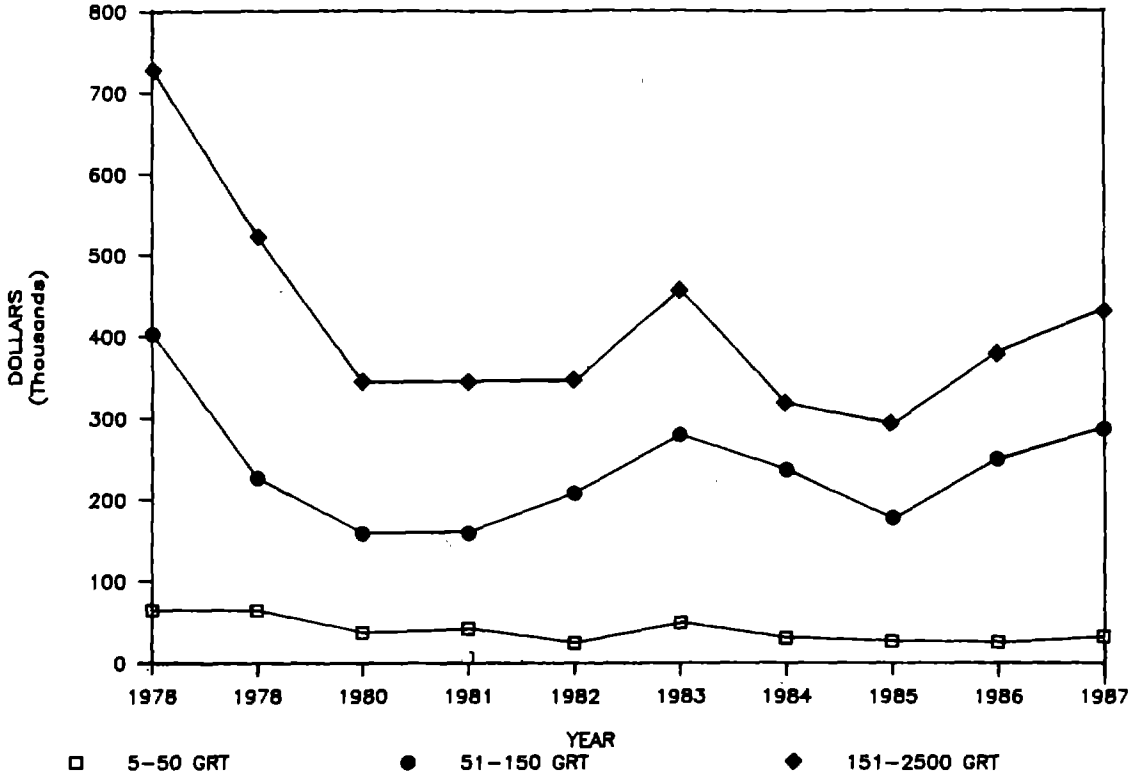



Figure C. Deflated (adjusted) gross revenue per vessel by tonnage class for vessels using scallop dredge gear and landing the catch in a New England port at least once during the year. All revenue is included, regardless of gear used or where the catches were sold. Revenue adjusted by the CPI, with 1978 as the base year.

Table E. New England landings, ex-vessel value and price of species of major importance, 1978-1987.

| Year | 1,000 mt | millions of dollars | $/lb | 1,000 mt | millions of dollars | $/lb | 1,000 mt | millions of dollars | $/lb |
|---|---|---|---|---|---|---|---|---|---|
| | | Lobster | | | Scallop Meats | | | Cod | |
| 1978 | 14.9 | $ 61.1 | $1.86 | 7.9 | $44.3 | $2.53 | 39.0 | $21.3 | $0.25 |
| 1979 | 16.1 | $ 68.4 | $1.92 | 7.4 | $55.2 | $3.39 | 44.1 | $28.2 | $0.29 |
| 1980 | 16.1 | $ 71.8 | $2.02 | 7.7 | $65.5 | $3.85 | 53.6 | $31.9 | $0.30 |
| 1981 | 16.3 | $ 82.1 | $2.29 | 8.8 | $79.4 | $4.06 | 45.3 | $32.8 | $0.33 |
| 1982 | 16.9 | $ 85.0 | $2.28 | 7.2 | $57.2 | $3.61 | 47.2 | $37.1 | $0.36 |
| 1983 | 19.1 | $100.7 | $2.39 | 6.3 | $77.9 | $5.57 | 50.7 | $37.5 | $0.34 |
| 1984 | 18.8 | $107.0 | $2.58 | 5.0 | $62.5 | $5.63 | 43.5 | $35.6 | $0.37 |
| 1985 | 19.0 | $102.4 | $2.44 | 4.6 | $50.0 | $4.90 | 37.3 | $34.7 | $0.42 |
| 1986 | 19.6 | $112.2 | $2.59 | 5.2 | $60.0 | $5.28 | 27.5 | $35.7 | $0.59 |
| 1987 | 19.4 | $124.5 | $2.91 | 8.2 | $80.6 | $4.43 | 26.6 | $43.7 | $0.75 |
| | | Yellowtail | | | Winter Flounder | | | Pollock | |
| 1978 | 11.2 | $ 14.9 | $0.61 | 10.7 | $10.4 | $0.44 | 17.7 | $ 6.6 | $0.17 |
| 1979 | 15.5 | $ 17.3 | $0.51 | 11.4 | $9.3 | $0.40 | 15.5 | $ 6.6 | $0.19 |
| 1980 | 18.4 | $ 19.1 | $0.47 | 15.5 | $12.0 | $0.35 | 18.0 | $ 7.2 | $0.18 |
| 1981 | 14.4 | $ 15.8 | $0.50 | 17.4 | $16.2 | $0.42 | 16.9 | $ 8.5 | $0.23 |
| 1982 | 20.1 | $ 24.5 | $0.55 | 13.7 | $14.5 | $0.48 | 14.2 | $ 7.0 | $0.22 |
| 1983 | 31.4 | $ 33.8 | $0.49 | 14.1 | $15.2 | $0.49 | 14.0 | $ 5.4 | $0.17 |
| 1984 | 16.4 | $ 26.4 | $0.73 | 13.5 | $20.2 | $0.68 | 17.9 | $ 6.4 | $0.16 |
| 1985 | 10.7 | $ 19.6 | $0.83 | 9.7 | $18.5 | $0.86 | 19.7 | $ 7.0 | $0.16 |
| 1986 | 10.1 | $ 20.5 | $0.92 | 7.2 | $16.0 | $1.01 | 24.7 | $14.0 | $0.26 |
| 1987 | 7.4 | $ 20.4 | $1.25 | 8.1 | $21.6 | $1.21 | 20.7 | $17.9 | $0.39 |
| | | Fluke | | | Haddock | | | Shrimp | |
| 1978 | 2.1 | $ 3.6 | $0.77 | 17.9 | $12.7 | $0.32 | -.- | $ -.- | $ -.-- |
| 1979 | 1.9 | $ 3.1 | $0.73 | 19.0 | $17.7 | $0.42 | 0.5 | $ 0.3 | $0.32 |
| 1980 | 0.7 | $ 1.5 | $0.91 | 25.0 | $21.4 | $0.39 | 0.3 | $ 0.5 | $0.65 |
| 1981 | 1.7 | $ 3.6 | $0.94 | 25.0 | $22.0 | $0.40 | 1.0 | $ 1.4 | $0.63 |
| 1982 | 3.0 | $ 5.5 | $0.81 | 20.3 | $22.0 | $0.50 | 1.5 | $ 2.0 | $0.59 |
| 1983 | 3.2 | $ 6.1 | $0.86 | 14.8 | $19.0 | $0.58 | 1.6 | $ 2.3 | $0.67 |
| 1984 | 2.8 | $ 6.3 | $1.03 | 11.8 | $18.4 | $0.71 | 3.2 | $ 3.5 | $0.49 |
| 1985 | 4.5 | $ 10.5 | $1.06 | 6.5 | $13.5 | $0.94 | 4.2 | $ 4.0 | $0.44 |
| 1986 | 4.6 | $ 13.1 | $1.30 | 5.0 | $10.9 | $0.99 | 4.7 | $ 6.5 | $0.63 |
| 1987 | 3.9 | $ 14.3 | $1.64 | 3.0 | $ 8.5 | $1.28 | 5.0 | $12.2 | $1.10 |
| | | Whiting | | | White Hake | | | Redfish | |
| 1978 | 15.9 | $ 4.7 | $0.13 | 4.9 | $ 1.7 | $0.16 | 16.1 | $ 6.1 | $0.17 |
| 1979 | 7.3 | $ 2.8 | $0.17 | 4.0 | $ 1.5 | $0.17 | 15.4 | $ 7.2 | $0.21 |
| 1980 | 7.9 | $ 3.0 | $0.17 | 4.7 | $ 1.7 | $0.17 | 11.0 | $ 5.6 | $0.23 |
| 1981 | 9.2 | $ 3.9 | $0.19 | 5.5 | $ 2.3 | $0.19 | 8.4 | $ 5.3 | $0.28 |
| 1982 | 10.9 | $ 4.6 | $0.19 | 6.2 | $ 2.4 | $0.18 | 8.5 | $ 5.2 | $0.27 |
| 1983 | 11.7 | $ 3.8 | $0.15 | 6.4 | $ 2.2 | $0.19 | 6.0 | $ 3.5 | $0.26 |
| 1984 | 15.0 | $ 4.2 | $0.13 | 6.8 | $ 2.6 | $0.17 | 5.6 | $ 3.6 | $0.29 |
| 1985 | 14.1 | $ 5.4 | $0.17 | 7.4 | $ 3.3 | $0.21 | 4.4 | $ 3.2 | $0.33 |
| 1986 | 14.2 | $ 5.9 | $0.19 | 6.6 | $ 4.9 | $0.34 | 3.0 | $ 3.2 | $0.48 |
| 1987 | 11.7 | $ 7.4 | $0.29 | 6.1 | $ 5.5 | $0.41 | 1.9 | $ 2.7 | $0.64 |

Table F. New England imports of selected fishery products from Canada and all other sources, 1978-1987 ( 1,000 mt).[1]

| Year | Cod | | Other Groundfish | | Flatfish | | Total Finfish | | Scallops | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Canada | Other | Canada | Other | Canada | Other | Canada | Other | Canada | Other |
| 1978 | 151 | 284 | 93 | 151 | 87 | 39 | 10.7 | 0.7 | 331 | 474 |
| 1979 | 204 | 229 | 92 | 153 | 88 | 28 | 8.3 | 0.8 | 384 | 410 |
| 1980 | 199 | 161 | 72 | 115 | 71 | 9 | 6.6 | 1.0 | 342 | 285 |
| 1981 | 233 | 157 | 114 | 109 | 96 | 7 | 8.4 | 1.3 | 443 | 273 |
| 1982 | 154 | 157 | 105 | 138 | 72 | 14 | 6.6 | 1.1 | 431 | 309 |
| 1983 | 290 | 193 | 865 | 136 | 60 | 8 | 5.9 | 2.0 | 436 | 337 |
| 1984 | 279 | 195 | 93 | 122 | 68 | 16 | 3.8 | 3.4 | 440 | 333 |
| 1985 | 276 | 189 | 97 | 117 | 67 | 26 | 5.1 | 1.9 | 440 | 332 |
| 1986 | 302 | 190 | 101 | 115 | 63 | 20 | 5.8 | 2.1 | 465 | 325 |
| 1987 | 309 | 173 | 109 | 114 | 73 | 20 | 6.6 | 2.0 | 491 | 307 |

[1] Product forms include whole fresh, whole frozen, frozen blocks, and fresh and frozen fillets. Groundfish are cusk, hake, haddock, pollock, and ocean perch. Flatfish include halibut. Finfish weights are expressed in live weight equivalents and scallops in meat weight.

Table G. Northeast region imports of selected fishery products from all sources, 1978-1987. [1]

| Year | Lobster products | | | | Clam Products | | Crab Products | |
|---|---|---|---|---|---|---|---|---|
| | Live (Quantity) | Other (Quantity) | Total (1,000 mt) | Value (millions of dollars) | Quantity (1,000 mt) | Value (millions of dollars) | Quantity (1,000 mt) | Value (millions of dollars) |
| 1978 | 5.5 | 43.1 | 48.6 | 175.3 | 1.3 | 1.8 | 12.6 | 20.6 |
| 1979 | 6.5 | 41.6 | 48.1 | 182.4 | 1.1 | 1.8 | 10.7 | 16.7 |
| 1980 | 5.4 | 32.3 | 37.7 | 156.5 | 2.3 | 3.7 | 9.8 | 16.9 |
| 1981 | 7.1 | 34.6 | 41.7 | 197.8 | 5.0 | 6.1 | 20.2 | 34.2 |
| 1982 | 7.7 | 32.5 | 40.2 | 204.8 | 7.3 | 8.9 | 26.4 | 57.4 |
| 1983 | 9.2 | 33.3 | 42.5 | 202.9 | 6.7 | 8.7 | 28.2 | 71.8 |
| 1984 | 10.6 | 39.7 | 50.3 | 250.4 | 5.7 | 9.6 | 24.3 | 48.4 |
| 1985 | 12.2 | 36.1 | 48.3 | 246.7 | 6.2 | 11.4 | 27.8 | 53.2 |
| 1986 | 13.1 | 35.8 | 48.9 | 252.5 | 6.6 | 13.1 | 24.7 | 63.7 |
| 1987 | 14.0 | 38.8 | 52.8 | 330.1 | 5.8 | 11.2 | 15.5 | 45.4 |

[1] Lobster quantities are live weight equivalent and include lobsters in airtight containers, rock lobster tails, and other products. Clam and crab products expressed in live weight equivalents.

Table H. Mid-Atlantic and Chesapeake landings and revenue 1978-1987: vessels of 5 gross registered tons or more. [1]

| Year | No. of Vessels | Revenue | Deflated Revenue[2] | Landings | No. of Vessels | Revenue | Deflated Revenue[2] | Landings |
|---|---|---|---|---|---|---|---|---|
| | | (millions of dollars) | (millions of dollars) | (1,000 mt) | | (millions of dollars) | (millions of dollars) | (1,000mt) |
| | | **All Vessels, All Gears** | | | **Surf Clam and Quahog Vessels** | | | |
| 1978 | 392 | $ 47.5 | $47.5 | 47.5 | 96 | $12.6 | $12.6 | 42.1 |
| 1979 | 478 | $ 53.6 | $48.2 | 48.2 | 90 | $14.0 | $12.6 | 40.6 |
| 1980 | 441 | $ 49.0 | $38.8 | 38.8 | 64 | $12.1 | $ 9.6 | 106.7 |
| 1981 | 598 | $ 66.8 | $47.9 | 47.9 | 135 | $21.3 | $15.3 | 152.4 |
| 1982 | 586 | $ 88.2 | $59.6 | 288.3 | 134 | $37.4 | $25.2 | 232.4 |
| 1983 | 654 | $116.5 | $76.3 | 313.7 | 128 | $33.0 | $21.6 | 241.5 |
| 1984 | 663 | $124.5 | $78.2 | 368.2 | 139 | $46.3 | $29.0 | 295.8 |
| 1985 | 619 | $106.6 | $64.5 | 370.9 | 139 | $48.6 | $29.4 | 322.3 |
| 1986 | 653 | $121.1 | $72.1 | 369.9 | 143 | $48.4 | $28.8 | 311.8 |
| 1987 | 644 | $129.2 | $74.2 | 384.1 | 137 | $39.3 | $22.6 | 310.4 |
| | | **Otter Trawl Vessels** | | | **Scallop Dredge Vessels** | | | |
| 1978 | 146 | $ 13.2 | $13.2 | 21.5 | 75 | $16.4 | $16.4 | 25.6 |
| 1979 | 177 | $ 16.9 | $15.2 | 25.3 | 124 | $22.0 | $19.8 | 26.0 |
| 1980 | 166 | $ 15.2 | $12.0 | 23.9 | 130 | $21.5 | $17.0 | 23.2 |
| 1981 | 225 | $ 19.5 | $14.0 | 25.6 | 134 | $23.0 | $16.5 | 23.5 |
| 1982 | 244 | $ 28.0 | $18.9 | 40.0 | 84 | $22.2 | $15.0 | 22.9 |
| 1983 | 274 | $ 40.4 | $26.4 | 42.2 | 122 | $46.6 | $30.5 | 35.6 |
| 1984 | 292 | $ 37.0 | $23.2 | 50.1 | 123 | $42.3 | $26.6 | 36.0 |
| 1985 | 266 | $ 28.0 | $16.9 | 29.0 | 93 | $29.9 | $18.1 | 25.5 |
| 1986 | 289 | $ 37.5 | $22.3 | 40.2 | 93 | $35.9 | $21.4 | 28.9 |
| 1987 | 295 | $ 40.3 | $23.1 | 37.5 | 99 | $50.3 | $28.9 | 47.9 |

[1] Landings and revenue figures are total annual amounts, regardless of port of sale, for all vessels of 5 GRT or more which sold at least one trip's catch in New York (1986 onward), New Jersey, Maryland (September 1981 onward) or Virginia (September 1981 onward). The deflated figures are used to compare revenue over several years and are expressed in 1978 dollars (CPI 1978 = 100).

[2] 1978 dollars

Table I. Mid-Atlantic and Chesapeake landings. Ex vessel value and price of species of major importance 1978-1987.

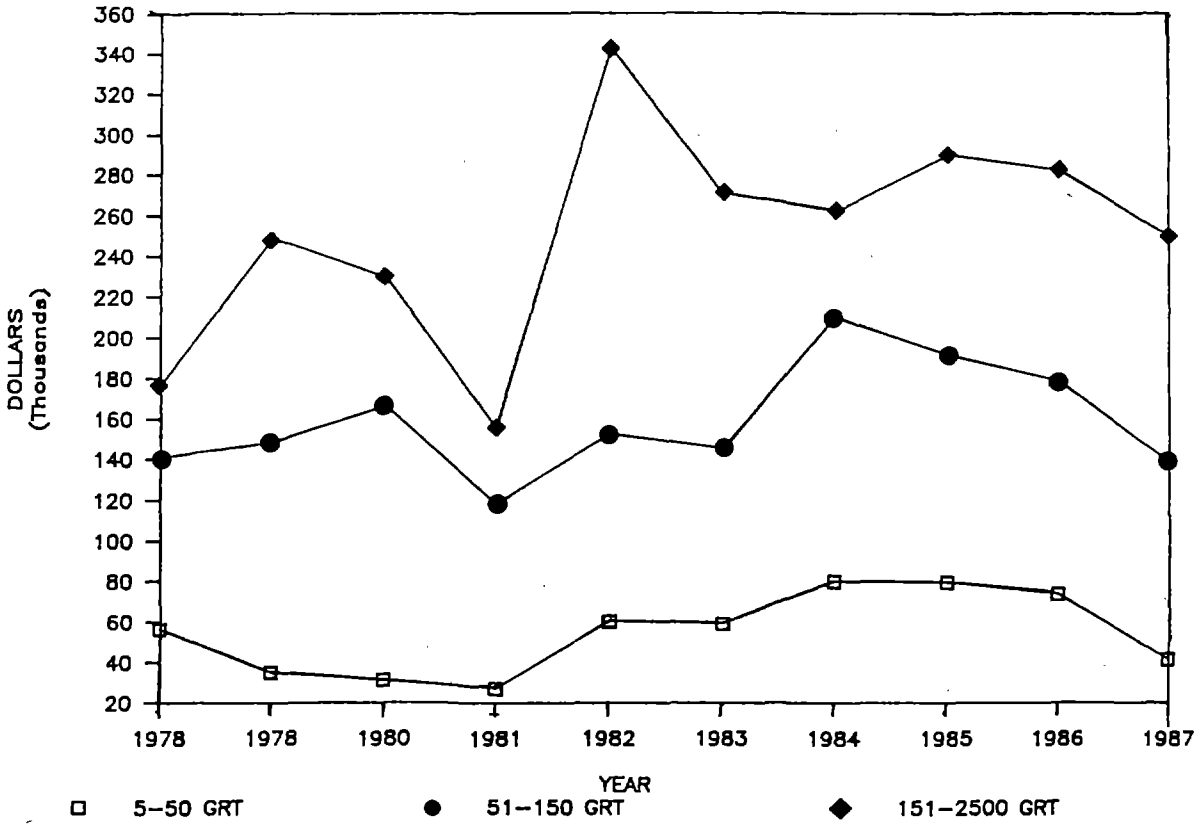
| Year | 1,000 mt | Millions of Dollars | $/lb | 1,000 mt | Millions of dollars | $/lb | 1,000 mt | Millions of dollars | $/lb |
|---|---|---|---|---|---|---|---|---|---|
| | **Scallop Meats** | | | **Fluke** | | | **Tilefish** | | |
| 1978 | 5.8 | $31.0 | $3.20 | 6.3 | $ 8.2 | $0.58 | 2.9 | $3.4 | $0.54 |
| 1979 | 6.1 | $43.7 | $3.20 | 8.8 | $10.2 | $0.53 | 3.2 | $4.3 | $0.60 |
| 1980 | 4.7 | $40.0 | $3.89 | 7.2 | $ 8.4 | $0.53 | 3.5 | $5.9 | $0.77 |
| 1981 | 2.7 | $24.2 | $4.09 | 4.6 | $ 6.9 | $0.68 | 3.1 | $6.2 | $0.92 |
| 1982 | 1.8 | $15.7 | $3.93 | 4.9 | $ 7.9 | $0.72 | 1.9 | $4.1 | $1.01 |
| 1983 | 2.6 | $31.7 | $5.63 | 7.0 | $ 9.8 | $0.64 | 1.8 | $4.4 | $1.12 |
| 1984 | 2.1 | $31.6 | $5.35 | 8.7 | $12.5 | $0.65 | 1.9 | $4.3 | $1.02 |
| 1985 | 2.1 | $21.9 | $4.64 | 6.2 | $12.8 | $0.93 | 1.7 | $4.4 | $1.21 |
| 1986 | 3.0 | $29.3 | $4.46 | 4.9 | $13.1 | $1.19 | 1.8 | $4.7 | $1.10 |
| 1987 | 4.9 | $42.3 | $3.88 | 6.1 | $17.9 | $1.34 | 2.9 | $7.4 | $1.14 |

Table J. Northeast region surf clam and ocean quahog meats: value, price (P) and deflated price (p), 1978-1987.

| | New England and New York | | | | | | Chesapeake and New Jersey | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0 - 3 miles) | | | (3 - 200 miles) | | | (0 - 3 miles) | | | (3 - 200 miles) | | |
| Year | Millions of dollars | P | p | Millions of dollars | P | p | Millions of dollars | P | p | Millions of dollars | P | p |
| **Surf Clam Meats** | | | | | | | | | | | | |
| 1978 | 1.3 | 0.37 | 0.37 | - | - | - | 1.7 | 0.35 | 0.35 | 18.1 | 0.58 | 0.57 |
| 1979 | 1.1 | 0.48 | 0.43 | * | 0.47 | 0.43 | 1.2 | 0.34 | 0.30 | 16.9 | 0.59 | 0.53 |
| 1980 | 1.0 | 0.42 | 0.33 | - | - | - | 0.3 | 0.35 | 0.28 | 17.9 | 0.52 | 0.41 |
| 1981 | 1.1 | 0.39 | 0.28 | - | - | - | 2.0 | 0.34 | 0.24 | 20.4 | 0.55 | 0.39 |
| 1982 | 2.6 | 0.49 | 0.33 | - | - | - | 2.4 | 0.32 | 0.22 | 20.9 | 0.57 | 0.38 |
| 1983 | 1.6 | 0.47 | 0.31 | 1.4 | 0.48 | 0.32 | 2.5 | 0.33 | 0.22 | 19.4 | 0.46 | 0.30 |
| 1984 | 1.3 | 0.44 | 0.27 | 3.3 | 0.43 | 0.27 | 5.6 | 0.45 | 0.28 | 24.1 | 0.51 | 0.32 |
| 1985 | 4.5 | 0.45 | 0.27 | 3.7 | 0.52 | 0.31 | 5.4 | 0.51 | 0.31 | 25.3 | 0.52 | 0.32 |
| 1986 | 5.4 | 0.41 | 0.24 | 3.1 | 0.52 | 0.31 | 5.5 | 0.54 | 0.32 | 27.2 | 0.58 | 0.35 |
| 1987 | 1.6 | 0.40 | 0.23 | 2.2 | 0.48 | 0.28 | 3.4 | 0.43 | 0.25 | 20.8 | 0.47 | 0.27 |
| **Ocean Quahog Meats** | | | | | | | | | | | | |
| 1978 | 0.8 | 0.29 | 0.29 | * | 0.30 | 0.30 | - | - | - | 5.9 | 0.29 | 0.29 |
| 1979 | 1.0 | 0.31 | 0.28 | * | 0.29 | 0.26 | - | - | - | 9.3 | 0.29 | 0.26 |
| 1980 | 1.0 | 0.31 | 0.24 | 0.1 | 0.33 | 0.26 | - | - | - | 9.1 | 0.30 | 0.22 |
| 1981 | 0.2 | 0.19 | 0.14 | 1.1 | 0.19 | 0.14 | - | - | - | 8.9 | 0.30 | 0.22 |
| 1982 | 0.2 | 0.38 | 0.26 | 1.2 | 0.38 | 0.26 | - | - | - | 9.5 | 0.30 | 0.21 |
| 1983 | 0.6 | 0.36 | 0.23 | 0.7 | 0.35 | 0.23 | - | - | - | 9.6 | 0.30 | 0.20 |
| 1984 | 0.9 | 0.36 | 0.22 | 0.2 | 0.35 | 0.22 | - | - | - | 10.7 | 0.30 | 0.19 |
| 1985 | - | - | - | 0.1 | 0.35 | 0.21 | - | - | - | 12.7 | 0.30 | 0.18 |
| 1986 | - | - | - | * | 0.31 | 0.18 | - | - | - | 10.8 | 0.30 | 0.18 |
| 1987 | - | - | - | 0.1 | 0.35 | 0.20 | - | - | - | 10.6 | 0.29 | 0.17 |

[1] Deflated price (p) is the actual price paid (P) which has been adjusted downward for inflation using the consumer price index with 1978 = 100. A (*) indicates that revenue is less than .1 million dollars.

Figure D. Deflated (adjusted) gross revenue per vessel by tonnage class for those vessels using surf clam and ocean quahog gear and landing the catch in a Mid-Atlantic or Chesapeake port at least once during the year. All revenue, regardless of whatever gear was used or wherever catches were sold, is included. Revenue adjusted by the Consumer Price Index (CPI) with 1978 as the base year.




# SUMMARY STATUS OF THE FISHERY RESOURCES

## Groundfish

**Atlantic cod.** The nominal 1987 commercial catch from the Gulf of Maine cod stock was 8,000 mt, the lowest since 1974. The United States' catch in 1987 (7,500 mt) was nearly 2,200 mt less than in 1986 and the lowest since 1973. The United States' commercial fishing effort was record high in 1987 while CPUE declined to a record low. The 1987 catch was dominated by the 1984 and 1983 year classes; together these cohorts accounted for 73% of the commercial catch by number and 62% by weight. Research vessel survey indices in 1987 were among the lowest ever recorded; both the spring and autumn 1987 survey biomass indices (weight per tow values) were the lowest in their respective survey time series. Recruitment of the 1985 and 1987 year classes appears strong, while the 1986 year class appears slightly above average. Record high fishing effort and record low CPUE and survey values imply that fishing mortality attained a record high level in 1987. The Gulf of Maine stock is currently depressed. Prospects for stock recovery are poor for 1988 and 1989 and will diminish further if fishing mortality is not reduced.

Total nominal 1987 commercial catch from the Georges Bank and South cod stock was 31,000 mt, 19% higher than in 1986, but still the second lowest annual total since 1977. The 1987 USA catch (19,000 mt) was 9% greater than in 1986 but far below the 1980-85 average annual catch of 35,000 mt. Canadian landings in 1987 totaled 11,900 mt, a 39% increase from 1986, and the highest Canadian catch since 1983. USA fishing effort for cod increased in 1987 and was only slightly below the record high levels attained in 1984-85. United States CPUE values declined for the fifth consecutive year in 1987 and were the lowest on record.

The USA commercial catch in 1987 was dominated by the strong 1985 year class, which accounted for 64% of the catch by number and 36% by weight. Spring and autumn 1987 survey abundance indices declined from 1986 and were among the lowest in the survey time series; the autumn number-per-tow index was the lowest since 1983, while the autumn indices of spawning stock size (numbers and biomass) were the second lowest ever. Recruitment from the 1986 year class presently appears to be below average, while recruitment of the 1987 year class appears strong. Fishing mortality increased in 1987 and is estimated to be greater than F= 0.60, and perhaps as high as F= 0.90. The latter value would represent a record high F on the stock. If the current level of fishing mortality continues, it will impede the spawning stock's attempts to rebuild from its present low level.

**Haddock**. The nominal commercial and recreational catch in the Gulf of Maine averaged 6,800 mt from 1981 to 1983, but dropped to only 1,800 mt in 1986 and further to 829 mt in 1987. Research vessel surveys indicated that the 1979, 1980 and 1982 year classes were relatively strong, but information from 1987 suggests that these cohorts have been much reduced by fishing and that stock biomass is low. The Georges Bank catch was 6,100 mt in 1987. The USA portion of the Georges Bank haddock catch was only 2,200 mt, a record low catch from this stock by USA fishermen. The 1983 year class is currently supporting the fishery since all year classes between 1979 and 1982 were very poor. The 1985 year class is probably stronger than any since 1983, but the stock will probably decline further in 1988.

**Redfish**. The nominal catch of 1,900 mt in 1987 was the lowest since the fishery began in the early 1930s. Stock biomass has declined by more than 80% since the late 1960s and commercial and research vessel survey indices suggest a continuing downward trend in recent years. The fishery continues to strongly depend on recruitment. Since recruitment prospects are poor, declines in stock biomass are expected to continue. Current fishing mortality levels are slightly above $F_{0.1}$.

**Silver hake**. Nominal catches in the Gulf of Maine - Middle Atlantic area totaled about 15,600 mt in 1987: 5,700 mt from the Gulf of Maine - northern Georges Bank stock, and 9,900 mt from the southern Georges Bank-Middle Atlantic stock. Catches (8,500 mt) in 1986 from the northern stock continued to be the highest since 1978, but are still well below past levels. In the southern area, the 1984 catch was the lowest reported since 1960. Preliminary estimates of stock biomass at the beginning of 1988 for silver hake are 41,000 mt and 72,000 mt for northern and southern stock respectively. While survey indices have remained fairly steady or declined slightly during the past few years, very little fishing pressure has been exerted on the stocks. Current fishing mortality is assumed to be well below $F_{0.1}$ in all areas. There is potential for increased catches in all areas.

**Red hake**. Nominal catches totaled only 1,900 mt in 1987, continuing a series of very low catches reported since about 1978. Catches were 1,000 mt in the Gulf of Maine - northern Georges Bank and 900 mt in southern Georges Bank - Middle Atlantic areas. Survey indices have remained fairly steady or have increased slightly in recent years. Current fishing mortality is assumed to be well below $F_{0.1}$ and there is potential for increased catches in all areas.

**Pollock.** Nominal catches from the Scotian Shelf, Gulf of Maine, and Georges Bank region totaled 66,700 mt in 1987, a slight decline from the record high level of 69,600 mt taken in 1986. USA landings also declined from 24,200 mt in 1986 to 20,400 mt in 1987. Recent stock biomass levels have declined sharply from 298,000 mt in 1984 to 150,000 mt in 1987. Fishing mortality has exceeded $F_{max}$ in recent years. The 1982 year class, which was almost fully recruited to the fishery in 1987, is dominant in the stock in terms of both numbers and biomass. Future recruitment prospects, however, are slight.

**Yellowtail flounder.** Nominal landings for 1987 (preliminary) totaled 6,000 mt for the Georges Bank and the Southern New England, Cape Cod, Mid-Atlantic management units (5Z E & W of 69°W, respectively), a 25% decrease from the 1986 value. Catch per unit effort (CPUE) values for all U.S. fisheries remain among the lowest in the time series. Southern New England and Cape Cod CPUE values have further declined; Georges Bank, however, shows a marginal increase. Research survey indices are among the lowest in their respective time series, with the exception of the 1987 spring survey of Cape Cod, which had the highest values in its time series. The 1984 year class was not a strong one, but continues to be the major support of this fishery. Fishing mortality remains substantially above $F_{max}$.

**Summer flounder.** Nominal catches were 9,500 mt in 1987, 13% lower than the 1980-86 average, and 34% below the 1979 peak of 14,500 mt. Estimated recreational catches have comprised from 26 to 77% of the total catch from 1979 to 1986. Stock biomass has been at a higher level in the last eight to ten years than between the late 1960s and early 1970s, but has fluctuated considerably in the past decade. Current estimates of fishing mortality exceed $F_{max}$.

**American plaice.** Nominal catches in 1987 were 3,800 mt, 15% less than in 1986, and the lowest since 1976. Stock biomass has declined to its lowest level since the mid-1970s. Fishing mortality is currently too high to sustain the present level of catch.

**Witch flounder.** Nominal catches increased from 1,900 mt in 1976 to 6,500 mt in 1984, the highest ever, but declined to 3,400 in 1987. Stock biomass, after declining steadily since 1977, increased in 1983 and 1984 but declined to its lowest recorded levels in 1987. There is some evidence that current levels of exploitation are adversely affecting the resource, and historical trends seem to preclude sustainable harvests greater than 6,000 mt.

**Winter flounder.** Nominal commercial catches in 1987 were 9,100 mt, 17% higher than they were in 1986, but still 50% less than the peak recorded in 1981. Recreational catches were estimated to be about 4,800 mt in 1987. This level, while an increase over 1986 was also well below average catches during the early 1980s. Overall abundance indices continued at low levels in 1987 indicating that catches will remain at low levels during 1988.

**Scup.** Nominal commercial and recreational catches decreased to 9,300 mt in 1987, 18% below the 1979-86 mean. The stock biomass index in the Southern New England - Mid-Atlantic area has decreased from a high level in 1981. The index has fluctuated considerably since 1979, declining sharply from 1985 to the lowest level of the time series. The stock, particularly in the Mid-Atlantic area, appears to be fully exploited.

**Ocean pout.** Stock biomass rose dramatically in 1980 and has since fluctuated around historic peak levels, although a sharp decline was observed in 1987. Nominal catches increased to 2,200 mt, 36% higher than in 1986, and the highest annual total since 1974.

**White hake.** Nominal catches have increased steadily since 1968, reaching a peak of 7,500 mt in 1984. The 1987 catch declined to 6,200 mt. Except for 1982, stock biomass has remained relatively constant since 1981.

**Cusk.** Nominal catches in 1987 were 1,600 mt, 16% less than in 1986. Stock biomass indices, while fluctuating considerably, declined in 1986 and again in 1987.

**Atlantic wolffish.** Nominal catches increased steadily, from 200 mt in 1970 to a peak of 1,300 mt in 1983, and decreased to 800 mt in 1987, representing a 20% decline from 1986. Stock biomass indices, while fluctuating considerably, have generally exhibited a declining trend since the 1970s.

## Pelagics

**Atlantic herring.** Nominal catches for Gulf of Maine herring in 1987 were 39,200 mt, a 25% increase over 1986 and the highest level since 1981. Coastal Maine catches increased 27% from 1986 to 1987, with 19,700 mt landed. Western Gulf of Maine catches (primarily adults on Jeffrey's Ledge) were 19,500 mt, a 24% increase over 1986. Stock biomass (ages 2 and older) in the Gulf of Maine was estimated to be about 170,000 mt in 1987, continuing a steady increase from a record low level of only 49,500 mt in 1982. Herring on Georges Bank, while showing signs of recovery based on U.S. and Canadian bottom trawl surveys during 1984-87, has not supported a fishery since its collapse in 1977.

**Atlantic mackerel.** Nominal commercial and recreational catches for this stock were 75,100 mt in 1987. The USA commercial catch has increased slowly every year since 1970, reaching 12,300 mt in 1987. Fishing mortality remained stable from 1977 to 1986 at a level much lower than $F_{0.1}$. The stock underwent rapid increases in numbers and biomass with recruitment of the strong 1981 and 1982 year classes. Total stock biomass increased from about 480,000 in 1980 to 1.5 million mt in 1987. The 1984 year class also appears to be strong.

**Butterfish.** Nominal total catch declined slightly from 4,800 mt in 1986 to 4,700 mt in 1987. The distant water fleet nominal catch was less than 1 mt in 1987. Stock abundance is currently about 30% below the long-term average. The high discard rates observed during the past several years eased considerably due to a new market category, "SSS", for small butterfish and a good bait market for fish that were previously being discarded.

**Bluefish.** Nominal total catch increased from an estimated 51,200 mt in 1985 to an estimated 65,700 mt in 1986, and then declined to about 52,900 mt in 1987. Commercial catch rose slightly, from 6,200 mt in 1985 to 6,300 mt in 1986 and 6,900 mt in 1987. Recreational catch, which continues to account for about 90% of the total catch, rose from an estimated 45,000 mt in 1985 to 59,400 mt in 1986, declining to about 46,000 mt in 1987. Recreational fishery CPUE indices by weight and numbers peaked in 1981 at 2.72 kg/trip (1.49 fish/trip), and since then have trended downward to 1.30 kg/trip (0.94 fish/trip) in 1987 (preliminary estimate).

## Other Finfish

**River herring.** Nominal catches in 1987 were about 4,100 mt, about equal to 3,900 mt in 1986. Catches have steadily declined from an annual average of 24,800 mt during 1963-69. Stock biomass has been depressed at a fairly stable low level since the late 1960s, although some increase has been evident in the Mid-Atlantic area since the mid-1970s.

**American shad.** Nominal commercial catches declined steadily from around 2,500 mt in the 1960s to about 900 mt in 1976 and has since averaged 900 mt per year.

Recreational catches, although unknown, are considered to be low at the present time. Excessive fishing, dams, and pollution have been blamed for the decline of American shad in most rivers. Restoration efforts currently underway in several areas are beginning to experience modest success.

**Black sea bass.** Nominal commercial catches in 1987 were 1,800 mt, the same level as 1986 commercial landings. Recreational catches in 1987 were 1,000 mt, well below the 1986 landings of 6,300 mt. Commercial landings have remained fairly stable for the past 10 years while the recreational catches were dramatically higher in 1982 and 1986. It appears that the stock is fully exploited.

**Striped bass.** Nominal commercial catches in 1987 were only 200 mt, due primarily to regulatory restrictions designed to rebuild the Chesapeake Bay spawning stocks. Although the abundance of young striped bass has increased dramatically since the early 1980s, many of the females are not yet mature. Recruitment in Virginia tributaries to Chesapeake Bay was very high in 1987, however juvenile production in Maryland waters remains very low.

**Spiny dogfish.** Nominal catches in 1987 were 2,600 mt, which is equal to 1986 levels. Minimum biomass estimated from NEFC spring survey catches increased 140% from 269,000 mt in 1986 to 647,000 mt in 1987, 156% above the long-term average (252,000 mt). Since dogfish school and are highly migratory, there tends to be rather high variability among the random survey catches, resulting in large fluctuations in the annual biomass estimates.

**Skates.** Nominal catches were 5,100 mt in 1987. Skates are taken principally as by-catch in groundfish fisheries, and both the domestic and export markets are limited. Minimum biomass estimates from survey data of all skates combined was 188,400 mt in 1987, which was 51% greater than the 1968-86 average of 124,400 mt. The increase is attributable to large catches of winter skate on Georges Bank.

## Invertebrates

**Short-finned squid.** Nominal catches and abundance of *Illex illecebrosus* have been at relatively low levels in recent years throughout the Northwest Atlantic. The fishery in Canadian waters virtually collapsed, with catches dropping from 153,000 mt in 1979 to less than 20 mt in 1985. The USA catch increased markedly from about 300 mt in 1980 to a record 9,900 mt in 1983 and 9,500 mt in 1984. The 1987 USA catch was 10,300 mt, including 3,100 mt of joint venture catch. Stock abundance in USA waters, based on the 1987 autumn NEFC survey, is currently at the third highest annual level since 1968, while pre-recruit abundance in autumn 1987 was comparable to the 1968-86 average.

**Long-finned squid.** Nominal catches of *Loligo pealei* were about 11,500 mt in 1987, 36% below the 1986 catch, with all but 2 mt taken by the USA fishery. The USA catch in 1987, the second highest ever, was about 15% below the catch in 1986. Stock abundance is apparently below the long-term average, based on the 1987 autumn survey. However, the decrease seen in the survey index may be more related to availability than to abundance.

**American lobster.** Nominal catches in 1987 were 20,700 mt, a slight decrease relative to 1986 levels. Inshore catches in 1987 were 17,300 mt, while offshore catches (including Canadian catches on Georges Bank) were about 3,300 mt. Stock biomass in offshore areas has remained relatively stable since the late 1970s. However, fishing mortality is currently well above $F_{max}$ and, particularly in coastal areas, remains a source of serious concern.

**Northern shrimp**. Nominal catches for 1987 totaled 5,000 mt, the highest in over a decade; while the NEFC autumn survey index value for 1986 was the highest observed since 1972. These values reflect a substantial increase in abundance since the late 1970s due in large part to recruitment of the 1982 year class. This year class has now passed through the fishery and subsequent year classes are much weaker, suggesting poorer prospects for the fishery in the immediate future. The NEFC autumn survey index and the cooperative state-federal summer survey index both dropped sharply in 1987, and the projected total harvest for the 1987-88 fishing season (December 1, 1987 to May 31, 1988) is 3,500 mt, a 38% reduction from the total for the preceding season.

**Surf clams**. Nominal landings (FCZ and state waters) in 1987 totaled 27,600 mt (meat weight), representing a 23% decline from the previous year, and the lowest total since 1983. FCZ landings declined by 11% to 22,100 mt in 1987, primarily due to decreased market demand for surf clams, rather than significant changes in resource abundance. Catches from state waters fell 50% from the previous year, to 5,400 mt in 1987. The substantial decline in nearshore waters is primarily attributed to declining resource abundance and fishery production from New York state waters. Strong 1976 and 1977 year classes in FCZ waters of the Mid-Atlantic states continue to predominate in the landings, and are sufficient to sustain the current levels of offshore fishery landings into the early 1990s. Resource abundance on Georges Bank and in New England waters can similarly sustain the fishery for a number of years to come.

**Ocean quahogs**. Nominal landings in 1987 (22,200 mt meat weight), increased 11% over 1986 and were near the 1985 record production of 23,600 mt. Adequate resources still exist to supply the annual FCZ catch quota of 27,200 mt. Virtually all (97%) of the 1987 landings were from FCZ waters, with about 75% of that from off New Jersey. The total standing stock throughout the region is estimated to be 1.2 million mt. Current annual catches represent only 2% of the standing stock, but significant increases in the exploitation rate are not warranted due to the very slow growth rate and extreme longevity of the species. If present catch levels persist, the stock and fishery in the New Jersey - Delmarva area should remain stable for the next several years, after which time the fishery may shift northeasterly to more dense concentrations of ocean quahogs.

**Sea scallops**. Nominal commercial catches in 1987 from the Gulf of Maine, Georges Bank, and Mid-Atlantic areas totaled 20,000 mt (meats), 50% higher than in 1986, and the highest annual catch since 1979. Compared to 1986, catches in 1987 in creased in all regions: Gulf of Maine landings increased 14% (400 mt vs. 350 mt); Georges Bank landings rose 27% (11,700 mt vs. 9,300 mt); and Mid-Atlantic landings more than doubled (7,900 mt vs. 3,800 mt). Total USA landings in 1987 were 13,200 mt, the highest since 1979. Total 1987 Canadian catch from the Georges Bank/Gulf of Maine area was 6,800 mt, a 45% increase from 1986 (4,700 mt). Overall USA fishing effort in 1987 was record high; declines in effort in the Gulf of Maine and Georges Bank fisheries were more than offset by a 77% increase in Mid-Atlantic fishing effort.

United States CPUE increased in 1987 in all three fisheries; CPUE values in the USA Georges Bank and Mid-Atlantic fisheries were the highest since 1982 and 1979, respectively, due to recruitment of the strong 1982 and 1983 year classes in both regions. Abundance indices from the 1987 sea scallop survey indicate that the marked improvement in abundance of the offshore scallop stocks that began in 1985 has continued. In both the USA sector of Georges Bank and in the Mid-Atlantic region, the 1987 survey abundance indices were the highest (Mid-Atlantic) or among the highest (Georges Bank) recorded in the 13-year survey time series. The survey results also indicate that, in both regions, the strong 1982 and 1983 year classes have been followed by a strong 1984 year class. As a result of the current high abundance of sea scallops, catches and CPUE in 1988 are expected to increase and remain high in 1989.

# AGGREGATE RESOURCE TRENDS

## Introduction

Two sources of data are available for measuring the trends in aggregate resource abundance:

1. research vessel trawl survey data
2. commercial trawl catch and effort data

While neither data source completely reflects the changes in all fishery resources, both provide information that is useful in interpreting changes in fishery resources and fishing activity in recent years.

## Research Vessel Trawl Survey Data

The Northeast Fisheries Center has conducted an intensive bottom trawl survey program off the northeast coast of the USA for more than 25 years. An autumn survey has been conducted annually since 1963; a spring survey was initiated in 1968, and summer and winter surveys have been run intermittently. These surveys have employed standard gear and sampling procedures following a stratified-random sampling design and thus provide a valuable time series of data for monitoring resource trends. Since bottom-tending gear is used, the data are most appropriate for demersal species, although reliable indices of abundance have been developed for some pelagic species as well.

Data from these surveys are usually analyzed separately for each species, but also can provide an overview of both historical and recent aggregate resource trends from Cape Hatteras to the Gulf of Maine. Four primary groups of species are considered:

1. Principal groundfish and flounders, including demersal species such as Atlantic cod, haddock and yellowtail flounder, that have supported many important trawl fisheries

2. Principal pelagics (Atlantic herring and Atlantic mackerel)

3. Other finfish, including a variety of demersal and pelagic species that are collectively of considerable economic importance

4. Skates and spiny dogfish, which have been of minor commercial impor tance but are a major component of the total finfish biomass

For each of these groups, an aggregate index of abundance has been developed to monitor resource trends. Autumn survey data were used for principal groundfish and flounders and for other finfish, while spring survey data were used for principal pelagics and for skates and spiny dogfish. For each group of species an aggregate index of abundance has been computed as the total weight of fish that were caught per trawl haul, smoothed for between- year variability using a first order auto regressive model. No adjustments have been made for differences in the vulnerability of each species to the trawl gear, so the overall index tends to reflect the abundance of those species that are more vulnerable to the survey gear. However, vulnerability to the gear is not thought to change markedly over time, so the aggregate indices derived from these data appear to provide a useful general index of overall resource trends.

## Principal Groundfish and Flounders

This group includes important groundfish species (Atlantic cod, haddock, redfish, silver and red hake, and pollock) and several important flatfish (yellowtail flounder, summer and winter flounder, American plaice, and witch flounder). The combined index for this group declined almost continually between 1963 and 1974, reflecting substantial increases in exploitation associated with the advent of distant-water fleets (Figure E). Pronounced declines in abundance occurred for many species-stocks in this group, notably Georges Bank haddock, most silver and red hake stocks, and most flatfish stocks. By 1974, indices of abundance for many species had dropped to the lowest level since the survey began.

Partial resource recovery occurred during the mid-to-late 1970s. This was attributed to reduced fishing effort associated with increasingly restrictive management under the International Commission for the Northwest Atlantic Fisheries (ICNAF) during the early 1970s and implementation of the Magnuson Fishery Conservation and Management Act (MFCMA) in 1976. Cod and haddock abundance increased markedly; stock biomass of pollock increased more or less continually, and recruitment and abundance also increased for several flatfish stocks. The aggregate index peaked in 1978. Subsequently, the index has decreased steadily and the 1987 index value was among the lowest in the time series. Almost without exception, the separate indices for species within this group have either declined continually since 1985 or have fluctuated about a low level.

## Other Finfish

This group includes a number of demersal and pelagic species that are taken in directed fisheries or are important in mixed fishery situations. The combined index for this group (Figure E) includes data for 10 demersal species (white hake, cusk, croaker, black sea bass, scup, weakfish, spot, wolffish, ocean pout, and goosefish) and five pelagic species (alewife, blueback, shad, butterfish and bluefish). Landings for many of these species have been minor although their combined contribution to USA commercial and recreational harvests has been significant.

This index was relatively stable from 1963 to 1975. The higher values from 1976-80 reflect unusually high survey catches of Atlantic croaker and spot, and strong recruitment of butterfish from the 1979 and 1980 year classes. Survey catches in 1982 were anomalously low for a number of demersal species for unknown reasons. Strong 1983 and 1984 butterfish year classes contributed to the peak in 1985. The index has declined subsequently.

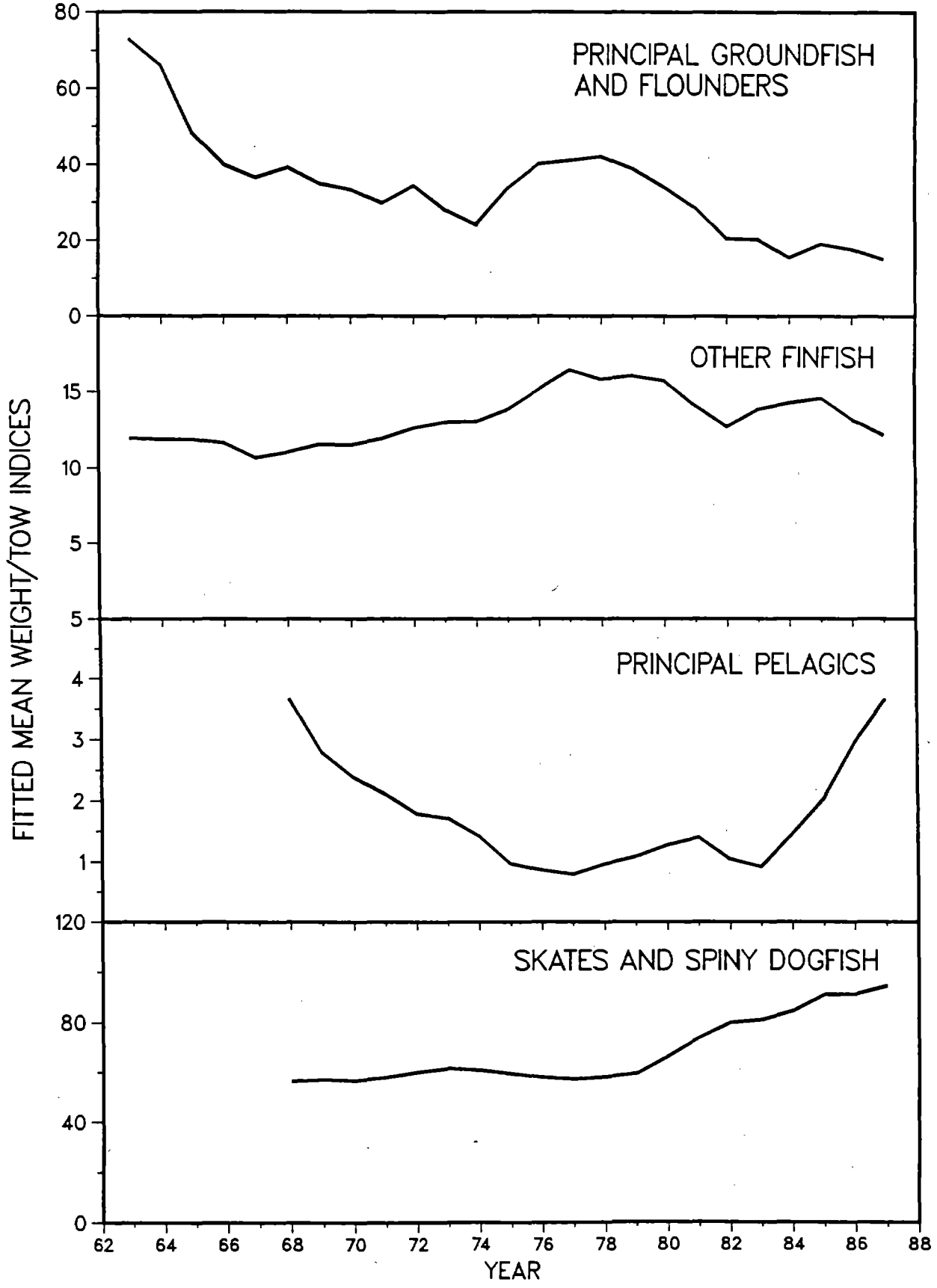
## Principal Pelagics

Abundance of Atlantic herring and Atlantic mackerel has been monitored using spring survey data; a combined index is given in Figure E. In general, indices for these species have been more variable than those calculated for principal groundfish and flounders, although the combined index appears adequate to depict overall trends. This index declined to minimal levels from the late 1960s to the mid-1970s, reflecting pronounced declines in abundance for both herring and mackerel (including the collapse of the Georges Bank herring stock). This has been followed by an increasing trend that has accelerated in recent years; values for 1986-87 were among the highest observed in the series. This trend is corroborated by virtual population analysis (VPA) of commercial catch at age data indicating recovery of both the Gulf of Maine herring stock and the northwest Atlantic mackerel stock to near late-1960s levels.

## Skates and Spiny Dogfish

The other finfish index does not include data for two extremely important resource components, spiny dogfish and seven species of skates, both of which are most effectively monitored using spring survey data (Figure E). The increase in this index in recent years reflects a major change in the finfish biomass, with increasing abundance of species of low commercial value. Both spring and autumn survey data indicate a decline in skate abundance from the late 1960s to the mid-to-late 1970s, followed by a more or

Figure E.Trends in indexes of aggregate abundance (catch in weight per survey trawl haul) for four species groups, reflecting the major changes in fishery resources in recent decades.



less continued increase. Recent values have been among the highest observed in either time series. Spiny dogfish abundance increased only gradually up to 1979, but more markedly in the 1980s. Spring survey index values have fluctuated around record high levels in recent years.

## Commercial Trawl Catch and Effort Data

Commercial trawl landings and effort data collected by NEFC using dock-side interviews and weigh-out reports have been collected consistently since implementation of the MFCMA. Because of the mixed species nature of this fishery throughout most of the region, the relationship between the amount of fishing effort and the landings of individual species or stocks is complex. While simple indices based on total landings and effort will not directly reflect the abundance of any one species, such indices do provide useful meas-ures of aggregate abundance that appear to accurately reflect overall trends.

Indices of multispecies CPUE were derived by aggregating trawl landings and effort data for three major fishery assessment areas:

1. Gulf of Maine (GM)

2. Georges Bank (GB)

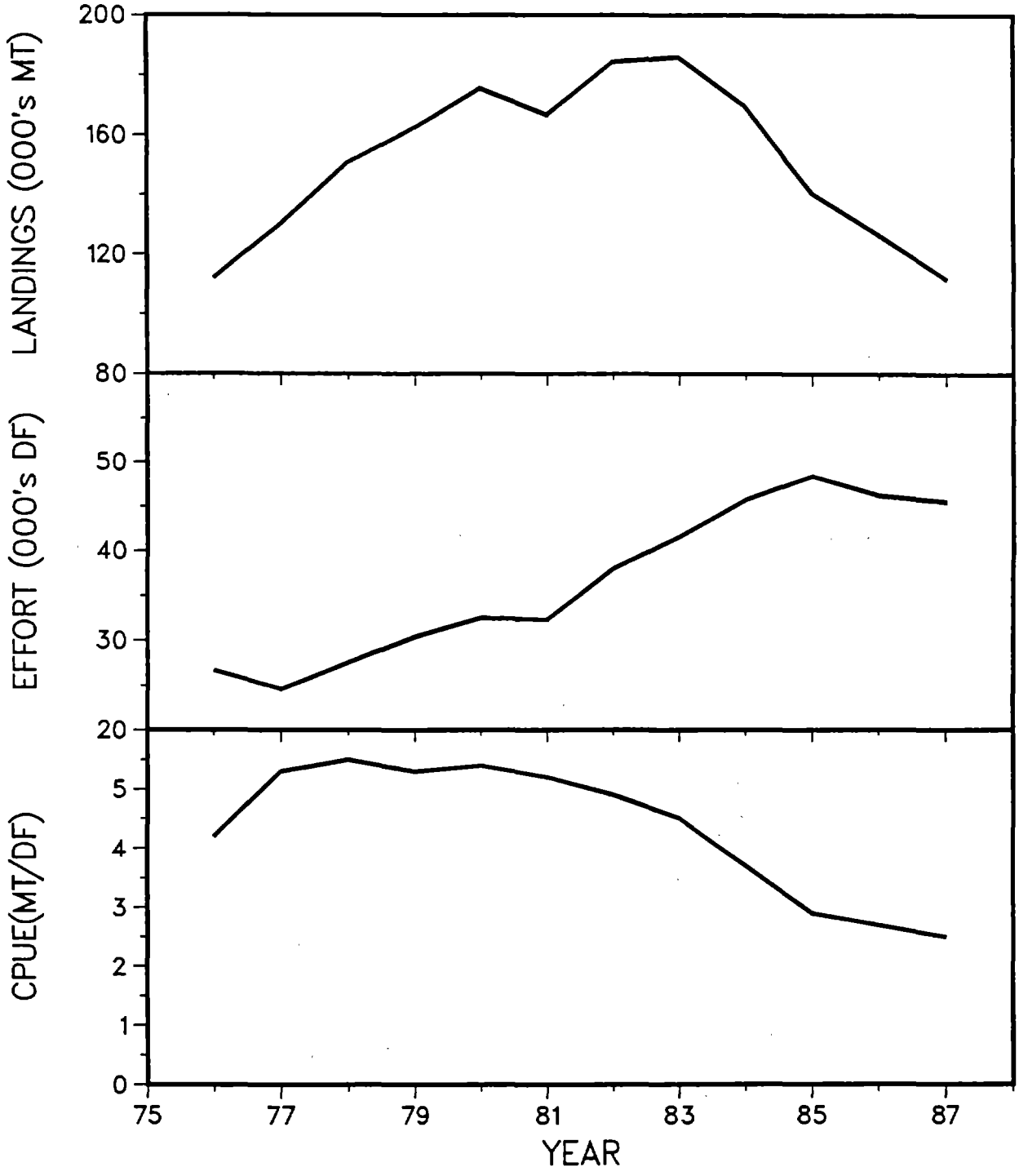
3. Northern Mid-Atlantic Bight (N. MA; comprising the area from CapeCod through New Jersey).

Fishing effort was standardized to account for variability in the size composition of trawl vessel fleets in the three regions, and the changes in fleet compositions over time. Data collected prior to 1976 were not included because of the problems of standardizing distant water fleet effort, and because complete trawl fishing effort data were not available for the more southern ports. Fishing effort was standardized to vessel performance by a tonnage class 3 trawler (51 to 150 GRT), fishing on Georges Bank. Appropriate weighting coefficients for smaller- and larger-sized vessels were then applied to derive single estimates of total standardized fishing effort by sub-area.

Total landings of all finfish and invertebrate species caught by trawlers were aggregated over all vessel size classes (Figure F). These landings peaked in 1983 at 186,000 mt, and declined steadily to 112,000 mt in 1987, a decrease of 40%. Landings in 1987 were approximately equal to the 1976 total. Total fishing effort (Figure F) nearly doubled from roughly 25,000 standard days in the 1976-78 period to roughly 48,000 in 1985. Subsequently, effort has declined slightly.

The total landings (mt) divided by the total standardized effort (days fished, DF) for all three regions combined, results in a catch per unit effort (CPUE) index that reflects the major changes in aggregate species abundance (Figure F). This index rose from 4.2 in 1976, held roughly steady from 1977 to 1980, but has since declined steadily and dramatically by about 50% to 2.5 in 1987. The changes in this CPUE index are similar to those observed in the research trawl data for principal groundfish and flounders, with an initial rise and subsequently a major decline. The trend in this CPUE index is markedly different from the research trawl data for pelagic species and for other finfish, as might be expected given the nature of the trawl fishery. This CPUE index may, however, underestimate the actual declines in abundance of demersal species because of increasing fleet efficiency. Also, this index includes species not included in the principal groundfish trawl index species that have remained at relatively high stock sizes, such as butterfish and mackerel.

Figure F. Total trawl catch (mt), standardized trawl fishing effort (days fished), and catch divided by effort (CPUE, mt/DF) since the introduction of the MFCMA in 1976, reflecting major changes in trawl fishing activity and aggregate resource abundance.



The same general trends in catch, effort, and CPUE are apparent in the data when treated separately for the three assessment regions (Figure G). During the period 1976-87 effort increased 100% in the Gulf of Maine, 58% on Georges Bank, and 63% in the Northern Mid-Atlantic. Landings peaked in 1983 for the Gulf of Maine (125,000 mt), in 1982 on Georges Bank (196,000 mt), and 1984 in the Northern Mid-Atlantic, (98,000 mt). Landings have subsequently declined 31, 55, and 28% in the three areas respectively, since their peak years. CPUE declines over the time period are even more pronounced, indicating rapid declines in stock abundance. The CPUE index for the Gulf of Maine region declined by more than 50% from its 1977 peak. Similarly, the index for Georges Bank region declined by more than 60% from its 1980 peak, while the index for the Northern Mid-Atlantic region declined by 50% from its 1982 peak.

During the period covered in these analyses, the species composition of landings changed dramatically in most vessel size classes and areas. In the Gulf of Maine, landings of cod, redfish, and flounders have declined. Currently, pollock, silver hake, and shrimp predominate. On Georges Bank, haddock and yellowtail flounder stocks have declined and are a small fraction of overall catches, which are primarily cod, winter flounder, and windowpane flounder. In the Northern Mid-Atlantic Bight, catches are generally highly mixed, but several trends are notable. Yellowtail, winter, and summer flounder catches have declined relative to other species including *Loligo* squid, butterfish, and silver hake.

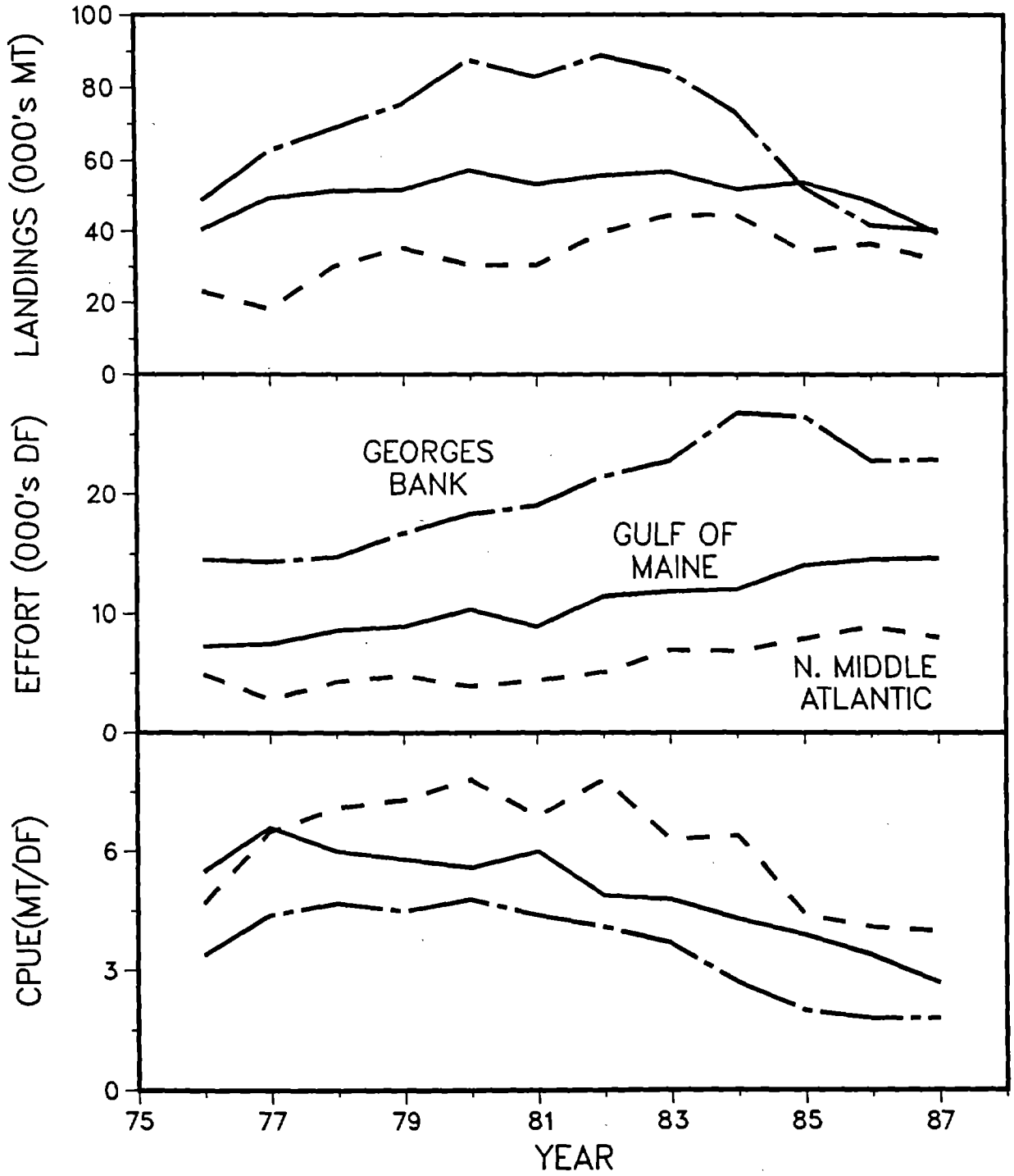
## Conclusions About Resource Abundance

Both the research trawl data and the aggregate trawl fishery data suggest major changes in the abundance of resources in the Northeast Atlantic, especially since the implementation of the FCMA in 1976. Increases in abundance of groundfish and flounders and the reduction of foreign fishery effort during the mid-1970s were followed by increases in domestic fishing effort and landings. Abundance of groundfish and flounders started declining after 1978, and currently are at historically low levels. Abundance of other finfish has fluctuated widely, while that of pelagics (primarily mackerel) has increased steadily in recent years. Trawl fishing effort increased steadily through 1985, and remains at near record high levels. Total trawl catches increased until 1983, and have subsequently declined to levels comparable to those seen in 1976. These major changes in the fisheries have included extensive changes in the species composition of the catches, with shifts to previously less-desirable species. At the same time, major increases in the abundance of nontarget species such as spiny dogfish, has occurred.

The causes of these changes in resource abundance are not completely understood, but it appears that many of them are directly related to changes in fishing mortality. For example, increases in abundance occurred from 1975 to 1978 when fishing effort was being reduced by international and subsequently by domestic management actions. Later, decreases in abundance occurred when fishing effort was increasing. Factors other than fishing effort may have played a role, as for example, in years when strong recruitment occurred for some species. However, there is little evidence of long-term climatic changes that might have affected the recruitment of several species simultaneously as would be necessary to cause declines in abundance of the magnitude apparent in these data. Similarly, there is little suggestion that environmental contamination has played a significant role in these changes in resource abundance because comparable decreases have been seen in all three regions even though pollution levels vary greatly.

Increased fishing effort in the three regions has resulted in elevated fishing mortality (exploitation) rates on the target species. Up to 70% of some harvestable stocks are removed by fishing each year. The high rates of population removal can result in two effects:

Figure G.Total trawl catch (mt), standardized fishing effort (days fished), and catch divided by effort (CPUE, mt/DF) since 1976, for three regions, reflecting major changes in trawl fishing activity and aggregate resource abundance.



1. Catching young, fast growing fish which may result in decreased aggregate yield in weight from a particular group of recruits

2. Reducing the total level of adult biomass to the point that too few young fish result from each year's spawning

The elevated levels of fishing mortality clearly have resulted in the first problem. Total catch has been less than what was possible because exploitation rates for many species are far in excess of the levels that result in maximum yield per recruited fish. Recent analyses of the relationship between the production of young fish and adult spawning biomass suggest that the second problem is also occurring. Present fishing mortality rates do not allow sufficient young fish to be produced for several species to maintain their populations at even their current low abundance levels.

While the causes of the changes in resource abundance shown by the indices of aggregate abundance described here are not completely understood, it appears that fishing is probably the major cause. Climatic or environmental changes of sufficient magnitude to cause simultaneous changes in all of these stocks are not apparent. The amount of fishing has increased markedly, exceeding levels producing maximum catch per recruit, and for several species exceeding levels that allow sufficient recruitment to maintain spawning stock size.

The pattern in the fishery is one of initial increases in stock abundances and catch rates after foreign fishing was restricted in 1976, followed by decreases as the domestic fishery expanded. This pattern is similar to that seen in the North Sea following both World War I and World War II. After being restricted from fishing during both wars, the English fishermen venturing out in the North Sea during 1919 and 1946 found greatly increased stocks and very high catch rates. But the increasing fishing effort over the subsequent few years rapidly reduced the stocks, and catch rates soon declined to pre-war levels. The message is clear: less fishing would result in increased abundance of fishery resources.

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# SPECIES SYNOPSES

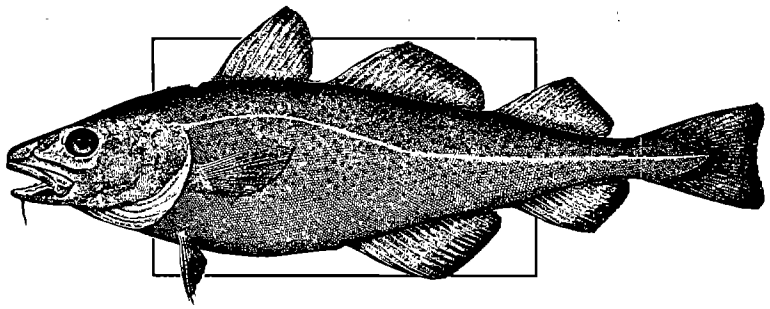
The synopses of information on the status of the stocks of the 33 species or groups of species presented in this section are based on commercial and recreational fishery data and on research survey data, as described in the overview to this report. Each synopsis briefly reviews the biology of the animals and the general nature of the fishery, summarizes recent catch statistics and research survey results, describes the current management of the fishery, and suggests the likely general status of the target stocks for different possible developments within the fishery.

For each stock or species a summary table of catch statistics is included, along with one or more graphs showing how landings and, where possible, stock abundance, have varied over time. The measures of stock abundance used include trawl survey catch per tow, estimated stock biomass from virtual population analyses, and catch per unit of fishing effort. Specific references in the text to catches or indices of abundance are usually to values given in these tables and figures, although some summary statistics for different areas, fishing gears, or data sources which are not in the tables and figures are given in the text.

Catch statistics in the tables are given in thousands of metric tons, rounded to the nearest one hundred metric tons; values less than 100 mt are indicated as $<0.1$. Values quoted in the text are also usually rounded to the nearest 100 mt when greater than that value , and are rounded to the hearest 10 mt when less. Values too small to be of any importance, or which are zero, or which are not defined in certain situations, or for which suitable data to base estimates on do not exist, are indicated by a dash. Values which are not yet available are indicated by N/A.

# ATLANTIC COD

## Gadus morhua



## Summary status

*** Record low abundance, record high fishing mortality**
*** Possibly strong 1987 year classes**
*** Not meeting management goals**

The Atlantic cod, *Gadus morhua,* is a demersal gadoid species distributed in the Northwest Atlantic from Greenland to North Carolina. Cod are omnivorous feeders and commonly attain lengths up to 130 cm (51 in.) and weights up to 25 to 35 kg (55 to 77 pounds). Maximum age is in excess of 20 years, although young fish (ages 2 to 5) generally comprise the bulk of the catch. Sexual maturity is attained between ages 2 to 6; spawning occurs during winter and early spring.

In USA waters, cod are assessed as two stocks: Gulf of Maine, and Georges Bank and South. Important commercial and recreational fisheries occur in both. The commercial fisheries are conducted year-round with otter-trawls and gill nets as primary gear. Recreational fishing also occurs year-round; peak activity occurs during late-summer in the lower Gulf of Maine, and during late-autumn to early spring from Massachusetts southward.

## Gulf of Maine

Total nominal commercial catch (USA and Canada) in 1987 was 8,000mt, 23% less than in 1986 (10,500 mt), and the lowest annual catch since 1974. The 1987 USA catch (7,527 mt) was the lowest since 1973 and was nearly 2,200 mt less than in 1986. Reported 1986 Canadian landings were 487 mt, 39% lower than in 1986. Canadian landings should be considered tentative, however, since substantial misreporting of Canadian Scotian Shelf landings as Gulf of Maine catch is believed to have occurred since 1982.

United States otter trawl fishing effort in 1987 attained a record-high level. USA CPUE indices (catch per day fished), however, declined to record-low levels. "Directed trips" (trips in which cod comprised 50% or more of the trip catch, by weight), which accounted for 44% of the USA catch in 1983 and 23 to 25% in 1984-85, only accounted for 15% of the 1987 USA total, the second lowest percentage in the past 23 years.

The 1987 USA catch was dominated by the 1983 and 1984 year classes. Together these cohorts accounted for 73% of the catch by number and 62% of the catch by weight. The 1983 year class was the most dominant, in terms of both numbers (47% of total) and weight (48%) landed. Otter trawl landings accounted for 58% of the 1987 USA Gulf of Maine cod catch, while gill net landings accounted for 40%.

NMFS research vessel survey indices in 1987 were among the lowest ever. Both the spring and autumn 1987 weight per tow indices was the lowest in the survey time series. Survey age composition data for 1987 indicate that the 1985 year class comprised about 40% of the total population, by number. In terms of weight, however, the 1983 cohort was dominant accounting for nearly 30% of the total stock biomass. Based on the two 1987 surveys and the spring 1988 survey, recruitment of the 1985 and 1987 year classes appears strong, while the 1986 year class appears slightly above average. Results from the 1987 autumn State of Massachusetts inshore survey indicate that recruitment of 1987 year class may be outstanding. The catch per tow index of age 0 cod (ie., the 1987 cohort) was the highest in the Massachusetts survey time series.

Figure 1.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic cod in the Gulf of Maine.

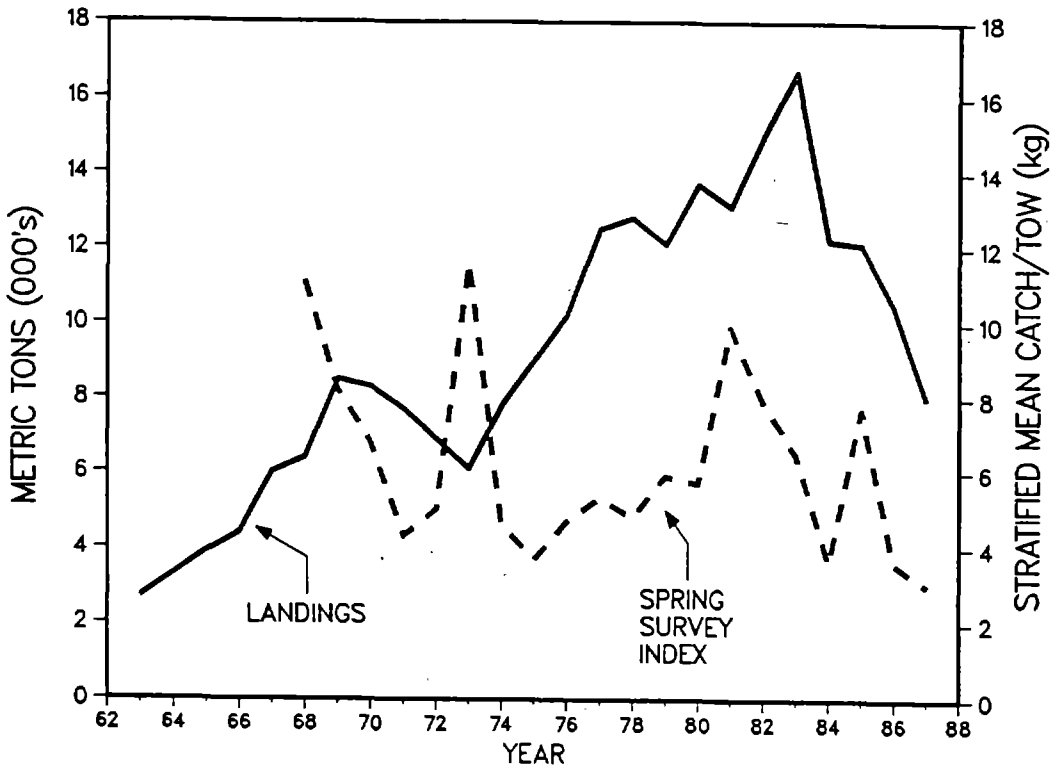



Table 1.1 Nominal catches (thousand metric tons) and management information for Atlantic cod from the Gulf of Maine.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational[1] | 0.9 | 3.1 | 1.1 | 1.2 | 1.1 | 1.7 | 2.7 | 1.6 | 0.9 |
| Commercial | | | | | | | | | |
| USA | 11.7 | 13.5 | 12.5 | 13.6 | 14.0 | 10.8 | 10.7 | 9.7 | 7.5 |
| Canada | 0.4 | 0.2 | 0.6 | 1.4 | 2.7 | 1.4 | 1.4 | 0.8 | 0.5 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 13.0 | 16.8 | 14.2 | 16.2 | 17.8 | 13.9 | 14.8 | 12.1 | 8.9 |

| | | |
|---|---|---|
| Long-term potential catch | = | 10,000 mt |
| Importance of recreational fishery | = | Major |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 4.2 yrs (males); 3.8 yrs (females) |
| Size at 50% maturity | = | 54 cm (21.3 inches) males<br>50 cm (19.7 inches) females |

M = 0.20 $F_{0.1}$ = 0.16 $F_{max}$ = 0.30 $F_{1987} > 0.62$

[1] Estimated for Maine and New Hampshire

Record-high fishing effort and record-low CPUE and survey abundance values imply that fishing mortality in 1987 increased to a record-high level. The stock is presently in a depressed condition. The fishery in 1988 will likely focus on the strong 1985 year class. Unless F is reduced, both yield and spawning potential will be sacrificed for short-term increases in catch. Although recruitment of the 1987 year class currently appears to be very strong, this cohort will not significantly contribute to commercial landings until mid-1989. Until then, prospects for stock recovery are poor and will be diminished even further if fishing mortality remains high.

## Georges Bank and South

Total nominal commercial catch (USA and Canada) in 1987 was 30,900 mt, 19% higher than in 1986 (26,000 mt), but still the second lowest annual total since 1977. The 1987 USA catch (19,000 mt) was 9% greater than in 1986, but far below the 1980-1985 average annual catch of 35,000 mt. Apart from 1986 and 1987, USA catches exceeded 20,000 mt in every year from 1977 onward. Canadian 1987 landings totaled 11,900 mt, a 39% increase from 1986, and the highest annual catch since 1983.

USA nominal commercial fishing effort in 1987 increased 14% from 1986, and was only slightly below (-13%) the record-high levels attained in 1984-85. United States commercial CPUE indices for all vessel classes, however, declined (for the fifth consecutive year) in 1987. CPUE values for all trips catching cod and for "directed trips" (which accounted for 67% of the 1987 USA Georges Bank cod catch) were the lowest on record.

The USA catch in 1987 was dominated by the strong 1985 year class. This cohort accounted for 64% of the 1987 catch in numbers and 36% of the catch in weight. The next most important year class was the 1983 year class, which accounted for 18% of the number of cod landed and 29% of the catch weight.

NMFS research vessel indices in 1987 declined from 1986 and were among the lowest in the survey time series. The autumn 1987 number-per-tow index was the lowest since 1983; the autumn 1987 indices of spawning stock size (age 3+, numbers and biomass) were each the second lowest ever. Age composition data from the 1987 surveys indicated that the 1985 year class comprised more than 50% of the total Georges Bank stock, by both number and weight.

Based on the two 1987 NMFS surveys, the autumn 1987 State of Massachusetts inshore survey, and the spring 1988 NMFS survey, recruitment from the 1986 year class appears to be below average, while recruitment of the 1987 year class appears to be strong. The spring 1988 NMFS survey results reveal that the 1985 year class continues to dominate the population, still accounting for over half of the total stock size by number.

Fishing mortality in 1987 is estimated, from research survey data, to be above F= 0.60, and perhaps as high as F= 0.90. The latter value would represent a record-high F level on the stock. Although the strong 1985 year class began recruiting to the fishery in 1987, CPUE and research vessel abundance indices declined implying that fishing mortality increased substantially in 1987 as a result of increased fishing effort.

Continuation of this high fishing mortality in the future will impede significant rebuilding of spawning stock biomass from its presently low level. The fishery in 1988 will again focus on the strong 1985 year class which, in 1988 and 1989, will constitute virtually the entire spawning stock. Given current effort levels, catches in 1988 are expected to be higher than in 1987 due to full recruitment of the 1985 year class in the fishery. However, if F is not reduced, the long-term yield and spawning potential of this cohort will be dissipated for short-term catch. Since the Georges Bank stock has declined to a level well below its normal historical range and because cod is a major component in the USA northeast multispecies fishery, the present state of the stock gives cause for concern.

Figure 1.2 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic cod in the Georges Bank and South area.

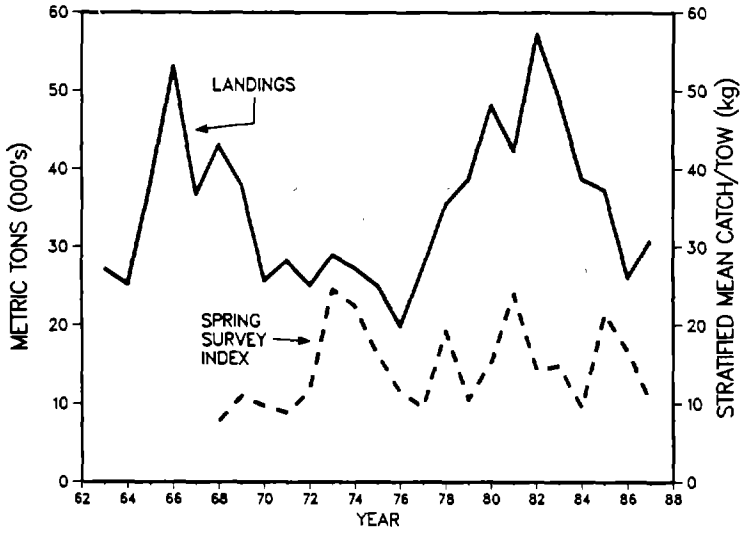



Table 1.2 Nominal catches (thousand metric tons) and management information for Atlantic cod from Georges Bank and South.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational[1] | 2.9 | 3.3 | 7.5 | 6.8 | 7.2 | 3.7 | 6.3 | 1.8 | 2.9 |
| Commercial | | | | | | | | | |
| USA | 32.7 | 40.0 | 33.9 | 39.3 | 36.8 | 32.9 | 26.8 | 17.6 | 19.0 |
| Canada | 6.0 | 8.1 | 8.5 | 17.9 | 12.1 | 5.8 | 10.5 | 8.5 | 11.8 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 41.6 | 51.4 | 49.9 | 64.0 | 56.1 | 42.4 | 43.6 | 27.9 | 33.7 |

| | | |
|---|---|---|
| Long-term potential catch | = | 35,000 mt |
| Importance of recreational fishery | = | Major |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning stock biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 2.6 yrs (males); 2.9 yrs (females) |
| Size at 50% maturity | = | 44 cm (17.3 inches) males; 51.5 cm (20.3 inches) females |

M = 0.20 $F_{0.1}$ = 0.16 $F_{max}$ = 0.28 $F_{1987}$ > 0.60

[1] Estimated for Massachusetts and southward

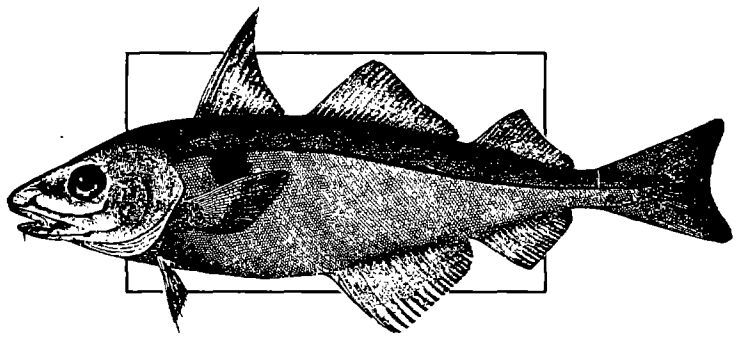
## Reference

Serchuk, F. M., and S. E. Wigley. 1986. Assessment and status of the Georges Bank and Gulf of Maine Atlantic cod stocks - 1986. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-12. 84 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Third NEFC Stock Assessment Workshop (Third SAW). Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# HADDOCK

## Melanogrammus aeglefinus



## Summary status

*** Record low abundance**
*** Recent year classes harvested too young to meet current management goals**
*** Not meeting management goals**

The haddock, *Melanogrammus aeglefinus*, is a demersal gadoid species commonly attaining lengths of 75 to 80 cm (30 to 32 in.) and weights up to 5 kg (11 lbs). In recent USA nominal catches, average lengths have ranged from 50 to 60 cm (20 to 24 in.), while average weights have ranged between 1.5 and 2.5 kg (3 to 5 lbs). Haddock mature sexually at ages 2 to 3, and ages up to 18 years have been documented for Georges Bank, although ages in excess of 9 years are uncommon. The species is distributed on both sides of the North Atlantic and, in the Northwest Atlantic, ranges from West Greenland to Cape Hatteras. Highest concentrations off the USA coast occur on northern and eastern Georges Bank and in the southwestern Gulf of Maine. Haddock are most common at depths of 45 to 135 m (25 to 75 fathoms) and temperatures of 2° to 10°C (36° to 50°F). Georges Bank haddock appear to be relatively sedentary, although seasonal coastal movements occur in the western Gulf of Maine. Small invertebrates constitute the bulk of the diet.

Spawning occurs between January and June, with peak activity during late March and early April. Individual females may produce up to 3 million eggs. Major spawning concentrations occur on eastern Georges Bank; some spawning also occurs to the east of Nantucket Shoals and along the Maine coast. Juvenile haddock are pelagic for several months and then settle to the bottom.

Haddock on Georges Bank and in the Gulf of Maine were managed separately by the New England Fishery Management Council (NEFMC) under the Fishery Management Plan (FMP) for Atlantic Groundfish from 15 March 1977 to 30 March 1982. This plan provided for optimal yield or OY management to be achieved by catch quotas, seasonal spawning area closures, cod end mesh size regulations and mandatory data reporting requirements. The Interim Plan for Atlantic Groundfish became effective on 31 March 1982. It redefined OY as the amount actually harvested by USA fishermen in accordance other Plan provisions, excluding catch quotas. The Northeast Multispecies Fishery Management Plan was implemented in October 1986. It provides the basis for managing the ten important demersal species in the New England area.

## Gulf of Maine

During 1978 - 1984, USA fishermen accounted for 86% of the nominal commercial catch of haddock from the Gulf of Maine, with the remainder being taken by Canada. Nominal commercial catches for the Gulf of Maine increased from 500 mt in 1973 to 7,700 mt in 1980, averaged 6,800 mt from 1981 to 1983, and declined steadily to 829 mt in 1987. Estimated recreational catches have declined from 1,700 mt in 1979 to less than 50 mt in 1981-87.

The NEFC autumn survey index has declined in nearly every year since 1978, while spring index values have shown a general downward trend since 1981. Spring and autumn index values for 1987 were among the lowest in the time series. Autumn surveys

Figure 2.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of haddock in the Gulf of Maine.

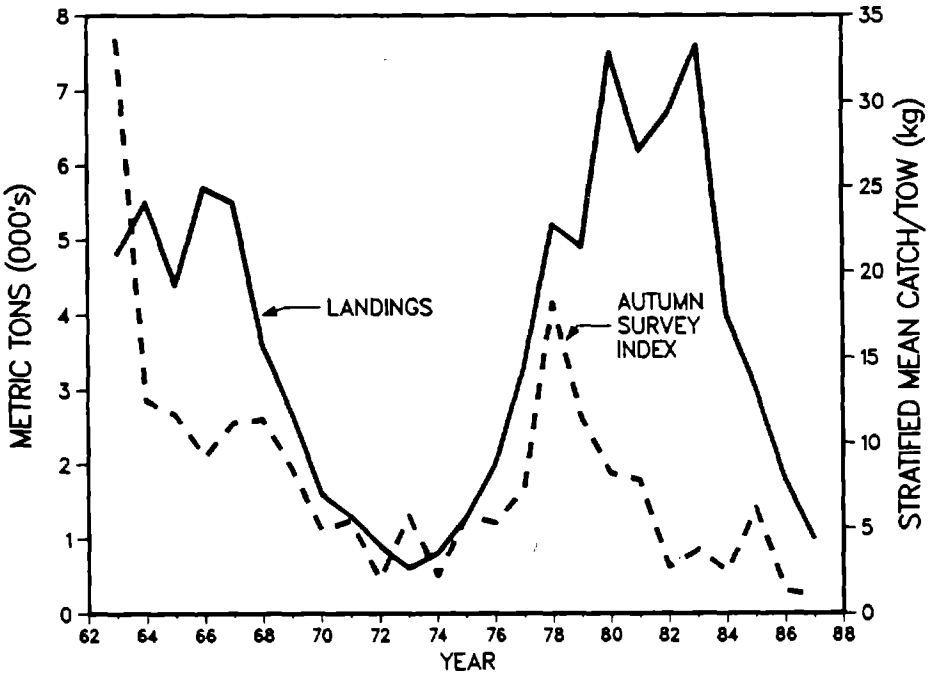



Table 2.1 Nominal catches (thousand metric tons) and management information for Gulf of Maine haddock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 1.7 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.1 |
| Commercial | | | | | | | | | |
| USA | 4.6 | 7.3 | 5.7 | 5.6 | 5.6 | 2.8 | 2.2 | 1.6 | 0.8 |
| Canada | 0.3 | 0.2 | 0.5 | 1.1 | 2.0 | 1.2 | 0.8 | 0.2 | 0.2 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 6 6 | 7.7 | 6.2 | 6.7 | 7.6 | 4.0 | 3.0 | 1.8 | 1.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | 5,000 mt |
| Importance of recreational fishery | = | Minor |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning stock biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 2 years |
| Size at 50 maturity | = | 38 cm (15 inches) |

M = 0.2 $F_{0.1}$ = 0.26 $F_{max}$ = 0.55 $F_{1987} > F_{max}$

by the Massachusetts Division of Marine Fisheries suggest that recruitment from the inshore portion of the Gulf of Maine has been negligible since 1982.

## Georges Bank

USA fishermen accounted for 69% of the nominal commercial catch between 1977 and 1984, but the percentage declined to 55% in 1985, 49% in 1986, and 34% in 1987. Almost all of the USA nominal catch has been taken by otter trawling.

The total Georges Bank nominal catch increased from 22,400 mt in 1978 to 27,600 mt in 1980 and declined in every year since that time to 6,100 mt in 1987. Research vessel survey data for 1979-87 indicate a succession of weak year classes. The fishery is dependent on the 1985 year class at the present time.

The NEFC spring and autumn indices for 1987 were both among the lowest values recorded since the series began in 1963. The 1981, 1982, 1984, 1986 and 1987 young-of-year indices for Georges Bank were among the lowest on record. Estimates for the 1983 year class and indices for the 1985 year class suggest that they may be comparable to the 1972 year class in size, however, high fishing mortality and discarding reduced these cohorts quickly.

Stock size estimates (age 2 and older) calculated from virtual population analysis or VPA have declined from 95 million fish or 116,000 mt in 1980 to 13 million fish and 17,000 mt in 1987. Current levels are well below the long-term (1935-60 average of 140 million fish or 153,000 mt) and appear comparable to the record lows observed during the early to mid-1970s when recruitment was poor. The stock is expected to decline further in 1988 and 1989.

## Reference

Clark, S.H., W.J. Overholtz, and R.C. Hennemuth. 1982. Review and assessment of the Georges Bank and Gulf of Maine haddock fishery. J. Northw. Atl. Fish. Sci. 3:1-27.

Overholtz, W.J., S.H. Clark, and D.Y. White. 1983. A review of the status of the Georges Bank and Gulf of Maine haddock stocks for 1983. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 83-23. 31 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second NEFC Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 2.2 Total commercial landings and estimates of stock biomass of haddock on Georges Bank.

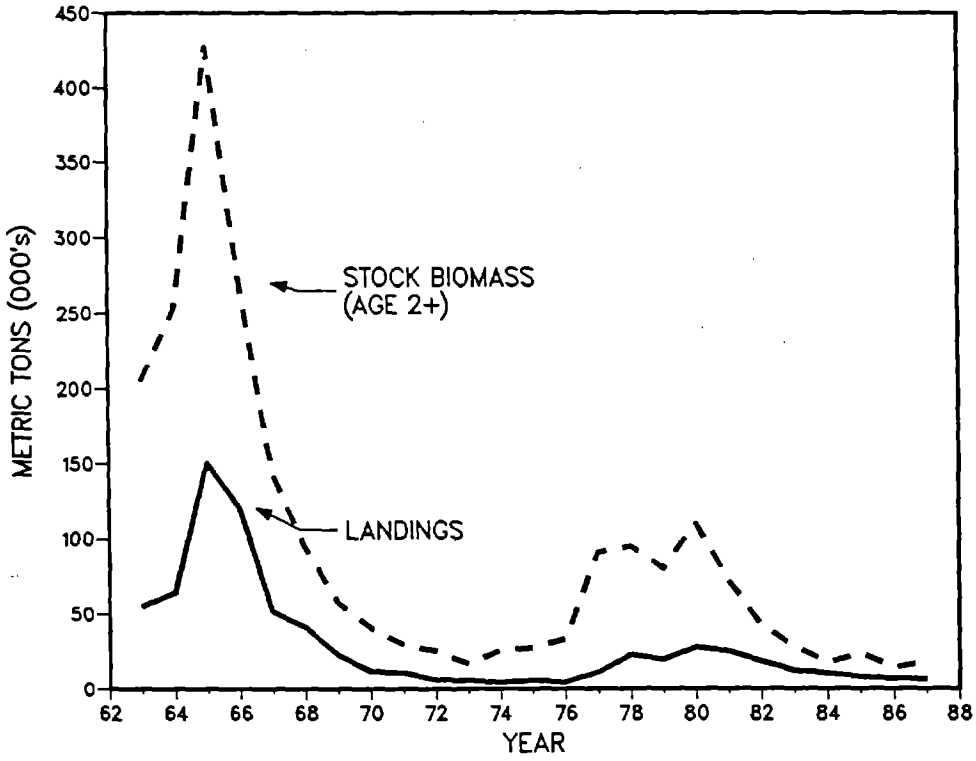



Table 2.2 Nominal catches (thousand metric tons) and management information for Georges Bank haddock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - |
| Commercial | | | | | | | | | |
| USA | 14.3 | 17.5 | 19.2 | 12.6 | 8.7 | 8.8 | 4.3 | 3.3 | 2.2 |
| Canada | 5.2 | 10.1 | 5.7 | 5.6 | 3.2 | 1.4 | 3.5 | 3.4 | 4.1 |
| Other | - | - | <0.1 | - | - | - | - | - | - |
| Total nominal catch | 19.5 | 27.6 | 24.9 | 18.2 | 11.9 | 10.2 | 7.8 | 6.7 | 6.3 |

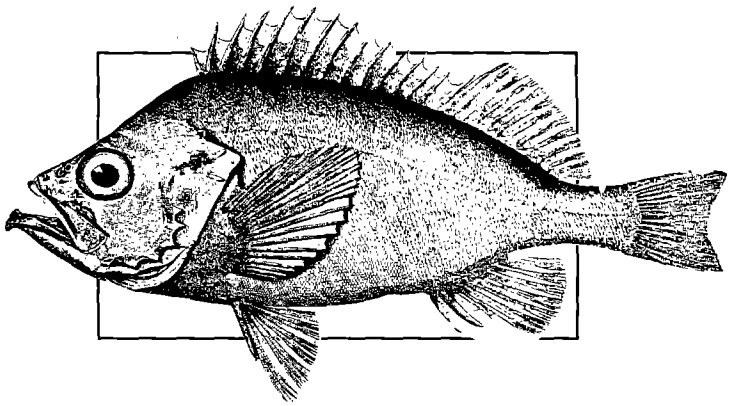
| | | |
|---|---|---|
| Long-term potential catch | = | 47,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 38 cm (15 inches) |

M = 0.20 $F_{0.1}$ = 0.26 $F_{max}$ = 0.55 $F_{1987} > F_{max}$

# REDFISH

## Sebastes fasciatus

**Ocean perch, red sea perch, red bream, Norway haddock**



## Summary status

*** Record low abundance**
*** Weak year classes**
*** Fewer fishermen targeting this species, fishing mortality significantly reduced**
*** No stock increase until a strong year class appears**

Redfish or ocean perch, *Sebastes* spp., are distributed throughout the North Atlantic from the coast of Norway to Georges Bank. Off New England, *Sebastes fasciatus* are most common in deep waters of the Gulf of Maine to depths of 300 m (975 ft). Redfish are slow growing, long-lived animals with an extremely low natural mortality rate. Ages in excess of 50 years and maximum sizes of 45 to 50 cm (18 to 20 in.) have been noted. In the Gulf of Maine, redfish reach maturity in about 5 to 6 years at an average length of 20 to 23 cm (8 to 9 in.). Females are viviparous, retaining eggs in the ovary after fertilization until yolk sac absorption. Mating takes place in autumn, with subsequent larval extrusion occurring the following spring and summer.

During the development phase of the Gulf of Maine fishery, USA nominal catches rapidly rose to a peak level of about 60,000 mt in 1942 followed by a gradual decline. Nominal catches in recent years increased from approximately 10,000 to 11,000 mt during 1974-1976 to approximately 14,000 to 15,000 mt in 1978-79. In 1986 and 1987, however, catches declined to 2,900 and 1,900 mt, respectively, the lowest annual figures since the directed fishery commenced in the early 1930s. Available evidence indicates that the Gulf of Maine redfish population is dominated by the 1971 and 1978 year classes. The 1971 year class accounted for 63% of the numbers landed in the commercial fishery in 1980 and 1981. In 1983, however, the 1978 year class recruited to the fishery, accounting for 15% of the total. In 1987, this year class represented 62% of the total number landed.

The standardized catch-per-unit-of-effort (CPUE) index declined from 6.1 mt/day in 1968 to approximately 2.4 mt/day between 1975 and 1978, and to 0.6 and 0.7 mt/day in 1986 and 1987, respectively. The NEFC autumn survey index declined from an average of 122 fish/tow in 1967-68 to an average of 10 fish/tow in 1983-85 although the 1987 autumn index increased slightly to 14 fish/tow. Estimates of exploitable biomass (ages 5 and older) from virtual population analysis declined by 75% from 136,000 mt in 1969 to 32,000 mt in 1985. Projections for 1988 indicate a 5+ stock biomass of 27,000 mt. Average fishing mortality during the 1970s was slightly greater than $F_{max}$ (0.14) and twice the $F_{0.1}$ (0.07) level. In addition, the combination of declining overall stock size and increased fishing effort on the 1971 year class produced fishing mortality rates that were 50% above $F_{max}$ and three times $F_{0.1}$ in the late 1970s. Fishing mortality has declined in recent years to a point slightly above $F_{0.1}$ and well below $F_{max}$. Equilibrium surplus production models have indicated that the long-term potential catch is about 14,000 mt. However, given the current low population abundance and poor recruitment, surplus production in the near future will be considerably less than that, as indicated by the sharp decline in nominal catches.

The population remains in a severe state of disequilibrium. With the present age structure and exploitation pattern,the fishery is extremely dependent on recruitment. However, except for the moderate 1978 year class, recruitment has been poor; thus, biomass is not expected to increase substantially in the near future.

Figure 3.1 Total commercial landings and catch per unit effort of redfish in the Gulf of Maine -Georges Bank area.

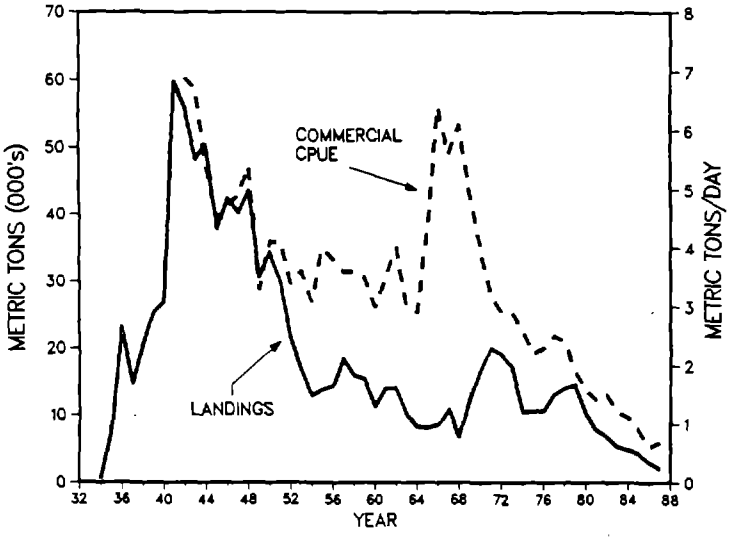



Table 3.1 Nominal catches (thousand metric tons) and management information for redfish from the Gulf of Maine and Georges Bank areas.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 14.7 | 10.1 | 7.8 | 6.7 | 5.2 | 4.7 | 4.2 | 2.9 | 1.9 |
| Canada | <0.1 | 0.1 | <0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Other | <0.1 | - | - | <0.1 | - | - | - | - | - |
| Total nominal catch | 14.7 | 10.2 | 7.8 | 6.8 | 5.3 | 4.8 | 4.3 | 3.0 | 2.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | 14,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in effect since October 1986 |
| Status of exploitation | = | Fully exploited |
| Projected spawning stock biomass per recruit | = | Increasing toward maintenance level |
| Age at 50% maturity | = | 5-6 years |
| Size at 50% maturity | = | 20-23 cm (7.9 - 9.0 inches) |

M = 0.05 $F_{0.1}$ = 0.07 $F_{max}$ = 0.14 $F_{1987}$ = 0.08

## Reference

Mayo, R. K. 1980. Exploitation of redfish, Sebastes marinus (L.), in the Gulf of Maine - Georges Bank region, with particular reference to the 1971 year class. J. Northw. Atl. Fish. Sci. 1:21-38.

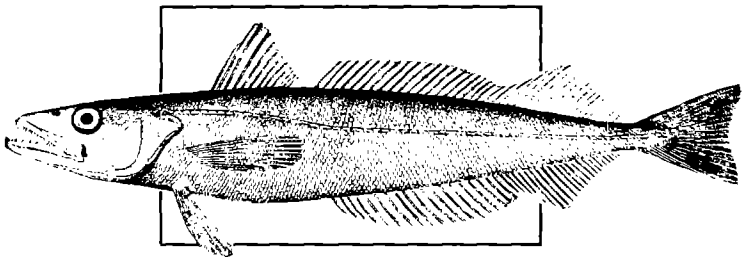
Mayo, R. K., U. B. Dozier, and S. H. Clark. 1983. An assessment of the redfish, Sebastes fasciatus, stock in the Gulf of Maine - Georges Bank region. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 83-22. 55 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# SILVER HAKE

## Merluccius bilinearis

### Whiting, New England hake



## Summary status

*** Relatively low abundance**
*** Low fishing mortality**
*** Increased catches are possible**

The silver hake or whiting, *Merluccius bilinearis*, is a widely distributed, slender, swiftly swimming fish with a range extending from Newfoundland to South Carolina, but most abundant off the New England coast. Research vessel bottom trawl surveys indicated that silver hake have wide geographic and depth ranges throughout the year, with only major concentrations of fish varying from season to season. In response to major seasonal changes in hydrographic conditions, availability of food, and spawning requirements, adult silver hake undergo extensive migrations, overwintering in the deep waters of the Gulf of Maine and along the outer continental shelf and slope south and west of Georges Bank and moving to shallower waters from March to November to spawn.

Major spawning areas for silver hake include the coastal region of the Gulf of Maine from Cape Cod to Grand Manan Island, southern and southeastern Georges Bank, and the Southern New England area south of Martha's Vineyard.

Silver hake grow to a maximum length of approximately 65 cm (25.6 in.). Ages of 15 years have been reported, although fish older than about 8-10 years are rarely encountered.

## Gulf of Maine - Northern Georges Bank

The nominal catch of silver hake in 1987 was 5,700 mt, taken exclusively by the USA. This catch was a third less than in 1986. While 1986 catch was slightly higher than 1985 and was the highest level reported since 1978, it is still well below catches reported in the past. Total catches from this area averaged approximately 49,100 mt during 1955-61. With the introduction of the distant water fleet (DWF) in 1962, catches rose sharply to a high of 94,500 mt in 1964, then dropped and averaged 27,700 mt from 1969 to 1974. Catches then increased to 39,900 mt in 1975, decreased to average about 13,300 mt during 1976-78, then dropped sharply to only 3,400 mt in 1979. During 1980-82, catches averaged only about 4,600 mt but they have increased since 1981. Prior to the inception of the MFCMA, the DWF catch averaged about 49% of the total, ranging from 21% in 1967 to 75% in 1972. During 1969-74, the DWF catch averaged 16,100 mt, increased to 28,600 mt in 1975, then declined to only 2 mt in 1977 before the fleet was excluded from these waters in 1978. During this same period, US catch remained relatively constant, averaging 12,000 mt during 1969-78.

The spring and autumn NEFC bottom trawl survey catch-per-tow indices reached high levels in 1976 and 1975 respectively, and both declined through 1984. In 1985 and 1986 both indices increased sharply due primarily to strong 1984 and 1985 year classes. The index for 1987 declined by a third from that of 1986. The autumn index reached its highest in the time series since 1963. Survey catch-per-tow-at-age data indicate that 1974-75 year classes were quite strong. These year classes supported the increase in commercial catch in 1975. The 1978 and 1982 year classes were also relatively strong in comparison to other years in the 1973 to 1983 time series. The 1983 year class was quite weak, recording its lowest and second lowest indices in the spring and autumn surveys, respectively. The

Figure 4.1 Total commercial landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of silver hake.

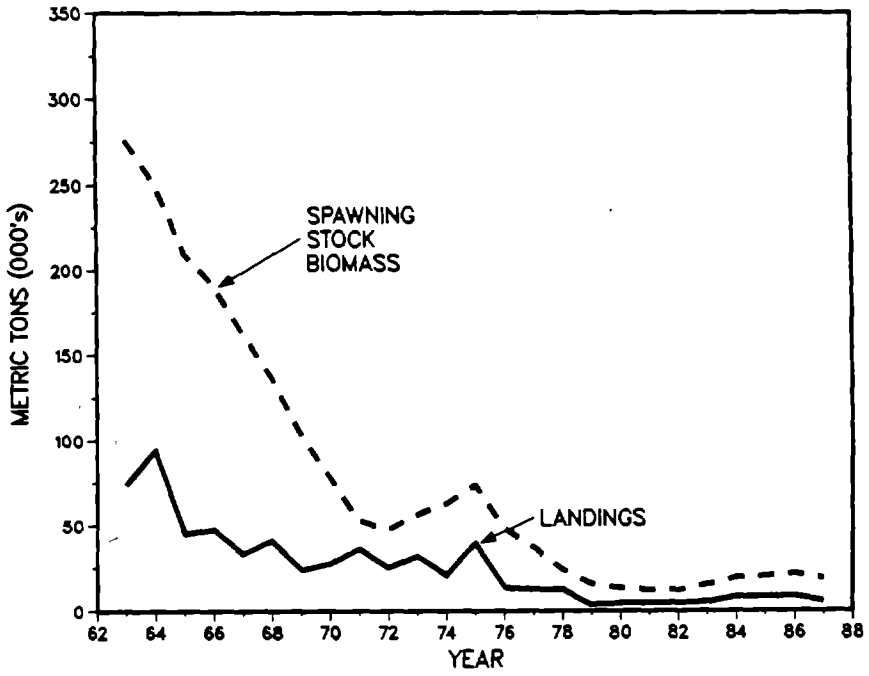



Table 4.1 Nominal catches (thousand metric tons) and management information for silver hake from the Gulf of Maine - Northern Georges Bank stock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 3.4 | 4.7 | 4.4 | 4.7 | 5.3 | 8.3 | 8.3 | 8.5 | 5.7 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 3.4 | 4.7 | 4.4 | 4.7 | 5.3 | 8.3 | 8.3 | 8.5 | 5.7 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | Preliminary FMP in force since 1977 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 23.8 cm (9.4 inches) males<br>25.0 cm (9.8 inches) females |

M = 0.40 $F_{0.1}$ = 0.44 $F_{max}$ > 2.00 $F_{1987}$ = .46

1984 year class appears to be strong. However, the 1985 year class may be the strongest with the autumn 1985 index of age 0 and 1 fish the highest in the time series since 1973.

Fishing mortalities for fully recruited ages determined from VPA ranged between 0.19 and 1.29 during 1955-87 and averaged 0.43. Before the introduction of the DWF, F was fairly steady, averaging 0.27 during 1955-61, however, F rose rapidly with the increased effort placed on the stock beginning in 1962 and reached 0.70 in 1964. In 1965, both landings and F dropped sharply and F stabilized at an average of 0.41 during 1965-70. In 1971 F increased dramatically, reaching 1.29, but dropped to 0.42 in 1972 and fluctuated in alternate years during 1972-78 between 0.28 and 0.78 before dropping to 0.19 in 1979 after the inception of MFCMA. Since 1979, F has remained fairly steady, averaging 0.41 through 1987 (0.46).

Spawning stock biomass increased from 251,800 mt in 1958 to a high of 301,900 mt in 1962 than began a steady ten year decline to 47,900 mt in 1972. As a result of strong 1971 to 1973 cohorts, spawning biomass increased to 73,700 mt in 1975, but declined to only 12,000 mt by 1982. Spawning biomass has increased since 1981 to an estimated 33,500 mt for 1987, and dropped to 18,900 mt at the beginning of 1988.

## Southern Georges Bank - Mid-Atlantic Stock

The international nominal catch of silver hake in 1987 was 9,900 mt. The 1986 USA commercial catch was 9,400 mt, the lowest level since 1976. U.S. fishermen however, maintained the 12.000 mt average catch that prevailed during 1978-83. DWF catch in 1987 was only 12 mt. The DWF catch, from 1963 to the inception of MFCMA in 1977, dominated the total catch from this stock, averaging 87% annually. Recreational catch in 1987 was estimated to be about 100 mt.

Total catches from this stock averaged about 15,500 mt during 1955-61, then increased sharply to 308,500 mt with the introduction of the DWF in 1965, before decreasing to only 28,000 mt in 1970. Catches subsequently increased to about 110,000 mt in 1974, then dropped steadily to 61,300 mt in 1977. Restrictions placed on the foreign fleet in 1978 caused further decreases in total catch to a point where present catch levels, averaging 15,500 mt, are similar to those prior to 1963. The DWF catch of silver hake is now taken primarily as by-catch in the squid fishery.

The autumn catch per tow index decreased from its highest levels from 1963 to 1965 to a low in 1974, and increased slightly between 1975 and 1978 then decreased through 1982. The indices fluctuated between 1983 and 1987. Survey catch per tow at age data indicate that, like the northern stock of silver hake, the 1973-74 year classes were strong in comparison to other years in the time series. Year-class strengths since 1975, with the exception of the 1977, 1981, and 1982 cohorts, were of only average strength, however, the 1985 year class showed quite strong in comparison to other years. The strength of 1986 year class appeared to be below the average level, and the weakest since 1973, while 1987 year class appeared to be better than that of 1986.

Fishing mortality for fully recruited ages from VPA ranged from 0.09 to 0.98 between 1955 and 1986 and averaged 0.45. During 1955-59, F averaged 0.32 but dropped to 0.11 during 1960-62 before rising dramatically with the introduction of the DWF to 0.98 in 1965. During 1968-77, F then dropped and averaged 0.52. With the inception of MFCMA and the restrictions placed on the foreign fishery, F dropped from 0.76 in 1977 to 0.31 in 1980, increased during 1981-84, and averaged 0.33 in 1985-87.

Spawning stock biomass increased from 51,600 mt in 1955 to a series high of 655,700 mt in 1965 before dropping steadily to 143,000 mt in 1970. Biomass then increased to 219,500 mt in 1974, but subsequently declined to only 24,200 mt in 1983. It has increased since then to an estimated 35,700 mt in 1988.

Figure 4.2 Total commercial landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of silver hake.

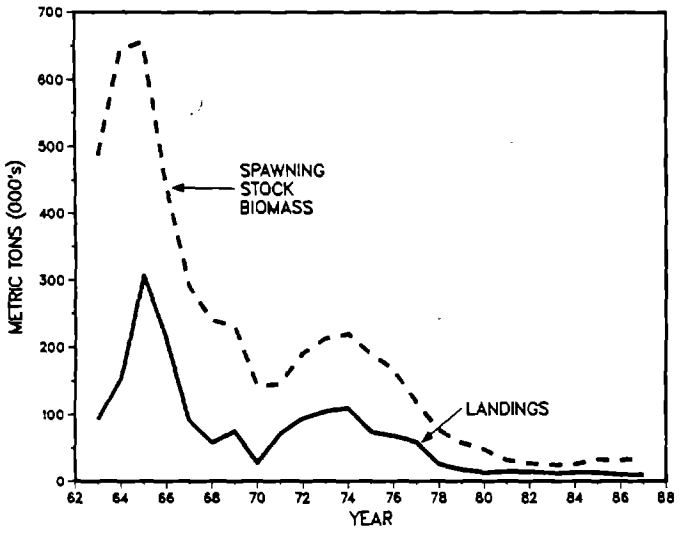



Table 4.2 Nominal catches (thousand metric tons) and management information for silver hake from the Southern Georges Bank - Middle Atlantic stock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 0.4 | 0.1 | 0.1 | 0.3 | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 |
| Commercial | | | | | | | | | |
| USA | 13.1 | 11.7 | 11.7 | 11.9 | 11.5 | 12.7 | 11.8 | 9.4 | 9.8 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | 4.9 | 1.7 | 3.0 | 2.4 | 0.6 | 0.4 | 1.3 | 0.5 | - |
| Total nominal catch | 18.4 | 13.5 | 14.8 | 14.6 | 12.1 | 13.1 | 13.1 | 10.0 | 9.9 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | Preliminary FMP in force since 1977 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 24.7 cm (9.7 inches) males<br>25.7 cm (10.1 inches) females |

M = 0.40 $F_{0.1}$ = 0.35 $F_{max}$ > 2.00 $F_{1987}$ = 0.33

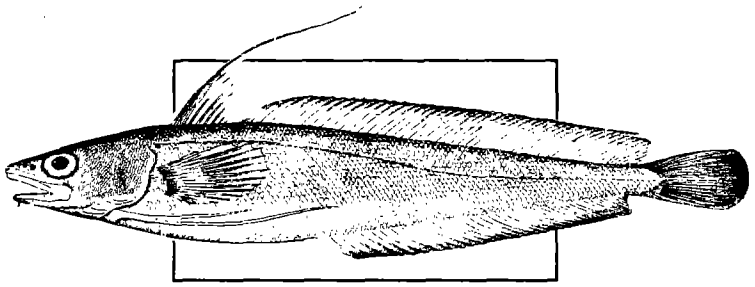
## Reference

Almeida, F. P. 1987. Status of the silver hake resources off the northeast coast of the United States - 1987. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 87-03. 60 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# RED HAKE

## Urophycis chuss

## Ling



## Summary status

*** High abundance, low fishing mortality**
*** Increased catches are possible**

The red hake, *Urophycis chuss*, is widely distributed with a range extending from the Gulf of St. Lawrence to North Carolina, but found in greatest numbers between Georges Bank and New Jersey. Like the silver hake, their general migration patterns indicated by research vessel survey data show over-wintering areas in the deep waters of the Gulf of Maine and along the outer continental shelf and slope south and southwest of Georges Bank. During their spawning period from May through November, red hake are found in the warmer shoal and inshore waters.

Major spawning areas include the southwest part of Georges Bank and the southern New England area south of Montauk Point, Long Island. The maximum length achieved by red hake is approximately 50 cm (19.7 in.). The maximum age is reported to be about 12 years, although fish of ages 8 to 10 are rarely seen.

## Gulf of Maine-Northern Georges Bank

The nominal catch of this stock of red hake in 1987 was 1,000 mt, taken exclusively by the USA vessels. This catch represented about a third less than 1986 and a continuation of the low levels reported since 1977. Trends in total catch from this stock have shown three distinct periods. The first period, from the early 1960s through 1971, was characterized by relatively low catches ranging from about 1,000 to 5,000 mt. The second period, from 1972 to 1976, showed a sharp increase, with catches ranging from 6,300 to 15,300 mt. During this period approximately 93% of the total annual catch was taken by the distant-water-fleet (DWF) on northern Georges Bank. Total catch then dropped sharply and has averaged only 1,100 mt from 1977 to the present, due primarily to the displacement of DWF from the waters inhabited by this stock.

The NEFC spring bottom trawl survey index increased from low levels in the late 1960s, reached a peak in 1973, then declined through 1979. The index increased dramatically in 1980, recording a series high in 1981, and has fluctuated at high levels since. The 1985 value was the third highest recorded in the series. The autumn survey reflected a trend similar to that in the spring, but has demonstrated more variability in recent years. This index also increased from low levels in the 1960s and early 1970s and has maintained a relatively high average during the 1980s. Survey catch-per-tow-at-age data indicate that the 1973 and 1974 year classes were the strongest since 1970. Year classes produced between 1975 and 1979 were of average strength with the exception of a weak 1977 cohort. The 1980 and 1981 year classes appeared to be above average while the 1983 year class appeared to be weak in comparison to other years. Preliminary estimates of the 1985 cohort indicate that it may be quite strong, recording the second highest age O autumn index in the 1970-85 time series. The strength of 1987 year class appeared to be above average.

The combination of minimal fishing pressure, and the average to above average year classes produced since about 1980 has resulted in an apparent increase in stock size as indicated from the NEFC bottom trawl survey. It is unlikely that this stock will undergo

Figure 5.1 Total commercial landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of red hake.

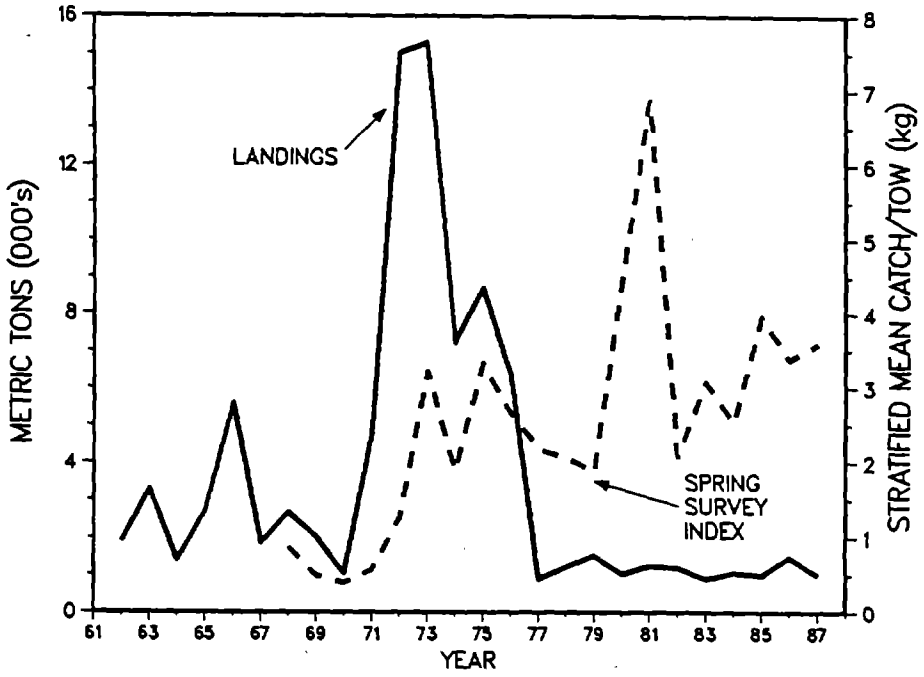



Table 5.1 Nominal catches (thousand metric tons) and management information for red hake from the Gulf of Maine - Northern Georges Bank stock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 1.5 | 1.0 | 1.2 | 1.2 | 0.9 | 1.1 | 1.0 | 1.5 | 1.0 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 1.5 | 1.0 | 1.2 | 1.2 | 0.9 | 1.1 | 1.0 | 1.5 | 1.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | Preliminary FMP in force since 1977 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 28.1 cm (11.1 inches) |

M = 0.40 $F_{0.1}$ = Unknown $F_{max} > 2.00$ $F_{1987}$ = Unknown

any major declines in 1988 if catches remain at or somewhat above the levels reported in recent years.

## Southern Georges Bank-Middle Atlantic Stock

The nominal catch of this stock of red hake in 1987 was 940 mt, a third more than in 1986. Catch in 1986 was the lowest reported in the 1960-86 time series and continued a trend of decreasing catches that began in 1977. The DWF catch was reported to be none. Recreational catch was estimated to be approximately 30 mt.

Total catches from this stock rose dramatically with the introduction of the DWF, from 4,600 mt in 1960 to a high of 108,000 mt in 1966. Catches subsequently declined to 18,700 mt in 1968, increased to 53,400 mt in 1969 then dropped to only 11,900 mt by 1970 before increasing to 61,400 in 1972. Since 1972, there has been a steady decline in total catch, initially because of a modest decline in DWF catch and later because of a sharp decline in DWF catch after of the USSR was excluded from the fishery. From 1965 to 1976 the fishery was dominated by the DWF, which averaged 83% of the total annual catch. Since 1978, the DWF catch has averaged only 10% of the total annual catch due to restrictions placed on the fleet after the inception of MFCMA. The DWF catch of red hake is currently taken as by-catch in the squid fishery.

USA commercial catch increased from 4,300 mt in 1960 to a series high of 32,600 mt in 1964 and then began a steady decline to 4,000 mt in 1966. USA catch has remained relatively steady between 1967 and 1979, when catches averaged 4,100 mt annually, and has since declined steadily.

The NEFC autumn bottom trawl survey index declined steadily from the highest levels in the mid-1960s, remained fairly constant between 1968 and 1973, and then dropped to a series low in 1974. The index increased sharply in 1975, declined slightly and remained fairly steady between 1976 and 1982 at a level similar to that between 1968 and 1973. The index reached the second highest in 1983, dropped sharply in 1984 (almost to the lowest level), but increased in 1985. It dropped again in 1986 and dropped even further in 1987 to the second lowest level since 1963. Survey catch per tow at age indices indicate that the 1974 and 1979 to 1981 year classes were stronger than other years in the series, with the 1974 cohort being the strongest. Other year classes since 1970 appeared to be of only average strength with the exception of the 1983 year class, which appeared to be weak. However, the autumn 1985 prerecruited index was the second highest in the time series, indicating the possibility of a strong 1985 year class.

As with the northern stock of red hake, there has been minimal fishing pressure exerted on this stock in recent years, allowing the age structure to remain fairly stable with three or four year classes contributing strongly to the survey indices. However, the survey indicates that the stock has declined somewhat in recent years. If the 1985 year class is as strong as the autumn index has indicated, then an increase in stock biomass will be expected in the next one or two years.

## Reference

Northeast Fisheries Center. 1986. Report of the Second Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 5.2 Total commercial and recreational landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of red hake.

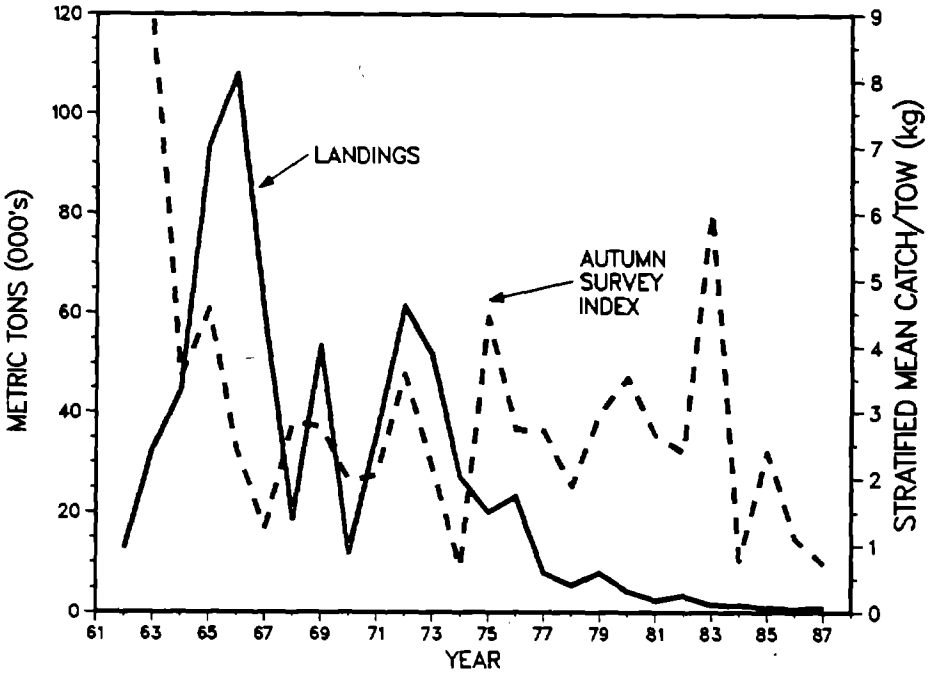



Table 5.2 Nominal catches (thousand metric tons) and management information for red hake from the southern Georges Bank - Middle Atlantic stock.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Commercial | | | | | | | | | |
| USA | 6.6 | 3.9 | 2.1 | 3.0 | 1.3 | 1.2 | 0.8 | 0.6 | 0.9 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | 1.0 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | - | - |
| Total nominal catch | 7.8 | 4.2 | 2.4 | 3.3 | 1.5 | 1.3 | 0.9 | 0.6 | 0.9 |

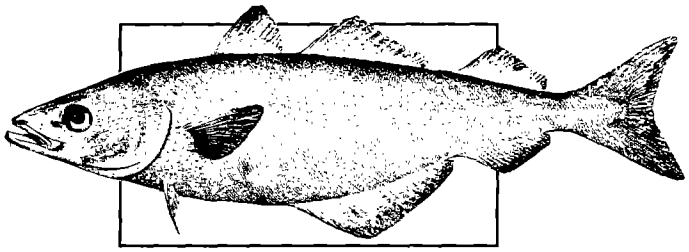
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | Preliminary FMP in force since 1977 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 27.6 cm (10.9 inches) |

M = 0.40 $F_{0.1}$ = Unknown $F_{max}$ > 2.00 $F_{1987}$ = Unknown

# POLLOCK

## Pollachius virens

**Boston bluefish, coalfish, green cod**



## Summary status

*** Record high fishing mortality, catches**
*** Decreased stock size**
*** Last strong year class was 1982**
*** Not meeting management goals**

Pollock, *Pollachius virens*, occur on both sides of the North Atlantic; in the Northwest Atlantic, they are most abundant on the southwestern Scotian Shelf and in the Gulf of Maine. One major spawning area exists in the western Gulf of Maine, and ancillary evidence suggests the potential for significant interchange of pollock between the Gulf of Maine and the Scotian Shelf area. Accordingly, pollock from Cape Breton Island and south have been assessed as a unit. Spawning occurs in winter; juvenile "harbor" pollock are common in inshore areas, but frequent more offshore areas as they grow older. Sexual maturity is essentially complete at age 6. Pollock may attain lengths up to 110 cm (43 in.) and weights of 16 kg (35 lbs).

Pollock have generally been taken as by-catch, although in recent years directed effort has increased. Nominal commercial catches from the entire Scotian Shelf, Gulf of Maine, and Georges Bank region increased from 38,200 mt during 1972-76 to 69,600 mt in 1986. Nominal catches for Canada increased steadily from 24,700 mt in 1977 to 43,300 mt in 1985 and 1986. USA catches have increased from an average of 9,700 mt during 1973-77 to more than 14,000 mt annually since 1978, peaking at 24,500 mt in 1986. Nominal catches by distant water fleets have declined from an annual average of 4,200 mt during 1973-77 to less than 1,000 mt since 1981. Most of this catch has been taken by USSR vessels on the Scotian Shelf. Estimated USA recreational catches have fluctuated between 100 and 1,300 mt since 1979. No information is available for Canadian recreational harvest, although it appears to be of minor importance. The total nominal catch, including recreational, declined slightly to 66,700 mt in 1987.

Increased catches in recent years have been sustained by relatively strong recruitment from the 1975, 1979, and 1982 year classes. In 1987, the 1982 year class accounted for 41% of USA landings and 35% of combined landings. The importance of this year class will increase in 1988 and 1989 as recruitment of year classes since 1982 has been at or below average.

Total stock size, after increasing throughout the late 1970s and early 1980s, has declined substantially since 1985. Canadian commercial abundance indices (mt/hour fished) were also relatively high between 1978 and 1984 but declined sharply in 1985 and 1987. Indices for USA trawlers also indicate similar trends. Abundance indices derived from NEFC spring bottom trawl surveys also increased during the 1970s, but have declined sharply since 1981. Virtual population analysis indicates a decrease in age 2+ stock biomass from 298,000 mt in 1984 to 150,000 mt in 1987.

Equilibrium yield calculations indicate that fishing at $F_{0.1}$ would provide a long-term catch of 47,700 mt from a stock biomass of 300,600 mt, while fishing at $F_{max}$ would provide a catch of 55,000 mt from a stock biomass of 175,200 mt. In 1987, fishing mortality was greater than $F_{max}$.

Figure 6.1 Total commercial and recreational landings and estimates of stock biomass of pollock in the Gulf of Maine, Georges Bank, and Scotian Shelf area.

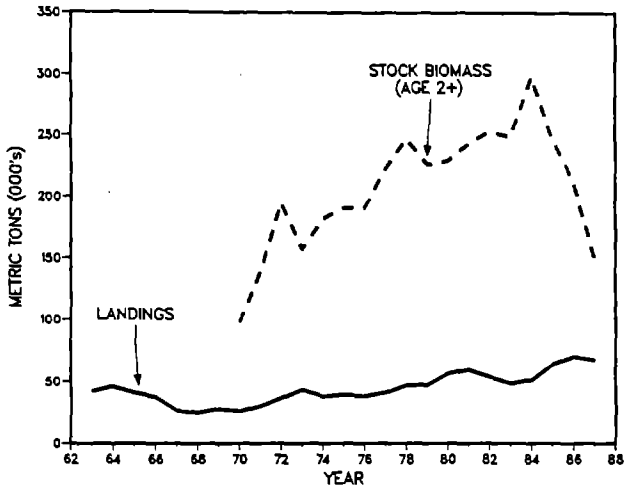



Table 6.1 Nominal catches (thousand metric tons) and management information for pollock from the Gulf of Maine, Georges Bank, and Scotian Shelf area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 0.7 | 1.0 | 0.7 | 1.3 | 1.3 | 0.2 | 0.7 | 0.2 | 0.1 |
| Commercial | | | | | | | | | |
| USA | 15.5 | 18.3 | 18.2 | 14.4 | 14.0 | 17.8 | 19.3 | 24.2 | 20.4 |
| Canada | 30.0 | 36.0 | 40.3 | 38.0 | 32.7 | 33.2 | 43.3 | 44.1 | 45.3 |
| Other | 1.1 | 1.2 | 0.5 | 0.4 | 0.5 | 0.1 | 0.4 | 1.0 | 0.9 |
| Total nominal catch | 47.3 | 56.5 | 59.7 | 54.1 | 48.5 | 51.3 | 63.7 | 69.5 | 66.7 |

| | | |
|---|---|---|
| Long-term potential catch | = | 55,000 mt |
| Importance of recreational fishery | = | Minor |
| Status of management | = | FMP in effect since October 1986 |
| Status of exploitation | = | Fully exploited |
| Projected spawning stock biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 3.7 years |
| Size at 50% maturity | = | 50 cm (20 inches) |

M = 0.20 $F_{0.1}$ = 0.19 $F_{max}$ = 0.45 $F_{1987}$ = 0.54

## Reference

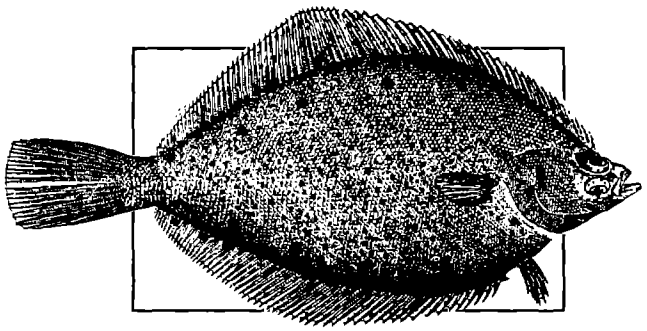
Annand, C., D. Beanlands, J. McMillan, and R. O.Boyle. 1987. The status of the NAFO divisions 4VWX and subarea 5 pollock resource during 1976-86 with yield predicted for 1988. Dartmouth, Nova Scotia: Department of Fisheries and Oceans, Canadian Atlantic Fisheries Scientific Advisory Committee. Research Document 87/96. 56p. Available from: DFO, P.O. Box 1006, Dartmouth, N.S., Canada B2Y4A2.

Mayo, R. K., and S. H. Clark. 1984 An assessment of the pollock Pollachius virens L. stock in the Scotian Shelf, Gulf of Maine, and Georges Bank region. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 84-13. 42p.

# YELLOWTAIL FLOUNDER

## Limanda ferruginea

**Rusty flounder**



**Summary status:**

*** Record low abundance**
*** Extremely high fishing mortality**
*** Weak year classes**
*** 1987 catches lowest in 30 years**
*** Fish too young and exploitation rates too high to meet management goals**

The yellowtail flounder, *Limanda ferruginea*, ranges from Labrador to Chesapeake Bay. Off the USA coast, it occurs in commercially important concentrations on Georges Bank, off Cape Cod, in the Mid-Atlantic, and off Southern New England, generally at depths of 37 to 73 m (20 to 40 fathoms). Yellowtail are also landed by US fishermen on that portion of the Grand Banks of Newfoundland outside the Canadian 200-mile limit (i.e., the "Tail of the Bank"). Yellowtail commonly attain lengths up to 47 cm (18.5 in.) and weights up to 1.0 kg (2.2 lbs); commercial catches tend to be dominated by smaller fish. Yellowtail appear to be relatively sedentary, although seasonal movements have been documented. Spawning occurs during spring and summer peaking in May; larvae drift for a month or more, then assume adult characteristics and become demersal.

Tagging studies and other information indicate that Southern New England, Georges Bank, and Cape Cod yellowtail form relatively discrete groups, although some intermingling does occur. Yellowtail are also fished commercially in the Mid-Atlantic and in the northern Gulf of Maine, but relationships between these groups are unknown at present. Two management units have been recognized in recent years: the Georges Bank unit (east of 69° W) and the Cape Cod, Southern New England, and Mid-Atlantic unit (west of 69° W).

Nominal USA landings of yellowtail flounder in 1987 (all areas) totaled 7,378 mt, 29% less than in 1986, and the lowest annual value for US since 1956. Of the 1987 total, Georges Bank landings comprised 37%, Southern New England landings 21%, Grand Banks landings 21%, Cape Cod landings 16%, Gulf of Maine landings 3%, and Mid-Atlantic landings 2%. Apart from Gulf of Maine and Mid-Atlantic areas, landings in all areas declined between 1986 and 1987.

## Georges Bank East of 69°W

Reported landings for Georges Bank (Statistical Areas 522-525) declined from an average of 14,700 mt during 1972-76 to only 4,600 mt in 1978. Landings increased gradually through 1980 and then rose sharply to 10,700 mt and 11,400 mt in 1982 and 1983, respectively, the highest catch levels since 1976. Subsequent landings declined to only 2,500 mt in 1985, the lowest value on record. Landings increased to 3,000 mt in 1986, due to recruitment of the 1984 year class to the fishery. Nominal catches in 1987 were 2,700 mt, 10% less than in 1986, and the second lowest annual total in the past 30 years (since 1957). During 1985-87, landings averaged about 2,700 mt/yr, the lowest three-year average since 1955-57 and far below the 1963-76 (pre-MFCMA) and 1977-84 (post-MFCMA) average annual catches of 14,100 mt and 7,500 mt, respectively.

The 1987 CPUE index (0.7 mt/day fished, discard not included) declined from 1986 (0.9 mt/day fished), and is the lowest value on record. Survey indices for total number and weight have also declined in 1987. Spring 1987 survey results indicate that the 1984 year class comprises approximately 32% of the population. The number of recruitment

Figure 7.1 Total commercial landings and stock biomass indices from NEFC autumn trawl surveys of yellowtail flounder on Georges Bank east of 69°W longitude.

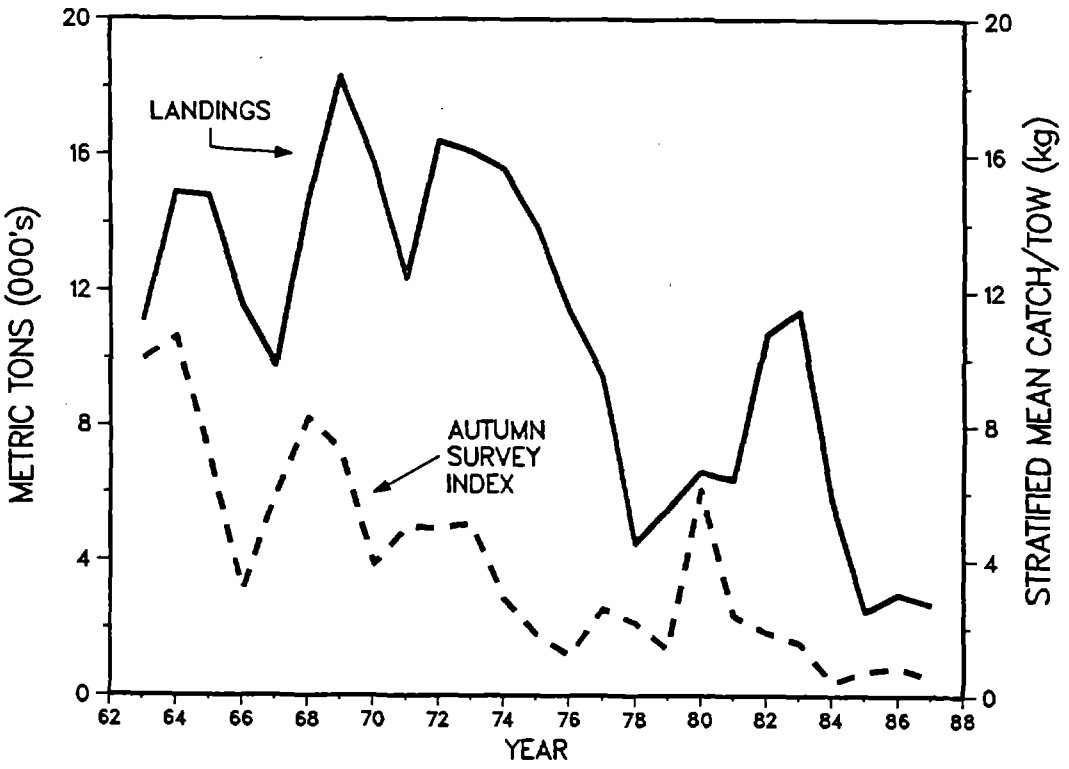



Table 7.1 Nominal catches (thousand metric tons) and management information for yellowtail flounder from the Georges Bank area (east of 69°W).

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 5.5 | 6.5 | 6.4 | 10.7 | 11.4 | 5.8 | 2.5 | 3.0 | 2.7 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 5.5 | 6.6 | 6.4 | 10.7 | 11.4 | 5.8 | 2.5 | 3.0 | 2.7 |

| | | |
|---|---|---|
| Long-term potential catch | = | 16,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of mgt. Northeast multispecies | = | FMP in effect since October 1986, amendment 1 |
| Status of exploitation | = | Overexploited |
| Projected spawning stock biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 26 cm (10 inches) |

M = 0.20 $F_{0.1}$ = 0.30 $F_{max}$ = 0.50 $F_{1987} > F_{max}$

age (2) fish was the lowest in the time series, suggesting that the 1985 year class is a poor one. The number of age 1's does not suggest that recruitment of the 1986 year class will be strong. Fall 1987 survey total number and weight indices were also among the lowest recorded.

Abundance of the Georges Bank yellowtail stock is currently at a record-low level. Prospects for stock recovery in the near future are extremely poor due to poor recruitment and high fishing mortality.

## Southern New England, Mid-Atlantic, Cape Cod, West of 69°W

Southern New England commercial and survey indices declined to very low levels in the mid-1970s; they then increased gradually until 1982-83 with recruitment of the 1980-81 year classes (the strongest in recent years). Total landings in 1987 (1,600 mt) decreased 52% from 1986. Survey indices for 1987 remain at or near the lowest on record. Commercial CPUE indices have also declined markedly, with 1987 representing the historic low. The significant increase (897%) in recruitment age (2) fish observed in the spring 1986 survey led to increases in landings and CPUE during the final calendar quarter of 1986. Spring 1987 survey results indicated that the number of 1984 year class (age 3, one year older) fish had decreased markedly, 44% below the number of age 3s in 1986, due to intense fishing pressure. However, in this diminished state, the 1984 year class still comprises approximately 73% of the current population. The number of recruitment age (2) fish dropped 95% from the 1986 value, becoming the lowest on record, and suggesting that the 1985 year class is poor. Spring 1987 survey results also did not suggest that the 1986 year class is not a strong one.

Trends for the Mid-Atlantic have been generally similar to those observed for Southern New England. Landings during the early 1980s also increased gradually with improved recruitment; the 200 mt landed in 1980 had increased to 1,500 mt by 1983. The landing value of 2,200 mt in 1984 was the highest in recent years. There has since been a trend of decline; 1987 landings (200 mt) represent a return to the lows of the early 1980s. Survey indices declined to very low levels in the mid-1970s, followed by sharp increases in number and weight during 1981-82 with improved year class strength. An equally sharp drop in both number and weight ensued in 1983. The subsequent years. indices have declined to levels similar to those observed during the mid- to late 1970s, with 1987 spring and fall survey values representing the lowest on record.

Prior to 1980, the Cape Cod yellowtail fishery generally appeared more stable than those for other areas. Nominal catch averaged between 1,000 and 2,000 mt from 1960 through 1975, but increased to more than 5,000 mt in 1980. Since then, landings have declined, only 1,100 mt/year during 1984-1987. Estimates of CPUE have also declined. Average CPUE during 1985-1987 (0.7 mt/day fished) was the lowest on record. Recent trends in abundance from spring and autumn survey data are inconsistent: 1987 spring indices (numbers and weight) represent the highest values in the time series, whereas fall 1987 indices are now at or near all-time lows.

## Grand Banks of Newfoundland

In April of 1985, US harvesters began a directed fishery for yellowtail on the Grand Banks of Newfoundland (outside the 200-mile limit). Landings from the Grand Banks in 1985 were 3,797 mt (34% of the US total). Landings have since declined to 2,562 mt in 1986 (25% of the US total); and 1,533 mt in 1987(21% of the US total).

## Reference

Clark, S. H., M. M. McBride, and B. Wells. 1984. Yellowtail flounder assessment update - 1984. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 84-39. 30 p. Available from: Northeast Fisheries Center, woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 7.2 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of yellowtail flounder west of 69°W longitude (southern New England).

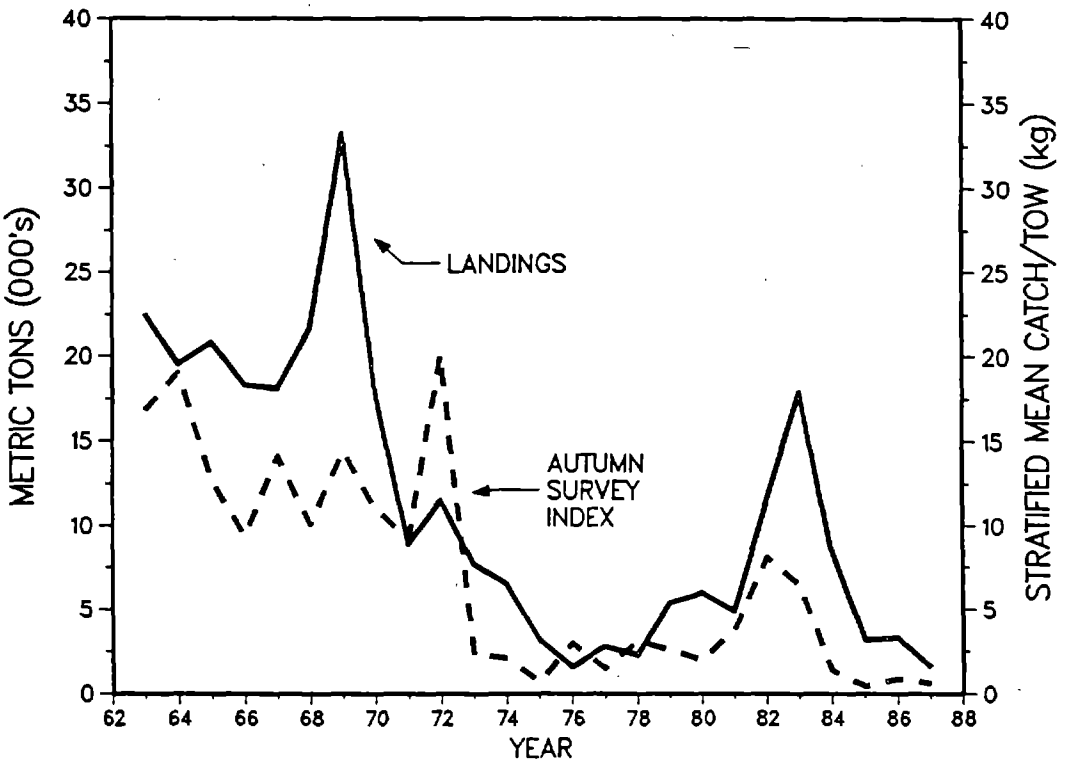



Figure 7.3 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl survey of yellowtail flounder west of 69°W longitude (Mid-Atlantic).

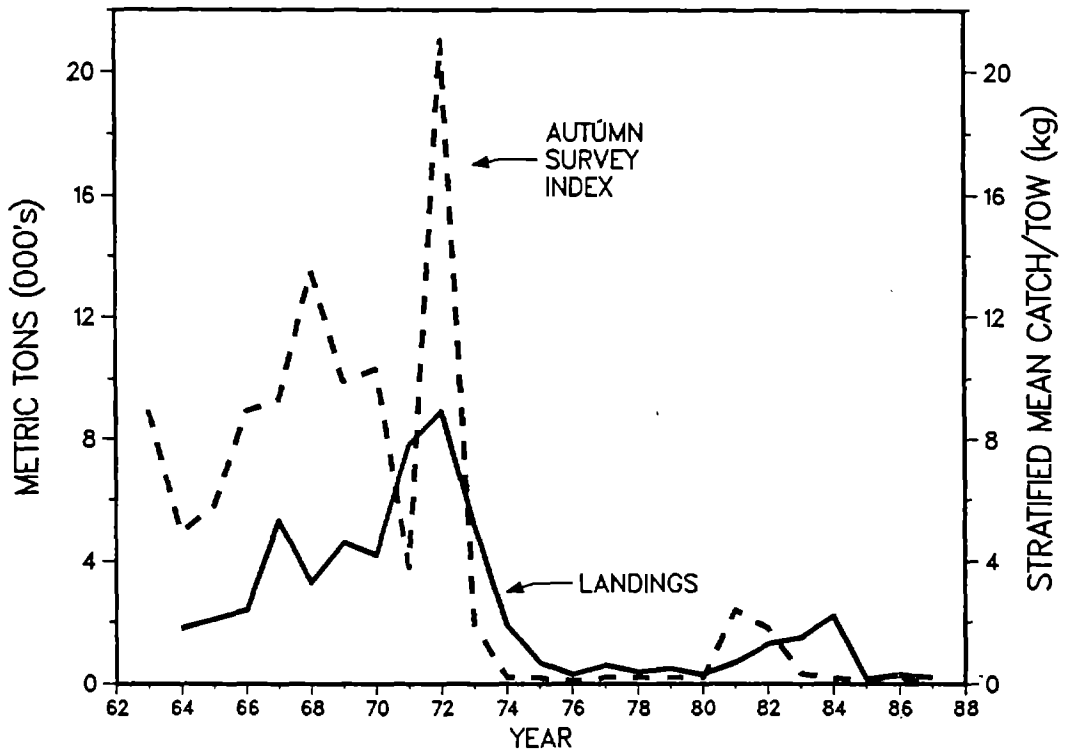


Figure 7.4 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of yellowtail flounder west of 69°W longitude (Cape Cod).

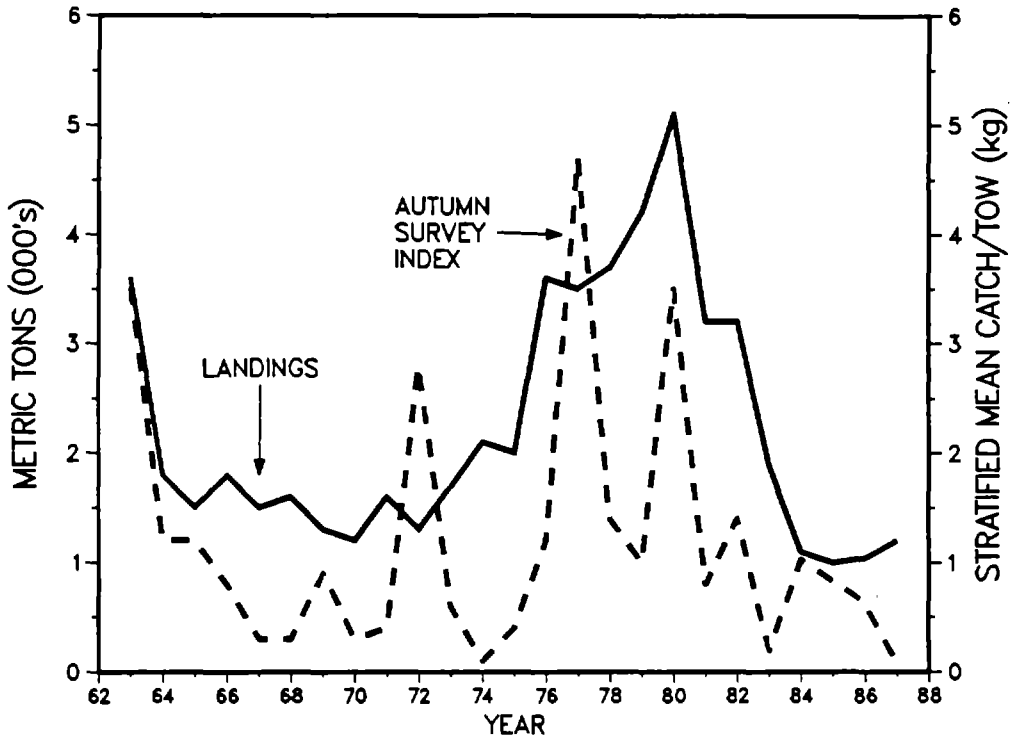



Table 7.2 Nominal catches (thousand metric tons) and management information for yellowtail flounder from the southern New England, Cape Cod, and Mid-Atlantic areas (west of 69°W).

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| So. New England | 5.3 | 6.0 | 4.9 | 11.5 | 17.9 | 8.5 | 3.2 | 3.3 | 1.6 |
| Cape Cod | 4.2 | 5.1 | 3.2 | 3.2 | 1.9 | 1.1 | 1.0 | 1.0 | 1.2 |
| Mid-Atlantic | 0.2 | 0.2 | 0.7 | 1.3 | 1.5 | 2.2 | 0.2 | 0.3 | 0.2 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 9.7 | 11.3 | 8.8 | 16.0 | 21.3 | 11.8 | 4.4 | 4.6 | 3.0 |

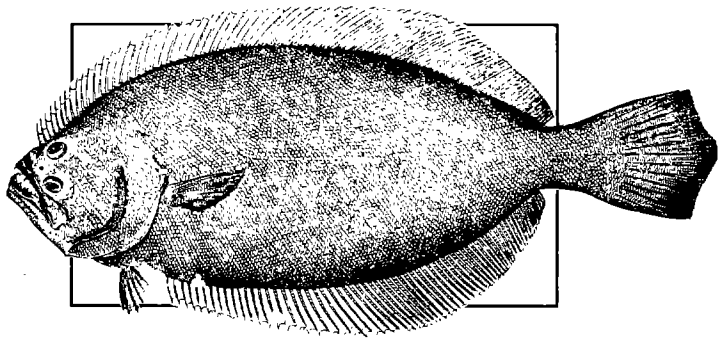
| | | |
|---|---|---|
| Long-term potential catch | = | 23,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of mgt. Northeast multispecies | = | FMP in effect since Oct. 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning stock biomass per recruit | = | Below maintenance level |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 26 cm (10 inches) |

M = 0.20 $F_{0.1}$ = 0.30 $F_{max}$ = 0.50 $F_{1987} > F_{max}$

# SUMMER FLOUNDER

## Paralichthys dentatus

### Flounder, fluke, plaicefish



## Summary status

*** Fluctuating stock with no trend evident since mid-1970s**
*** High catches**
*** Fishing mortality appears high**
*** Fishery needs to target older fish**

The summer flounder or fluke, *Paralichthys dentatus*, occurs from the southern Gulf of Maine to South Carolina. Important commercial and recreational fisheries for summer flounder exist within the Mid-Atlantic Bight (Cape Cod to Cape Hatteras). Summer flounder are concentrated in coastal embayments and estuaries from late spring through early autumn. An offshore migration to the outer continental shelf is undertaken in autumn; larger individuals tend to move to more northerly locations. Spawning occurs during the offshore autumn migration, and the larvae are transported toward coastal areas by prevailing water currents. Development of post-larvae and juveniles occurs primarily within embayments and estuarine areas, notably Pamlico Sound and Chesapeake Bay. Growth rates differ appreciably between the sexes with females attaining weights up to 11.8 kg (26 lbs). Female summer flounder may live up to 20 years, but males rarely exceed 7 years.

Nominal commercial catches of summer flounder averaged 8,300 mt during 1950-60 and declined sharply to 1,700 mt in 1969. Yield began to recover in the early 1970s, reached a high of 14,500 mt in 1979, and averaged 11,000 mt from 1980-87. The USA nominal catch in 1987 was 9,500 mt, a decrease relative to the 1986 level of 11,000 mt. The estimated recreational harvest of summer flounder ranged from 5,000 to 15,900 mt (8.6 to 25.4 million fish) between 1979 and 1986. An additional 2.5 to 16.7 million fish were caught and released alive. Since the inception of the MFCMA, nominal catches by foreign vessels have been very small.

Stock biomass is currently at a higher average level than during the late 1960s and early 1970s, based on NEFC survey indices. The spring survey index rose from 0.06 kg/tow in 1970 to a peak of 1.25 kg/tow in 1976. Since the late 1970s, the survey index has fluctuated widely, from a low of 0.22 kg/tow in 1979 to a high of 0.82 kg/tow in 1985. The 1987 index value dropped to 0.31 kg/tow.

Catch curve analysis of survey and commercial age composition data collected from 1976 through 1983 indicated fishing mortality rates of about 0.8 to 0.9, well in excess of $F_{max}$. Although mortality estimates are not available for the last several year classes, they are assumed to still be above $F_{max}$. Yield per recruit and long-term yield could be increased significantly by increasing the minimum size of fish caught and by reducing fishing mortality.

Figure 8.1. Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of summer flounder in the Georges Bank -Mid-Atlantic area.

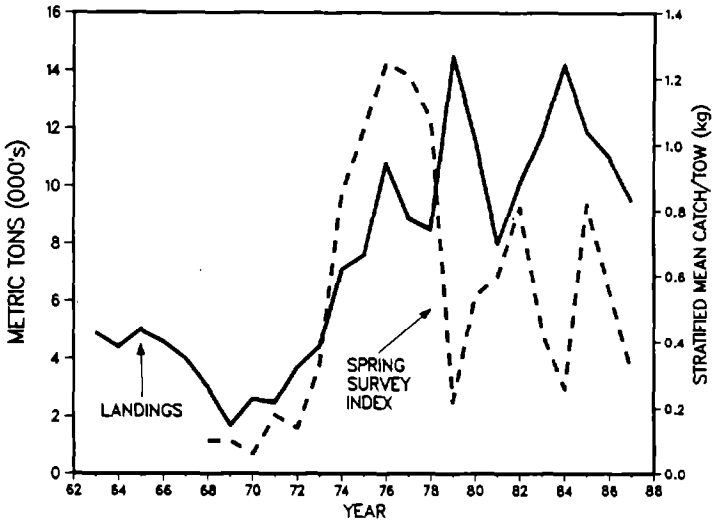



Table 8.1 Nominal catches (thousand metric tons) and management information for summer flounder from the Georges Bank - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 9.2 | 12.2 | 5.0 | 8.0 | 15.9 | 12.5 | 7.1 | 7.8 | 6.3 |
| Commercial | | | | | | | | | |
| USA | 14.5 | 11.5 | 8.0 | 10.1 | 11.8 | 14.2 | 11.9 | 11.1 | 9.5 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - | - | - |
| Total nominal catch | 23.7 | 23.7 | 13.0 | 18.1 | 27.7 | 26.7 | 19.0 | 18.9 | 15.8 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Major |
| Status of management | = | FMP in preparation |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 2 years (females) |
| Size at 50% maturity | = | 32 cm (12.6 inches) |

M = 0.20 $F_{0.1}$ = 0.16 (females) $F_{max}$ = 0.26 (females) $F_{1987}$ = Unknown

## Reference

Northeast Fisheries Center. 1986. Report of the Third NEFC Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

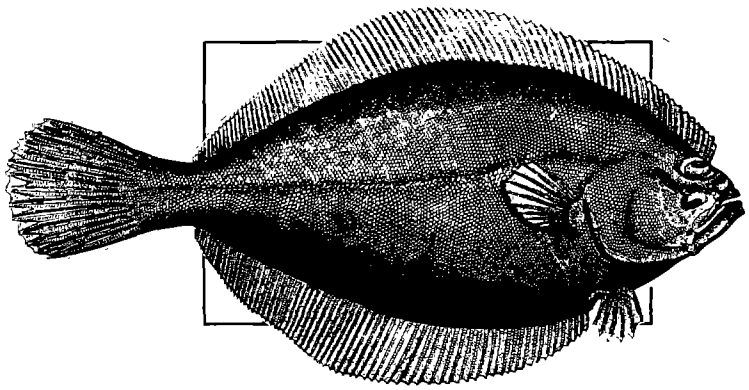
Fogarty, M. J. 1981. Review and assessment of the summer flounder, Paralichthys dentatus, in the North west Atlantic. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 80-22. 57 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Lange, A. M. T. 1984. Long-term effects of change in mesh size on yield of summer flounder. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 84-04. 14 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# AMERICAN PLAICE

## Hippoglossoides platessoides

**American dab, Canadian plaice, long rough dab**



## Summary status

*** Record low abundance, high fishing mortality**
*** Catches have declined since early 1980s**
*** Continued declines expected**

The American plaice or dab, *Hippoglossoides platessoides*, is a large-mouthed, "right-handed" flounder distributed along the Northwest Atlantic continental shelf from southern Labrador to Rhode Island in relatively deep waters. Off the USA coast, the greatest commercial concentrations exist between 90 and 182 m (50 and 100 fathoms). Sexual maturity begins between ages 2 and 3; spawning occurs in spring, generally during March through May. Growth is rather slow; 3-year-old fish are normally between 22 and 28 cm (9 to 11 in.) long and weigh between 90 and 190 g (0.2 and 0.4 lbs). After age 4, females grow faster than males.

Commercial 1987 landings of American plaice from the Gulf of Maine - Georges Bank region were 3,800 mt, 15% less than in 1986, and the lowest annual catch since 1976. The 1987 landings are less than a third of the average for 1984-87 (12,700 mt) and are just slightly greater than the 1960-78 mean of 3,600 mt. USA commercial CPUE indices were relatively stable between 1964 and 1969, declined in the early 1970s, and sharply increased in 1977 when total landings doubled. CPUE indices in the Gulf of Maine peaked in 1981, while Georges Bank CPUE values peaked in 1983; in these years, record CPUE values were attained. Subsequently, annual CPUE indices have sequentially declined.

The 1987 indices in both areas declined relative to 1986 and are among the lowest observed. Effort in 1987, however, was near record high. Between 1960 and 1974, 67%

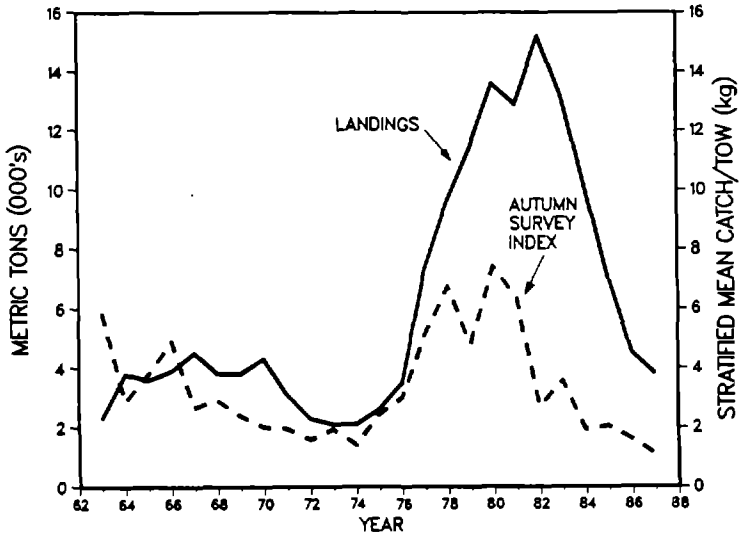



Figure 9.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of American plaice in the Gulf of Maine - Georges Bank area.

of USA landings were from deepwater areas on Georges Bank. Since then, Gulf of Maine landings have exceeded those from Georges Bank. The 1987 Gulf of Maine catch (2,800 mt) was nearly three times as large as that from Georges Bank (1,000 mt). In both areas, however, shifts in landings by vessel class have recently occurred. In 1987, for the fourth year in succession in the Gulf of Maine, plaice landings by small vessels (Class 2: 5 to 50 gross registered tons (GRT)), accounted for less than half of the Gulf of Maine catch. Class 3 (51 to 150 GRT) and Class 4 (151 to 500 GRT) vessels accounted for 44% and 18% respectively of the 1987 total Gulf of Maine landings. On Georges Bank, Class 3 vessels accounted for 63% of the 1987 catch which was 1% above 1986 record low values for this percentage. Landings by Class 4 vessels composed 34% of the Georges Bank total.

In both the Gulf of Maine and Georges Bank regions, the American plaice fisheries became highly directed during 1981 and 1982. In 1981, 70% of the total Gulf of Maine catch was taken by trips in which plaice comprised more than 50% of the trip catch. In 1982, 29% of the Georges Bank landings was taken in such trips. Since then, directed trips have become much less important in accounting for yield. In 1987, directed trips accounted for only 7% of the Gulf of Maine catch and 12% of the Georges Bank catch. Landings trends have generally paralleled trends in NEFC autumn indices.

The 1987 autumn survey weight per tow index continued to decline to the lowest observed in the 25 year time series. The declining trend in survey values since 1980 is consistent with that observed in CPUE values. American plaice abundance, high in the late 1970s, has now been markedly reduced. Due to increased effort, fishing mortality is now too high to sustain annual landings at their present levels. Given these conditions, abundance is expected to remain low during 1988.

## Reference

Northeast Fisheries Center. 1987. Report of the Third Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Sullivan, L.F. 1982. American plaice, Hippoglossoides platessoides, in the Gulf of Maine. Kingston, RI: University of Rhode Island. 96 p. Masters thesis.

Table 9.1 Nominal catches (thousand metric tons) and management information for American plaice from the Gulf of Maine - Georges Bank area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - |
| commercial | | | | | | | | | |
| USA | 11.4 | 13.5 | 12.9 | 15.1 | 13.2 | 10.1 | 7.0 | 4.5 | 3.8 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | ≤0.1 |
| Other | 0.1 | - | <0.1 | - | - | - | - | - | - |
| Total nominal catch | 11.5 | 13.6 | 12.9 | 15.2 | 13.2 | 10.1 | 7.0 | 4.5 | 3.8 |

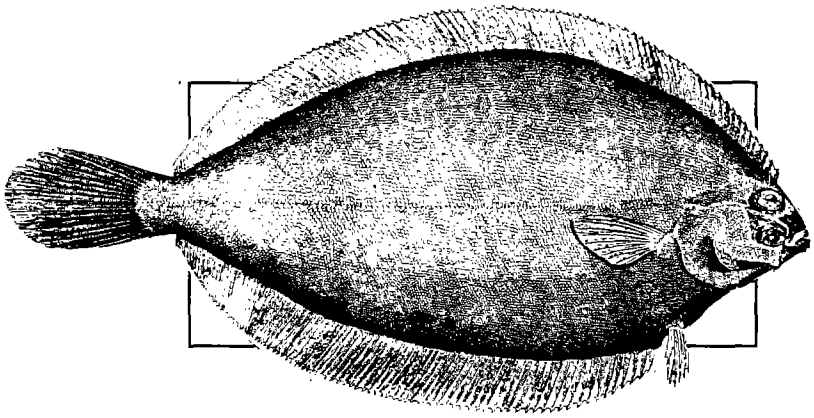
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning stock biomass per recruit | = | Unknown |
| Age at 50% maturity | = | 3.2 yrs (males); 3.8 yrs (females) |
| Size at 50% maturity | = | 25.6 cm (10.1 inches) males; 29.7 cm (11.7 inches) females |

M = 0.20 $F_{0.1}$ = 0.17 $F_{max}$ = 0.34 $F_{1987}$ = Unknown

# WITCH FLOUNDER

## Glyptocephalus cynoglossus

### Gray sole, fluke, pole flounder



## Summary status

*** Near record low abundance**
*** High fishing mortality**
*** Catch decline since 1984 expected to continue**

The witch flounder or gray sole, *Glyptocephalus cynoglossus*, is common throughout the Gulf of Maine and also occurs in deeper areas on and adjacent to Georges Bank and along the shelf edge as far south as Cape Hatteras. Research vessel survey data suggest that the Gulf of Maine population may be relatively discrete from populations in other areas. Witch flounder appear to be sedentary, preferring moderately deep areas; few fish are taken shallower than 27 m (15 fathoms) and most are caught between 110 and 275 m (60 and 150 fathoms). Spawning occurs in late spring and summer. Witch flounder attain lengths up to 60 cm (24 in.) and weights of approximately 2 kg (4.5 lbs).

Since 1960, the USA nominal catch has been distributed almost evenly between Georges Bank and the Gulf of Maine, although in recent years most of the USA catch has come from the latter area. No recreational catches have been reported for this species. Canadian nominal catches from both areas have been minor (less than 50 mt annually since 1970). Distant water fleet catches on Georges Bank averaged 2,600 mt in 1971-72, but subsequently declined sharply and have been negligible since 1977. The total Georges Bank - Gulf of Maine nominal catch increased from 1,000 mt in 1961 to an annual average of 5,700 mt in 1971- 72 and subsequently declined to 1,800 mt in 1976. Nominal catches have since increased more or less continually to 6,500 mt in 1984, but declined to 3,400 mt in 1987, 24% below 1986 levels.

NEFC autumn survey catches seem to accurately reflect trends in biomass. Heavy exploitation by distant water fleets in 1971-72 was followed by a decline in the autumn index from an average of 3.6 kg/tow in 1966-70 to 1.0 kg/tow in 1976. Abundance increased sharply in 1977-78; subsequent indices have been lower, with the 1987 value 2.0 kg/tow below the long-term average; Fall 1987 catch levels were also the lowest observed since that survey began in 1963. There is evidence, based on preliminary catch per unit effort indices and the declining trends in the autumn survey index and total catch to indicate that this resource is being adversely affected by current levels of exploitation. It appears that harvests of 6,000 mt or more cannot be sustained over the long term, given recent and historical trends.

## Reference

Burnett, J. and S. H. Clark. 1983. Status of witch flounder in the Gulf of Maine - 1983. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 83-36. 31 p Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 10.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of witch flounder in the Gulf of Maine - Georges Bank area.

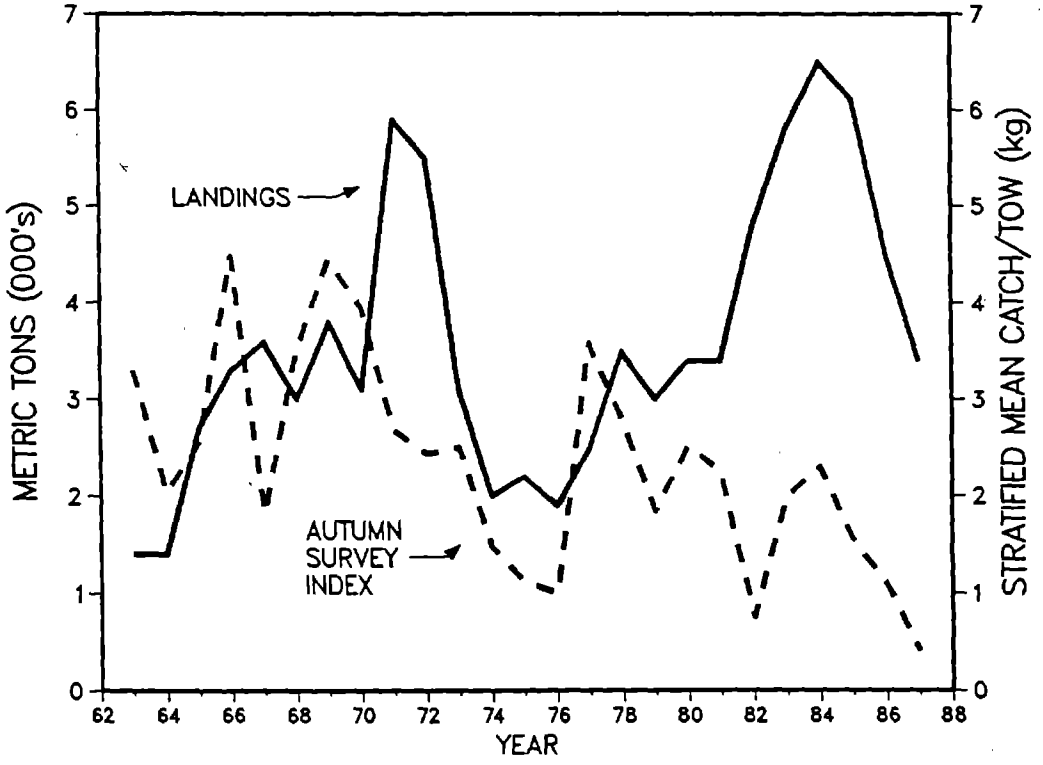



Table 10.1 Nominal catches (thousand metric tons) and management information for witch flounder from the Gulf of Maine - Georges Bank area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 3.0 | 3.4 | 3.4 | 4.8 | 5.8 | 6.5 | 6.0 | 4.5 | 3.4 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 3.0 | 3.4 | 3.4 | 4.8 | 5.8 | 6.5 | 6.1 | 4.5 | 3.4 |

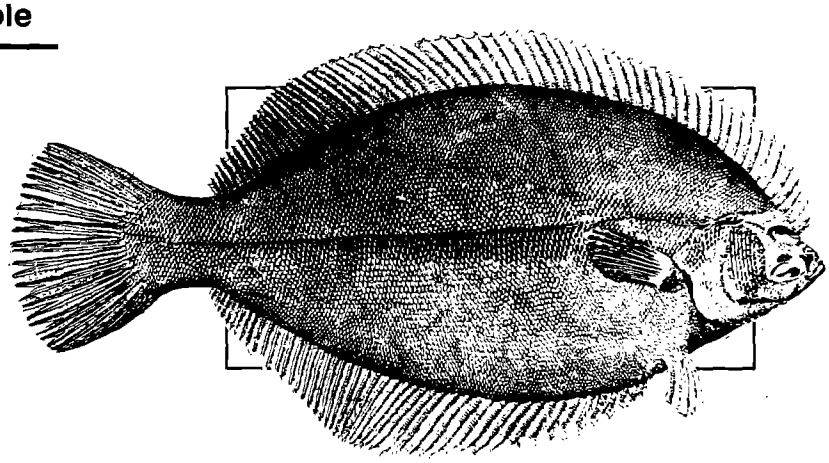
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Over exploited |
| Projected spawning stock biomass per recruit | = | Unknown |
| Age at 50% maturity | = | 4 years (males); 5 years (females) |
| Size at 50% maturity | = | 29 cm (11.4 inches) males; 32 cm (12.6 inches) females |

M = 0.15 $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# WINTER FLOUNDER

## Pseudopleuronectes americanus

### Blackback, lemon sole



## Summary status

*** Near record low abundance**
*** Catch declining since early 1980s**

The winter flounder, blackback, or lemon sole, *Pseudopleuronectes americanus*, is distributed in the Northwest Atlantic from Labrador to Georgia. Abundance is highest from the Gulf of St. Lawrence to Chesapeake Bay. Winter flounder may attain sizes up to 58 cm (23 in.) total length. The diet consists primarily of benthic invertebrates. Movement patterns are generally localized. Small-scale seasonal migrations occur during winter to estuaries, embayments, and saltwater ponds to spawn, and from these locations to deeper water during summer. There is evidence that winter flounder tend to return to the same spawning locations in consecutive years. Restricted movement patterns and differences in growth, meristic, and morphometric characteristics suggest that relatively discrete local groups exist.

Tagging and meristic studies indicate discrete groups of winter flounder north of Cape Cod, east and south of Cape Cod, and on Georges Bank. For descriptive purposes these groups are located within the approximate boundaries of: Gulf of Maine, Southern New England - Middle Atlantic, and Georges Bank respectively. Winter flounder are typically exploited in coastal locations, although offshore shoal areas, particularly Georges Bank and Nantucket Shoals, support important winter flounder fisheries.

## Georges Bank

The estimated recreational catch of winter flounder in 1987 was 4,814 mt, a 33% increase over 1986 but 40% lower than the 1979-85 average.

For the Georges Bank area, commercial fishing increased in 1987 to 2,600 mt, 40% more than 1986 landings. However, 1987 landings were still 35% below the record high landings of about 4,000 mt taken during the early 1980s. CPUE indices in 1986 were among the lowest that have been observed. The NEFC autumn survey index fluctuates widely but has had a downward trend since 1976. While the index increased somewhat in 1986, it declined in 1987 to 0.9 kg/tow, which is near the lowest observed in the 25 year time series.

## Southern New England-Middle Atlantic

In Southern New England - Middle Atlantic area, commercial catch in 1987 was 5,200 mt, a modest 5% increase over 1986 but still well below the peak of 11,600 mt in 1981. Since 1981, catches have generally decreased each year to their current low levels. NEFC spring survey indices have shown similar trends as catches since about 1975, increasing

Figure 11.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of winter flounder from the Georges Bank area.

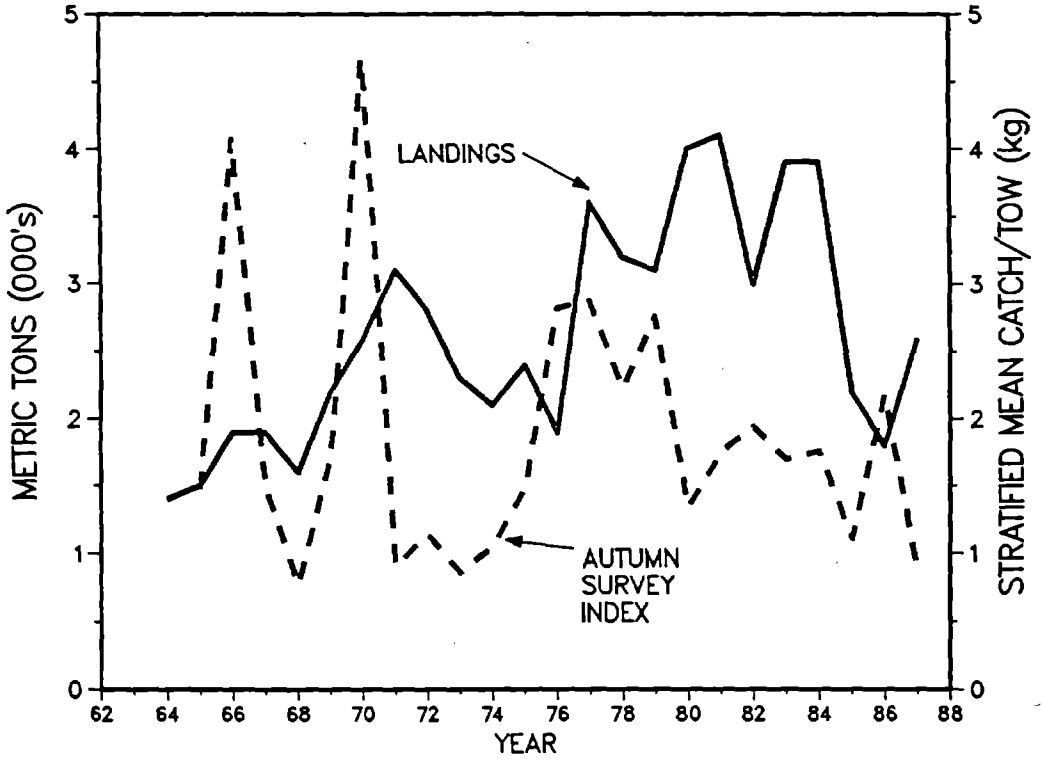



Table 11.1 Nominal catches (thousand metric tons) and management information for winter flounder from the Georges Bank area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 3.1 | 4.0 | 4.1 | 3.0 | 3.9 | 3.9 | 2.2 | 1.8 | 2.6 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 3.1 | 4.0 | 4.1 | 3 0 | 3.9 | 3.9 | 2.2 | 1.8 | 2.6 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Fully exploited |
| Projected spawning stock biomass per recruit | = | Unknown |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 25 cm (9.8 inches) males; 26 cm (10.2 inches) females |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

through 1981 (1.0 kg/tow) and generally declining, with the exception of 1985, until 1986. The 1987 index was 0.3 kg/tow, the same as in 1986.

## Gulf of Maine

In the Gulf of Maine, nominal catches continued to decline from a peak of 2,800 mt in 1982 to 1,200 mt in 1987. The 1987 catch was the lowest since 1976. Nominal catches were relatively low and stable during 1963-74, averaging 1,000 mt, followed by a steady increase to their peak in 1982. Bottom trawl survey abundance indices from the Massachusetts Division of Marine Fisheries spring survey for the Massachusetts Bay sampling area (where the majority of the Gulf of Maine nominal catch is taken) decreased sharply from 1981 to 1983, remained relatively constant during 1984-86, averaging 12.3 kg/tow, but increased to 20.7 kg/tow in 1987.

Based on declining or below average survey indices in most areas and recent and often sharp declines in CPUE, it appears that winter flounder are fully exploited and current catch levels are unlikely to be sustained.

## Reference

Foster, K.L. 1987. Status of winter flounder, Pseudopleuronectes americanus stocks in the Gulf of Maine, Southern New England and Middle Atlantic areas. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 87-06. 70p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Gabriel, W. L. and K. L. Foster. 1986. Preliminary assessment of winter flounder, Pseudopleuronectes americanus on Georges Bank. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-16. 31p. Available from: Northeast Fisheries Center, Woods Hole, MA.

U.S. Department of Commerce. 1986. Status of the Fishery Resources off the Northeastern United States for 1986. Washington, DC: U.S. Department of Commerce, NOAA, NMFS, NEFC. NOAA Technical Memorandum NMFS-F/NEC-43. 130 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 11.2 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of winter flounder in the southern New England - Mid-Atlantic area.

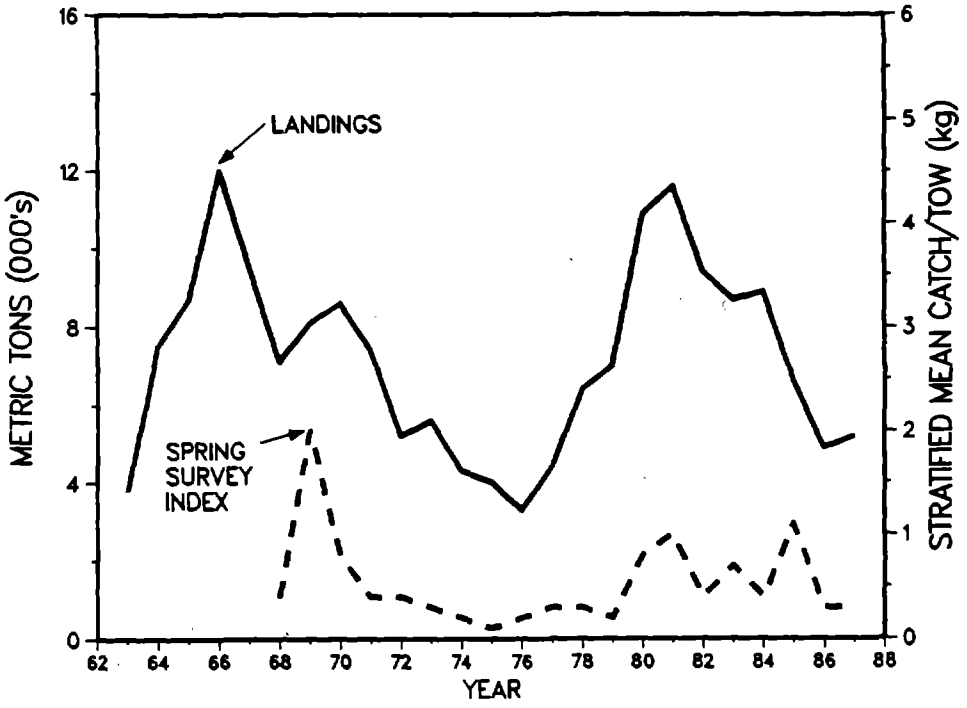



Table 11.2 Nominal catches (thousand metric tons) and management information for winter flounder from the southern New England - Mid Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 11.3 | 6.2 | 7.0 | 7.5 | 6.4 | 7.5 | 9.7 | 3.6 | 4.8 |
| Commercial | | | | | | | | | |
| USA | 7.0 | 10.9 | 11.6 | 9.4 | 8.7 | 8.9 | 6.6 | 4.9 | 5.2 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 17.8 | 16.8 | 18.2 | 16.9 | 15.1 | 16.4 | 16.3 | 8.3 | 10.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 25 cm (9.8 inches) males; 26 cm (10.2 inches) females |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

[1] Recreational catches not separated between the Gulf of Maine and the southern New England - Mid-Atlantic stocks, all are included here.

Figure 11.3 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of winter flounder in the Gulf of Maine area.

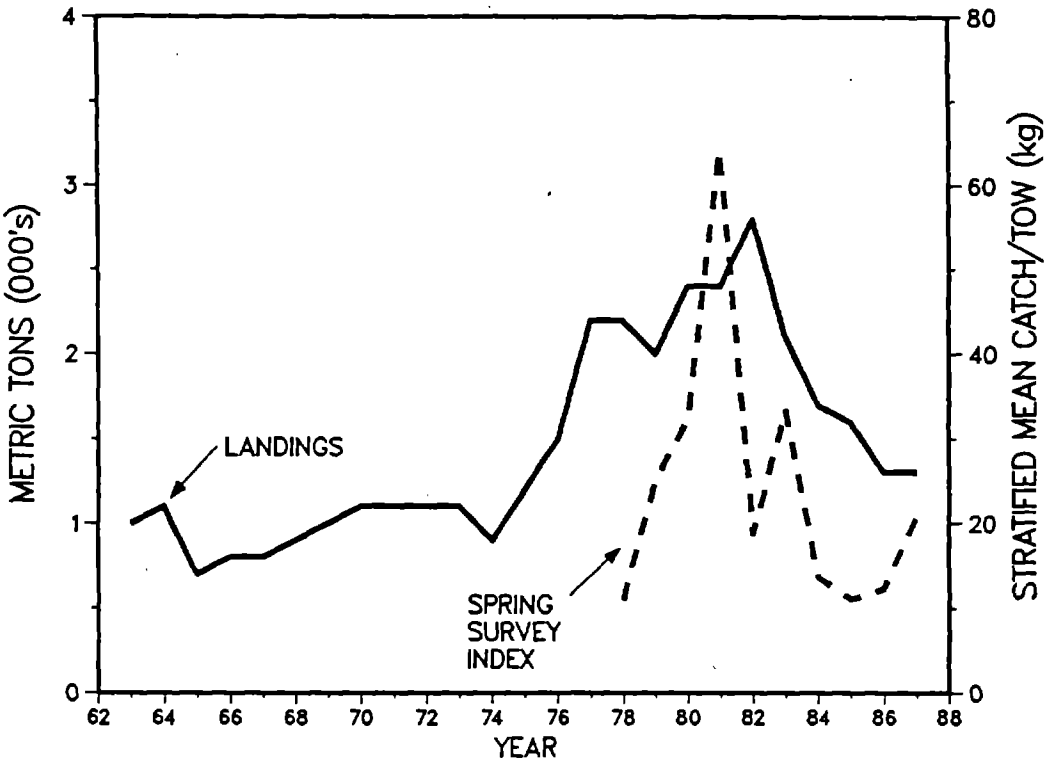


Table 11.3 Nominal catches (thousand metric tons) and management information for winter flounder from the Gulf of Maine area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational[1] | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 2.0 | 2.4 | 2.4 | 2.8 | 2.1 | 1.7 | 1.6 | 1.3 | 1.3 |
| Canada | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 2.0 | 2.4 | 2.4 | 2.8 | 2.1 | 1.7 | 1.6 | 1.2 | 1.3 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | FMP in force since October 1986 |
| Status of exploitation | = | Fully exploited |
| Projected spawning stock biomass per recruit | = | Unknown |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 25 cm (9.8 inches) males; 26 cm (10.2 inches) females |

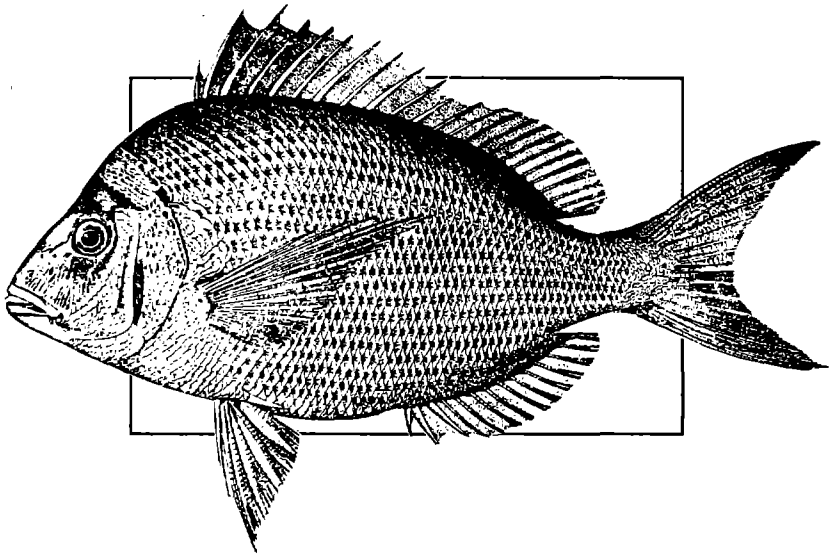
M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

[1] Recreational catches not separated between the Gulf of Maine and the southern New England - Mid-Atlantic stocks, all are included in Table 11.2.

# SCUP

## Stenotomus chrysops

## Porgy



## Summary Status

*** Catches declining since 1981 peak**
*** Stock abundance fluctuating, currently at record low**
*** Need to evaluate fishery effect on stock**

Scup or porgy, *Stenotomus chrysops*, occur primarily in the Mid-Atlantic Bight from Cape Cod to Cape Hatteras. Seasonal migrations occur during spring and autumn. In summer, scup are common in inshore waters from Massachusetts to Virginia, while in winter, scup are found in offshore waters between Hudson Canyon and Cape Hatteras at depths ranging from 70 to 180 m. Sexual maturity is essentially complete by age 2 at a total length of 21 cm (9 in.); spawning occurs during summer months. Although ages up to 20 years have been reported, recent catches have been dominated by age 2 to 3 fish. Scup attain a maximum length of about 40 cm (16 in.). Tagging studies have indicated the possibility of a Southern New England stock and another stock extending south from New Jersey.

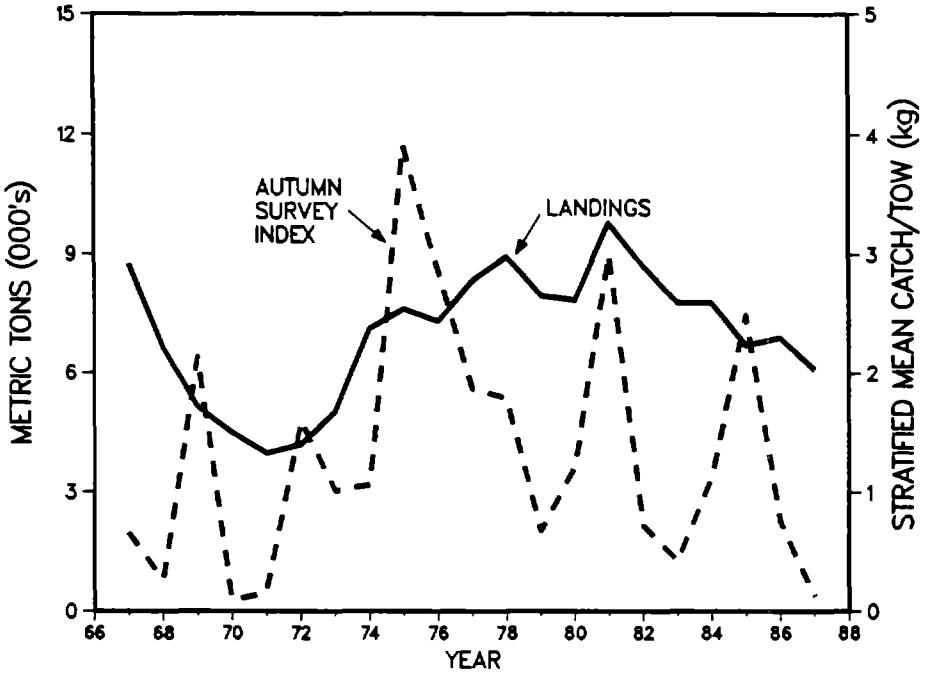



Figure 12.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys in the southern New England - Mid-Atlantic area.

Table 12.1 Nominal catches (thousand metric tons) and management information for scup from the southern New England - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 3.7 | 3.9 | 2.0 | 3.1 | 3.4 | 1.4 | 3.3 | 5.9 | 3.2 |
| Commercial | | | | | | | | | |
| USA | 8.0 | 7.9 | 9.8 | 8.7 | 7.8 | 7.8 | 6.7 | 6.9 | 6.1 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | <0.1 | <0.1 | - | - | <0.1 | <0.1 | <0.1 | - |
| Total nominal catch | 11.7 | 11.8 | 11.8 | 11.8 | 11.2 | 9.2 | 10.0 | 12.8 | 9.3 |

| | | |
|---|---|---|
| Long-term potential catch | = | 10,000 to 15,000 mt |
| Importance of recreational fishery | = | Major |
| Status of management | = | None |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 21 cm (9 inches) |

M = 0.20 $F_{0.1}$ = 0.20 $F_{max}$ = 0.35 $F_{1987}$ = Unknown

[1] Recreational catches unknown.

Nominal commercial catches by USA vessels fluctuated between 18,000 and 22,000 mt annually between 1953 and 1963, but declined to between 4,000 and 5,000 mt during the early 1970s. Nominal catches by distant water fleets peaked at 5,900 mt in 1963, but declined to less than 100 mt per year after 1975.

Beginning in the early 1970s, the USA nominal commercial catch steadily increased and reached a peak of 9,800 mt in 1981. Since 1981, landings have decreased considerably. The 1987 catch decreased to 6,100 mt, 23% below the average for the past eight years, making it the lowest catch during that time period. Most of the earlier increase is attributable to increased fixed gear and otter trawl catches in the Southern New England - New Jersey area. The Virginia winter trawl fishery, which produced nominal catches in excess of 5,000 mt in the early 1960s, has averaged less than 500 mt in the past 10 years. This includes an anomalistic yield of 70 mt in 1985 and below average catches of approximately 270 mt and 230 mt in 1986 and 1987, respectively. The proportion taken by the Virginia fishery has declined from 40 to 60% of the total prior to 1967, to less than 10% since 1973. In New Jersey, catches are now negligible in both the purse seine fishery, which annually accounted for up to 2,500 mt prior to 1964, and the pound net fishery, which formerly produced 1,000 mt per year.

Estimated recreational catches represent 20 to 50% of total nominal catches from 1979 to 1985. The 1987 estimated recreational catch decreased to the mean level after the 1986 series high.

Catch per unit effort of Southern New England otter trawlers increased from 2.2 mt/day fished in 1971 to 6.2 mt/day in 1977 and 1979. Recent values have decreased markedly from 5.9 mt/day fished in 1984 to 3.9 mt/day fished in 1987. The NEFC autumn

survey index (age 1 and older) is quite variable. The index increased sharply from 1979 to the second highest value in the time series in 1981. Since 1981, the index has fluctuated greatly. Recently the 1986 and 1987 indices were both below the long term mean. In fact, the 1987 index was the second lowest of the time series. Generally, in recent years stock abundance appears to have been considerably lower in the Mid-Atlantic area than in the Southern New England area. But, in 1987 there was an anomaly of young-of-the-year (YOY) scup in the Mid-Atlantic area. These YOY did not appear to be present in the Southern New England area. The large catches of YOY were concentrated in two inshore strata east of Delaware Bay.

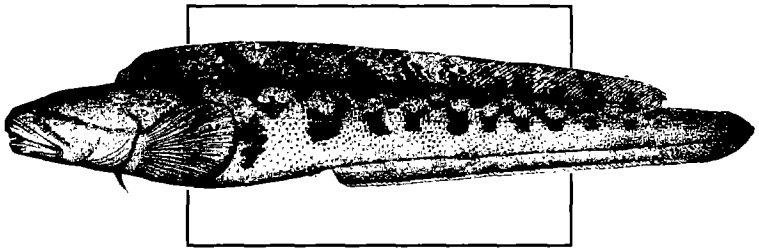
Instantaneous fishing mortality (F) in the Southern New England area was estimated to be about 0.3 in 1981 but may have increased in recent years due to decreased CPUE compared to 1981.

## Reference

Mayo, R. K., 1982. An assessment of the scup, Stentotomus chrysops, L., population in the Southern New England and Mid-Atlantic regions. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 82-46, 59 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Fourth Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 87-07. 101 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# OCEAN POUT



**Macrozoarces americanus**

**Eelpout, congo eel, muttonfish**

## Summary status

*** Decreasing stock abundance since 1985**
*** Recent catch levels probably not sustainable**

The ocean pout, *Macrozoarces americanus*, is a demersal eel-like species ranging from Labrador to Delaware that attains lengths of up to 98 cm (39 in.) and weights of 5.3 kg (14.2 lb). Ocean pout prefer depths of 15 to 80 meters and temperatures of 6° to 7°C. Tagging studies and NEFC bottom trawl survey data indicate that ocean pout do not undertake extensive migrations, but rather move seasonally to different substrates. During winter and spring, ocean pout feed over sand or sand-gravel bottom and are vulnerable to otter trawl fisheries. In summer, ocean pout stop feeding and move to rocky areas, where they spawn in September and October. The demersal eggs are guarded by both parents until hatching. During this period ocean pout are not available to commercial fishing operations. Catches typically increase again when adults return to their feeding grounds in late autumn and winter. The diet consists primarily of invertebrates: brittle stars, sand dollars, sea urchins, and bivalves, with fish being only a minor component. Stock identification studies suggest the existence of two stocks: one occupying the Bay of Fundy area and the northern Gulf of Maine east of Cape Elizabeth, and a second stock ranging from Cape Cod Bay south to Delaware. This southern stock is characterized by faster growth rates, and to date has supported the commercial fishery.

Commercial interest in ocean pout has fluctuated widely. Ocean pout were marketed as a food fish during World War II, and landings peaked at 4,500 mt in 1943. However, an outbreak of a protozoan parasite that caused lesions eliminated consumer demand for ocean pout as a food item. From 1964 to 1974, an industrial fishery developed, and nominal catches for the USA averaged 4,700 mt during these years. Soviet vessels began harvesting ocean pout in large quantities in 1966 with nominal catches peaking at 27,000 mt in 1969. Foreign catches subsequently declined substantially and none have been reported since 1974. USA nominal catches declined to an average of 600 mt annually from 1975 to 1983. Catches increased in 1984 and 1985 to 1,300 mt and 1,500 mt respectively, due to the development of a small directed fishery in Cape Cod Bay supplying the fresh fillet market. Although landings fell to 800 mt in 1986, catches increased markedly in 1987 to 2,200 mt, the highest annual total since 1974. Landings from Cape Cod Bay and southern New England dominated the catch, accounting for 58% and 34% respectively, of the total 1987 USA harvest. Ocean pout are taken primarily during the winter and spring (December to May) with virtually no catches reported during the remainder of the year.

Due to the ocean pout's pattern of seasonal distribution, the NEFC spring survey index is more useful than the autumn survey for evaluating relative abundance. From 1968 to 1975 (encompassing peak levels of foreign fishing and the domestic industrial fishery), commercial landings and NEFC spring survey indices followed similar trends; both declined from historic high values (27,000 mt and 6.15 kg/tow) in 1969 to lows of 300 mt and 1.34 kg/tow, respectively, in 1975. Between 1975 and 1985, survey indices increased to record high levels, peaking in 1981 and 1985 to more than 7.0 kg. per tow. Subsequently, survey catch per tow indices declined; the spring 1987 index (2.7 kg. per

tow) was the lowest since 1979 and one of the lowest ever recorded. Declining relative abundance coupled with increasing nominal catches suggests that fishing mortality has rapidly increased. Catches at the present level do not appear to be sustainable.

## Reference

Olsen , Y. H. and D. Merriman. 1946. Studies on marine the marine resources of Southern New England, IV. The Biology and economic importance of the ocean pout, Macrozoarces americanus (Bloch and Schneider). Bull. Bingham Oceanogr. Collec. 9:1-184.

Orach-Meza, F.L. 1975. Distribution and abundance of ocean pout, Macrozoarces americanus Bloch and Schneider) in western North Atlantic Ocean. Kingston, RI: University of Rhode Island. Master's thesis.

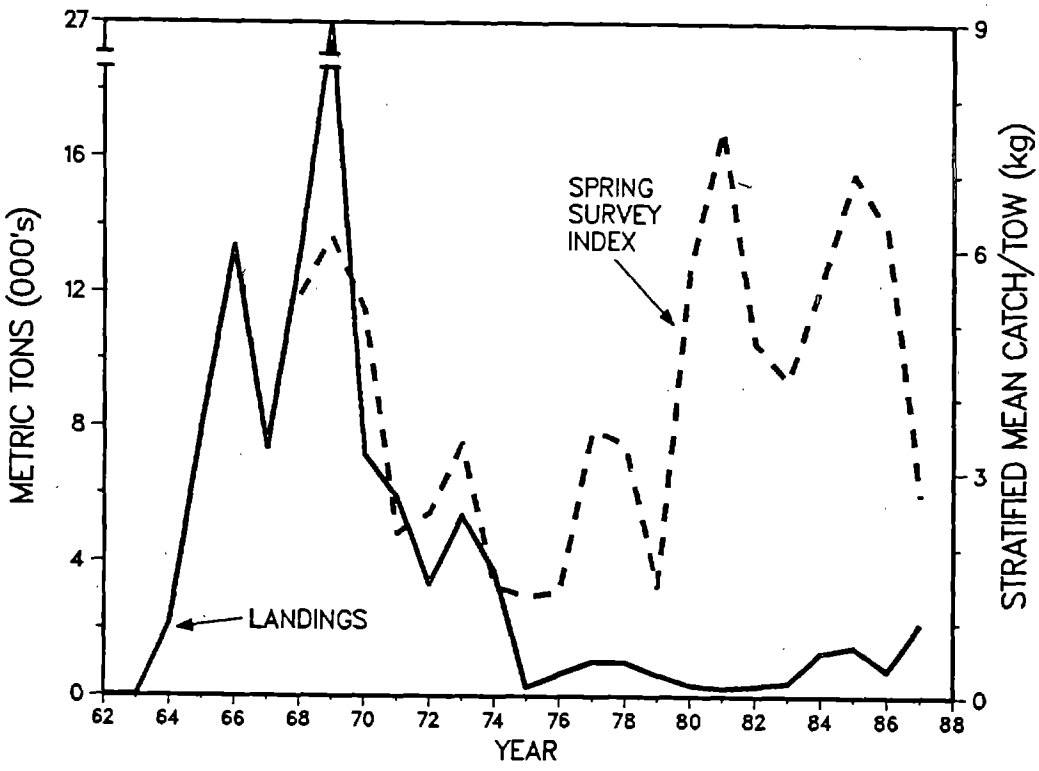



Figure 13.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of ocean pout in the Mid-Atlantic - Gulf of Maine area.

Table 13.1 Nominal catches (thousand metric tons) and management information for ocean pout from Middle Atlantic - Gulf of Maine area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 0.7 | 0.4 | 0.3 | 0.3 | 0.4 | 1.3 | 1.5 | 0.8 | 2.2 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 0.7 | 0.4 | 0.3 | 0.3 | 0.4 | 1.3 | 1.5 | 0.8 | 2.2 |

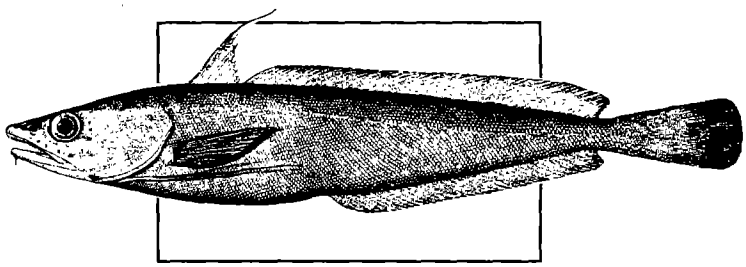
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Moderately exploited |
| Age at 50% maturity | = | Unknown |
| Size at 50% maturity | = | Unknown |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# WHITE HAKE

## Urophycis tenuis

**Boston hake, black hake, mud hake, hake, ling**



## Summary status

*** Stable stocks since 1970s**
*** Landings increased until last several years**
*** Recent catch levels not likely sustainable**

The white hake, *Urophycis tenuis*, is a boreal species that is common on muddy bottom throughout the Gulf of Maine. Stock boundaries are uncertain, although research vessel survey data indicate that the Gulf of Maine population is more or less discrete from populations further east. Depth distribution varies by age and season; juveniles typically occupy shallower areas than adults, but individuals of all ages tend to move inshore or shoalward in spring and summer, dispersing to deeper areas in autumn. Most trawl catches are taken at depths of 110 m (60 fathoms) or more, although they are taken as shallow as 27 m (15 fathoms) during gillnetting operations in summertime.

In the Gulf of Maine region, spawning occurs in winter and spring although the season is not clearly defined. White hake attain total lengths of 135 cm (53 in.) and weights of up to 21 kg (46 lbs.) with females being larger. Ages of over 20 years have been documented in the Gulf of Maine. Juveniles feed primarily upon shrimp and other crustaceans, but fish become more important with approaching maturity and adults feed almost exclusively on other fish, including juveniles of their own species.

The USA nominal catch has been taken primarily in the western Gulf of Maine both incidentally to directed operations for other demersal species and as an intended component in mixed species fisheries. Since 1968, USA vessels have accounted for approximately 94% of the Gulf of Maine - Georges Bank white hake catch. Total nominal catch increased steadily from less than 1,000 mt during the late 1960s to a peak level of 7,500 mt in 1984. The nominal catch has since declined to 6,200 mt in 1987. The increase evident throughout the 1970s and early 1980s likely reflects both a general increase in incidental catches associated with the greater fishing power of the expanded New England otter trawl fleet and an increase in directed fishing effort toward white hake. Small individuals are difficult to distinguish from red hake, *Urophycis chuss*, resulting in an unknown degree of bias in reported nominal catches.

The NEFC autumn survey biomass index has fluctuated without any consistent long-term trends since the early 1970s, although total landings tended to follow inter-annual deviations in biomass until the early 1980s. Except for an anomalous decline in the survey index in 1982, recent indices for 1981 to 1987 have been quite stable, while catches have continued to remain high relative to pre-1981 levels. However, declines in 1986 and 1987 catches suggest that harvest levels in excess of 7,000 mt, evident in 1984 and 1985, cannot be sustained at current biomass levels.

## Reference

Burnett, J., S. H. Clark, and L. O.Brien. 1984. A preliminary assessment of white hake in the Gulf of Maine Georges Bank area. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 84-31. 33 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 14.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of white hake in the Gulf of Maine - Georges Bank area.

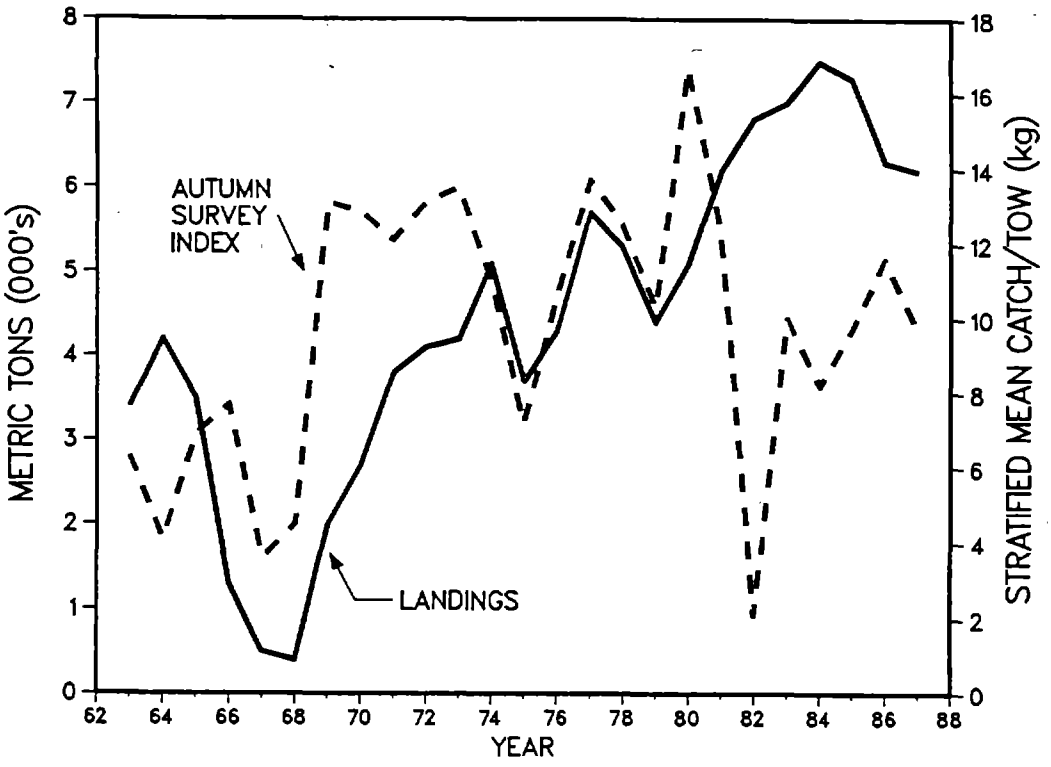



Table 14.1 Nominal catches (thousand metric tons) and management information for white hake from the Gulf of Maine - Georges Bank area.

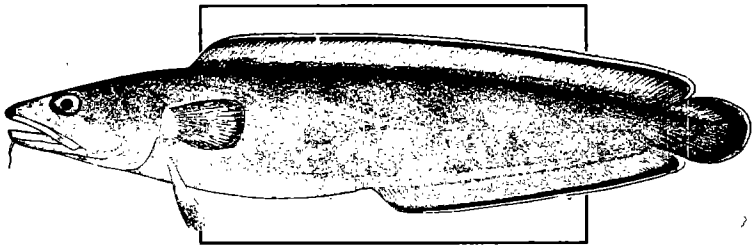
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Commercial | | | | | | | | | |
| USA | 4.1 | 4.8 | 5.7 | 6.0 | 6.2 | 6.5 | 6.4 | 5.3 | 5.5 |
| Canada | 0.3 | 0.3 | 0.5 | 0.8 | 0.8 | 1.0 | 0.9 | 1.0 | 0.7 |
| Other | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Total nominal catch | 4.4 | 5.1 | 6.2 | 6.8 | 7.0 | 7.5 | 7.3 | 6.3 | 6.2 |

| | | |
|---|---|---|
| Long-term potential catch | = | 5,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in effect since October 1986 |
| Status of exploitation | = | Fully exploited |
| Projected spawning stock biomass per recruit | = | Unknown |
| Age at 50% maturity | = | Unknown |
| Size at 50% maturity | = | 42 cm (16.5 inches) |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# CUSK

## Brosme brosme



## Summary status

*** Catches declining in recent years**
*** Stock abundance fluctuating**

The cusk, *Brosme brosme*, is a deepwater species that is found in rocky, hard bottom areas throughout the Gulf of Maine. Spawning occurs in spring and early summer; eggs rise to the surface where hatching and larval development occur. Juveniles move to the bottom at about 5 cm (2 in.) in length where they become sedentary and rather solitary in habit. Individuals commonly attain lengths up to 80 cm (32 in.) and weights up to 4.5 kg (20 lbs). Little is known about stock structure.

Between 1977 and 1987, annual landings of cusk from the Gulf of Maine - Georges Bank region ranged between 1,400 mt (1977) and 4,000 mt (1981) and averaged 2,300 mt per year. In this period, 75% of the catch was taken by the USA with almost all the remainder taken by Canada. The bulk of the USA catch has been taken from the Gulf of Maine while nearly all of the Canadian catch has been from Georges Bank.

In 1987, cusk landings totaled 1,600 mt, 16% less than in 1986. The 1987 USA catch was 1,400 mt and accounted for 87% of the total yield. Canadian landings in 1987 were 300 mt. Historically, otter trawls have accounted for between 50 and 87% of the annual USA landings. Before 1985, longline landings never exceeded 2% of the total. In 1985 and 1986, longline landings of cusk increased dramatically to 23% of the total landings as a result of a new auto-longline fishery. However, this new auto-longline fishery collapsed during 1987 and longline landings fell to 90 mt, 6% of the total. Otter trawls accounted 70% of the landings in 1987 while gill nets and live trawls accounted for most of the remainder (13% and 10% respectively).

NEFC spring and autumn survey indices have fluctuated considerably. From 1982 to 1985, the autumn indices had been increasing, but in 1987 the index decreased. The spring index, which had increased markedly in 1985, also decreased in 1986 and again in 1987.

## Reference

Bigelow, H.B. and W.C. Schroeder, 1953. Fishes of the Gulf of Maine. Cambridge, MA: Harvard University. Museum of Comparative Zoology.

Figure 15.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of cusk in the Gulf of Maine - Georges Bank area.

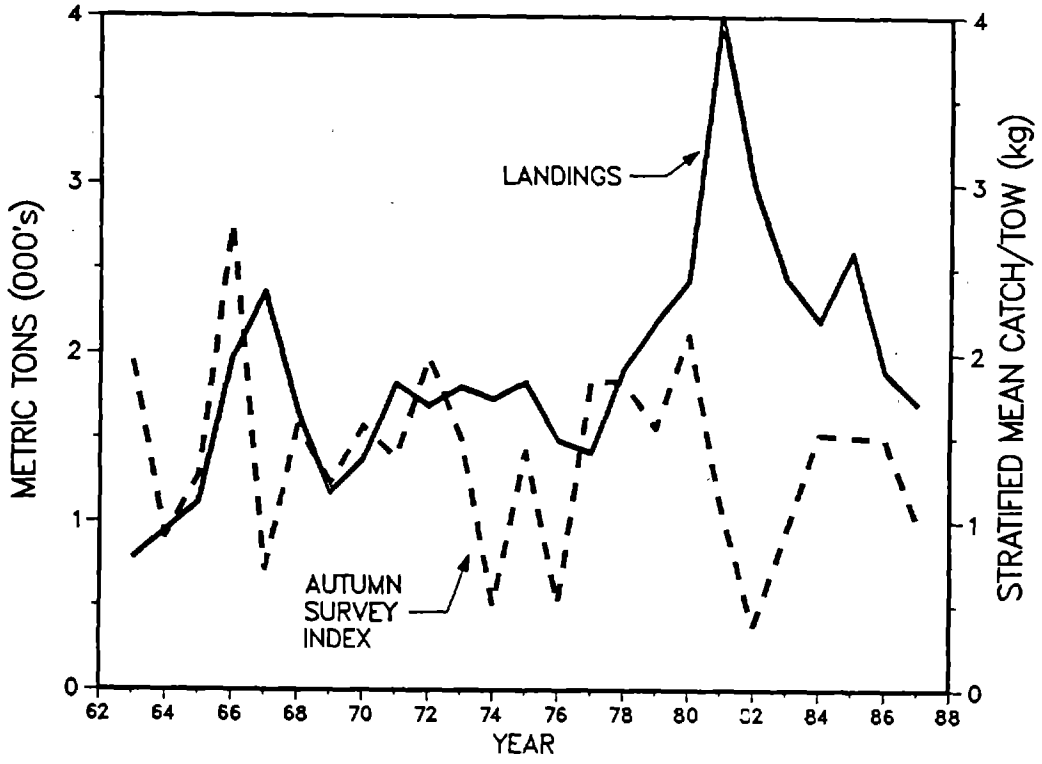



Table 15.1 Nominal catches (thousand metric tons) and management information for cusk from the Gulf of Maine - Georges Bank area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Commercial | | | | | | | | | |
| USA | 1.7 | 1.8 | 1.9 | 1.8 | 1.8 | 1.7 | 2.3 | 1.8 | 1.4 |
| Canada | 0.5 | 0.6 | 2.1 | 1.2 | 0.6 | 0.5 | 0.3 | 0.1 | 0.3 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 2.2 | 2.4 | 4.0 | 3.0 | 2.4 | 2.2 | 2.6 | 1.9 | 1.7 |

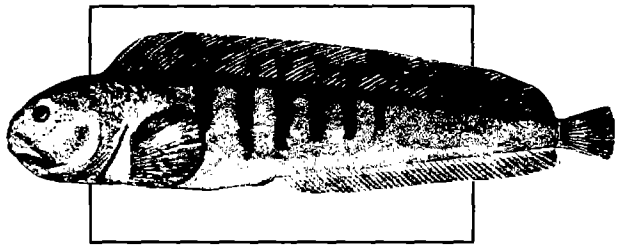
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | Unknown |
| Size at 50% maturity | = | Unknown |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# ATLANTIC WOLFFISH

## Anarhichas lupus

### Catfish, ocean white-fish



## Summary status

*** Stock abundance at record low**
*** Recent catch levels declining**

The wolffish or catfish, *Anarhichas lupus*, is a cold water species of relatively minor importance in Gulf of Maine fisheries. Northeast Fisheries Center research vessel surveys indicate that populations on Georges Bank and in the western Gulf of Maine are discrete from groups in the Browns Bank - Scotian Shelf area. West of the Scotian Shelf, abundance appears to be highest in the southwestern portion of the Gulf of Maine from Jeffreys Ledge to the Great South Channel at depths of 80 to 120 m (45 to 65 fathoms). Wolffish are sedentary and rather solitary in habit, and populations tend to be rather localized. Little is known about the biology of this species. Individuals may attain lengths of 150 cm (59 in.) and weights of perhaps 18 kg (40 lbs). They are significant shellfish predators.

Wolffish have been taken primarily as by-catch, although the species may also be an intended component in some mixed fishery situations. Since 1970, the USA nominal commercial catch has been about evenly divided between Georges Bank and the Gulf of Maine. In the last two decades, USA vessels have taken over 75% of the total Georges Bank - Gulf of Maine catch, with most of the remainder taken by Canadian fishermen. Recreational catches have been minor. The total Georges Bank - Gulf of Maine nominal catch increased from 200 mt in 1970 to an average of around 1,000 mt since 1980. US landings in 1986 were just over 700 mt, a decline of around 20% from 1986 and have been declining at a rate of 100 to 200 mt a year since 1983. The NEFC spring survey index has fluctuated considerably while exhibiting a downward trend in recent years. The autumn survey index has also shown a downward trend in recent years and declined sharply in 1987 by more than 60% of the 1986 value.

## Reference

Bigelow, H. B. and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. Cambridge, MA: Harvard University. Museum of Comparative Zoology.

Figure 16.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic wolffish in the Gulf of Maine - Georges Bank area.

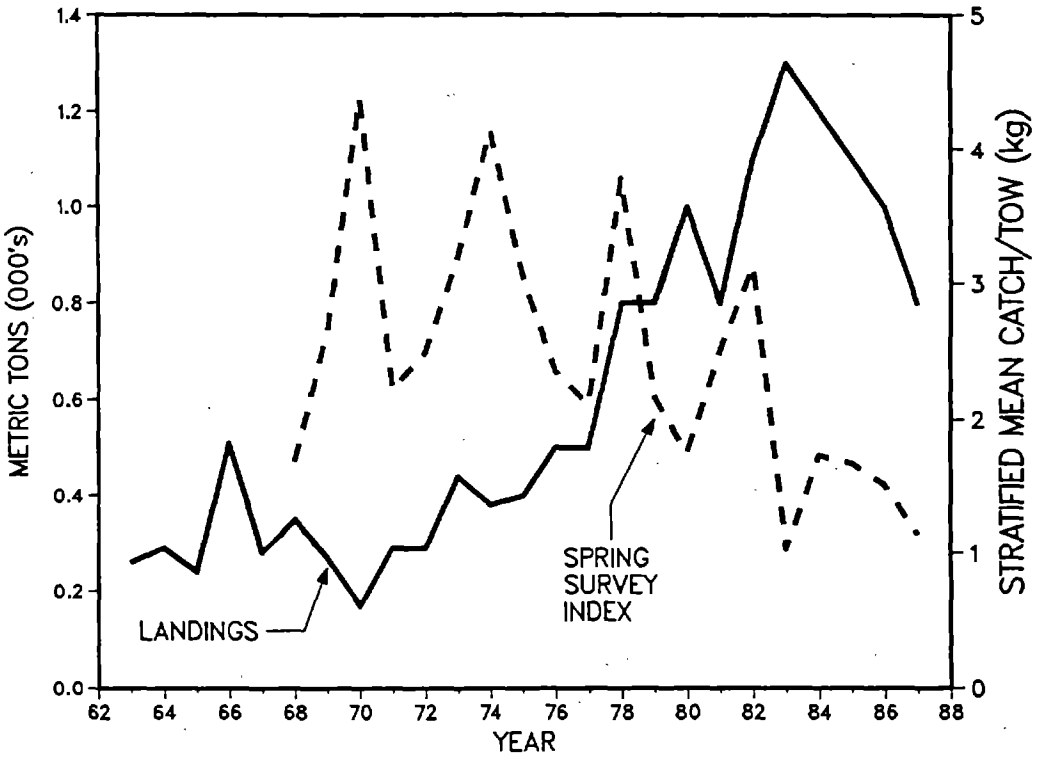



Table 16.1 Nominal catches (thousand metric tons) and management information for Atlantic wolffish from the Gulf of Maine - Georges Bank area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Commercial | | | | | | | | | |
| USA | 0.7 | 0.9 | 0.7 | 0.9 | 1.2 | 1.1 | 1.0 | 0.9 | 0.7 |
| Canada | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 1.0 | 0.8 | 1.1 | 1.3 | 1.1 | 1.1 | 1.0 | 1.0 | 0.8 |

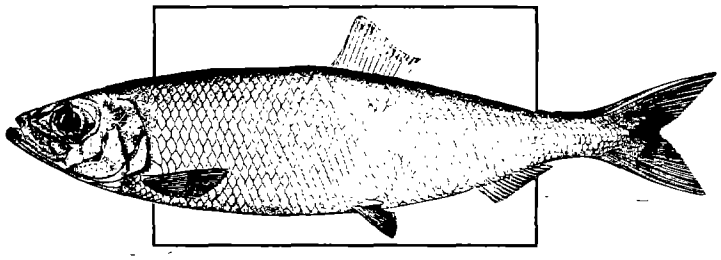
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | fully exploited |
| Age at 50% maturity | = | Unknown |
| Size at 50% maturity | = | Unknown |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# ATLANTIC HERRING

## Clupea harengus

**Sea herring, Labrador herring, herring, sardine, sperling, Brit**



## Summary status

*** Gulf of Maine stock increased in recent years**

*** Some evidence of increased spawning in Georges Bank stock, possible indication of recovery**

The Atlantic herring, *Clupea harengus*, is widely distributed in continental shelf waters from Labrador to Cape Hatteras. Important commercial fisheries for juvenile herring (ages 1-3) have been in existence since the last century along the coasts of Maine and New Brunswick. Development of large-scale fisheries for adult herring is comparatively recent, primarily occurring in the western Gulf of Maine, on Georges Bank, and on the Scotian Shelf. Gulf of Maine herring migrate from feeding grounds along the Maine coast during autumn to the southern New England - Mid-Atlantic region during winter, with larger individuals tending to migrate further distances. Tagging experiments have provided evidence of intermixing of Gulf of Maine - Scotian Shelf herring during different phases of the annual migration.

Spawning in the Gulf of Maine occurs during late August-October, beginning in northern locations and progressing southward. Atlantic herring are not fully mature until ages 4-5. Recent evidence suggests a density- dependent effect on growth and maturation, indicating that the average age at maturity may vary annually. The eggs are demersal and are typically deposited on rock or gravel substrates. Primary spawning locations off the northeastern United States occur on Jeffreys Ledge and Nantucket Shoals; Georges Bank formerly supported an extensive spawning ground. Incubation is temperature dependent, but usually requires 7-10 days. Larvae metamorphose by late spring into juvenile "brit" herring which may form large aggregations in coastal waters during summer. Juvenile herring are fully vulnerable to the coastal fixed gear fisheries (stop seines and weirs) by age 2.

## Gulf of Maine

Total catches in the Gulf of Maine declined from an average of 61,800 mt from 1977-1981 to 31,200 mt in 1986. These changes are best understood by examining the changes in the two principal fisheries, the coastal fixed gear and the western Gulf mobile gear.

Coastal Maine nominal catches averaged 57,000 mt during 1950-1965, subsequently declining to an average of 23,000 mt during 1966-1979. Catches from this fishery are taken primarily during the summer-autumn from July to November. With the exception of the strong 1970 year class, recruitment during the latter period remained below average. Nominal catches increased to an average of 45,000 mt during 1979-1981 with recruitment of a succession of relatively strong year classes (1976, 1977, 1979). The 1981 yield of 48,200 mt was the highest since 1963. The 1987 nominal catch was 19,700 mt, an increase relative to the 1986 level of 15,500 mt. The general reduction noted since the early 1980s appears to be related to reduced availability to the fixed gear fisheries and reduced abundance as measured by NEFC survey indices. Steady declines in survey indices have been noted in recent years. The 1984-87 NEFC autumn survey indices, however, indicated a recovery relative to 1982-83 levels.

Figure 17.1 Total commercial landings and estimates of stock biomass of Atlantic herring in the Gulf of Maine.

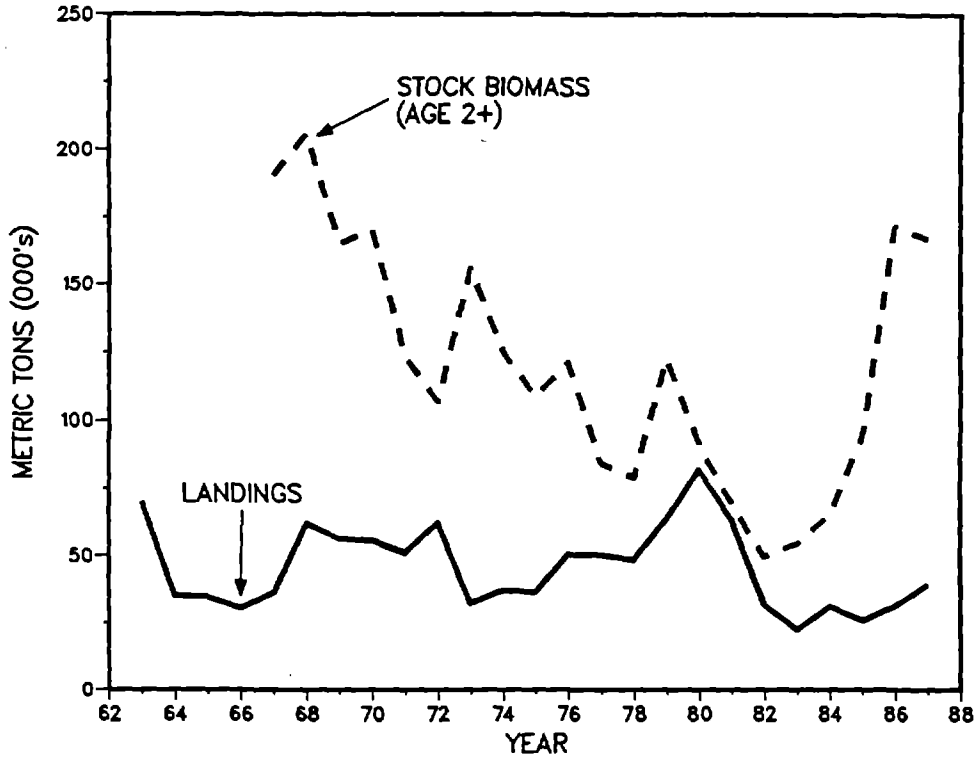



Table 17.1 Nominal catches (thousand metric tons) and management information for Atlantic herring from the Gulf of Maine (coastal Maine the western Gulf of Maine).

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 63.7 | 82.1 | 63.6 | 31.7 | 22.5 | 31.1 | 25.8 | 31.2 | 39.2 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch[1] | 63.7 | 82.1 | 63.6 | 31.7 | 22.5 | 31.1 | 25.8 | 31.2 | 39.2 |

| | | |
|---|---|---|
| Long-term potential catch[2] | = | 20,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 3 years |
| Size at 50% maturity | = | 26 cm (10.2 inches) |

M = 0.20 $F_{0.1}$ = 0.24 $F_{max}$ = None $F_{1987}$ = 0.35

[1] Age groups 1 and older.
[2] Age groups 3 and older.

The 1987 nominal catch of 19,500 mt in the western Gulf of Maine mobile gear fishery (including offshore Maine and southern New England landings) represented a 24% increase relative to 1986 levels but remained slightly below the 1975-80 mean level of 22,900 mt. Due to declines in export markets in recent years with recovery the North Sea fishery, a significant proportion of the adult herring catch has not been used for human consumption.

Stock biomass (ages 2 and older) for the total Gulf of Maine region (coastal Maine and western Gulf of Maine) averaged 183,000 mt between 1965 and 1970 before declining to an estimated 124,000 mt in 1971. Stock biomass remained fairly constant between 1971 and 1978 at about 112,000 mt per year. After increasing to 122,000 mt in 1979, stock biomass declined steadily to an estimated 50,000 mt in 1982, the lowest level yet observed. Recent preliminary estimates indicate an increase to 170,000 mt in 1987.

## Georges Bank

The fishery for herring on Georges Bank was initiated in 1961 with increased foreign fishing activity off the northeast coast of the United States. Landings peaked in 1967 at 373,600 mt and subsequently declined to only 43,500 mt in 1976; the stock collapsed in 1977. Spawning stock biomass (ages 4 and older) increased from 300,000 mt in 1961 to nearly 1.2 million mt in 1967 and subsequently declined steadily to extremely low levels. There has been no directed fishery for Atlantic herring on Georges Bank in recent years. Indication of some level of recovery has been obtained based on US and Canadian bottom trawl surveys during 1984 - 1987 and reports of incidental catches by commercial vessels. Prospects for redevelopment of the fishery are currently unknown.

## Reference

Fogarty, M.J., and S.H. Clark. 1983. Status of herring stocks in the Gulf of Maine region for 1983. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 83-46. 33 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Table 17.2 Nominal catches (thousand metric tons) and management information for Atlantic herring from the Georges Bank area.[1]

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 2.1 | 1.1 | 1.7 | 0.7 | 1.0 | 1.6 | 0.2 | 0.2 | - |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 2.1 | 1.1 | 1.7 | 0.7 | 1.0 | 1.6 | 0.2 | 0.2 | - |

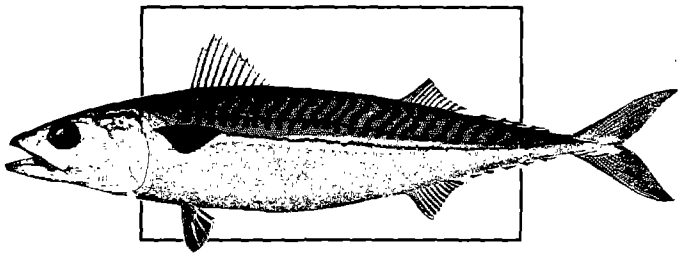
| | | |
|---|---|---|
| Long-term potential catch | = | 100,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Not exploited |
| Age at 50% maturity | = | 3 years |
| Size at 50% maturity | = | 26.4 cm (10.4 inches) |

M = 0.20 $F_{0.1}$ = 0.36 $F_{max}$ = None $F_{1987} < 0.01$

1 Includes landings for the southern New England area.

# ATLANTIC MACKEREL

**Scomber scombrus**



Atlantic mackerel, *Scomber scombrus*, is a fast swimming, pelagic, schooling species distributed in the Northwest Atlantic between Labrador and North Carolina. There are two major spawning components of this population, a southern group, which spawns primarily in the Mid-Atlantic Bight during April and May, and a northern group which spawns in the Gulf of St. Lawrence in June and July. Both groups overwinter between Sable Island (off Nova Scotia) and Cape Hatteras in waters generally warmer than 7°C, with extensive northerly (spring) and southerly (autumn) migrations to and from spawning and summering grounds. Maximum observed size in recent years is about 47 cm or 18.5 in. (fork length) and 1.3 kg (3 lbs) in weight. Sexual maturity begins at age 2 and is usually complete by age 3. Maximum age is about 20 years.

**Summary status**

* **Substantial increase in stock abundance**
* **Low fishing mortality**
* **Decline in growth and reproductive rates**
* **Potential for larger catches**

Mackerel are subjected to seasonal fisheries, both commercial and recreational, throughout most of their distributional range. USA commercial catches have occurred mainly between January and May in southern New England and Mid-Atlantic coastal waters and between May and December in coastal Gulf of Maine waters. USA recreational catches occur mainly between April and October in areas of seasonal occurrence. Catches in Canadian waters off Nova Scotia and Newfoundland have typically been between May and November. Catches by other countries, principally during the intensive fishery conducted between 1968 and 1977, occurred mainly between December and April between Georges Bank and Cape Hatteras.

Mackerel in the northwest Atlantic were managed by nationally-allocated catch quotas between 1973 and 1977 by ICNAF. Since implementation of the MFCMA on 1 March 1977, mackerel in USA waters have been managed by the NMFS, initially by a PMP and since February 1980 by an FMP and amendments developed by the Mid-Atlantic Fishery Management Council.

The international nominal catch of mackerel in the Northwest Atlantic increased from 39,400 mt in 1984 to 71,100 mt in 1985, declined to 65,400 mt in 1986 and increased to 75,082 mt in 1987. Catches remained fairly stable between 1978 and 1984, averaging 33,000 mt annually, and were taken largely by Canadian and USA fishermen. The increase in recent years (1984 to 1987) was due primarily to joint ventures in USA waters.

The USA accounted for 24% of the 1987 international catch, including about 12,300 mt of commercial and an estimated 5,600 mt of recreational catch. The Canadian catch declined from 25,400 mt in 1986 to 22,100 mt in 1987. The distant water fleet catch decreased from 33,200 mt in 1985 to 26,400 mt in 1986 and rose to 35,100 mt in 1987. Approximately 5,800 mt of the 1987 catch was taken by Poland in a research fishery with the NEFC.

Fish from the 1982 (age 5) and 1981 (age 6) year classes comprised 64% and 9% respectively of the distant-water catch in numbers in 1987. The 1984 (age 3) and 1985 (age 2) year classes also contributed significantly to the catch, providing 9 and 7% respectively of the total in 1987.

Year classes from 1975 to 1980 were all considered to be weak. Cohorts since 1981 have been much stronger (except for the apparently weak 1983 year class), particularly the 1982 year class which is the strongest to appear since 1969. The 1984 to 1986 cohorts also appear to be relatively strong.

Total stock biomass (ages 1 and older) increased from around 300,000 mt in 1962-65 to 1.9 million mt in 1970-71 before dropping to a stable low level during 1977-81 averaging 485,000 mt per year. The total stock increased to about 1.6 million mt at the beginning of 1987. Spawning stock biomass (50% of age 2 fish and 100% of ages 3 and older) increased from about 600,000 mt in 1981 to an estimated 1.5 million mt at the start of 1987.

Rebuilding of the mackerel stock has been aided by relatively low catches during 1977-86 (average of 40,800 mt) as well as improved recruitment from the 1981-82 and 1984 to 1986 year classes. Projections indicate that the catch in 1988 can be increased without adversely affecting the spawning stock biomass. These recommendations are based on a projected $F_{0.1}$ catch of roughly 325,000 mt for the total international mackerel fishery in the Northwest Atlantic.

## Reference

Anderson, E.D. 1984. Status of the Northwest Atlantic mackerel stock -1984. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 85-03. 46 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Overholtz, W.J., and B.L. Parry. 1985. Update of the status of the Northwest Atlantic mackerel stock for 1985. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 85-13. 16 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of the Second NEFC Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-09. 114 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 18.1 Total commercial and recreational landings and estimates of stock biomass of Atlantic mackerel in the Labrador-North Carolina area.

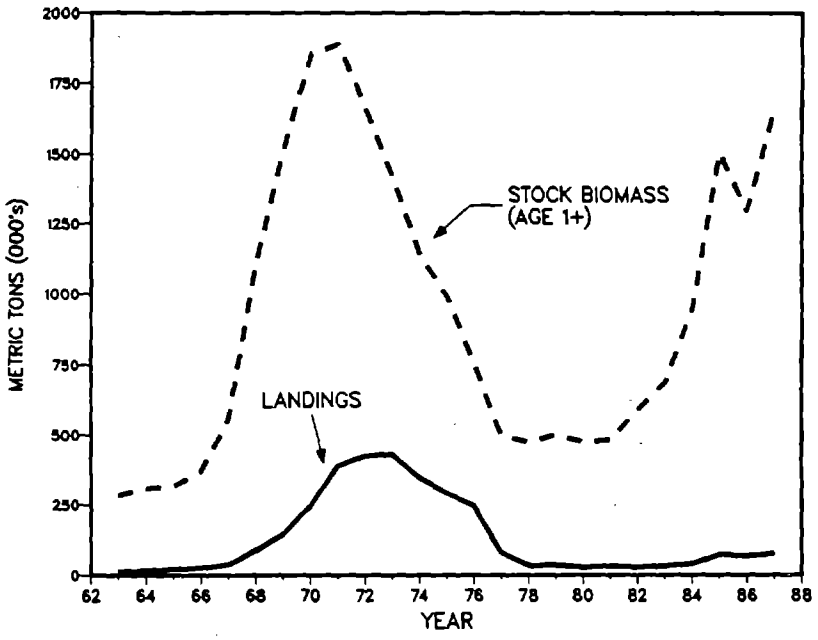



Table 18.1 Nominal catches (thousand metric tons) and management information for Atlantic mackerel from Labrador to North Carolina.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 3.7 | 2.4 | 5.1 | 1.1 | 3.0 | 3.0 | 1.5 | 4.0 | 5.6 |
| Commercial | | | | | | | | | |
| USA | 2.0 | 2.7 | 2.9 | 3.3 | 3.8 | 4.4 | 6.6 | 9.6 | 12.3 |
| Canada | 30.2 | 22.1 | 19.3 | 16.4 | 19.8 | 17.0 | 29.8 | 25.4 | 22.1 |
| Other | 0.4 | 0.6 | 5.4 | 6.6 | 6.0 | 15.0 | 33.2 | 26.4 | 35.1 |
| Total nominal catch | 36.3 | 27.8 | 32.6 | 27.5 | 32.6 | 39.4 | 71.1 | 65.4 | 75.1 |
| Total allowable catch | 15.5 | 30.0[1] | 30.0[1] | 30.0[1] | 101.7[1] | 87.0[1] | 196.5[1] | 196.5 | 196.5 |

| | | |
|---|---|---|
| Long-term potential catch | = | 134,000[2] mt |
| Importance of recreational fishery | = | Moderate |
| Status of management | = | FMP in force since 1979 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 32.7 cm (12.9 inches) fork length |

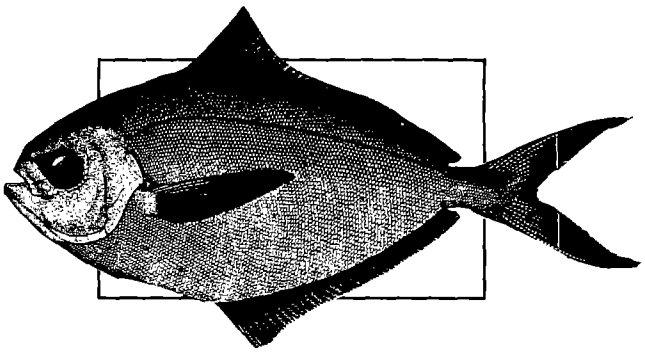
M = 0.20 $F_{0.1}$ = 0.29 $F_{max}$ = 0.62 $F_{1987}$ = 0.05

[1] 1 April - 31 March fishing year

[2] Assuming constant recruitment at level of geometric mean of 1961-1984 year classes and fishing mortality at $F_{0.1}$

# BUTTERFISH

## Peprilus triacanthus



## Summary status

*** Great fluctuation in stock abundance**
*** Low harvest level**
*** Smaller fish being landed**
*** No change in catch levels expected**
*** Stock capable of producing MSY levels of catch**

The butterfish, *Peprilus triacanthus*, is found along the Atlantic coast of North America from Newfoundland to Florida, and is commercially important between Cape Hatteras and Southern New England. North of Cape Hatteras, butterfish migrate inshore and northward during the summer and offshore to the edge of the continental shelf in late autumn as northern inshore waters cool.

Spawning takes place chiefly during the summer months, with the peak in July. Butterfish begin recruiting to the spawning stock at the end of their first year. The maximum recorded age for this species is 6 years, but few fish are seen beyond age 3.

The international nominal catch declined slightly from 4,800 mt in 1986 to 4,700 mt in 1987. The international catch peaked in 1973 at 19,500 mt, most of which was taken by distant water fleets (DWF) in conjunction with their squid fisheries. The USA nominal catch increased slightly from 4,600 mt in 1986 to 4,700 mt in 1987. The DWF nominal catch declined from 164 mt in 1986 to less than 1 mt in 1987, representing the lowest butterfish catches by DWFs on record.

Discard rates of small butterfish in the domestic fishery during 1987 declined dramatically compared to rates reported in the early 1980s ( < 10% compared to 40 to 70% by weight of the landed catch). This decline is primarily due to a new market category, "SSS", for small butterfish and a good bait market for fish that were previously being discarded.

The catch per tow index (all ages) from the NEFC 1987 autumn bottom trawl survey (4.7 kg/tow) declined 31% from 1986. Likewise, the recruitment index (78.6 age 0 fish/tow) and the age $1^+$ index (39.0 age one and older fish/tow) from the 1987 autumn survey declined 44% and 12%, respectively, below the 1986 values. Also, the 1987 recruitment, age $1^+$, and biomass indices are 46%, 13%, and 33% respectively below the 19-year (1968-86) averages (144.6, 45.3, and 7.0). The decline in age $1^+$ abundance is largely attributed to declines in age 2 and older fish.

Although the 1987 NEFC survey abundance indices are the lowest observed since 1983, they are generally above 1968 to 1976 levels when total butterfish catches were high (6,500 to 19,500 mt). This suggests that sufficient fish are available to support a catch up to the maximum (16,000 mt) currently allowed by the fishery management plan. However, partial recruitment factors used in yield per recruit analyses that established MSY (Murawski and Waring 1979) may not be appropriate under current fishing practices. The spatial and seasonal nature of the fishery was different than the current USA fishery, and SSS market size fish were not taken then. The domestic fishery has been conducted principally in autumn in southern New England waters (Waring 1986), whereas the pre-1977 DWF fleets harvested butterfish throughout its range.

Figure 19.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of butterfish in the Gulf of Maine - Mid-Atlantic area.

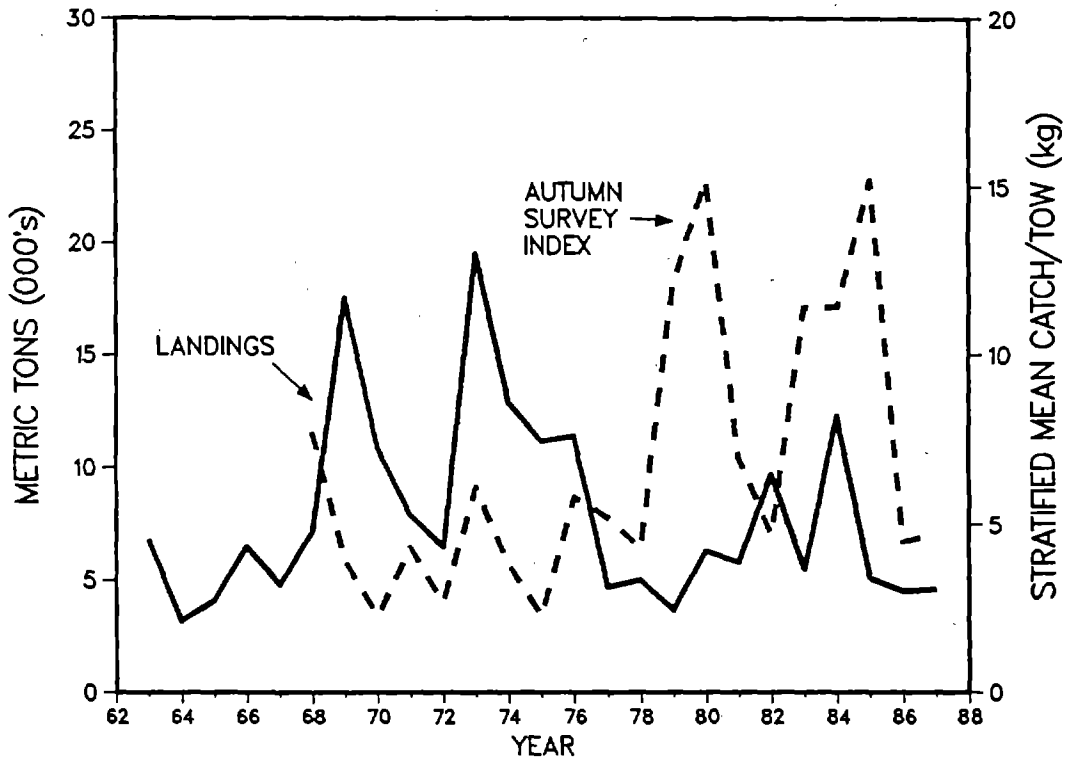



Table 19.1 Nominal catches (thousand metric tons) and management information for butterfish from the Gulf of Maine Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 2.8 | 5.4 | 4.9 | 9.1 | 4.9 | 11.8 | 4.7 | 4.6 | 4.7 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | 0.8 | 0.9 | 0.9 | 0.8 | 0.6 | 0.4 | 0.4 | 0.1 | <0.1 |
| Total nominal catch | 3.7 | 6.3 | 5.8 | 9.7 | 5.5 | 12.3 | 5.1 | 4.7 | 4.7 |
| Total allowable catch | 18.0 | 11.0[1] | 11.0[1] | 11.0[1] | 11.0[1] | ≤16.0[1] | ≤16.0[1] | ≤16.0 | ≤16.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | 16,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since 1979 |
| Status of exploitation | = | Moderately exploited |
| Age at 50% maturity | = | 1.5 years |
| Size at 50% maturity | = | 14.0 cm (5.5 inches) fork length |

M = 0.80 $F_{0.1}$ = 1.60 $F_{max}$ > 2.50 $F_{1987}$ = Unknown

[1] 1 April - 31 March fishing year.

The decline in 1987 recruitment indices may be attributed to cooler than normal bottom temperatures. Age 0 butterfish are usually caught in NEFC inshore sampling strata between Delaware Bay and Cape Cod, but in 1987 catches in those strata were at record low levels. Likewise, butterfish catches in 1987 Massachusetts inshore bottom trawl surveys were the lowest on record. High discard rates that have beset the fishery over the past several years have ceased as new markets have developed for previously unmarketed sizes. Presently, the butterfish market remains strong and landings can be expected to remain at or above 1987 levels.

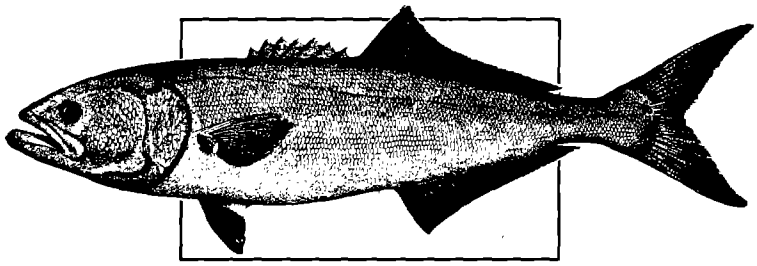
## Reference

Murawski, S.A. and G.T. Waring. 1979. A population assessment of butterfish, Peprilus triacanthus, in the northwestern Atlantic Ocean. Trans. Am. Fish. Soc. 108:427-439.

Waring, G.T. 1986. An analysis of spatial difference in size composition and abundance of butterfish, Peprilus triacanthus, off the Northeast United States. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 86-04. 23 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Waring, G.T. and E.D. Anderson. 1983. Status of the Northwestern Atlantic butterfish stock - 1983. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 83-41. 39 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

# BLUEFISH



**Pomatomus saltatrix**

**Snapper**

The bluefish, *Pomatomus saltatrix*, is a migratory, pelagic species found throughout the world in most temperate coastal regions, except the eastern Pacific. Along the US Atlantic coast, bluefish are found from Maine to Florida, migrating northward in the spring and southward in the fall. Bluefish are voracious predators that feed on a wide variety of fish and invertebrates. They may reach ages of about 12 years and sizes in excess of 100 cm (39 in.) in length and 14 kg (31 lbs.) in weight. Currently, a unit stock along the Atlantic coast is assumed for management purposes.

Total catches of bluefish (commercial and recreational) from Maine to Florida peaked in 1980 at an estimated 76,200 mt. The 1986 total catch was about 65,700 mt, declining to an estimated 52,900 mt in 1987. The commercial fishery for bluefish peaked in 1983, at 7,600 mt. Commercial landings rose from 6,300 mt in 1986 to 6,900 mt in 1987.

## Summary status

* Recreational catch per unit effort declining
* Slightly decreasing catch
* Recreational fishermen take most fish
* Information needed on age composition of catches

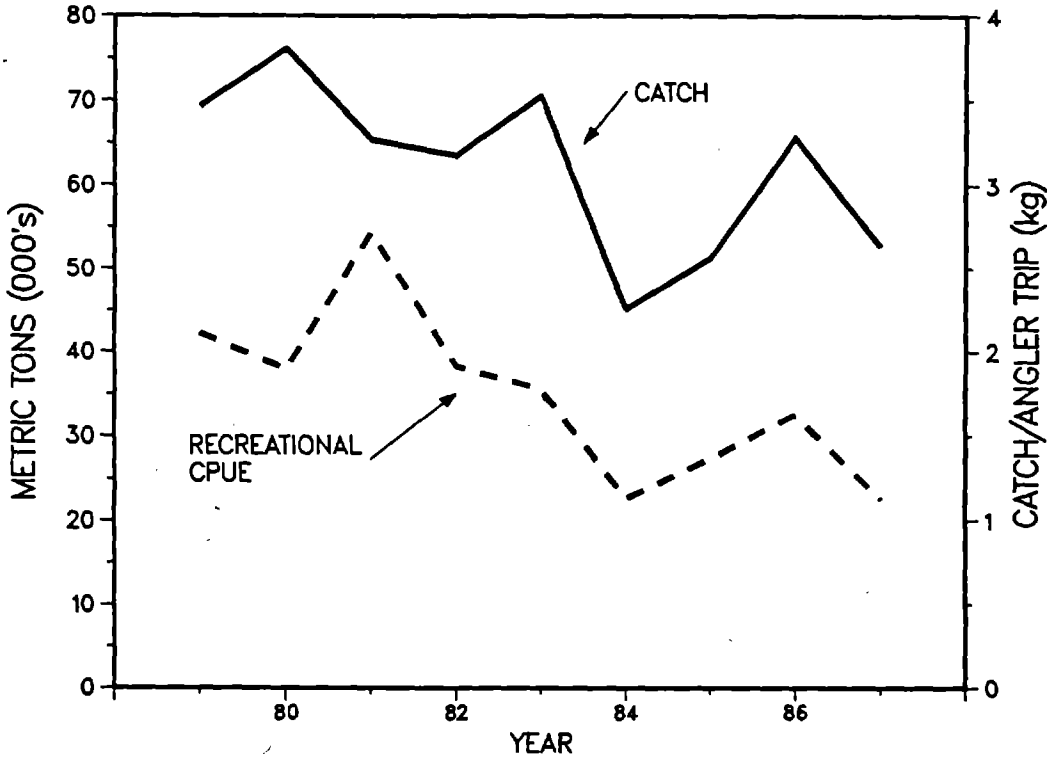



Figure 20.1 Total (commercial and recreational) catch and recreational catch per angler trip (kg) for bluefish along the Atlantic coast, Maine to Florida.

The recreational fishery accounts for about 90% of the total catch. Recreational bluefish catch peaked in 1980 at an estimated 69,600 mt, dropped to 39,300 to 45,000 mt in 1984-85, increased to 59,400 mt in 1986, and then declined to 46,000 mt in 1987 (below the 1979-86 average recreational catch of 56,800 mt). Most of the recreational catch of bluefish is taken in the Middle Atlantic states (NY to VA) by boat-based fishermen. The largest fish are usually caught in the North Atlantic states (ME to CT), and the smallest in the South Atlantic states (NC to FL). Coastwide, bluefish recreational catch per angler trip by weight and numbers rose from 2.11 kg/trip (1.18 fish/trip) in 1979 to a peak of 2.72 kg/trip (1.49 fish/trip) in 1981, and has since trended downward, declining to 1.30 kg/trip (0.94 fish/trip) in 1987 (preliminary estimate). The mean recreational CPUE during 1979-86 was 1.82 kg/trip (1.09 fish/trip).

A fishery management plan for bluefish is currently being developed by the Atlantic States Marine Fisheries Commission (ASMFC) in cooperation with the New England, Mid-Atlantic, and South Atlantic Fishery Management Councils and the coastal states.

## Reference

Northeast Fisheries Center. 1988. Report of the Fifth NEFC Stock Assessment Workshop (Fifth SAW). Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 87-12. 66 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1988. Report of the Sixth NEFC Stock Assessment Workshop (Sixth SAW). Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 88-02. 78p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Table 20.1 Nominal catches (thousand metric tons) and management information for bluefish from the Atlantic coast (Maine - Florida).

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 163.8 | 69.6 | 58.2 | 56.6 | 62.8 | 39.3 | 45.0 | 59.4 | 46.0[1] |
| Commercial | | | | | | | | | |
| USA | 5.6 | 6.5 | 7.2 | 6.9 | 7.6 | 5.8 | 6.2 | 6.3 | 6.9 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | <0.1 | - | - | - | - | - | - | - |
| Total Nominal catch | 69.4 | 76.2 | 65.4 | 63.5 | 70.4 | 45.1 | 51.2 | 65.7 | 52.9 |

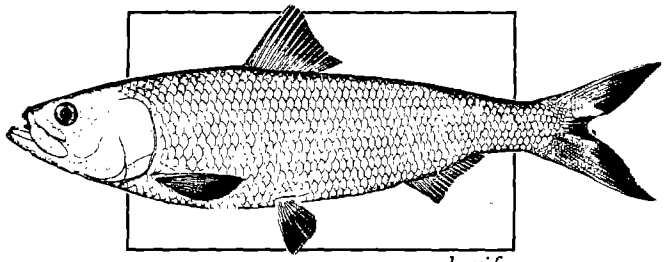
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Major |
| Status of management | = | FMP in preparation |
| Status of exploitation | = | Unknown |
| Age at 50% maturity | = | 1 year |
| Size at 50% maturity | = | 35 cm (13.8 inches) |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

[1] Preliminary estimate

# RIVER HERRING

**Alosa pseudoharengus**
**Alewife**
**Alosa aestivalis**
**Blueback herring**



*alewife*

River herring is a term applied collectively to alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*. The coastal range of the blueback herring is from Nova Scotia to Florida; the coastal range of alewives is farther north, from Labrador to South Carolina. In coastal rivers where the ranges overlap, the fisheries for the two species are mixed. Both species are anadromous and undergo upriver spawning migrations during spring. Alewives may live as long as 10 years and reach a size of 36 cm (14 in.) in length; blueback herring live for about seven or eight years and reach a maximum length of about 32 cm (13 in.).

Alewives spawn earlier in the spring than blueback herring, when water temperatures are between 16°C and 19°C; blueback herring spawn when water temperatures are about 5°C warmer. Fecundity and age at maturity for both species are similar. Egg production is between 60,000 and 300,000 eggs per female and maturity is reached at ages 3 to 5, with age 4 being dominant.

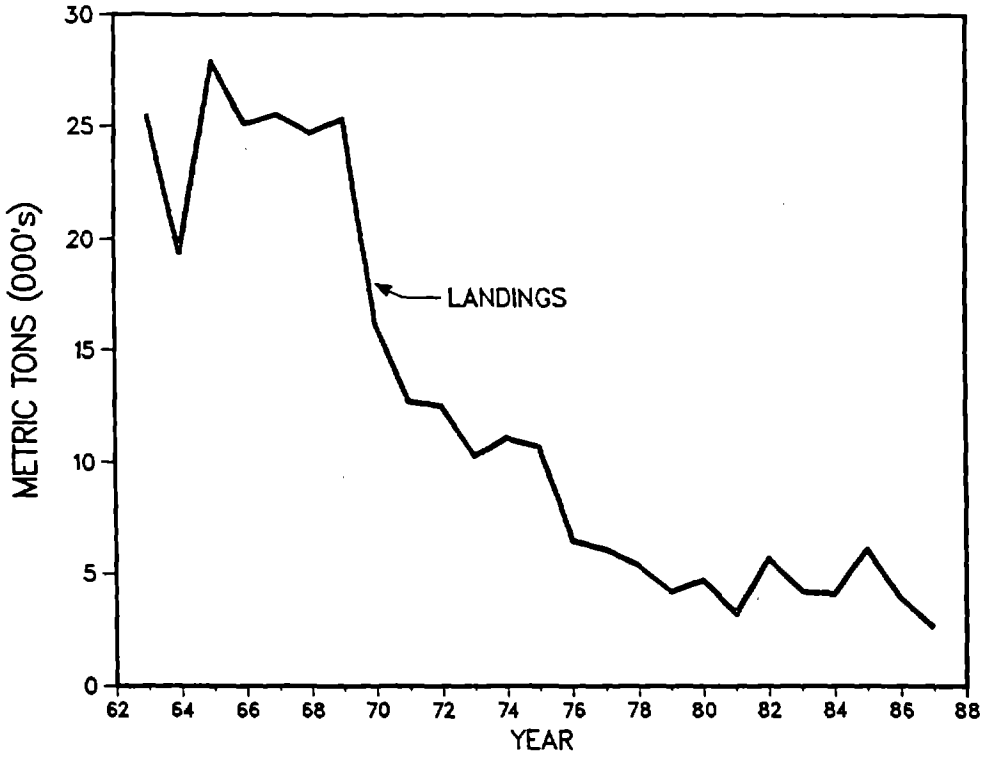



Figure 21.1 Total commercial landings of river herring (alewife and blueback herring) in the Gulf of Maine - Middle Atlantic area.

## Summary status

* **Greatly reduced stocks**
* **Low catch level**
* **Prospects for recovery depend on habitat restoration**

River herring have been subjected to intensive exploitation along the Atlantic coast. Nominal catch has declined considerably in the last 10 years, parallel to a decline in the nominal catch of American and hickory shad. The river herring fishery is one of the oldest in North America and was exclusively a USA inshore fishery until the late 1960s, when distant water fleets began fishing for river herring off the Mid-Atlantic coast. The USA nominal catch averaged 24,800 mt annually between 1963 and 1969. In 1969 the nominal catch exhibited a downward trend until the mid-to-late 1970s and has since been around 4,000 to 5,000 mt. North Carolina remains the only state with a substantial commercial fishery, accounting for approximately 80% of total landings.

An MSY estimate of 23,000 to 28,000 mt has been determined for the river herring resource extending from the Gulf of Maine to Cape Hatteras (Hoagman et al. 1973). However, stock biomass in recent years has been depressed to a point where this level is no longer a useful indication of long-term potential yield. Although fishing pressure on the resource has eased considerably, especially since the foreign catch was restricted in 1976, recovery to historic levels is not evident. Data from the NEFC spring and autumn bottom trawl surveys indicate that stock levels have been relatively stable since 1968, although data from spring bottom trawl surveys between northern New Jersey and Cape Hatteras indicate a slight increase in biomass since 1975.

In response to the observed decline in nominal catch and the lack of a coastwide increase in stock biomass, the Mid-Atlantic Fishery Management Council recommended that a comprehensive, coastwide management plan be prepared for shad and river herring. The plan has been prepared through the Atlantic States Marine Fisheries Commission with the participation of all coastal states between Maine and Florida.

## Reference

Boreman, J. 1981. River herring stocks along the Atlantic coast. Woods Hole, MA: NMFS, NEFC Woods Hole Laboratory Reference Document 81-35. 23 p. Available from: Northeast Fisheries Center, Woods Hole MA.

Hoagman, W. J., J. V. Merriner, R. St. Pierre, and W. L. Wilson. 1973. Biology and management of river herring and shad in Virginia. Gloucester Pt., VA: Virginia AFC 7-1 to 7-3, Completion Report. Available from: VIMS, Gloucester Pt., VA.

Richkus, W. A. and G. DiNardo. 1984. Current status and biological characteristics of the anadromous alosid stocks of wastern United States: American shad, hickory shad, alewife, and blueback herring. Columbia, MD: Martin Marietta Environmental center. Available from: Atlantic States Marine Fisheries Commission, Washington, D.C.

Table 21.1 Nominal catches (thousand metric tons) and management information for river herring (alewife and blueback herring) from the Gulf of Maine /Mid-Atlantic area.

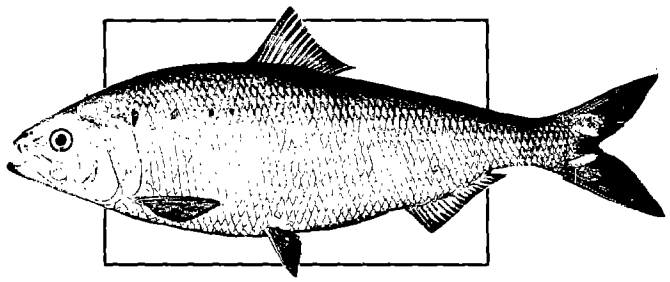
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 4.2 | 4.7 | 3.2 | 5.7 | 4.2 | 4.1 | 6.1 | 3.9 | 4.1 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Total nominal catch | 4.2 | 4.7 | 3.2 | 5.7 | 4.2 | 4.1 | 6.1 | 3.9 | 4.1 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Minor |
| Status of management | = | Local (state, county or municipality, depending on area) |
| Status of exploitation | = | Unknown |
| Age at 50% maturity | = | 2-4 (varies by latitude) |
| Size at 50% maturity | = | 28 cm (11.0 inches) |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# AMERICAN SHAD

## Alosa sapidissima



## Summary status

*** Very low stock abundance**
*** Stable catch levels of recent years may reflect habitat restoration efforts**

The American shad, *Alosa sapidissima*, is an anadromous member of the family Clupeidae (herrings). Along the Atlantic coast, its range extends from southern Labrador to northern Florida. Virtually every major coastal river along the Atlantic seaboard has at one time supported a stock. American shad have been the subject of intensive exploitation for their flesh and roe. Nominal commercial catch along the Atlantic coast exceeded 22,000 mt in 1896, but currently averages less than 1,000 mt per year. Excessive fishing has been blamed for the decline in the Hudson River, the Connecticut River, in Maryland rivers, in North Carolina rivers, and in Florida. Dams along the Susquehanna River have led to an almost complete disappearance of what was once a major fishery. Pollution in the lower Delaware has been cited as the cause for the decline in the fishery in that system. Nominal commercial catch reported for states along the Atlantic coast in the 1980s has been the lowest on record.

Recreational landings, like commercial landings, have declined in recent years. Rhode Island, Delaware, and Maryland reported to the Atlantic States Marine Fisheries Commission that recreational harvests have declined to virtual non-existence since 1970. Since the marine recreational fishing surveys conducted by the NMFS and its predecessor agency did not include American shad as a distinct species, data relevant to the nominal recreational catch along the eastern seaboard during the past two decades are not available. The American shad, however, is a popular sport fish in many states.

The Atlantic States Marine Fisheries Commission has prepared a coastwide management plan for American shad and river herring to facilitate cooperative management and restoration plans between states. Restoration efforts involving habitat improvement, fish passageways, and stocking programs are resulting in improved returns to some river systems, particularly the Delaware and Connecticut Rivers. A continuation of current restoration and monitoring programs should result in increasing numbers of American shad in coastal rivers.

## Reference

Boreman, J. 1981. American shad stocks along the Atlantic coast. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 81-40. 21 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Richkus, W. A., and G. DiNardo. 1984. Current status and biological characteristics of the anadromous alosid stocks of eastern United States: American shad, hickory shad, alewife, and blueback herring. Columbia, MD: Martin Marietta Environmental Center. Available from: Atlantic States Marine Fisheries Commission, Washington, D.C.

Figure 22.1 Total commercial landings of American shad in the Gulf of Maine - Middle Atlantic area.

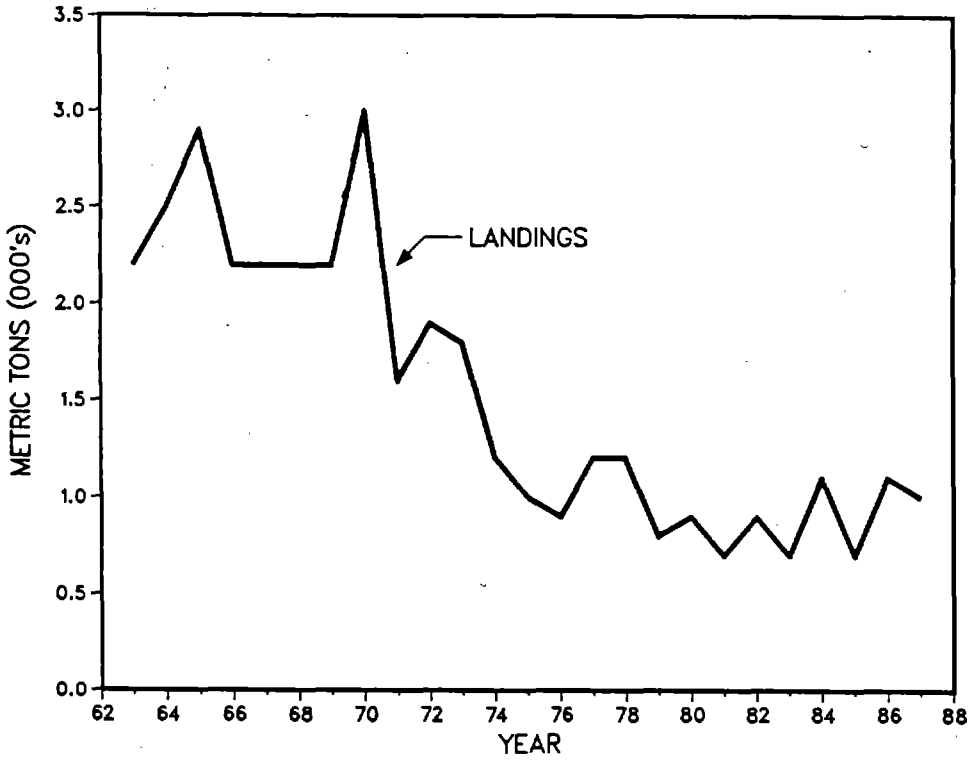



Table 22.1 Nominal catches (thousand metric tons) and management information for American shad from the Gulf of Maine - Mid-Atlantic area.

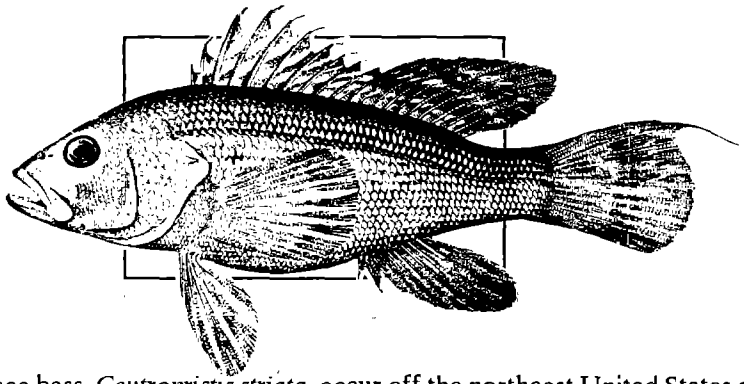
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 0.8 | 0.9 | 0.7 | 0.9 | 0.7 | 1.1 | 0.7 | 1.1 | 0.9 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 0.8 | 0.9 | 0.7 | 0.9 | 0.7 | 1.1 | 0.7 | 1.1 | 0.9 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Major |
| Status of management | = | Local (state, county or municipality, depending on area |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 2-4 years (varies by latitude) |
| Size at 50% maturity | = | 40 cm (15.8 inches) |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# BLACK SEA BASS

## Centropristis striata



## Summary status

*** Stock stable at low levels**
*** Stable commercial landings**
*** Fluctuating recreational landings**
*** Prediction of stock abundance difficult**
*** Need to evaluate fishery effect given unusual life history**

Black sea bass, *Centropristis striata*, occur off the northeast United States along the entire Atlantic coast, with the greatest concentrations found off Cape May, New Jersey. Black sea bass overwinter along the 100 m isobath off Virginia and Maryland, then migrate north and west into the major coastal bays and become associated with structured bottom habitat (reefs, oyster beds, wrecks). Spawning begins in June off Virginia and occurs progressively later (until October) further north. Most black sea bass are protogynous hermaphrodites, beginning life as females and later transforming into males. As a result, females generally mature earlier (age 2, 16.3 cm or 6.4 in., standard length) than males (age 3, 21.3 cm or 8.4 in.). Females are rarely found older than 8 years ( > 35 cm or 13.8 in.), while males may live up to 20 years ( > 60 cm or 23.6 in.). Black sea bass are omnivores, feeding on crustaceans, molluscs, echinoderms, fish, and plants.

Reported commercial landings north of Cape Hatteras fluctuated around 2,600 mt from 1887 to 1948, then increased to over 6,900 mt. After reaching a peak of 9,900 mt in 1952, catch declined steadily to 600 mt in 1971 then increased to 2,400 mt in 1977. Nominal catches have averaged 1,400 mt from 1980 to 1986 and were 1,800 mt in 1987. The only reported catch by distant water fleets was 1,500 mt in 1964. The estimated recreational catch has comprised from 21% (1981) to 86% (1982) of the total nominal catch in those years for which comparisons are possible.

Estimated 1987 recreational catches from the middle Atlantic and New England regions was 930 mt but has ranged between 300 and 8,100 mt since 1980. The high values for 1982 and 1986, 7,300 mt and 8,100 mt respectively, are inconsistent with available stock abundance indices, and are perhaps attributable to an increase in directed boat effort.

Catch per unit effort of the Mid-Atlantic and Chesapeake pot/trap fishery declined from 78.9 kg/trap in 1953 to 10.0 kg/trap in 1968. Trap CPUE rose to 46.9 in 1977 and has since fallen to the most recent (1980) CPUE value of 18.6 kg/trap. NEFC spring offshore bottom trawl survey data indicate an increase in abundance from 1970 (0.1 fish/tow) to 1977 (8.2 fish/tow) followed by a decline to 0.3 fish/tow in 1985. Indices increased to 2.4 fish/tow in 1986, but has dropped to 1.4 fish/tow in 1987.

Size composition data from commercial landings indicate that black sea bass recruit fully to the trap and trawl fishery by ages 2 and 3, respectively. The biologically optimum age for harvesting black sea bass, based on yield-per-recruit analysis, is 6 years. Black sea bass north of Cape Hatteras are being fully exploited.

Connecticut, New York, New Jersey, and North Carolina have imposed restrictions on buying or selling black sea bass less than 8 in. (20.3 cm) in length, whereas Massachusetts and Maryland have 12 in. (30.4 cm) limits. The remaining Atlantic coastal states north of North Carolina do not have regulations pertaining to black sea bass. The Mid-Atlantic Fishery Management Council is considering management of black sea bass either on a single species basis or in conjunction with other associated species.

Figure 23.1 Total commercial landings and stock abundance indices from NEFC spring bottom trawl surveys of black sea bass in the Gulf of Maine - Middle Atlantic area.

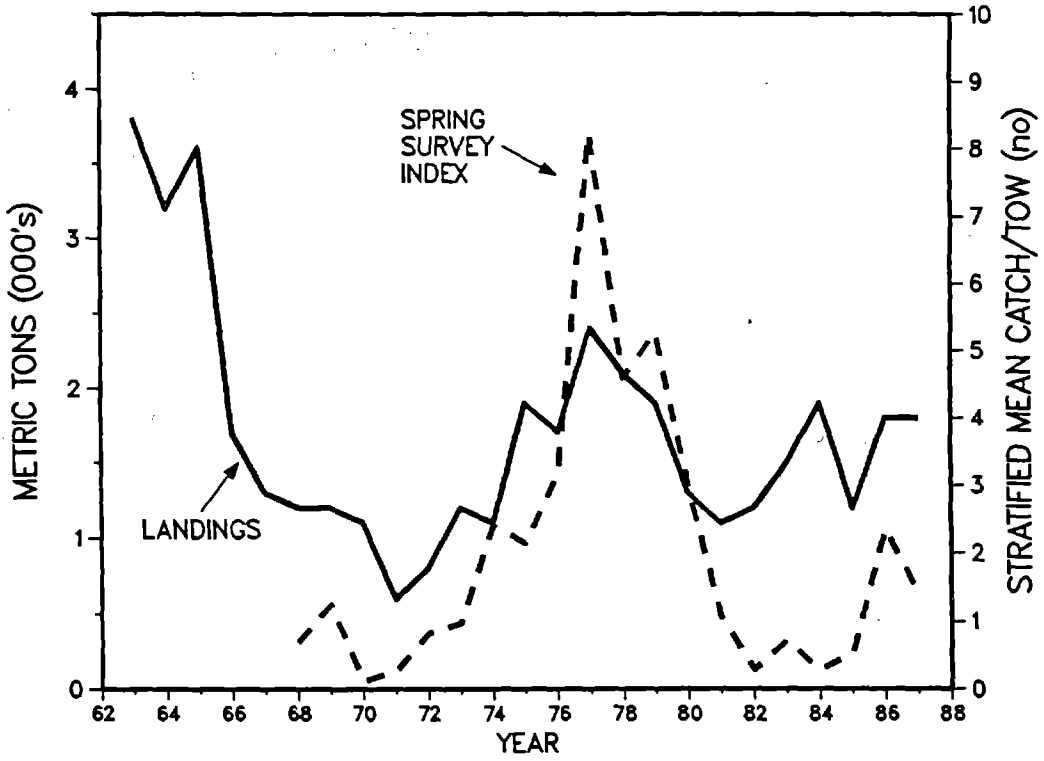



Table 23.1 Nominal catches (thousand metric tons) and management information for black sea bass from the Gulf of Maine - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 10.3 | 0.7 | 0.5 | 8.1 | 2.3 | 0.7 | 1.5 | 6.3 | 1.0 |
| Commercial | | | | | | | | | |
| USA | 1.9 | 1.3 | 1.1 | 1.2 | 1.5 | 1.9 | 1.2 | 1.8 | 1.8 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 2.2 | 2.0 | 1.6 | 9.3 | 3.8 | 2.6 | 2.7 | 8.1 | 2.8 |

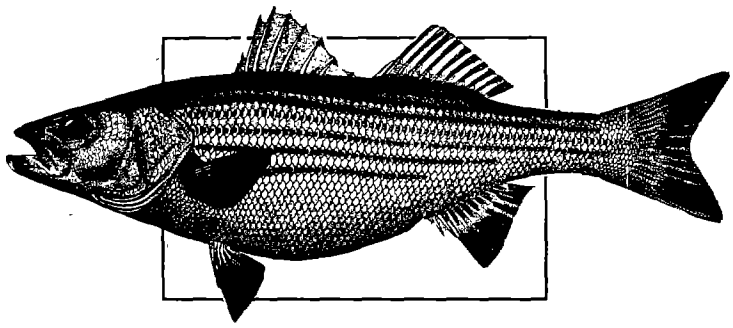
| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Major |
| Status of management | = | Some state regulations |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 3 years |
| Size at 50% maturity | = | 27.2 cm (10.7 inches) |

$M = 0.3$ $F_{0.1} = 0.2$ $F_{max} = 0.3$ $F_{1987} =$ Unknown

# STRIPED BASS

## Morone saxatilis

## Rockfish, rock, striper



## Summary Status

*** Trend of declining recruitment and catches during 1970s stimulated increases in size limits to protect immature females**
*** Recovery depends on reproductive success of these protected fish**

The striped bass, *Morone saxatilis*, is an anadromous species distributed along the Atlantic coast from northern Florida to the St. Lawrence estuary, along the Pacific coast from Ensenada, Mexico to British Columbia, and in numerous inland lakes and reservoirs. Striped bass spawn in mid-February in Florida and late June or July in Canada, and from mid-March to late July in California. Spawning occurs at or near the surface in fresh or slightly brackish waters at temperatures ranging from 10° to 23°C; peak spawning activity is observed between 15° and 20°C. Larvae range from 2.0 to 3.7 mm in total length at hatching and initiate feeding after 4 to 10 days. At about 13 mm in length, larval striped bass form small schools and move inshore; juvenile striped bass move downriver into higher salinity waters during their first summer or autumn.

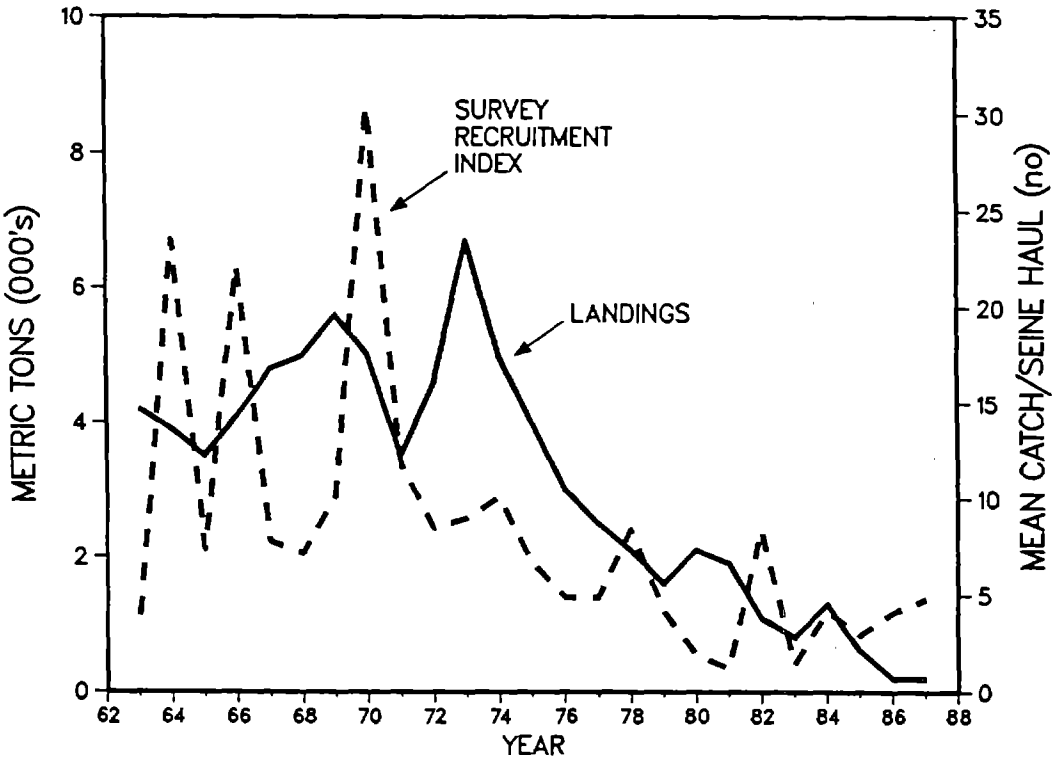



Figure 24.1 Total commercial landings and recruitment indices (from Maryland seine surveys in Chesapeake Bay) for striped bass in the Gulf of Maine - Mid-Atlantic area.

Table 24.1 Nominal catches (thousand metric tons) and management information for striped bass from the Gulf of Maine - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | 2.9 | 0.8 | 0.6 | 1.6 | 1.2 | 0.5 | 0.8 | 0.4 | 0.4 |
| Commercial | | | | | | | | | |
| USA | 1.6 | 2.1 | 1.9 | 1.1 | 0.8 | 1.3 | 0.6 | 0.2 | 0.2 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 4.5 | 2.9 | 2.5 | 2.7 | 2.0 | 1.8 | 1.4 | 0.6 | 0.6 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Major |
| Status of management | = | FMP in effect since October 1981 |
| Status of exploitation | = | Protected |
| Age at 50% maturity | = | 2 years (males; 5 years (females) |
| Size at 50% maturity | = | 29.7 cm (11.7 inches) males<br>61.0 cm (24.0 inches) females |

M = 0.10 - 0.20 $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

Most striped bass along the Atlantic coast are involved in two types of migration: an upriver spawning migration from late winter to early spring, and an offshore migration that is apparently not associated with spawning activity. Offshore migrations may be quite extensive; striped bass tagged in Chesapeake Bay have been captured in the Bay of Fundy. Coastal migratory behavior appears to be limited to stocks north of Cape Hatteras and appears to be related to sex and age of the fish.

Atlantic coastal fisheries for striped bass have in recent years relied on production from stocks spawning in the Hudson River, tributaries to the Chesapeake Bay, and possibly also the Roanoke River, North Carolina. The Chesapeake stock has historically produced most of the striped bass found along the coast, however since 1970, juvenile production in the Chesapeake Bay has been extremely poor and consequently, commercial landings declined severely. Findings of the Emergency Striped Bass Study (ongoing since 1980) suggest that the decline in abundance of the Chesapeake Bay stock is probably due to a combination of factors, with overfishing being the primary culprit. In addition, water quality monitoring in conjunction with field and laboratory bioassays on the spawning grounds in Maryland have shown that river water can be toxic to larvae at some times and in some places. The study findings also indicate that the decline in commercial and recreational catch between 1974 and 1980 may have cost the northeast approximately 7,000 jobs and more than $220 million in economic activity in 1980.

During the mid-1980s, stringent management measures were adopted by the states from Virginia to Maine to attempt to rebuild the Chesapeake stocks. These measures, aimed at protecting the 1982 and subsequent year-classes until the females could spawn at least once, have been effective in increasing the abundance of striped bass.

Females of the protected year-classes began to appear on the spawning grounds in 1987. In that same year, juvenile production in Virginia.s tributaries to the Chesapeake Bay was at a record high. Maryland.s index of juvenile abundance however remained far below average in 1987, as did the index for the Roanoke River stock. The Hudson stock, which has not experienced the same decline as the Chesapeake stock, had its highest juvenile index on record in 1987.

Nominal catches of striped bass in the commercial fisheries from Maine to North Carolina averaged 2,700 mt per year between 1929 and 1983. Gill nets, haul seines, pound nets, and handlines accounted for more than 80% of the commercial catch. The nominal commercial catch from Maine to North Carolina in 1987 (200 mt) was one of the lowest on record. The recreational harvest of striped bass has remained low throughout the 1980s. Since 1986, more than 90% of the striped bass caught by recreational fisherman have been released alive. Recent landings have been affected not only by decreased abundance of striped bass but also by major changes in management regulations since 1982.

## Reference

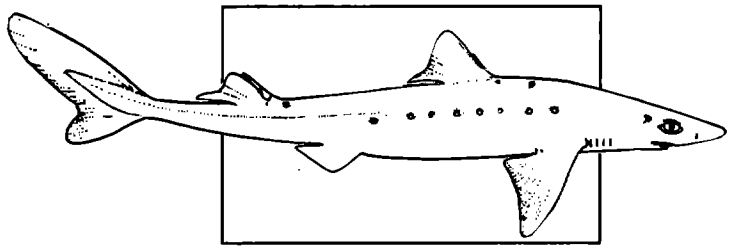
Richards, R.A. and D.G. Deuel. 1987. Atlantic striped bass: Stock status and the recreational fishery. Marine Fisheries Review. 49(2):58-66.

USDOI and USDOC. 1987. Emergency striped bass research study. Report for 1986. Washington, DC: U.S. Department of the Interior, U.S. Department of Commerce. Available from: NMFS F/CM3, 1825 Connecticut Ave., NW, Washington, DC 20235.

# SPINY DOGFISH

**Squalus acanthias**

**Dogfish, piked dogfish, grayfish**



**Summary status**

*** Increased stock, declining catches in 1980s**
*** May be preying significantly on other commercial species**
*** Increased catches possible**

Spiny dogfish, *Squalus acanthias*, are distributed in the western North Atlantic from Georgia to Newfoundland. During spring and autumn, they are found along the coastal waters between North Carolina and Southern New England. Dogfish are chiefly summer visitors to the Gulf of Maine (including Georges Bank) and more northern waters, and in winter are distributed primarily in deeper waters along the edge of the continental shelf.

They tend to school by size and, for large mature individuals, by sex. Dogfish are voracious feeders and are known to attack schools of herring and mackerel, as well as concentrations of haddock, cod, and other species. They will also tear at commercial fishing nets. In the Northwest Atlantic, the maximum ages reported for males and females are 35 and 40 years, respectively. The species bears live young, with a gestation period of about 18 to 22 months producing 2 to 15 pups or an average of six.

Reported international nominal catches peaked at about 21,000 mt in 1972 and declined sharply from 1975 to 1978. Distant water fleets consistently accounted for virtually all of the reported catches. The reported USA 1987 nominal catches were 2,600 mt, which is equal to 1986 levles. Low catches during the last two years are attributable to decreased availablility of marketable-sized dogfish on the traditional summer fishing

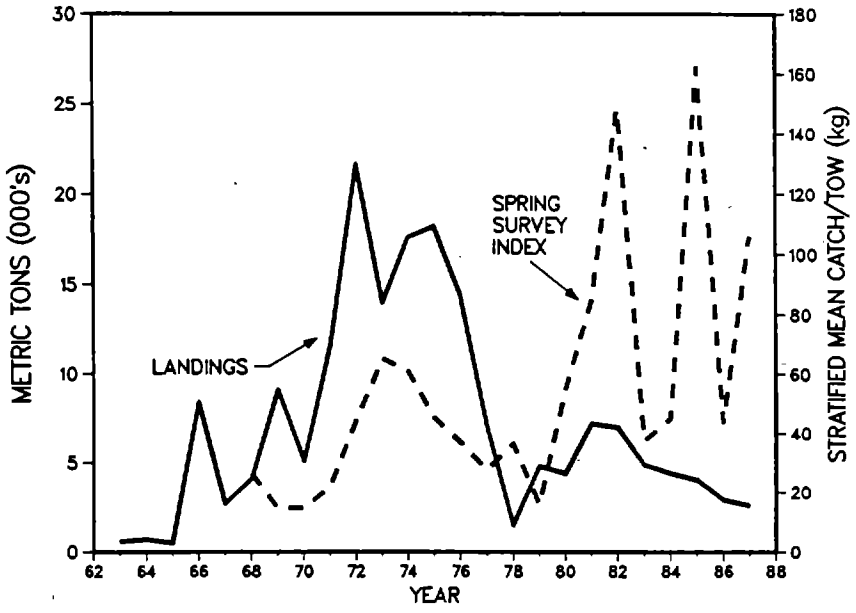



Figure 25.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of spiny dogfish in the Gulf of Maine - Mid-Atlantic area.

grounds. During summer, large concentrations of marketable-sized dogfish were usually found in the vicinity of and on Stellwagen Bank. However, in 1986 dogfish abundance within this region was low, coinciding with drastic declines in sandlance, a principal prey item. This situation is expected to continue in 1988.

Minimum biomass estimates of spiny dogfish based on NEFC spring bottom trawl survey catches increased 140% from 269,000 mt in 1986 647,000 mt in 1987, 156% above the 1968-86 geometric average of 252,000 mt. Since dogfish school, there tends to be rather high variability among the random survey catches, resulting in large fluctuations in the annual biomass estimates.

The USA fishery for dogfish is similar in nature to the European fisheries in being selective for large individuals [ > 2.3 kg (5.1 lbs.), 83 cm (33 in.)], which are mainly mature females, to meet processing and marketing requirements. However, during certain times of the year, smaller individuals, consisting of both mature and immature males as well as immature females, are taken as by-catch and discarded. Additionally, since this species bears live young, a directed fishery on mature females directly impacts on recruits. The potential for rapid overexploitation of sharks has been observed in European fisheries. This results from low growth and fecundity rates, schooling of large mature individuals by sex, and direct stock-recruitment relationships. Optimal levels of annual harvest in USA waters are currently unknown, but are likely above present catch levels.

## Reference

Colvocoresses, J. A., and J. A. Musick. 1980. A preliminary evaluationof the potential for a shark fishery in Virginia. Gloucester Point, VA. Virginia Inst. Mar. Sci. Spec. Rept. Appl. Mar. Sci. Ocean. Engineering No. 234, 37 p.

Nammack, M. F. 1982. Life history and management of spiny dogfish, Squalus acanthias, off the northeastern United States. Williamsburg, VA. College of William and Mary. 63 p. MS thesis.

Slauson, T. P. 1982. Growth, maturation, and fecundity of the spinydogfish, Squalus acanthias, in the northwestern Atlantic. Stoney Brook, NY. State University of New York at Stony Brook, 97 p. MS Thesis.

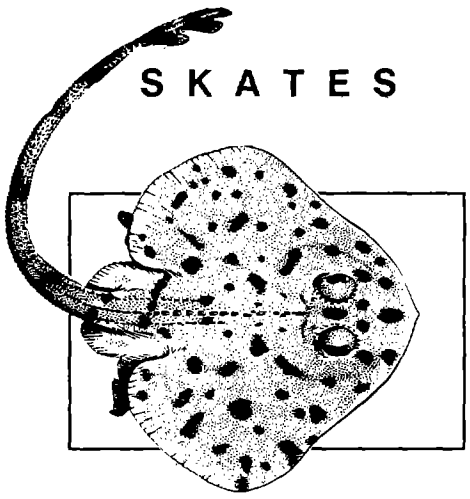
Table 25.1 Nominal catches (thousand metric tons) and management information for spiny dogfish from the Gulf of Maine - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 4.8 | 4.2 | 6.9 | 6.6 | 4.9 | 4.4 | 4.0 | 2.6 | 2.6 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | 0.2 | 0.3 | 0.4 | - | - | - | 0.1 | - |
| Total Nominal catch | 4.8 | 4.4 | 7.2 | 7.0 | 4.9 | 4.4 | 4.0 | 2.7 | 2.6 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 6 yrs, (males); 12 yrs (females) |
| Size at 50% maturity | = | 60.1 cm (23.4 inches) males; 80.7 cm (31.8 inches) females; |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

# SKATES



**Raja erinacea**
**little skate**
**R. ocellata**
**winter skate**
**R. laevis**
**barndoor skate**
**R. radiata**
**thorny skate**
**R. eglanteria**
**clearnose skate**
**R. garmani**
**rosette skate**
**R. senta**
**smooth skate**

Skates, Family Rajidae, are distributed throughout the Northwest Atlantic from near the tide line to depths exceeding 700 m. Members of this family lay eggs that are enclosed in a hard, leathery case commonly called a "mermaid's purse." Incubation time is 6 to 12 months, with the young having the adult form at the time of hatching. There are seven species of Raja occurring along the North Atlantic coast of the USA: little skate, *Raja erinacea*, winter skate, *R. ocellata*, barndoor skate, *R. laevis*, thorny skate, *R. radiata*, brier skate, *R. eglanteria*, leopard skate, *R. garmani*, and smooth-tailed skate, *R. senta*. The center of distribution for the little and winter skates is Georges Bank and Southern New England. The thorny, barndoor, smooth-tailed, and leopard skates are commonly found in the Gulf of Maine. The brier skate is a southern species, located primarily in the Chesapeake Bight. Skates are not known to undertake large-scale migrations, but they do move inshore and offshore in response to seasonal changes in water temperature, generally offshore in the summer and early autumn and vice versa during the winter-spring period.

There is no directed fishery for skates, and total nominal catches between 1975 and 1982 were less than 2,000 mt annually. Most of the domestic catch has traditionally been discarded at sea. Beginning in 1983, domestic landings began increasing in response to an expansion of the domestic food fish market, and the development of a bait market in southern New England. Nominal catches increased 21% from 4,200 mt in 1986 to 5,100 mt in 1987.

The species composition of the 1987 landings of skates for human consumption was unknown since only the pectoral fins or wings are landed for most species. The little skate is the principal species sold as bait. Nominal catches are not expected to markedly increase in the near future unless the limited export or domestic markets expand.

Minimal biomass estimates for all skates in the Gulf of Maine - Mid-Atlantic area, determined from NEFC bottom trawl survey data, increased nearly 85% from 102,000 mt in 1986 to 188,400 mt in 1987. The 1987 estimate was 51% greater than the 1968-86 average of 124,400 mt. The 1987 increase is largely attributable to large catches of winter skate on Georges Bank.

## Summary status

*** Stock size increasing**
*** Landings increasing since early 1980s**
*** Difficult to assess without more information**

## Reference

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine.Cambridge, MA: Harvard University Museum of Comparative Zoology.

Holden, M. J. 1973. Are long-term sustainable fisheries for elasmobranchs possible? Rapp. P.-v. Reun. Cons. int. Explor. Mer 164:360-367.

Wáring, G. T. 1980. A preliminary stock assessment of the little skate, Raja erinacea, in the Northwest Atlantic. Bridgewater, MA: Bridgewater State College. 122 p. MA Thesis.

Figure 26.1 Total commercial landings and estimates of minimum stock biomass from NEFC spring bottom trawl surveys of skates in the Gulf of Maine - Mid-Atlantic area.

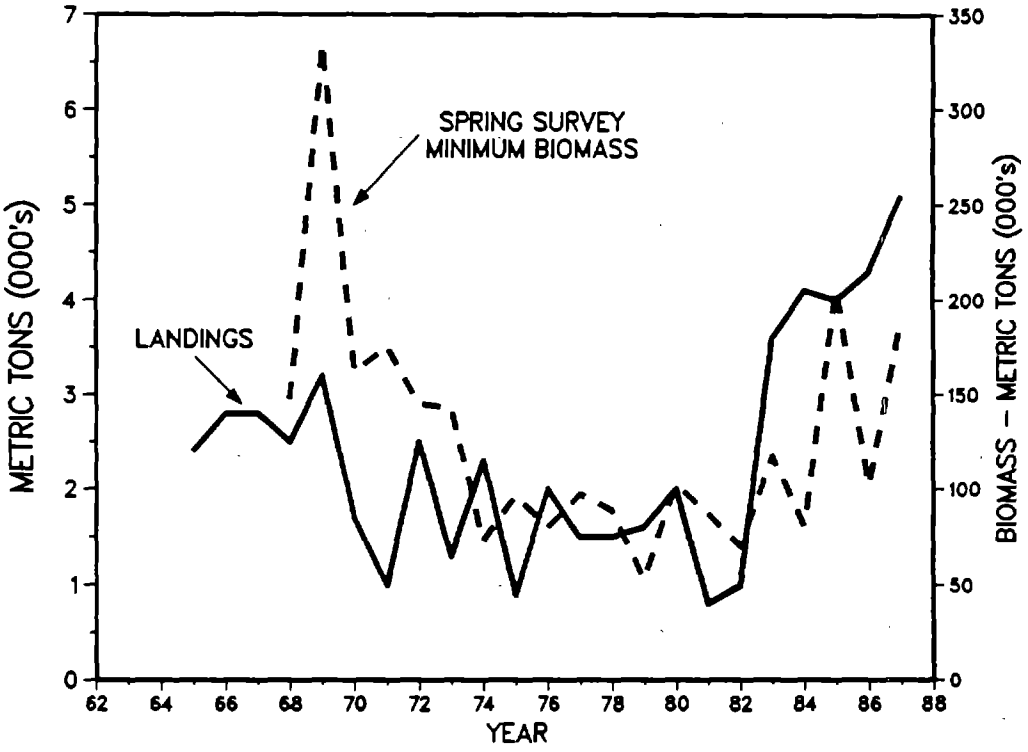



Table 26.1 Nominal catches (thousand metric tons) and management information for skates (all species) from the Gulf of Maine - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 1.6 | 2.0 | 0.8 | 1.0 | 3.6 | 4.1 | 4.0 | 4.2 | 5.1 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | 0.1 | - |
| Total nominal catch | 1.6 | 2.0 | 0.8 | 1.0 | 3.6 | 4.1 | 4.0 | 4.3 | 5.1 |

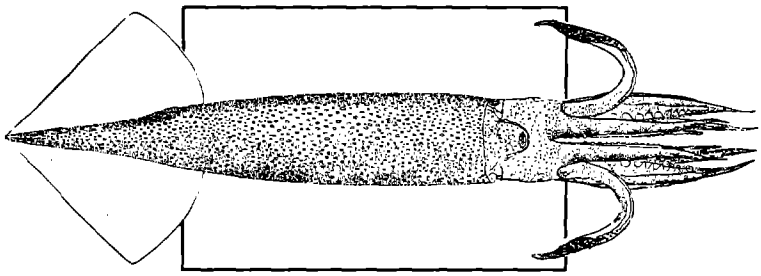
| | | |
|---|---|---|
| Long term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | None |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 4 years[1] |
| Size at 50% maturity | = | 40 cm (15.8 inches)[1] |

$M = 0.40^{1}$ $F_{0.1} = 0.49^{1}$ $F_{max} = 1.00^{1}$ $F_{1987} =$ Unknown

[1] Pertains to the little skate.

# SHORT-FINNED SQUID

## Illex illecebrosus



The short-finned squid, *Illex illecebrosus*, is found in commercial quantities between Cape Hatteras and Newfoundland. Based on present scientific information, this range represents the major distribution of a single stock. *Illex* undergo seasonal migrations onto the continental shelf during summer and off the edge of the shelf in winter to spawn. Results of recent larval and juvenile surveys indicate that spawning probably occurs somewhere south of Cape Hatteras near the Gulf Stream. Larvae and juveniles are assumed to be transported north and east in the fringes of the Gulf Stream. In some years, the spawning season is prolonged so that two cohorts (winter and late spring) are produced. These cohorts tend to vary in relative importance from year to year. Illex grow to a maximum length of about 35 cm (14 in., dorsal mantle length) and live about 12 to 24 months. Commercial catches off the USA are comprised mainly of 10 to 28 cm (4 to 11 inches) individuals which are probably 8 to 24 months of age.

### Summary status

*** Catch declines since 1970s, with increase in 1987**

Total catches increased from 5,400 mt in 1986 to 10,300 mt in 1987, compared to the 1968-85 mean of 13,800 mt. The USA nominal catch increased from 5,200 mt in 1986 to 10,300 mt in 1987, the highest on record. About one third of the 1987 USA catch was taken in joint ventures. There were no distant water fleet allocations of *Illex* during 1987, and no reported catches.

The 1987 NEFC autumn survey index for *Illex* was about ten times greater than that for 1986 and the third highest of the time series (1968 to 1987). Prerecruit ($\leq$10 cm) abundance in 1987 was comparable to the 1968-86 average. The prerecruits sampled in the 1987 autumn survey will compose the bulk of the catch in the 1988 fishery. While abundance seems adequate to support the catches during 1988 at the recent levels, whether the fishery can take this level of catch depends upon the availablility of squid within the fishing area. This availability is associated with environmental and behavioral factors which are not yet fully understood.

### Reference

Lange, Anne M. T. 1984. Status of the short-finned squid, Illex illecebrosus, off the Northeastern U.S. November 1984. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 84-38. 20 p. Available from Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of Fourth Stock Assessment Workshop. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 27.1 Total commercial landings and stock abundance indices from NEFC autumn bottom trawl surveys of short-finned squid in the Gulf of Maine - Mid-Atlantic area.

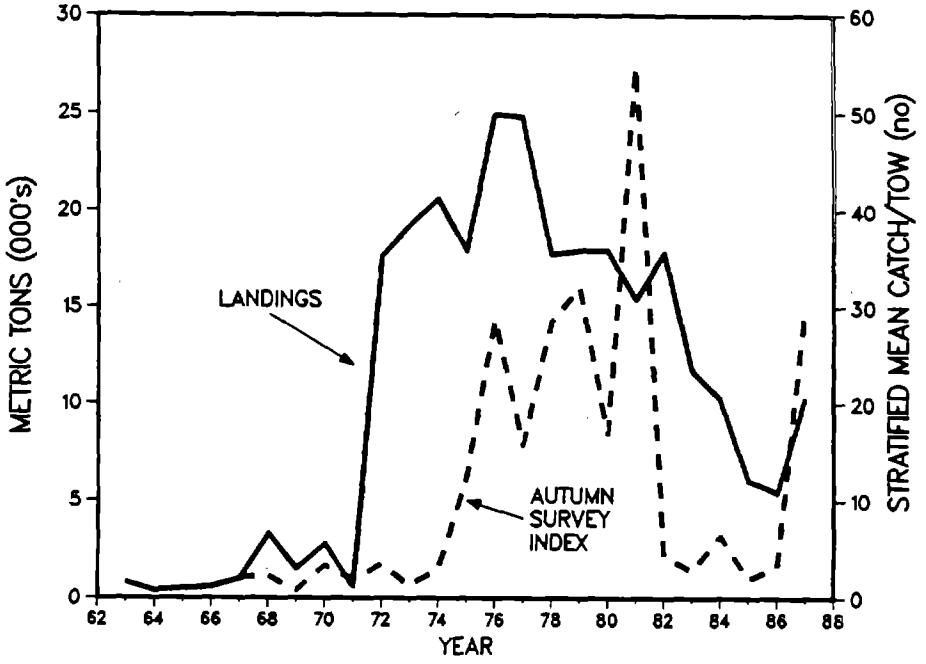



Table 27.1 Nominal catches (thousand metric tons) and management information for the short-finned squid *Illex* from the Gulf of Maine - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA[1] | 1.6 | 0.3 | 0.6 | 5.4 | 9.9 | 9.5 | 5.0 | 5.6 | 10.3 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | 16.3 | 19.6 | 14.9 | 12.4 | 1.8 | 0.7 | 1.1 | 0.2 | - |
| Total nominal catch | 17.9 | 17.9 | 15.4 | 17.8 | 11.7 | 10.2 | 6.1 | 5.8 | 10.3 |
| Total allowable catch | 30.0 | 30.0[2] | 30.0[2] | 30.0[2] | 30.0[2] | 30.0[2] | 25.0[2] | 22.5 | 22.5[3] |

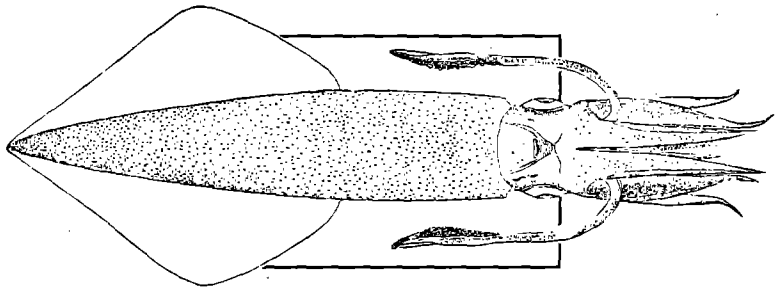
| | | |
|---|---|---|
| Long-term potential catch | = | 30,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since 1979 |
| Status of exploitation | = | Under exploited |
| Age at 50% maturity | = | 18 months |
| Size at 50% maturity | = | 20 cm (7.9 inches) dorsal mantle length |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

[1] Includes prorated amounts of squid catches not identified to species
[2] 1 April - 31 March fishing year
[3] MSY value; actual allocated level [Final Optimum Yield (OY)] was 17.0

# LONG-FINNED SQUID

## Loligo pealei



The long-finned squid, *Loligo pealei*, is found in commercial quantities from Cape Hatteras to southern Georges Bank. *Loligo* undergo seasonal migrations, moving into shallow inshore waters from southern Cape Cod to the Chesapeake Bay in spring and summer to spawn. In late autumn, they begin to move offshore to the edge of the continental shelf where the distant water fishery traditionally occured in winter. An extended spawning season results in two cohorts, with the early (spring) cohort generally more important than the late summer cohort, although this importance may vary from year to year. Loligo may reach lengths of more than 40 cm (16 in., dorsal mantle length) and ages of about 3 years, but most individuals taken in commercial catches are 8 to 20 cm (3 to 8 inches) and 8 to 14 months.

Total catches decreased from 17,900 mt in 1986 to 11,500 mt in 1987 and were 51% below the 1970-82 average (23,300 mt). The USA nominal catch decreased from 13,300 mt in 1986 to 11,500 mt in 1987. Joint venture catches accounted for about 9% of that total. Distant water fleet (DWF) allocations during 1987 were reduced to low by-catch levels and only 2 mt were taken.

The NEFC autumn survey index for 1987 was the lowest of the 1968 to 1987 series, 81% below the 1968-85 average. The 1987 prerecruit index was 87% below the 1968-85 mean. Minimum abundance was estimated to be 3.1 billion individuals during the 1986 autumn survey, with 80% (2.5 billion) being of prerecruit size ($\leq$8 cm or $\leq$3 in.). Recruitment from the 1986 year class should be 1.7 to 3.6 billion individuals, assuming 100% to 45% catchability of *Loligo* to the survey net. Yield per recruit and stock recruitment relationship analyses based primarily on results of the 1987 autumn survey indicate that yields from the 1987 year class may not exceed 10,000 mt even if fishing mortality were increased to the level corresponding to the maximum equilibrium yield. However, unusually cold bottom water temperatures during the autumn survey may have attributed to the low apparent abundance as *Loligo* may have moved off bottom to find preferred water temperatures, and became less available to the survey gear. Catches during the first three months of 1988 were above average for the USA fishery, further indicating that low catches during the autumn survey were due to low availability rather than low abundance.

### Summary status

*** Catches declining due to decrease**
*** Decreased foreign landings**
*** Steady domestic landings**
*** Low 1987 survey catch may be due to decreased availability to gear**

### Reference

Lange, Anne M. T. 1984. An assessment of the long-finned squid resource off the northeastern United States, Autumn 1984. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 84-37. 24 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Northeast Fisheries Center. 1986. Report of Fourth Stock Assessment Workshop. Woods Hole, MA. NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Figure 28.1 Total commercial landings and stock abundance indices from NEFC autumn bottom trawl surveys of long-finned squid in the Gulf of Maine - Mid-Atlantic area.

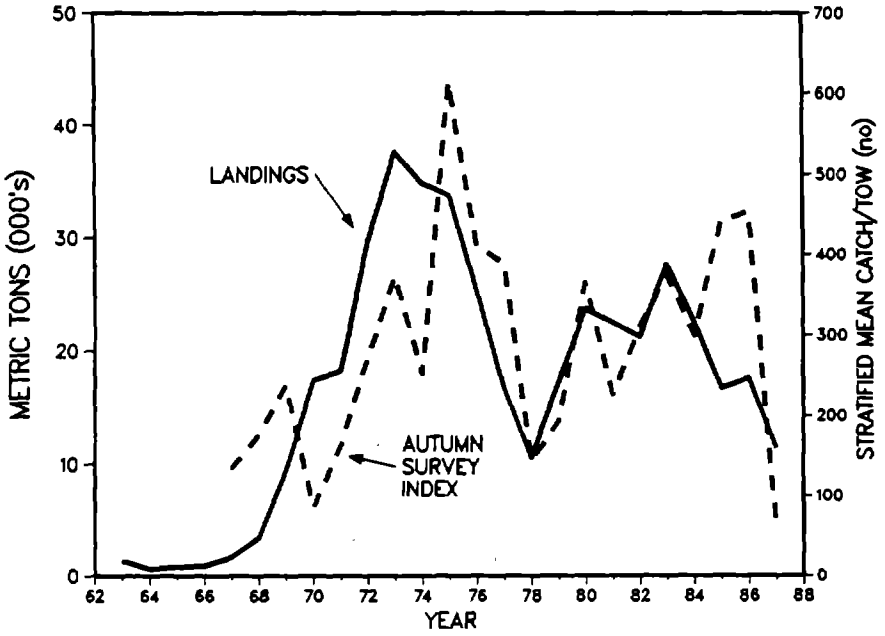



Table 28.1 Nominal catches (thousand metric tons) and management information for long-finned squid *Loligo* from the Gulf of Maine - Mid-Atlantic area.

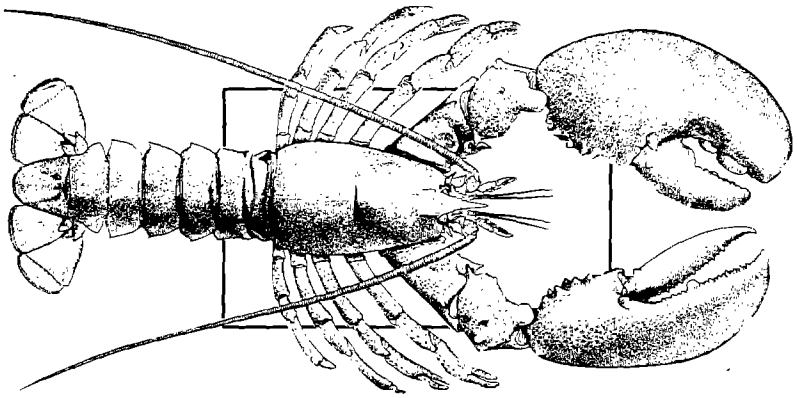
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA[1] | 4.3 | 4.0 | 2.3 | 5.4 | 15.9 | 11.6 | 10.2 | 13.3 | 11.5 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | 13.1 | 19.8 | 20.2 | 15.9 | 11.7 | 11.0 | 6.5 | 4.3 | <0.1 |
| Total nominal catch | 17.3 | 23.7 | 22.5 | 21.3 | 27.6 | 22.6 | 16.7 | 17.7 | 11.5 |
| Total allowable catch | 44.0 | 44.0[2] | 44.0[2] | 44.0[2] | 44.0[2] | 44.0[2] | 33.0[2] | 37.02 | 37.0[3] |

| | | |
|---|---|---|
| Long-term potential catch | = | 44,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since 1979 |
| Status of exploitation | = | Moderately exploited |
| Age at 50% maturity | = | 12 months |
| Size at 50% maturity | = | 16 cm (6.3inch) dorsal mantle length |

M = Unknown $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = Unknown

[1] Includes prorated amounts of squid catches not identified to species
[2] 1 April - 31 March fishing season
[3] MSY value; actual allocated level (Final Optimum Yield) was 10.1

# AMERICAN LOBSTER



**Homarus americanus**

**Northern lobster**

## Summary status

* **Stable stock sizes**
* **High fishing mortality**

The American lobster, *Homarus americanus*, is distributed in the Northwest Atlantic from Labrador to Cape Hatteras at depths up to 700 m (380 fathoms). Lobsters are locally abundant in coastal areas within the Gulf of Maine and off southern New England, decreasing in abundance in more southerly locations. Coastal lobsters are primarily concentrated in rocky areas where shelter is readily available, although occasional high densities occur in offshore mud substrates suitable for burrowing. Offshore lobsters are most abundant in the vicinity of submarine canyons along the edge of the continental shelf. Tagging experiments in coastal waters suggest that movements of small lobsters are rather limited, although there is evidence that larger individuals may travel extensively. In contrast, offshore lobsters undertake well-defined shoalward migrations during spring, traveling up to 300 km (186 mi) and commonly migrating up to 80 km (50 mi), and a return migration occurs during autumn. Lateral movements along the shelf edge have also been demonstrated.

Lobsters exhibit a complex life cycle in which mating occurs following molting of the female; the eggs (7,000 to 80,000) are carried under the female.s abdomen during the 10 to 11 month incubation period. Hatching occurs during late spring to early summer, and the pelagic larvae undergo four molts before attaining adult characteristics and settling to the bottom. Lobsters molt approximately 20 times before reaching the minimum legal size at 5 to 7 years of age. A significant proportion of lobsters caught in inshore waters are not sexually mature.

Nominal catches in the USA inshore fishery remained relatively stable between 1965 and 1975, ranging from 10,300 to 12,200 mt and averaging 11,100 mt. From 1978 to 1985 the catch rose from 12,900 mt to a record level of 18,000 mt, before falling slightly to 17,800 mt in 1986. A further decline to 17,300 mt occurred in 1987. Nominal catches for the offshore lobster trap fishery increased rapidly following its inception in 1969, from 50 mt to 2,900 mt in 1972. From 1975 to 1978 landings were relatively stable at approximately 2,000 mt. During the years 1982 and 1983 offshore trap landings rose to an average of 2,500 mt and from 1983 to 1987 have averaged around 3,000 mt. The offshore trawl fishery averaged 1,900 mt during the period 1965 to 1974. Since 1977 this component of the landings has decreased steadily to a level of 200 to 300 mt. Total offshore landings declined between 1978 and 1981 but have returned to the mid-1970s levels of 20,000 to 21,000 mt during the last five years. The offshore landings remain below 20% of the total catch of American lobster.

The NEFC autumn survey biomass index declined steadily from 1.3 kg/tow in 1964 to 0.5 kg/tow in 1970, averaged 0.7 kg/tow during 1971-76, and then increased to an average of 1.0 kg/tow during 1977-80. The autumn index decreased to 0.8 kg/tow in 1985. The 1987 autumn index has dropped to 0.63 kg/tow. The commercial CPUE index (kg-per-trap-haul-set-over-day or kg/THSOD) for the southern New England region also indicated sharp declines in stock biomass during the 1970s, dropping from 1.5 kg/THSOD

in 1969 to only 0.4 kg/THSOD in 1972. This index subsequently increased to 0.5 kg/THSOD in 1974 before dropping to 0.2 kg/THSOD in 1983. Thus, trends in offshore commercial landings, commercial CPUE, and research vessel survey indices are generally consistent in indicating a reduction in stock biomass following the development of the offshore trap fishery and stabilization at reduced levels in more recent years. The inshore lobster fishery, in contrast, is known to depend heavily on newly recruited lobsters, with very high fishing mortality rates.

## Reference

Fogarty, M.J., R.A. Cooper, J.R. Uzmann, and T.S. Burns. 1982. Assessment of the USA offshore American lobster, Homarus americanus, fishery. ICES, C.M. 1982/K:13. 21 p.

NEFMC. 1987. Final Ammendment #2, Fisheries Management Plan for American lobster. 31 p. Available from: New England Fishery Management Council, Suntaug Office Park, 5 Broadway (Rt. 1), Saugus, MA, 01906.

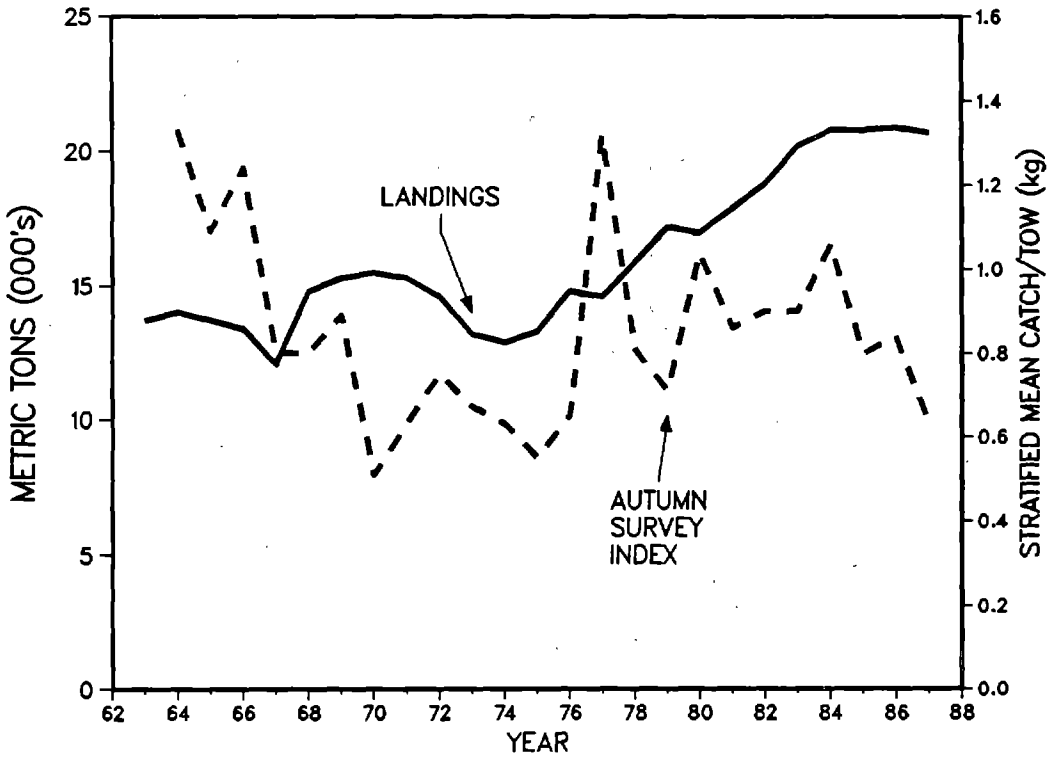



Figure 29.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of American lobster in the Gulf of Maine - Mid-Atlantic area.

Table 29.1 Commercial and recreational landings (thousand metric tons, live weight) of American lobster from the Gulf of Maine - Mid-Atlantic area (landings statistics have been revised to reflect unreported catches).

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational[1] | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA: Offshore[2] | 2.2 | 1.9 | 1.8 | 2.5 | 2.4 | 4.2 | 2.6 | 3.1 | 3.3 |
| Inshore[3] | 4.7 | 14.9 | 15.9 | 16.1 | 17.6 | 16.4 | 18.0 | 17.8 | 17.3 |
| Canada: Georges Bank | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | <0.1 | <0.1 |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 17.2 | 17.0 | 17.9 | 18.8 | 20.2 | 20.8 | 20.8 | 20.9 | 20.7 |

| | | |
|---|---|---|
| Long-term potential catch | = | 3,400 mt[4] |
| Importance of recreational fishery | = | Insignificant[4] |
| Status of management | = | FMP in place since 1985 |
| Status of exploitation | = | Fully exploited offshore<br>Over exploited inshore |
| Size at 50% maturity | = | 10 cm (3.9 inch) carapace length |

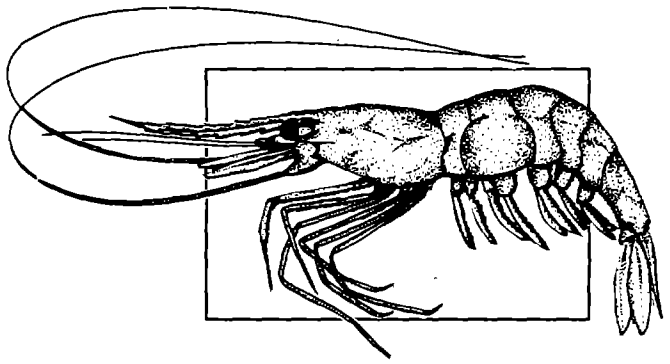
$M = 0.10$ $F_{0.1}$ = Unknown $F_{max}$ = 0.18 (males), 0.23 (females) $F_{1987} > F_{max}$

[1] Recreational catches unknown
[2] Includes trawl and offshore trap catches
[3] Inshore trap catches
[4] Offshore fishery only

# NORTHERN SHRIMP

## Pandalus borealis

## Pink shrimp



## Summary status

*** Stock, catches increasing since 1982, based on strong 1982 year class**

*** Decline in landings expected**

The northern shrimp, *Pandalus borealis*, supports important commercial fisheries in the North Atlantic and the North Pacific; the Gulf of Maine marks the southernmost extent of its Atlantic range. Distribution within the Gulf appears to be governed in large measure by temperature conditions; highest concentrations occur in the southwestern Gulf of Maine where temperatures are coolest, and seasonal changes in distribution appear to correlate well with localized temperature trends. Historical trends in abundance also appear largely attributable to environmental conditions. This stock collapsed during the mid-1970s in response to high exploitation and poor recruitment; some recovery has been evident in recent years, but abundance remains considerably below peak levels observed during the late 1960s.

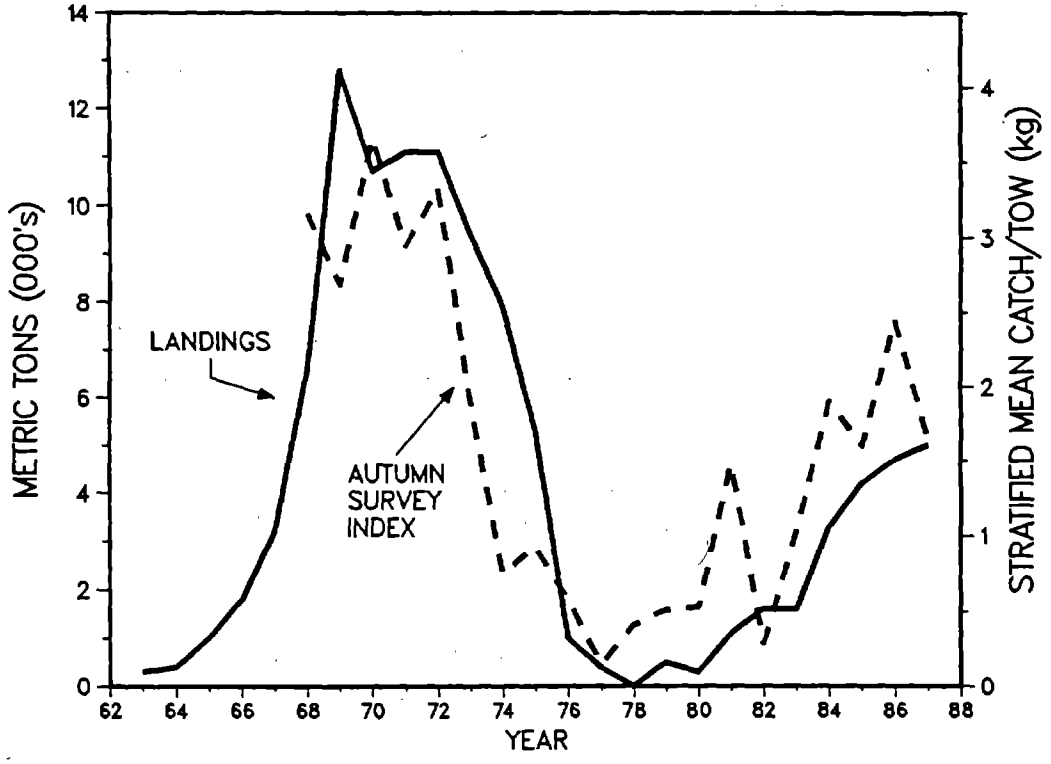
Northern shrimp are protandric hermaphrodites, maturing first as males (generally at 2.5 years of age); they then pass through a series of transitional stages and mate again as females the following summer at age 3.5. During autumn and winter, egg-bearing (ovigerous) females migrate into inshore areas where the eggs hatch. These females may survive to spawn in subsequent years, although natural mortality appears to increase sharply after first hatching at age 4.

The Gulf of Maine northern shrimp fishery is managed jointly by the participating states (Maine, New Hampshire and Massachusetts) under the auspices of the Atlantic States Marine Fisheries Commission (ASMFC). Under this arrangement, regulations are posted and enforced in the name of the Commission, but enforcement authority remains vested with the individual states. The fishery has been managed primarily by mesh size regulations and seasonal closures. Beginning in 1985, the fishing season has extended from 1 December to 31 May, the maximum allowable under current ASMFC policy.

Shrimp are taken primarily by otter trawling, although pots have also been used successfully along the central Maine coast. Effort has been directed primarily toward mature females in inshore areas during winter; effort tends to shift further offshore in spring reflecting both post-hatch movement and improving weather conditions. Total effort on this stock (number of trips) has risen steadily since the late 1970s; the 1986-87 season total (11,000 trips) was more than triple the 1982-83 average.

Nominal catches peaked at 12,800 mt in 1969, averaged approximately 11,000 mt during 1971-72, and then declined precipitously to only 400 mt in 1977. Landings have since increased from an average of 400 mt in 1979-80 to 4,700 mt in 1986. The 1987 total was 5,000 mt. The recent upward trend reflects improved recruitment, particularly from the 1982 year class. The NEFC autumn survey index has increased more or less continually since 1977; the 1986 value was 2.46, the highest observed since 1972. Results of the state-federal cooperative summer survey aboard R/V Gloria Michelle initiated in 1983, indicate an increase in abundance and biomass from 1984 to 1986 and relatively low exploitation levels during 1986 and 1987.

Figure 30.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of northern shrimp in the Gulf of Maine.




The strong 1982 year class has now passed though the fishery and subsequent year classes are weaker; thus, prospects for the fishery do not appear as favorable as seen in recent years. Both the NEFC autumn survey index and the cooperative summer survey index dropped sharply in 1987. The projected total harvest for the 1987-88 season (December 1, 1987 to May 31, 1988) is 3,500 mt, a 38% reduction from the 1986-87 season total of 5,600 mt.

## Reference

Clark, S. H. 1982 Assessment and management of the Gulf of Maine northern shrimp, Pandalus borealis, fishery. ICES C.M. 1982/K:13. 20 p.

McInnes, D. 1986. Interstate fishery management plan for the northern shrimp Pandalus borealis (Kroyer) fishery in the western Gulf of Maine. Atl. States Mar. Fish. Comm. Fish. Mgt. Rept. No. 9. 79p.

Northern Shrimp Technical Committee. 1987. Gulf of Maine northern shrimp stock status - 1987. Report to Northern Shrimp Section of the Atlantic States Marine Fisheries Commission, October, 1987. 16p.

Table 30.1 Nominal catches (thousand metric tons) and management information for Gulf of Maine northern shrimp.

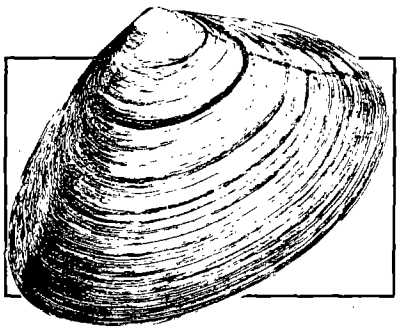
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| USA | 0.5 | 0.3 | 1.1 | 1.6 | 1.6 | 3.3 | 4.2 | 4.7 | 5.0 |
| Canada | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - |
| Total nominal catch | 0 .5 | 0.3 | 1.1 | 1.6 | 1.6 | 3.3 | 4.2 | 4.7 | 5.0 |

| | | |
|---|---|---|
| Long-term potential catch | = | Unknown |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | Jointly by participating states[1] |
| Status of exploitation | = | Moderately exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 9 cm (3.5 inches) |

M = 0.5 $F_{0.1}$ = Unknown $F_{max}$ = Unknown $F_{1987}$ = 0.3

[1] Under Amendment No. 1 to the Atlantic States Marine Fisheries Compact.

# SURF CLAMS



## Spisula solidissima

**Skimmer clam, hen clam, bar clam, sea clam**

Surf clams, *Spisula solidissima*, are distributed in western North Atlantic waters from the southern Gulf of St. Lawrence to Cape Hatteras. Commercial concentrations are found primarily off New Jersey and the Delmarva Peninsula, although some fishable quantities exist in Southern New England waters, on Georges Bank, and off the Virginia Capes. In the Mid-Atlantic region, surf clams are found from the beach zone to a depth of about 60 m; beyond 40 m, however, abundance is low. Growth rates are relatively rapid, with clams reaching harvestable size in about six to seven years. Maximum size is about 22.5 cm (8 7/8 in.), but clams larger than 20 cm (7 7/8 inches) are rare. Surf clams are capable of reproduction at the end of their first year of life, although most do not spawn until the end of their second year. Eggs and sperm are shed directly into the water column; recruitment to the bottom occurs after a planktonic larval period of about three weeks (at 22° C).

### Summary status

*** Stocks, catches stabilized**
*** Current catch sustainable through early 1990s**

Atlantic surf clam populations inhabiting offshore (Fishery Conservation Zone) waters of the USA East Coast have been managed since November 1977 under provisions of the Magnuson Fishery Conservation and Management Act. Prior to enactment of the comprehensive management plan, stock abundance and total commercial landings in the Mid-Atlantic Bight fell dramatically; total (inshore and offshore) landings declined from 46,300 mt of shucked meats in 1974 to 22,300 mt in 1976. Regulation of the fishery has proceeded with one objective being to re-build Mid-Atlantic stocks. Various regulatory devices to effect this and other objectives have included landings quotas, a moratorium on new vessel entrants, closure of areas to protect pre-recruit sized clams, effort restrictions, a minimum clam size, and target discarding rates to be achieved by changes in minimum shell size. Two management areas (New England and Mid-Atlantic) are identified in the management plan reflecting the different status of resources and fisheries within these regions. Separate quotas have been established for the Middle Atlantic region (Cape Hatteras to Montauk), Southern New England, and Georges Bank. Quota levels for the three areas in 1987 and 1988 were 2.65 million, 200 thousand, and 300 thousand bushels, respectively.

Intensive fishing for surf clams was initiated during the post-World War II era in response to increased demand and dwindling supplies of traditional clam species. Almost all of these early landings were taken off Long Island and northern New Jersey. Extensive offshore beds were discovered and developed off Pt. Pleasant during the 1950s; combined with inshore beds near Cape May - Wildwood, the New Jersey resources supported the fishery until the early 1970s. Declining productivity of New Jersey fishing areas prompted a shift of effort to the south during the early 1970s. New beds off southern Virginia and North Carolina contributed to a tremendous increase in total landings during 1973-75. Average catches in these three years of 40,100 mt (meats) were 50% greater than the 1965-77 average of 27,000 mt. The southern Virginia - North Carolina fishery collapsed during 1976; most vessels returned to more northern ports. During 1987, most of the Middle Atlantic FCZ surf clam landings were taken off New Jersey, with

the remainder taken off the Delmarva Peninsula, from the southern Virginia - North Carolina region. Total FCZ landings in 1987 were 22,100 mt, representing an 11% decline from the previous year's total of 24,900 mt. The decline in offshore catch is primarily related to market demands for the product, rather than to any significant change in surf clam abundance.

## Northern New Jersey

Biomass indices from research vessel surveys generally parallel trends in landing statistics from various portions of the management area. Stock biomass and landings of surf clams declined steadily off the northern New Jersey coast from the mid-1960s to 1977. A mass mortality of clams in the northern New Jersey area during the summer of 1976 reduced the abundance of commercial-sized clams to extremely low levels. Subsequent surveys of the area (1978 to 1984) have indicated a substantial 1976 year class in the area subjected to the clam kill. Growth to harvestable size of this single year class off northern New Jersey resulted in an increasing proportion of total Mid-Atlantic nominal catches from that area. Much of the 1976 year class has recruited to the exploitable stock, particularly since the minimum legal size has been reduced in the past two years from 14 to 12.7 cm shell length.

## Delmarva Peninsula

Biomass off the Delmarva Peninsula was maintained until the return of the fleet from southern Virginia - North Carolina during 1976. Concentration of the offshore

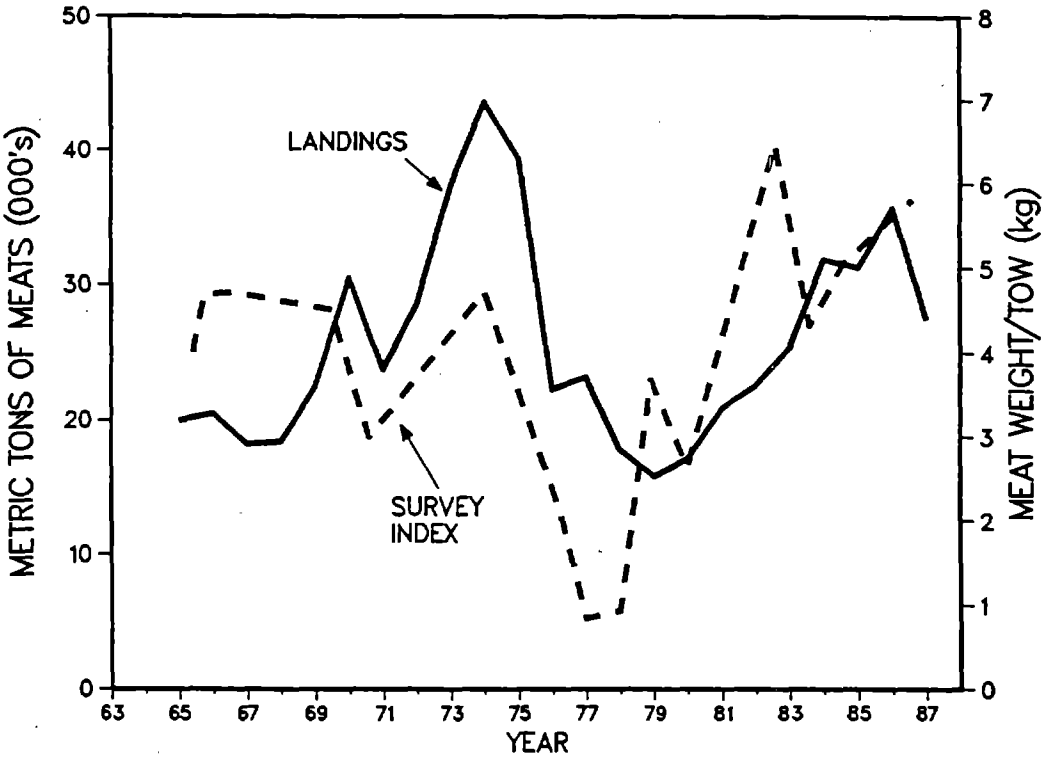



Figure 31.1 Total commercial landings and stock biomass indices from NEFC dredge surveys of surf clams in the Mid-Atlantic area.

fishery in Delmarva waters between 1976 and 1980 resulted in declining stocks of commercial sizes. Recent surveys indicate that the biomass of commercial sizes has increased, due to the partially recruited 1977 year class. Based on growth rate projections, increasing proportions of the 1977 year class will reach harvestable size during 1987 and 1988.

## Southern New Jersey; Southern Virginia-North Carolina

Surf clam resources in the southern New Jersey and southern Virginia - North Carolina areas remain at relatively low levels, although fishing activity in the two regions increased during 1982 and 1983. The slight increase in activity in the two areas, primarily due to the predominance of small clams in catches off northern New Jersey and Delmarva, necessitated laborious culling of the catch to land legal-sized clams. The increases in surf clam landings from Southern New England and Georges Bank during 1983 and 1984 were also in part a result of the restrictions on fishing effort and clam size for the Middle Atlantic FCZ fishery.

## Middle Atlantic FCZ

Research vessel survey data through 1986, the last year of synoptic surveying, indicated adequate surf clam resources currently exist to support the Middle Atlantic FCZ fishery at or near current levels (18,000 to 23,000 mt of meats) until the mid-1990s.

Table 31.1 Nominal catches (thousand metric tons) and management information for surf clams from the New England - Mid-Atlantic area.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| FCZ waters | 13.2 | 15.7 | 16.9 | 16.7 | 20.5 | 24.7 | 23.7 | 24.9 | 22.1 |
| State waters | 2.6 | 1.4 | 4.0 | 5.9 | 4.9 | 7.2 | 9.2 | 10.8 | 5.4 |
| Total | 15.8 | 17.1 | 20.9 | 22.5 | 25.4 | 31.9 | 32.9 | 35. 7 | 27.6 |
| Total allowable FCZ catch | 13.6 | 13.6 | 18.1 | 18.1 | 18.9 | 24.3 | 24.3 | 24.3 | 24.3 |

| | | |
|---|---|---|
| Long-term potential catch | = | 24,300 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since November 1977 |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 2 years |
| Size at 50% maturity | = | 5 cm (2.0 inches) |

M = 0.20 $F_{0.1}$ = Unknown $F_{max}$ = 0.25 $F_{1987}$ = approximately 0.1

## New England

Likewise, landings of 3,000 to 4,000 mt of meats can be sustained from the New England management area (Southern New England and Georges Bank) for the next decade as well. Although no resource surveys for surf clam were conducted in 1987 or 1988, it is unlikely that significant new recruits that had not been previously documented will enter the fishery, since it takes at least five years for surf clams to reach harvestable size.

## Inshore Fisheries

Landings from inshore (state) waters decreased dramatically between 1986 and 1987 (from 10.8 to 5.4 thousand mt). This decline in nearshore landings is due primarily to sharp reductions in landings from inshore New York waters, and to a lesser extent, from off New Jersey.

## Total landings

The dramatic decline in landings from nearshore waters, coupled with slight reductions from FCZ waters, resulted in total 1987 surf clam landings being reduced 23% from the previous year's total. Total landings in 1988 will likely remain stable.

## Reference

Murawski, S. A. 1986. Assessment updates for Middle Atlantic, New England, and Georges Bank offshore surf clam, Spisula solidissima populations, - summer 1986. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-11. 34 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

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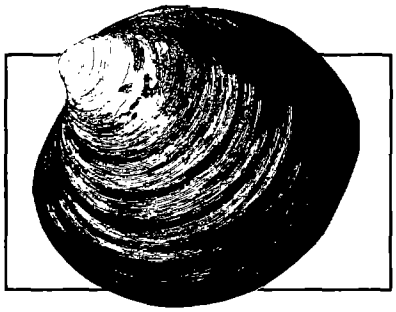
# OCEAN QUAHOGS

## Arctica islandica



### Summary status

*** Stock size relatively constant, catches increasing in proportion to management limits**
*** Local reductions in abundance may soon cause shifts in areas fished**

The ocean quahog, *Arctica islandica*, is found in temperate and boreal waters on both sides of the North Atlantic. Distribution in the Western Atlantic ranges from Newfoundland to Cape Hatteras in depths from 8 to 256 m. Quahogs are rarely found where bottom water temperatures exceed 16.C and occur progressively further offshore between Cape Cod and Cape Hatteras. Highest densities in the Mid-Atlantic region are in depths between 40 and 60 m; few quahogs have been found deeper than 100 m. Results of recent age and growth studies indicate that ocean quahogs are extremely slow-growing and long-lived compared to other continental shelf pelecypods. Specimens averaging 77 mm shell length (3 in.) marked off Long Island during 1978 grew about 0.6 mm in one calendar year and 1.2 mm in two years. Analyses of a series of length frequency data and examination of banding patterns of small individuals corroborate slow growth rates implied from mark-recapture studies. Spawning apparently occurs over a protracted interval from summer through autumn; little is known of larval and juvenile life history.

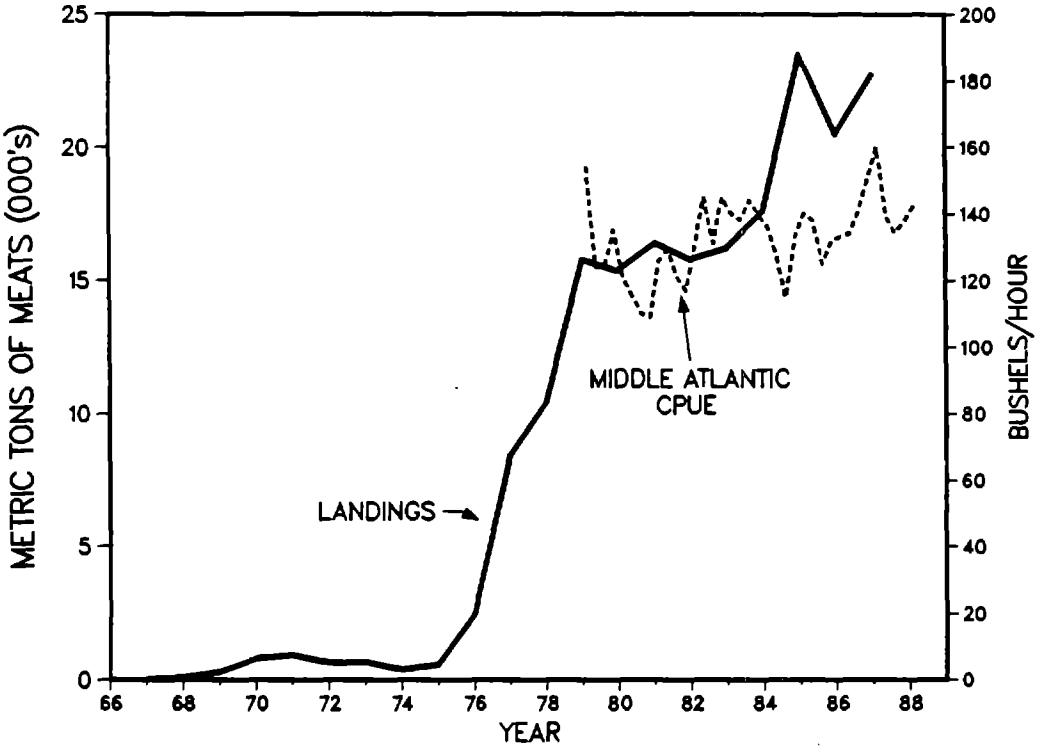
Harvesting of ocean quahogs was initiated during World War II off Rhode Island. Total landings, however, never exceeded 2,000 mt of shucked meats until 1976 when offshore exploitation began off New Jersey and Maryland. Steady declines in offshore surf clam stocks combined with the massive kill of surf clams off New Jersey in 1976 stimulated fishing for the deeper-dwelling ocean quahog. Total ocean quahog landings increased dramatically between 1976 and 1979 from 2,500 to 15,800 mt of meats per year. Increased landings in 1987 (22,200 mt of meat) were near the record high level observed in 1985. Virtually all landings are derived from FCZ waters. Most of the FCZ landings are from off New Jersey, and the remainder from the Delmarva Peninsula. Small quantities of quahogs were also landed from state waters off Rhode Island and Maine.

The FCZ fishery has been regulated since 1977 under provisions of the Surf Clam and Ocean Quahog Fishery Management Plan (FMP) developed by the Mid-Atlantic Fishery Management Council. The primary management measure has been an annual landings quota, which has increased from 13,600 mt of meats in 1978 to 27,200 mt in 1986-87.

Resource surveys for ocean quahogs in the Georges Bank - Cape Hatteras region have been conducted by the NEFC since 1965. Biomass indices for six assessment areas in the region were extremely stable from 1965 to 1982, indicating little fluctuation in biomass. Total standing stock of quahogs in the region is estimated to be 1.2 million mt of meats. The majority of the resource occurs on Georges Bank (29%) and off southern New England (26%), with smaller amounts off Long Island (19%), New Jersey (19%), Delmarva (7%), and southern Virginia - North Carolina (< 1%).

Trends in fishery performance from 1979 to 1986 were evaluated using mandatory logbook data submitted by each permitted vessel. The offshore ocean quahog fishery is conducted primarily with dredging vessels greater than 100 GRT. Average catch per

Figure 32.1 Total commercial landings of ocean quahogs in the New England - Mid-Atlantic area and commercial catch per unit effort in the New Jersey and Delmarva ocean quahog dredge fisheries.




hour for the large vessels varied somewhat during the period, exhibiting a declining trend from 1979 to early 1980, and again from 1983 to 1985. CPUE is likely to continue to exhibit such variability as new beds are located. The catch is primarily composed of quahogs 65 to 105 mm shell length. Little size selectivity is apparent in the fishery, as the size composition of landings is similar to that from resource surveys.

Although annual landings are currently only 2% of the total estimated stock, landings considerably greater than this are not warranted due to the extremely slow growth rate and poor annual recruitment exhibited by the populations. Annual landings off New Jersey and the Delmarva Peninsula are currently about 5% of the total resource in these areas. If current harvest levels and patterns are maintained, the quahog resource and fishery in the New Jersey - Delmarva area should remain stable for the next few years, after which the fishery will probably shift northward and to the east to take advantage of higher marginal catch rates.

## Reference

Murawski, S.A. and F.M. Serchuk. 1983. An assessment of the ocean quahog, Arctica islandica, resource and fishery in FCZ waters off the Northeastern USA - Autumn 1983. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 83-25. 31 p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Murawski, S.A., J.W. Ropes, and F.M. Serchuk. 1982. Growth of the ocean quahog, Arctica islandica, in the Middle Atlantic Bight. Fish. Bull., U.S. 80(1):21-34.

Ropes, J.W., D.S. Jones, S.A. Murawski, F.M. Serchuk, and A. Jearld, Jr. 1984. Documentation of annual growth lines in ocean quahogs, Arctica islandica Linne. Fish. Bull., U.S. 82(1): 1-19.

Northeast Fisheries Center. 1986. Report of the Third NEFC Stock Assessment Workshop. Woods Hole, MA: NMFS, NEFC. Woods Hole Laboratory Reference Document 86-14. 98p. Available from: Northeast Fisheries Center, Woods Hole, MA.

Table 32.1 Nominal catches (thousand metric tons, meats and management information for ocean quahogs from the New England - Mid-Atlantic area.

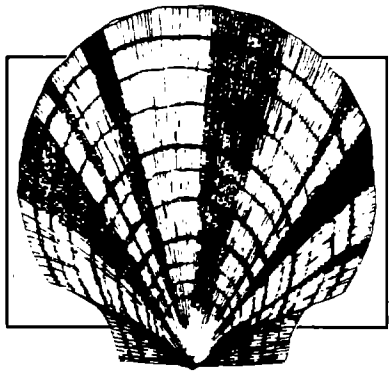
| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| USA commercial | | | | | | | | | |
| FCZ waters | 14.3 | 13.9 | 16.0 | 15.6 | 15.3 | 16.4 | 23.6 | 19.8 | 22.2 |
| State waters | 1.4 | 1.5 | 0.4 | 0.2 | 0.7 | 1.2 | <0.1 | 0.8 | 0.6 |
| Total nominal catch | 15.8 | 15.3 | 16.4 | 15.8 | 16.0 | 17.6 | 23.6 | 20.5 | 22.8 |
| Total allowable FCZ catch | 13.6 | 15.9 | 18.1 | 18.1 | 18.1 | 18.1 | 20.4 | 27.2 | 27.2 |

| | | |
|---|---|---|
| Long-term potential catch | = | 27,200 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since November 1977 |
| Status of exploitation | = | Fully exploited in some areas |
| Age at 50% maturity | = | 8 years (males); 11 years (females) |
| Size at 50% maturity | = | 50 mm (2.0 inches) shell length |

M = 0.01 - 0.10 $F_{0.1}$ = Unknown $F_{max}$ = 0.03 - 0.05 $F_{1987}$ = Unknown, probably < 0.1

# SEA SCALLOPS

## Placopecten magellanicus



## Summary status

*** Stock abundance high**
*** Elevated catches, near-record high levels**
*** Record high fishing effort**
*** Catch likely to remain high in 1988 and 1989**

Sea scallops, *Placopecten magellanicus*, are distributed in western North Atlantic continental shelf waters from Newfoundland to North Carolina. North of Cape Cod, scattered concentrations may occur in shallow water less than 20 m (11 fathoms), but in more southerly and in offshore areas, scallops normally are found at depths between 40 and 200 m (22 to 110 fathoms). Commercial concentrations generally exist between 40 and 100 m (22 to 55 fathoms) in waters cooler than 20°C. Principal USA commercial fisheries are conducted in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic offshore region. Recreational fishing is insignificant, occurring primarily in Maine where shallow water scallop beds frequently exist.

Scallops grow rapidly during the first several years of life. Between ages 3 and 5, scallops commonly increase 50 to 80 percent in shell height and quadruple in meat weight. During this time span, the number of meats per pound is reduced from greater than 100 to about 23. Maximum size is about 23 cm (9.0 in.), but scallops larger than 17 cm (6.7 in.) are rare. Sexual maturity commences at age 3, but scallops less than age 4 probably contribute little to total egg production due to their presumed low fecundity. Spawning occurs in late summer and early autumn, varying slightly between years and areas. Eggs are buoyant, and larvae remain in the water column for 4 to 6 weeks until spatfall occurs.

## Gulf of Maine

Nominal catch in 1987 from the Gulf of Maine was 400 mt (meat weight), 14% more than in 1986. USA landings (380 mt) accounted for 96% of the 1987 total, with Canada accounting for the remaining 4%. Most of the USA catch (83%, 300 mt) was from inshore, territorial waters along the coast of Maine. USA landings (70 mt) from the EEZ (more than 3 n mi from shore) were the lowest since 1978, indicating continued dependence by the fishery on inshore beds.

Commercial fishing effort declined in 1987 (29% from 1986 and 71% from the record-high 1983 level), largely due to sharp reductions in both Class 2 [5 to 50 gross registered tons (GRT)] and Class 4 (more than 151 GRT) fishing activity. USA commercial CPUE in 1987 increased to its highest level since 1982, ending a six-year decline.

## Georges Bank

Total (USA and Canada) nominal catch from Georges Bank (Area 5Ze) in 1987 was 11,700 mt, 27% higher than in 1986, and the highest annual catch since 1981. Of the 1987 total, USA landings accounted for 42% (4,885 mt) while Canadian landings (6,800 mt) accounted for 58%. The 1987 USA catch was 8% higher than 1986 and was the highest since 1982. Canadian landings increased 45% between 1986 and 1987; the 1987 Canadian catch was the highest since 1981.

USA fishing effort declined in 1987 (down 11% from 1986), but remained within the historically high range of effort observed since the early 1980s. Most of the decrease in USA effort was due to reduced fishing activity by large vessels (Class 4). Canadian

Figure 33.1 Total commercial landings of sea scallops in the Gulf of Maine.

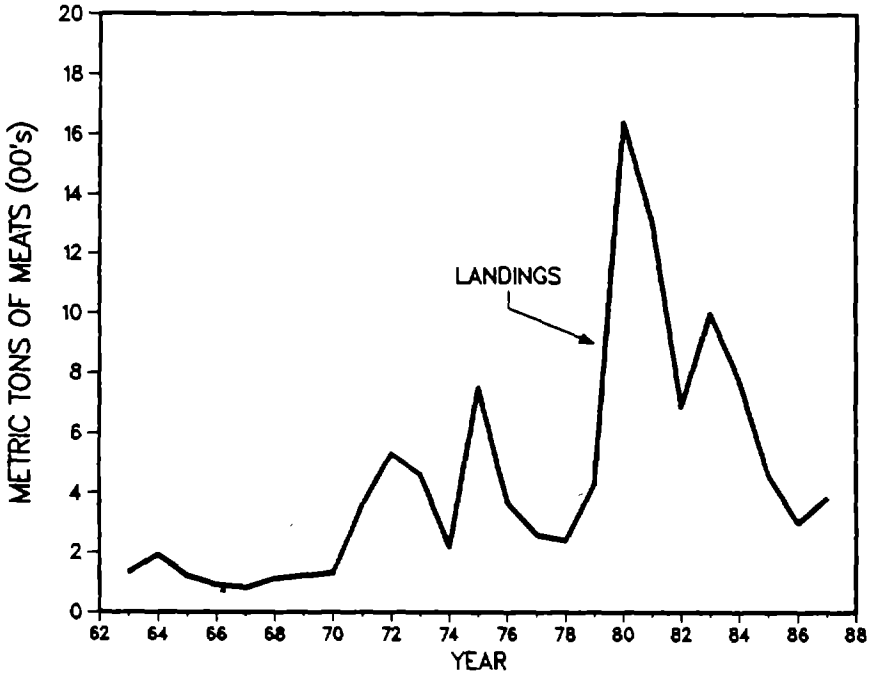



Figure 33.2 Total commercial landings and stock biomass indices from NEFC dredge surveys of sea scallops on Georges Bank.

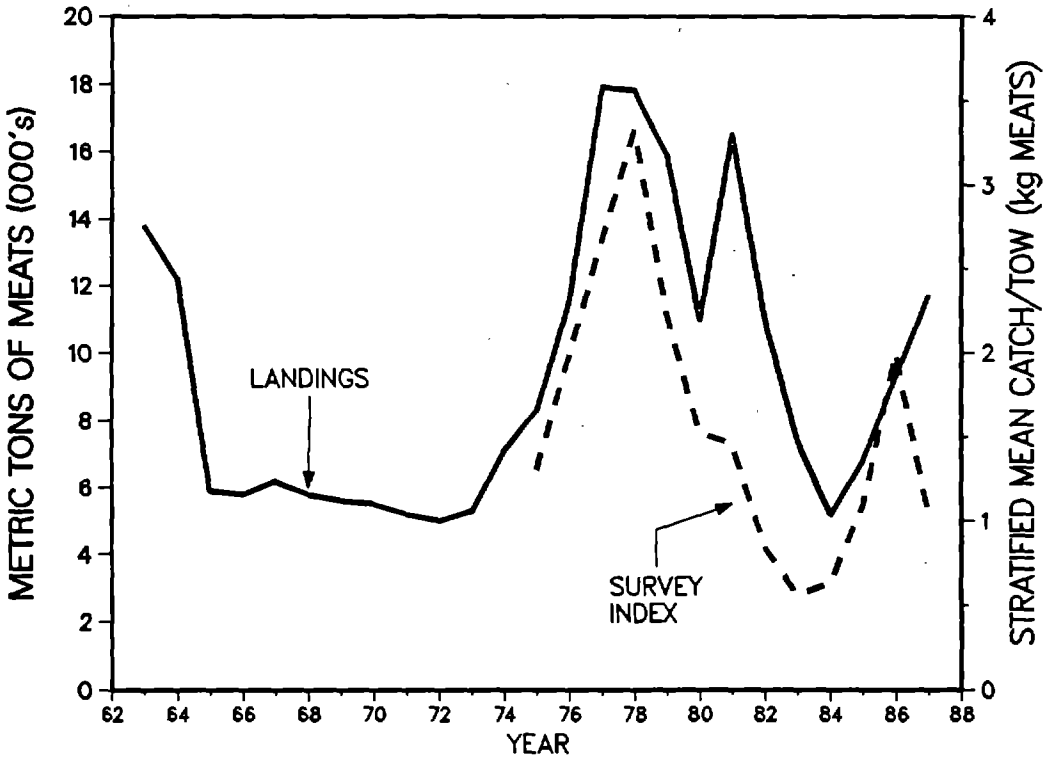
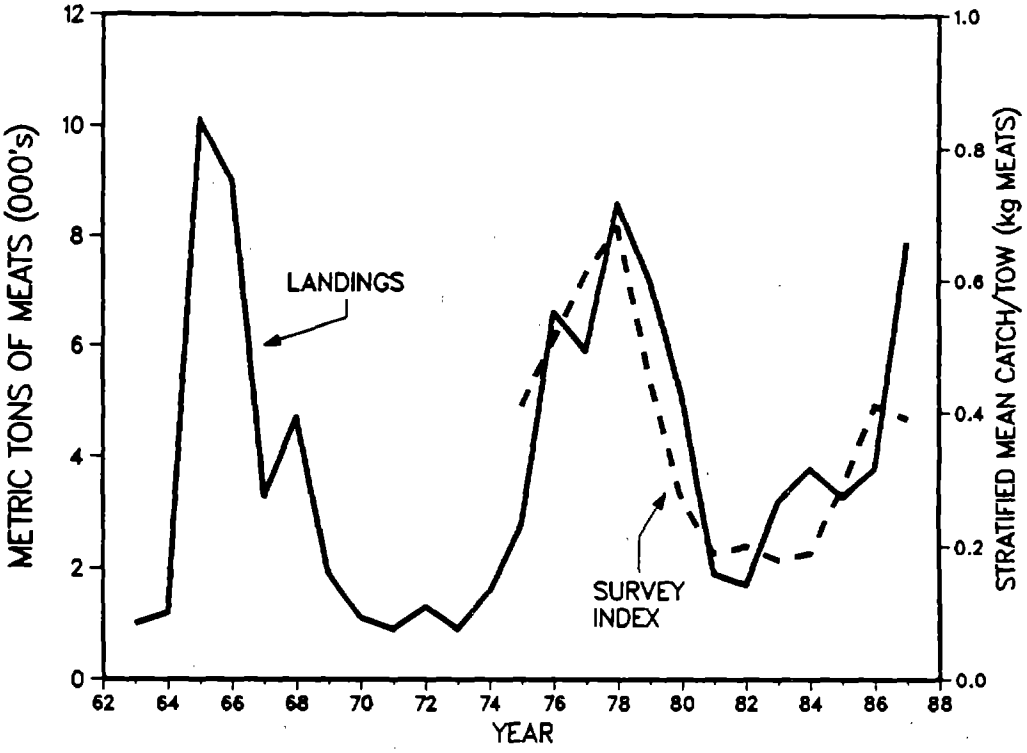


Figure 33.3 Total commercial landings and stock biomass indices from NEFC dredge surveys of sea scallops in the Mid-Atlantic area.




fishing effort increased by 56% in 1987 while Canadian CPUE declined by 11%. The 1987 Canadian CPUE value, however, was still one of the highest values observed. USA CPUE in 1987 increased 21% from 1986 (and was the highest since 1982) due to recruitment of the strong 1982 and 1983 year classes to the USA fishery.

Abundance indices from the 1987 USA sea scallop research vessel survey indicate that the marked improvement in abundance that began in 1985 has continued. In the USA sector of Georges Bank, the 1987 survey abundance values were among the highest in the 13-year survey time series. The survey results also indicate that the strong 1982 and 1983 year classes have been followed by a strong 1984 year class.

The Georges Bank scallop resource has rapidly recovered from the record-low 1983-84 levels. Stock abundance is presently at a high level. As a result, USA catches and CPUE are expected to increase in 1988 and remain high in 1989.

## Mid-Atlantic

Total nominal catch (exclusively USA) in 1987 was 7,900 mt, more than twice the 1986 total (3,800 mt). For the first time since 1979, more than half of the total USA sea scallop catch was taken from the Mid-Atlantic area. Most of the Mid-Atlantic catch (64%) was from the New York Bight region where landings doubled between 1986 and 1987 (from 2,500 to 5,000 mt). In the more southerly scallop regions (Delmarva and Virginia-North Carolina), landings in 1987 were sharply higher than in 1986 (2,900 mt compared to 1,200 mt).

Fishing effort in the Mid-Atlantic area markedly increased in 1987 (up 77% from 1986) and attained a record high level. Commercial CPUE also increased in 1987, reaching its highest level since 1979. As on Georges Bank, the increase in Mid-Atlantic CPUE was due to recruitment of the 1982 and 1983 year classes, which are also very abundant in the Mid-Atlantic area.

Table 33.1 Nominal catches (thousand metric tons, meat weight) and management information for sea scallops from the Gulf of Maine, Georges Bank and the Mid-Atlantic areas.

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| USA recreational | - | - | - | - | - | - | - | - | - |
| Commercial | | | | | | | | | |
| Gulf of Maine | | | | | | | | | |
| USA | 0.4 | 1.6 | 1.3 | 0.7 | 0.9 | 0.7 | 0.4 | 0.3 | 0.4 |
| Canada | - | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 | <0.1 | <0. | <0.1 |
| Total | 0.4 | 1.6 | 1.3 | 0.7 | 1.0 | 0.8 | 0.5 | 0.3 | 0.4 |
| Georges Bank | | | | | | | | | |
| USA[1] | 6.7 | 5.8 | 8.5 | 6.7 | 4.6 | 3.2 | 3.0 | 4.6 | 4.9 |
| Canada | 9.2 | 5.2 | 8.0 | 4.3 | 2.8 | 2.0 | 3.8 | 4.7 | 6.8 |
| Total | 15.9 | 11.0 | 16.5 | 11.0 | 7.4 | 5.2 | 6.1 | 9.3 | 11.7 |
| Mid-Atlantic | | | | | | | | | |
| USA | 7.2 | 5.1 | 1.9 | 1.7 | 3.2 | 3.8 | 3.3 | 3.8 | 7.9 |
| Total nominal catch | 23.5 | 17.7 | 19.7 | 13.4 | 11.6 | 9.8 | 10.6 | 13.4 | 20.0 |

| | | |
|---|---|---|
| Long-term potential catch | | |
| Gulf of Maine | = | 300 mt (territorial waters) |
| Georges Bank | = | 10,000 mt |
| Mid-Atlantic | = | 3,000 mt |
| Importance of recreational fishery | = | Insignificant |
| Status of management | = | FMP in force since May 1982 |
| Status of exploitation | = | Fully exploited |
| Age at 50% maturity | = | 3-4 years (GB and MA) |
| Size at 50% maturity | = | 60-90 mm shell height (GB and MA) |

M = 0.10 $F_{0.1}$ = 0.14 (GM), 0.15 (GB), 0.14 (MA) $F_{max}$ = 0.22 (GM), 0.26 (GB), 0.25 (MA) $F_{1987}$ = > $F_{max}$ in all areas

[1] For USA, Georges Bank landings include Southern New England catches.

The 1987 USA sea scallop survey abundance indices in the Mid-Atlantic area were the highest ever. Outstanding recruitment of the 1982, 1983, and 1984 year classes has resulted in a four-fold increase in population abundance (from the record low 1983 level) and a doubling of stock biomass.

Given the presently high abundance of the Mid-Atlantic resource, catches from this stock are expected to remain high, near the 1987 level, during 1988 and 1989.

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# INDEX

## Common Names and Scientific Names

# Common Name Index

# Scientific Name Index



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49. **Northeast Fisheries Center Framework for Inshore Research.** By Research Planning & Coordination Staff, Northeast Fisheries Center. July 1987. vi + 44 p., 2 figs., 2 tables. NTIS Access. No. PB87-232286/AS.

50. **Status of the Fishery Resources Off the Northeastern United States for 1987.** By Conservation & Utilization Division, Northeast Fisheries Center. October 1987. iii + 132 p., 48 figs., 50 tables. NTIS Access. No. PB88-148549.

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