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Status of the Fishery Resources Off the Northeastern United States for 1986

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts
September 1986

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Conservation & Utilization Division, Northeast Fisheries Center

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September 1986

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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 the major finfish and shellfish resources off the northeast coast of the United States from Cape Hatteras to Nova Scotia, and presents detailed information as needed to administrators, managers, the fishing industries, and the public. This report is in two parts, an Overview section and a Species Synopses section. Trends in recreational and commercial fisheries are described in the Overview section, and the general status of the resources through 1985 are described in the Species Synopses section.

Many of the assessments on which the Species Synopses are based are available as Laboratory Reference Documents at the Woods Hole Laboratory and may be obtained upon request. The most recent complete assessments for each stock are listed in the appropriate species synopsis. Additionally, NEFC initiated this past year a new procedure and had assessments of selected species-stocks reviewed in a workshop. For species-stocks where the conclusions of the most recent complete assessment are still valid, detailed updates to that information were reviewed, as described in the report of that workshop. That report is cited in the Species Synopses 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. For some fisheries (e.g., yellowtail flounder, 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 for these fisheries is crucial for the production of accurate assessments. Recently there has been an acceptance of smaller fish of some species in the market. The definitions of the 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.

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 recreational fishermen. Catch and effort information has been especially poor for the recreational fisherman, although significant progress in collecting this information is now being made.

Many of the species assessments herein are fairly new, developed in response to management initiatives of the Fishery Management Councils established under the FCMA. These assessments may involve an examination of harvest levels, biology, and survey abundance indices only for recent years; in contrast, assessments of some other species (e.g., haddock, cod, mackerel, and herring) are based on long time series of catch and survey information, and on detailed analyses of the age composition of the catch.

Depending on the nature of 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. The simplest approach (1) is when catch data are used to generate indices of 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, more complex analytic assessments (4) can be developed which utilize this information 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 shown diagramatically 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 in order 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, and of the mixed species nature of many of the fisheries. These interactions have implications for how assessment information is generated, and for the effect of management of fisheries on one species-stock on other species and other fisheries. Research and management initiatives are being taken to address this limited perspective, but the needed information is difficult to obtain.

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 as indicated in the units applied. Nominal catches do not include unreported discards or unidentified young fish put into fish meal.

[1] All Tables and Figures in this Overview section are labeled with letters of the alphabet, to distinguish them from the decimally labeled tables and figures in the Species Synopses.

STOCK ASSESSMENT SYSTEMS MODEL

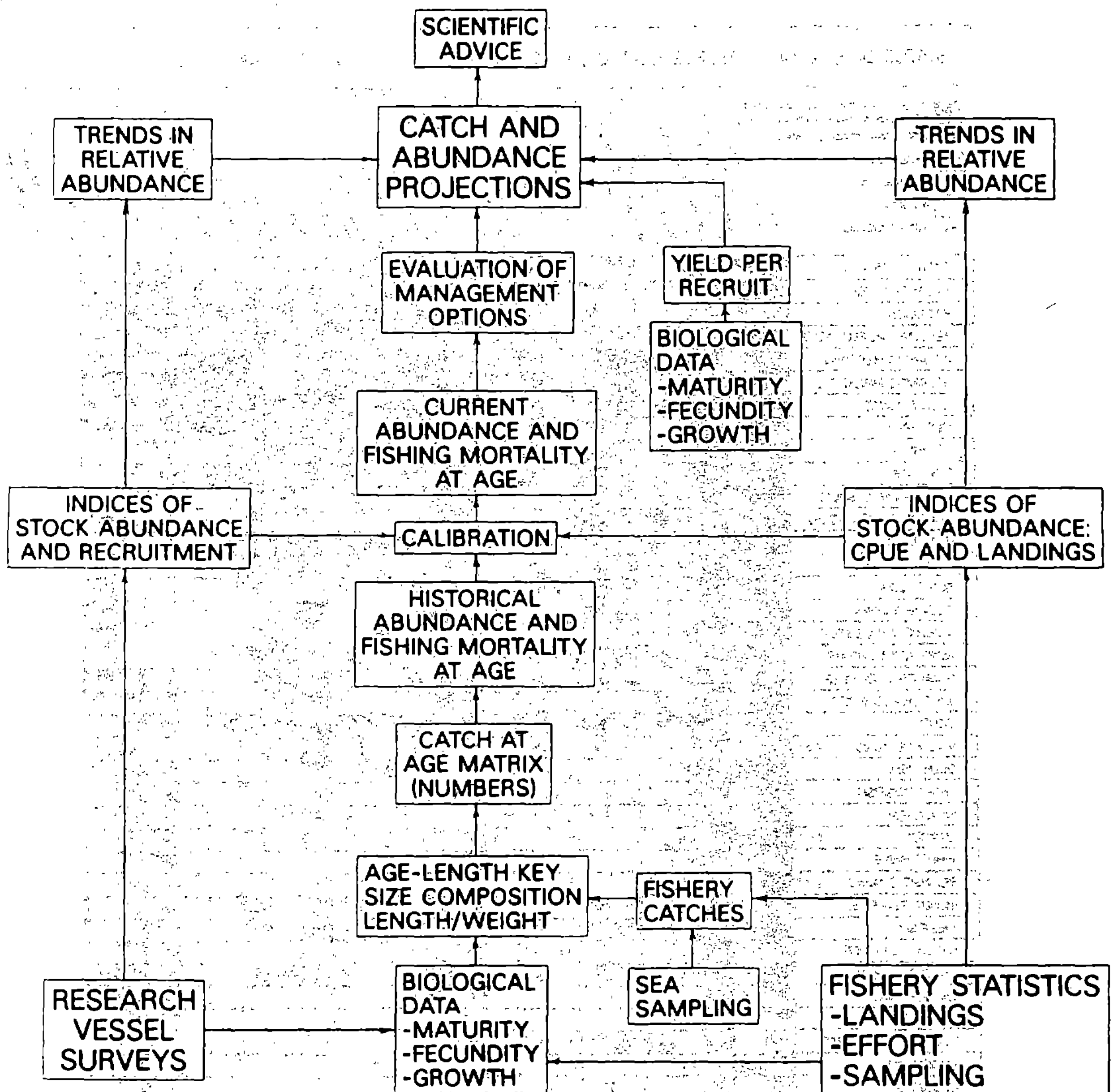
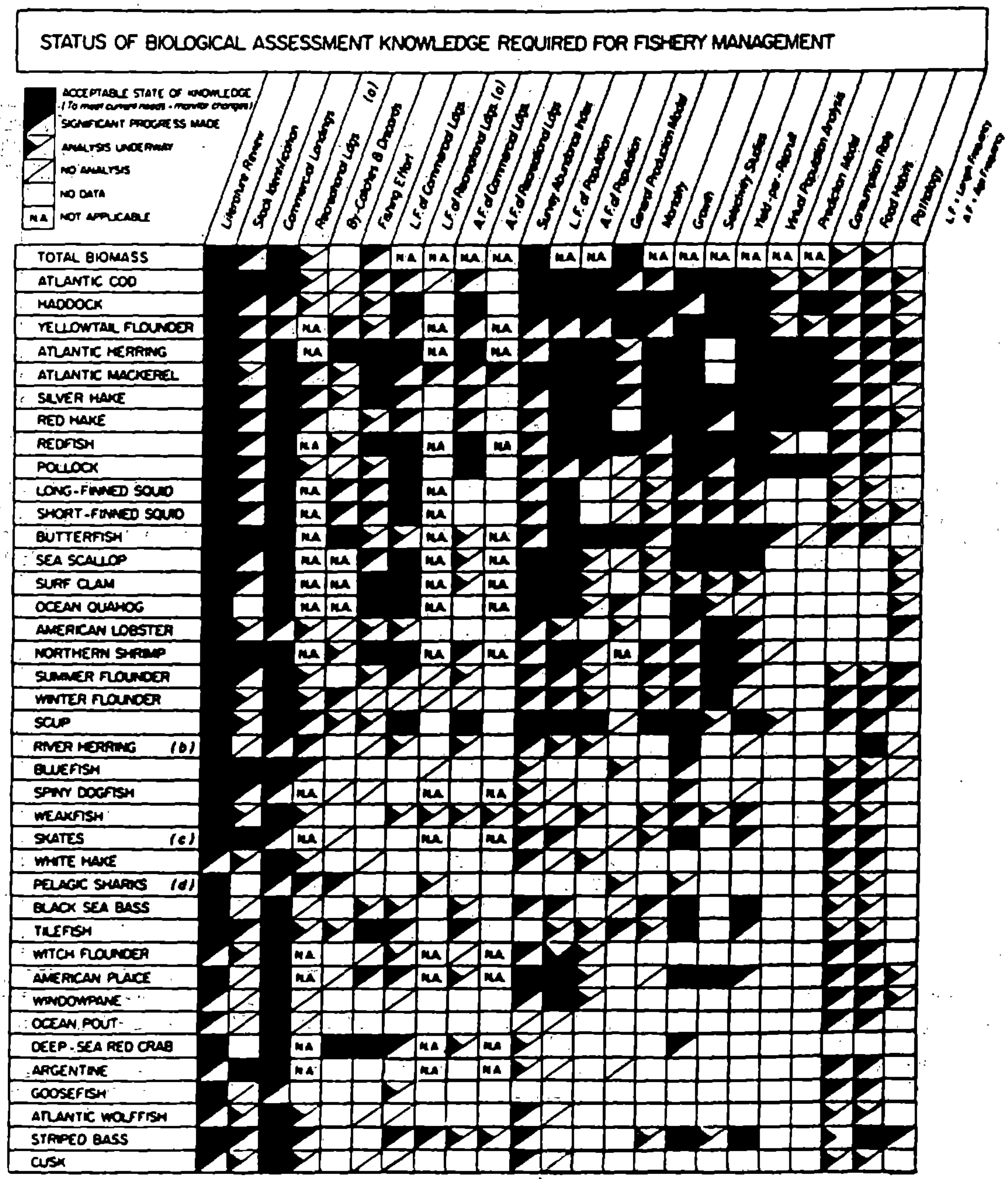


Figure A. Diagram of alternative ways in which fishery-generated data and research data (lower right and left boxes, respectively) are combined to provide scientific advice on the status of stocks (top box).

Table A.



(a) A COMPREHENSIVE RECREATIONAL FISHERIES SURVEY BEGAN IN 1979 UNDER A NATIONAL MARINE FISHERIES SERVICE CONTRACT. SUITABILITY OF THE RESULTING CATCH AND LENGTH-FREQUENCY DATA FOR BIOLOGICAL ASSESSMENTS WILL BE DETERMINED WHEN THE DATA BECOME AVAILABLE TO THE NORTHEAST FISHERIES CENTER.

(b) COMBINED ALEWIFE AND BLUEBACK HERRING.

(c) COMBINED LITTLE SKATE, WINTER SKATE, BARNDOOR SKATE, SMOOTH SKATE, ROSETTE SKATE, AND CLEARNOSE SKATE.

(d) ALL SHARKS EXCEPT DOGFISH SHARKS

Sustainable Yield The catch by weight from a fish stock when it is in equilibrium with fishing of a given intensity, and (apart from effects of environmental variation) its biomass is not changing from year to year.

TAC Total Allowable Catch is the total regulated catch from a stock in a given time period, usually a year.

Quota A regulated portion of a TAC from an allowance or estimated estimated catch.

Year Class (or Cohort) This term refers to a group of fish which were born in a particular year and are referred to throughout their life by their year of birth. It is a very useful term because occasionally fish born in a particular year are extremely abundant or extremely scarce, and there is a need to follow the catches or abundance of this year class annually as the fish get older. Fish born in 1978, therefore, are of the 1978 year class and are age 2 in 1980, age 3 in 1981, age 5 in 1983, etc.

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

Instantaneous Total Mortality Rate (Z) This is the proportion of the population that dies in a very small time interval but which is usually expressed on an annual basis. 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. If Z = 1.7 and a day represents the time interval, then approximately 1.7/365 or 0.466% of the population is declining, 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.

Instantaneous Fishing Mortality Rate (F) This is the instantaneous rate of death due to fishing, usually expressed over the entire year. 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. There are other causes of death, however, that are also acting on the population of fish at the same time as the fishery that must be considered in calculating the number that die from fishing. The number that die from fishing is the proportion that fishing is of the total mortality, 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 explained above, then this calculation is:

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

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

or 721,186 fish that die from fishing.

Instantaneous Natural Mortality Rate (M) This is also an instantaneous rate expressed over the year and is equal to Z-F. All causes of death other than fishing are usually lumped under the category of "natural" for convenience since these causes of mortality are usually much smaller than the mortality due to fishing and are of less immediate interest in themselves. The most important causes of natural death are predation, disease, and cannibalism, and are expressed separately when their rates of mortality are known. Following the examples given above, 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:

$$\frac{M}{Z} \quad (1-e^{-Z}) \quad (1 \text{ million})$$

or (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 predation, etc. 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 $(1-e^{-0.2})$ multiplied by 1 million or 181,269 fish and 18.1% of the beginning population.

Long-term potential catch The largest average 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.

Recruitment The addition of fish to the fishable population due to migration or to growth. Recruits are usually fish from one year class that have just grown large enough to be retained by the fishing gear.

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

$F_{0.1}$ The rate of fishing mortality for a given method of fishing at which the increase in yield per recruit for a small increase in fishing mortality results in only one-tenth the increase in yield per recruit for the same increase in fishing mortality from a virgin fishery.

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 backwards 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 backwards year by year for the year class, a very precise estimate of the abundance can be determined by three or four years back in time (by 1976 or 1975).

The 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 catches taken each year 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.

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) decreased less than 2% from 1984 to 1985. The total catch decreased from 1.27 million metric tons (mt) in 1984 to 1.25 million mt in 1985. The catch of finfish increased 7%, whereas the invertebrate catch decreased 9%.

Groundfish

Total groundfish commercial catches decreased 11% from 1984 to 1985. Catches of the principal groundfish (cod, haddock, redfish, red hake, silver hake, and pollock) decreased 6% from 116,102 mt in 1984 to 108,780 mt in 1985. Cod and haddock catches decreased 6% and 2% respectively, whereas silver hake, pollock, redfish, and red hake catches showed little or no change from 1984 to 1985.

Flounder catches decreased 16,550 mt from 1984 to 1985 (25% decrease). Yellowtail flounder catch decreased from 17,809 mt in 1984 to 7,345 mt in 1985 accounting for 63% of the total flounder catch decline. Summer flounder catches also decreased 25% from 1984 to 1985.

Other groundfish catches increased by 4% from 1984 to 1985. This increase seems to be due to small increases in several species.

Pelagics

Catches of the principal pelagics species, herring and mackerel, increased 25% from 1984 (52,197 mt) to 1985 (65,273 mt). The USA herring catch decreased by 21%, approximately 7,000 mt, and USA mackerel catch increased by 49%. The distant-water-fleet mackerel catch increased 118% from approximately 15,000 mt to 33,000 mt.

Catches of other pelagic species increased 19% due to a 23% increase in the menhaden catch. However, butterfish catch decreased 59% from 1984 (12,256 mt) to 1985 (4,990 mt).

Other finfish

The catch of other finfish increased 6% from 1984 (32,547 mt) to 1985 (34,680 mt).

Invertebrates

The total USA and foreign catch of invertebrates decreased 9% from 700,847 mt in 1984 to 637,039 mt in 1985. Foreign catches increased 38% due to a 89% increase in the Canadian sea scallop catch. Domestic catches decreased 11%.

Total squid catch decreased 29%. Foreign catches of long-finned squid (Loligo) decreased 41% from 1984 (11,028 mt) to 1985 (6,495 mt), while short-finned squid (Illex) increased 87%. Most of the overall decrease in the total invertebrate catch is accounted for by decreases in the catch of inshore species.

Table B. USA commercial and foreign nominal catches* (mt) from the marine finfish and invertebrate resources off the northeastern United States (Gulf of Maine to Cape Hatteras, North Carolina Mid-Atlantic) in 1984 and 1985. All catches are expressed as live weight; 1985 catches are provisional, and recreational catches are not included.

Species	Foreign		USA Commercial		TOTAL	
	1984	1985	1984	1985	1984	1985
Principal Groundfish	15,387	19,444	100,715	89,336	116,102	108,780
Cod	8,849	11,885	43,768	37,521	52,617	49,406
Haddock	2,708	4,275	11,601	6,505	14,309	10,780
Redfish	71	118	4,722	4,162	4,793	4,280
Silver hake	412	1,322	21,005	20,139	21,417	21,461
Red hake	57	80	2,278	1,819	2,335	1,899
Pollock	3,290	1,764	17,341	19,190	20,631	20,954
Flounders	366	520	65,397	48,693	65,763	49,213
American plaice	8	41	10,132	7,030	10,140	7,071
Witch flounder	14	48	6,532	6,070	6,546	6,118
Yellowtail flounder	4	3	17,805	7,342	17,809	7,345
Greenland halibut	0	0	0	<1	0	<1
Atlantic halibut	62	57	73	57	135	114
Winter flounder	5	12	14,605	10,883	14,610	10,895
Summer flounder	0	0	14,199	12,834	14,199	12,834
Windowpane flounder	0	0	1,830	4,205	1,830	4,205
Flatfishes (not specified)**	273	359	221	272	494	631
Other Groundfish	2,065	3,330	23,139	23,024	25,204	26,354
Cusk	477	298	1,709	2,341	2,186	2,639
Scup	15	18	7,769	6,713	7,784	6,731
White hake	1,013	953	6,490	6,359	7,503	7,312
Atlantic wolffish	82	81	1,039	940	1,121	1,021
Groundfish (not specified)	478	1,980	6,132	6,671	6,610	8,651
Principal Pelagics	14,957	32,612	37,240	32,661	52,197	65,273
Atlantic herring	0	8	32,711	25,914	32,711	25,922
Atlantic mackerel	14,957	32,604	4,529	6,747	19,486	39,351
Other Pelagics	310	439	273,172	324,312	273,482	324,751
Bluefish	0	0	4,171	5,026	4,171	5,026
Atlantic butterfish	285	207	11,971	4,783	12,256	4,990
Atlantic menhaden	11	81	253,450	311,593	253,461	311,674
Pelagic (not specified)	14	151	3,580	2,910	3,594	3,061
Other Finfish	1,407	1,472	31,140	33,208	32,547	34,680
River herring	206	217	4,117	6,137	4,323	6,354
Spiny dogfish	22	94	4,390	3,944	4,412	4,038
Skates	5	0	4,134	3,969	4,139	3,969
Finfish (not specified)	1,174	1,161	18,499	19,158	19,673	20,319
Invertebrates	28,822	39,849	672,025	597,190	700,847	637,039
Illex	576	1,082	9,423	4,987	9,999	6,069
Loligo	11,028	6,495	10,790	10,123	21,818	16,618
American lobster	267	309	20,605	20,614	20,872	20,923
Shrimp (Pandalid)	0	0	3,227	4,198	3,227	4,198
Crab (not known)	1	0	59,383	33,684	59,384	33,684
Surf clams	0	0	172,579	171,343	172,579	171,343
Ocean quahogs	0	0	147,998	182,644	147,998	182,644
Sea Scallops	16,950	31,963	64,560	56,181	81,510	88,144
Invertebrates (not specified)	0	0	183,460	113,416	183,460	113,416
Grand Total	63,314	97,666	1,202,828	1,148,424	1,266,142	1,246,090

* Catches for specific stocks given in the species synopses later in this report may differ because they are for the species in selected geographic areas.

** Not specified indicates that there are other species in this category which are not listed in the table.

RECREATIONAL FISHERY TRENDS

The recreational landings of many species of fish and shellfish caught in the coastal waters of the northeastern United States are equal or exceed the commercial landings. Notable examples are mackerel, striped bass, bluefish, weakfish, and pelagic sharks. Obtaining detailed records on recreational fishing is a formidable task because sportfishing occurs 24 hours a day, 7 days a week, 52 weeks a year in coastal rivers, bays, sounds, and the ocean. Sport anglers fish from private boats, party and charter boats, rented boats, and shore, and from man-made structures such as piers, bridges, and jetties.

National saltwater angling surveys were conducted in 1960, 1965, and 1970 as supplements to the national surveys of hunting and fishing. Relying on mail questionnaires, results from these surveys were of questionable accuracy because of, among other factors, the length of recall periods (up to 12 months) and the potential for species misidentification. In 1974, NMFS conducted surveys that were more regional in scope and that reduced the recall period to less than 2 months. Surveys were also conducted by the NEFC in the mid-1970's that focused on bluefish, summer flounder, and the party and charter boat fishery from New York to Maryland.

In 1979, a new survey methodology was introduced by NMFS that consisted of two complementary surveys: a household survey and a direct-intercept creel census. The new survey methodology was intended to avoid many of the problems of the earlier survey, particularly the recall period and poor response to questionnaires. The recreational fisheries of the Atlantic coast have been surveyed annually since 1979 by the new NMFS survey. Results from 1979-1984 have been incorporated into some of the species-stocks assessments summarized in this report. It is expected that results from the 1985 survey will be available for use in the near future. Since the new methodology represents a radical change from previous methodologies, data from the 1979-present surveys will not be directly comparable to earlier survey results.

Since recreational fishery data are an important factor in determining the status of many stocks, the NMFS survey data, representing the only source of information, have to be used. Typically, the recreational catch between survey years has been derived by interpolation, using the relationship between the sport catch and other indices of stock abundance (commercial catch or NEFC bottom trawl survey indices) in the survey years. Interpolating between surveys that used different data collection techniques adds to the biases in the catch statistics. Therefore, use of the recreational survey data to monitor the status of these stocks should be done with caution and with other indices of stock abundance, such as pre-recruit survey data or total adult biomass indices.

For further information see:

Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1983-1984, Current Fishery Statistics Number 8326, National Marine Fisheries Service, Washington, D.C., August, 1985.

COMMERCIAL FISHERY ECONOMIC TRENDS

NEW ENGLAND

From 1978 to 1985 the number of vessels of five gross registered tons (GRT) or more which landed catches in New England has increased, with some annual fluctuations, from 907 to 1327 (Table C). The average age and tonnage in 1978 were 19 years and 67 GRT, respectively, while in 1985 these averages were 17 years and 83 GRT. Average landings per vessel, also demonstrating some minor variability from year to year, have declined significantly. The period began with average vessel landings of 305 metric tons (mt) and ended with average landings of only 193 mt. The average number of days at sea per vessel, however, was higher in 1985 than for any of the seven previous years.

Total fleet revenue from all trips has risen from $157 million dollars in 1978 to $243 million in 1985. However, in constant 1978 dollars, a measure of purchasing power, the expanded fleet earned $10 million fewer dollars in 1985 than the smaller fleet did in 1978.

The fleet of vessels using otter trawls (Table C), which has grown by over 300 units in eight years, has seen a decline in landings from 225 mt per vessel to a period low of 147 mt in 1985. These same vessels grossed $170 million dollars in 1985 from all trips. The deflated or constant dollar gross returns to forty-eight percent more days at sea in 1985 were slightly less than they were eight years before. The unadjusted gross revenue per vessel for the average otter trawl vessel in each of three tonnage classes is shown in Figure B. Also included is the Consumer Price Index (CPI) showing 1978 as the base year. Each of the gross revenue indices lies below the CPI indicating the declining purchasing power of the average firm even before costs are deducted.

The number of vessels in the scallop dredge fleet has varied widely over the period (Table C). This reflects temporary migrations from other regions into New England. Landings per vessel using dredges was up slightly in 1985 over the previous year but still on the lower end of the range for the period. The fleet grossed slightly over $53 million dollars in 1985, the lowest since 1978. In constant 1978 dollars, last year's grosses were the lowest for the entire period. The gross revenue per vessel, for the average vessel using scallop dredge gear in each of the tonnage classes is shown in Figure C. As with the trawl vessels, the revenue index for each class of scallop dredge vessel lies below the CPI.

The cost of landing the average pound of seafood has increased since 1978 because more vessels are expending more days at sea and because the cost of those days at sea has risen significantly in eight years. Until the last two years fuel and interest costs on loans rose more rapidly than the rate of inflation as measured by the CPI. Both of these have declined substantially in 1985. In contrast, insurance costs have escalated by between 100 and 300 percent since 1982.

Table C . New England[1] Landings and Revenue for Vessels of 5 Gross Tons or More 1978-1985.

Year	Number of Vessels	Total Revenue All Trips $ 000,000 Nominal	Total Revenue All Trips $ 000,000 Deflated[3]	Total Landings All Trips 000's (m.t.)	Landings per Vessel Primary Gear Only[2] (m.t.)	Number of Fishermen
			All Gears	All Trips		
1978	907	156.6	156.6	276.6	--	4160
1979	1145	186.3	167.5	281.7	--	5453
1980	1305	203.8	161.4	315.8	--	6480
1981	1342	229.4	164.6	293.9	--	6780
1982	1341	241.1	162.9	322.0	--	6486
1983	1590	267.7	175.3	314.8	--	7262
1984	1383	254.9	160.1	295.9	--	6860
1985	1327	242.7	146.6	256.0	--	6537
			Otter Trawl Vessels			
1978	643	103.6	103.6	187.1	225	2765
1979	768	118.9	106.3	188.9	198	3229
1980	894	133.0	105.3	210.1	185	3889
1981	914	152.1	109.1	199.3	175	4044
1982	988	179.3	121.1	236.1	182	4496
1983	975	179.6	117.6	207.7	183	4463
1984	994	179.3	112.6	198.8	163	4623
1985	946	170.2	102.9	157.0	147	4377
			Scallop Dredge Vessels			
1978	129	45.0	45.0	65.9	465	939
1979	200	55.3	49.7	63.6	284	1602
1980	272	64.2	50.8	65.3	213	2261
1981	292	82.8	59.4	88.1	229	2473
1982	191	65.3	44.1	66.1	286	1661
1983	221	82.6	54.1	69.0	215	1744
1984	213	65.7	41.3	46.9	175	1751
1985	168	53.1	32.1	41.2	213	1478

1 Landings in Maine, Massachusetts and Rhode Island.

2 Excludes landings from use of other gears. In 1985, 32 vessels used both trawls and dredges. These are represented in each of the last two groups of columns. In 1984, 77 vessels used both of these gears.

3 Deflated or adjusted by Comsumer Price Index with 1978=100.

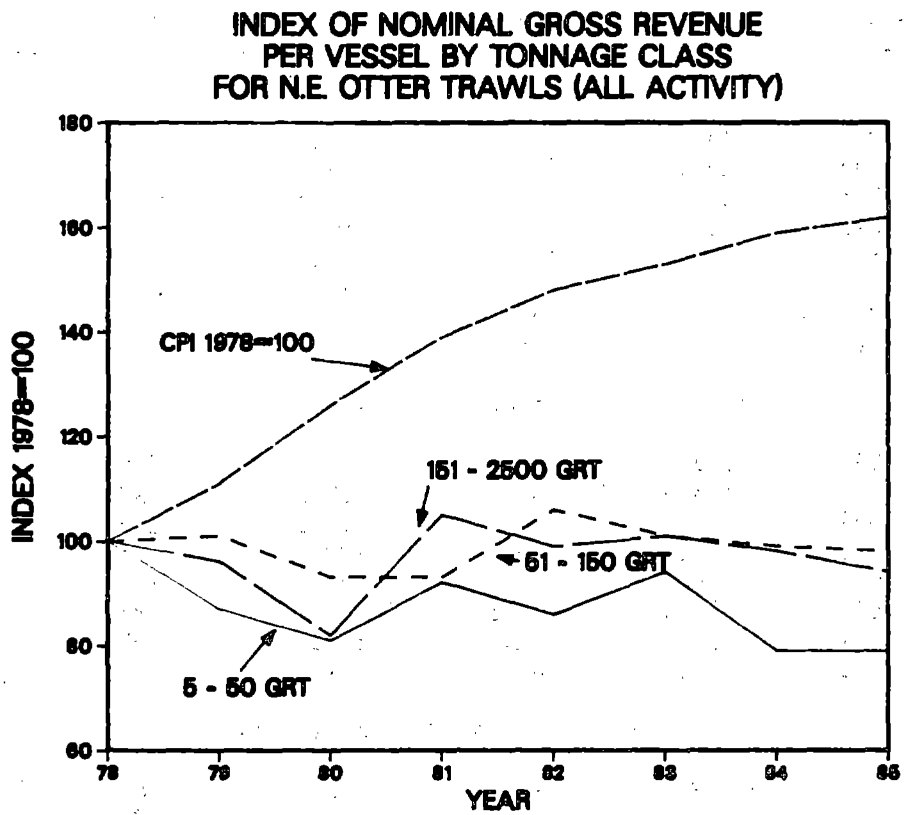


Figure B. Indices of average unadjusted gross revenue for otter trawl vessels in three tonnage classes compared to the Consumer Price Index with 1978 as the base year. Returns from all fishing activity, regardless of gear used, is included.

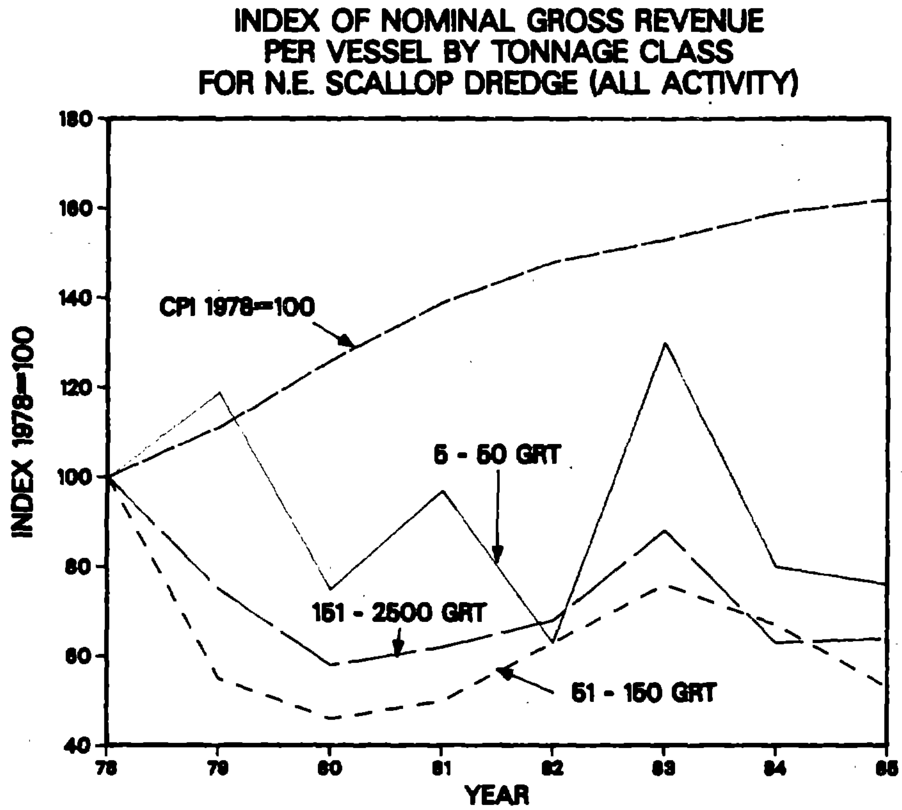


Figure C. Indices of average unadjusted gross revenue for scallop dredge vessels in three tonnage classes compared to the Consumer Price Index with 1978 as the base year. Returns from all fishing activity, regardless of gear used, is included.

For the majority of finfish species important to the New England fleet the price at the dock rose at the same rate or slightly slower than the consumer price index from 1978 through 1983 (Table D). Deflated prices for cod, pollock, yellowtail flounder, whiting, and hake actually fell, while those for winter flounder and redfish rose at the same rate as the CPI. Only haddock prices showed real growth.

In 1984 and 1985, the reduced landings of many of these species contributed to a reversal of this trend. Flounder prices rebounded strongly while those for cod, redfish, hake and whiting rose slightly in relations to all other goods. Only the pollock price continues to lag slightly in real terms. However, the effects of smaller catches have outweighed the price rises in many cases. The net result is that revenue generated by many of the higher valued species--for cod, haddock, redfish, yellowtail and winter flounders -- is less in 1985 than for 1984 in both nominal and adjusted dollars. In contrast, the lower valued species have contributed relatively more to fleet revenue.

Imports of fish products, whose availability tends to moderate prices that fishermen receive, rose significantly between 1978 and 1983 (Table E). Supplies from Canada have been relatively constant since 1981 while those from other nations are approaching rough equivalency with the quantity coming from Canadian sources. The vast majority of finfish exports to (and through) New England from all sources was in cod products. The absolute magnitude of these products is significant. On a live weight equivalent basis cod imports were fully 16 times the quantity of cod landed by the New England fleet.

Total sea scallop imports, though fluctuating slightly, have shown a gradual, downward trend. Canada exported 1.3 million more pounds of meats in 1985 than in the previous year, but other sources of supply decreased slightly more. Consequently, imports of this product were at their lowest level since 1974. Available quantities of domestically landed Calico scallops, a frequently cited sea scallop subtitute, fell off by 66% between 1985 and 1984. The combined supply of imported sea scallops and domestic Calico scallops, though substantially reduced from 1984 levels, failed to support sea scallop meat prices in 1985; the price fell by 13% and revenues by 16%.

Over 95% of the northeast region's lobster catch is landed in New England, with Maine reporting almost half of this. New England landings have grown slowly over the period (Table F). Catches in 1985 were 4,000 mt (live weight) more than 1978 catches, an increase of about 4% per year. While the income from these landings has risen by $50 million dollars, the purchasing power generated by the fishery has remained virtually constant. The 1985 price, expressed in constant 1978 dollars, was the lowest for the entire period. Imports have contributed to this lack of growth in real income despite larger landings. In 1983 New England imports exceeded New England landings for the first time. The gap has increased slowly for the last two years.

Table D. New England[1] Prices and Nominal Value ($ 000,000) of Major Species Landed by Vessels 5 Gross Registered Tons or More 1978-1985.

	Cod			Haddock			Pollock		
			Deflated[2]			Deflated			Deflated
Year	Value	$/lb	$/lb	Value	$/lb	$/lb	Value	$/lb	$/lb
1978	18.0	.25	.25	12.2	.32	.32	5.7	.17	.17
1979	24.3	.30	.27	17.0	.42	.38	5.6	.20	.18
1980	27.0	.28	.22	20.0	.39	.31	6.1	.19	.15
1981	30.1	.34	.24	22.2	.41	.29	7.3	.22	.16
1982	35.6	.33	.22	21.4	.51	.34	5.9	.21	.14
1983	34.2	.34	.22	18.5	.58	.38	4.9	.18	.12
1984	31.2	.38	.24	17.8	.70	.44	5.6	.17	.11
1985	30.4	.42	.25	13.2	.94	.57	6.2	.16	.10

	Redfish			Winter Flounder			Yellowtail		
			Deflated			Deflated			Deflated
Year	Value	$/lb	$/lb	Value	$/lb	$/lb	Value	$/lb	$/lb
1978	6.1	.17	.17	10.9	.46	.46	14.5	.61	.61
1979	7.2	.21	.19	9.8	.42	.38	17.0	.51	.46
1980	5.4	.23	.18	12.7	.36	.28	18.7	.47	.37
1981	5.3	.28	.20	15.4	.43	.31	17.8	.57	.41
1982	4.9	.27	.18	14.3	.48	.32	27.6	.51	.34
1983	3.5	.26	.17	15.1	.51	.33	32.9	.49	.32
1984	3.5	.29	.18	20.0	.71	.45	25.6	.74	.46
1985	3.1	.33	.20	18.1	.91	.55	18.8	.84	.51

	Whiting			Hake			Scallop Meats		
			Deflated			Deflated			Deflated
	Value	$/lb	$/lb	Value	$/lb	$/lb	Value	$/lb	$/lb
1978	4.7	.13	.13	1.6	.18	.18	40.6	2.55	2.55
1979	2.7	.17	.15	1.7	.14	.13	50.7	3.40	3.06
1980	2.8	.17	.13	1.8	.19	.15	59.0	3.84	3.04
1981	3.4	.17	.12	2.6	.18	.13	71.6	4.00	2.87
1982	4.6	.19	.13	2.5	.16	.11	54.7	3.72	2.51
1983	3.6	.15	.10	2.5	.15	.10	69.6	5.67	3.71
1984	4.2	.13	.08	2.7	.15	.09	54.6	5.59	3.51
1985	5.3	.17	.10	3.6	.21	.13	45.7	4.85	2.94

1 Landings in Maine, Massachusetts and Rhode Island regardless of gear used.
2 Deflated or adjusted downward by Consumer Price Index with 1978=100.

Table E. New England Imports of Selected Fishery Products from Canada and from All Other Sources 1978-1985.

	Cod		Other[1] Groundfish		Flatfish		Total Finfish		Scallops[2]	
	Canada	Other	Canada	Other	Canada	Other	Canada	Other	Canada	Other
Year	Thousand Metric Tons									
1978	151.4	284.4	34.6	144.4	86.1	38.2	272.1	467.0	10.7	.73
1979	204.3	229.2	36.2	136.8	86.8	27.8	327.3	393.8	8.3	.82
1980	199.2	160.8	37.5	98.9	69.9	8.5	306.7	265.9	6.6	1.00
1981	233.3	157.0	59.6	89.6	94.3	6.4	377.2	253.1	8.4	1.27
1982	253.9	157.1	44.9	112.1	70.1	13.4	368.9	282.6	6.6	1.09
1983	290.4	192.6	42.0	110.9	57.6	7.8	390.0	311.3	5.9	1.95
1984	279.3	194.5	35.9	94.3	65.4	15.2	380.7	304.2	3.8	3.40
1985	275.5	189.1	46.1	96.9	63.7	25.4	385.3	311.3	5.1	1.91

1 Cusk, Hake, Haddock and Pollock.
2 Scallop imports expressed in meat weight; others in live weight equivalents.

Table F. New England Lobster Landings, Value, Prices and Lobster Imports from All Sources 1978-1985.

Year	Landings 000's (m.t.)	Value $000,000 Nominal	Value $000,000 Deflated[1]	$/lb Nominal	$/lb Deflated	Imports 000's (m.t.) Live	Meats[2]	Total
1978	14.9	62.2	62.2	1.86	1.86	5.5	2.8	8.3
1979	16.1	68.4	61.5	1.92	1.73	6.5	3.7	10.2
1980	16.1	71.9	56.9	2.01	1.59	5.4	4.8	10.2
1981	16.3	82.1	58.9	2.29	1.64	6.9	4.3	11.2
1982	16.9	85.0	57.4	2.28	1.54	7.7	3.9	11.6
1983	19.1	100.8	66.0	2.40	1.57	9.1	10.7	19.8
1984	18.8	107.0	67.2	2.58	1.62	10.6	13.9	24.5
1985	19.0	102.4	62.0	2.44	1.48	12.1	13.4	25.5

1 Revenue and prices adjusted by Consumer Price Index (CPI) with 1978 = 100.
2 Live weight equivalent.

MID-ATLANTIC

In contrast to New England fisheries in which the value of landings from off-shore resources exceeds that from in-shore resources ($239 million vs. $167 million in 1985), the Mid-Atlantic region's inshore resources yielded slightly more revenue than those fished beyond three miles ($124 million vs. $101 million). Furthermore, the single most valuable fishery in the region covering New York, New Jersey, Delaware, Maryland and Virginia is the off-shore surf clam fishery, while in New England, the in-shore lobster fishery generates more revenue than any other.

The Northeast surf clam and ocean quahog fisheries have been under careful management in the 1980's. The ocean quahog fishery is overseen as one large area, while the surf clam fishery is divided into three distinct areas: New England's Georges Bank, the Nantucket shoals area and the Mid-Atlantic area. Quotas exist for each fishery. A regulated inshore surf clam fishery has existed in New Jersey for many years and, recently, near-shore beds have been discovered and exploited off Long Island.

The quota for quahogs, expressed in meat weight equivalent is approximately 20,000 metric tons. The Georges Bank, Nantucket Shoals and Mid-Atlantic surf clam quota equivalents are, respectively 2.3, 1.5 and 20.4 thousand metric tons. Nominal catches of each species are reported in later sections of this document.

In the Mid Atlantic area the surf clam fishery management scheme employs a permit limitation program with 143 vessels permitted to fish the Southern New Jersey and Chesapeake beds. Approximately 50 of these vessels also retain permits for the New Jersey inshore fishery. In 1984, thirty-three vessels which held permits for the off-shore surf clam fishery did not exercise their rights in that fishery. In 1985, only twenty-seven did not participate. Although over forty off-shore vessels landed quahogs in the region in 1985, there are fewer than twenty full-time quahog vessels.

Table G shows the rapid rise in the value of surf clam landings in New England and New York and the predominance of the Mid-Atlantic region in both surf clam and ocean quahog landings. Most striking is the stability, in nominal terms, and the decline, in adjusted terms, of the off-shore ocean quahog prices. A similar but less pronounced trend exists for off-shore surf clam prices throughout the period.

After surf clams, the blue crab, scallop, oyster, fluke and lobster resources are the most valuable to the mid-Atlantic region's fishermen. The crab, oyster and lobster fisheries are carried out close to shore and yielded, in 1985, $28 million, $16 million and $7 million respectively.

The principal off-shore species, the value of their landings, the price and the deflated price are given in Table H.

Table G. Northeast Region Surf Clam and Ocean Quahog Meats: Value ($000's), Price and Deflated[1] Price 1978-1985.

Surf Clam Meats

	New England and New York (0 - 3 miles)			New England and New York (3 - 200 miles)			Chesapeake and New Jersey (0 - 3 miles)			Chesapeake and New Jersey (3 - 200 miles)		
	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb
1978	1,301	.37	.37	-	-	-	1,730	.35	.35	18,117	.58	.57
1979	1,062	.48	.43	45	.47	.43	1,226	.34	.30	16,940	.59	.53
1980	954	.42	.33	-	-	-	268	.35	.28	17,885	.52	.41
1981	1,116	.39	.28	-	-	-	1,958	.34	.24	20,392	.55	.39
1982	2,587	.49	.33	-	-	-	2,444	.32	.22	20,932	.57	.38
1983	1,610	.47	.31	1,438	.48	.32	2,452	.33	.22	19,414	.46	.30
1984	1,341	.44	.27	3,286	.43	.27	5,606	.45	.28	24,101	.51	.32
1985	4,459	.45	.27	3,731	.52	.31	5,376	.51	.31	25,311	.52	.32

Ocean Quahog Meats

	New England and New York (0 - 3 miles)			New England and New York (3 - 200 miles)			Chesapeake and New Jersey (0 - 3 miles)			Chesapeake and New Jersey (3 - 200 miles)		
	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb
1978	767	.29	.29	44	.30	.30	-	-	-	5,896	.29	.29
1979	966	.31	.28	5	.29	.26	-	-	-	9,262	.29	.26
1980	954	.31	.24	111	.33	.26	-	-	-	9,084	.30	.22
1981	172	.19	.14	1,149	.19	.14	-	-	-	8,863	.30	.22
1982	173	.38	.26	1,161	.38	.26	-	-	-	9,516	.30	.21
1983	550	.36	.23	652	.35	.23	-	-	-	9,551	.30	.20
1984	940	.36	.22	212	.35	.22	-	-	-	10,677	.30	.19
1985	N/A	N/A	N/A	106	.35	.21	-	-	-	12,721	.30	.18

1 Deflated or adjusted downward using the Consumer Price Index with 1978=100.
N/A Not available.

Table H. Important Mid-Atlantic[1] Off-shore Species: Value ($000,000) Price and Deflated (1978 = 100) Price 1979 - 1985.

	Scallops			Fluke			Tilefish		
	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb
1979	43.7	3.20	2.90	10.2	.53	.48	4.3	.60	.54
1980	40.0	3.89	3.08	8.4	.53	.42	5.9	.77	.61
1981	24.2	4.08	2.92	6.9	.68	.49	6.2	.92	.66
1982	15.7	3.93	2.66	7.9	.72	.49	4.1	1.01	.68
1983	31.7	5.63	3.68	9.8	.64	.42	4.4	1.12	.73
1984	31.6	5.35	3.36	12.5	.65	.41	4.3	1.02	.64
1985	21.9	4.64	2.81	12.8	.93	.56	4.4	1.21	.73
	Scup/Porgy			**Squid (all)**			**Butterfish**		
	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb	Value	$/lb	Def. $/lb
1979	3.3	.38	.34	1.8	.43	.39	.7	.39	.35
1980	3.8	.41	.32	1.3	.35	.28	.7	.46	.36
1981	4.4	.35	.25	1.2	.46	.33	.6	.45	.32
1982	4.5	.47	.32	2.4	.21	.14	.6	.41	.28
1983	4.0	.43	.28	3.9	.28	.18	.9	.40	.26
1984	4.1	.56	.35	3.9	.22	.14	.6	.35	.22
1985	3.0	.56	.34	2.7	.30	.18	.9	.35	.21

	Mackeral		
	Value	$/lb	Def $/lb
1979	.4	.22	.20
1980	.3	.14	.11
1981	.6	.14	.10
1982	.6	.12	.08
1983	.4	.16	.10
1984	.4	.16	.10
1985	.3	.11	.07

[1] Landings regardless of gear used or distance from shore.

SUMMARY STATUS OF THE FISHERY RESOURCES

Groundfish

Atlantic Cod. The nominal 1985 commercial catch from the Gulf of Maine cod stock was 12,100 mt, the lowest since 1979. Stock biomass has declined due to record fishing effort. The fishery is presently being supported by the 1980-1982 year classes. Research vessel surveys indicated that the 1983 and 1984 year classes are about average while the 1985 year class is above-average in strength. Current fishing mortality is well above F_{max} and, if continued, will result in further declines in stock biomass and catch. Nominal catch in 1985 from the Georges Bank and South cod stock was 37,300 mt, 4% less than in 1984 and the lowest since 1978. Fishing effort in 1985 remained at the record-high 1984 level while CPUE fell to a record-low. The fishery is dependent on the above-average 1983 year class which comprised 40% of the 1985 catch by number. The 1985 year class will not significantly contribute to commercial landings until mid-1987. Until that time, landings and harvestable biomass are expected to decline further.

Haddock. The nominal commercial and recreational catch in the Gulf of Maine averaged 6,800 mt from 1981-1983, but dropped to only 3,000 mt in 1985. The fishery is presently being supported by the remainder of the 1978 year class. Research vessel surveys indicated that the 1979, 1980 and 1982 year class were relatively strong, but information from 1985 suggests that these cohorts have been much reduced by fishing and stock biomass is low. The Georges Bank catch was 7,800 mt in 1985, a 24% drop from 1984. The 1978 year class is currently supporting the fishery since all year classes between 1979-1984 were very poor. The 1985 year class is probably stronger than any since 1978 and will result in some increase in stock biomass during 1986-1987.

Redfish. The nominal catch of 4,300 mt in 1985 was the lowest since the fishery began in the early 1930's. Stock biomass has declined by over 80% since the late 1960's and commercial and research vessel survey indices suggest a continuing downward trend in recent years. The fishery continues to be strongly dependent upon recruitment and as recruitment prospects are poor, declines in stock biomass are expected to continue. Current fishing mortality levels are well above those corresponding to F_{max} and $F_{0.1}$.

Silver hake. Nominal catches in the Gulf of Maine - Middle Atlantic area totalled about 23,400 mt in 1985: 8,300 mt from the Gulf of Maine - northern Georges Bank stock, and 15,100 mt from the southern Georges Bank-Middle Atlantic stock. Catches 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. Estimates of biomass for silver hake are currently not available due to a revision in stock boundary definition; new assessments are in preparation. 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 totalled only 1,900 in 1985, 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 totalled 64,000 mt in 1985, the highest level ever observed. Stock biomass increased from 144,000 mt in 1970 to 260,000 mt in 1985. The 1979 year class is strong and there are also indications that the 1982 year class is also strong. Fishing mortality has exceeded $F_{0.1}$ in recent years.

Yellowtail flounder. Total nominal catches in Georges Bank and southern New England declined in 1985 to 7,100 mt, 78% below 1983. This trend reflects reduction of the strong 1980 and 1981 year classes by intense fishing and poor recruitment from more recent year classes. The fishery is now almost completely dependent upon incoming recruitment. Commercial and research vessel survey indices of abundance have declined sharply and in most cases 1985 survey values were at or near historic lows. Fishing mortality has been substantially above F_{max} during recent years.

Summer flounder. Nominal catches were 10,700 mt in 1985, 25% below the 1984 level and 26% below the 1979 peak of 14,500 mt. Estimated catches comprise from 26-77% of the total catch. Stock biomass has been at a much higher level in the last 8-10 years than during the late 1960's - early 1970's, but appears to have undergone considerable fluctuations in the last 5 years. The current level of fishing mortality is probably in excess of F_{max}.

American plaice. Nominal catches in 1985 were 7,000 mt, 30% less than in 1984, and the lowest since 1976. Stock biomass has declined to its lowest level since the mid-1970's. 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, and declined somewhat to 6,100 in 1985. Stock biomass, after declining steadily since 1977, increased in 1983 and 1984 but was below the long-term average in 1985. There is some evidence that current levels of exploitation are adversely affecting the resource, and historical trends seem to preclude sustainable harvests above 6,000 mt.

Winter flounder. The nominal commercial catches in 1985 declined to 10,900 mt, 25% below 1984 and 37% below the peak in 1981. Recreational catches are at over one-half the level of commercial catches. Overall stock biomass has exhibited no major trend during 1976-1985, although it appears to have declined in 1983-1985 relative to the 1980-1981 level.

Scup. Nominal commercial and recreational catches declined to 7,900 mt in 1985, significantly below the 1977-1984 mean. The stock biomass index in the Southern New England - Mid-Atlantic area has decreased from a high level in 1981. Following a decrease in 1981, the index remained steady from 1983-1984 and then decreased further in 1985. The stock, particularly in the Mid-Atlantic area, appears to be fully exploited.

Ocean Pout. Nominal catches increased to 1,500 mt, 14% greater than in 1984, and the highest domestic catch since 1974. Stock biomass rose sharply in 1980 and has since fluctuated around historic peak levels. It would appear that increased catches are sustainable for this developing fishery.

White hake. Nominal catches have increased steadily since 1968, reaching a peak of 7,500 mt in 1984. The 1985 catch declined slightly to 7,300 mt. Stock biomass has exhibited a declining trend since 1980, and it appears unlikely that current harvest levels will be sustainable over the long term.

Cusk. Nominal catches in 1985 were 2,600 mt, 21% greater than in 1984. The USA catch of 2,300 mt was the highest since 1940 and reflected the emerging USA offshore auto-longline fishery. USA longline landings increased from 13 mt in 1984 to 600 mt in 1985. Stock biomass has recently increased and current catch levels appear sustainable over the next several years.

Atlantic wolffish. Nominal catches increased steadily from 200 mt in 1970 to a peak of 1,300 mt in 1983, and decreased slightly to 1,100 mt in 1985. Stock biomass, while fluctuating considerable, has generally exhibited a declining trend throughout this period.

Tilefish. Nominal catches, after rising dramatically from 300-400 mt per year in 1967-1971 to a peak of 3,900 mt in 1979, dropped sharply to 1,800 mt in 1983. Landings in 1985 were 1,900 mt. Fishing effort (primarily by longlines) increased substantially during the 1970's and remained at a relatively high constant level during 1979-1983. CPUE decreased about 80% from 1973 to 1983. Fishing mortality is currently estimated to be about twice F_{max}. Stock biomass has apparently undergone a substantial decrease in response to excessive fishing mortality exerted since the late 1970's.

Pelagics

Atlantic herring. Coastal Maine nominal catches dropped from about 48,200 mt in 1981 (the highest since 1963) to 13,900 mt in 1985. Western Gulf of Maine (Jeffreys Ledge) catches (adults) were about 11,900 mt in 1985. Stock biomass (ages 2 and older) in the Gulf of Maine declined 37% from 1979 to 1982 to 134,000 mt, the lowest stock level yet observed. The Georges Bank stock, as large as 1.2 million mt in 1967 (spawning stock of ages 4 and older), collapsed in 1977 and has not supported a fishery since.

Atlantic mackerel. Nominal commercial and recreational catches for this stock were 71,100 mt in 1985, an 80% increase over 1984. The USA commercial catch has increased slowly in every year since 1970, reaching 6,600 mt in 1985. Fishing mortality remained stable from 1977-1985 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 1,500,000 mt in 1985, a 212% increase. The 1984 year class also appears to be strong.

Butterfish. Nominal catches declined 58% from 12,300 mt in 1984 to 5,100 mt in 1985. The USA catch declined from a record high of 11,800 mt in 1984 to 4,700 mt in 1985. The decline primarily reflected a reduced export market for "super small" butterfish, and decreased availability of large butterfish. Discard rates of small butterfish continued to be relatively high, 30-80% by weight of the landed catch. Stock abundance is currently above the long-term average. However, since most of the stock biomass is comprised of "small" and "super small" butterfish, discard rates during 1986 will probably continue to be high.

Bluefish. Nominal commercial catches totalled an estimated 5,500 mt in 1984 and 6,000 mt in 1985. Recreational catches have averaged close to 90% of the total catch of bluefish along the Atlantic Coast. Based on trawl survey indices of recruitment, which are strongly correlated with catches 2-4 years later, total catches should remain at the current levels for at least the next several years, providing no significant changes occur in fishing effort.

Other Finfish

River herring. Nominal catches in 1985 were about 6,100 mt, up from 4,100 mt in 1984. Catches have steadily declined from an annual average of 24,800 mt during 1963-1969. Stock biomass has been depressed at a fairly stable low level since the late 1960's, although some increase has been evident in the Mid-Atlantic area since the mid-1970's.

American shad. Nominal commercial catches have declined steadily from around 2,500 mt in the 1960's to a low of about 700 mt in 1985. Recreational catches, although unknown, are considered to be very low at the present time. Excessive fishing, dams and pollution have been blamed for the decline of American shad in most rivers. Restoration efforts are currently underway in several areas.

Black sea bass. Nominal commercial catches in 1985 were 1,200 mt, slightly below the 1981-1985 average of 1,400 mt. Recreational catches have comprised 21-86% of the combined catch in years for which estimates are available. Stock abundance has declined since 1977. It appears that the stock is fully exploited at the present time.

Striped bass. Nominal commercial catches in 1985 were only about 500 mt, reflecting both decreased abundance of harvestable striped bass and major regulatory changes. Estimated recreational catches accounted for approximately 35% of the total catch during 1980-1984. Recruitment has generally been poor since 1970, although the 1982 year class was above average. Efforts are currently underway to rebuild the striped bass resource by protecting the spawning stocks and by improving water quality.

Spiny dogfish. Nominal catches in 1984 were 4,000 mt, down from 4,400 mt in 1984. Minimum biomass estimated from NEFC spring survey catches increased 360% from 275,000 mt in 1984 to a record high 990,500 mt in 1985. Since dogfish school, there tends to be rather high variability among the random survey catches which results in large fluctuations in the annual biomass estimates. The USA fishery is selective for large females to satisfy market demands. There is a potential for rapid overexploitation of sharks such as spiny dogfish. Although optimal levels of annual harvest are currently not defined, they are likely above current catch levels.

Skates. Nominal catches were 4,000 mt in 1985. 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 206,600 mt in 1985, which was 116% greater than the 1968-1984 average of 121,000 mt. The increase is attributable to large catches of winter skate in the Georges Bank - Southern New England region.

Invertebrates

Short-finned squid. Nominal catches and abundance of *Illex illecebrosus* have declined drastically in recent years throughout the Northwest Atlantic. The fishery in Canadian waters has virtually collapsed, with catches dropping from 153,000 mt in 1979 to under 20 mt in 1985. Although 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 1985 USA catch decreased significantly to 5,000 mt. Due to the decrease in the USA catch in 1985 and the minimal foreign catch, the total international catch decreased to a low of 6,100 mt in 1985. Stock abundance in USA waters is currently the lowest since 1974. Pre-recruit abundance in autumn 1985 was one of the second lowest since 1970.

Long-finned squid. Nominal catches of *Loligo pealei* were about 16,700 mt in 1985, 26% below the 1983 catch. The USA catch in 1985 was 10,200 mt, still the third highest ever behind 1984, but about 36% below the catch in 1983. Stock abundance is currently above the long-term average. The 1985 year class, if fished at the average 1978-1981 level of fishing mortality, should support catches during the 1986-1987 fishing year at about the 1984 level.

American lobster. Nominal catches in 1985 were 20,800 mt, a slight increase relative to 1984 levels. Inshore catches in 1985 were 18,000 mt, while offshore catches (including Canadian catches on Georges Bank) were about 2,800 mt. Stock biomass in offshore areas has remained relatively stable since the late 1970's. However, fishing mortality is currently well above F_{max} and, particularly in coastal areas, remains a source of serious concern.

Northern shrimp. Nominal catches during the 1984-1985 fishing season totalled 4,100 mt, and a catch of 5,000 mt is projected for 1985-1986. Abundance has increased substantially in recent years with recruitment of the 1982 new class. Subsequent year classes appear weaker, suggesting that abundance will decline in the near future as the 1982 year class passes through the fishery. Research vessel survey data suggest relatively low levels of exploitation at present.

Surf clams. Nominal landings (FCZ and state waters) in 1985 totalled 32,900 mt (meat weight), representing a 5% increase over 1984 landings, and the fourth highest total on record. FCZ landings in 1985 were 23,700 mt, an increase of 1% over the previous year. Inshore landings (from state waters) increased 30% from 7,200 mt in 1984 to 9,200 mt in 1985, primarily due to the discovery and exploitation of dense surf clam concentrations in Long Island Sound, New York. Sufficient stock biomass exists in the Middle-Atlantic and

Georges Bank regions to sustain the FCZ fishery at current landings levels into the early 1990's. There do not appear to be additional strong year classes offshore following the strong 1976 and 1977 year classes off New Jersey and the Delmarva Peninsula. The FCZ fishery will thus be supported almost exclusively by the 1976 and 1977 year classes for at least the next six years.

Ocean quahogs. Nominal landings in 1985 were 23,600 mt (meats), representing a record total for the species and a 34% increase over the previous year. Virtually all of the 1985 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 drastic increases in the exploitation rate are not warrented 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 5-7 years, after which the fishery may shift northeasterly to more dense concentrations.

Sea scallops. Nominal catches from the entire Gulf of Maine, Georges Bank and Mid-Atlantic resources were 10,600 mt of meats, 8% higher than in 1984, but 60% lower than the 1978 peak of 26,600 mt. Catches in 1985 declined in the Gulf of Maine (500 mt; -41%), in Southern New England (80 mt; -51%) and in the Mid-Atlantic fisheries (3,300 mt; -14%), but increased on Georges Bank (6,800 mt; +35%) due to a near doubling of Canadian landings between 1984 and 1985. USA catches, however, declined in all areas in 1985 compared to 1984. USA commercial CPUE values in 1985 fell to record-low levels in all resource areas. Due to outstanding recruitment of the 1982 year class in both the Mid-Atlantic area and in the USA portion of Georges Bank, scallop abundance has markedly improved. Significant increases in catches should occur in the latter half of 1986 and during 1987 as scallops from the 1982 cohort recruit to the fishery. If, however, the 1982 year class is subjected to high fishing mortality in 1986 before individual scallops attain a 40-count meat size and begin to spawn, long-term yield from the growth and spawning potential of this year class will be sacrificed.

INTRODUCTION

The synopses of information on the status of the stocks of the 34 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[1] of catch statistics is included, along with one or more graphs[1] 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 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 nearest 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 estimates do not exist are indicated by a dash. Values which are not available are indicated by NA or N/A.

1 The tables and figures in this section are labeled using decimal notation by species and by table or figure within species. For example, Figure 7.3 indicates the third figure for the seventh species synopsis, yellowtail flounder.

ATLANTIC COD

The Atlantic cod (Gadus morhua) is distributed in the Northwest Atlantic from Greenland to North Carolina. It is a heavy-bodied, bottom-dwelling, cold-water species found from near-shore surf areas to depths exceeding 200 fathoms. Cod are omnivorous, eating a wide variety of mollusks, crustaceans, and fishes. Spawning occurs during winter and early spring, normally at water temperatures between 5-7°C (41-45°F). A large mature female may produce 3-9 million eggs. Growth varies among geographical regions, but is generally slower in the more northerly portions of the range. The maximum age is probably in excess of 20 years.

In USA Atlantic waters, three groups of cod occur: Gulf of Maine, Georges Bank, and Southern New England - Mid-Atlantic. These groups are presently managed as two units: Gulf of Maine, and Georges Bank and South. Important commercial and recreational fisheries occur in both units. The commercial fisheries are prosecuted year-round using otter trawls, line trawls, gill nets, pair trawls, Danish seines, hand lines, jigs, and traps. Recreational fishing also occurs year-round, although peak activity occurs during the summer in the lower Gulf of Maine, and from late autumn to early spring in inshore waters from Massachusetts southward. Party and charter boat fishing, as well as shore-based and private boat angling, comprise the major modes of recreational cod fishing.

Gulf of Maine

Commercial Gulf of Maine cod landings in 1985 were 12,100 mt, slightly less than in 1984, and the lowest annual catch since 1979. The 1985 USA catch of 10,700 mt was the lowest since 1976 and was also slightly less than in 1984. Canadian 1985 landings totaled 1,400 mt, essentially unchanged from 1984 but half as large as in 1983. Substantial misreporting of Canadian Scotian Shelf landings as Gulf of Maine catch is believed to have occurred in 1983 and preceding years.

Commercial fishing effort in 1985 increased 11% from 1984 and was a record high. USA commercial CPUE in 1985, however, remained at the low 1984 level. The 1984 and 1985 CPUE indices for directed cod trips (trips in which cod comprised 50% or more of trip weight) was the third and fourth lowest since 1965 and were lower than any values since 1973.

NMFS research vessel survey indices in 1985 indicated an increase in stock abundance from 1984, although this increase may be an artifact of a change in the survey trawl doors used in the 1985 surveys. The Spring 1986 survey values declined to below 1984 levels, indicating that the 1985 increases were more apparent than real. Survey age composition data indicate the 1980-82 year classes comprise 78% of the Gulf of Maine cod population by number and 73% by weight. The 1983 and 1984 year classes currently appear to be about average, while the 1985 year class appears to be above-average in strength.

The 1985 USA commercial catch was dominated by the 1980 and 1981 year classes which each accounted for 26% of the total weight landed. The 1982 year class contributed 24% to the total 1985 yield. Together the 1980-1982 year classes constituted 82% of the 1985 cod landings by number, and 76% by weight (i.e., similar to the survey population values). Otter trawl landings accounted for 67% of the 1985 USA catch, while gill net landings comprised 29% of the USA total.

Record-high fishing effort, low commercial CPUE, and relatively low survey abundance values indicate that fishing mortality in 1985 remained high and in excess of the level producing maximum yield. Should fishing pressure in 1986 remain high, further declines in Gulf of Maine cod abundance and landings are expected.

Georges Bank and South

Total commercial 1985 landings were 37,300 mt, 4% less than in 1984. The 1985 catch was the lowest since 1978 and marked the third consecutive year in which yield has declined. The 1985 USA catch of 26,800 mt, also the lowest since 1978, declined 18% from 1984. Canadian 1985 landings totaled 10,500 mt, 81% higher than in 1984, and the third highest annual catch since 1967.

USA fishing effort in 1985 remained at the record high level attained in 1984. USA commercial CPUE in 1985 markedly declined from 1984 (-24%). The 1985 CPUE index for directed trips (which accounted for 70% of the USA landings) was the lowest in the 1965-1985 time series.

NMFS spring 1985 research vessel survey indices were among the highest values ever obtained. However, the higher values are believed to reflect an increase in catchability rather than abundance since almost all catch at age indices were higher in 1985 than they were in spring 1984. The autumn 1985 survey indices were among the lowest in the survey time series; the autumn weight per tow value was the lowest observed. Both spring and autumn data indicated that the 1983 year class is above average and that the 1985 year class may be quite large.

Survey age composition data reveal that the 1980, 1981 and 1983 year classes dominate the Georges Bank cod population, accounting in 1985 for about 76% of the harvestable fish by number, and 54% by weight. The 1983 year class was the most important in terms of numbers (40%) while the 1980 year class was the most important in terms of weight (28%).

The 1980, 1981 and 1983 cohorts were also dominate in the 1985 USA commercial catch. Together these year classes accounted for 74% by number and 64% by weight of the 1985 USA Georges Bank cod landings. The 1983 year class alone comprised 47% of the catch in number while the 1980 year class comprised 27% of the catch in weight. In the 1985 fishery otter trawl landings comprised 86% of the USA catch while gill net catches constituted 10% of the total.

Increased fishing effort during the past three years has been accompanied by sequential annual declines in commercial CPUE. Since landings have also declined during the past three years, fishing mortality has increased. Although the spring and autumn 1985 surveys gave disparate abundance patterns, the autumn data suggest that, despite above-average recruitment of the 1983 year class, stock biomass has continued to decline. This increased mortality has presumably resulted from increased fishing pressure on cod due to declines in abundance of other groundfish resources (haddock, redfish, yellowtail flounder). Although recruitment of the 1985 year class appears to be very good, these fish will not significantly contribute to commercial landings until mid-1987. Until that time, landings and harvestable biomass are expected to decrease further.

For further information see:

Serchuk, F.M., R.S. Rak, and J. Penttila. 1982. Status of the Georges Bank and Gulf of Maine Atlantic cod stocks - 1982. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 82-33, 46 p.

Table 1.1 Nominal catches (thousand metric tons) and management information for Atlantic cod from the Gulf of Maine, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
					Year				
USA recreational	-	-	1.0[1]	3.1	1.2	1.7	1.1	1.8	N/A
Commercial									
USA	12.4	12.4	11.7	13.5	12.5	13.6	14.0	10.8	10.7
Canada	0.1	0.4	0.4	0.2	0.6	1.4	2.7	1.4	1.4
Other	-	-	-	-	-	-	-	-	-
Total nominal catch[3]	12.5	12.8	12.1	13.7	13.1	15.0	16.7	12.2	12.1
Total allowable catch	12.0	8.0	9.7	9.5	9.5	-[2]	-[2]	-[2]	-[2]

Long-term potential catch = 10,000 mt
Importance of recreational fishery = Major
Status of management = FMP in force since March 1977
Status of exploitation = Fully exploited
Age at 50% maturity = 4.2 yrs (males); 3.8 yrs (females)
Size at 50% maturity = 54 cm (21.3 inches) males
50 cm (19.7 inches) females

$M = 0.20$ $F_{0.1} = 0.16$ $F_{max} = 0.30$ $F_{1985} = \geq 0.80$

[1] Includes estimated recreational cod catch in Maine and New Hampshire.

[2] Quota management was eliminated on 31 March 1982 with implementation of Interim Groundfish Plan.

[3] Commercial only.

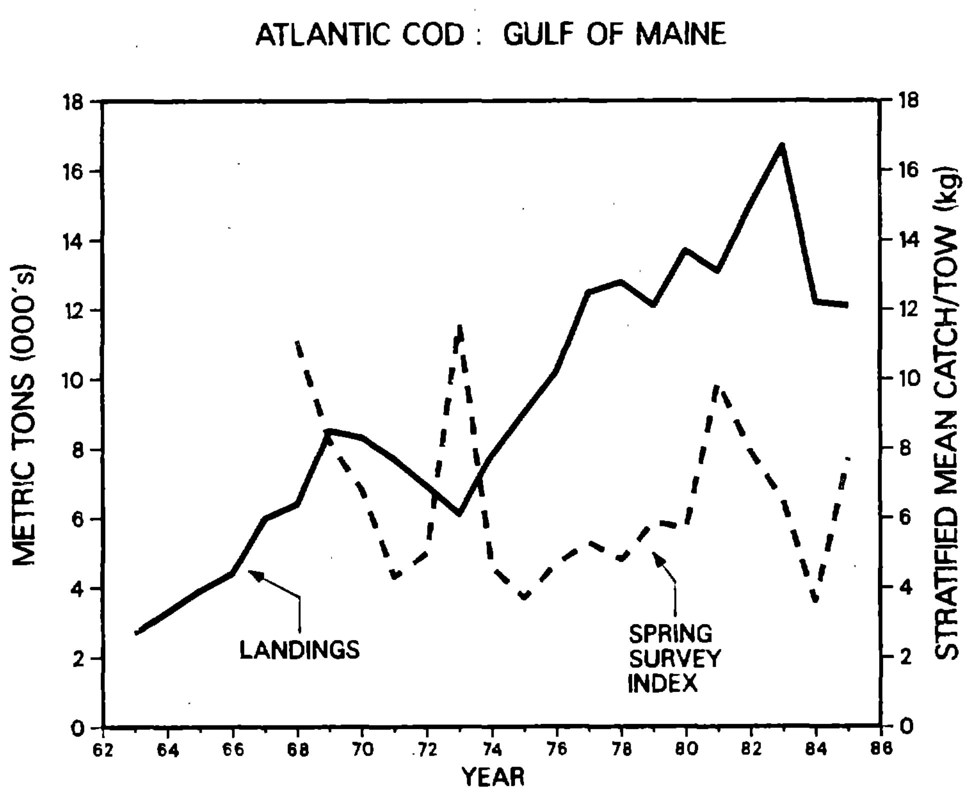


Figure 1.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic cod in the Gulf of Maine.

Table 1.2 Nominal catches (thousand metric tons) and management information for Atlantic cod from Georges Bank and South, 1977 - 1985

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	-	-	2.8	3.3[1]	7.4	6.3	7.2	3.6	N/A
Commercial									
USA	21.1	26.6	32.7	40.0	33.9	39.3	36.8	32.9	26.8
Canada	6.2	8.9	6.0	8.1	8.5	17.9	12.1	5.8	10.5
Other	0.1	-	-	-	-	-	-	-	-
Total nominal catch[3]	27.4	35.5	38.7	48.1	42.4	57.2	48.9	38.7	37.3
Total allowable catch	26.7	26.0	36.9	35.0	35.0	-[2]	-[2]	-[2]	-[2]

Long-term potential catch = 35,000 mt
Importance of recreational fishery = Major
Status of management = FMP in force since March 1977
Status of exploitation = Fully exploited
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

$M = 0.20$ $F_{0.1} = 0.15$ $F_{max} = 0.30$ $F_{1985} = \geq 0.65$

[1] Includes estimated recreational cod catch from Massachusetts and southward

[2] Quota management was eliminated on 31 March 1982 with implementation of Interim Groundfish Plan.

[3] Commercial only.

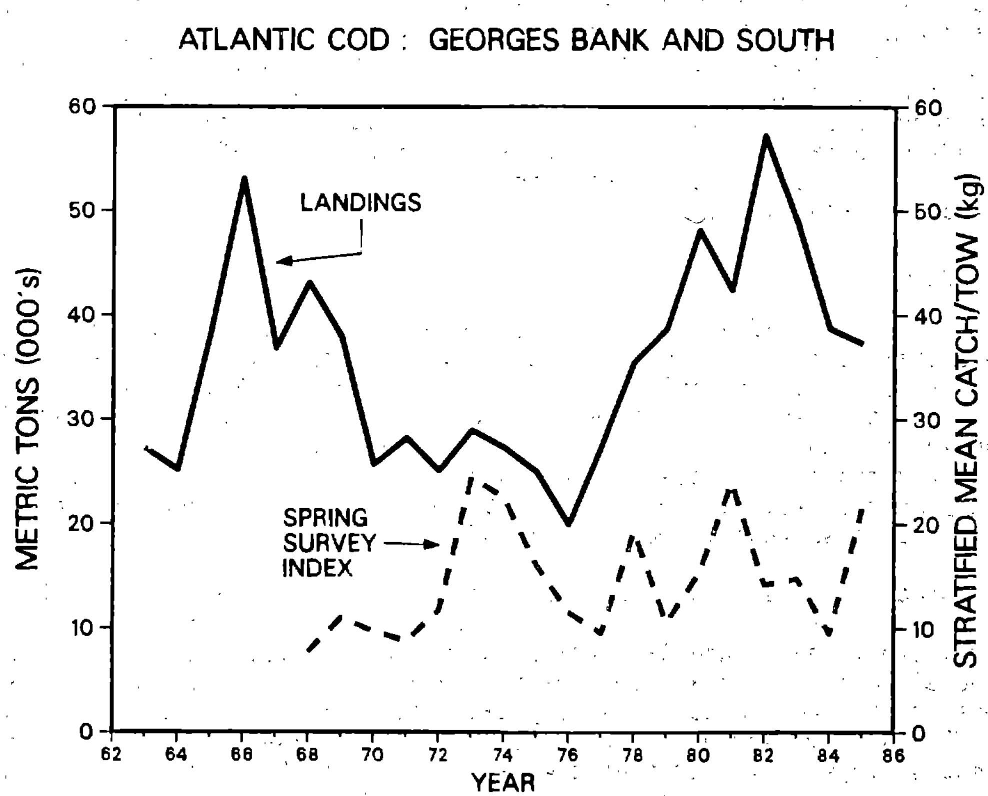


Figure 1.2 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic cod in the Georges Bank and South area.

HADDOCK

The haddock (Melanogrammus aeglefinus) is a demersal gadoid species commonly attaining lengths of 75-80 cm (30-32 inches) and weights up to 5 kg (11 pounds). In recent USA nominal catches, average lengths have ranged from 50-60 cm (20-24 inches), while average weights have ranged between 1.5 and 2.5 kg (3-5 pounds). Haddock mature sexually at ages 2-3, 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 45-135 m (25-75 fathoms) and temperatures of 2-10°C (36° - 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 spawing area closures, codend mesh size regulations and mandatory data reporting requirements. The current 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.

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 1981-1983, dropped to 4,000 mt in 1984, and declined further to 3,000 mt in 1985. Since 1980, the fishery has been supported primarily by the 1978, 1979, 1980 and 1982 year classes. Estimated recreational catches have declined from 1,700 mt in 1979 to less than 50 mt in 1981-1985.

Stock size estimates calculated from a modified DeLury analysis have declined 82% from 1977 to 1985. The NEFC autumn survey index has declined in nearly every year since 1978 while spring index values have shown a downward trend since 1981. Spring and autumn index values for 1984 were among the lowest on record and autumn survey catch per tow in numbers was the lowest in the 22 year time series. Both index values increased in 1985. Although recent surveys indicated that the 1979, 1980 and 1982 year classes were relatively strong, data for 1985 suggest that these year classes have been much reduced by fishing and that the stock is now in extremely poor condition.

Georges Bank

USA fishermen accounted for 69% of the nominal commercial catch during 1977-1985, with practically all of the remainder being taken by Canada. Almost all of the USA nominal catch has been taken by otter trawling. USA catches have tended to increase somewhat each year in late spring and summer due to ending of seasonal spawning area closures, recruitment, and improved weather conditions. This tendency has been most evident during years when recruiting year classes have been strong.

The Georges Bank nominal catch increased from an annual average of 4,700 mt during 1974-1976 to 27,600 mt in 1980; the total for 1984 was 10,200 mt, and the provisional total for 1985 is 7,800 mt. Recreational catches for this stock have been negligible. Since 1977, the Georges Bank fishery has been supported primarily by the 1975 and 1978 year classes. Research vessel survey data for 1979-1984 indicate a succession of weak year classes. The fishery is highly dependent on the 1978 and 1983 year classes at the present time.

The NEFC spring survey index for Georges Bank rose from 5.4 kg/tow in 1975 to 35.7 kg/tow in 1980, the highest value observed in the spring survey time series (which began in 1968). The autumn survey index rose from 2.6 kg/tow in 1974 to 26.9 kg/tow in 1979, the highest value observed since 1985. These increases resulted primarily from recruitment and growth of the 1975 and 1978 year classes. Since 1980 both indices have declined; the autumn survey index dropped from 11.8 kg/tow in 1981 to 2.9 kg/tow in 1984 and rose slightly to 3.7 kg/tow in 1985. The 1981, 1982 and 1984 young-of-year indices for Georges Bank were among the lowest on record. Indices for the 1983 year class suggest that it may be comparable to the 1972 year class in size, however, high fishing mortality and discarding in 1984 have already reduced this cohort.

Stock size estimate (age 2 and older) calculated from virtual population analysis or VPA have declined from 91 million fish or 110,000 mt in 1980 to 15 million fish in 1985. Current levels are well below the long-term (1935-1960 average of 140 million fish or 153,000 mt) and appear comparable to the record lows observed during the early to mid-1970's when recruitment was poor. The stock is expected to decline even further in 1986.

For further information see:

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. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-23, 31 p.

NEFC. Report of the Second NEFC Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 2.1 Nominal catches (thousand metric tons) and management information for Gulf of Maine haddock, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	1.0	1.0	1.7	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial									
USA	3.3	4.5	4.6	7.3	5.7	5.6	5.6	2.8	2.2
Canada	<0.1	0.6	0.3	0.2	0.5	1.1	2.0	1.2	0.8
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	4.3	6.1	6.6	7.7	6.2	6.7	7.6	4.0	3.0
Total allowable catch[2]	10.5	19.0[3]	8.2[4]	9.6[5]	9.6[5]	-	-	-	-

Long-term potential catch = 5,000 mt
Importance of recreational fishery = Minor
Status of management = (Interim) FMP in force since 31 March 1982
Status of exploitation = Fully exploited
Age at 50% maturity = 2 years
Size at 50 maturity = 38 cm (15 inches)

$M = 0.20$ $F_{0.1} = 0.26$ $F_{max} = 0.55$ $F_{1985} = >F_{max}$

1 Values for and 1970-1982 obtained from surveys; remaining points estimated.
2 Values for 1977-1978 are for Georges Bank and the Gulf of Maine, inclusive.
3 Represents total USA commercial allocations for Quarters 1-3 of 1978 and Quarter 1 of the 1978-1979 fishing year and total Canadian and USA recreational allocations for Calendar Year 1978.
4 Represents USA commercial allocations for the Gulf of Maine for Quarters 2-4 of the 1978-1979 fishing year and Quarter 1 of the 1979-1980 fishing year and total USA recreational allocation for Calendar Year 1979.
5 Represents USA commercial allocation for the Gulf of Maine and total recreational allocation for Calendar Years 1980 and 1981 under Final Supplement No. 4 to the Fishery Management Plan (FMP) for Atlantic Groundfish (effective September 1981).

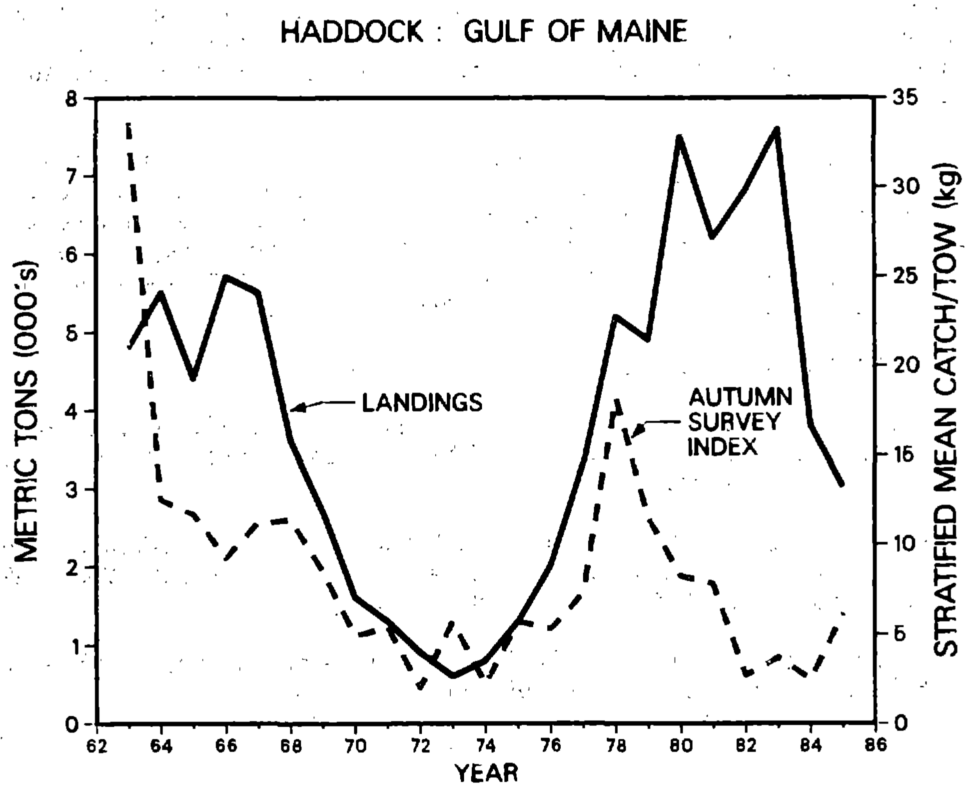


Figure 2.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of haddock in the Gulf of Maine.

Table 2.2 Nominal catches (thousand metric tons) and management information for Georges Bank haddock, 1977 - 1985.

Category	Year 1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial									
USA	7.9	12.2	14.3	17.5	19.2	12.6	8.7	8.8	4.3
Canada	2.9	10.2	5.2	10.1	5.7	5.6	3.2	1.4	3.5
Other	-	-	-	-	<0.1	-	-	-	-
Total nominal catch	10.8	22.4	19.5	27.6	24.9	18.2	11.9	10.2	7.8
Total allowable catch[1]	10.5	19.0[2]	22.1[3]	22.9[4]	22.9[4]	-	-	-	-

Long-term potential catch = 47,000 mt
Importance of recreational fishery = Insignificant
Status of management = (Interim) FMP in force since 31 March 1982
Status of exploitation = Fully exploited
Age at 50% maturity = 2 years
Size at 50% maturity = 38 cm (15 inches)

$M = 0.20$ $F_{0.1} = 0.26$ $F_{max} = 0.55$ $F_{1985} \doteq > F_{max}$

1 Values for 1977-1978 are for Georges Bank and the Gulf of Maine, inclusive.
2 Represents total USA commercial allocations for Quarters 1-3 of 1978 and Quarter 1 or the 1978-1979 fishing year and total Canadian and USA recreational allocations for Calendar Year 1978.
3 Represents USA commercial allocations for Georges Bank for Quarters 2-4 of the 1978-1979 fishing year and Quarter 1 of the 1979-1980 fishing year and total Canadian allocation for Calendar Year 1979.
4 Represents USA commercial allocation for Georges Bank and total Canadian allocacation for Calendar Years 1980 and 1981 under Final Supplement No.4 to the Fishery Management Plan (FMP) for Atlantic Groundfish (effective September 1981).

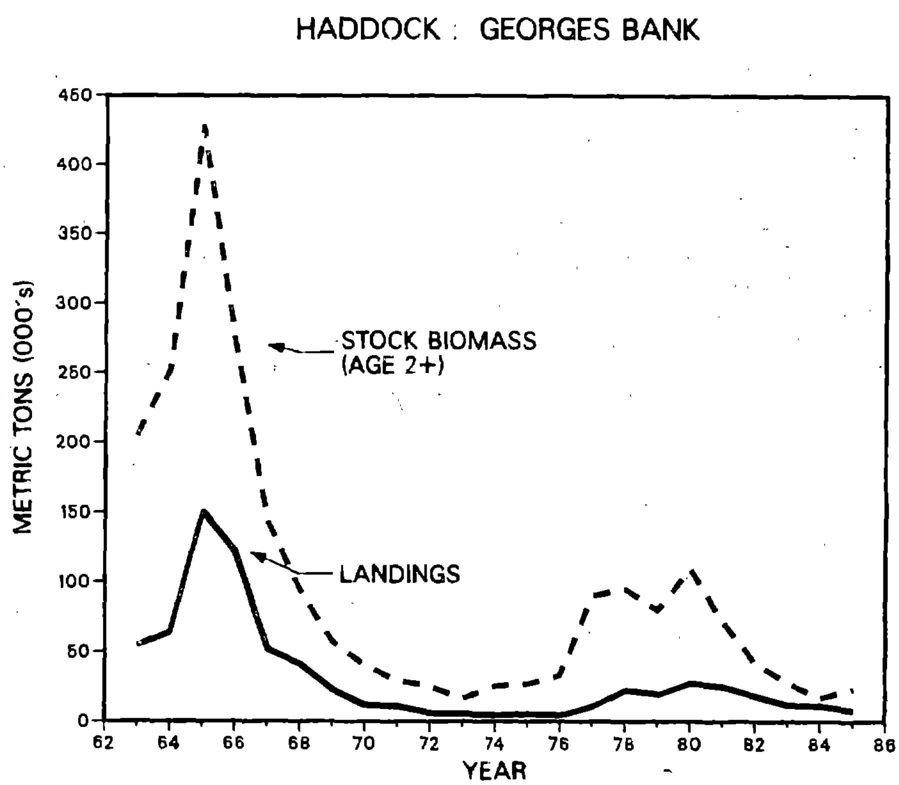


Figure 2.2 Total commercial landings and estimates of stock biomass of haddock on Georges Bank.

REDFISH

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 feet). Redfish are slow growing, long-lived animals with an extremely low natural mortality rate. Ages in excess of 50 years and maximum sizes of 45-50 cm (18-20 inches) have been noted. In the Gulf of Maine, redfish reach maturity in about 8-9 years at an average length of 22-23 cm (8-9 inches). 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 - 11,000 mt during 1974-1976 to 14,000 - 15,000 mt in 1978-1979. In 1984 and 1985, however, catches declined to 4,700 and 4,200 mt, respectively, the lowest annual figures since the directed fishery commenced in the early 1930's. Available evidence indicates that the Gulf of Maine redfish population is dominated by the 1971 year class and that the fishery continues to depend on this year class. 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 1984 and 1985, this year class represented 27% and 36% 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 1.1 and 0.9 mt/day in 1984 and 1985, respectively. The NEFC survey index declined from an average of 122 fish/tow in 1967-1968 to an average of 43 fish/tow in 1977-1978. Recent autumn indices for 1983 through 1985 (10 fish/tow) are the lowest values observed since the beginning of the survey. Estimates of exploitable biomass (ages 5 and older) from virtual population analysis declined 75% from 138,000 mt in 1969 to 34,000 mt in 1984. Projections for 1986 indicated a stock biomass of 26,000 mt. Average fishing mortality during the 1970's 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 1970's. The current level of fishing mortality is above the calculated F_{max} and $F_{0.1}$ values.

Equilibrium surplus production models have indicated that long-term potential catches is about 14,000 mt. However, given the current low population abundance, 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 and, with the present age structure and exploitation pattern, the fishery continues to be extremely dependent on recruitment. However, except for the moderate 1978 year class, recruitment has been poor; thus, declines in biomass are expected to continue.

For further information see:

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. North. 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. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-22, 55 p.

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 3.1 Nominal catches (thousand metric tons) and management information for redfish from the Gulf of Maine and Georges Bank area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	13.0	14.0	14.7	10.1	7.8	6.7	5.2	4.7	4.2
Canada	0.2	0.1	<0.1	0.1	<0.1	0.2	0.1	0.1	0.1
Other	<0.1	-	<0.1	-	-	<0.1	-	-	-
Total nominal catch	13.2	14.1	14.7	10.2	7.8	6.8	5.3	4.8	4.3
Total allowable catch	9.0[1]	-	-	-	-	-	-	-	-

Long-term potential catch = 14,000 mt
Importance of recreational fishery = Insignificant
Status of management = None
Status of exploitation = Fully exploited
Age at 50% maturity = 8-9 years
Size at 50% maturity = 22-23 cm (8.5 - 9.0 inches)

$M = 0.05$ $F_{0.1} = 0.07$ $F_{max} = 0.14$ $F_{1985} = 0.17$

[1] Recommended by ICNAF, but not implemented under extended jurisdiction.

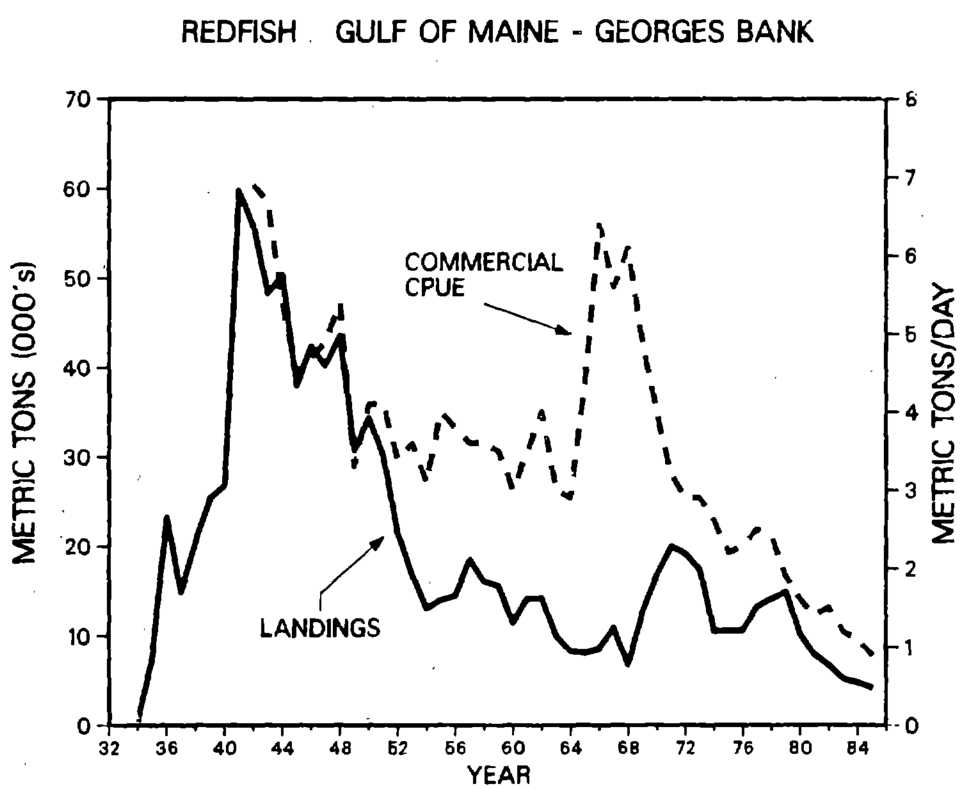


Figure 3.1 Total commercial landings and catch per unit effort of redfish in the Gulf of Maine - Georges Bank area.

SILVER HAKE

The silver hake or whiting (<u>Merluccius bilinearis</u>) 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 have indicated that silver hake have wide areal 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 during March-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 inches). Ages of 15 years have been reported, although fish older than about 8-10 years are rarely encountered.

Gulf of Maine - Northern Georges Bank Stock

The nominal catch of silver hake in 1985 was 8,300 mt, taken exclusively by the USA. While this catch was virtually equivalent to 1984 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 1955-1961. 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 1976-1978, then dropped sharply to only 3,400 mt in 1979. During 1980-1982, catches averaged only about 4,600 mt but 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 1969-1974, 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 1969-1978.

Both the spring and autumn NEFC bottom trawl survey catch-per-tow indices reached high levels in 1976 and then declined through about 1982. In 1983, the spring index increased only slightly; however, the autumn index increased sharply to its highest level since 1976 due primarily to a strong 1982 year class. In 1984, both surveys declined, then both increased in 1985. Survey catch-per-tow-at-age data indicate that the 1973-1974 year classes were quite strong with 1974 being the strongest. These year classes supported the increase in commercial catch in 1975. The 1977-1978 and 1981-1982 year classes were also strong in comparison to other years in the 1973-1984 time series. The 1983 year class was quite weak, recording its lowest and second lowest indices in the spring and autumn surveys, respectively. The 1984 year class appears to be of at least average strength, however. The 1985 year class may be quite strong with the autumn 1985 index of age 0 fish the highest since 1978 and the fourth highest since 1973.

With continued low levels of catch and average year classes, it is unlikely that this stock will undergo any major declines in 1985 if catches remain at or slightly above the levels reported in recent years.

Southern Georges Bank - Middle Atlantic Stock

The international nominal catch of silver hake in 1985 was 15,100 mt. The USA commercial catch in 1985 was 11,800 mt, the fourth highest level since 1965 and maintaining the fairly constant level of catches which have averaged about 12,000 mt during 1978-1983. DWF catch in 1985 was only 1,300 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 1985 was estimated to be about 2,000 mt.

Total catches from this stock averaged about 15,500 mt during 1955-1961 before increasing sharply with the introduction of the DWF to 308,500 mt 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 during 1963-1965 to a low in 1969, increased briefly during 1970-1971 then decreased through 1974. The index then increased in 1978 before declining steadily through 1981. Since 1981, the index has generally increased. Survey catch-per-tow-at-age data indicate that, like the northern stock of silver hake, the 1973-1974 year classes were strong in comparison to other years in the time series. Year-class strength since 1975, with the exception of the 1977, 1981, and 1982 cohorts, were of only average strength, however, the 1985 year class may be quite strong.

Since 1978, this stock has been under very little fishing pressure compared to 1963-1977 when the fishery was dominated by the DWF. However, biomass, as indicated by the NEFC bottom trawl survey, has not increased substantially. With catch levels remaining at their present level and average year classes, it is unlikely that this stock will undergo any major declines in 1986.

For further information see:

Almeida, F. P. 1985. An analysis of the stock structure of silver hake, Merluccius bilinearis, off the northeast coast of the United States. MS Thesis, Oregon State University, Corvallis, Oregon, 141 p.

Table 4.1 Nominal catches (thousand metric tons) and management information for silver hake from the Gulf of Maine - Northern Georges Bank stock, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
	Year								
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	12.4	12.6	3.4	4.7	4.4	4.7	5.3	8.3	8.3
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	12.4	12.6	3.4	4.7	4.4	4.7	5.3	8.3	8.3
Total allowable catch[1]	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = FMP in preparation
Status of exploitation = Underexploited
Age at 50% maturity = 2 years
Size at 50% maturity = 23.8 cm (9.4 inches) males; 25.0 cm (9.8 inches) females

M = 0.40 $F_{0.1}$ = 0.44 F_{max} = >2.00 F_{1985} = Unknown

[1] Past TAC's not applicable to this stock grouping.

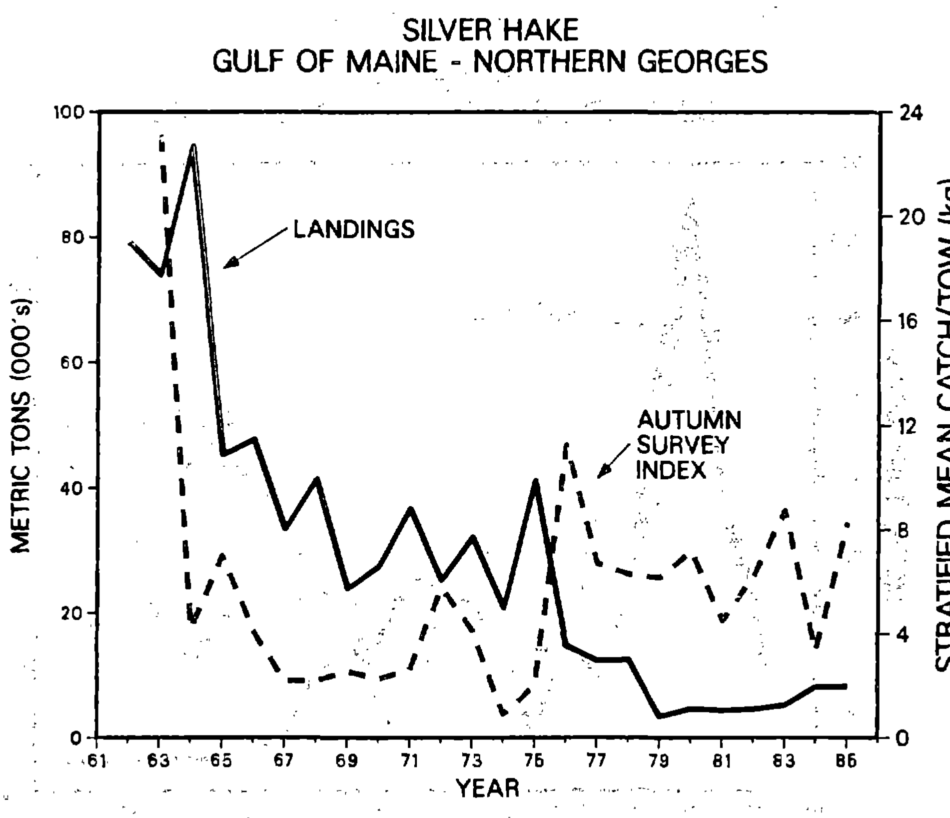


Figure 4.1 Total commercial landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of silver hake.

Table 4.2 Nominal catches (thousand metric tons) and management information for silver hake from the Southern Georges Bank - Middle Atlantic stock, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	3.9	2.0	2.3	2.0	2.0	2.0	1.9	2.2	2.0
Commercial									
USA	9.5	11.4	13.1	11.7	11.7	11.9	11.5	12.7	11.8
Canada	-	-	-	-	-	-	-	-	-
Other	47.9	14.4	4.9	1.7	3.0	2.4	0.6	0.4	1.3
Total nominal catch	61.3	27.8	20.3	15.4	16.7	16.3	14.0	15.3	15.1
Total allowable catch[2]	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Minor
Status of management = FMP in preparation
Status of exploitation = Underexploited
Age at 50% maturity = 2 years
Size at 50% maturity = 24.7 cm (9.7 inches) males
25.7 cm (10.1 inches) females

M = 0.40 $F_{0.1}$ = 0.43 F_{max} = >2.00 F_{1985} = Unknown

1 Estimated

2 Past TAC's not applicable to this stock grouping.

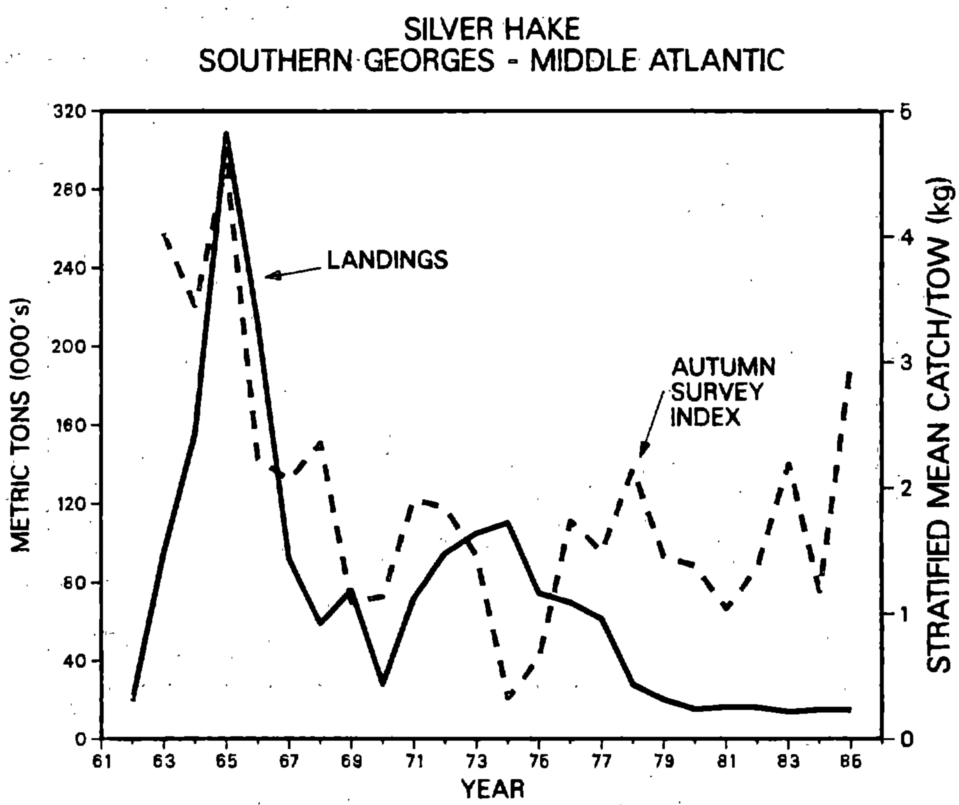


Figure 4.2 Total commercial landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of silver hake.

RED HAKE

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 overwintering 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 inches). The maximum age is reported to be about 12 years, although fish of age 8-10 are rarely seen.

Gulf of Maine - Northern Georges Bank Stock

The nominal catch of this stock of red hake in 1985 was 1,000 mt, taken exclusively by the USA vessels. This catch represented a slight decrease from 1984 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 1960's through 1971 was characterized by relatively low catches ranging from about 1,000 to 5,000 mt. The second period, 1972-1976, 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 1960's and reached a peak in 1973 then declined through 1979. The index then increased dramatically in 1980, recorded a series high in 1981, and has fluctuated at high levels since. The 1985 value was the second 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 1960's and early 1970's and has maintained a relatively high average during the 1980's. Survey catch-per-tow-at-age data indicate that the 1973 and 1974 year classes were the strongest since 1970. Year classes produced during 1975-1979 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 0 autumn index in the 1970-1985 time series.

The combination of minimal fishing pressure, combined with average to above average year classes produced since about 1980 have resulted in an apparent increase in stock size as indicated from the NEFC bottom trawl survey. It is unlikely that this stock will undergo any major declines in 1986 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 1985 was 900 mt, the lowest catch reported in the 1960-1985 time series and continuing a trend of decreasing catches which began in 1977. The USA catch in 1985 was 800 mt, and the DWF catch was reported to be only 800 mt. 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 the exclusion of the USSR from the fishery. During the period of 1965-1976 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 during 1967-1979 when catches averaged 4,100 mt annually, and has since declined steadily.

The NEFC autumn bottom trawl survey index declined steadily from high levels in the mid-1960's, remained fairly constant during 1968-1973, and then dropped to a series low in 1974. The index increased sharply in 1975, declined slightly and remained fairly steady during 1976-1982 at a level similar to that during 1968-1973. In 1984, the index dropped sharply to the second lowest level in the series but increased in 1985. Survey catch-per-tow-at-age indices indicate that the 1974 and 1979-1981 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 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 3-4 year classes contributing strongly to the survey indices. However, the survey does indicate 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 1-2 years.

For further information see:

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 5.1 Nominal catches (thousand metric tons) and management information for red hake from the Gulf of Maine - Northern Georges Bank stock, 1977-1985.

Category	Year 1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.9	1.2	1.5	1.0	1.2	1.2	0.9	1.1	1.0
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	0.9	1.2	1.5	1.0	1.2	1.2	0.9	1.1	1.0
Total allowable catch[1]	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = FMP in preparation
Status of exploitation = Underexploited
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_{1985} = Unknown

[1] Past TAC's not applicable to this stock grouping.

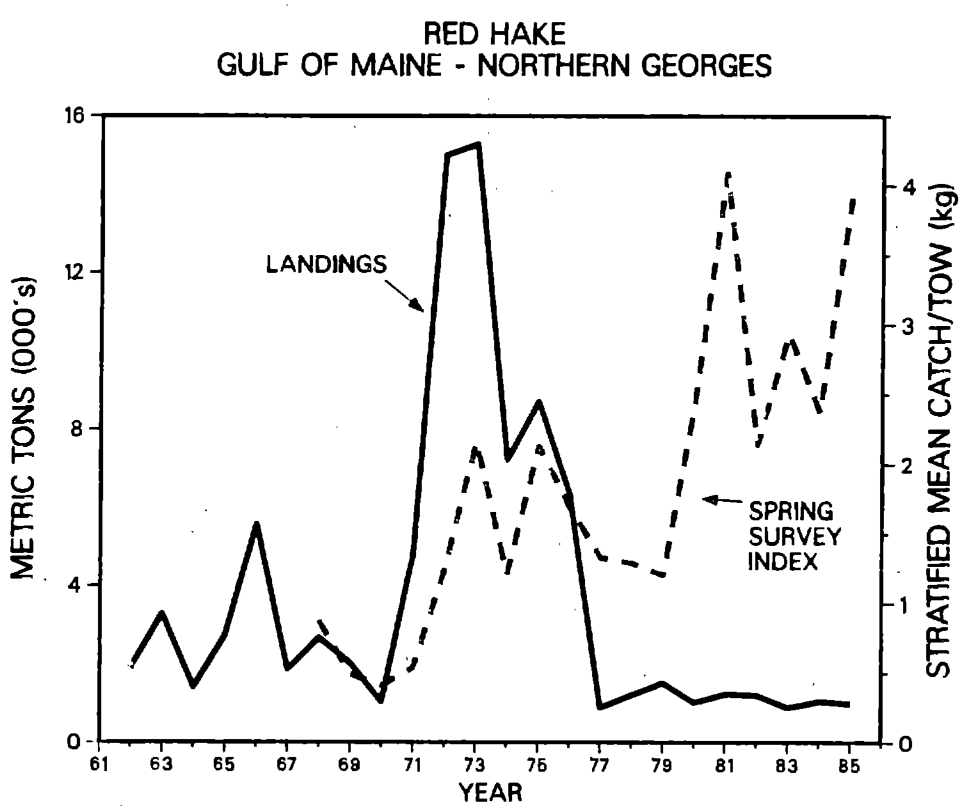


Figure 5.1 Total commerical landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of red hake.

Table 5.2 Nominal catches (thousand metric tons) and management information for red hake from the Southern Georges Bank - Middle Atlantic stock, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	0.8	1.0	0.2	0.1	0.1	0.1	0.1	<0.1	<0.1
Commercial									
USA	2.5	3.3	6.6	3.9	2.1	3.0	1.3	1.2	0.8
Canada	-	-	-	-	-	-	-	-	-
Other	4.5	2.1	1.0	0.2	0.2	0.2	0.1	0.1	0.1
Total nominal catch	7.8	6.4	7.8	4.2	2.4	3.3	1.5	1.3	0.9
Total allowable catch[2]	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Minor
Status of management = FMP in preparation
Status of exploitation = Underexploited
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_{1985} = Unknown

[1] Estimated.

[2] Past TAC's not applicable to this stock grouping.

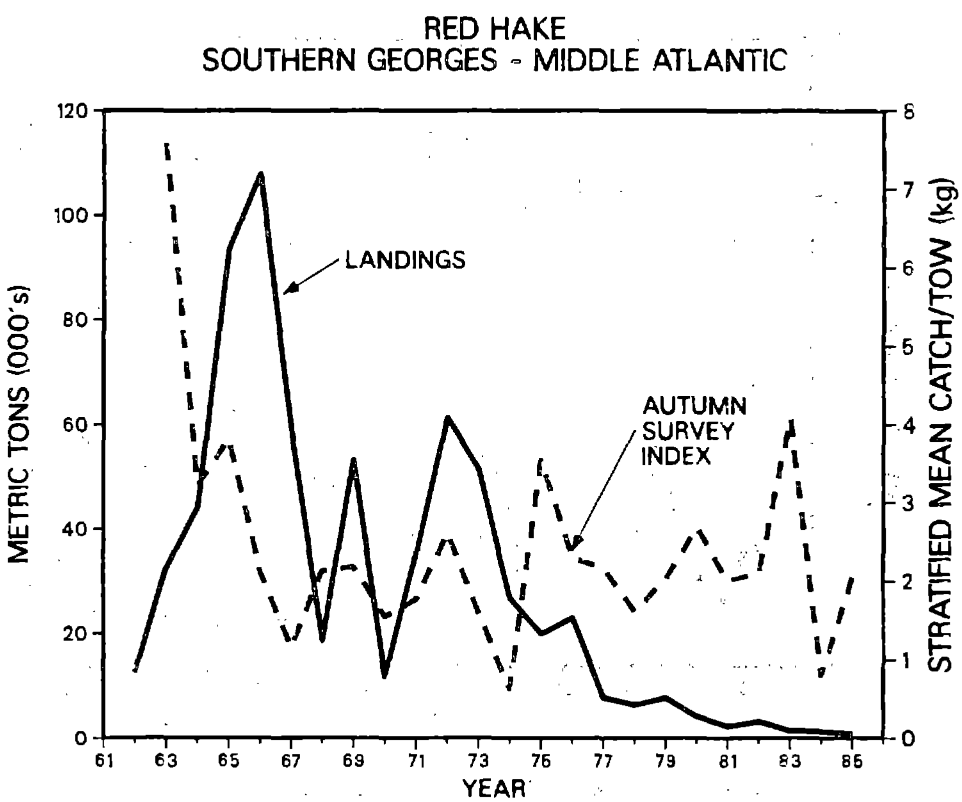


Figure 5.2 Total commercial and recreational landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of red hake.

POLLOCK

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 is currently known to exist 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 inches) and weights of 16 kg (35 pounds).

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 1972-1976 to 63,000 mt in 1985. Nominal catches for Canada increased steadily from 24,700 mt in 1977 to 43,300 mt in 1985; USA catches have increased from an average of 9,700 mt during 1973-1977 to over 14,000 mt annually since 1978, peaking at over 19,000 mt in 1985. Nominal catches by distant-water fleets have declined from an average of 4,200 mt during 1973-1977 to approximately 400 mt since 1981. Most of this catch has been taken by USSR vessels on the Scotian Shelf. Estimated USA recreational catches have fluctuated between 200 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, peaked at 64,000 mt in 1985.

Total stock size appears to be relatively high at present. Canadian commercial abundance indices (mt/hour fished) increased sharply in 1978, and the 1978-1984 average for 501-999 gross registered tons (GRT) trawlers (1.4 mt/hour) is almost twice the corresponding 1974-1977 average (0.8 mt/hour). Indices for USA 51-500 GRT trawlers have also doubled since the early 1970's. Abundance indices derived from Canadian summer and NEFC spring and autumn bottom trawl surveys also increased during the 1970's, but have declined sharply since 1981. Virtual population analysis indicates an increase in age 2+ stock biomass from 144,000 mt in 1970 to 260,000 mt in 1985.

Equilibrium yield calculations indicate that fishing at $F_{0.1}$ would provide a long-term catch of 50,000 mt from a stock biomass of 302,000 mt, while fishing at F_{max} would provide a catch of 57,000 mt from a stock biomass of 170,000 mt. Since 1980, fishing mortality levels appear to have been intermediate between $F_{0.1}$ and F_{max}.

For further information see:

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. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-13, 42 p.

McGlade, J., M. C. Annand, and D. Beanlands. 1985. The exploitation and biological status of pollock in Divisions 4VWX and Subarea 5. CAFSAC Res. Doc. 85/99, 90 p.

Table 6.1 Nominal catches (thousand metric tons) and management information for pollock from the Gulf of Maine, Georges Bank, and Scotian Shelf area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	2.7	1.8	0.7	1.0	0.7	1.3	1.3	0.2	1.0
Commercial									
USA	13.1	17.7	15.5	18.3	18.2	14.4	14.0	17.8	19.3
Canada	24.7	26.8	30.0	36.0	40.3	38.0	32.7	33.2	43.3
Other	0.7	0.8	1.1	1.2	0.5	0.4	0.5	0.1	0.4
Total nominal catch[1]	41.2	47.1	47.3	56.5	59.7	54.1	48.5	51.3	64.0
Total allowable catch[2]	30.0[2]	-	-	-	-	-	-	-	-

Long-term potential catch = 56,000 mt
Importance of recreational fishery = Minor
Status of management = FMP in preparation (USA fishery)
Status of exploitation = Fully exploited
Age at 50% maturity = 3.7 years
Size at 50% maturity = 50 cm (20 inches)

$M = 0.20$ $F_{0.1} = 0.19$ $F_{max} = 0.45$ $F_{1985} = 0.34$

1 Data for 1979-84 taken from recreational surveys; remaining points estimated.

2 Recommended by ICNAF but not implemented under extended jurisdiction.

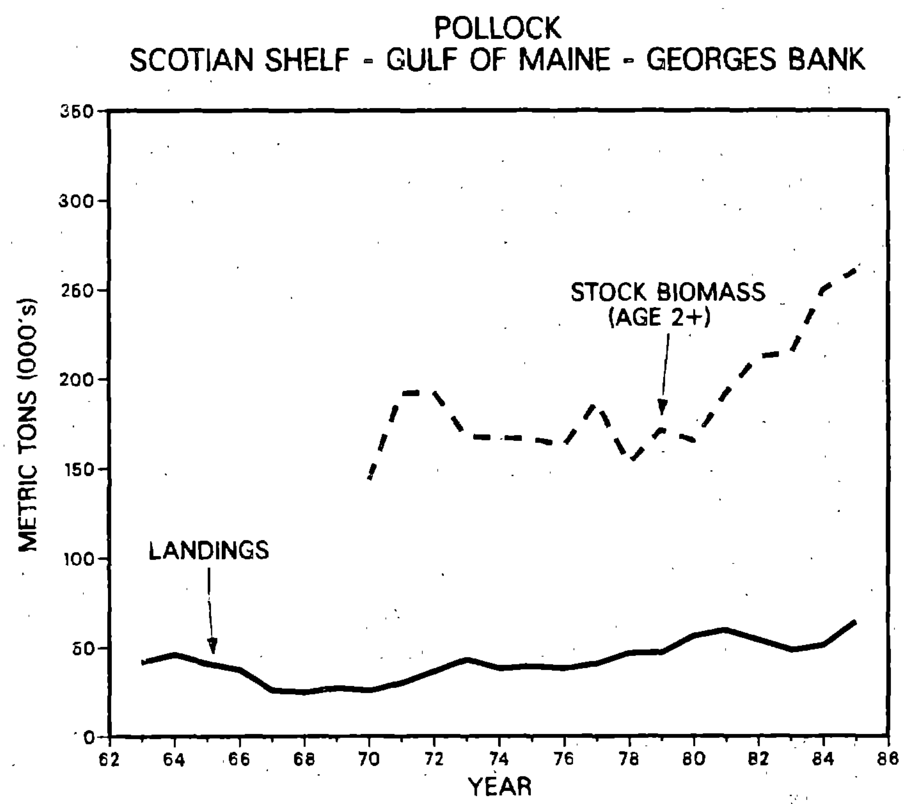


Figure 6.1 Total commercial and recreational landings and estimates of stock biomass of pollock in the Gulf of Maine, Georges Bank and Scotian Shelf area.

YELLOWTAIL FLOUNDER

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, and off Southern New England, generally at depths of 37-73 m (20-40 fathoms). Yellowtail commonly attain lengths up to 47 cm (18.5 inches) and weights up to 1.0 kg (2.2 pounds), although commercial catches tend to be dominated by smaller fish. They appear to be relatively sedentary in habit, although seasonal movements have been documented. Spawning occurs during spring and summer, peaking in May; larvae drift for a month or more, after which they assume adult characteristics and become demersal in habit.

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 of the above groups are unknown at present. Two management units have been recognized in recent years: the Georges Bank (east of 69 W) unit and the Cape Cod, Southern New England, and Mid-Atlantic unit (west of 69 W).

Georges Bank (East of 69 W)

Nominal catches declined from an average of 14,700 mt during 1972-1976 to only 4,600 mt in 1978. Landings increased gradually from 1979-1981 and then rose sharply to 10,600 mt and 11,400 mt in 1982 and 1983, respectively, the highest catches since 1977. In 1984, however, landings dropped to only 5,800 mt and subsequently declined to only 2,500 mt in 1985. Discard rates on a per-trip basis were as high as 30% of the landed total by weight in 1982, but have since declined.

The commercial abundance index (mt/day fished) for Georges Bank declined to minimal levels in the late 1970's and then increased with improving recruitment. Values for 1982-1983 were the highest observed in recent years, but remained consistently below peak levels observed during the early to mid-1960's. A steady declining trend in the NEFC autumn trawl survey indices from 1963 to 1976 was followed by a relatively steady but low index until 1981. The index has declined steadily subsequently, with the 1985 value the lowest in the series. Survey catch-per-tow at age data indicate that recent year classes have been relatively weak. The pre-recruit (age 1) index for the 1985 autumn survey showed a noticeable increase, but still remained much lower than the long-term average. Fishing mortality has considerably exceeded the F_{max} level in recent years.

Southern New England, Mid-Atlantic, and Cape Cod (West of 69 W)

Nominal catches declined from an average of 11,600 mt during 1972-1976 to 6,400 mt in 1978; landings then rose to 13,800 mt in 1982, to 21,300 mt in 1983 and have since declined sharply to only 4,600 mt in 1985. Again, the 1980-1981 year classes have predominated in the subsequent year's landings. Recruitment in more recent years has been poor, however, the fishery continues to be heavily reliant upon 2 and 3 year old fish. Hence, the 1984-1985 decline reflects both reduction of these year classes due to heavy fishing pressure and poor recruitment from subsequent year classes. Reported trip discard rates ranged from 25-80% of the landed total by weight in 1982; since that year, the discard rate appears to have declined.

For Southern New England, commercial and survey indices declined to very low levels in the mid-1970's; they then increased gradually until 1982 with recruitment of the 1980-1981 year classes (the strongest in recent years). Since that year abundance has declined sharply and now appears to be at a historic low point. Research vessel survey catches of prerecruit (age 1, 1984 year class) yellowtail in spring and autumn of 1985 show some improvement over the 1984 catches, but remain well below the long-term historic average. Results of a directed survey for yellowtail on the Southern New England grounds in the winter of 1985 also suggest very low levels of abundance and poor recruitment prospects. The 1980-1981 year classes have been severely reduced by fishing and are not expected to contribute appreciably to the fishery in the future. Fishing mortality has substantially exceeded F_{max} in recent years.

Trends for the Mid-Atlantic have been generally similar to those observed for Southern New England. NEFC autumn survey indices declined to very low levels in the mid-1970's, followed by a sharp increase in 1981-1982. Since 1982, abundance has again declined sharply; the increase in nominal catch in 1984 over 1983 levels reflected an increase in fishing effort. Landings in 1985 are substantially lower than those in 1983 and 1984.

The Cape Cod yellowtail fishery has generally been more stable than those for other areas. Nominal catch averaged between 1,000-2,000 mt from 1960 through 1975 and then increased to over 5,000 mt in 1980; since that year, landings have declined steadily to only 1,000 mt in 1985. Commercial and NEFC research vessel survey indices increased somewhat during the late 1970's and early 1980's; more recent data again indicated a declining trend.

For further information see:

Clark, S. H., M. M. McBride, and B. Wells. 1984. Yellowtail flounder assessment update - 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-39, 30 p.

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 7.1 Nominal catches (thousand metric tons) and management information for yellowtail flounder from the Georges Bank area (east of 69°W), 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	9.5	4.5	5.5	6.4	6.4	10.6	11.4	5.8	2.5
Canada	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	9.5	4.6	5.5	6.5	6.4	10.6	11.4	5.8	2.5
Total allowable catch	10.0	4.4	4.5[1]	5.0[2]	5.0[2]	-	-	-	-

Long-term potential catch = 16,000 mt
Importance of recreational fishery = Insignificant
Status of management = Interim FMP in effect since 31 March 1982
Status of exploitation = Fully exploited
Age at 50% maturity = 2 years
Size at 50% maturity = 26 cm (10 inches)

$M = 0.20$ $F_{0.1} = 0.30$ $F_{max} = 0.50$ $F_{1985} = >F_{max}$

1 Represents USA allocations for Quarters 2-4 of the 1978-1979 fishing year and Quarter 1 of the 1979-1980 fishing year.

2 Represents USA allocations for Calendar Years 1980 and 1981 under Final Supplement No. 4 to the FMP for Atlantic Groundfish (effective September 1981).

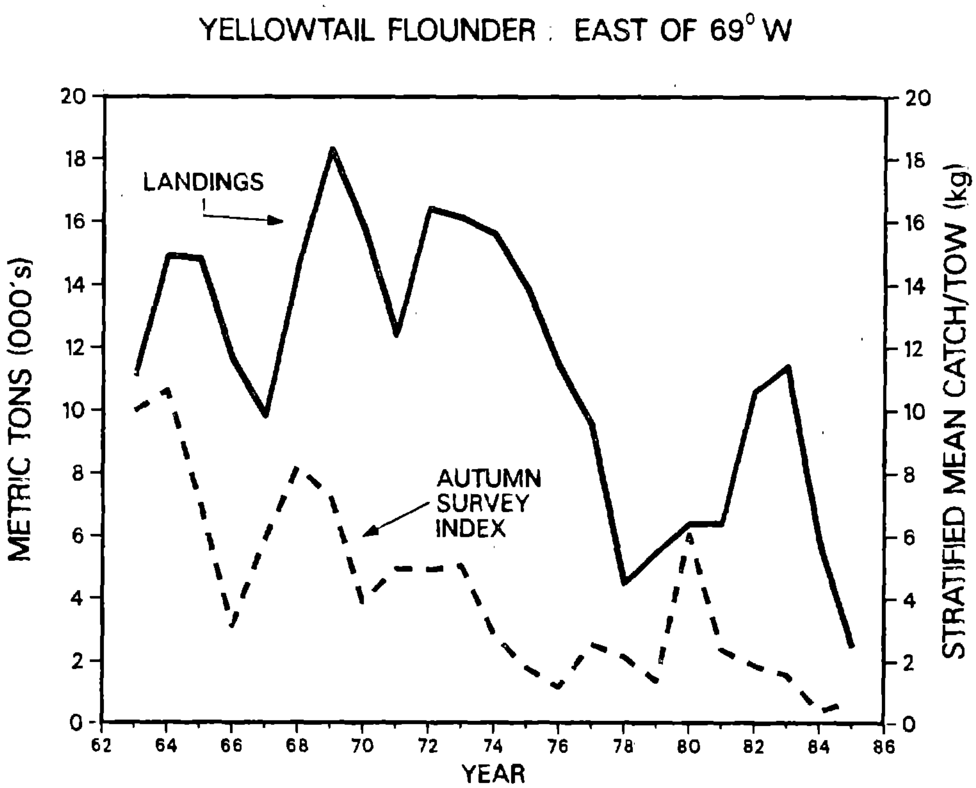


Figure 7.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of yellowtail flounder on Georges Bank east of 69°W longitude.

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), 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	6.8	6.4	10.1	11.4	8.7	13.8	21.3	11.7	4.6
Canada	-	<0.1	-	-	-	-	-	-	-
Other	<0.1	-	-	-	-	-	-	-	-
Total nominal catch	6.8	6.4	10.1	11.4	8.7	13.8	21.3	11.7	4.6
Total allowable catch	6.0	3.7	4.0[1]	5.0[2]	5.0[2]	-	-	-	-

Long-term potential catch = 23,000 mt
Importance of recreational fishery = Insignificant
Status of management = Interim FMP in effect since 31 March 1982
Status of exploitation = Fully exploited
Age at 50% maturity = 2 years
Size at 50% maturity = 26 cm (10 inches)

$M = 0.20$ $F_{0.1} = 0.30$ $F_{max} = 0.50$ $F_{1985} = >F_{max}$

[1] Represents USA allocations for Quarters 2-4 of the 1978-1979 fishing year and Quarter 1 of the 1979-1980 fishing year.

[2] Represents USA allocations for Calendar Years 1980 and 1981 under Final Supplement No. 4 to the FMP for Atlantic Groundfish (effective September 1981).

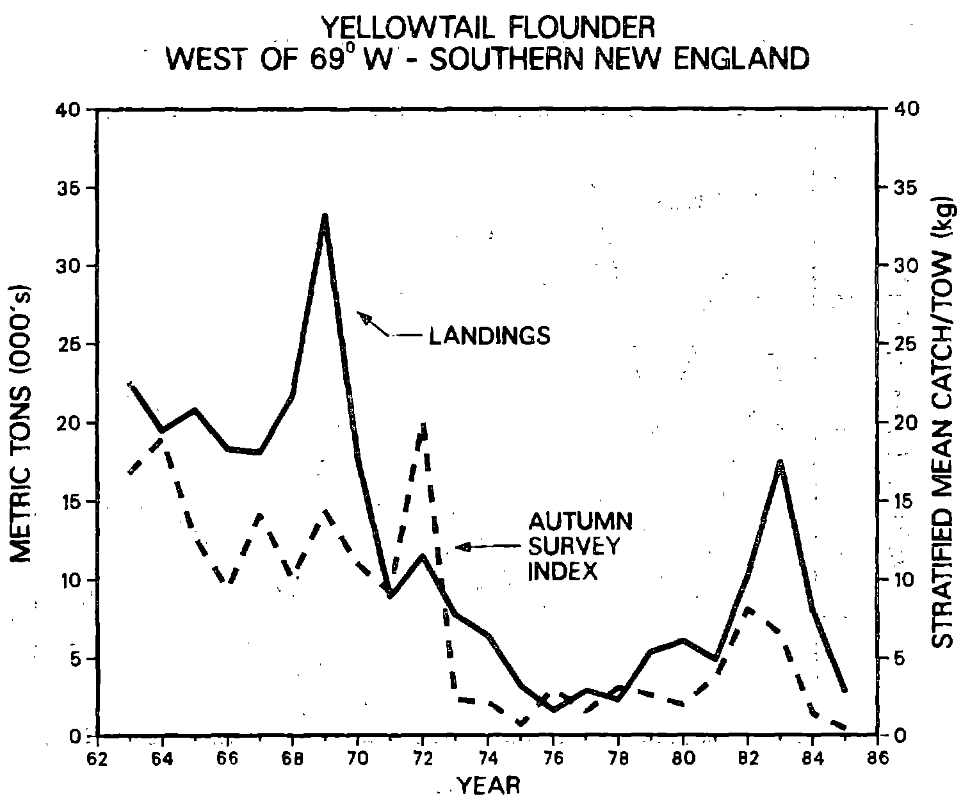


Figure 7.2 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of yellowtail flounder west of 69°W longitude (southern New England).

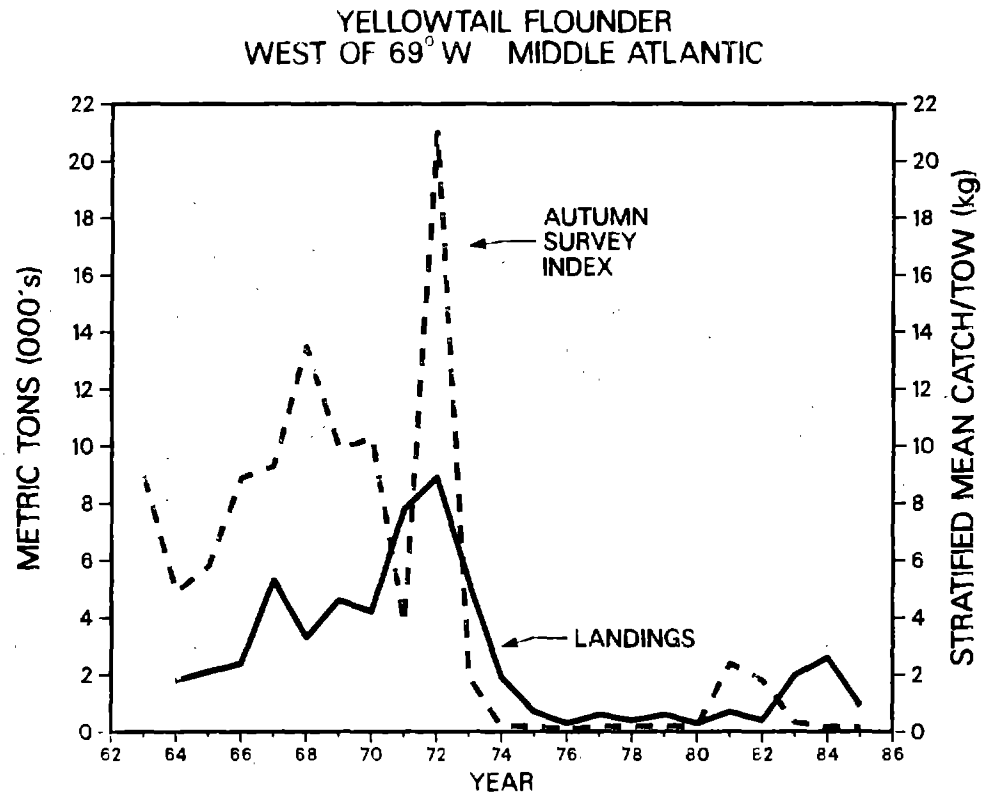


Figure 7.3 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl survey of yellowtail founder west of 69°W longitude (Mid-Atlantic).

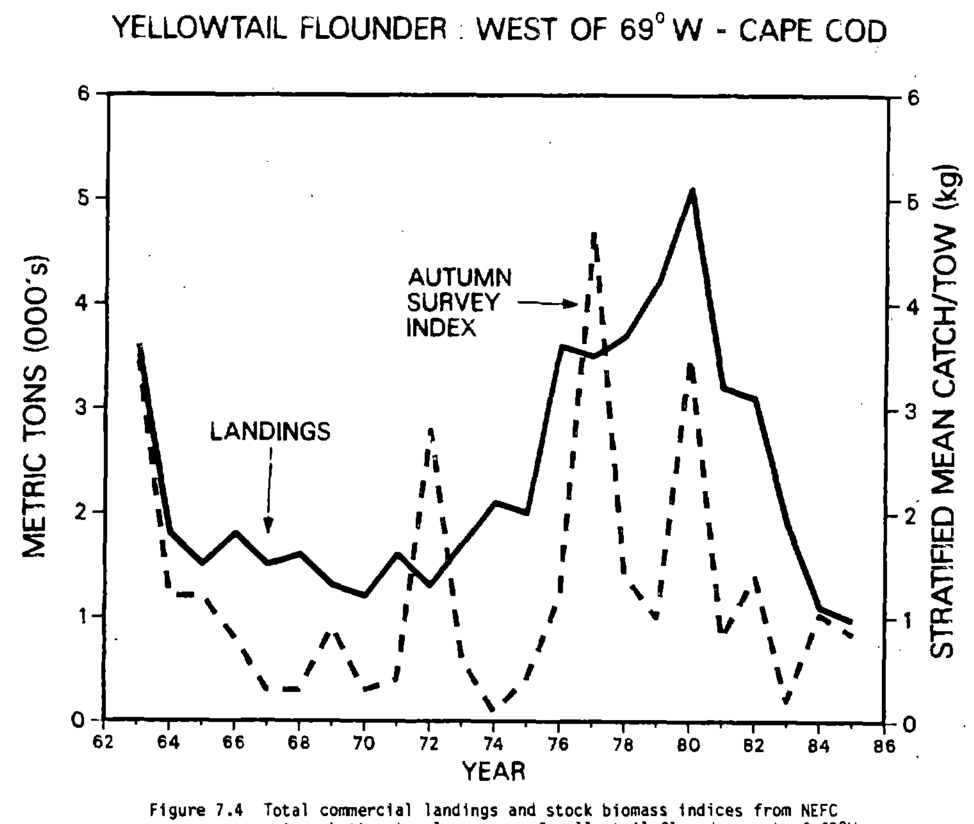


Figure 7.4 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of yellowtail flounder west of 69°W longitude (Cape Cod).

SUMMER FLOUNDER

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 pounds). 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 1950-1960 and declined sharply to 1,700 mt in 1969. Yield subsequently recovered during 1974-1978 to an average of 8,600 mt. The USA nominal catch in 1985 was 10,700 mt, a 25% decrease relative to the 1984 level of 14,200 mt but roughly equal to the 1980-1983 average of 10,400 mt. The estimated recreational catch of summer flounder ranged from 2,900 to 11,800 mt (5,000 to 18,900 million fish) during 1979-1984. An additional 4 to 7 million fish were harvested but not available to be weighed, and 3 to 17 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 level than during the late 1960's and early 1970's, based on NEFC survey indices. The spring survey index rose from 0.06 kg/tow in 1970 to a peak of 0.99 kg/tow in 1976. Following a sharp drop to 0.17 kg/tow in 1979, the index increased to 0.79 kg/tow in 1982, fell to 0.26 kg/tow in 1984, and increased again to 0.81 kg/tow in 1985. Catch curve analysis of survey and commercial age composition data collected during 1976-1979 indicated fishing mortality rates of about 0.8, well in excess of F_{max}. Although mortality estimates are not available for the last several years, they are assumed to still be above F_{max}. Analyses indicate that yield per recruit and long-term yield can be increased significantly by increasing the minimum size of fish caught and reducing fishing mortality.

Evidence suggests that summer flounder are extremely susceptible to a hemoflagellate parasite and that large scale mortality of juvenile summer flounder may have occurred in Chesapeake Bay during 1981 as a result of parasite infestation.

For further information see:

Fogarty, M. J. 1981. Review and assessment of the summer flounder (Paralichthys dentatus) in the Northwest Atlantic. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 80-22, 57 p.

Lange, A. M. T. 1984. Long-term effects of change in mesh size on yield of summer flounder. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-04, 14 p.

Table 8.1 Nominal catches (thousand metric tons) and management information for summer flounder from the Georges Bank - Mid-Atlantic area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	-	-	7.1	17.2	2.8	3.8	11.8	10.5	-
Commercial									
USA	8.9	8.5	14.5	11.5	8.0	10.1	11.8	14.2	10.7
Canada	-	-	-	-	-	-	-	-	-
Other	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
Total nominal catch[2]	8.9	8.5	14.5	11.5	8.0	10.1	11.8	14.2	10.7
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = 15,000 to 20,000 mt
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")

$M = 0.20$ $F_{0.1} = 0.16$ $F_{max} = 0.19$ F_{1985} = Unknown

1 Estimates available only for years shown.

2 Commercial only.

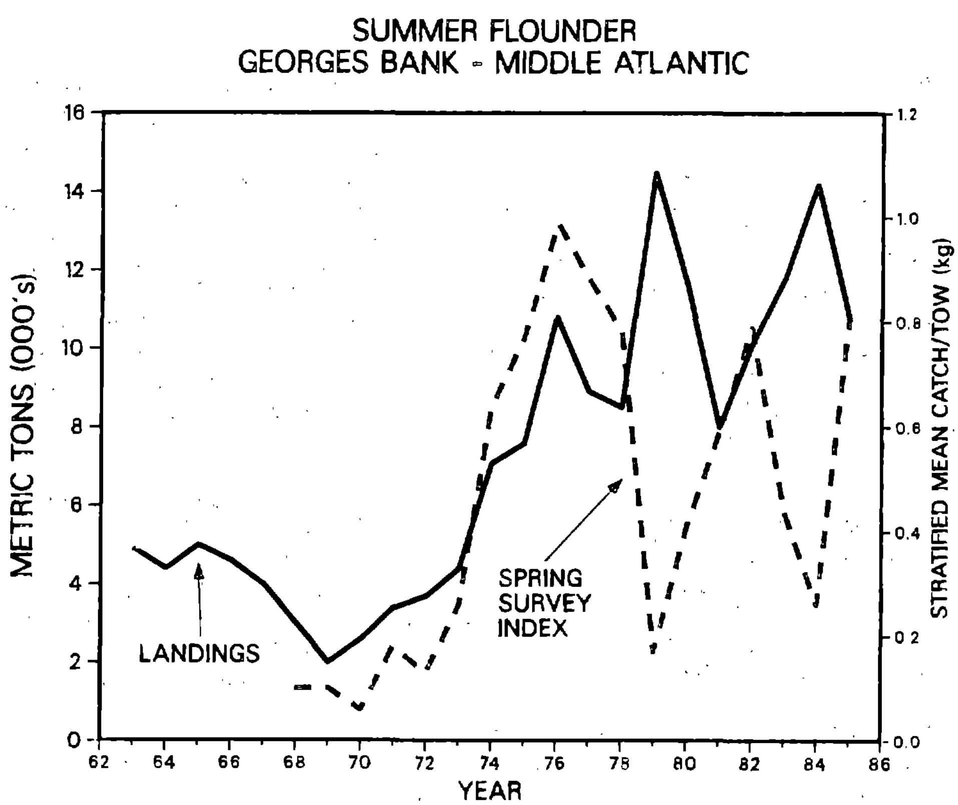


Figure 8.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of summer flounder in the Georges Bank - Mid-Atlantic area.

AMERICAN PLAICE

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 (50-100 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 (9-11 inches) in length and weigh between 90 and 190 g (0.2-0.4 pounds). After age 4, females grow faster than males.

Commercial 1985 landings of American plaice from the Gulf of Maine-Georges Bank region were 7,000 mt, 30% less than in 1984, and the lowest annual catch since 1976. Annual landings during 1979-1985 averaged 11,900 mt, about 3.3 fold higher than the 1960-1978 annual mean (3,600 mt). USA commercial CPUE indices were relatively stable during 1964-1969, declined in the early 1970's 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 1985 indices in both areas were the lowest since the mid-1970's. Effort in 1985, however, was a record high.

During 1960-1974, 67% of USA landings were from deepwater areas on Georges Bank. Since then, Gulf of Maine landings have exceeded those from Georges Bank. The 1985 Gulf of Maine catch (4,800 mt) was twice as large as that from Georges Bank (2,300 mt). In both areas, however, shifts in landings by vessel class have recently occurred. In 1985, for the second year in succession in the Gulf of Maine, plaice landings by small vessels (Class 2: 5-50 gross registered tons (GRT)), accounted for less than half of the Gulf of Maine catch. Class 3 (51-150 GRT) and Class 4 (151-500 GRT) vessels accounted for 41% and 19% respectively of the 1985 total Gulf of Maine landings, record percentages for these tonnage categories. On Georges Bank, Class 3 vessels accounted for 65% of the 1985 catch, the lowest percentage ever, while landings by Class 4 vessels comprised 31% of the Georges Bank total, near the record high of 32% obtained in 1983.

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 1985, "directed trips" accounted for only 15% of the Gulf of Maine catch and only 6% of the Georges Bank catch.

Landings trends have generally paralleled trends in NEFC autumn indices. The 1985 autumn survey weight per tow index remained low, with the 1984 index the lowest since the mid-1970's. The declining trend in survey values since 1980 is consistent with that observed in CPUE values.

American plaice abundance, high in the late 1970's, 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 1986 accompanied by a continued decline in landings.

For further information see:

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Sullivan, L.F. 1982. American plaice, Hippoglossoides platessoides, in the Gulf of Maine. MA Thesis, Univer. of Rhode Island, Kingston, RI, 96 p.

Table 9.1 Nominal catches (thousand metric tons) and management information for American plaice from the Gulf of Maine - Georges Bank area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	7.1	9.5	11.4	13.5	12.9	15.1	13.2	10.1	7.0
Canada	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other	0.2	<0.1	0.1	-	<0.1	-	-	-	-
Total nominal catch	7.3	9.6	11.5	13.6	12.9	15.2	13.2	10.1	7.0
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = FMP in planning stage
Status of exploitation = Becoming fully exploited
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_{1985} = Unknown

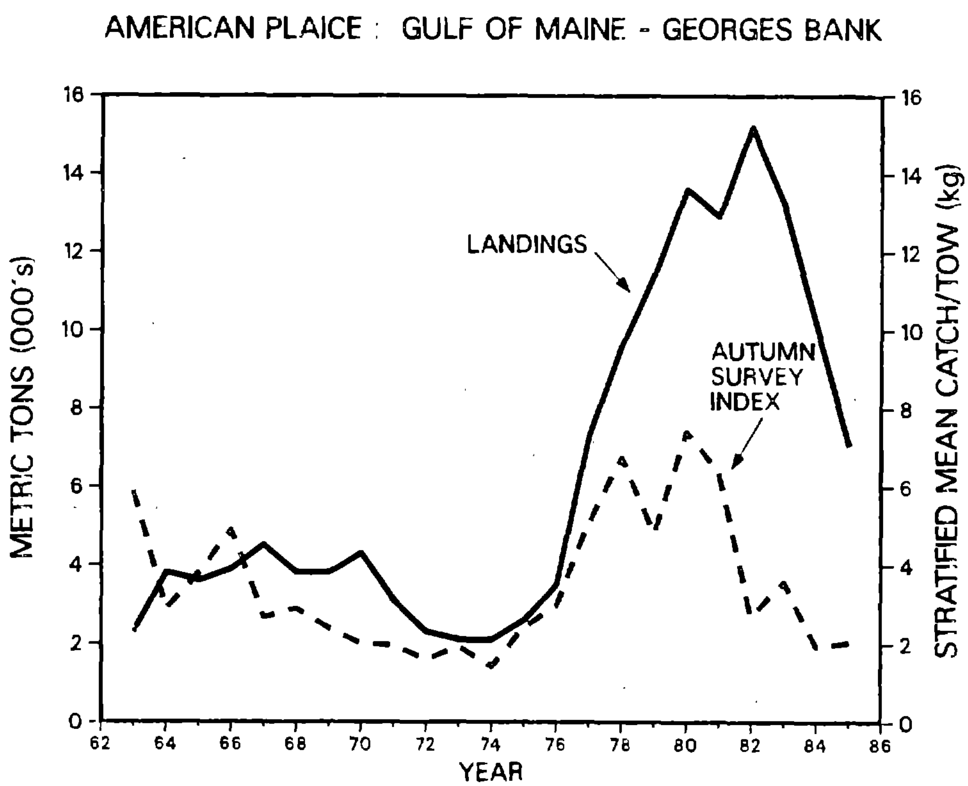


Figure 9.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of American plaice in the Gulf of Maine - Georges Bank area.

WITCH FLOUNDER

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 in habit, preferring moderately deep areas; few fish are taken shoaler than 27 m (15 fathoms) and most are caught between 110 and 275 m (60-150 fathoms). Spawning occurs in late spring and summer. Witch flounder attain lengths up to 60 cm (24 inches) and weights of approximately 2 kg (4.5 pounds).

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 1971-1972, 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 1971-1972 and subsequently declined to 1,800 mt in 1976. Nominal catches have since increased more or less continually to 6,500 mt in 1984, declining slightly to 6,100 mt in 1985.

NEFC autumn survey catches seem to accurately reflect trends in biomass Heavy exploitation by distant-water fleets in 1971-1972 was followed by a decline in the autumn index from an average of 3.6 kg/tow in 1966-1970 to 1.0 kg/tow in 1976. Abundance increased sharply in 1977-1978; subsequent indices have been lower, with the 1985 value below the long-term average. Spring 1985 catch levels were also comparable to the long-term NEFC spring survey average. There is some evidence, based on preliminary catch per unit effort indices and the declining trend in the autumn survey index to indicate that this resource is being adversely affected by current levels of exploitation. It remains questionable whether harvests of 6,000 mt or more can be sustained over the long term given historical trends.

For further information see:

Burnett, J., and S. H. Clark. 1983. Status of witch flounder in the Gulf of Maine - 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-36, 31 p.

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 10.1 Nominal catches (thousand metric tons) and management information for witch flounder from the Gulf of Maine - Georges Bank area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	2.5	3.5	3.0	3.4	3.4	4.8	5.8	6.5	6.0
Canada	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other	-	<0.1	-	-	-	-	-	-	
Total nominal catch	2.5	3.5	3.0	3.4	3.4	4.8	5.8	6.5	6.1
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = FMP in planning stage
Status of exploitation = Fully exploited
Age at 50% maturity = 5 years (males); 6-7 years (females)
Size at 50% maturity = 29 cm (11.4 inches) males
36 cm (14.2 inches) females

$M = 0.20$ $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

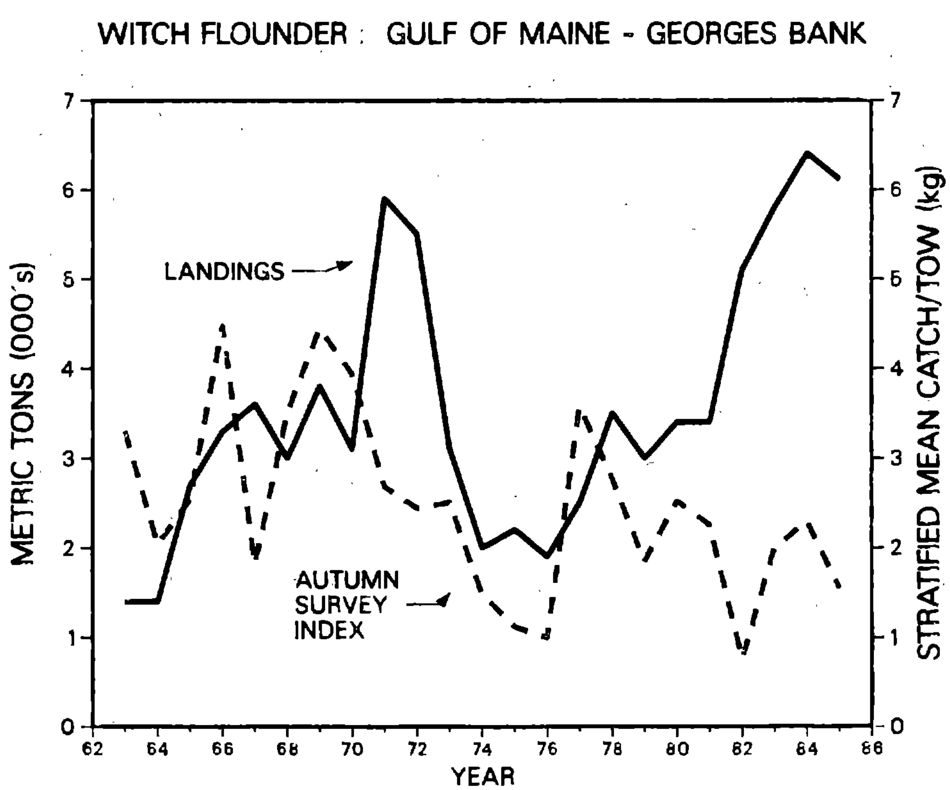


Figure 10.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of witch flounder in the Gulf of Maine - Georges Bank area.

WINTER FLOUNDER

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 inches) total length. The diet consists primarily of benthic invertebrates. Movement patterns of winter flounder are generally localized, with small-scale seasonal movements. Winter flounder migrate during winter to estuaries, embayments, and salt-water ponds to spawn and move 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 meristic and morphometric characteristics suggest that relatively discrete local groups exist.

For descriptive purposes, the winter flounder resource and fishery has been divided into four geographic groups which may comprise approximate boundaries to various local distributions: Gulf of Maine, Georges Bank, Southern New England, and Mid-Atlantic. Winter flounder are typically exploited in coastal locations, although offshore shoal areas, particularly Georges Bank and Nantucket Shoals, support important winter flounder fisheries.

Total commercial landings in 1985 were 10,900 mt, about 38% below the record high landings of around 17,500 mt in 1980-1981, 26% below the 1984 landings (14,600 mt) and the lowest since 1977. Estimates indicate a large decrease in landings from Georges Bank and decreases in landings from the Gulf of Maine, Southern New England, and Middle Atlantic areas. Total USA commercial landings increased rapidly from an average of 7,960 mt between 1972-1976 to levels comparable to the late 1960's in 1977 and 1979 (12,000 mt). The nominal catch of winter flounder by foreign vessels in 1983 was 19 mt, taken entirely by Canada. Landings by foreign vessels have been sharply reduced since the implementation of the MFCMA. The estimated recreational catch of winter flounder in 1984 was 9,900 mt, nearly equal to the 1979 high of 10,300 mt. Due to change in recreational survey methodology, however, the 1979 estimate is not directly comparable to previous estimates.

The 1985 NEFC autumn survey index (1.1 kg/tow) continued a decline relative to 1983 (2.1 kg/tow), approaching the low levels of the mid-1970's (0.9 kg/tow in 1975).

In the Gulf of Maine, commercial landings declined from a peak of 2,800 mt in 1982 to 1,600 mt in 1985. USA commercial catch per unit effort (CPUE) indices declined from peaks in 1980-1981 to historical low levels in 1985. NEFC offshore survey indices fluctuate widely, but 1985 indices are the lowest in five years.

For the Georges Bank area, 1985 commercial landings dropped to 2,100 mt, almost half those of 1983-1984 (3,900 mt), and the lowest landings level observed since 1976. CPUE indices in 1985 were the lowest observed. The NEFC autumn survey index fluctuates widely, but has trended downward from 1976-1985, from 7.1 to 1.1 kg/tow, currently the lowest index observed.

In Southern New England, commercial landings declined steadily from a peak of 11,100 mt in 1981 to 7,000 mt in 1985. Landings in 1985 still exceeded landings in any year before 1980, however. CPUE indices have declined rapidly from a peak in 1981 to historical low levels in 1985. NEFC offshore survey indices declined from local peak values in 1981 (3.6 kg/tow, spring survey) to levels below the long term average in 1984-1985 (0.8 and 1.0 kg/tow, respectively).

In the Mid-Atlantic, commercial landings are typically low. In 1984, 94 mt were landed, twice the levels landed from 1981-1984 and near the peak of 115 mt landed in 1978. CPUE cannot be calculated because most of the catch is by fyke nets, for which no effort data are available. Both spring and fall NEFC offshore survey indices have shown overall increases since lows in 1978-1979 (which followed record high commercial landings of 115 mt in 1978).

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

For further information see:

Foster, K. L., and W. L. Gabriel. 1986. Status of winter flounder (Pseudopleuronectes americanus) stocks from the Gulf of Maine to the Middle Atlantic areas. NMFS, NEFC, Woods Hole Lab. Ref. Doc. 86 - IN REVIEW.

Gabriel, W. L. and K. L. Foster. 1986. Preliminary assessment of winter flounder (Pseudopleuronectes americanus) on Georges Bank. NMFS, NEFC Woods Hole Lab. Ref. Doc. 86 - IN REVIEW.

Table 11.1 Nominal catches (thousand metric tons) and management information for winter flounder from the Gulf of Maine - Mid-Atlantic area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	10.3	7.5	8.7	8.6	7.9	9.9	-
Commercial									
USA	10.6	12.3	12.2	17.4	17.7	15.4	15.3	14.6	10.9
Canada	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other	<0.1	-	-	-	-	-	-	-	-
Total nominal catch[1]	10.6	12.4	12.2	17.4	17.4	15.4	15.3	14.7	10.9
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Major
Status of management = None
Status of exploitation = 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_{1985} = Unknown

[1] Commercial only.

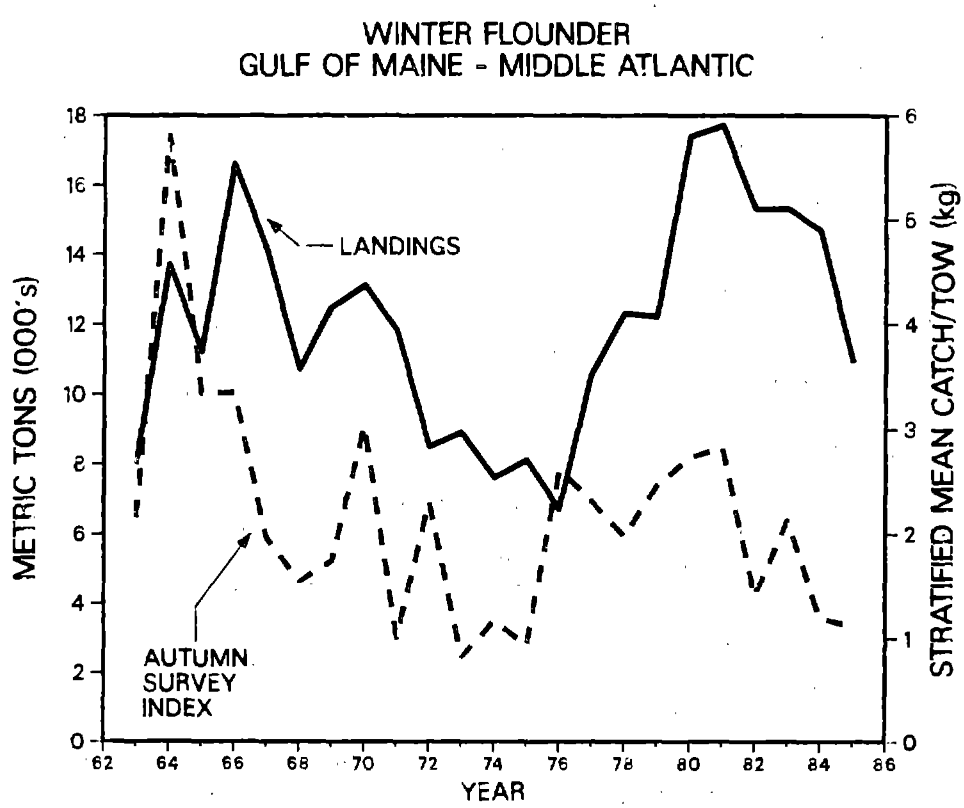


Figure 11.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of winter flounder in the Gulf of Maine - Mid-Atlantic area.

SCUP

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 (8 inches); spawning occurs during summer months. Although ages up to 20 years have been reported, recent catches have been dominated by age 2-3 fish. Scup attain a maximum length of about 40 cm (16 inches). Tagging studies have indicated the possibility of a Southern New England stock and another stock extending south from New Jersey.

Nominal commercial catches by USA vessels fluctuated between 18,000 and 22,000 mt annually during 1953-1963, but declined to 4,000-5,000 mt during the early 1970's. 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 1970's, the USA nominal commercial catch steadily increased and reached a recent peak of 9,800 mt in 1981. Since 1981, landings have decreased considerably. The 1985 landings were approximately 6,400 mt, 24% below the average for the past seven years and 10% below the 1973-1977 average. 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 had previously produced nominal catches in excess of 5,000 mt annually, has recently yielded less than 750 mt per year; the 1984 nominal catch was 700 mt. The proportion taken by the Virginia fishery has declined from 40-60% of the total prior to 1967 to less than 15% since 1973. In New Jersey, catches 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 about 1,000 mt per year, are now negligible.

Estimated recreational catches declined from 7,500 mt in 1960 to 2,800 mt in 1974. There were further declines in the estimated recreational catch in 1984 (1,800 mt) and 1985 (1,500 mt), the lowest levels since 1972. In general, the estimated recreational catch represents approximately 20-40% of the total nominal catch in those years for which comparisons are available. Assuming that recreational catches in years lacking survey estimates were in about the same proportion to commercial catches as in years when survey estimates were available, total catches (commercial and recreational) during 1974-1984 were fairly steady at around 11,000 mt per year. After increasing to about 11,800 mt between 1980-1983, total estimated catches have declined to 9,600 mt and 7,900 mt in 1984 and 1985, respectively.

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 were 5.9 mt/day in 1984 and 5.5 mt/day in 1985.

The NEFC autumn survey index (ages 1 and older) increased sharply from 1979 to the second highest value in the time series in 1981, but dropped markedly in 1982 and 1983 to some of the lowest levels observed. In 1984, the index continued to increase and rose above the long term (1967-1985) average. In recent years, stock abundance appears to have been considerably lower in the Mid-Atlantic area than in the Southern New England area.

Instantaneous fishing mortality (F) in the Southern New England area was estimated to be about 0.3 in 1981. Estimates have not been made for 1982-1984. Relative exploitation rates declined throughout the 1970's in the Southern New England area, but increased substantially in the Mid-Atlantic region. All available evidence indicates that this resource is being fully exploited, particularly in the Mid-Atlantic region.

For further information see:

Mayo, R. K., 1982. An assessment of the scup, *Stenotomus chrysops* (L.), population in the Southern New England and Mid-Atlantic regions. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 82-46, 59 p.

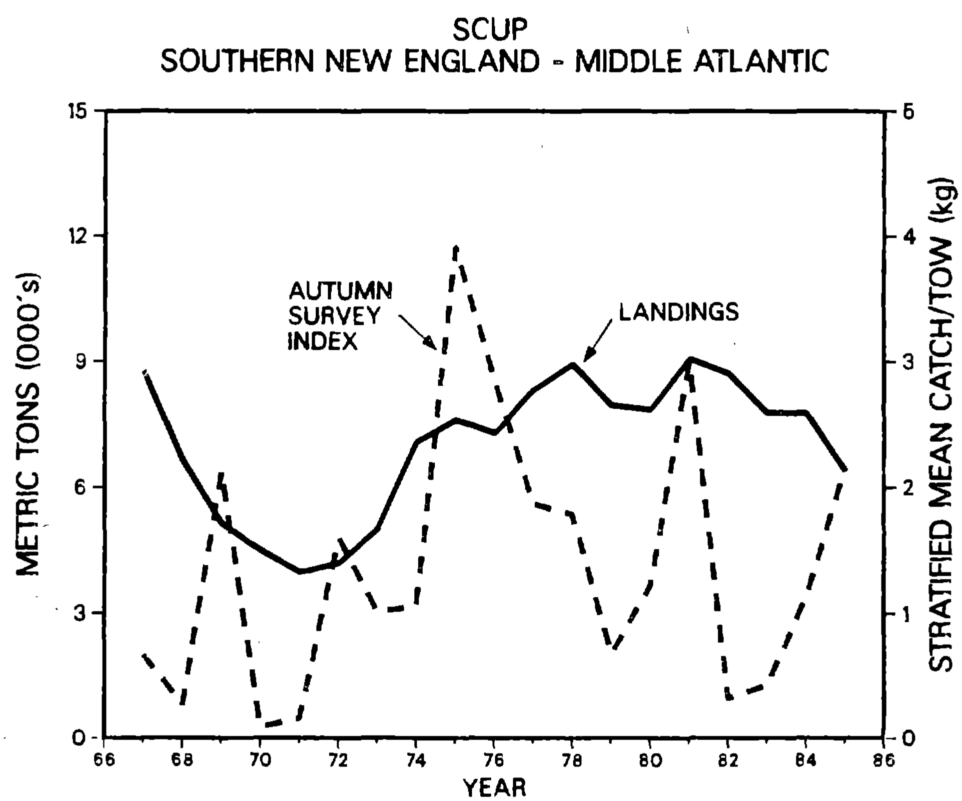
Table 12.1 Nominal catches (thousand metric tons) and management information for scup from the southern New England - Mid-Atlantic area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational[1]	2.8	2.5	2.3	3.9	2.0	3.1	3.9	1.8	1.5
Commercial									
USA	8.3	8.9	8.0	7.9	9.8	8.7	7.8	7.8	6.4
Canada	-	-	-	-	-	-	-	-	-
Other	<0.1	<0.1	-	<0.1	<0.1	-	-	<0.1	<0.1
Total nominal catch[1]	11.2	11.4	10.3	11.8	11.8	11.8	11.7	9.6	7.9
Total allowable catch	-	-	-	-	-	-	-	-	-

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_{1985} = Unknown

[1] Estimates for 1971-1973 determined by applying interpolated ratios of recreational/commercial catch between 1970 and 1974 to commercial catches; estimates for 1975-1978 determined by applying interpolated ratios between 1974 and 1979 to commercial catches.



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

OCEAN POUT

The ocean pout (Macrozoarces americanus) is a demersal eel-like species ranging from Labrador to Delaware which 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 metric tons in 1943. However, an outbreak of a protozoan parasite which 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 to 1300 mt in 1984 largely due to the development of a small directed fishery in Cape Cod Bay supplying the fresh fillet market. In 1985, USA landings increased to 1,500 mt, 14% greater than in 1984, and the highest domestic catch since 1974. The 1985 areal landings patterns differed markedly from 1984. In 1985, landings from Cape Cod Bay and Southern New England each accounted for 46% of the USA total, whereas in 1984 Cape Cod Bay landings dominated the USA catch (72% of total) while Southern New England landings comprised only 21% of the 1984 total. Catches of ocean pout are taken primarily during the winter and spring (December-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, respecively, by 1975. Since 1975, relative abundance has steadily increased. Above-average recruitment appears to have occurred in 1978, 1980, and 1981, and the average weight of an ocean pout caught in NEFC spring surveys has increased from 0.29 kg in 1978 to 0.72 kg in 1985. With relative abundance near an historic high level, it would appear that catches of 3,000-4,000 mt are sustainable for the next several years.

For further information see:

Olsen, Y. H., and Merriman, D. 1946. Studies on 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. MS. Thesis. Kingston, RI: Univ. Rhode Island.

Table 13.1 Nominal catches (thousand metric tons) and management information for ocean pout from middle Atlantic - southern New England area, 1977-1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.0	1.0	0.7	0.4	0.3	0.3	0.4	1.3	1.5
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	1.0	1.0	0.7	0.4	0.3	0.3	0.4	1.3	1.5
Total allowable catch	-	-	-	-	-	-	-	-	-

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

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

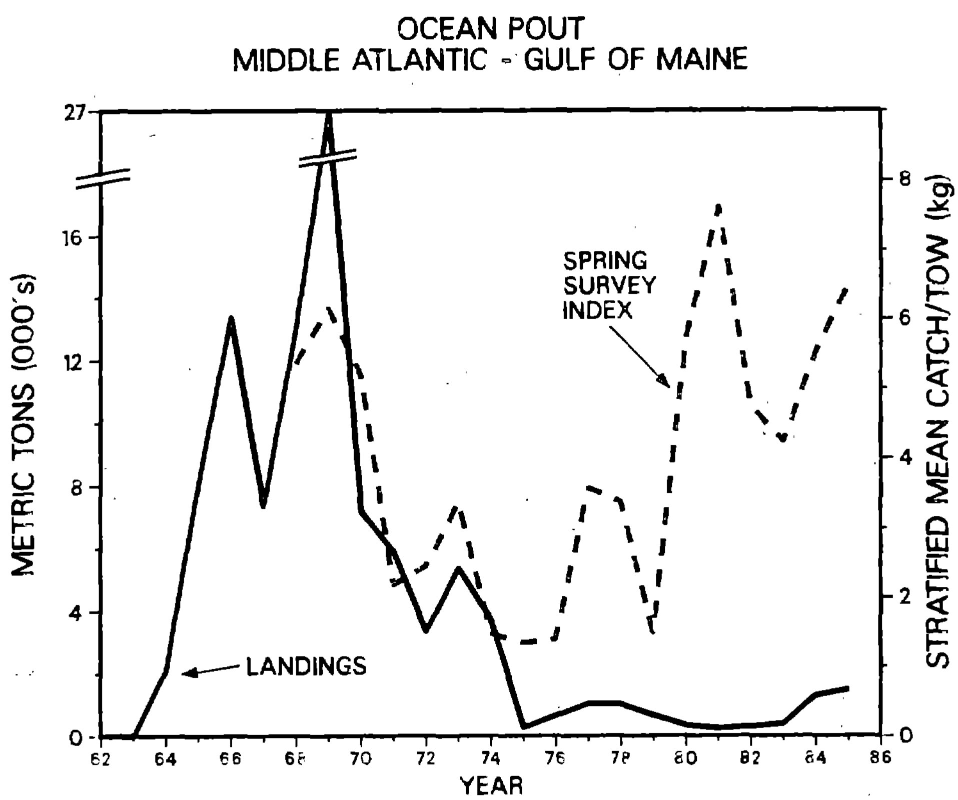


Figure 13.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of ocean pout in the Mid-Atlantic - Gulf of Maine area.

WHITE HAKE

The white hake (*Urophycis tenuis*) is a boreal species which is common on muddy bottom throughout the Gulf of Maine. Stock boundaries are uncertain, although research vessel survey data indicate the Gulf of Maine population to be 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.

Much remains to be learned about the biology of this species. In the Gulf of Maine region, spawning occurs in winter and spring although the season is not clearly defined. Little is known about growth or maturation rates. White hake attain total lengths of 135 cm (53 inches) and weights of up to 21 kg (46 pounds) 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 averaged 4,500 mt during 1971-1980, but has since increased steadily to over 7,300 mt in 1984 and 1985. This increase appears to reflect both a general increase in incidental catches associated with recent increases in size and total fishing power of the New England otter trawl fleet as well as an increase in directed effort. Recreational catches for this species have been negligible. Small individuals are difficult to distinguish from red hake (*Urophycis chuss*), resulting in an unknown degree of bias in reported nominal catches.

During the 1970's, the NEFC autumn survey index fluctuated without a definite trend, although values have declined somewhat in more recent years. NEFC spring survey catches have also declined sharply since 1981. These results, together with recent increases in nominal catch, indicate declining abundance and increased fishing mortality in recent years. It appears unlikely that current harvest levels (of 7,000 tons or more) will be sustainable over the long term.

For further information see:

Burnett, J., S. H. Clark, and L. O'Brien. 1984. A preliminary assessment of white hake in the Gulf of Maine - Georges Bank area. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-31, 33 p.

NEFC. 1986. Report of the Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 14.1 Nominal catches (thousand metric tons) and managment information for white hake from the Gulf of Maine - Georges Bank area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial									
USA	5.3	5.1	4.1	4.8	5.7	6.0	6.2	6.5	6.4
Canada	0.2	0.2	0.3	0.3	0.5	0.8	0.8	1.0	0.9
Other	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total nominal catch	5.7	5.3	4.4	5.1	6.2	6.8	7.0	7.5	7.3
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = 5,000 mt
Importance of recreational fishery = Insignificant
Status of management = None
Status of exploitation = 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_{1985} = Unknown

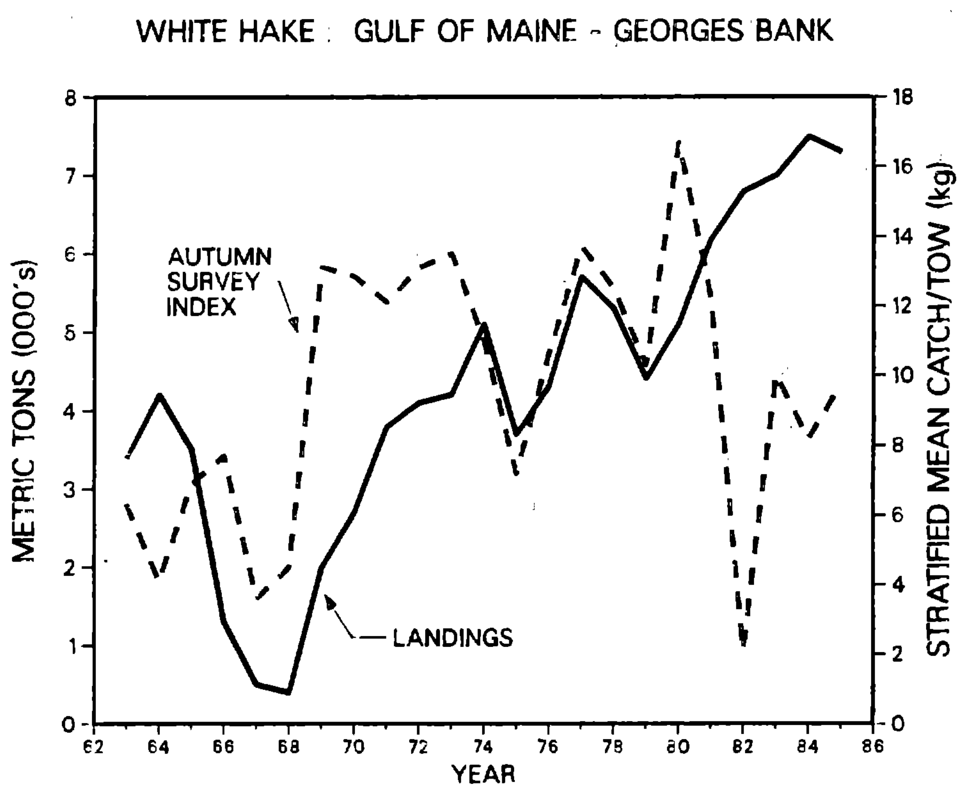


Figure 14.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of white hake in the Gulf of Maine - Georges Bank area.

CUSK

The cusk (Brosme brosme) is a deepwater species which 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 inches) in length where they become sedentary and rather solitary in habit. Individuals commonly attain lengths up to 80 cm (32 inches) and weights up to 4.5 kg (20 pounds). Little is known about stock structure.

During 1973-1985, 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 2,200 mt per year. In this period, 72% 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 (71% of the 1973 - 1985 total) while nearly all of the Canadian catch has been from Georges Bank.

In 1985, cusk landings totaled 2,600 mt, 21% greater than in 1984. The 1985 USA catch (2,300 mt) was the highest since 1940 and accounted for 89% of the total yield. Canadian landings in 1985 were 300 mt, 38% less in 1984, and the lowest since 1977. The increase in total landings in 1985 was almost exclusively due to emerging USA offshore auto-longline fishery. Longline landings of cusk increased from 13 mt in 1984 to 600 mt in 1985. Historically, otter trawls have accounted for between 50-87% of annual USA catches; in 1985, otter trawls accounted for 67% of the USA total (the lowest since 1978) while longline catches accounted for 26%.

NEFC spring and autumn survey indices have fluctuated considerably. Since 1982, the autumn indices have increased with the autumn 1985 value comparable to the long-term average. The spring 1985 index, which had been declining since 1981, increased sharply and was the third highest in the survey time series.

For further information see:

Bigelow, H.B., and W.C. Schroeder, 1953. Fishes of the Gulf of Maine. Fish Bull., U.S., 53(74):1-577.

Table 15.1 Nominal catches (thousand metric tons) and management information for cusk from the Gulf of Maine - Georges Bank area, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Commercial									
USA	1.2	1.5	1.7	1.8	1.9	1.8	1.8	1.7	2.3
Canada	0.2	0.4	0.5	0.6	2.1	1.2	0.6	0.5	0.3
Other	-	-	-	-	-	-	-	-	-
Total nominal catch[1]	1.4	1.9	2.2	2.4	4.0	3.0	2.4	2.2	2.6
Total allowable catch	-	-	-	-	-	-	-	-	-

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

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

[1] Commercial landings only.

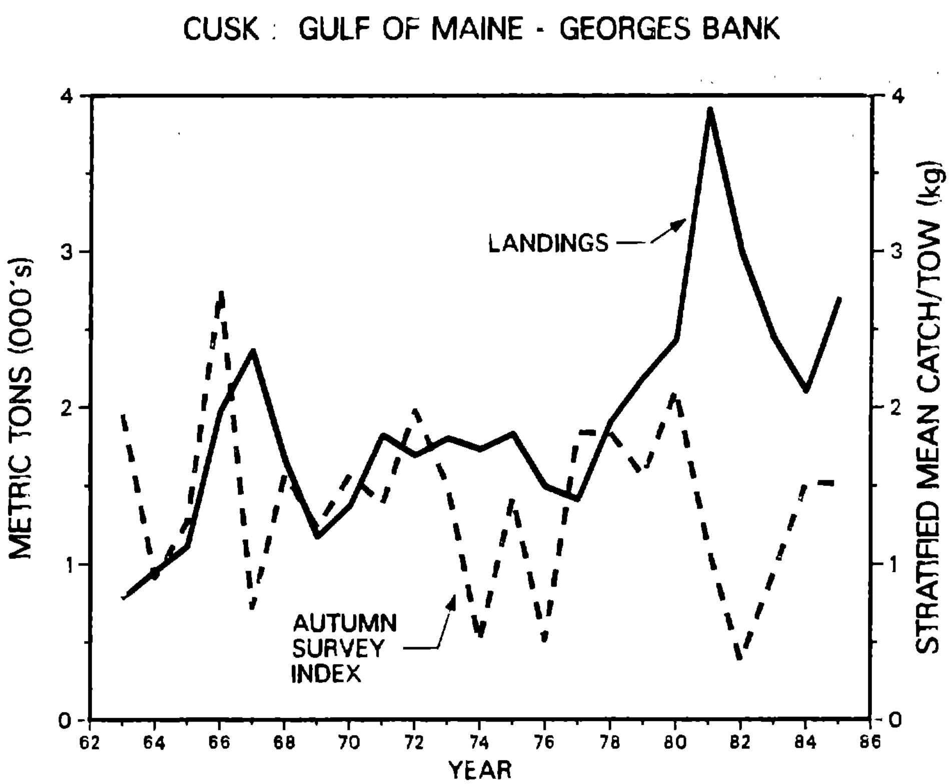


Figure 15.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of cusk in the Gulf of Maine - Georges Bank area.

ATLANTIC WOLFFISH

The wolffish or catfish (Anarhichas lupus) is a coldwater species of relatively minor importance in Gulf of Maine fisheries. NEFC 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 80-120 m (45-65 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 inches) and weights of perhaps 18 kg (40 pounds). 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 nearly 1,200 mt in 1983-1985. The NEFC spring survey index has fluctuated considerably while exhibiting a downward trend in recent years, as has the corresponding autumn survey index.

For further information see:

Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fish. Bull., U.S., 53(74):1-577.

Table 16.1 Nominal catches (thousand metric tons) and management information for Atlantic wolffish from the Gulf of Maine - Georges Bank area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial									
USA	0.4	0.6	0.7	0.9	0.7	0.9	1.2	1.1	1.0
Canada	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	0.5	0.8	0.8	1.0	0.8	1.1	1.3	1.1	1.1
Total allowable catch	-	-	-	-	-	-	-	-	-

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

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

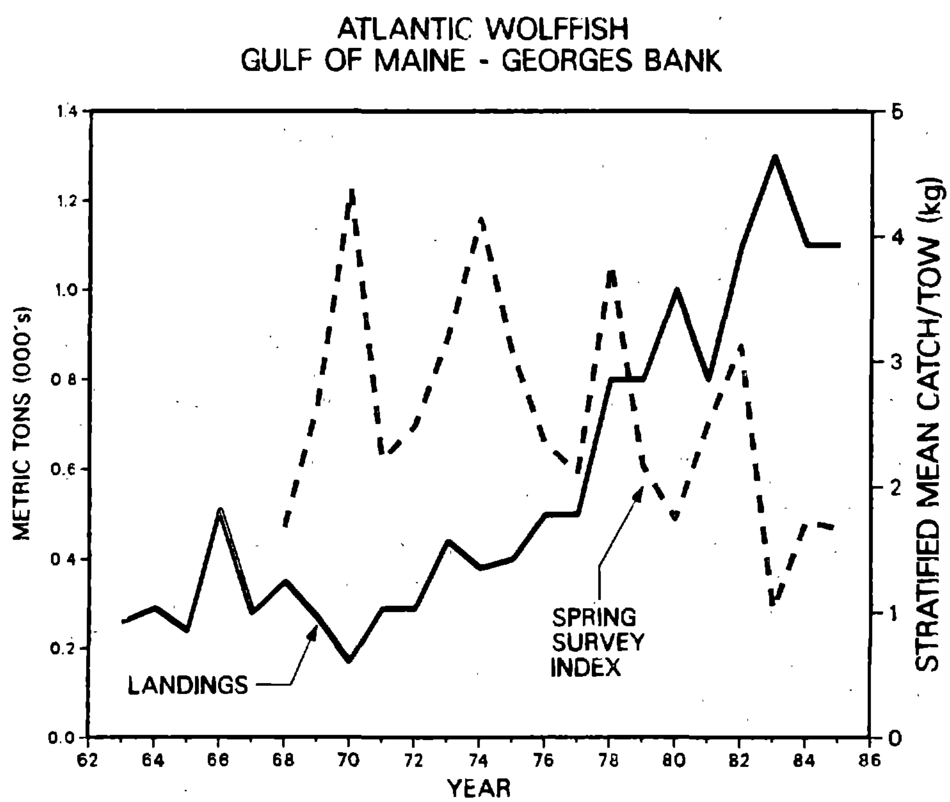


Figure 16.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of Atlantic wolffish in the Gulf of Maine - Georges Bank area.

TILEFISH

Tilefish (Lopholatilus chamaeleonticeps) are found along the outer continental shelf from Nova Scotia to South America. They are relatively abundant in the Southern New England - Mid-Atlantic area, occurring at depths of 80-440 m (44-240 fathoms), and are generally found in and around the submarine canyons where they occupy burrows in the substrate. Tilefish are relatively slow growing and long-lived, with a maximum observed fork length in excess of 110 cm (43 inches) and a maximum observed age of 33 years. Sexual maturity is completed by about age 6 for females and age 9 for males.

Nominal catches were first recorded in 1915 (148 mt); 4,500 mt were taken in 1916 (the largest annual catch to date), but only 5 mt were reported in 1920. The fishery has since undergone several cycles with catches increasing to a peak and then declining. Most recently, USA catches increased from about 30 mt in 1968-1969 to 3,800 mt in 1979. Catches declined steadily to about 3,400 mt in 1981 and to approximately 1,800 mt in 1983, with a slight increase to around 1,900 mt in 1984 and 1985.

Longlines were the predominant gear used by the USA fishery until the early 1940's. Bottom trawls were the most commonly used gear from then until the early 1970's, after which longlines were again predominant. Since 1972, New Jersey has averaged about 70% of the annual catch, followed by New York and Rhode Island.

A recreational fishery for tilefish developed in the Mid-Atlantic area in the late 1960's. Annual catches apparently reached no higher than about 100 mt (1974) and have been insignificant since the mid-1970's.

Reported catches of tilefish by distant-water fleets have been small, with the highest being about 150 mt in 1978. However, unreported catches prior to MFCMA may have reached 300 mt annually.

Fishing effort on tilefish by USA longliners has increased substantially since the early 1970's. The number of active vessels from New Jersey and New York increased from five in 1973 to 31 in 1979 and then declined to 25 in 1981-1984. Fishing effort, expressed as standardized tubs of longline (1 tub = 225 hooks and 0.5 mile of line), increased from 2,300 tubs in 1973 to an estimated 44,600 tubs in 1979 and has remained at about that level since. Catch per unit effort (CPUE) decreased from 218.5 kg/tub in 1973 to 46.7 kg/tub in 1983. Estimates of fishing effort and CPUE have not been analyzed subsequent to 1983, but are not thought to have changed much since that year. In the last several years, the fishery has only been conducted during winter and spring, with the participating vessels switching to swordfish and tuna during summer and autumn. In recent years there has also been a shift to a more efficient type of longline gear, which may have resulted in a slight increase in effective fishing effort.

Estimates of fishing mortality (F) derived from virtual population analysis increased from 0.20 (mean F at ages 7 and older) in 1977 to 0.74 in 1981 (M = 0.15), with a slight decrease to 0.65 in 1982. Since fishing effort in 1983 was about the same as in 1982, F in 1983 probably remained at about 0.65. F since 1984 is unknown, but probably similar to that estimated for

1982 and 1983. Yield-per-recruit analysis based on an age at first capture of four years produced an estimate of $F_{0.1}$ = 0.17 and F_{max} = 0.27.

Long-term potential catch for tilefish was estimated from a generalized stock production model to be about 2,400 mt. Fishing effort to obtain this catch was estimated to be approximately 30,700 tubs or about 75% of the effort in 1982-1983.

Available data and analyses indicate clearly that tilefish have been overexploited in recent years. Total catches during 1977-1981 exceeded the long-term potential catch by as much as 60% (1979). Fishing effort during 1979 and subsequent years exceeded the corresponding fishing effort level by as much as 45% (1979). Estimated fishing mortality in 1981 exceeded the $F_{0.1}$ and F_{max} levels by 335% and 174%, respectively. The rapidly declining catch rate and particularly the sharp drop in catch from 1981 to 1982 indicates that stock abundance decreased substantially in response to the excessive levels of fishing mortality exerted since the late 1970's. Average size of fish caught also declined during this time and continued to remain low in 1985. This stock continues to be overexploited.

For further information see:

Turner, S. C., C. B. Grimes, and K. W. Able. 1983. Report to Mid-Atlantic Fishery Management Council on Rutgers University preliminary tilefish stock assessment.

Turner, S. C., E. D. Anderson, and S. J. Wilk. 1981. A preliminary analysis of the status of the tilefish population in the Southern New England - Middle Atlantic region. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 81-03, 18 p.

Table 17.1 Nominal catches (thousand metric tons) and management information for tilefish from the Georges Bank - Mid-Atlantic area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial									
USA	2.1	3.4	3.8	3.7	3.4	2.0	1.8	1.9	1.9
Canada	-	-	-	-	-	-	-	-	-
Other	0.3	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total nominal catch	2.4	3.6	3.9	3.7	3.4	2.0	1.8	1.9	1.9
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = 2,400 mt
Importance of recreational fishery = Insignificant
Status of management = FMP in preparation
Status of exploitation = Overexploited
Age at 50% maturity = 5 years (females); 8 years (males)
Size at 50% maturity = 55 cm (21.6 inches) females
65 cm (25.6 inches) males

$M = 0.15$ $F_{0.1} = 0.17$ $F_{max} = 0.27$ F_{1985} = Unknown

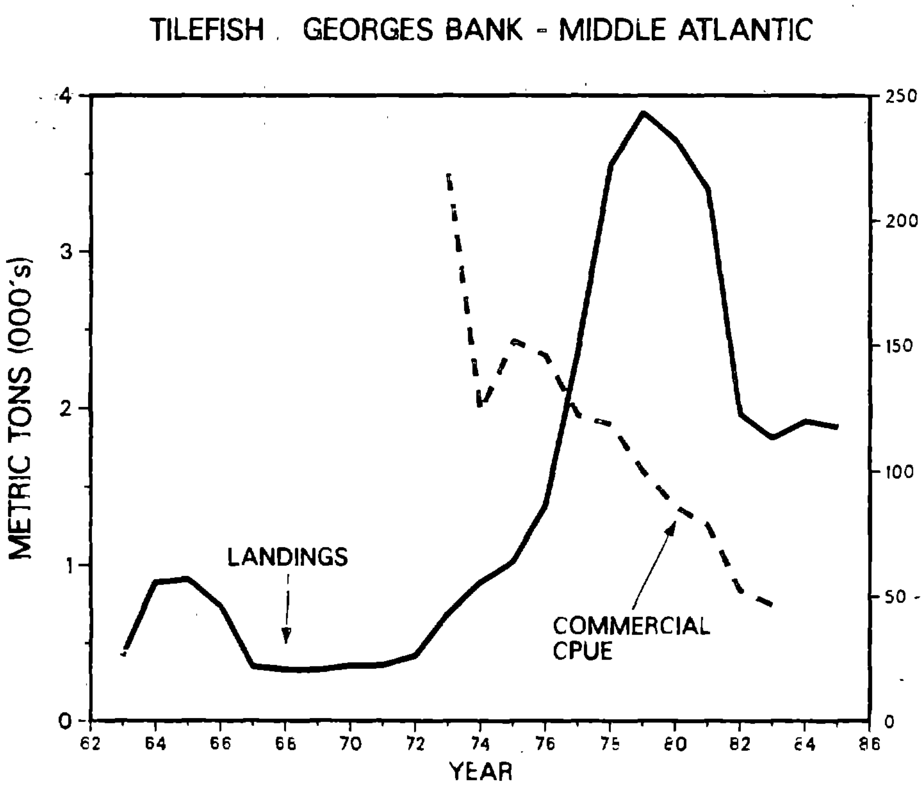


Figure 17.1 Total commercial landings and catch per unit effort of tilefish in the Georges Bank - Mid-Atlantic area.

ATLANTIC HERRING

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. The Georges Bank stock collapsed during 1976-1977. 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 27,800 mt from 1982 to 1985, an average decline of 55%. 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 this period remained below average. Nominal catches increased to an average of 45,000 mt during 1979-1981 with recruitment of a succession of strong year classes (1976, 1977, 1979). The 1981 yield of 48,200 mt was the highest since 1963. The 1985 nominal catch was 13,900 mt, a 29% decline relative to the 1984 level of 19,500 mt. The reduction noted during recent years 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 and 1985 NEFC autumn survey index, however, indicated a slight recovery relative to 1982-83 levels. A larval herring sampling program conducted by the State of Maine indicated that the 1984 year class, which will be fully recruited to the inshore fishery in 1986, may be relatively weak (Graham and Sherman, 1986). Thus, prospects for recovery of the fishery in 1986 do not appear to be strong.

The 1985 nominal catch of 11,900 mt in the western Gulf of Maine mobile gear fishery[1] represented a slight decline relative to the 1984 level and remained well below the 1975-80 mean level of 22,900 mt. The fishery was primarily dependent on the 1979-82 year classes during 1985. 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 257,000 mt during 1965-1970 before declining to an estimated 146,000 mt in 1971. Stock biomass remained fairly constant during 1971-1978 at about 150,000 mt per year. After increasing to 213,000 mt in 1979, stock biomass declined steadily to an estimated 134,000 mt in 1982, the lowest level yet observed.

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 larval surveys and bottom trawl surveys conducted during 1984. Prospects for redevelopment of the fishery are currently unknown.

For further information see:

Fogarty, M.J., and S.H. Clark. 1983. Status of herring stocks in the Gulf of Maine region for 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-46, 33 p.

Graham, J.J. and K. Sherman. 1986. Evaluation of the Strength of the 1984 Larval Year Class of Herring, Clupea harengus, Along Coastal Maine. Res. Ref. Doc. 86/1. Maine Dept. Mar. Res. Fish. Res. Lab. Boothbay Harbor, ME 04575.

[1] Includes offshore Maine and southern New England landings.

Table 18.1 Nominal catches (thousand metric tons) and management information for Atlantic herring from the Gulf of Maine (coastal Maine the western Gulf of Maine), 1977 - 1985.

Category	1977	1978	1979[1]	1980	1981	1982	1983[2]	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	50.2	48.4	63.7	82.1	63.6	31.7	22.5	31.1	25.8
Canada	0.9	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch[1]	51.1	48.4	63.7	82.1	63.6	31.7	22.5	31.1	25.8
Total allowable catch[1,2]	16.0	7.0	7.0	8.0	12.0	12.0	12.0	-	-

Long-term potential catch = 20,000 mt
Importance of recreational fishery = Insignificant
Status of management = FMP withdrawn in 1982
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 $F_{1985} = 0.40$

[1] Age groups 1 and older.

[2] Age groups 3 and older.

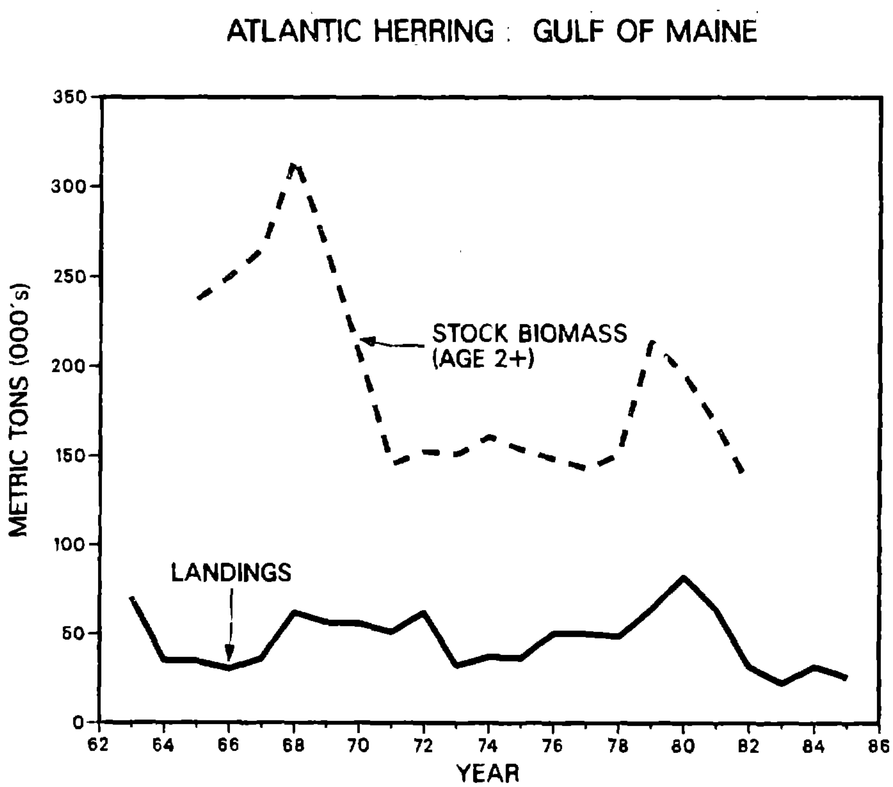


Figure 18.1 Total commercial landings and estimates of stock biomass of Atlantic herring in the Gulf of Maine.

Table 18.2 Nominal catches (thousand metric tons) and management information for Atlantic herring from the Georges Bank area[1], 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.7	0.4	2.1	1.1	1.7	0.7	1.0	1.6	0.2
Canada	-	-	-	-	-	-	-	-	-
Other	42.8	1.8	-	-	-	-	-	-	-
Total nominal catch	43.5	2.2	2.1	1.1	1.7	0.7	1.0	1.6	0.2
Total allowable catch	60.0	33.0	8.0	15.0	15.0	15.0	-	-	-

Long-term potential catch = 100,000 mt
Imporance of recreational fishery = Insignificant
Status of management = FMP withdrawn in 1982
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 $F_{1985} = <0.01$

1 Includes landings for the southern New England area.

ATLANTIC MACKEREL

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-May and a northern group which spawns in the Gulf of St. Lawrence in June-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 inches (fork length) and 1.3 kg (3 pounds) in weight. Sexual maturity begins at age 2 and is usually complete by age 3. Maximum age is about 20 years.

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

Mackerel in the northwest Atlantic were managed by nationally-allocated catch quotas during 1973-1977 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 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. Catches remained fairly stable during 1978-1984, averaging 33,000 mt annually, and were taken largely by Canadian and USA fishermen. The increase in 1984 was due primarily to joint ventures in USA waters. The recent fishery is in sharp contrast to the intensive fishery conducted during during 1968-1977 by vessels from 13-14 nations when reported catches peaked at 430,400 mt in 1973.

The USA accounted for 12% of the 1984 international catch, including about 6,600 mt of commercial and an estimated 1,500 mt of recreational catch. The Canadian catch increased from 17,000 mt in 1984 to 29,800 mt in 1985, 42% of the total. The distant-water-fleet catch increased from about 6,000 mt in 1983 to 32,200 mt in 1985. About 6,200 mt of the 1985 catch was taken by Poland in a research fishery with the NEFC.

Fish from the 1982 (age 2) and 1981 (age 3) year classes comprised 43% and 28% respectively of the distant-water catch in numbers in 1984. The 1974 year class (age 10) with 8% and the 1978 year class (age 6) with 5% were also important. A January-April 1985 Polish research catch of about 6,200 mt was comprised mainly of the 1982 (81%) and 1981 (10%) year classes.

The catch-per-tow indices for mackerel from the NEFC spring bottom trawl surveys increased from 1984 to 0.89 kg/tow in 1985, the second highest value in the series.

Fishing mortality (F) at ages 3 and older in 1984 was estimated to be 0.07; natural mortality (M) = 0.20. Separable virtual population analysis was used to estimate the exploitation pattern (proportion of F at age relative to the mean F at ages 3 and older) for the fishery in 1983. Results of this analysis indicated a dome-shaped pattern increasing from 2% at age 1 to 268% at age 9 and decreasing to 50% at age 13. This general pattern has been evident since 1978. Results from virtual population analyis indicate that mean F at ages 3 and older increased from 0.06 in 1962-1964 to a high of 0.59 in 1976 and then dropped to an average of 0.08 during 1978-1982 and to 0.06 in 1983. $F_{0.1}$ for mackerel under the current pattern of exploitation in the fishery is 0.29.

The 1975-1979 year classes were all weak. Year classes beginning with the 1980 cohort 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 cohort also appears to be relatively strong.

Total stock biomass (ages 1 and older) increased from around 300,000 mt in 1962-1965 to 1.9 million mt in 1970-1971 before dropping to a stable low level during 1977-1981 wich averaged 485,000 mt per year (Figure 29). The total stock increased to about 1,500,000 mt at the beginning of 1985. Spawning stock biomass (50% of age 2 fish and 100% of ages 3 and older) increased from about 400,000 mt in 1981 to an estimated 1.2 million mt at the start of 1985.

Rebuilding of the mackerel stock has been aided by relatively low catches during 1977-1985 (average of 42,300 mt) as well as markedly improved recruitment from the 1980-1982 and 1984 year classes. In addition, higher mean weights at age in recent years resulting from improved growth rates have also influenced the upward trend in stock biomass. Projections indicate that the catch in 1986 can be increased substantially without adversely affecting the spawning stock biomass. Management measures recommended by the Mid-Atlantic Fishery Management Council for the 1 April 1985 - 31 March 1986 fishing year include an OY (USA waters only) of 225,300 mt, a DAH of 123,200 mt, and a TALFF of 102,100 mt. These recommendations are based on a projected catch of roughly 300,000 mt for the total international mackerel fishery in the Northwest Atlantic resulting from fishing mortality at $F_{0.1}$ = 0.29.

For further information see:

Anderson, E.D. 1984. Status of the Northwest Atlantic mackerel stock - 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 85-03, 46 p.

Overholtz, W.J., and B.L. Parry. 1985. Update of the status of the Northwest Atlantic Mackerel Stock for 1985. NMFS, NEFC, Woods Hole Lab. Ref. Doc. 85-13, 16 p.

NEFC. Report of the Second NEFC Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 19.1 Nominal catches (thousand metric tons) and management information for Atlantic mackerel from Labrador to North Carolina, 1977 - 1985.

	Year								
Category	1977	1978	1979[1]	1980	1981	1982	1983[2]	1984[3]	1985
USA recreational	0.5	6.6	3.7	2.4	5.1	1.1	3.0	3.0	1.5
Commercial									
USA	1.4	1.6	2.0	2.7	2.9	3.3	3.8	4.4	6.6
Canada	20.4	25.4	30.2	22.1	19.3	16.4	19.8	17.0	29.8
Other	56.1	0.8	0.4	0.6	5.4	6.6	6.0	15.0	33.2
Total nominal catch	78.9	34.4	36.4	27.8	32.6	27.5	32.6	39.4	71.1
Total allowable catch[1,2]	105.0	15.5	15.5	30.0	30.0	30.0	101.7	87.0	196.5[4]

Long-term potential catch = 134,000[3] mt
Importance of recreational fishery = Moderate
Status of management = FMP in force since 1979
Status of exploitation = Underexploited
Age at 50% maturity = 2 years
Size at 50% maturity = 32.7 cm (12.9 inches) fork length

$M = 0.20$ $F_{0.1} = 0.29$ $F_{max} = 0.62$ $F_{1985} = 0.05$

1 Fishery Conservation Zone only for 1978 and later.
2 1 April - 31 March fishing year for 1980 and later.
3 Assuming constant recruitment at level of geometric mean of 1961-1984 year classes and fishing mortality at $F_{0.1}$.
4 Fishery Managment Plan (FMP) for squid, mackerel and butterfish has changed from the traditional fishing year to the Calendar Year.

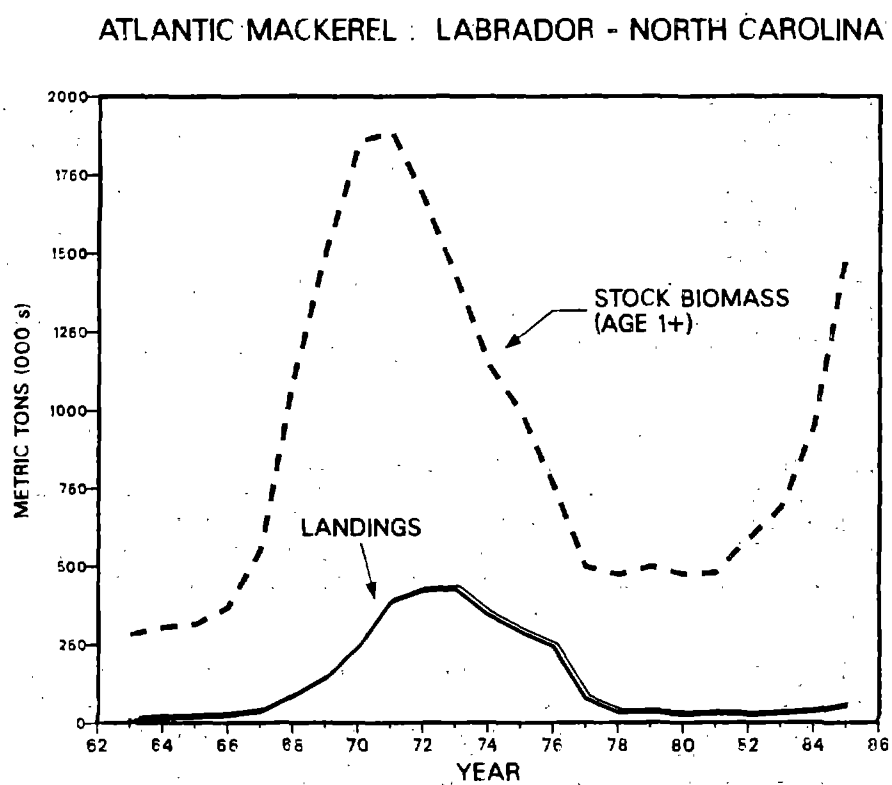


Figure 19.1 Total commercial and recreational landings and estimates of stock biomass of Atlantic mackerel in the Labrador-North Carolina area.

BUTTERFISH

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 58% from 12,200 mt in 1984 to 5,100 mt in 1985. 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 declined from a record high of 11,800 mt in 1984 to 4,700 mt in 1985. The decline primarily reflected a reduced export market for "super small" butterfish, and decreased availability of large butterfish. The DWF nominal catch declined from 400 mt in 1984 and in 1985, representing a continued decline in DWF catches.

Discard rates of small butterfish continued to be relatively high (30 - 80% by weight of the landed catch) as new freezer-trawlers and some otter trawlers equipped with size-sorting machines continue to fish in areas of high abundance of small butterfish. These machines select marketable fish and discard sub-marketable fish at sea, thus allowing vessels to make a profitable trip.

Butterfish are managed under the provisions of the Fishery Management Plan (FMP) for the Atlantic Mackerel, Squid, and Butterfish Fisheries, developed by the Mid-Atlantic Fishery Management Council (MAFMC). The FMP currently allows an annual butterfish catch (USA and foreign combined) of up to 16,000 mt, which is based on an estimate of the maximum sustainable yield (MSY) for this species. The allowable domestic harvest is less than or equal to 16,000 mt, minus the DWF by-catch Total Allowable Level of Foreign Fishery (TALFF). The TALFF equals 6% of the allocated portion of the Loligo. TALFF and 1% of the allocated portions of the Illex, mackerel, silver hake and red hake TALFF's.

The catch-per-tow index (all ages) from the NEFC 1985 autumn bottom trawl survey (15.2 kg/tow) increased 33% from 1984. Likewise, the recruitment index (286.3 age 0 fish/tow) and the age 1^+ index (100.4 age one and older fish/tow) from the 1985 autumn survey increased 6.7% and 7.5%, respectively, above 1984 values. Additionally, the age 1^+ index is a record high value for the 18-year (1968-1985) time series. Age 1, 2, 3, and 4 fish accounted for 85%, 12%, 2%, and 1%, respectively, of this index.

The 1985 autumn survey values represent the sixth year in the past seven years that abundance indices were greater than values observed during 1973-1976 when nominal catches from the international fishery were high (11,200 - 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 FMP. However, the length composition of all age 0 and 61% of the age 1 butterfish taken in the autumn 1985 survey were below marketable size. Therefore, discard rates during 1986 will probably continue to be high under current fishing practices. Since butterfish have a short life span and a relatively high natural mortality rate ($M = 0.8$), delaying the age of first harvest from age 0 to an older age does not lead to higher yields, as would be the case for longer-lived species with lower natural mortlaity rates. One benefit from delaying capture would be that a larger fish would probably command a higher price per pound to the fishermen. However, if fishing mortality were reduced on age 0 fish and undersize age 1 fish, stock biomass, on average, would increase by at least 25%. An increased stock will improve spawning potential, hopefully ensure a higher probability of producing good recruitment, and provide a buffer to help support the fishery in the event of poor recruitment.

For further information see:

Waring, G.T. 1986. An analysis of spatial difference in size composition and abundance of butterfish, Perprilus triacanthus, off the Northeast United States. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-04, 23 p.

Waring, G.T., and E.D. Anderson, 1983. Status of the Northwestern Atlantic butterfish stock - 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-41, 39 p.

NEFC. 1986. Report of the Second NEFC Status of Stocks Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 20.1 Nominal catches (thousand metric tons) and management information for butterfish from the Gulf of Maine - Mid-Altantic area, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
	Year								
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.4	3.7	2.8	5.4	4.9	9.1	4.9	11.8	4.7
Canada	-	-	-	-	-	-	-	-	-
Other	3.2	1.3	0.8	0.9	0.9	0.8	0.6	0.4	0.4
Total nominal catch	4.7	5.0	3.7	6.3	5.8	9.7	5.5	12.3	5.1
Total allowable catch	18.0	18.0	18.0	11.0[1]	11.0[1]	11.0[1]	11.0[1]	≤16.0[1]	≤16.0[1]

Long-term potential catch = 16,000 mt
Importance of recreational fishery = Insignificant
Status of management = FMP in force since 1979
Status of exploitation = Becoming fully 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_{1985} = Unknown

[1] For 1 April - 31 March fishing year.

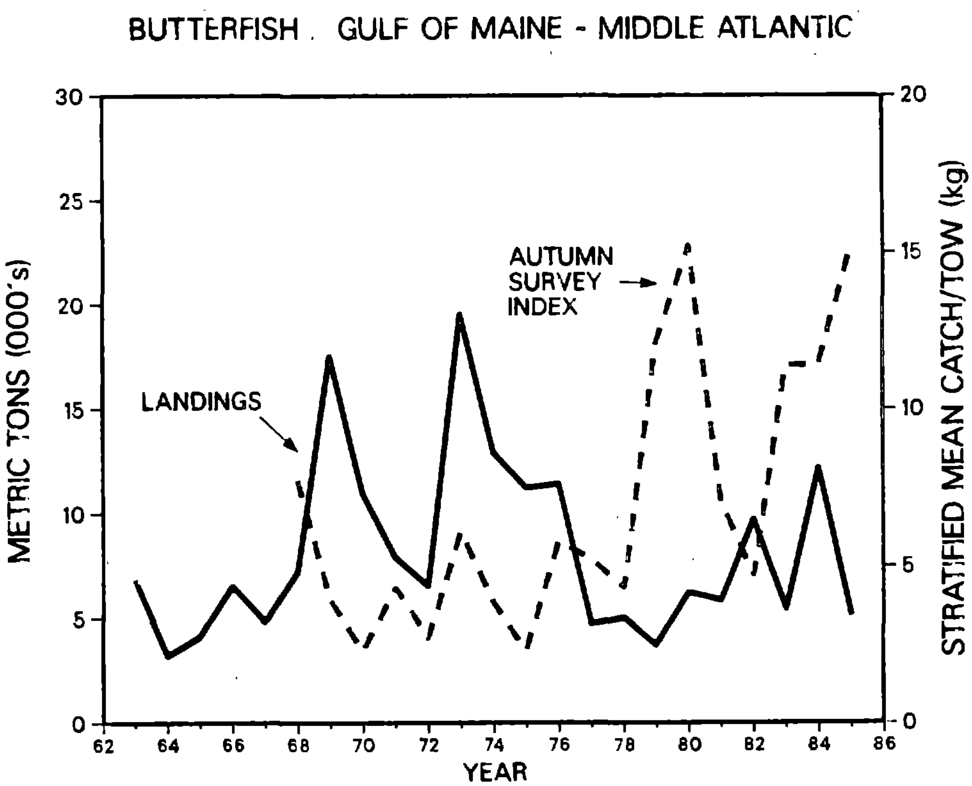


Figure 20.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of butterfish in the Gulf of Maine - Mid-Atlantic area.

BLUEFISH

The bluefish (*Pomatomus saltatrix*) is a migratory, pelagic species found throughout the world in most temperate and warm temperate coastal regions, except the eastern Pacific. Along the Atlantic coast, bluefish are found from Nova Scotia to Texas, moving northward in the spring and southward in the autumn and winter. Based on various studies, two and possibly more distinct stocks exist along the Atlantic coast. Bluefish are ferocious predators that feed on a wide variety of fish and invertebrates. They may reach ages of about 15 years and sizes in excess of 100 cm (30 inches) in length and 14 kg (31 pounds) in weight.

The bluefish has become perhaps the most important species to the marine recreational fishery along the Atlantic coast of the USA in recent years. Total nominal catches of bluefish (commercial and recreational) from Maine to Florida increased from about 24,200 mt in 1960 to about 71,900 mt in 1983. During this period, recreational landings averaged about 90% of the total nominal catch. USA commercial catches steadily increased from 1,300 mt in 1960 to 7,300 mt in 1983, with over 50% of the 1973-1983 catch coming from the Mid-Atlantic region (New Jersey - Cape Hatteras).

The stratified mean number of bluefish per tow in the NEFC autumn inshore survey from Cape May to Cape Cod is used as an index of recruitment. Over 90% of the bluefish caught in this survey are age 0 (<30 cm in length). The index rose abruptly between 1974 and 1977 and has since fluctuated between 10 and 20 fish/tow.

For further information see:

Boreman, J. 1983. Status of bluefish along the Atlantic coast, 1982. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-28, 35 p.

Table 21.1 Nominal catches (thousand metric tons) and management information for bluefish from the Atlantic coast (Maine - Florida, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	N/A	N/A	60.3	67.7	59.9	46.5	64.6	40.1	44.9
Commercial									
USA	4.9	4.9	5.6	6.5	7.2	6.9	7.3	5.5	6.0[1]
Canada	-	-	-	-	-	-	-	-	-
Other	<0.1	-	-	<0.1	-	-	-	-	-
Total Nominal catch	-	-	65.9	74.2	67.1	53.4	71.9	45.6	50.9
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Major
Status of management = FMP in preparation
Status of exploitation = Possibly fully exploited
Age at 50% maturity = 2 years
Size at 50% maturity = 35 cm (13.8 inches)

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

[1] Preliminary

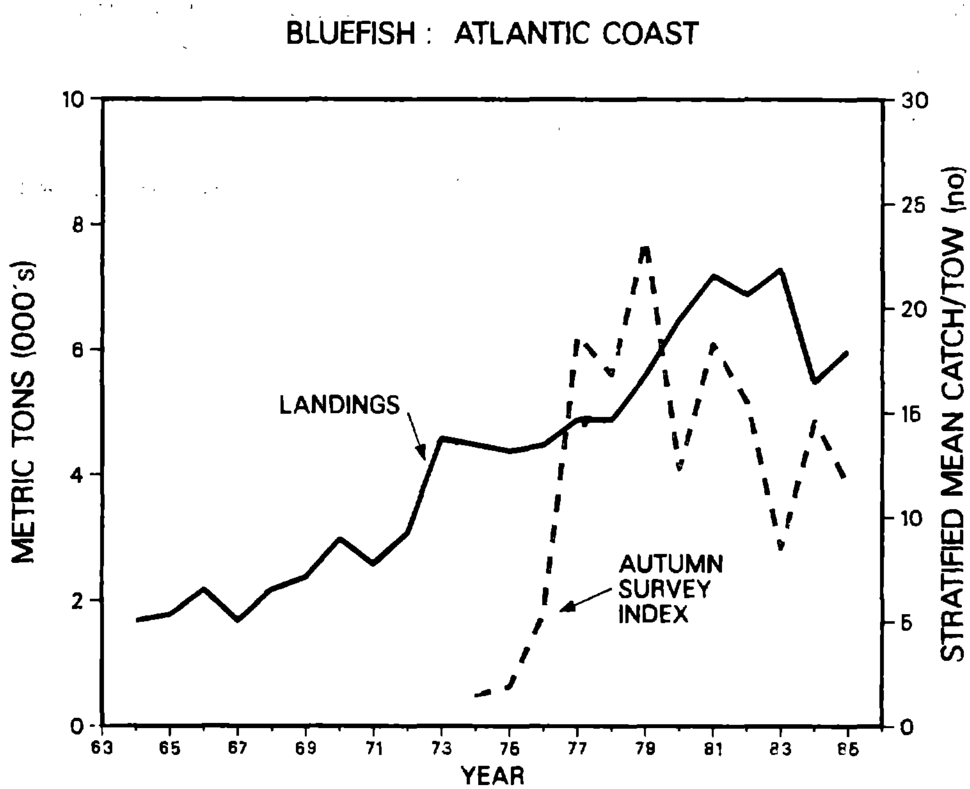


Figure 21.1 Total commercial landings and recruitment indices from NEFC autumn bottom trawl surveys of bluefish along the Atlantic coast.

RIVER HERRING

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 inches) in length; blueback herring live for about 7 or 8 years and reach a maximum length of about 32 cm (13 inches).

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 3-5, with age 4 being dominant.

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 1960's, 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. Since 1969, the nominal catch has exhibited a downward trend from 1969 to the mid-to-late 1970's and has since been relatively stable.

An MSY estimate of 23,000-28,000 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 is not evident. Data from the NEFC spring and autumn bottom trawl surveys from the Gulf of Maine to northern New Jersey indicate that stock levels have been relatively stable since 1968. Data from the spring bottom trawl surveys between northern New Jersey and Cape Hatteras indicate an 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.

For further information see:

Boreman, J. 1981. River herring stocks along the Atlantic coast. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 81-35. 23 p.

Table 22.1 Nominal catches (thousand metric tons) and management information for river herring (alewife and blueback herring) from the Gulf of Maine - Mid-Atlantic area, 1977 - 1985.

	Year								
Category	1977	1977	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	6.1	5.4	4.2	4.7	3.2	5.7	4.2	4.1	6.1
Canada	-	-	-	-	-	-	-	-	-
Other	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total nominal catch	6.3	5.4	4.2	4.7	3.2	5.7	4.2	4.1	6.1
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Minor
Status of management = Local (state, county or municipality, depending on area)
Status of exploitation = Fully exploited
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_{1985} = Unknown

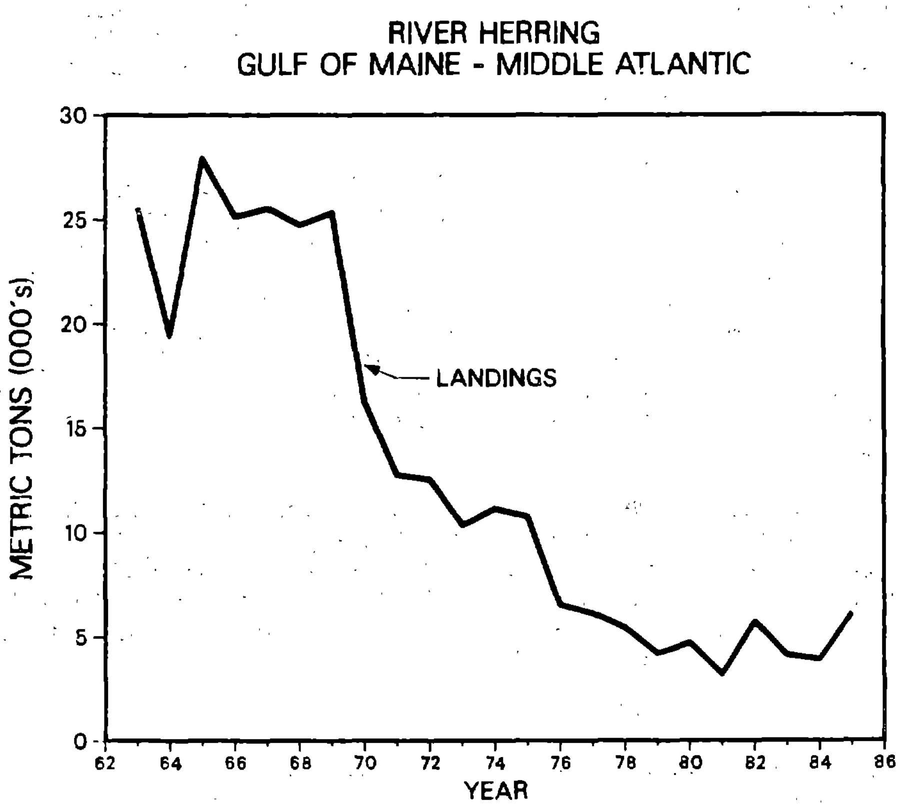


Figure 22.1 Total commercial landings of river herring (alewife and blueback herring) in the Gulf of Maine - Mid-Atlantic area.

AMERICAN SHAD

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 1980's has been the lowest on record. Restoration efforts (particularly in the Delaware and Connecticut river systems) are apparently starting to be effective, as nominal catch appears to be leveling off.

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. In fact, Maryland has closed its recreational (and commercial) fishery since 1980 to protect the stock, which is at an extremely low level. 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.

Management of the American shad is done at the state level. Interstate cooperative management programs have been established to help coordinate shad restoration in the Connecticut River, the Delaware River, and the Merrimac River. The Atlantic States Marine Fisheries Commission has prepared a coastwide management plan for American shad and river herring.

For further information see:

Boreman, J. 1981. American shad stocks along the Atlantic coast. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 81-40. 21p.

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. Martin Marietta Environmental Center, prepared for the Atlantic States Marine Fisheries Commission, Washington, D.C.

Table 23.1 Nominal catches (thousand metric tons) and management information for American shad from the Gulf of Maine - Mid-Atlantic area, 1977-1985

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.2	1.2	0.8	0.9	0.7	0.9	0.7	1.1	0.7
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	1.2	1.2	0.8	0.9	0.7	0.9	0.7	1.1	0.7
Total allowable catch	-	-	-	-	-	-	-	-	-

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_{1985} = Unknown

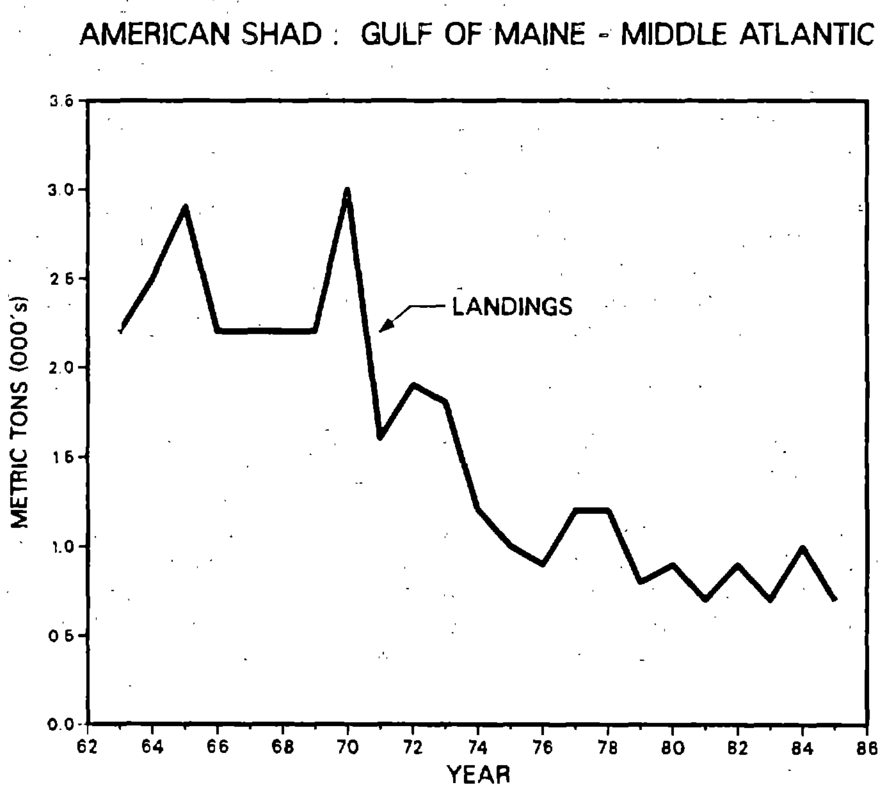


Figure 23.1 Total commercial landings of American shad in the Gulf of Maine - Mid-Atlantic area.

BLACK SEA BASS

Black sea bass (Centropristis striata) occur off the northeast United States along the entire Atlantic coast, with the greatest concentrations found off Cape May. Black sea bass overwinter along the 100-meter 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 inches, standard length) than males (age 3, 21.3 cm or 8.4 inches). Females are rarely found older than 8 years (>35 cm or 13.8 inches), while males may live up to 20 years (>60 cm or 23.6 inches). Black sea bass are omnivores, feeding on crustaceans, molluscs, echinoderms, fish, and plants.

Reported commercial landings 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 averaged 1,400 mt from 1980 - 1984 and were 1,200 mt in 1985. 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 recreational catches have ranged between 300 and 1,900 mt since 1980, with the exception of the 1982 catch, estimated at 7,300 mt. This high figure is inconsistent with the available stock abundance indices, and is perhaps attributable to an increase in party/charter 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 (0.3 fish/tow) to 1977 (18.3 fish/tow) followed by a precipitous decline to 0.3 fish/tow in 1985.

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, and New Jersey have imposed restrictions on buying or selling black sea bass less than 8 inches (20.3 cm) in length. The remaining Atlantic coastal states from Maine to 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.

Table 24.1 Nominal catches (thousand metric tons) and mangement information for black sea bass from the Gulf of Maine - Mid-Atlantic area, 1977-1985

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	N/A	N/A	N/A	0.5	0.3	7.3	1.9	0.6	N/A
Commercial									
USA	2.4	2.1	1.9	1.3	1.1	1.2	1.5	1.9	1.2
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	-	-	-	1.8	1.4	8.5	3.4	2.5	-
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Major
Status of management = Some state regulations; FMP being planned
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_{1985} = Unknown

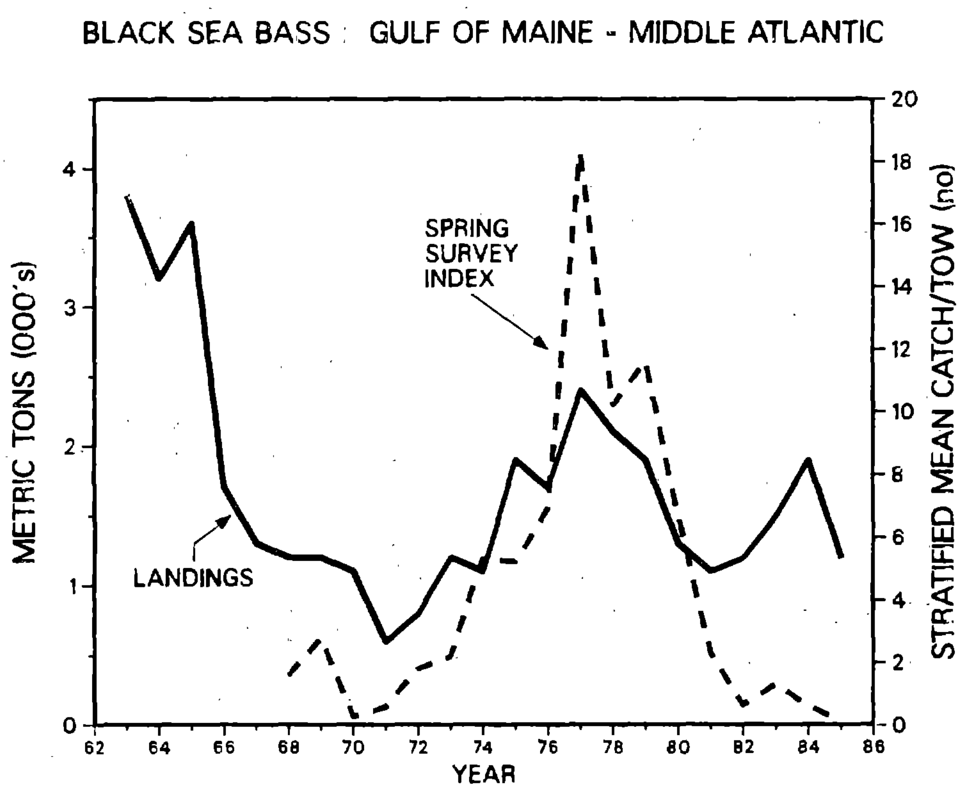


Figure 24.1 Total commercial landings and stock abundance indices from NEFC spring bottom trawl surveys of black sea bass in the Gulf of Maine - Mid-Atlantic area.

STRIPED BASS

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 C to 23 C; peak spawning activity is observed between 15 C and 20 C. Larvae range from 2.0 to 3.7 mm in total length at hatching and initiate feeding after 4-10 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.

Most striped bass along the Atlantic coast are involved in two types of migration: an upriver spawning migration in late winter - early spring, and an offshore migration which 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.

The coastal migratory stock of striped bass is largely maintained by dominant year classes. The last such year class in Chesapeake Bay, the largest in the past 30 years, occurred in 1970 and resulted in peak commercial landings in the coastal states in 1973. The decline in landings since 1973 is largely the result of low levels of recruitment, as evidenced by annual young-of-the-year surveys conducted in the Maryland portion of Chesapeake Bay coupled with intensive exploitation of the adult stock. Young-of-the-year indices for the populations that contribute to the coastal migratory stock (Roanoke River, Chesapeake Bay, and Hudson River) were all better than average in 1982, but below the level produced in the late 1960's and early 1970's. The 1985 index for the Roanoke River was higher than the 1983 and 1984 indices, but was only 28% of the 1982 index. In 1985, the Chesapeake Bay index was slightly lower than the 1984 index and was 65% below the 1982 index The Hudson River index dropped sharply in 1985 to only 14% of the long-term average.

Nominal catch of striped bass in the commercial fisheries from Maine to North Carolina averaged 2,700 mt between 1929 and 1983. Gill nets, haul seines, pound nets, and handlines accounted for over 80% of the commercial catch. The nominal commercial catch from Maine to North Carolina in 1985 (500 mt) was the lowest since 1931. Landings have been affected not only by decreased abundance of striped bass but also by significant changes in management regulations which have occurred since 1982.

A coastwide management plan for striped bass was adopted by the Atlantic States Marine Fisheries Commission (ASMFC) in 1981. The plan recommended a 14-inch total length (35.6 cm) minimum size limit in nursery rivers and bays, a 24-inch total length (61.0 cm) minimum size limit on the coastal fisheries, and that fishing be banned in spawning rivers during the spawning season. Due to the continued decline in abundance and landings since 1981, the plan was amended in 1984 to include an additional 55% reduction in fishing mortality.In 1985, an additional amendment was adopted which provides for protection of 1982 and subsequent year-class females until 95% have spawned at least once. This measure will result in a 33" minimum size limit in all areas by summer of 1988 and will be in effect until the Maryland recruitment index reaches a three-year average of 8.0.

Findings of the Emergency Striped Bass Study (ongoing since 1980) link the decline in abundance of the Chesapeake Bay stock to a combination of factors including contaminant toxicity, exploitation, climatic events, and larval nutrition. Low pH in combination with aluminum toxicity has been implicated as a possible reason for poor production of striped bass in the Maryland eastern shore rivers of the Chesapeake Bay. The Study findings also indicate that the decline in commercial and recreational catch since 1974 may have cost the northeast approximately 7,000 jobs and over $220 million in economic activity in 1980.

For further information see:

Boreman, J. and C. P. Goodyear. 1984. Effects of fishing on the reproductive capacity of striped bass in Chesapeake Bay, Maryland. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-29, 20 p.

Table 25.1 Nominal catches (thousand metric tons) and management information for striped bass from the Gulf of Maine - Mid-Atlantic area, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	N/A	N/A	2.1	0.5	0.4	1.5	1.0	0.2	N/A
Commercial									
USA	2.5	2.1	1.7	2.0	1.8	1.0	0.8	1.2	0.5
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	-	-	3.8	2.5	2.2	2.5	1.8	1.4	-
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Major
Status of management = FMP in effect
Status of exploitation = Overexploited
Age at 50% maturity = 2 years (males; 4 years (females)
Size at 50% maturity = 29.7 cm (11.7 inches) males; 47.0 cm (18.5 inches) females

M = 0.10 - 0.20 $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

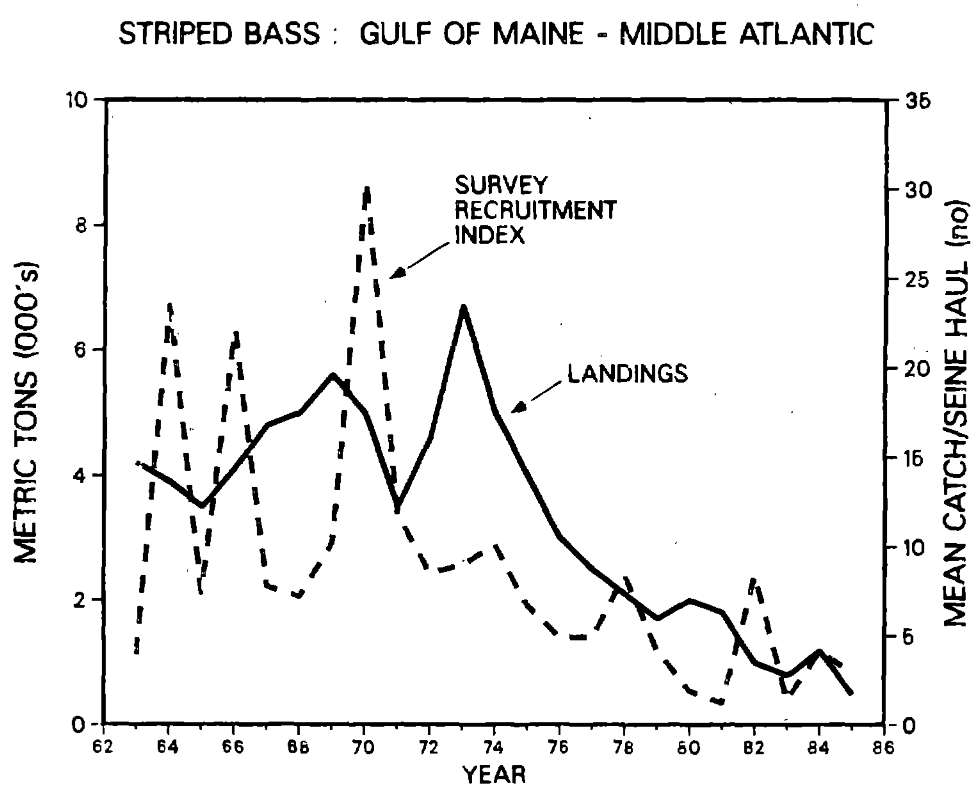


Figure 25.1 Total commercial landings and recruitment indices (from Maryland seine surveys in Chesapeake Bay) for striped bass in the Gulf of Maine - Mid-Atlantic area.

SPINY DOGFISH

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 a summer visitor 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 during fishing operations. 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 18-22 months producing 2-15 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 nominal catch declined from 4,400 mt in 1984 to 4,000 mt in 1985, which represents the fourth consecutive year of declining catches, and is attributable to a weak export market. The principal fishing season extends from June to October in the Gulf of Maine. During this period, large concentrations of marketable-sized dogfish are found in the vicinity of and on Stellwagen Bank. Attempts at fishing during November to May have met with limited success.

Minimum biomass estimates of spiny dogfish based on NEFC spring bottom trawl survey catches increased 360% from 275,000 mt in 1984 to a record high of 990,500 mt in 1985, 400% above the 1968-1984 geometric average of 240,000 mt. Since dogfish school, there tends to be rather high variability among the random survey catches which results 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 pounds), 83 cm (33 inches)], 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.

For further information see:

Colvocoresses, J. A., and J. A. Musick. 1980. A preliminary evaluation of the potential for a shark fishery in Virginia. 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. MA Thesis, The College of William and Mary, 63 p.

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

Table 26.1 Nominal catches (thousand metric tons) and management information for spiny dogfish from the Gulf of Maine - Mid-Atlantic area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.5	0.9	4.8	4.2	6.9	6.6	4.9	4.4	4.0
Canada	-	-	-	-	-	-	-	-	-
Other	6.5	0.6	-	0.2	0.3	0.4	-	-	-
Total Nominal catch	7.0	1.5	4.8	4.4	7.2	7.0	4.9	4.4	4.0
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = None
Status of exploitation = Underexploited
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_{1985} = Unknown

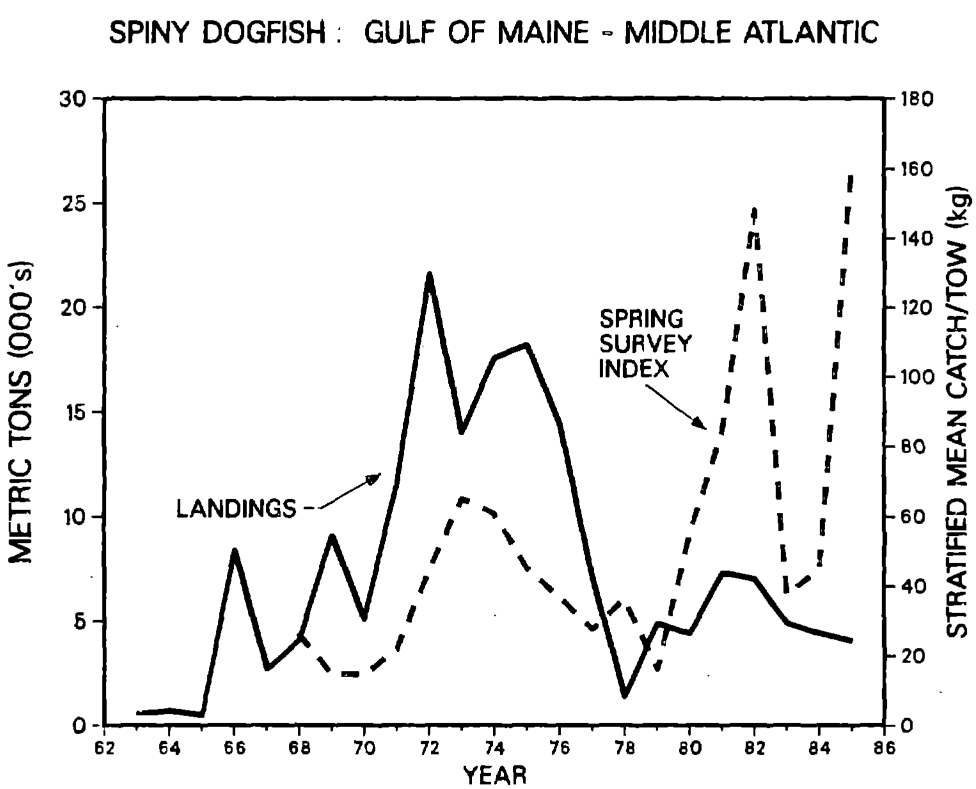


Figure 26.1 Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of spingy dogfish in the Gulf of Maine - Mid-Atlantic area.

SKATES

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 which are enclosed in a hard, leathery case commonly called a "mermaid's purse." Incubation time is 6-12 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 during 1975-1982 were less than 2,000 mt annually. Most of the domestic catch has traditionally been discarded at sea. Beginning in 1983, domestic catches 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 in 1985 were 4,000 mt, down slightly from 1984 levels.

The species composition of the 1985 catch 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 market expands.

Minimal biomass estimates for all skates combined in the Gulf of Maine - Mid-Atlantic area determined from NEFC bottom trawl survey data increased from 81,000 mt in 1984 to 206,600 mt in 1985. The 1985 estimate was 116% greater than the 1968-1984 average of 121,000. This is the second highest observed in the 18-year (1968-1985) time series, and the highest observed since 1969 (335,000 mt). The increase is attributable to large catches of winter skate in the Georges Bank - Southern New England region.

For further information see:

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. Fish. Bull., U.S., 53(74):1-577.

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

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

Table 27.1 Nominal catches (thousand metric tons) and management information for skates (all species) from the Gulf of Maine - Mid-Atlantic area, 1977-1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.3	1.5	1.6	2.0	0.8	1.0	3.6	4.1	4.0
Canada	-	-	-	-	-	-	-	-	-
Other	0.2	-	-	-	-	-	-	-	-
Total nominal catch	1.5	1.5	1.6	2.0	0.8	1.0	3.6	4.1	4.0
Total allowable catch	-	-	-	-	-	-	-	-	-

Long term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = None
Status of exploitation = Underexploited
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_{1985} = Unknown

[1] Pertains to the little skate (*Raja erinacea*).

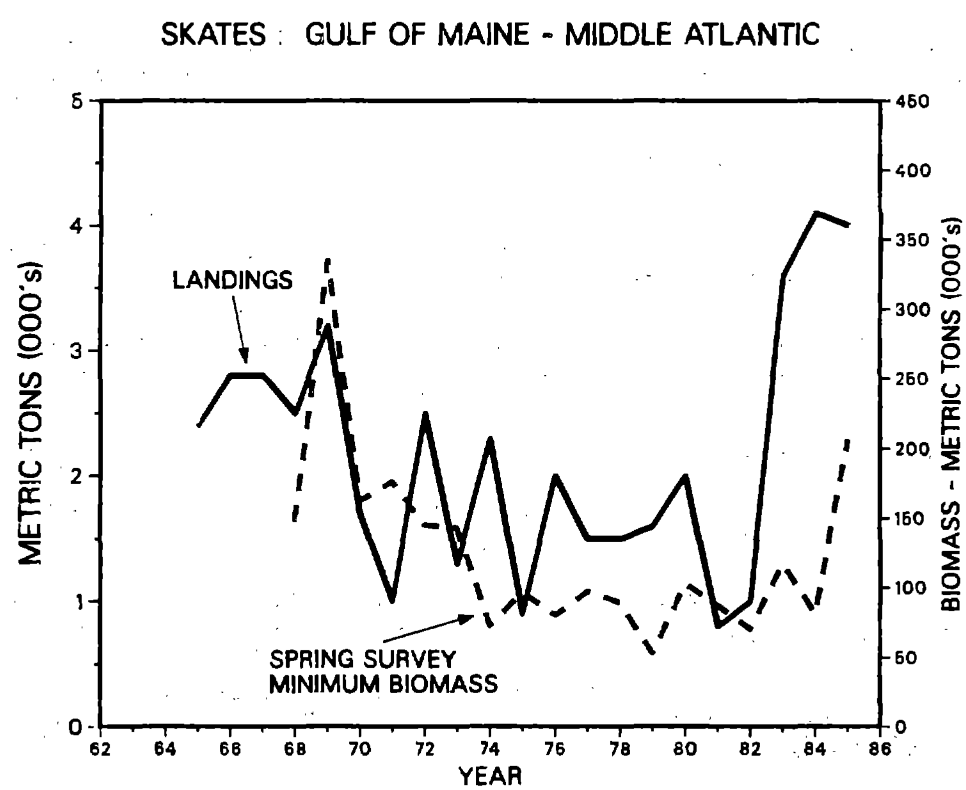


Figure 27.1 Total commercial landings and estimates of minimum stock biomass from NEFC spring bottom trawl surveys of skates in the Gulf of Maine - Mid-Atlantic area.

SHORT-FINNED SQUID

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 in or near the Gulf Stream. Larvae and juveniles are assumed to be transported north and east by 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 inches, dorsal mantle length) and live about 12-24 months. Commercial catches off the USA are comprised mainly of 10-28 cm (4-11 inches) individuals which are probably 8-24 months of age.

Total catches decreased from 10,200 mt in 1984 to 6,100 mt in 1985, compared to the 1968-1982 mean of 14,700 mt. The USA nominal catch decreased from 9,500 mt in 1984 to 5,000 mt in 1985. The 1985 USA catch, though about half that seen in 1983 and 1984, still represented over a fivefold increase from the 1968-1982 average. About half the 1985 USA catch was taken in joint ventures. Distant-water-fleet catches during 1985 were 1,100 mt, a 56% increase from 1984 (700 mt), and 92% below the 1968-1982 mean catch of 13,800 mt.

The 1985 NEFC autumn survey index for Illex was the lowest since 1973, 14% below that seen during the previous period of low abundance (1968-1974). Pre-recruit (<10 cm) abundance in 1985 was the second lowest since 1973, 64% below the 1968-1974 average. The pre-recruits sampled in the 1985 autumn survey will comprise the bulk of the catch in the 1986-1987 fishery.

For further information see:

Lange, Anne M. T. 1984. Status of the short-finned squid, (Illex illecebrosus) off the Northeastern USA, November 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-38, 20 p.

NEFC. 1986. Report of Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 28.1 Nominal catches (thousand metric tons) and management information for the short-finned squid (Illex) from the Gulf of Maine - Mid-Atlantic area, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA[2]	1.0	0.4	1.6	0.3	0.6	5.4	9.9	9.5	5.0
Canada	-	-	-	-	-	-	-	-	-
Other	23.8	17.3	16.3	19.6	14.9	12.4	1.8	0.7	1.1
Total nominal catch	24.8	17.7	17.9	17.9	15.4	17.8	11.7	10.2	6.1
Total allowable catch	30.0	35.0	30.0[1]	30.0[1]	30.0[1]	30.0[1]	30.0[1]	30.0[1]	25.0[1]

Long-term potential catch = 30,000 mt
Importance of recreational fishery = Insignificant
Status of management = FMP in force since 1979
Status of exploitation = Underexploited
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_{1985} = Unknown

[1] 1 April - 31 March fishing-year (Absolute Biological Catch-ABC).

[2] Includes prorated amounts of squid catches not identified to species.

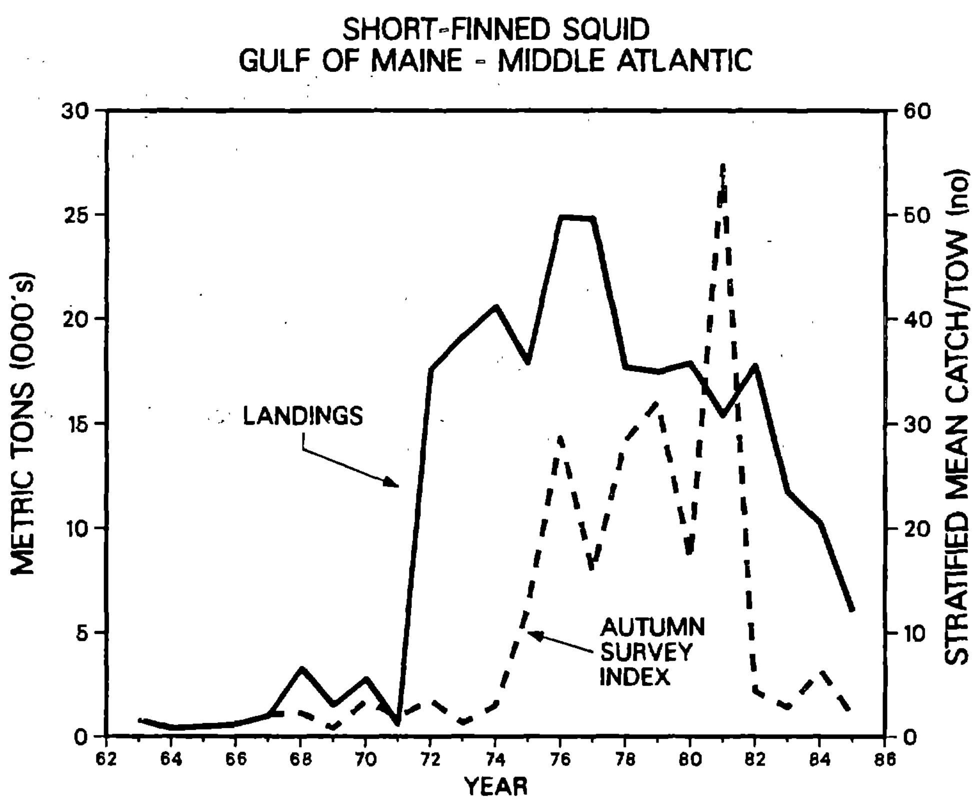


Figure 28.1 Total commercial landings and stock abundance indices from NEFC autumn bottom trawl surveys of short-finned squid in the Gulf of Maine - Mid-Atlantic area.

LONG-FINNED SQUID

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 occurs 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 reach lengths of over 40 cm (16 inches, dorsal mantle length) and ages of about 3 years, but most individuals taken in commercial catches are 8-20 cm (3-8 inches) and 8-14 months.

Total catches decreased from 22,600 mt in 1984 to 16,700 mt in 1985 and were 28% below the 1970-1982 average (23,300 mt). The USA nominal catch decreased from 11,600 mt in 1984 to 10,200 mt in 1985, still the third highest level recorded. Joint venture catches accounted for 1,100 mt. Distant-water-fleet (DWF) catches during 1985 were 6,500 mt compared with 11,000 mt in 1984. The 1985 DWF catches were 70% below the 1970-1982 mean (21,500 mt).

The NEFC autumn survey index for 1985 increased 48% from 1984 and was 58% above the 1967-1984 average. The 1984 pre-recruit index was more than double that of 1984 and 35% above the 1967-1984 mean. Minimum abundance was estimated to be 4.9 billion individuals during the time of the 1985 autumn survey, with 70% (3.4 billion) being of pre-recruit size (<8 cm or <3 inches). Recruitment from the 1985 year class should be 1.4-3.2 billion individuals assuming 100%-45% catchability of Loligo to the survey net. Yield-per-recruit and stock recruitment relationship analyses indicate that yields from this level of recruitment would be between 54,000 and 61,000 mt with the present fishery, if fishing mortality were increased to the level corresponding to the maximum equilibrium yield.

For further information see:

Lange, Anne M. T. 1984. An assessment of the long-finned squid resource off the northeastern United States, Autumn 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-37, 24 p.

NEFC. 1986. Report of Second Stock Assessment Workshop. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-09, 114 p.

Table 29.1 Nominal catches (thousand metric tons) and mangement information for long-finned squid (Loligo) from the Gulf of Maine - Mid-Atlantic area 1975-1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	885
USA recreational[1]	-	-	-	-	-	-	-	-	-
Commercial									
USA[2]	1.1	1.3	4.3	4.0	2.3	5.4	15.9	11.6	10.2
Canada	-	-	-	-	-	-	-	-	-
Other	15.6	9.4	13.1	19.8	20.2	15.9	11.7	11.0	6.5
Total nominal catch	16.7	10.6	17.3	23.7	22.5	21.3	27.6	22.6	16.7
Total allowable catch	44.0	44.0	44.0[1]	44.0[1]	44.0[1]	44.0[1]	44.0[1]	44.0[1]	33.0[1]

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

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

[1] 1 April - 31 March fishing year (Absolute Biological Catch - ABC).

[2] Includes prorated amounts of squid catches not identified to species.

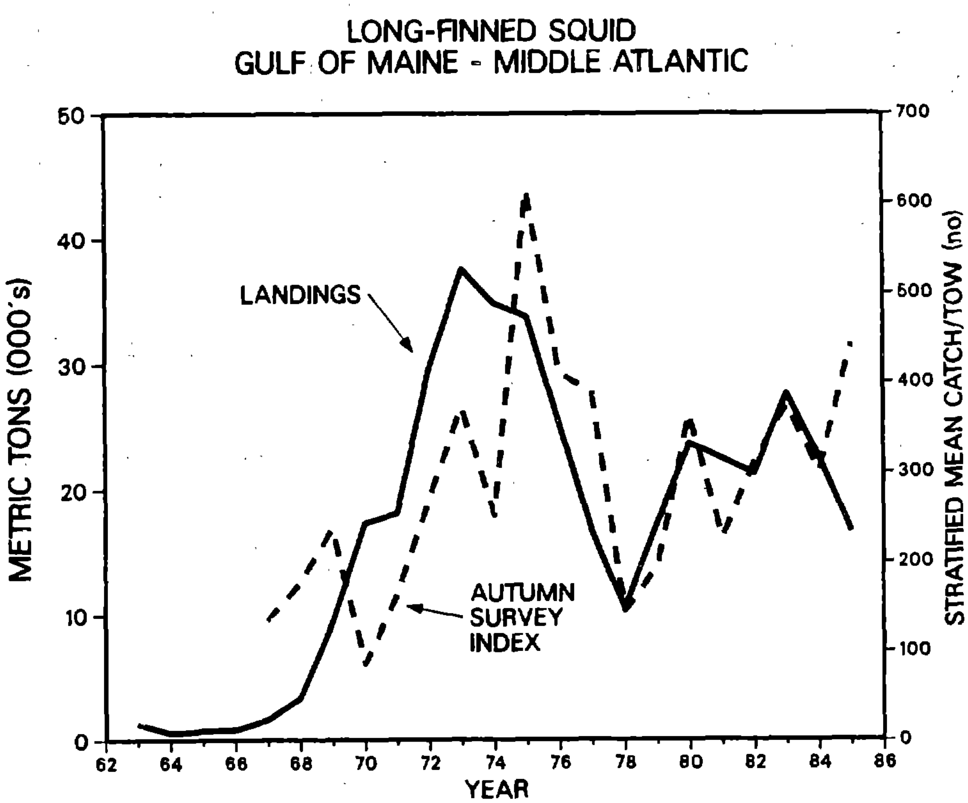


Figure 29.1 Total commercial landings and stock abundance indices from NEFC autumn bottom trawl surveys of long-finned squid in the Gulf of Maine - Mid-Atlantic area.

AMERICAN LOBSTER

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, travelling up to 300 km (186 miles) and commonly migrating up to 80 km (50 miles), 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 (7,000-80,000) are carried under the female's abdomen during the 10-11 month incubation period. Hatching occurs during late spring - early summer, and the pelagic larvae undergo four molts before attaining adult characteristics and settling to the bottom. Lobsters molt approximatley 20 times before reaching the minimum legal size at 5-7 years of age. A significant proportion of lobsters caught in inshore waters are not sexually mature.

Nominal catches in the USA inshore trap fishery remained relatively stable during 1965-1975, ranging from 10,300 to 12,200 mt and averaging 11,100 mt. The nominal inshore catch subsequently increased to record levels during 1979-1982, averaging 15,400 mt. The 1985 nominal catch increased to 18,000 mt. Nominal catches for the offshore lobster trap fishery increased rapidly following its inception in 1969 from 50 mt in 1969 to 2,900 mt in 1972. Yield remained relatively stable at approximately 2,000 mt during 1975-1978; landings during 1982-1983 averaged 2,500 mt. The 1985 nominal catch of 2,600 mt represented a decrease from the 1984 level. The offshore trawl fishery averaged 1,900 mt per year during 1965-1974 and then decreased steadily and fluctuated from 1977 to 1985 at between 200 and 300 mt. Total offshore landings have declined from 1978 to 1981, but returned to levels of the mid-1970's more recently.

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 1971-1976, and then increased to an average of 1.0 kg/tow during 1977-1980. The autumn index decreased to 0.8 kg/tow in 1985. 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 1970's, 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. High fishing mortality rates, particularly in coastal locations, remain a source of serious concern for this extremely valuable resource.

For further information see:

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.

Table 30.1 Commercial and recreational landings (thousand metric tons, live weight) of American lobster from the Gulf of Maine - Mid-Atlantic area, 1977-1985. Landings statistics have been revised to reflect unreported catches.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
					Year				
USA recreational									
State waters[1]	-	-	-	-	-	-	-	-	-
Commercial									
USA: Offshore[2]	2.5	2.7	2.2	1.9	1.8	2.5	2.4	4.2	2.6
Inshore[3]	11.9	12.9	14.7	14.9	15.9	16.1	17.6	16.4	18.0
Canada: Georges Bank	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	14.6	15.9	17.2	17.0	17.9	18.8	20.2	20.8	20.8
Total allowable catch	-	-	-	-	-	-	-	-	-

*Long-term potential catch = 3,400 mt
Importance of recreational fishery = Insignificant
Status of management = FMP in place
Status of exploitation = Fully exploited
Size at 50% maturity = 10 cm (3.9") carapace length

M = 0.10 $F_{0.1}$ = Unknown F_{max} = 0.18 (males) 0.23 (females) F_{1985} = >F_{max}

* Offshore fishery only
1 Unknown.
2 Includes trawl and offshore trap catches.
3 Inshore trap catches.

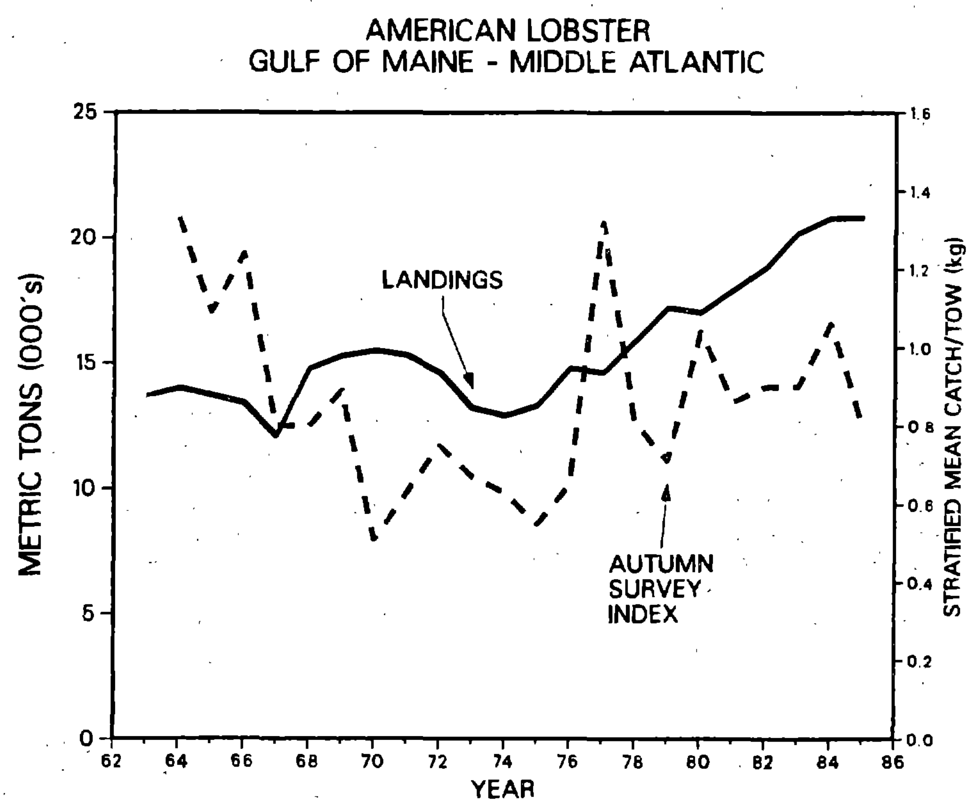


Figure 30.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of American lobster in the Gulf of Maine - Mid-Atlantic area.

NORTHERN SHRIMP

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-1970's 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 1960's.

Northern shrimp are protandric hermaphrodites, maturing first as males (generally at 2 ½ years of age); they then pass through a series of transitional stages and mate again as females the following summer at age 3 ½. 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; however, enforcement authority remains vested with the individual states. The fishery has been managed primarily by mesh size regulations and seasonal closures. The 1984-1985 fishing season extended from 1 December to 15 May; and during 1985-1986 the season extended from 1 December - 31 May, the maximum allowable under current ASMFC policy.

Historically, effort has been directed primarily towards ovigerous females in inshore areas during the winter, although during the early 1970's, substantial quantities of all age groups were also harvested further offshore during the summer. Shrimp have been taken primarily by otter trawling, although pots have also been used successfully along the central Maine coast.

Nominal catches peaked at 12,800 mt in 1969, averaged approximately 11,000 mt during 1971-1972, and then declined precipitously to only 400 mt in 1977. Nominal catches have since increased from an average of 400 mt in 1979-1980 to an average of approximately 1,500 mt in 1982-1983. The catch for the 1983-1984 season increased further to 3,000 mt; a catch of 4,100 mt was taken during the 1984-1985 season, and a catch of approximately 5,000 mt is projected for 1985-1986. This increase reflects both increased abundance and a substantial increase in fishing effort. Since 1983 the number of trips directed towards shrimp has more than doubled annually compared to the 1981-1983 average.

NEFC spring and autumn survey indices have increased in recent years, although values remain considerably below average levels of the late 1960's and early 1970's. Also, results of cooperative surveys by state and federal personnel since 1983 indicate a sharp increase in abundance due to recruitment of the 1982 year class, apparently the strongest to appear in a decade. Subsequent year classes appear weaker, suggesting that abundance will decline in the near future as the 1982 year class passes through the fishery. Harvestable biomass and mortality estimates calculated from these data indicate relatively low exploitation rates in spite of the above-mentioned effort increase.

For further information see:

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

Northern Shrimp Technical Committee. 1985. Gulf of Maine northern shrimp stock status - 1985. Report to Northern Shrimp Section of Atlantic States Marine Fisheries Commission, November 1985, 19 p.

Anon. 1985 Cruise results - Gulf of Maine Northern Shrimp Survey, August 1985. Unpublished Rept., Woods Hole, MA, 25 p.

Table 31.1 Nominal catches (thousand metric tons) and management information for Gulf of Maine northern shrimp, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.4	<0.1	0.5	0.3	1.0	1.5	1.4	3.0	4.1
Canada	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total nominal catch	0.4	<0.1	0.5	0.3	1.0	1.5	1.4	3.0	4.1
Total allowable catch[1,2]	1.6	-	-	-	-	-	-	-	-

Long-term potential catch = Unknown
Importance of recreational fishery = Insignificant
Status of management = Jointly by participating states[5]
Status of exploitation = Fully exploited
Age at 50% maturity = 2 years
Size at 50% maturity = 9 cm (3.5 inches)

M = Unknown $F_{0.1}$ = Unknown F_{max} = Unknown F_{1985} = Unknown

[1] Fishery closed during 1978.
[2] 15 December 1982 - 15 May 1983.
[3] 15 December 1983 - 30 April 1984.
[4] 1 December 1984 - 15 May 1985.
[5] Under Amendment No. 1 to the Atlantic States Marine Fisheries Compact.

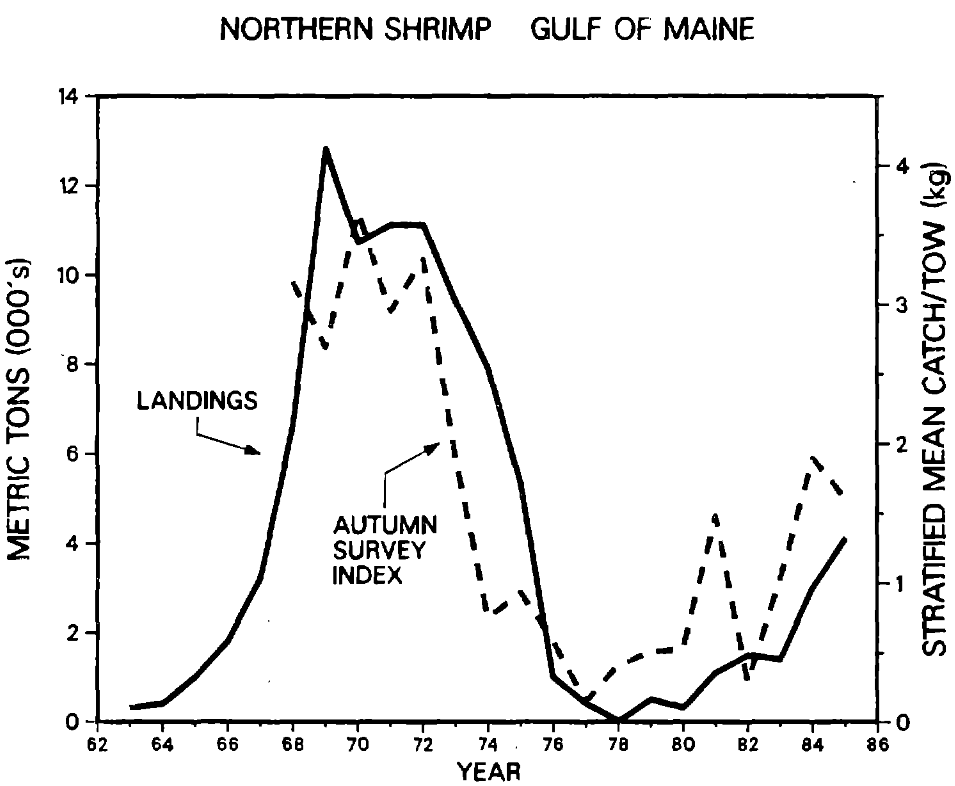


Figure 31.1 Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of northern shrimp in the Gulf of Maine.

SURF CLAMS

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 6-7 years. Maximum size is about 22.5 cm (8-7/8 inches), 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 3 weeks (at 22 C).

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 the re-building of 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 1985 and 1986 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 1950's; combined with inshore beds near Cape May - Wildwood, the New Jersey resources supported the fishery until the early 1970's. Declining productivity of New Jersey fishing areas prompted a shift of effort to the south during the early 1970's. New beds off southern Virginia and North Carolina contributed to a tremendous increase in total landings during 1973-1975. Average catches in these three years of 40,100 mt (meats) were 50% greater than the 1965-1977 average of 27,000 mt. The southern Virginia - North Carolina fishery collapsed during 1976; most vessels returned to more northern ports. During 1984, 60% of Middle Atlantic FCZ surf clam landings were taken off New Jersey, 34% off the Delmarva Peninsula, and 6% from the southern Virginia - North Carolina region. Total FCZ landings in 1985 were 23,700 mt, slightly less than the combined annual quotas for the Mid-Atlantic and New England areas.

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-1960's 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 (1978-1984) have indicated the existence of 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.

Biomass off the Delmarva Peninsula was maintained until the return of the fleet from southern Virginia - North Carolina during 1976. Concentration of the offshore fishery in Delmarva waters during 1976-1980 resulted in declining stocks of commercial sizes. Recent surveys indicate that the biomass of commercial sizes has remained relatively low, although a significant pre-recruit resource (1977 year class) presently exists off Delmarva. Based on growth rate projections, increasing proportions of the 1977 year class will reach harvestable size during 1985 and 1986.

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 a result of the restrictions on fishing effort and clam size for the Middle Atlantic FCZ fishery.

Research vessel survey data indicate adequate surf clam resources currently exist to support the Middle Atlantic FCZ fishery at near current levels (18,000-23,000 mt of meats) until the mid-1990's. Likewise, landings of 3,000-4,000 mt of meats can be sustained from the New England management area (Southern New England and Georges Bank) for the next decade as well.

Landings from inshore (state) waters increased 28% between 1984-1985 (from 7,200 to 9,200 mt), reflecting the intensive harvest of clams from Long Island Sound, New York waters. Clams from this area will continue to support an important inshore fishery during 1986, however, the magnitude and long-term prospects for this resource have not been evaluated.

For further information see:

Murawski, S. A., and F. M. Serchuk. 1984. Assessment update for Middle Atlantic offshore surf clam, Spisula solidissima, populations - autumn 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. 84-32, 40 p.

Murawski, S.A., and F.M. Serchuk. 1984. An assessment of the Georges Bank surf clam resource - summer 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-28, 23 pp.

Murawski, S. A., and F. M. Serchuk. 1984. An assessment of the surf clam resource in FCZ waters off Southern New England - spring 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-20, 19 pp.

Table 32.1 Nominal catches (thousand metric tons) and management information for surf clams from the New England - Mid-Atlantic area, 1977 - 1985.

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA:									
FCZ waters	19.5	13.2	13.2	15.7	16.9	16.7	20.5	24.7	23.7
State waters	3.7	3.6	2.6	1.4	4.0	5.9	4.9	7.2	9.2
Total	23.2	17.8	15.8	17.1	20.9	22.5	25.4	31.9	32.9
Total allowable FCZ catch	13.6	13.6	13.6	13.6	18.1	18.1	18.9	24.3	24.3

Long-term potential catch = 24,300 mt
Importance of recreational fishry = 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} = Unknown F_{1985} = Unknown, probably = 0.1

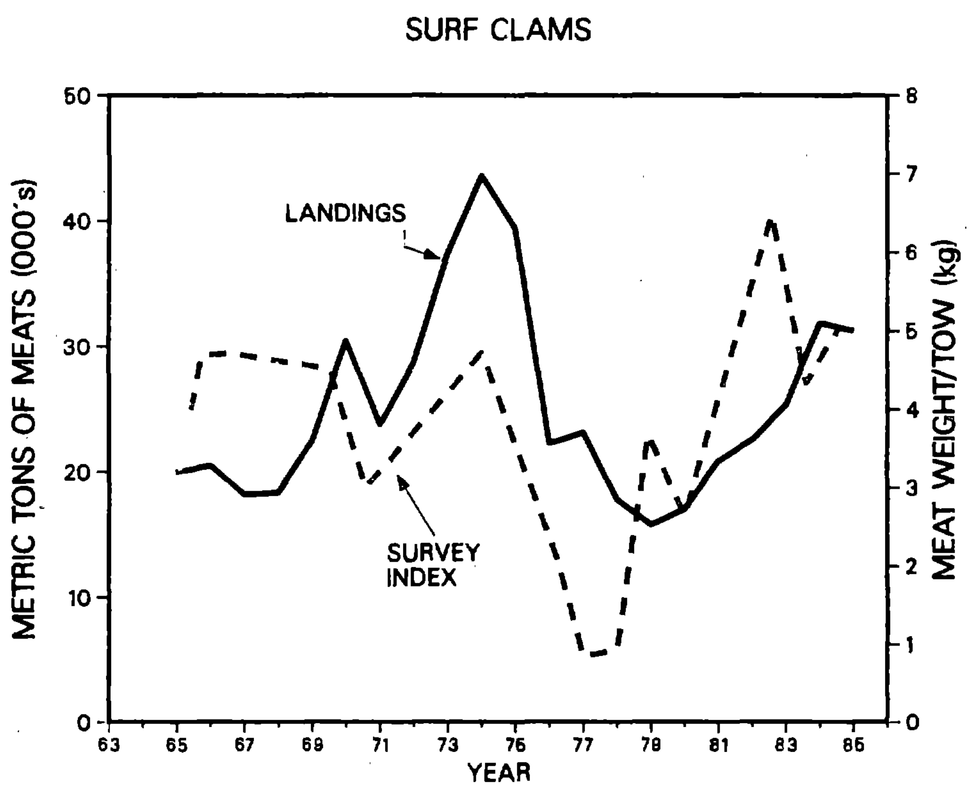


Figure 32.1 Total commercial landings and stock biomass indices from NEFC dredge surveys of surf clams in the Mid-Atlantic area.

OCEAN QUAHOGS

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 in excess of 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 inches) 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 slam 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 during 1976-1979 from 2,500 to 15,800 mt of meats per year. Landings stabilized at about 16,000 mt per year between 1978-1980 and have since increased to a record 23,600 mt 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.

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 during 1965-1982, 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 during 1979-1985 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 hour for the large vessels varied somewhat during the period, exhibiting a declining trend during 1979 - early 1980, and again in 1983-1985. CPUE is likely to continue to exhibit such variability as new beds are located. The catch is primarily composed of quahogs 65-105 mm shell length. Little size selectivity by the fishery is apparent 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 in excess of this level 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 5-7 years, after which the fishery will probably shift northward and to the east to take advantage of higher marginal catch rates.

For further information see:

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. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-25. 31 p.

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.

Table 33.1 Nominal catches (thousand metric tons, meats and management information for ocean quahogs from the New England - Mid-Atlantic area, 1977-1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA:									
FCZ waters	7.3	9.2	14.3	13.9	16.0	15.6	15.3	16.4	23.6
State waters	1.1	1.2	1.4	1.5	0.4	0.2	0.7	1.2	<0.1
Total	8.4	10.4	15.8	15.3	16.4	15.8	16.0	17.6	23.6
Total allowable FCZ catch	-	13.6	13.6	15.9	18.1	18.1	18.1	18.1	20.4

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_{1985} = Unknown, probably <<0.1

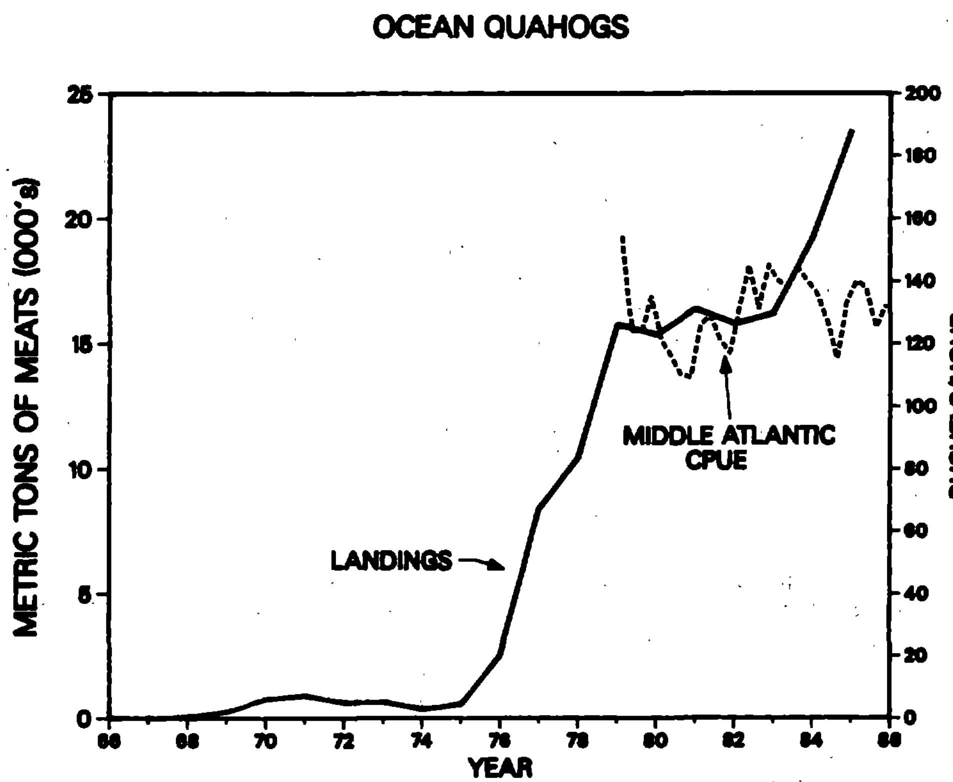


Figure 33.1 Total commercial landings of ocean quahogs in the New England - Mid-Atlantic area and commercial catch per unit effort in the New Jersey and Delmarva ocean quahog dredge fisheries.

SEA SCALLOPS

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 (22-110 fathoms). Commercial concentrations generally exist between 40 and 100 m (22-55 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 50-80% 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 inches), but scallops larger than 17 cm (6.7 inches) 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 4-6 weeks until spatfall occurs.

Gulf of Maine

Commercial 1985 landings were 500 mt (meat weight), 41% less than in 1984. Both USA and Canadian landings (400 and 40 mt, respectively) were sharply lower than in 1984 (700 and 100 mt, respectively). As in 1984, most (78%) of the 1985 USA catch was from inshore territorial waters along the coast of Maine. Offshore landings in 1985 were 42% less than in 1984 (92 vs 159 mt) indicating a continued dependence by the fishery on the inshore beds and a return to historical patterns of fishing. During 1970-1979, landings from territorial waters accounted for 84% of the total Gulf of Maine sea scallop catch.

Total effort in the Gulf of Maine fishery declined significantly in 1985 (-28% from 1984 and -50% from the record 1983 value), largely due to a sharp reduction in Class 2 [5-50 gross registered tons (GRT)] fishing activity. USA 1985 commercial CPUE declined to a record low level.

Performance patterns in the commercial fishery indicate that the Gulf of Maine fishery will continue to depend on inshore rather than offshore sea scallop beds in the near future.

Georges Bank

Total international (USA and Canada) 1985 commercial landings from Georges Bank were 6,800 mt, 35% higher than 1984, but less than half the 1976-1982 average annual catch of 14,400 mt. The 1985 USA catch (3,000 mt) was the lowest since 1976. Canadian landings in 1985 were 3,800 mt, nearly double the 1984 catch. As a result, Canadian landings comprised more than 50% of the Georges Bank total for the first time in six years. About 71% of the total

1985 Georges Bank catch was from the Northern Edge and Peak region of the Bank, although most of the USA catch (53%) was taken in the South Channel fishery. Declines in 1985 landings occurred in two of the three principal fishery regions on the Bank: the South Channel (-5%) and the Southeast Part (-42%). As in 1978-1984, all of the 1985 Canadian landings on Georges Bank were taken from the Northern Edge and Peak.

Total USA effort in the 1985 Georges Bank fishery decreased 2% from 1984 and was lower than in any year since 1979. USA commercial CPUE declined in 1985 to its lowest level in the 1965-1985 time series. Canadian fishing effort increased by almost 50% from 1984 to 1985 but Canadian CPUE in 1985 also markedly increased (+30% from 1984) due to strong recruitment of the 1981 year class in the Northern Edge and Peak region.

Catch-per-tow indices from the NEFC 1985 Georges Bank sea scallop survey indicated a marked improvement in scallop abundance due to strong recruitment of the 1982 year class. The 1985 pre-recruit abundance indices for the South Channel and Southeast Part regions were among the highest values in the survey time series, and were triple and double, respectively, the 1984 pre-recruit indices. In the South Channel, an increase in the abundance of larger-sized scallops (greater than or equal to 70 mm shell height) was also observed in the 1985 survey. This improvement was due primarily to increased abundance of 40-80 count scallops which should more fully recruit to the fishery in early 1986. Scallops from the strong 1982 year class, however, will not attain a 40 count size until late 1986 or early 1987. Survey results from the Northern Edge and Peak region showed a significant increase in commercial-size scallops over 1984 due to the exceptionally abundant 1981 year class localized in this region. The highest densities of this cohort, however, are concentrated in waters under Canadian jurisdiction.

The prospects for recovery of the Georges Bank sea scallop resources are excellent due to the outstanding abundance of the 1982 year class. If this year class is not subjected to "mixing" or high fishing mortality in 1986, it should sustain elevated fishery yields for at least 2-3 years (i.e., through 1989). Failure to protect and husband this cohort before moderate gains in yield per recruit and spawning potential can be achieved (during 1986 and 1987) will result in a significant loss in yield and a likely return to the depressed resource conditions characteristic of recent years.

Mid-Atlantic

Commercial 1985 landings (exclusively USA) from the Mid-Atlantic area were 3,300 mt, 14% less than in 1984. For the second consecutive year, more catch was taken by the USA fleet from the Mid-Atlantic region than from Georges Bank (3,300 vs 3,000 mt). Mid-Atlantic landings comprised 49% of the total 1985 USA sea scallop harvest, essentially the same proportion of the total USA catch as in 1984. Most (84%) of the 1985 Mid-Atlantic catch was taken from the New York Bight region (off Long Island and New Jersey) where landings were unchanged from 1984. In the more southerly scallop regions (Delmarva, and Virginia-North Carolina) landings in 1985 declined sharply from 1984 (-44% for Delmarva; -90% for Virginia-North Carolina).

Fishing effort in the Mid-Atlantic area slightly declined (-3%) from the record 1984 level but was still the second highest observed in the fishery. Effort was greatest in the New York Bight region where effort attained a record high in 1985 due to a 20% increase in fishing activity over 1984 by large scallop vessels (Class 4:151-500 GRT). The average number of days fished per trip increased for all vessel classes in 1985; the average trip duration in 1985 was the longest in the 21-year time series. During both 1984 and 1985, the USA fleet exerted more effort in the Mid-Atlantic fishery than on the Georges Bank grounds.

Commercial CPUE indices declined to record low levels in the Mid-Atlantic in 1985. Catch rates for all vessel classes in all fishery regions in 1985 fell to historic lows.

Catch per tow values from the 1985 NEFC Mid-Atlantic sea scallop survey were much higher than those obtained in 1984 due to excellent recruitment of the 1982 year class throughout the region. The 1985 pre-recruit index of small scallops in the New York Bight area was the highest in the survey time series; in the Delmarva area, the 1985 pre-recruit abundance index increased almost fivefold from 1984 and was the third highest value obtained. Improved abundance of scallops was also evident in the 1985 survey results from Virginia-North Carolina.

Similar to Georges Bank, the prospects for recovery of the Mid-Atlantic sea scallop resources are excellent due to the extremely abundant 1982 year class. Significant increases in landings should occur in the latter half of 1986 and during 1987 as scallops from the 1982 cohort recruit to the fishery. If, however, the 1982 year class receives considerable exploitation before autumn 1986 when individual scallops initially attain a 40-count size and begin to spawn, long-term yield from the growth and spawning potential of this year class will be sacrificed.

For further information see:

Serchuk, F. M., and S. E. Wigley. 1984. Results of the 1984 USA sea scallop research vessel survey: Status of sea scallop resources in the Georges Bank, Mid-Atlantic, and Gulf of Maine regions and abundance and distribution of Iceland scallops off the southeastern coast of Cape Cod. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-34, 74 p.

Serchuk, F. M. 1985. The New Bedford sea scallop fishery: Historical landings and value statistics, 1939-1983. NMFS, NEFC, Woods Hole Lab. Lab. Ref. Doc. No. 85-02, 10 p.

Serchuk, F. M., and S. E. Wigley. 1986. Status of the sea scallop resources off the Northeastern United States, 1986. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-08, 36 p.

Table 34.1 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, 1977 - 1985.

	Year								
Category	1977	1978	1979	1980	1981	1982	1983	1984	1985
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
Gulf of Maine									
USA	0.3	0.2	0.4	1.6	1.3	0.7	0.9	0.7	0.4
Canada	-	-	-	<0.1	<0.1	<0.1	0.1	0.1	<0.1
Total	0.3	0.2	0.4	1.6	1.3	0.7	1.0	0.8	0.5
Georges Bank									
USA[1]	4.8	5.6	6.7	5.8	8.5	6.7	4.6	3.2	3.0
Canada	13.1	12.2	9.2	5.2	8.0	4.3	2.8	2.0	3.8
Total	17.9	17.8	15.9	11.0	16.5	11.0	7.4	5.2	6.8
Mid-Atlantic									
USA	5.9	8.6	7.2	5.1	1.9	1.7	3.2	3.8	3.3
Total nominal catch	24.1	26.6	23.5	17.7	19.7	13.4	11.6	9.8	10.6
Total allowable catch	-	-	-	-	-	-	-	-	-

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 in 1981 = 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) $F_{1985} = >F_{max}$ in all areas

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

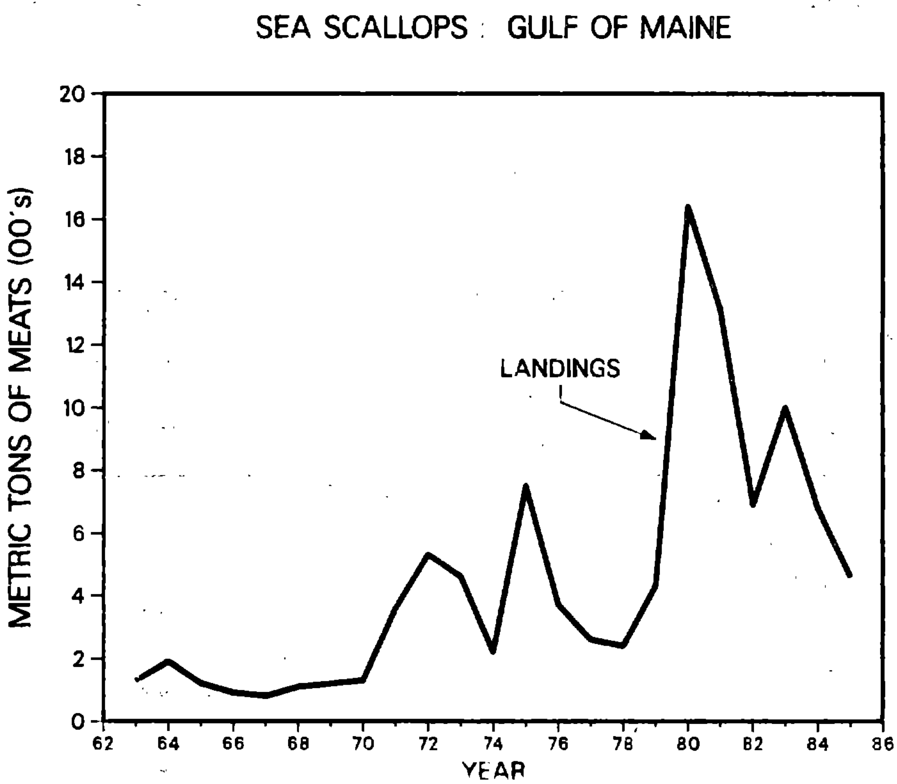


Figure 34.1 Total commercial landings of sea scallops in the Gulf of Maine.

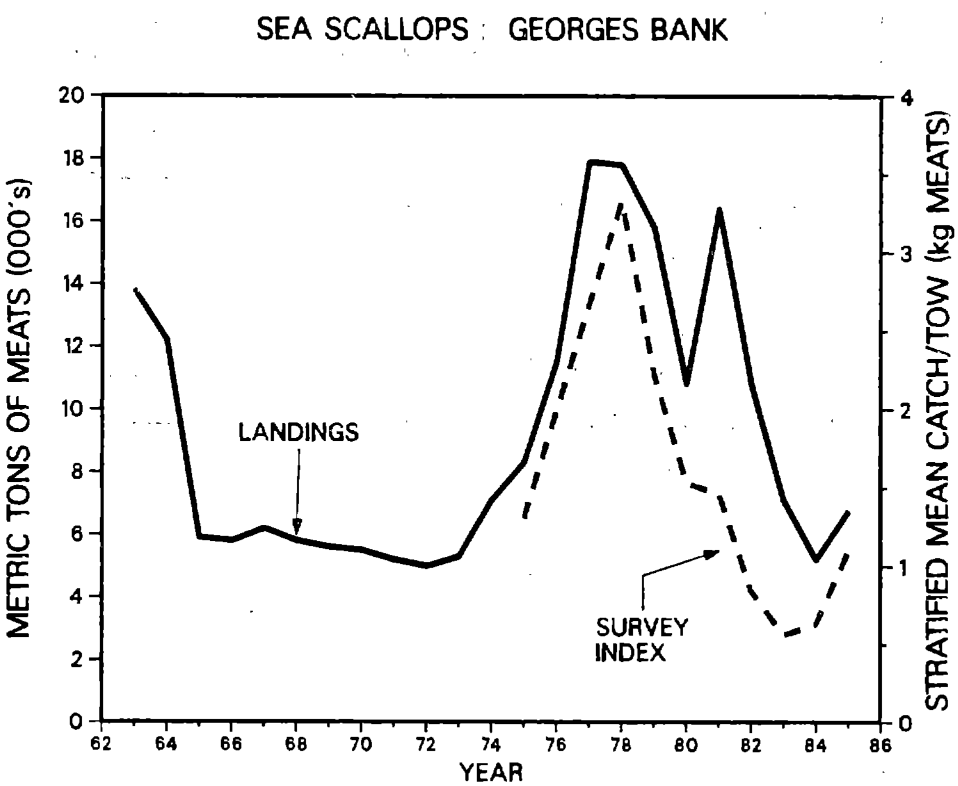


Figure 34.2 Total commercial landings and stock biomass indices from NEFC dredge surveys of sea scallops on Georges Bank.

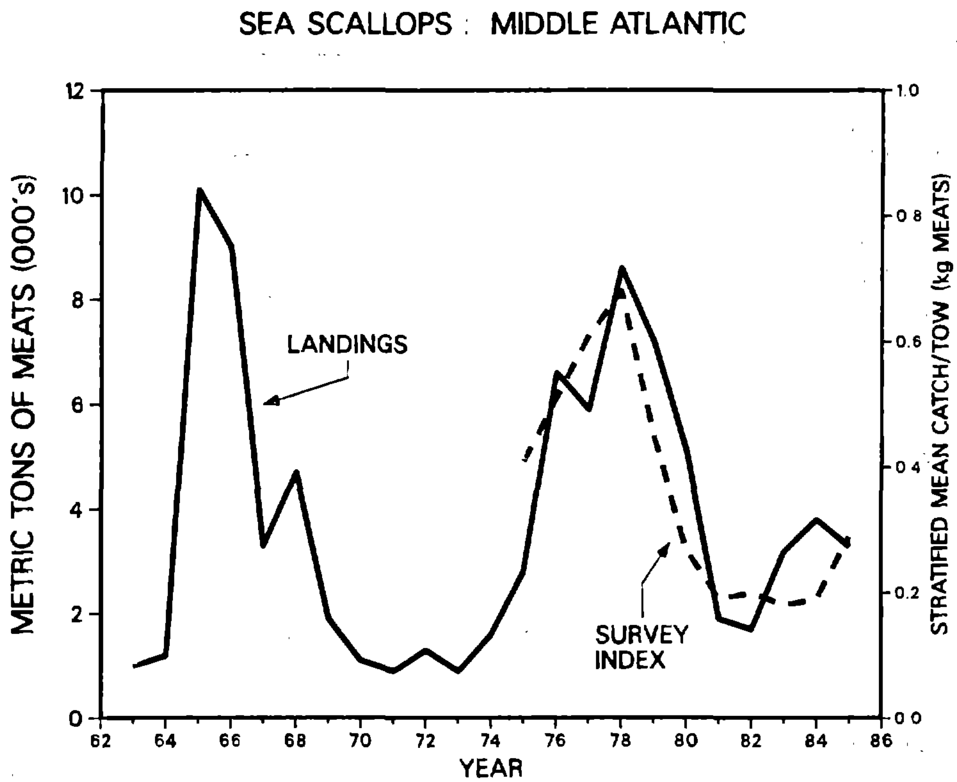


Figure 34.3 Total commercial landings and stock biomass indices from NEFC dredge surveys of sea scallops in the Mid-Atlantic area.

INDEX OF SPECIES SYNOPSES

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