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Status of Underutilized Species Stocks off the Northeast Coast of the United States

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INTRODUCTION

In recent years, increased interest has been generated in harvesting non-traditional fishery resources off the northeast coast of the United States. With recently developed technologies for handling and processing "underutilized" species, formerly considered nuisance catches, and sharp declines in traditionally harvested stocks, the possibility for increased catches is apparent. Questions are now being raised on the distribution, abundance, and yield potential of these so-called underutilized species to sustain heightened exploitation.

This report attempts to address these concerns by summarizing available data on the present status and potential yield of 14 underutilized species in the northwest Atlantic. The stock status of most of the species included in the document are excerpted from the Status of the Fishery Resources off the Northeastern United States for 1985 prepared by the Conservation and Utilization Division of the Northeast Fisheries Center. This report, updated annually, provides summaries of the general status of finfish and shellfish species inhabiting the continental shelf waters from Cape Hatteras, NC and Nova Scotia.

The seasonal distribution of each species was obtained from spring and autumn NEFC bottom trawl surveys conducted annually in the offshore continental shelf region. These surveys provided the data for examining the temporal and spatial distribution of the species as they occurred on the shelf.

Catches for each species were pooled by season over all years and plotted as catch (in weight) density distributions. The data were not

adjusted to account for trawl efficiency in capturing each species (catchability) nor for the difference between trawls used during the spring and autumn surveys. Therefore, the density distributions are not directly comparable between species, due to varying catchabilities, or directly comparable between spring and autumn for a given species, due to trawl differences. However, the distributional plots of the pooled data are representative of the relative density distribution for each species.

USA commercial landings data were also examined to detect seasonal trends. For each species, monthly catch data from 1979-1984 were summarized by stock or management area (primarily the Gulf of Maine and South for most species). For each year and area, the percentage of the annual catch taken in each month was calculated. The average monthly percentage was then calculated over the six year period and depicted in bar graphs for each species.

There are no directed fisheries for many of the species included in the analysis such as skates, longhorn sulpins, northern searobins. Consequently, monthly catch patterns for these species were based upon their by-catch in other, more traditional New England fisheries. Catch data for longhorn sculpins and northern searobins were insufficient to produce seasonal catch distributions. In these cases, the survey distribution plots depict seasonality. For those species with directed fisheries during the year, the bar graphs demonstrate their availability to the fisheries in each of the areas.

Also included is a table containing a summary of the resource and management status and estimates of potential increases in USA harvest for each species (Table 1).

ACKNOWLEDGEMENTS

The following members of the scientific staff of the Conservation and Utilization Division, listed alphabetically, contributed tables or stock status sections to this report: Frank Almeida, Emory Anderson, John Burnett, Steven Clark, Michael Fogarty, Anne Lange, Ralph Mayo, Fredric Serchuk, and Gordon Waring. Assistance in preparing the distributional plots was provided by Lorretta O'Brien, and Elizabeth Pritchard.

Table 1. Summary of status of commercial and recreational fisheries for 1985 and potential increases possible for USA harvests assuming technological improvements, conversion of foreign fisheries to full domestic use, and developing fisheries for species not currently exploited.

Species	1984 Commercial Landings		1982 Recreational Landings	Estimated[1] MSY (mt)	Current[2] Resource Status	Current[3] Management Status	Potential Increase[4] for USA Harvest (mt)
	USA	Foreign					
Red hake	2,300	100	500	42,000	UE	FMP/p	21,000
Silver hake	21,000	400	2,000	154,000	UE	FMP/p	27,000
Ocean pout	1,300	-	-	(15,000)	UE	None	14,000
Atlantic mackerel	4,500	30,000 *CD*	1,100	134,000	UE	FMP/e	200,000
Pollock	17,800	33,100 *C*	1,300	56,000	FE	FMP/p	-
Spiny dogfish	4,400	-	-	65,000	UE	None	60,000
Skates	4,100	-	-	(14,000)	UE	None	10,000
Short-finned squid	9,300	700	-	30,000	UE	FMP/e	20,000

[1]MSY values in parentheses ( ) are assumed.

[2]FE = Fully Exploited; UE = Underexploited.

[3]FMP/e = FMP currently in effect; FMP/p = FMP currently in preparation.

[4]Commercial and recreational combined.

C = Canadian landings constitute 100% of foreign catch.
CD = Canadian landings constitute 14,000 mt; Foreign landings constitute 16,000 mt.

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 (Figure 3). During their spawning period from May through November, red hake are found in the warmer shoal and inshore waters. A behavioral characteristic peculiar to red hake juveniles is the fact that many are found inside live sea scallop shells apparently using the shells as protection against predators.

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 in the commercial catch.

The following summaries of the status of the red hake stocks represent a departure from the three stock assessments performed in the past. Based upon evidence obtained from an examination of the distributional patterns from research vessel bottom trawl surveys and their general similarity to silver hake, red hake are now considered to populate two stocks. These include a northern stock, with fish from the Gulf of Maine and northern Georges Bank, and a southern stock made up of individuals inhabiting southern Georges Bank south to Cape Hatteras. Analytical assessments of these stocks are in preparation.

Gulf of Maine - Northern Georges Bank Stock

The nominal catch of red hake in 1984 was 1,059 mt, taken exclusively by the US (Table 2, Figure 1). While this catch was a modest 18% increase over 1983, it represented 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 during 1972-1976 showed a sharp rise in catches ranging from 6,300 to 15,300 mt. During this period, large catches averaging approximately 93% of the total annual catch, were taken by the distant-water-fleet 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 the distant-water fleet from the waters inhabited by this stock. US catch from this stock are taken primarily during the peak spawning period from June to October (Figure 4), however, catches are taken during all months.

The NEFC spring bottom trawl survey index increased from low levels in the late 1960's and reached a peak in 1975 before dropping sharply through 1979. The index then increased dramatically in 1980 and recorded a series high in 1982. After a decline in 1982, the survey index increased in 1983 and again in 1984. The 1984 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. The index also increased from low levels in the 1960's and early 1970's and has maintained a relatively high average value during the 1980's. Survey catch-per-tow-at-age data indicate that, like silver hake, the 1973 and 1974 year classes were the strongest since 1970. Year classes produced during 1975-1980 were of average strength with the exception of a weak 1977 cohort. The 1981 year class appeared to be above average while the 1983 year class appeared to be weak in comparison to other years. Preliminary estimates of the 1984 cohort indicate that it is of average strength.

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 1985 if catches remain at or somewhat above the levels reported in recent years.

Table 2. Nominal catches (thousands of metric tons) and management information for red hake from the Gulf of Maine - northern Georges Bank stock, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.5	0.9	1.2	1.5	1.0	1.2	1.2	0.9	1.1
Canada	-	-	-	-	-	-	-	-	-
Other	9.9	-	-	-	-	-	-	-	-
Total nominal catch	10.4	0.9	1.2	1.5	1.0	1.2	1.2	0.9	1.1
Total allowable catch	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[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 yrs
Size at 50% maturity = 28.1 cm (11.1 inches)

$M = 0.40$ $F_{0.1}$ = Unknown F_{max} = >2.00 F_{1984} = Unknown

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

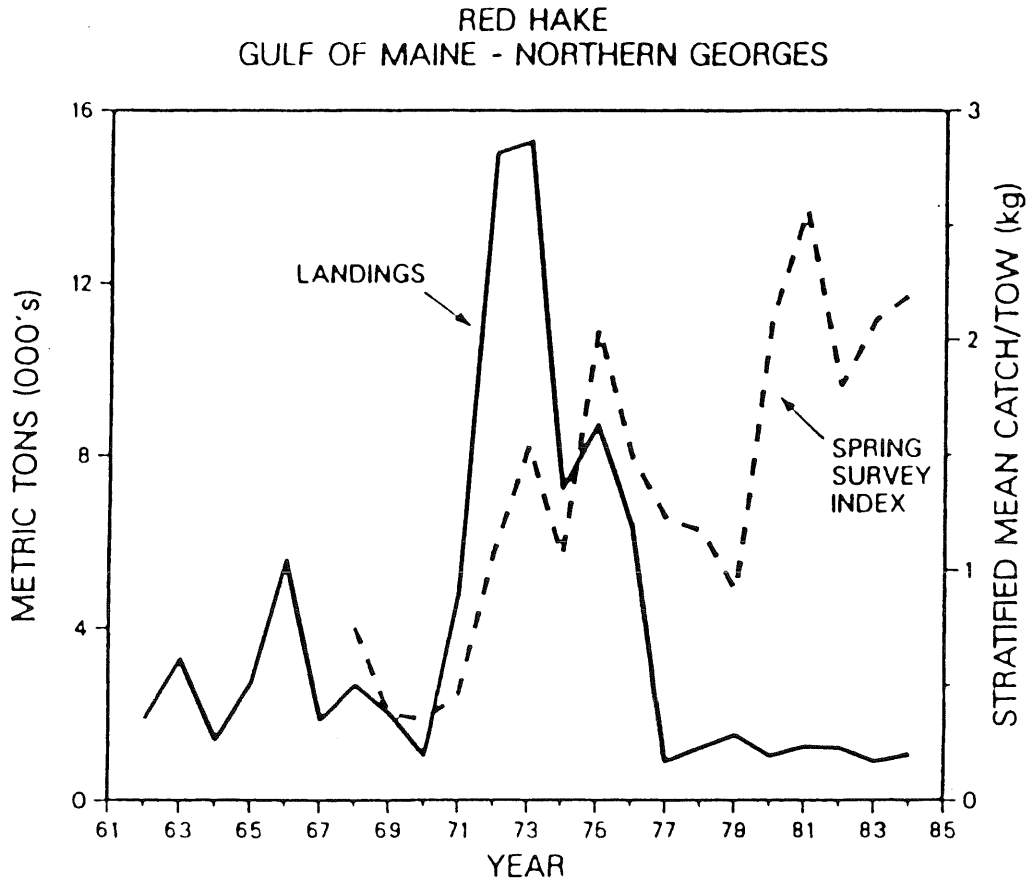


Figure 1. Total commercial landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of red hake.

Southern Georges Bank-Middle Atlantic Stock

The international nominal catch of red hake in 1984 was 1,771 mt, the lowest catch reported in the 1960-1984 time series and continuing a trend of decreasing catches which began in 1977 (Table 3, Figure 2). The US catch in 1984 was 1,214 mt, and the distant-water-fleet catch was reported to be only 57 mt. Recreational catch was assumed to be about 500 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 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 due to modest declines in DWF catch and then, because of a sharp decline in DWF catch; from 18,600 mt in 1976 to an average of only 130 mt during 1980-1984. 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 foreign squid fishery. Catches from this stock are reported during all months with peak months being November-January and again in April-May (Figure 4).

US 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 4,700 mt in 1970. US catch has remained relatively steady during the 1970's and 1980's. With the exception of 1979 which saw a US catch of 6,600 mt, catches have ranged between 3,900 mt in 1980 and 1,214 mt in 1984 and have averaged 2,600 mt.

The NEFC autumn bottom trawl survey index declined steadily from high levels in the mid-1960's and then remained fairly constant during 1968-1973 before dropping to a series low in 1974. The index increased sharply in 1975 before declining slightly and again remaining fairly steady during 1976-1983 at a level similar to that during 1968-1973. In 1984, the index dropped sharply to the second lowest level in the series. Survey mean catch-per-tow-at-age indices indicated 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.

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 to the catch. It is unlikely that any major declines will be effected in 1985 if catches remain at or somewhat above the levels reported in recent years.

Table 3. Nominal catches (thousands of metric tons) and management information for red hake from the southern Georges Bank - Middle Atlantic stock, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational[1]	0.3	0.8	0.7	0.5	0.5	0.5	0.5	0.5	0.5
Commercial									
USA	2.8	2.5	3.3	6.6	3.9	2.1	3.0	1.3	1.2
Canada	-	-	-	-	-	-	-	-	-
Other	33.6	4.5	2.1	1.0	0.2	0.2	0.2	0.1	0.1
Total nominal catch[1]	36.7	7.8	6.1	8.1	4.6	2.8	3.7	1.9	1.8
Total allowable catch[2]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]

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 yrs
Size at 50% maturity = 27.6 cm (10.9 inches)

M = 0.40 $F_{0.1}$ = Unknown F_{max} = >2.00 F_{1984} = Unknown

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

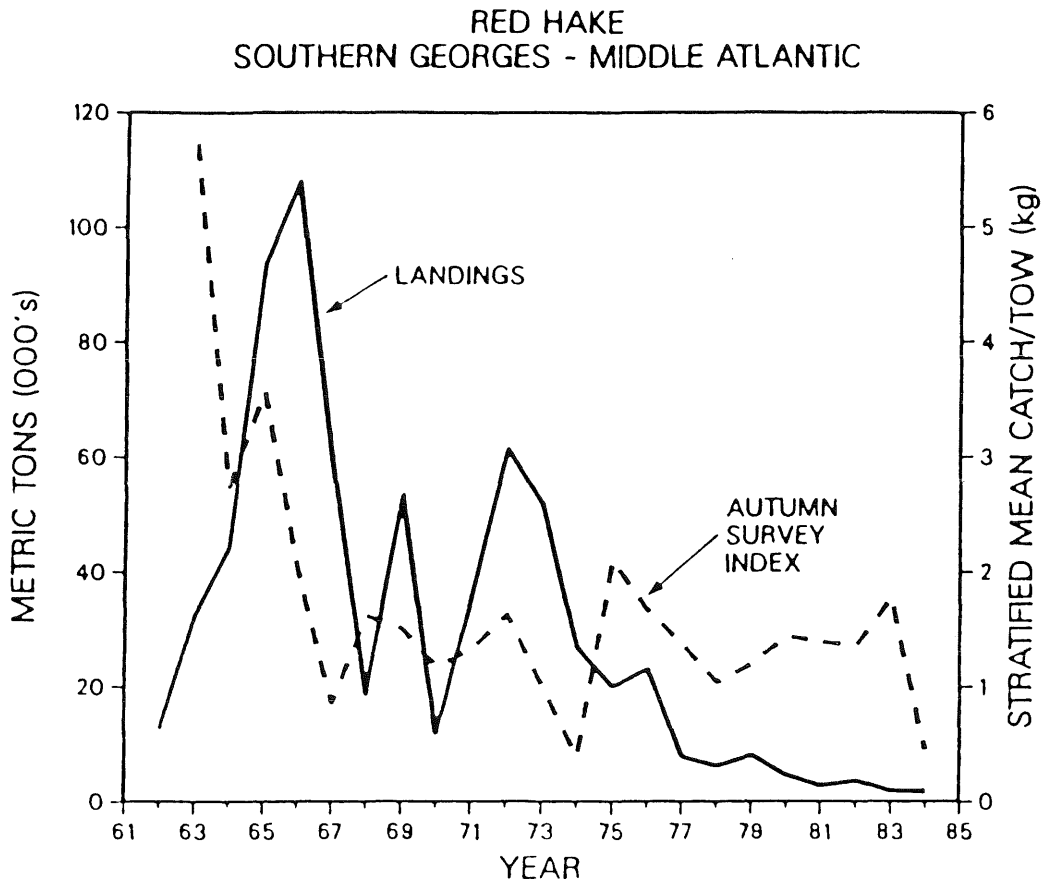


Figure 2. Total commercial landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of red hake.

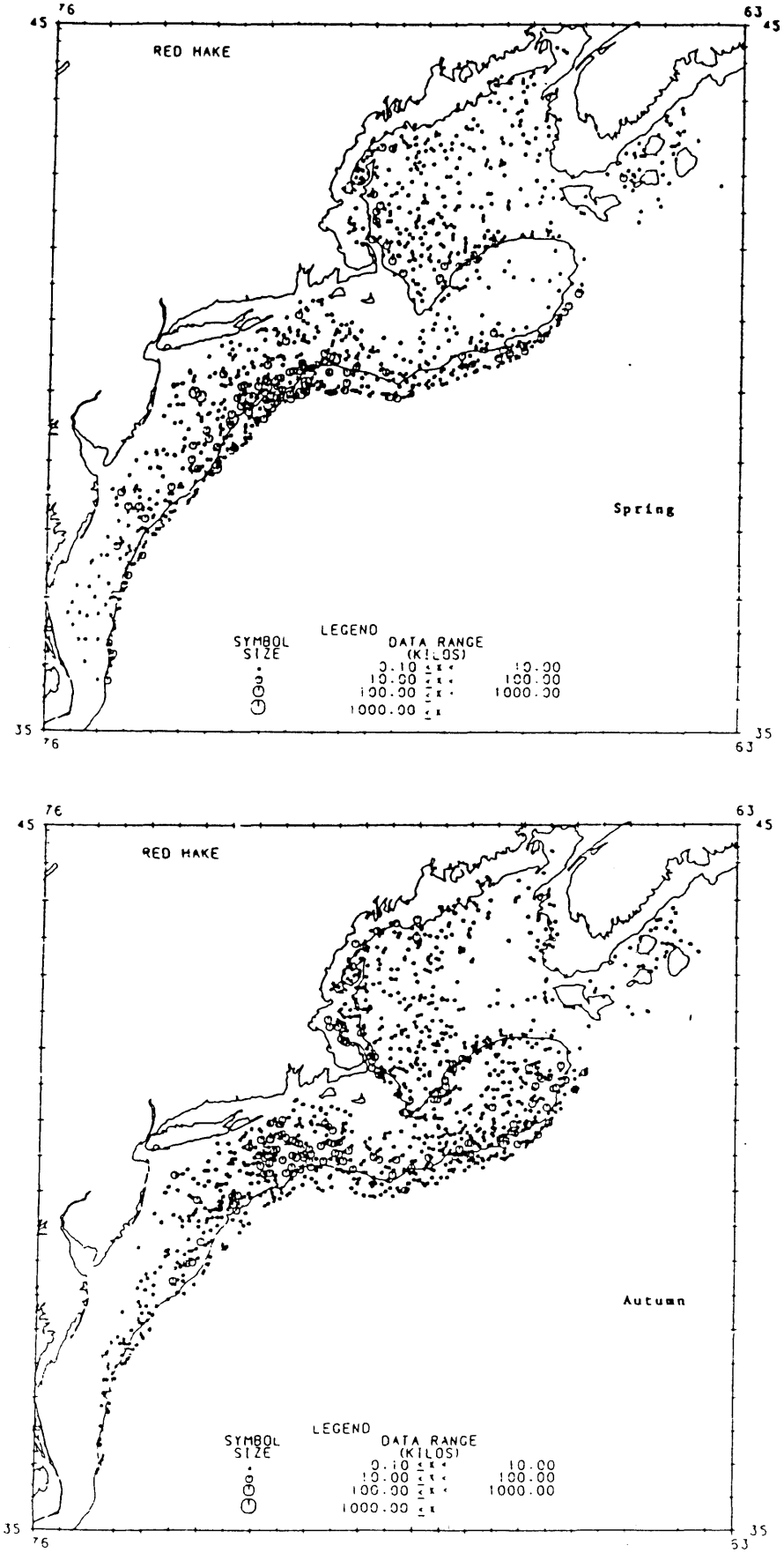


Figure 3. Distribution of red hake during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

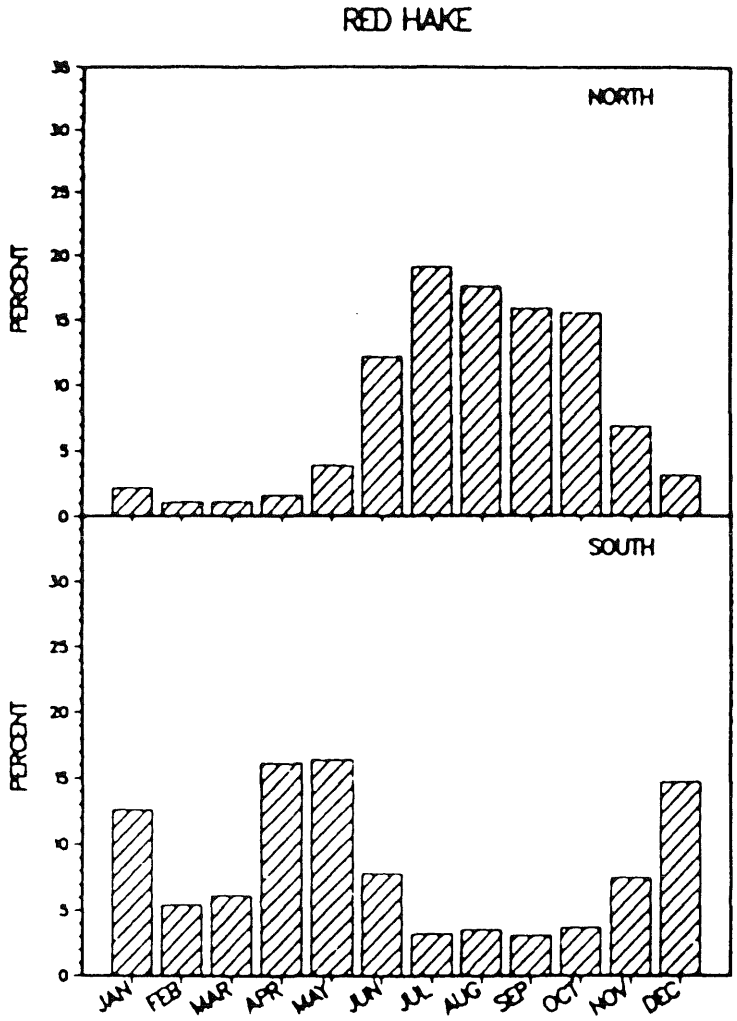


Figure 4. Distribution of average monthly commercial red hake landings from 1979-1984.

SILVER HAKE

The silver hake or whiting (Merluccius bilinearis) is a widely distributed, slender, swiftly swimming fish with a range extending from Newfoundland to South Carolina, but most abundant off the New England coast. Research vessel bottom trawl surveys 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 (Figure 8).

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.

The following summaries of the status of silver hake stocks represent a departure from the three stock assessments performed in the past. Recently completed stock delineation studies have indicated that silver hake should be assessed as two stocks. These are a northern stock including fish from the Gulf of Maine and northern Georges Bank, and a southern stock made up of silver hake inhabiting southern Georges Bank south to Cape Hatteras. For more information regarding the stock identification studies see Almeida (1985). Analytical assessments of the silver hake stocks are in preparation.

Gulf of Maine-Northern Georges Bank Stock

The nominal catch of silver hake in 1984 was 8,300 mt, taken exclusively by the US (Table 4, Figure 6). While this catch represented a 56% increase over 1983 and was the highest level reported since 1978, this level is still well below those 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 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 41,200 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 before increasing in both 1983 and 1984. Prior to the inception of the MFCMA, the distant-water-fleet 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. However, after 1978 catches declined and have remained at a reduced level.

The US fishery for silver hake is primarily prosecuted during the summer and autumn, July-November. During the rest of the year, this species inhabits offshore waters and are sought after by US fishermen (Figure 9).

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, in the autumn the index increased sharply to its highest level since 1976 due primarily to a strong 1982 year class. In 1984, both surveys declined. 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.

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.

Table 4. Nominal catches (thousands of metric tons) and management information for silver hake from the Gulf of Maine - northern Georges Bank stock, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	10.7	12.4	12.6	3.4	4.7	4.4	4.7	5.3	8.3
Canada	-	-	-	-	-	-	-	-	-
Other	16.2	-	-	-	-	-	-	-	-
Total nominal catch	26.9	12.4	12.6	3.4	4.7	4.4	4.7	5.3	8.3
Total allowable catch	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[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 yrs
Size at 50% maturity = 23.8 cm (9.4 inches) males; 25.0 cm (9.8 inches) females

M = 0.40 $F_{0.1}$ = Unknowwn F_{max} = >2.00 F_{1984} = Unknown

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

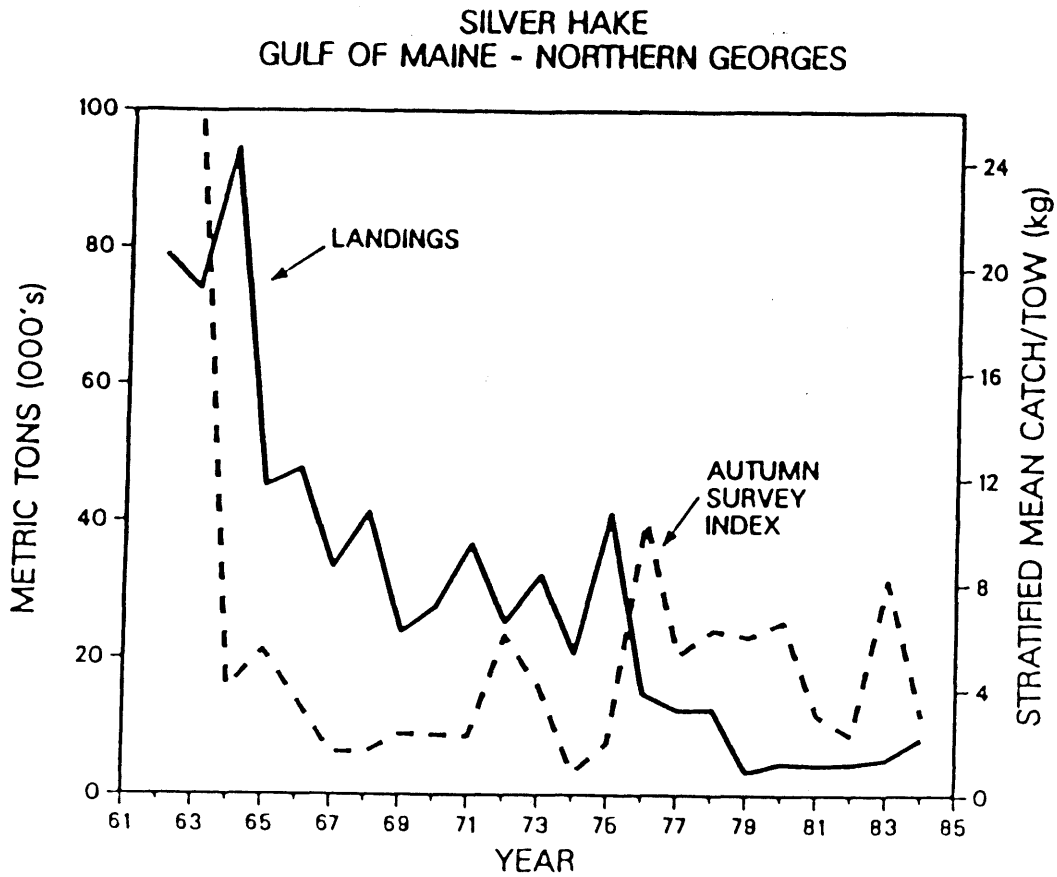


Figure 6. Total commercial landings and stock biomass indices for the Gulf of Maine - northern Georges Bank stock of silver hake.

Southern Georges Bank-Middle Atlantic Stock

The international nominal catch of silver hake in 1984 was 15,143 mt (Table 5, Figure 7). This level of catch was the lowest reported since 1960. The US catch in 1984 was 14,731 mt, the second highest level since 1965 and maintaining the fairly constant level of catches which have averaged about 14,000 mt during 1977-1983. Distant-water-fleet catch was only 412 mt, the lowest level reported since their introduction to the fishery in 1962. The DWF catch, from 1963 to the inception of MFCMA, dominated the catch from this stock averaging 87% annually. Recreational catch in 1984 was assumed to be about 2,000 mt.

Total catches from this stock increased from an average of 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 15,800 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. US catches are taken primarily in the winter months, December-May, although catches are reported during all months (Figure 9).

The NEFC autumn bottom trawl survey catch-per-tow index has reflected trends similar to those in commercial catch statistics. The index increased to a high in 1965 and declined steadily thereafter to a low level in 1969. The index then increased and remained fairly constant during 1970-1973, but dropped sharply to its lowest level in 1974. After increasing steadily through 1978 the index then dropped again during 1979-1981, and then increased again in 1982 and 1983. However, in 1984, the index dropped to its 1981 level. 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 cohort, has appeared to be of only average strength although the 1982 year class may be stronger than others.

Since 1978, this stock has been under very little fishing pressure when 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 1985.

Table 5. Nominal catches (thousands of metric tons) and management information for silver hake from the southern Georges Bank - Middle Atlantic stock, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	0.9	3.9	2.0	2.3	2.0	2.0	2.1	2.0	2.0
Commercial									
USA	7.4	9.5	11.4	13.1	11.7	11.7	11.9	11.5	12.7
Canada	-	-	-	-	-	-	-	-	-
Other	82.1	47.9	14.4	4.9	1.7	3.0	2.4	0.6	0.4
Total nominal catch	90.4	61.3	27.8	20.3	15.4	16.7	16.4	14.1	15.1
Total allowable catch	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]

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 yrs
Size at 50% maturity = 24.7 cm (9.7 inches) males; 25.7 cm (10.1 inches) females

M = 0.40 $F_{0.1}$ = Unknown F_{max} = >2.00 F_{1984} = Unknown

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

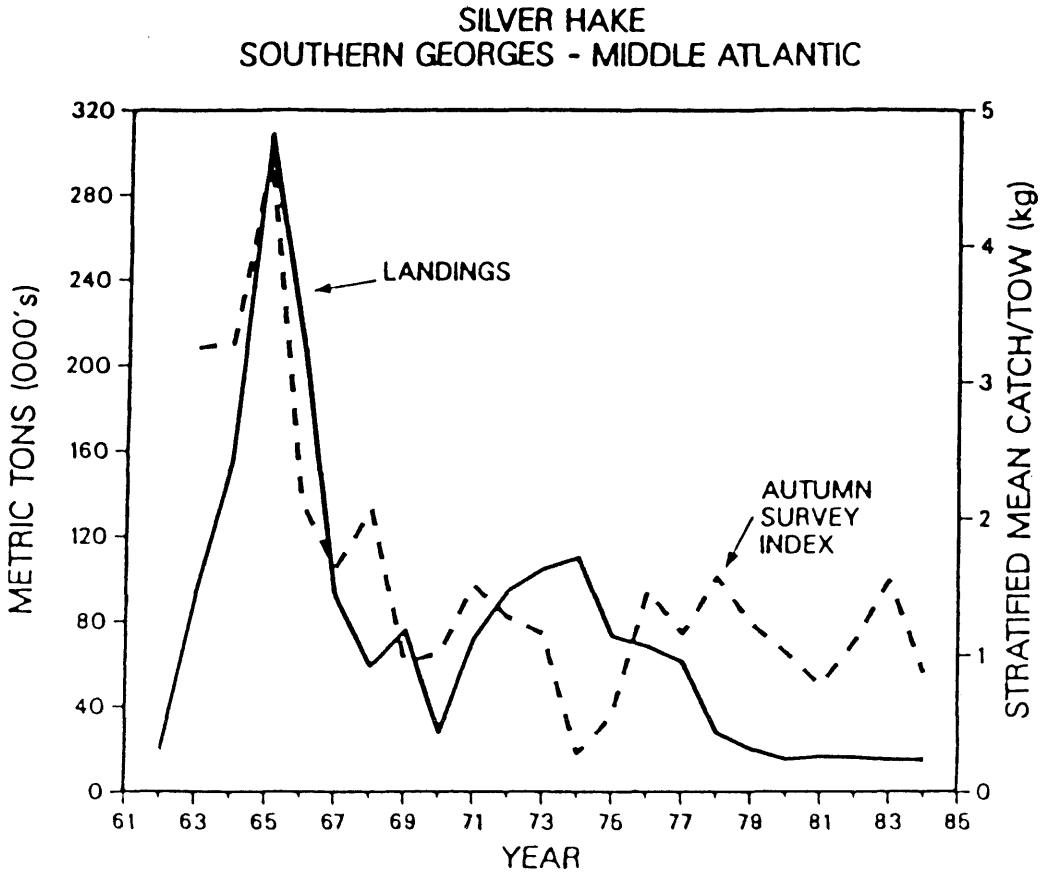
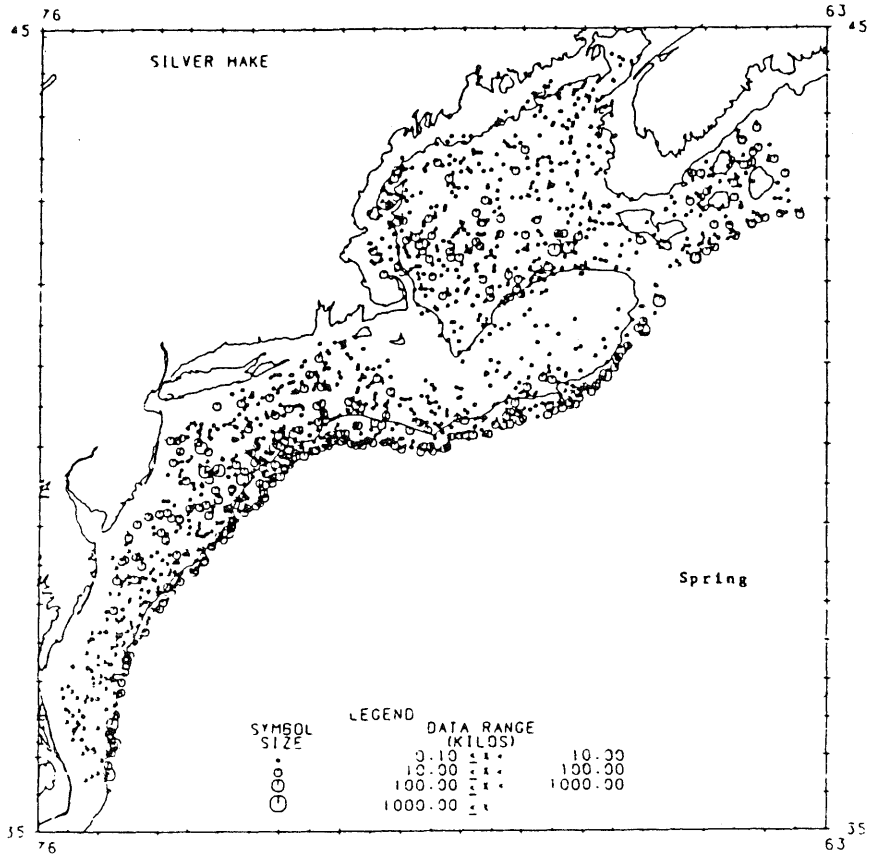


Figure 7. Total commercial landings and stock biomass indices for the southern Georges Bank - Middle Atlantic stock of silver hake.



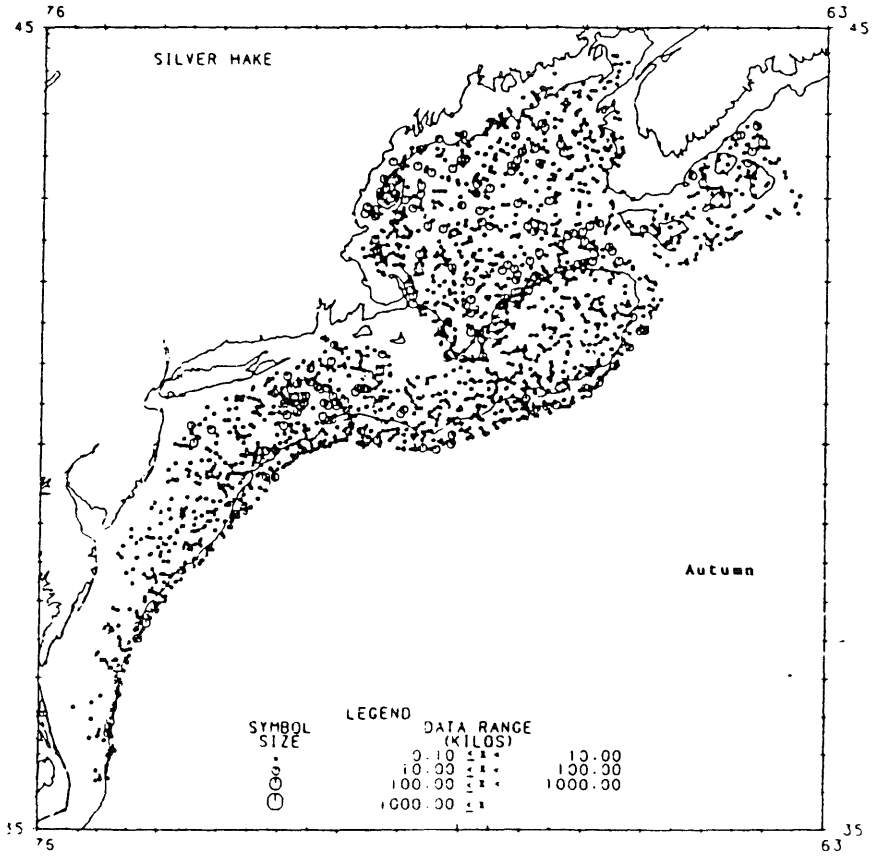


Figure 8. Distribution of silver hake during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

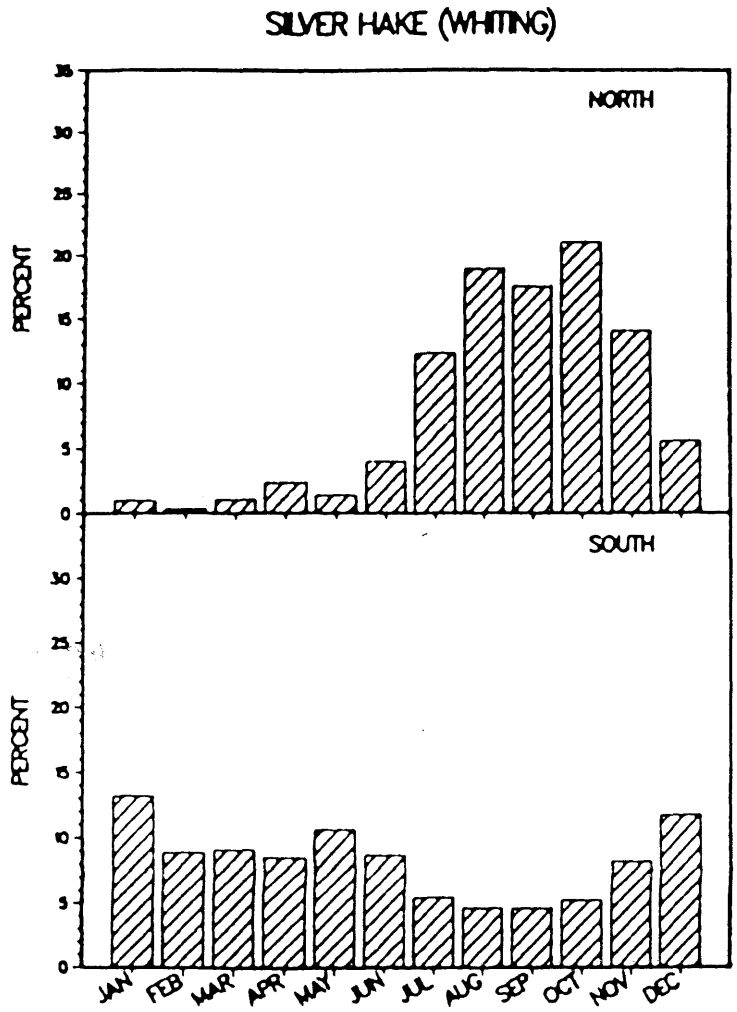


Figure 9. Distribution of average monthly commercial silver hake landings from 1979-1984.

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 (Figure 11). 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 (Table 8, Figure 10). 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 560 mt annually from 1975 to 1983; however, catches increased to 1324 mt in 1984 largely due to the development of a small directed fishery in Cape Cod Bay supplying the fresh fillet market. 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 (Figure 12).

Due to the ocean pout's pattern of seasonal distribution, the NEFC spring survey index is more useful in 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 277 mt and 1.34 kg/tow, respectively, by 1975 (Figure 10). 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 0.75 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.

Table 8. Nominal catches (thousands of metric tons) and management information for ocean pout from the Middle Atlantic - southern New England area, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.9	1.0	1.0	0.7	0.4	0.3	0.3	0.4	1.3
Canada	-	-	-	-	-	-	-	-	-
Other	0.9	-	-	-	-	-	-	-	-
Total nominal catch	2.8	1.0	1.0	0.7	0.4	0.3	0.3	0.4	1.3
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_{1984} = Unknown

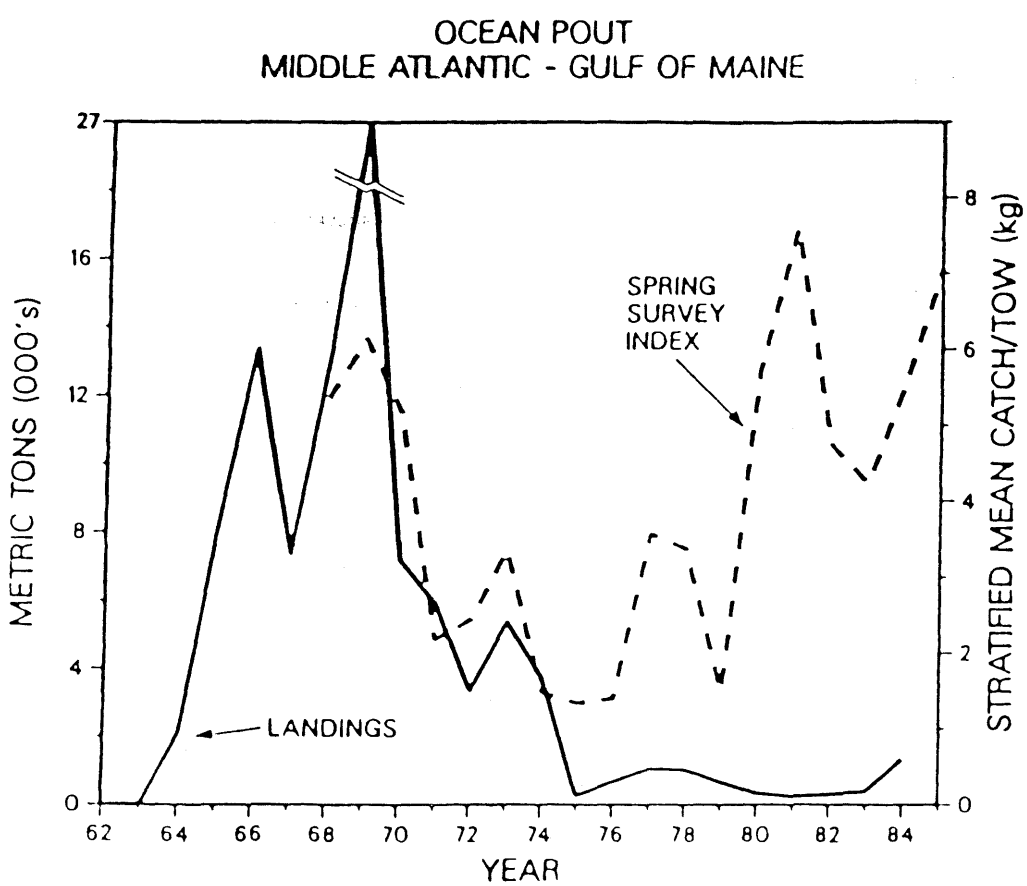
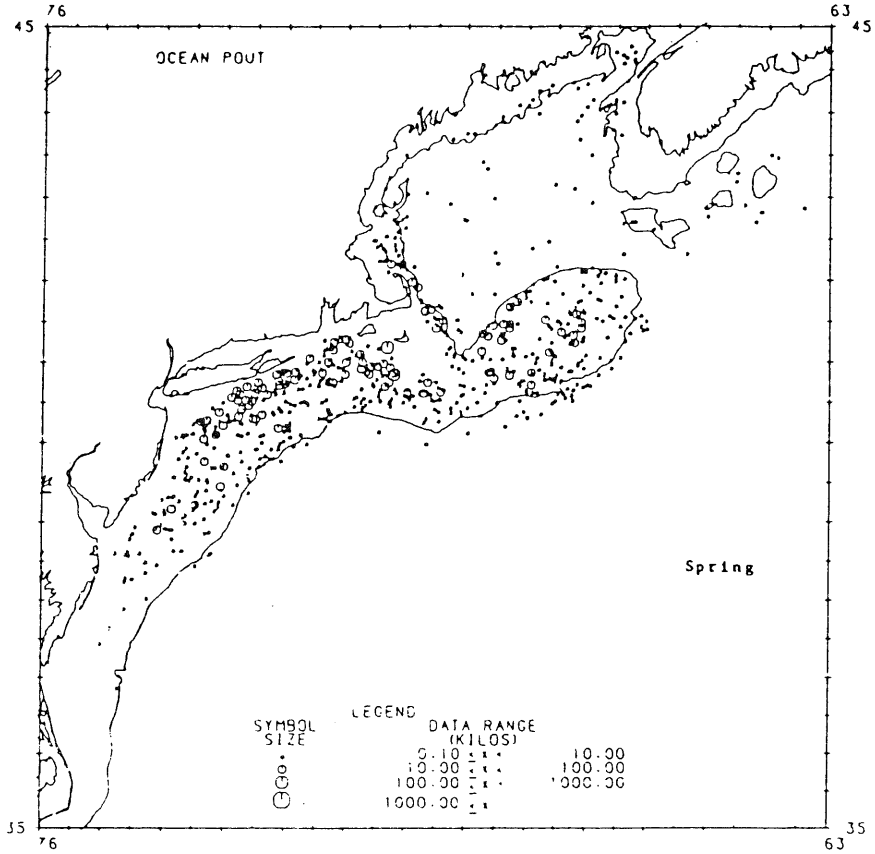


Figure 10. Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of ocean pout in the Middle Atlantic - Gulf of Maine area.



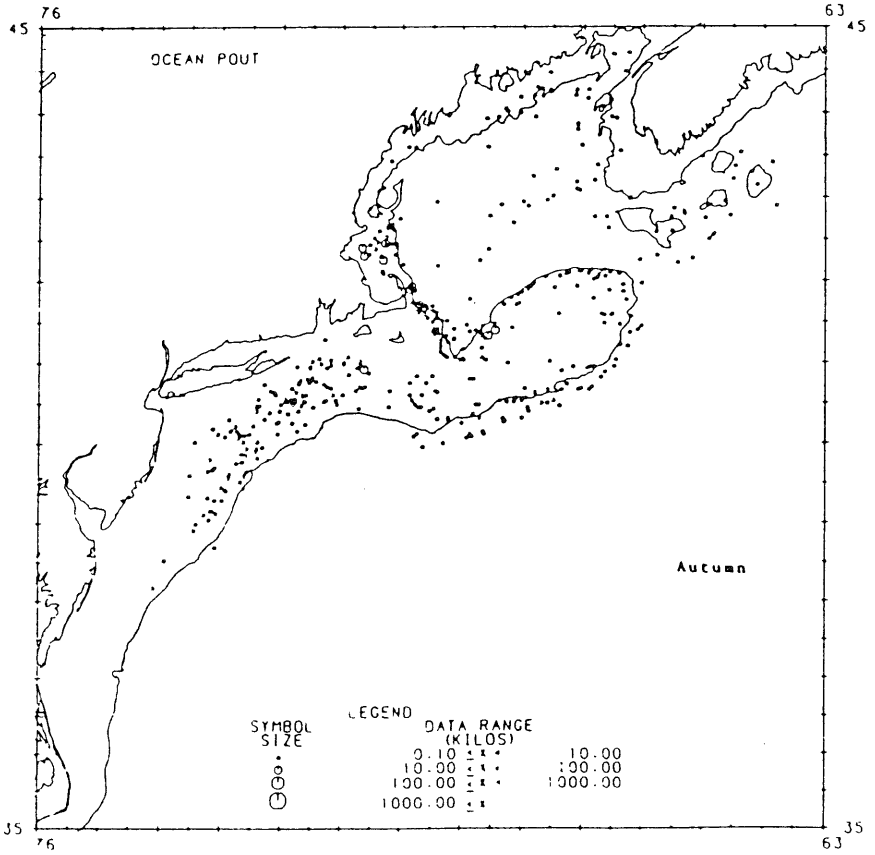


Figure 11. Distribution of ocean pout during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

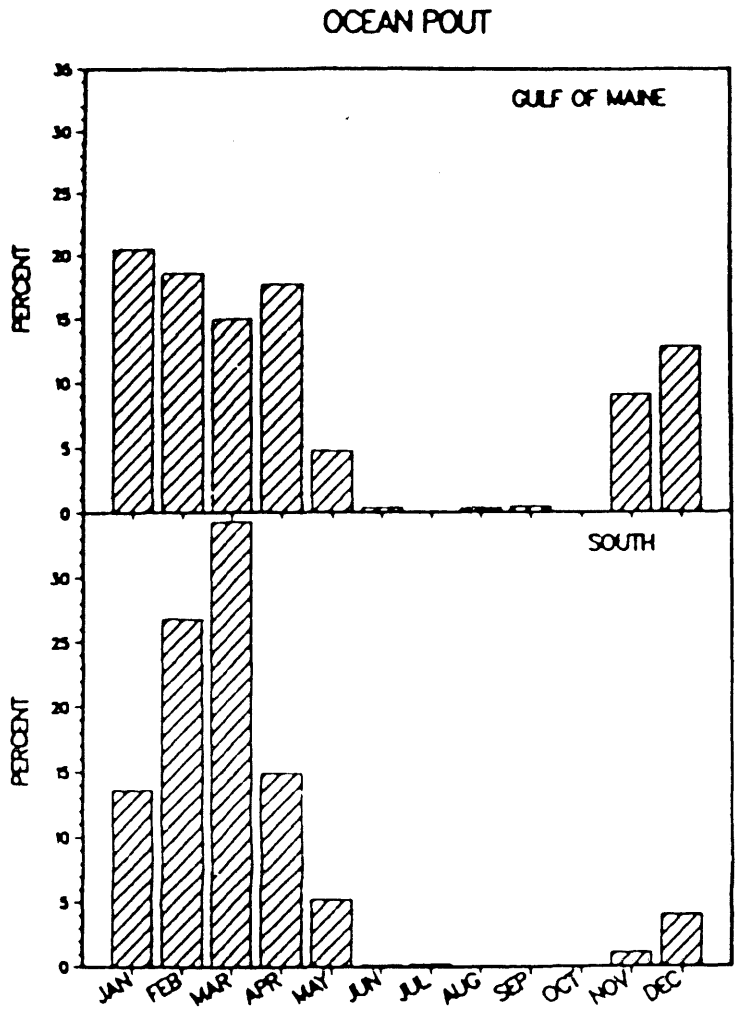


Figure 12. Distribution of average monthly commercial ocean pout landings from 1979-1984.

ATLANTIC MACKEREL

Atlantic mackerel (Scomber scombrus) is a fast swimming, pelagic, schooling species distributed in the Northwest Atlantic between Labrador and North Carolina (Figure 14). 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°, 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 or 2.85 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 - Mid-Atlantic coastal waters and during May-December in coastal Gulf of Maine waters (Figure 15). 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 32,556 mt in 1983 to 37,700 mt in 1984 (Table 11). Catches remained fairly stable during 1978-1984, averaging 32,800 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 1968-1977 by vessels from 13-14 nations when reported catches peaked at 430,400 mt in 1973 (Figure 13).

The USA accounted for 20% of the 1984 international catch, including about 4,400 mt commercial and an estimated 3,000 mt recreational, a slight increase from 1983. The Canadian catch declined from 19,785 mt in 1983 to about 14,500 mt in 1984, 38% of the total. The distant-water-fleet catch increased from about 6,000 mt in 1983 to 15,800 mt in 1984. About 5,500 mt of the 1984 catch was taken by Poland in a research fishery with the NEFC.

Fish from the 1981 year class (age 2) comprised 26% of the international catch in numbers in 1983. The 1974 year class (age 9) with 19% and the 1978 year class (age 5) with 13%, were also important contributors to the 1983 international catch. The 1983 Canadian catch consisted of 24% age 9 and 15% age 5 fish. The USA commercial catch was 63% 1981 year-class fish (age 2) followed by 7% 1982 year-class fish and 7% 1974 year-class fish. The distant-

water-fleet catch in 1983 (principally Polish) consisted primarily of the 1981 (33%) and 1974 (17%) year classes. A January-April 1984 Polish research catch of about 5,500 mt was comprised mainly of the 1982 (32%) and 1981 (28%) year classes.

The catch-per-tow indices for mackerel from the NEFC spring and autumn bottom trawl surveys increased sharply from 1983 to 1984. USA commercial catch-per-day for ages 4 and older increased slightly from 1982 to 1983 reflecting the steady increase in biomass of age 4 and older fish.

Fishing mortality (F) at ages 3 and older in 1983 was estimated to be 0.06; 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 analysis 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. The catch of 37,700 mt in 1984 generated an estimated F of 0.05. $F_{0.1}$ for mackerel at 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.

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 which averaged 485,000 mt per year (Figure 13). The total stock increased to about 1,200,000 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 1,000,000 mt at the start of 1985.

Rebuilding of the mackerel stock has been aided by relatively low catches during 1978-1984 (average of 32,800 mt) as well as markedly improved recruitment from the 1980-1982 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 international catch in 1985 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, a TALFF of 51,050 mt, and a Reserve of 51,050 mt. These recommendations are based on a projected catch of 270,300 mt for the total international mackerel fishery in the Northwest Atlantic resulting from fishing mortality at $F_{0.1}$ = 0.29.

Table 11. Nominal catches (thousands of metric tons) and management information for Atlantic mackerel from Labrador to North Carolina, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	8.7	0.5	6.6	3.7	2.4	5.1	1.1	3.0	3.0
Commercial									
USA	1.8	1.4	1.6	2.0	2.7	2.9	3.3	3.8	4.4
Canada	16.8	20.4	25.4	30.2	22.1	19.3	16.4	19.8	14.4
Other	321.0	56.1	0.8	0.4	0.6	5.4	6.6	6.0	15.8
Total nominal catch	348.3	78.9	34.4	36.4	27.8	32.6	27.5	32.6	37.6
Total allowable catch[1,2]	-	105.0	15.5	15.5	30.0	30.0	30.0	101.7	87.0

Long-term potential catch = 134.0[3]
Importance of recreational fishery = Moderate
Status of management = FMP in force since 1979
Status of exploitation = Underexploited
Age at 50% maturity = 2 yrs
Size at 50% maturity = 32.7 cm (12.9 inches) fork length

$M = 0.20$ $F_{0.1} = 0.29$ $F_{max} = 0.62$ $F_{1984} = 0.05$

[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 $F_{0.1}$.

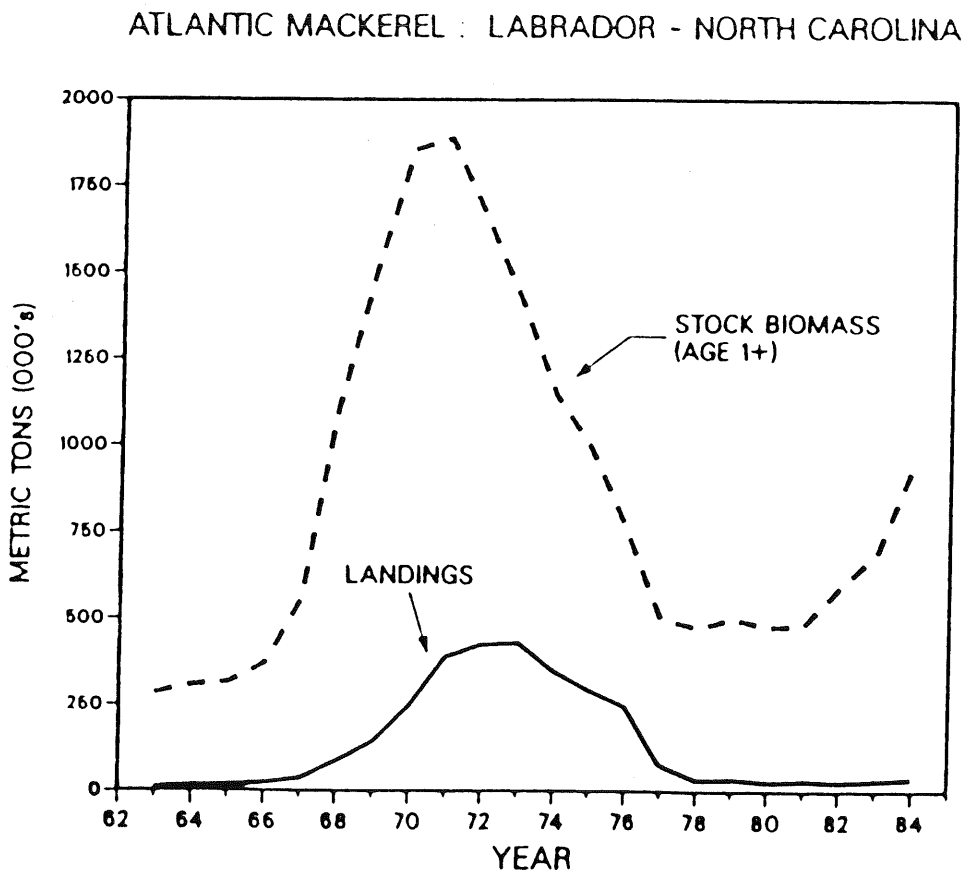
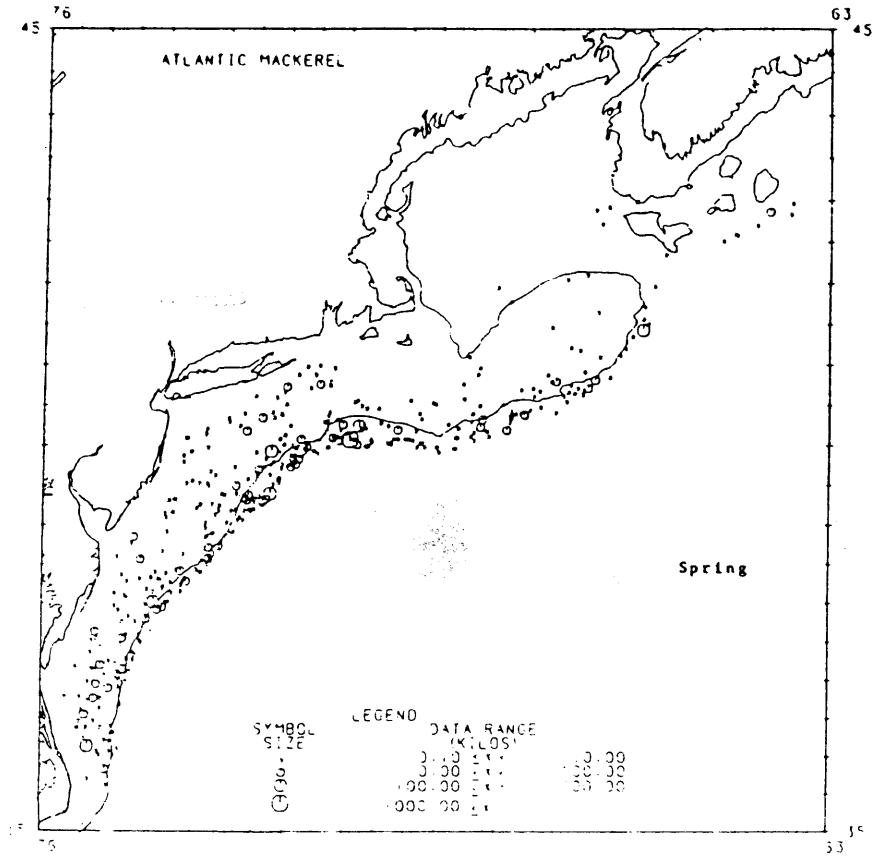


Figure 13. Total commercial and recreational landings and estimates of stock biomass of Atlantic mackerel in the Labrador - North Carolina area.



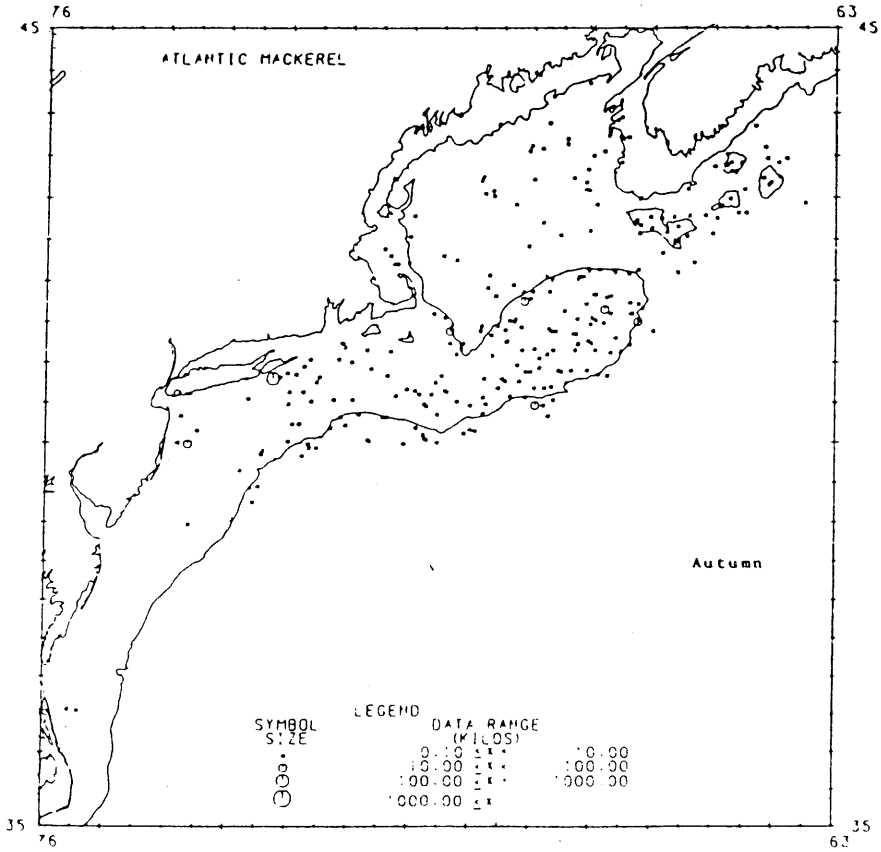


Figure 14. Distribution of Atlantic mackerel during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

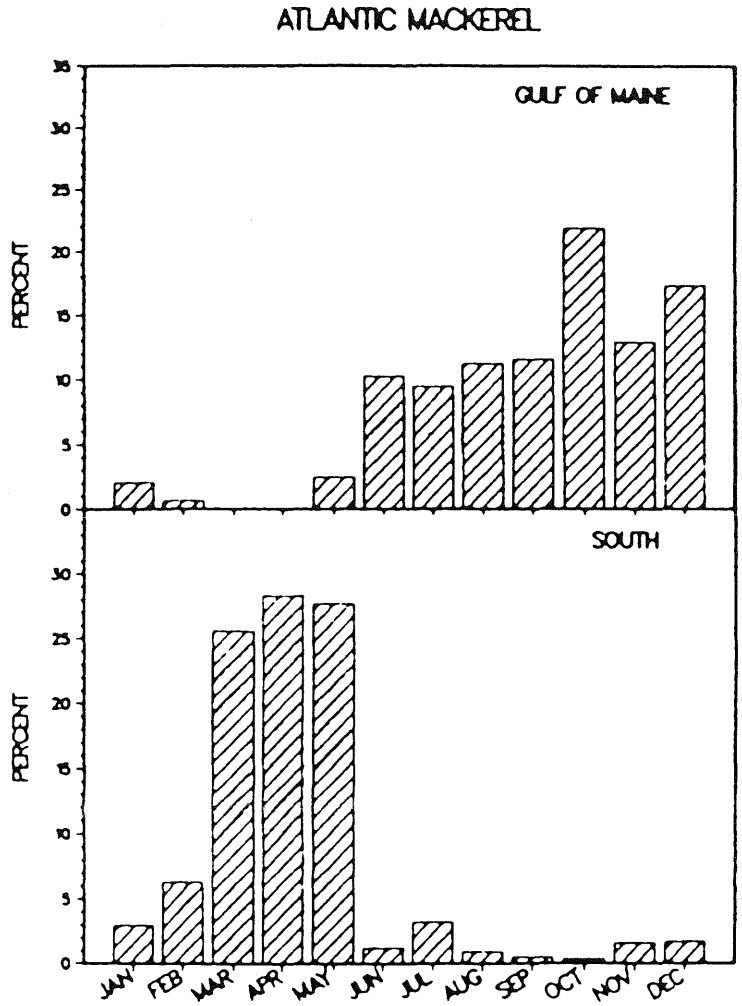


Figure 15. Distribution of average monthly commercial Atlantic mackerel landings from 1979-1984.

ATLANTIC MENHADEN

Atlantic menhaden (Brevoortia tyrannus) are distributed in temperate coastal waters from Nova Scotia to Florida and are found in waters north of Cape Hatteras, NC primarily during the summer and autumn months. Like herring, they travel in schools made up of hundreds to thousands of individuals, usually of similar size. Spawning north of Cape Hatteras takes place primarily in southern New England waters during June-August. Adults average about 31-38 cm (12-15 inches), however individuals as large as 46 cm (18 inches) have been observed.

Menhaden are one of the most important commercial species in the USA, used primarily for industrial purposes such as for oil, fishmeal, fertilizer, bait, and pet foods. Nominal catches from waters north of Cape Hatteras during 1970-1984 have been fairly steady, averaging 289,000 mt (range of 200,000 to 350,000 mt) (Figure 16) taken primarily during June-September (Figure 17). These catches however are only a small percentage of the total Atlantic and Gulf menhaden landings reported each year, averaging 20% of the total annual catch during 1981-1984. Catches are taken virtually exclusively by the USA, total foreign catch for 1970-1984 were 213 mt for all years combined.

Relatively little assessment research has been done by the NEFC concerning this species because of the small percentage of the total catch taken in the waters north of Cape Hatteras.

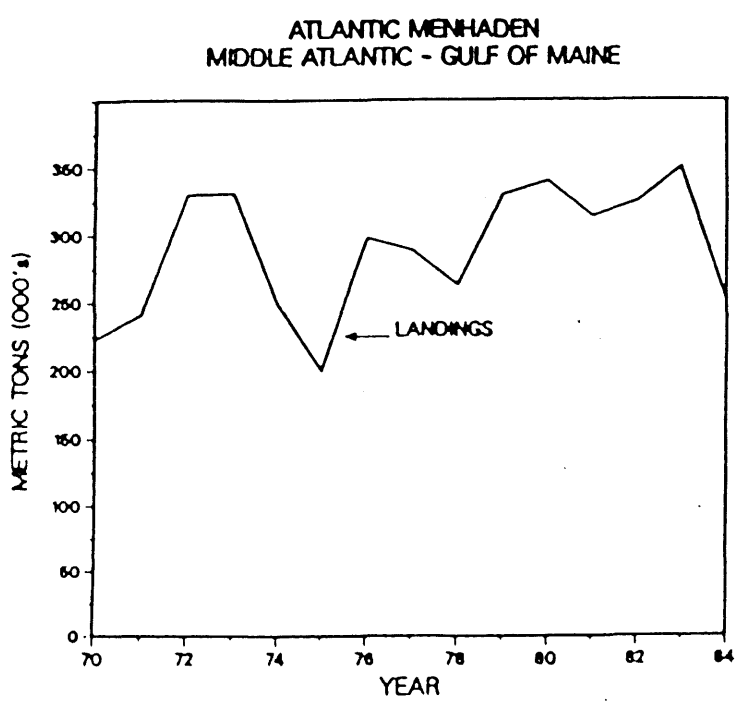


Figure 16. Total commercial landings of Atlantic menhaden in the Middle Atlantic - Gulf of Maine area.

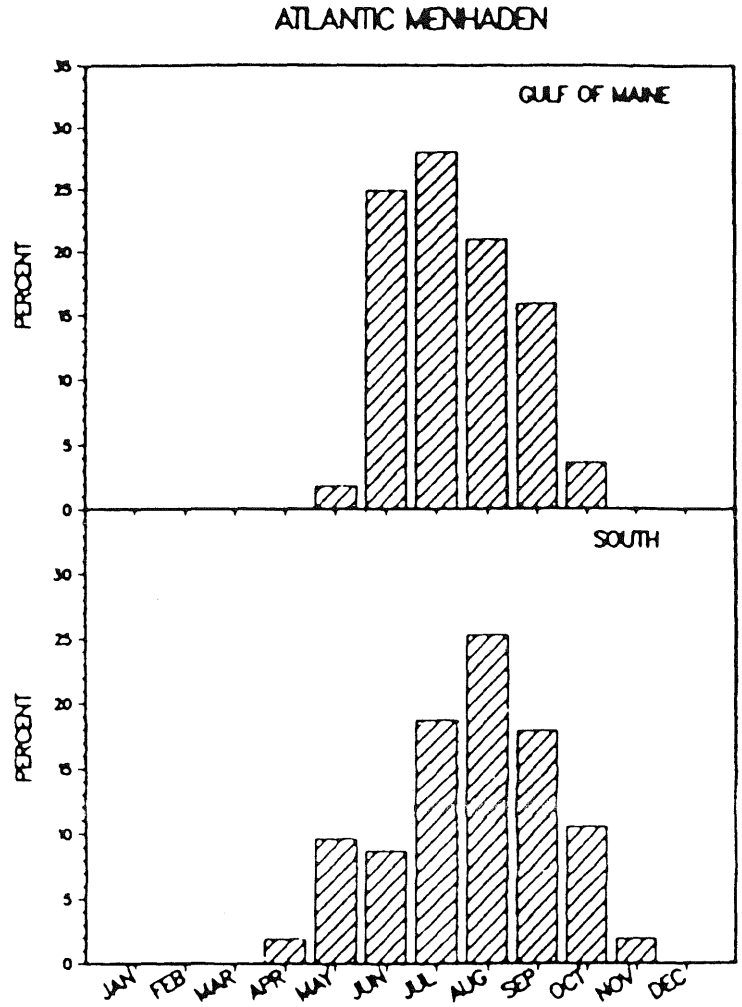


Figure 17. Distribution of average monthly commercial Atlantic menhaden landings from 1979-1984.

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 (Figure 19). 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 appears to have 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 59,000 mt in 1981, but have since declined. The 1984 total was 51,000 mt, of which 33,100 mt was taken by Canada and 17,800 mt by the USA (Table 12). Nominal catches from the Gulf of Maine are generally fairly constant during May through October and then increase during their spawning period, November-January. The lowest percentages of average monthly catches are usually reported during February-April. In waters south of the Gulf of Maine, primarily on Georges Bank, catches are fairly constant throughout the year (Figure 20). Nominal catches for Canada increased steadily from 24,700 mt in 1977 to 40,300 mt in 1981, but have since declined; USA catches have increased from an average of 8,200 mt during 1972-1976 to over 14,000 mt annually since 1978, peaking at over 18,000 mt in 1980 and 1981. Nominal catches by distant-water fleets have declined from an average of 6,000 mt during 1972-1976 to only 400-500 mt during 1981-1983. Most of this catch has been taken by USSR vessels on the Scotian Shelf. Estimated USA recreational catches have fluctuated between 700 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 almost 60,000 mt in 1981; the 1984 total was 52,000 mt.

Total stock size appears to be relatively high at present. Canadian commercial abundance indices (mt/hour fished) increased sharply in 1979, and the 1979-1983 average for 501-999 GT trawlers (1.2 mt/hour) is almost twice the corresponding 1974-1977 average (0.7 mt/hour). Indices for USA 51-500 GT 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 176,000 mt in 1973-1974 to 322,000 mt in 1981. Biomass subsequently declined to 296,000 mt in 1983, but has since increased to 312,000 mt in 1984 (Figure 18).

Equilibrium yield calculations indicate that fishing at $F_{0.1}$ would provide a long-term catch of 56,000 mt from a stock biomass of 338,000 mt, while fishing at F_{max} would provide a catch of 61,000 mt from a stock biomass of 225,000 mt. Since 1980, fishing mortality levels appear to have approximated F0.1.

Table 12. Nominal catches (thousands of metric tons) and management information for pollock from the Scotian Shelf, Gulf of Maine, and Georges Bank area, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational[1]	1.1	2.7	1.8	0.7	1.0	0.7	1.3	1.0	1.0
Commercial									
USA	8.2	13.1	17.7	15.5	18.3	18.2	14.4	14.0	17.8
Canada	24.0	24.7	26.8	30.0	36.0	40.3	38.0	32.7	33.1
Other	6.0	0.7	0.8	1.1	1.2	0.5	0.4	0.5	0.1
Total nominal catch	39.3	41.2	47.1	47.3	56.5	59.7	54.1	48.2	52.0
Total allowable catch	-	30.0[2]		-	-	-	-	-	-

Long-term potential catch = 56.0
Importance of recreational fishery = Minor
Status of management = FMP in preparation (USA fishery)
Status of exploitation = Fully exploited
Age at 50% maturity = 3.1 yrs
Size at 50% maturity = 50 cm (20 inches)

$M = 0.20$ $F_{0.1} = 0.25$ $F_{max} = 0.49$ $F_{1984} = 0.27$

[1]Data for 1974 and 1979-82 taken from recreational surveys; remaining points estimated.
[2]Recommended by ICNAF but not implemented under extended jurisdiction.

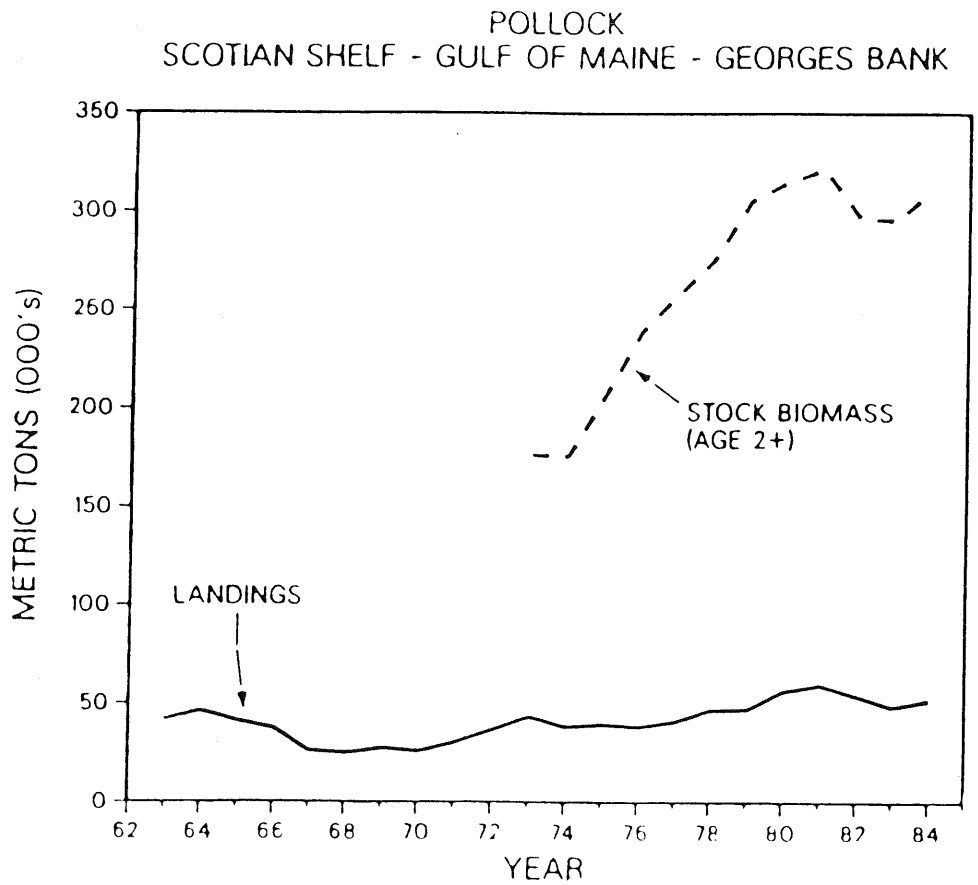


Figure 18. Total commercial and recreational landings and estimates of stock biomass of pollock in the Scotian Shelf, Gulf of Maine, and Georges Bank area.

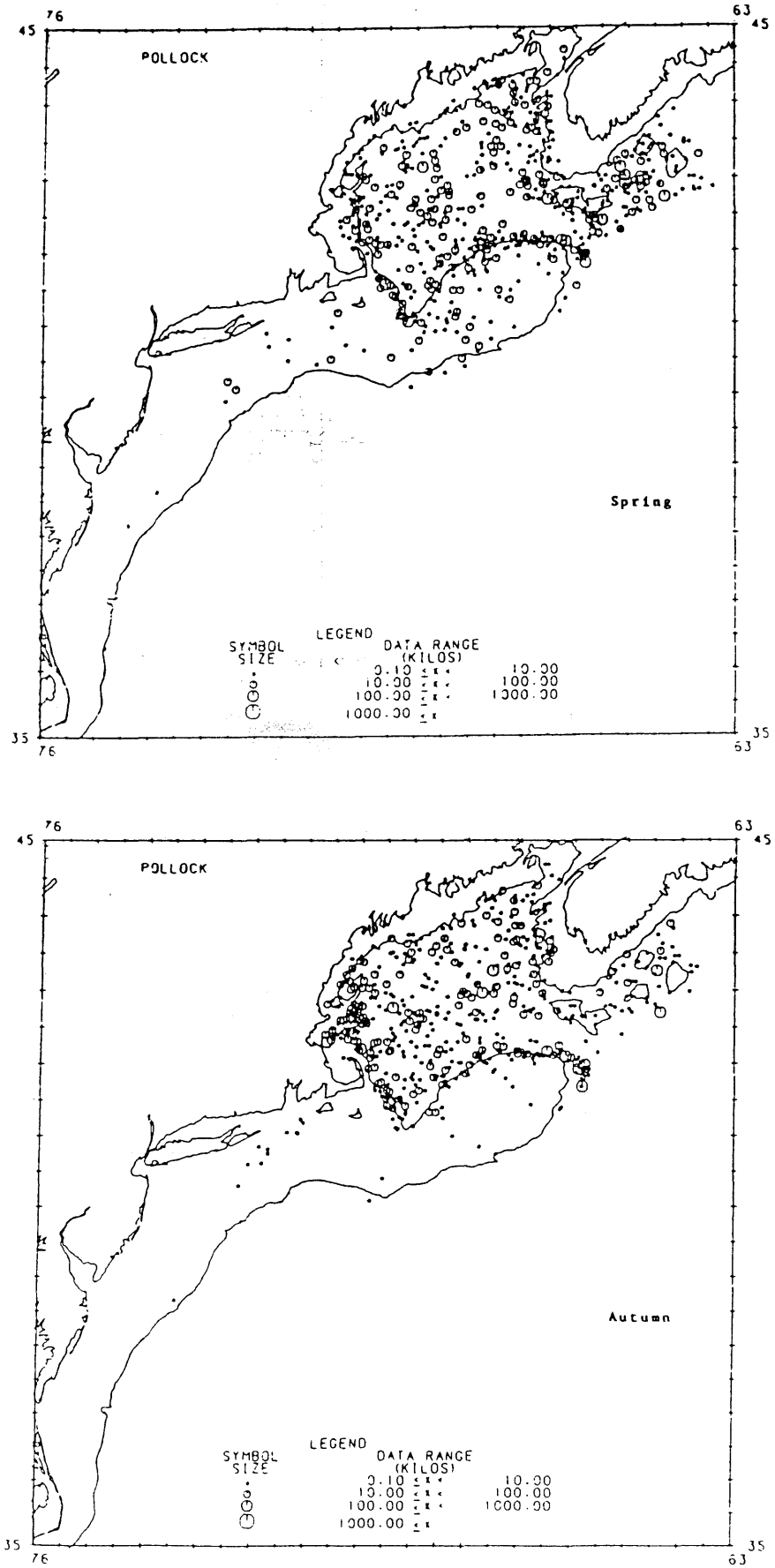


Figure 19. Distribution of pollock during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

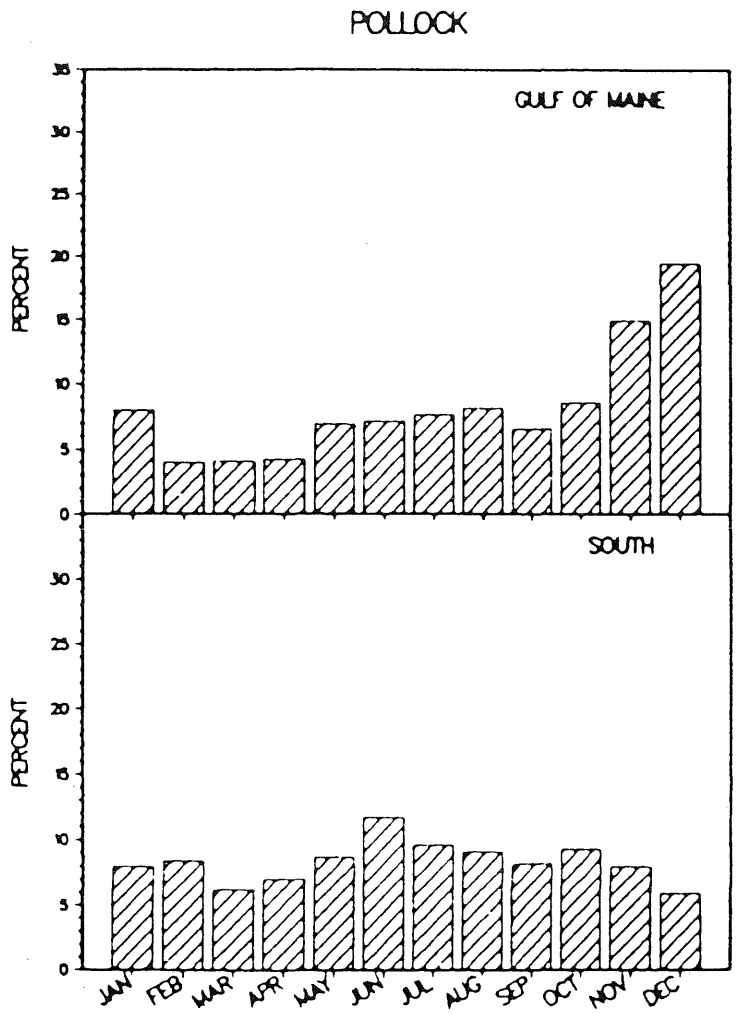


Figure 20. Distribution of average monthly commercial pollock landings from 1979-1984.

LONGHORN SCULPIN

The longhorn sculpin (Myoxocephalus octodecimspinosus) is a species found in northwestern Atlantic waters from Newfoundland south to Delaware Bay. Distributional data from NEFC bottom trawl surveys indicate that they are generally found in shelf waters to depths of about 100 m. However, they can be found in shallow bays and harbors to depths occasionally greater than 200 m. Major seasonal migrations are not evident (Figure 22). Sculpins are sexually mature by about age 3; spawning occurs from November to February with a peak in late December throughout its range. They apparently do not form spawning concentrations. Their eggs are demersal and stick together and to rocks and other bottom materials. Longhorn sculpins grow to a maximum length of about 46 cm (18 inches), but are most commonly found in the 25 to 36 cm (10 to 14 inch) range. Their maximum weight is approximately 0.5 kg (1 pound).

Nominal catches increased from 2,694 mt in 1971 to 8,582 mt in 1973, the highest since 1970, but declined to only 97 mt by 1977. After increasing sharply to 661 mt in 1978, catches dropped and have averaged only 91 mt during 1979-1984. In 1984, there was no reported catch. USA catch during 1970-1976 averaged about 40% of the total annual catch; the highest reported catch was 2,925 mt in 1970. Since 1977, longhorn sculpins have been taken exclusively by the USA. This species has been considered a 'nuisance' fish by USA fishermen because of their long, sharp spines. One of the principal uses of longhorn sculpins in the USA is as a lobster bait fish in the Gulf of Maine (Table 13 and Figure 21).

NEFC spring bottom trawl survey catch per tow indices (kg) have fluctuated between single years with relatively high indices (1973, 1978, 1981, and 1985) and periods of 2-4 years with low values. If this trend were to continue, the 1986 value should be significantly lower than the fairly high 1985 level (Figure 21).

Table 13 Nominal catches (thousands of metric tons) and management information for longhorn sculpin from the Middle Atlantic - Gulf of Maine area, 1972-1984.

Category	YEAR								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.9	0.1	0.7	0.2	0.1	0.2	0.1	-	-
Canada	-	-	-	-	-	-	-	-	-
Other	2.8	-	-	-	-	-	-	-	-
Total nominal catch	3.7	0.1	0.7	0.2	0.1	0.2	0.1	-	-
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_{1984} = Unknown

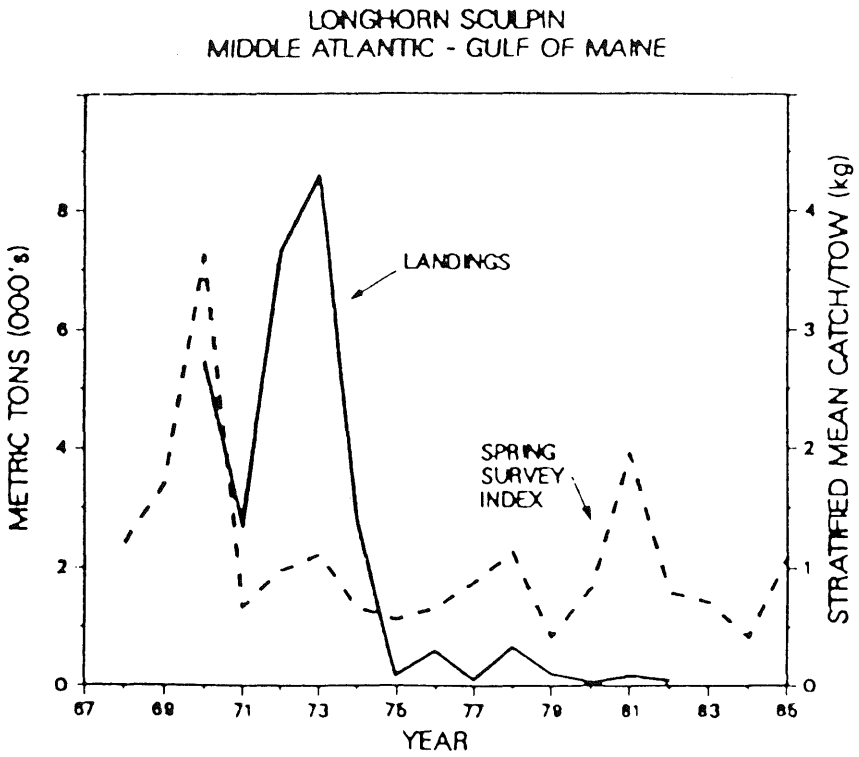
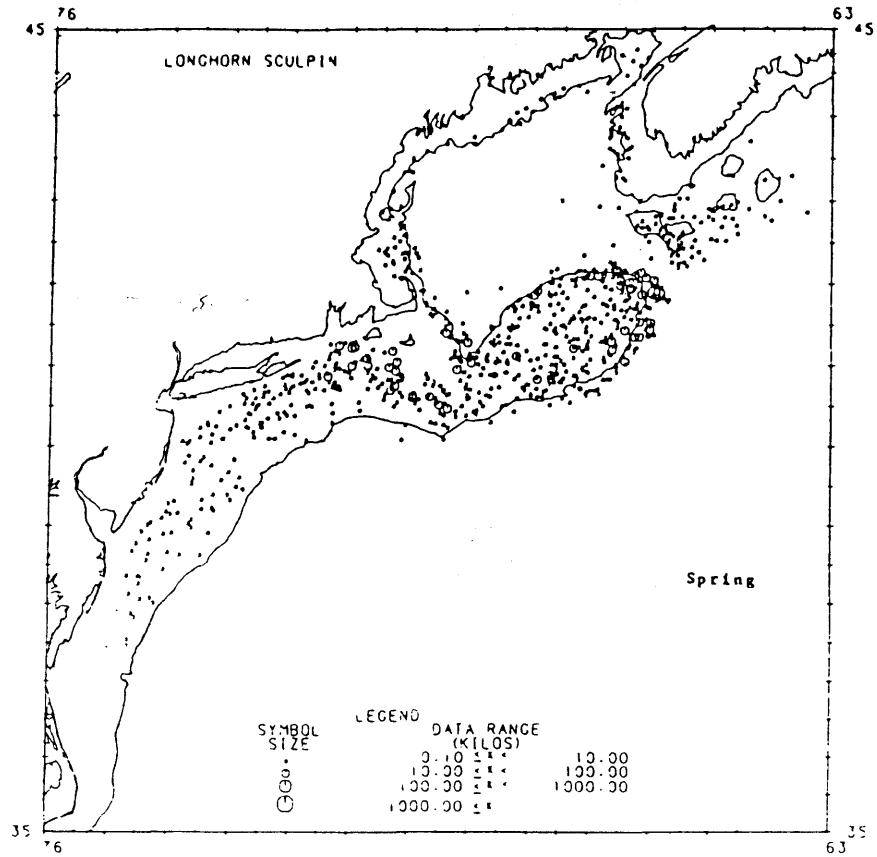


Figure 21. Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of longhorn sculpin in the Middle Atlantic - Gulf of Maine area.



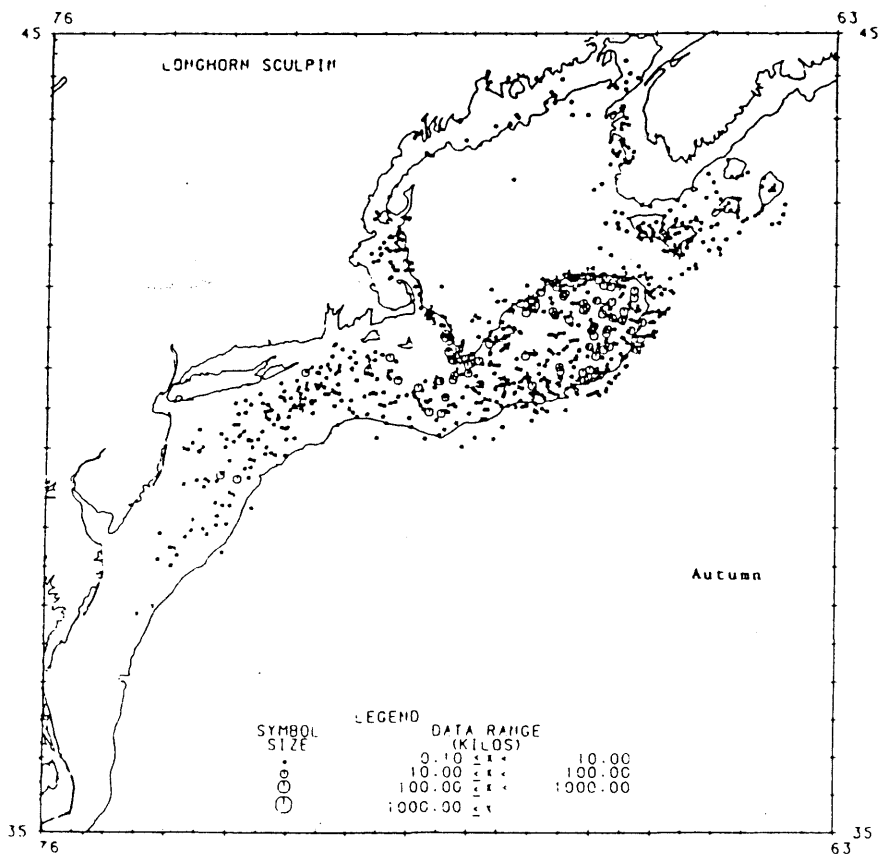


Figure 22. Distribution of longhorn sculpin during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

NORTHERN SEAROBIN

Northern searobins (Prionotus carolinus) inhabit waters primarily from Nova Scotia to South Carolina. They undergo seasonal inshore-offshore migrations and are found generally in nearshore shelf waters in depths of about 27-100 m during the autumn months and overwinter along the shelf break to depths greater than 350 m (Figure 24). Northern searobins are sexually mature by about age 2-3. Spawning generally takes place during the summer months, but may begin as early as April in the northerly portion of their range and extend to September further south. Their eggs are pelagic, and juveniles assume demersal habits by about 3 cm. The maximum length attained by northern searobins is reported to be 41 cm (16 inches), but they are uncommon over about 30 cm (12 inches). Maximum age is about 11 years.

Nominal catches, available since 1972, have ranged from a high of 3,920 mt in 1972 to a low of 21 mt in 1984. Catches declined steadily from 1972 to 1,135 mt in 1975, but rose sharply to 3,311 mt by 1977. With the inception of MFCMA and the exclusion of the USSR fleet from the FCZ in 1977, catches dropped to average only 105 mt during 1978-1984. USA catches were fairly steady during 1972-1981 averaging about 100 mt. Since 1982, catches have dropped steadily to only 21 mt in 1984. Foreign catches, primarily from the USSR, during 1973-1977 dominated the landings averaging 95% of the total annual catch (the 1973-1977 average was about 2,400 mt). Since 1978, percentages of USA and foreign catches have been about equal (Table 14).

NEFC autumn bottom trawl survey indices were relatively high during 1967-1972, but declined sharply in 1973 and have remained at a fairly low level since. The spring surveys indicated a similar trend, however the 1983 and 1984 indices were similar to those reached in the early 1970s (Figure 23).

Table 14. Nominal catches (thousands of metric tons) and management information for northern searobin from the Middle Atlantic - Georges Bank area, 1972-1984.

Category	YEAR								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.1	0.1	0.1	0.2	0.1	0.1	+	+	+
Canada	-	-	-	-	-	-	-	-	-
Other	2.3	3.2	+	0.1	+	0.1	+	-	-
Total nominal catch	2.4	3.3	0.1	0.3	0.1	0.2	0.1	+	+
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_{1984} = Unknown

+ indicates less than 50 metric tons.

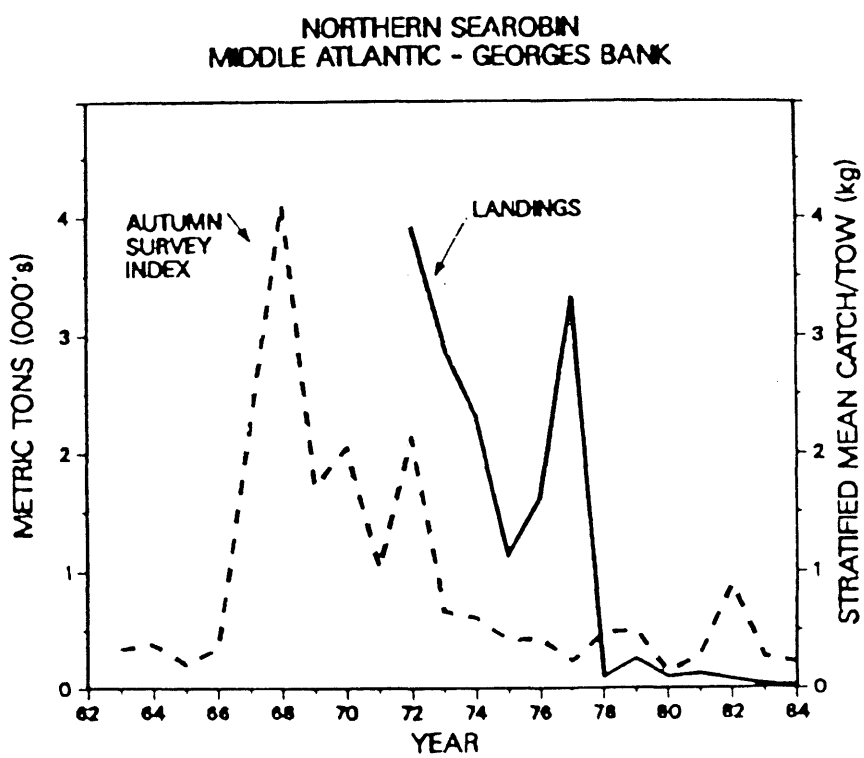
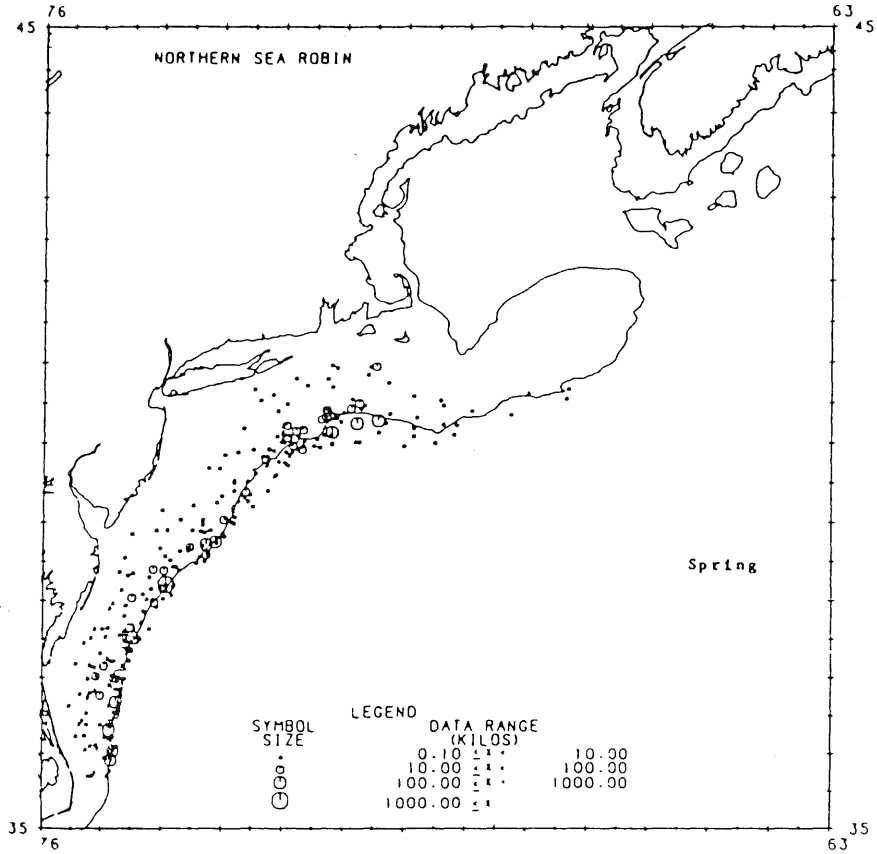


Figure 23. Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of northern searobin in the Middle Atlantic - Georges Bank area.



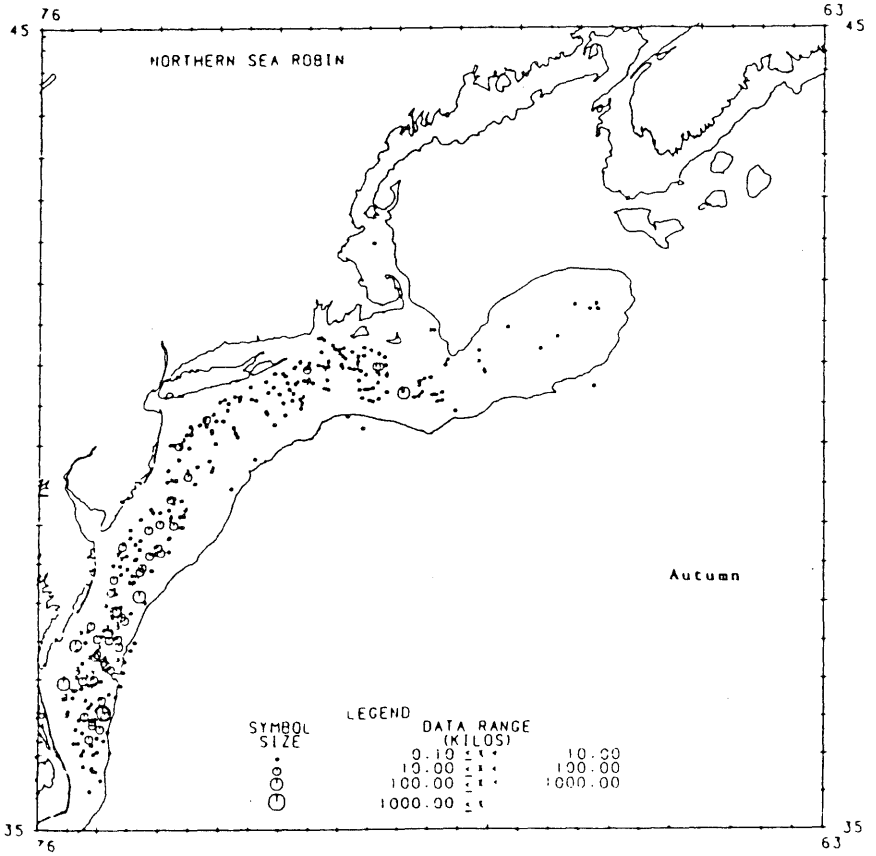


Figure 24. Distribution of northern searobin during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

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 (Figure 26). 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 6.

Reported international nominal catches peaked at about 21,000 mt in 1972 and declined sharply from 1975 to 1978 (Table 15, Figure 25). Distant-water fleets consistently accounted for virtually all of the reported catches. The reported USA nominal catch declined from 4,900 mt in 1982 to 4,400 mt in 1984, which represents the third consecutive year of declining catches. The principal fishing season extends from June to October in the Gulf of Maine (Figure 27). 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 from 229,000 mt in 1983 to 275,000 mt in 1984, slightly above the 1968-1983 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.

Table 15. Nominal catches (thousands of metric tons) and management information for spiny dogfish from the Middle Atlantic - Gulf of Maine area, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.2	0.5	0.9	4.8	4.2	6.9	6.6	4.9	4.4
Canada	-	-	-	-	-	-	-	-	-
Other	16.9	6.5	0.6	-	0.2	0.3	0.4	-	-
Total nominal catch	17.1	7.0	1.5	4.8	4.4	7.2	7.0	4.9	4.4
Total allowable catch	-	-	-	-	-	-	-	-	-

Long-term potential catch = 65.0
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_{1984} = Unknown

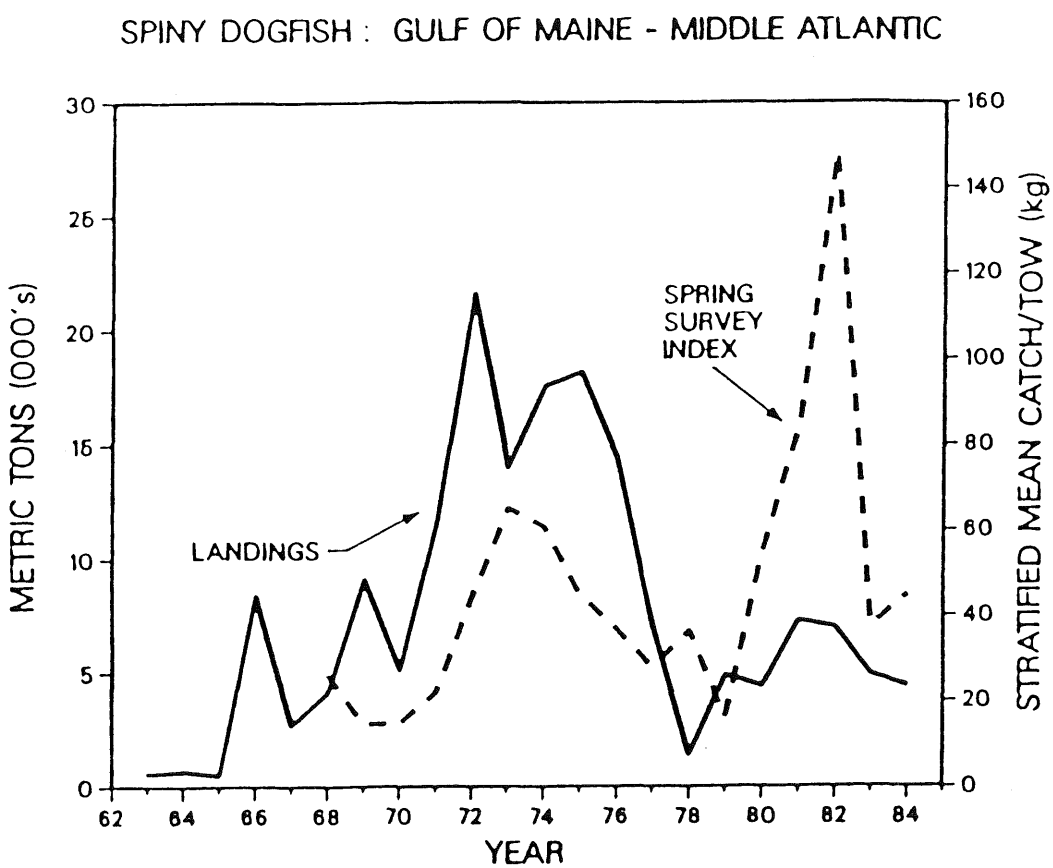


Figure 25. Total commercial landings and stock biomass indices from NEFC spring bottom trawl surveys of sping dogfish in the Gulf of Maine - Middle Atlantic area.

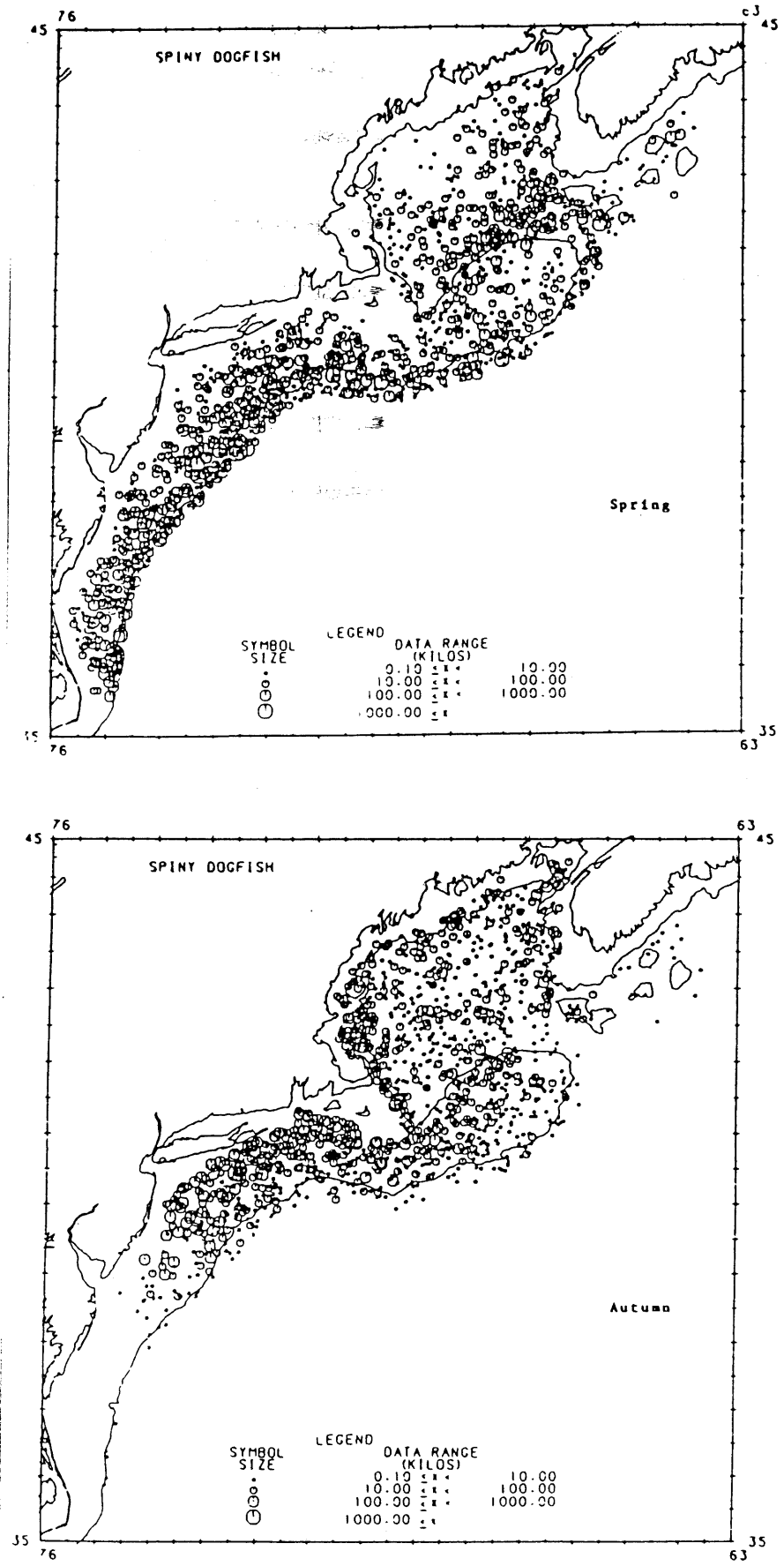


Figure 26. Distribution of spiny dogfish during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

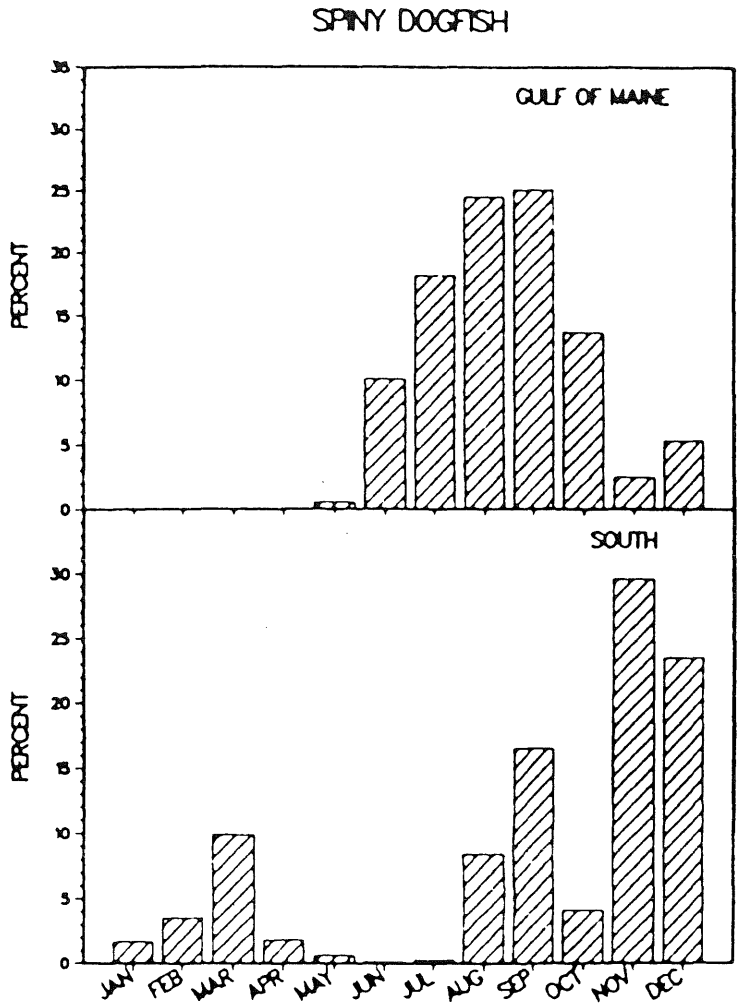


Figure 27. Distribution of average monthly commercial spiny dogfish landings from 1979-1984.

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) (Figure 29), winter skate (R. ocellata) (Figure 30), barndoor skate (R. laevis), thorny skate (R. radiata) (Figure 31), 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 (Table 16). The majority of the US landings are taken during the winter, January-May, although catches have been reported during all months (Figure 32). Most of the domestic catch has traditionally been discarded at sea. The reported USA nominal catch increased 14% from 3600 mt in 1983 to 4100 mt in 1984. Beginning in 1983 domestic catches began increasing in response to an expansion of both the European export and domestic markets.

The species composition of the 1984 catch of skates was unknown since only the pectoral fins or wings are landed. Nominal catches are not expected to markedly increase in the near future unless the limited export or domestic market expands.

Minimum biomass estimates (mt) for all skates combined in the Gulf of Maine - Mid-Atlantic area determined from NEFC bottom trawl survey data declined from 107,000 mt in 1983 to 81,000 mt in 1984 (Figure 28). The 1984 estimate was about 35% less than the 1968-1983 average of 124,000 mt. Since 1974, the total skate biomass estimate has remained at about or below 100,000 mt, excepting 1983 (117,000 mt) compared to 1968-1973 when yearly biomass estimates ranged from 143,000 to 335,000 mt.

Table 16. Nominal catches (thousands of metric tons) and management information for skates (all species) from the Middle Atlantic - Gulf of Maine area, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	1.1	1.3	1.5	1.6	2.0	0.8	1.0	3.6	4.1
Canada	<0.1	-	-	-	-	-	-	-	-
Other	5.0	0.2	-	-	-	-	-	-	-
Total nominal catch	6.1	1.5	1.5	1.6	2.0	0.8	1.0	3.6	4.1
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 yrs[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_{1984} = Unknown

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

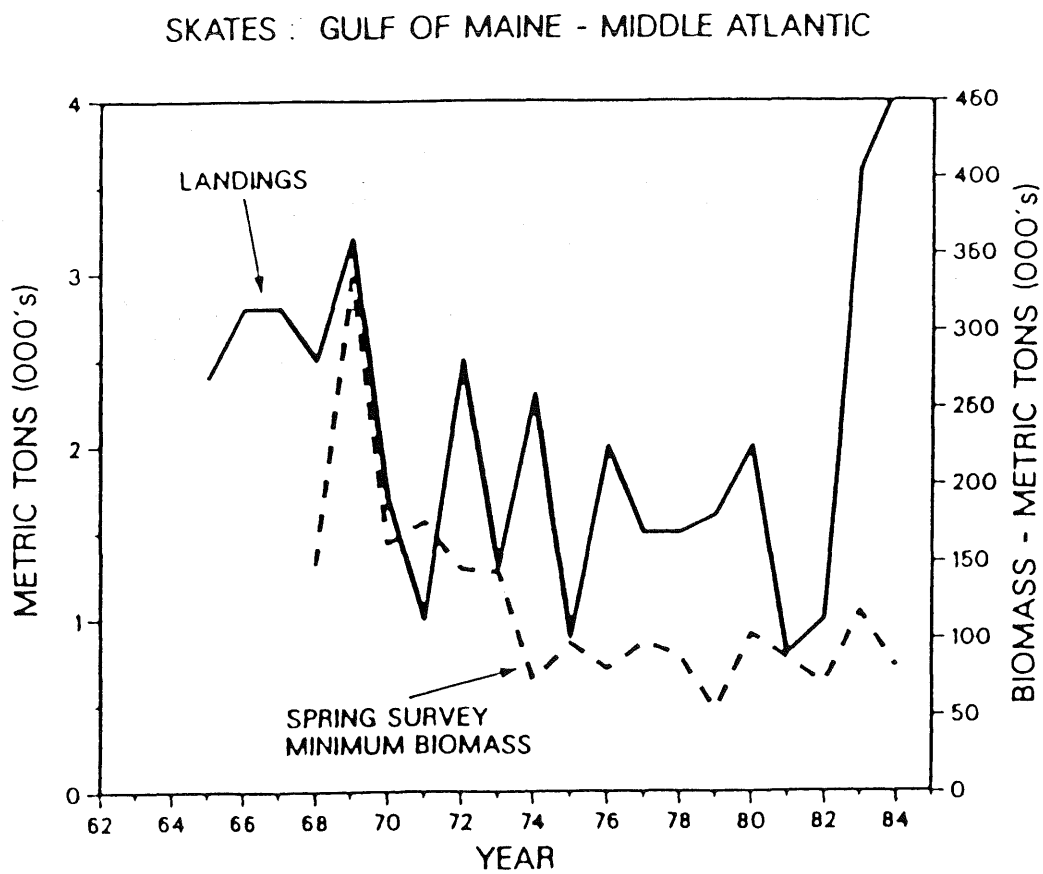
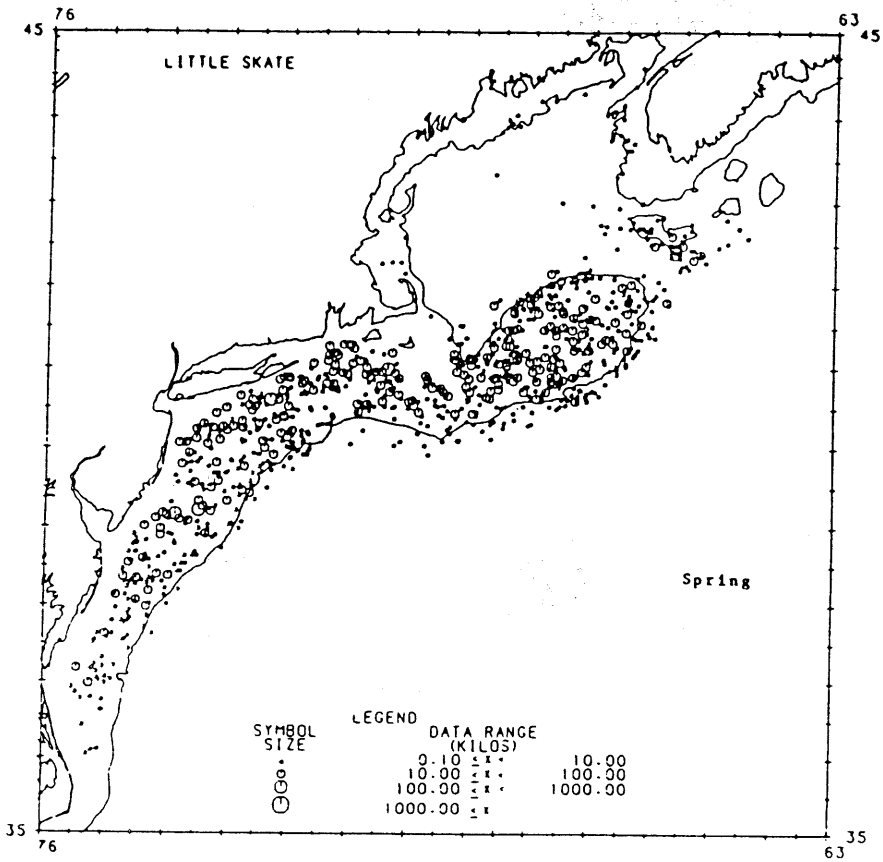


Figure 28. Total commercial landings and estimates of minimum stock biomass from NEFC spring bottom trawl surveys of skates in the Gulf of Maine - Middle Atlantic area.



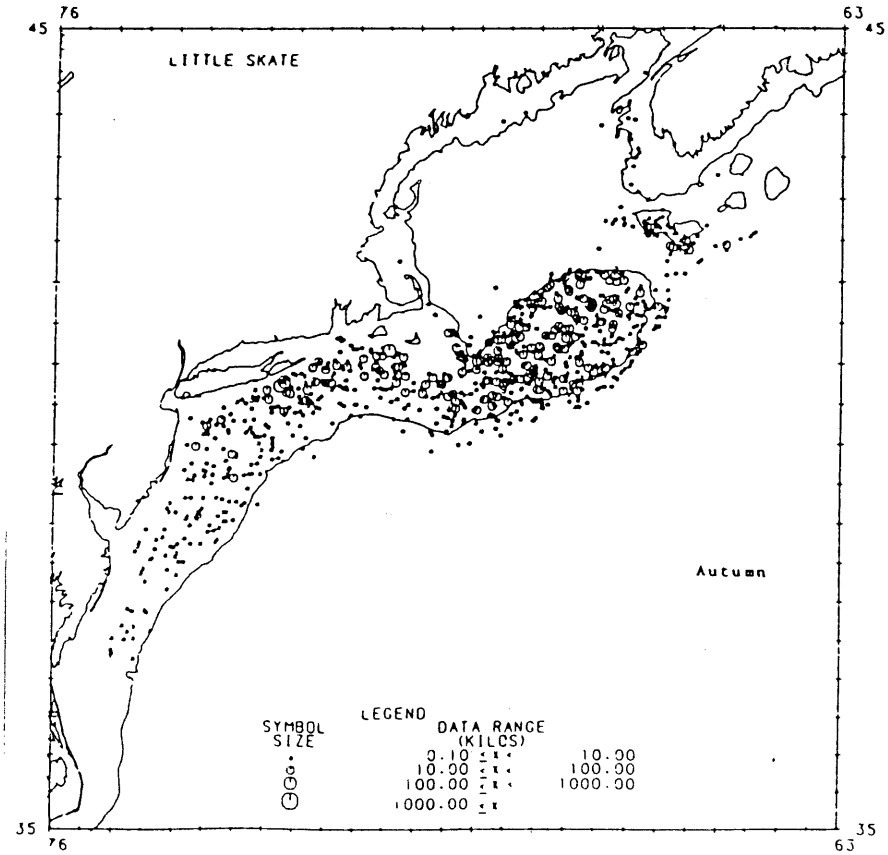
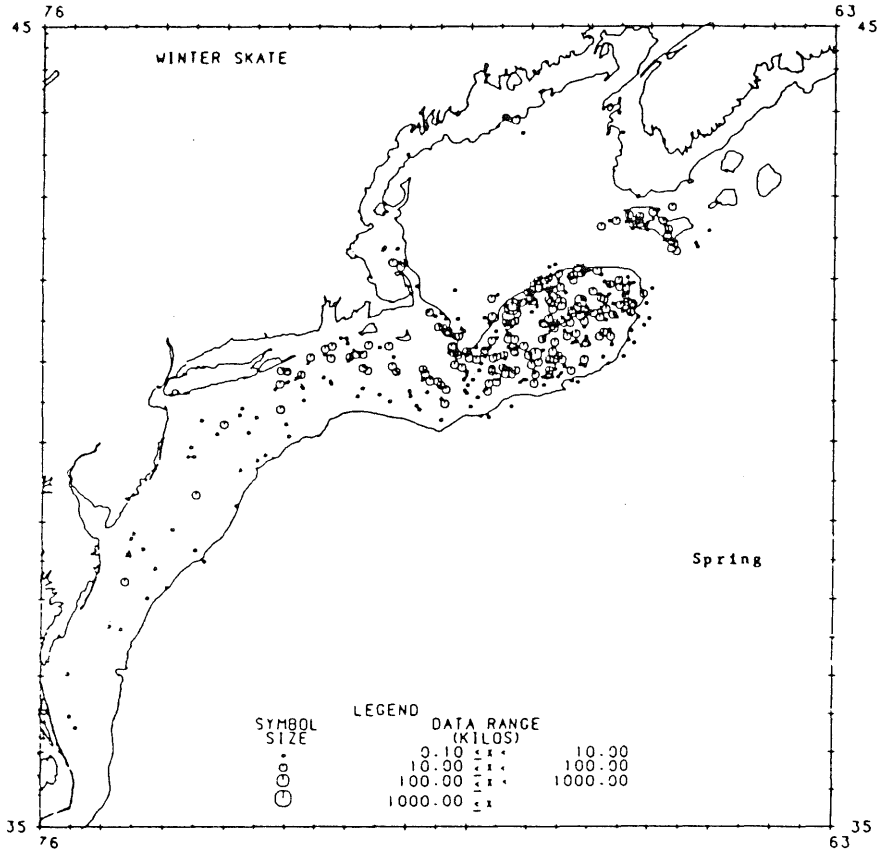


Figure 29. Distribution of little skates during spring (top) and autumn (bottom) NEFC bottom trawl surveys.



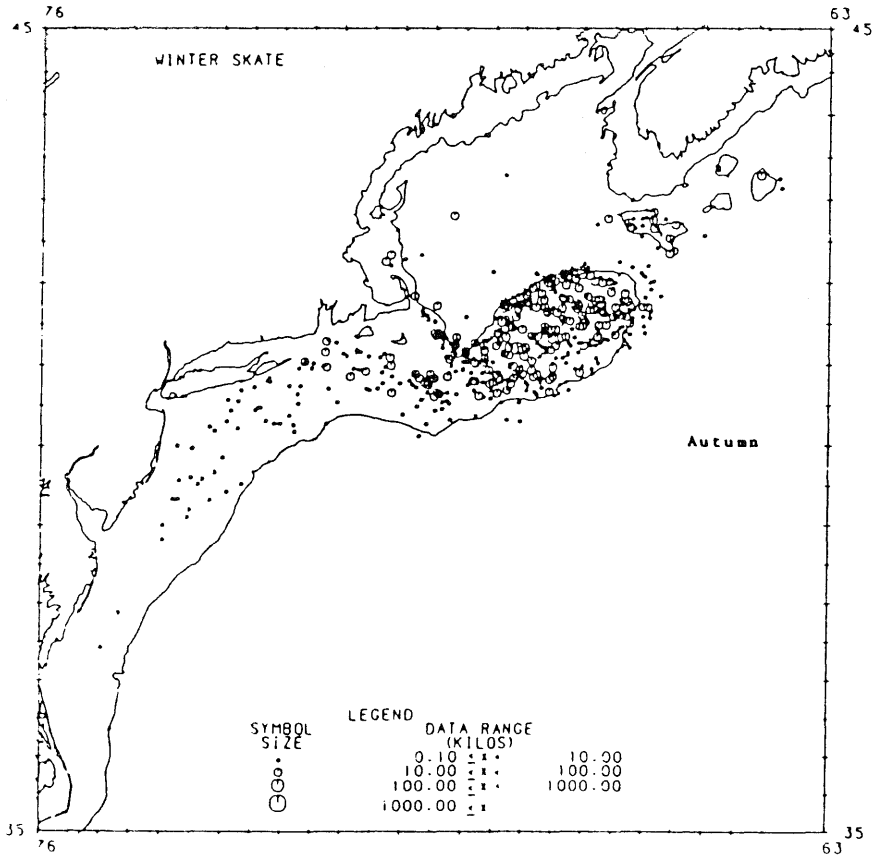
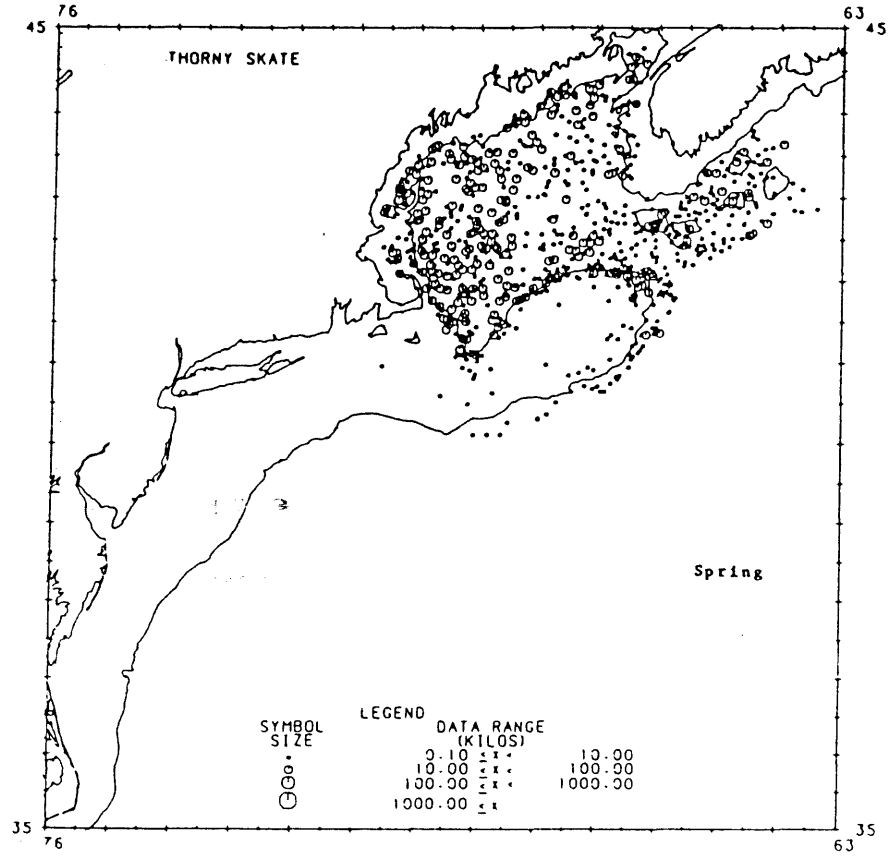


Figure 30. Distribution of winter skates during spring (top) and autumn (bottom) NEFC bottom trawl surveys.



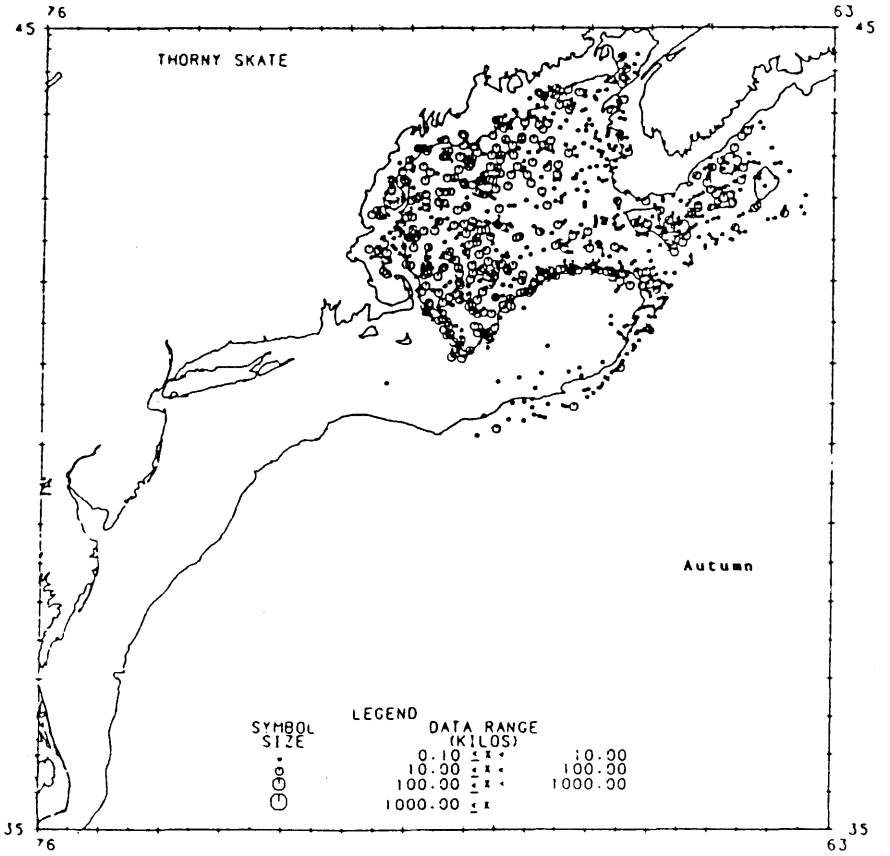


Figure 31. Distribution of thorny skates during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

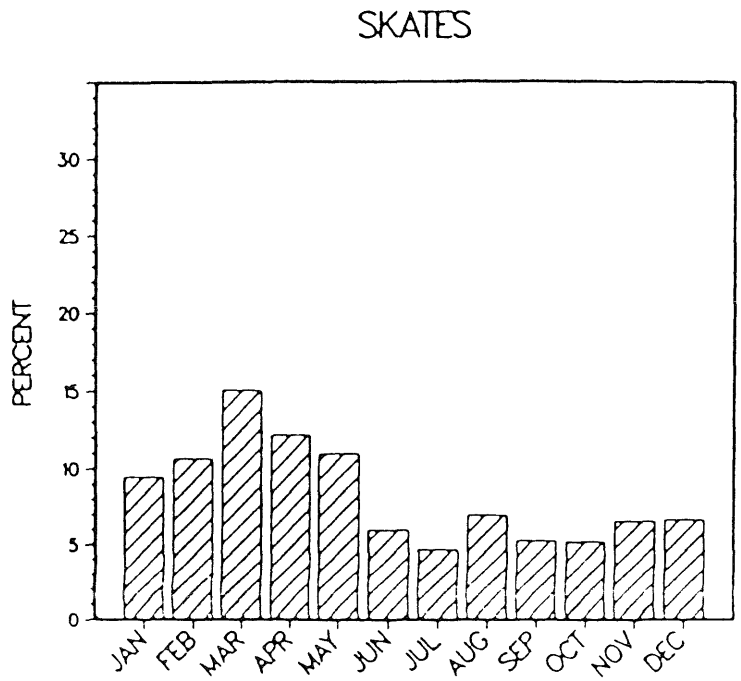


Figure 32. Distribution of average monthly commercial skate landings from 1979-1984.

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 (Figure 34). 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 11,720 mt in 1983 to 9,983 mt in 1984, compared to the 1972-1982 mean of 19,250 mt. The USA nominal catch decreased from 9,944 mt in 1983 to 9,307 mt in 1984 (Table 17). Virtually all of the USA catch for 1979-1984 was reported during May-November with peaks occurring in September and October (Figure 35). (USA catches include prorated amounts of non-specified squids which are not included in Table 2.) The 1983 and 1984 USA catches represented almost six-fold increases over the 1977-1982 average. The 1984 catch included about 6,010 mt taken in joint ventures. Distant-water-fleet catches during 1984 were 676 mt, a 62% decrease from 1983 (1,776 mt), and 96% below the 1972-1982 mean catch of 18,202 mt.

The reported catch in Canadian waters in 1983 was only 408 mt, indicating a collapse of the fishery which has seen catches decline from a high of 162,000 mt in 1979. The 1982 catch was about 9,000 mt.

The NEFC autumn survey index for Illex increased three-fold from 1983 to 1984 but was 33% below the 1968-1982 mean (Figure 33). Minimum abundance off the USA coast was estimated to be 32 million individuals in 1984 compared to 10 million in 1983. This was 46% below the 1968-1983 mean. Pre-recruit ($\leq$10 cm) abundance in 1984 was double the low 1983 level but was 76% below the 1968-1983 average. The pre-recruits sampled in the 1984 autumn survey will comprise the bulk of the catch in the 1985-1986 fishery.

Table 17. Nominal catches (thousands of metric tons) and management information for short-finned squid from the Middle Atlantic - Gulf of Maine area, 1972-1984.

Category	Year								
	1972-1976 average	1977	1978	1979	1980	1981	1982	1983	1984
USA recreational	-	-	-	-	-	-	-	-	-
Commercial									
USA	0.3	1.0	0.4	1.6	0.3	0.6	5.4	9.9	9.3
Canada	-	-	-	-	-	-	-	-	-
Other	19.8	23.8	17.3	16.3	19.6	14.9	12.4	1.8	0.7
Total nominal catch	20.1	24.8	17.7	17.9	17.9	15.4	17.8	11.7	10.0
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]

Long-term potential catch = 30.0
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_{1984} = Unknown

[1] 1 April - 31 March fishing year.

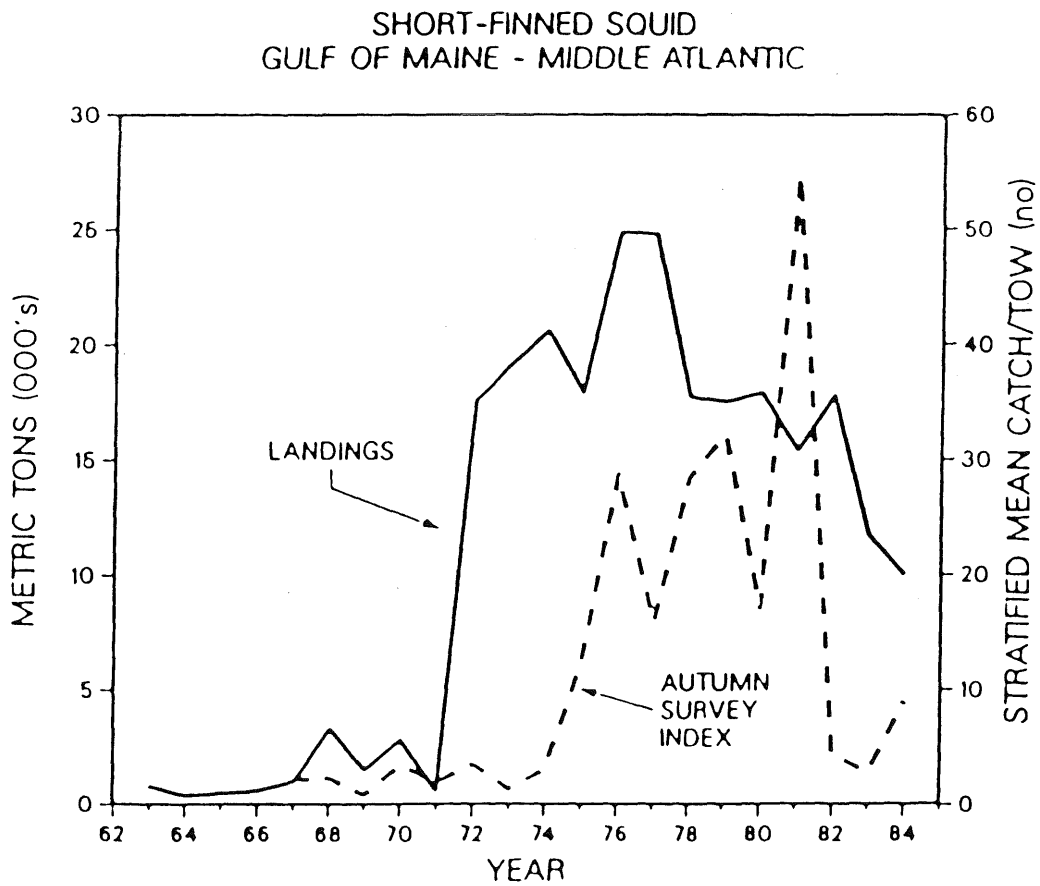
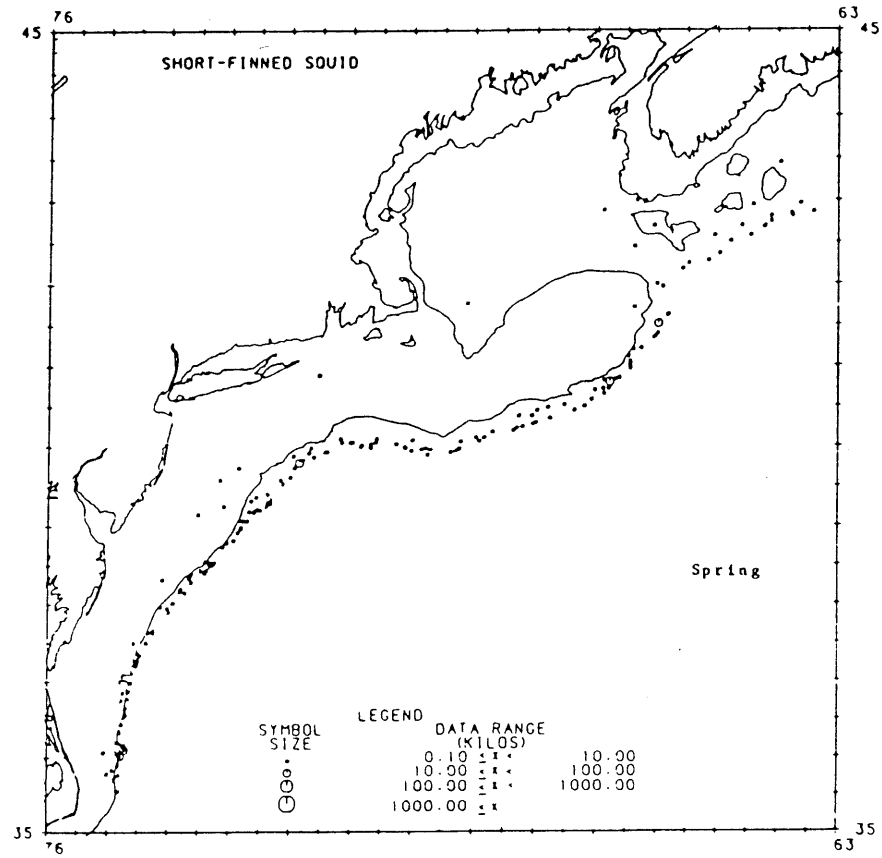


Figure 33. Total commercial landings and stock biomass indices from NEFC autumn bottom trawl surveys of short-finned squid in the Gulf of Maine - Middle Atlantic area.



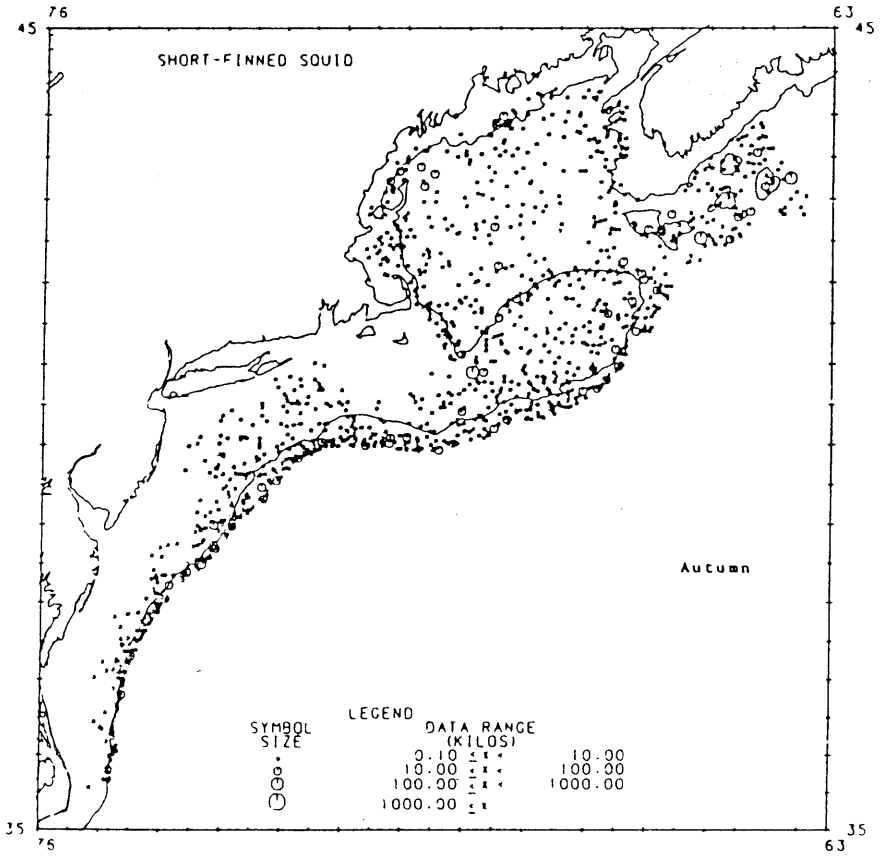


Figure 34. Distribution of short-finned squid during spring (top) and autumn (bottom) NEFC bottom trawl surveys.

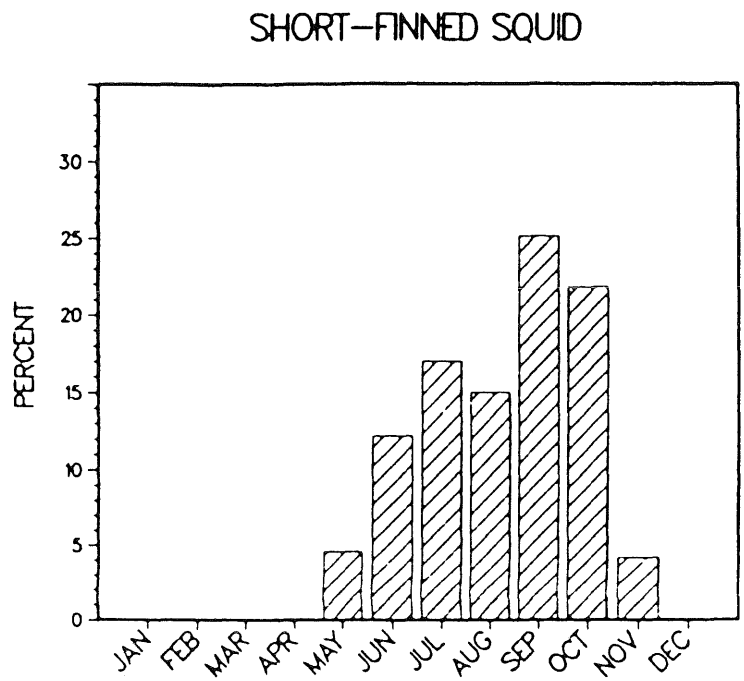


Figure 35. Distribution of average monthly commercial short-finned squid landings from 1979-1984.