

E.6.3.3 Endangered Species and Marine Mammals

E.6.3.3.1 Endangered and Protected Species

A number of endangered and other protected species inhabit the management unit addressed in Atlantic Herring Fishery Management Plan. Eleven are classified as endangered or threatened under the Endangered Species Act (ESA) of 1973; the remainder are protected by the provisions of the Marine Mammal Protection Act (MMPA) of 1972. In the Northeast, protected species utilize marine habitats for purposes of feeding, reproduction, as nursery areas and as migratory corridors. Some species occupy the area year round while others use the region only seasonally or move intermittently inshore and offshore.

Entanglements of several species of marine mammals have been documented in fishing gear employed in the Atlantic herring fishery. They include the northern right whale, humpback whale, minke whale, harbor porpoise, harbor seal and gray seal. The status of these and other marine mammal populations inhabiting the Northwest Atlantic has been discussed in great detail in the U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. Initial assessments were presented in Blaylock, et al. (1995) and are updated in Waring, et al. (1997). The report presents information on stock definition and geographic range, population size and productivity rates and unknown impacts. The species found in New England and Mid-Atlantic waters are listed below. Species of particular concern include harbor porpoise as well as right and humpback whales.

Endangered

- Right whale (*Eubalaena glacialis*)
- Humpback whale (*Megaptera novaeangliae*)
- Fin whale (*Balaenoptera physalus*)
- Sperm whale (*Physeter macrocephalus*)
- Blue whale (*Balaenoptera musculus*)
- Sei whale (*Balaenoptera borealis*)
- Kemp's ridley (*Lepidochelys kempi*)
- Leatherback turtle (*Dermochelys coriacea*)
- Green sea turtle (*Chelonia mydas*)
- Shortnose sturgeon (*Acipenser brevirostrum*)

Threatened

- Loggerhead turtle (*Caretta caretta*)

More detailed descriptions of the species in the above list, including endangered sea turtles and fish, was provided the Final Environmental Impacts Statements for Amendments 5 and 7 to the Northeast Multispecies FMP, Amendment 5 to the American Lobster FMP and Amendment 4 to the Atlantic Sea Scallop FMP. The most recent information on sea turtle status is contained in the 1995 and 1997 status reviews of listed turtles prepared jointly by NMFS and the U.S. Fish and Wildlife Service (NMFS and USFWS 1995 and 1997).

Other Protected Species/Marine Mammals

Other species of marine mammals likely to occur in the management unit include the minke whale (*Balaenoptera acutorostrata*), white-sided dolphin (*Lagenorhynchus acutus*), white-beaked dolphin (*Lagenorhynchus albirostris*), bottlenose dolphin (*Tursiops truncatus*), [coastal stock listed as depleted under the MMPA], pilot whale (*Globicephala melaena*), Risso's dolphin (*Grampus griseus*), common dolphin (*Dephinis delphis*), spotted dolphin (*Stenella* spp.), striped dolphin (*Stenella coeruleoalba*). Pinnipeds species include harbor (*Phoca vitulina*) and gray seals (*Halichoerus grypus*) and less commonly, hooded (*Cystophora cristata*) harp (*Pagophilus groenlandicus*) and ringed seals (*Phoca hispida*).

E.6.3.3.2 Other Biota

Zoogeographically, the Gulf of Maine region is boreal, and the fauna is typically Acadian. South of Cape Cod to Cape Hatteras is warm temperate, and the fauna is Virginian. Although Cape Cod is the general dividing line, many species are found throughout the region from the Gulf of Maine to Cape Hatteras. Gulf of Maine fauna may include subtropical, tropical, temperate, and arctic immigrants at various times of the year.

The Plankton The plankton are microscopic plants (phytoplankton) and animals (zooplankton) that drift in the water column. The annual cycle of the plankton community is typical of the temperate zone. In winter, nutrients are abundant in the water by phytoplankton abundance is low because productivity is suppressed by low levels of solar radiation and temperature. The level of solar radiation increases as spring approaches, and causes an intense phytoplankton bloom which is comprised primarily of diatoms. This level of productivity results in a decrease of inorganic nutrients, and as summer approaches, phytoplankton abundance begins declining.

Zooplankton feed predominantly on phytoplankton, but fish larvae commonly feed on zooplankton (often copepods). During summer, zooplankton reach maximum abundance, while the phytoplankton decline to near winter levels. Dinoflagellates and other phytoplankters, apparently more suited to warm, nutrient-poor waters, become abundant during summer. Although bacteria in sediments actively remineralizes nutrients from organic debris, summer stratification of the water column may prevent nutrients from being returned to the near surface where they may contribute to primary productivity through photosynthesis. On Georges Bank and the eastern and northeastern edge of the Gulf of Maine, vertical mixing of the water column occurs during the summer, thereby recirculating nutrients and maintaining high plankton productivity. Water column stability may be affected by severe storms, and anomalies in temperature may disturb the timing between annual cycles of interacting species. In the autumn, decreasing water temperatures result in a breakdown of the vertical temperature gradient, and nutrients are again circulated up into the euphotic zone. Another phytoplankton bloom results, and lasts until slow solar radiation levels inhibit photosynthesis. Phytoplankton and zooplankton levels then decline to the winter minimum, and nutrient levels increase to their winter maximum.

The Nekton The nekton are animals that swim in the water column. They are predominantly fish, but also include other animals such as squid, whales and porpoises. The ability to swim allows nektonic organisms to migrate between locations or to maintain a specific breeding location with some consistency year after year.

The feeding habits of nekton vary by species, by the size of the individual, and probably by season and food availability. Adults of many commercially important species of the region feed on either fish or invertebrates, but small fish, including the young of some large species, often feed on plankton. Adults of some large species, such as various whales, basking sharks and ocean sunfish, are plankton eaters throughout life.

The Benthos The benthos are animals that live on or within the bottom sediments. They are predominantly invertebrates (e.g. tube worms, starfish), although strongly bottom-oriented fishes are considered benthic. Benthic organisms are extremely diversified, and include species from several phyla. They can be classified by size, by their location on or in the sediments, by the type of bottom in which they live (sand, mud, gravel, rock, etc), by feeding type, and by the type of community with which they are associated.

E.6.3.4 Stellwagen Bank Marine Sanctuary

On October 7, 1992, Congress reauthorized Title III of the Marine Protection, Research and Sanctuaries Act and passed an amendment which designated Stellwagen Bank as a National Marine Sanctuary. The area, located between Cape Cod and Cape Ann, Massachusetts, is known to support a rich and diverse population of marine life at different times of the year, including several species of endangered whales, groundfish stocks and bluefin tuna. Commercial fishing is not a regulated sanctuary activity, and will continue to be the responsibility of the NEFMC.

The Sanctuary designation places a prohibition on the "exploration for, and mining of, sand and gravel and other minerals" and requires a consultation process of agencies proposing actions which are likely to destroy, cause the loss of, or injure any Sanctuary resource. To the extent that certain activities with deleterious effects on fish stocks may be affected, the designation may have positive impacts on commercial stocks.

E.6.4 Human environment

E.6.4.1 History of exploitation

Herring fisheries have existed in Europe for over 1,000 years and in the Northwest Atlantic for about 450 years. Along the coast, aboriginal fisheries were practiced prior to the arrival of 16th century fishermen. During the colonial period, a sizeable herring fishery developed which supplied bait for the cod fisheries that were expanding off the coasts of the U.S. and Canada. By the end of the 18th century, as the U.S. cod fishery extended its range as far as the Labrador coast, the demand for herring as bait increased and by the

early 19th century the U.S. was importing salt and pickled herring for use both as bait and food. During the early years of the twentieth century, the market for bait herring declined as the cod fishery changed from hook and line methods to the otter trawl.

The herring fishery in Maine developed during the late 19th century along the eastern Maine coast. Two events during the latter part of the 19th century led to a resurgence of the herring fisheries. One was the development of the sardine canning industry in eastern Maine in the 1870's, which later spread throughout the Maine coast and into New Brunswick. The other was the expansion and intensification of the lobster fishery after the 1860's. Exploitation of herring fishery from this time until the early 1970's was primarily of young herring of a size suitable for canning as sardines.

The growth of the fishery was stimulated by the development of the canning industry in eastern Maine and New Brunswick during this period and through the first half of the 20th century. There were nearly 50 canneries in operation along the Maine coast during the late 1940's and early 1950's, packing over 3 million cases (100 cans per case) of sardines a year. The establishment of the lobster fishery in the late 19th century also created an additional market for herring as bait. Landings as high as 80,000-90,000 mt were recorded as early as 1898, 1905, 1911, and 1916. Landings of the same magnitude were recorded in the late 1940's and 1950's. Historically, landings have been highly variable due largely to changes in the availability of juveniles along the coast. From 1896 to 1916 the catch averaged around 60,000 tons, then declined to around 25,000 tons from 1917 to 1940, and then in the late 1940's through the 1950's increased again to around 60,000 tons. From 1964 to 1969 the catch was consistently low at about 28,000 tons and from 1970 to 1975 it averaged only 17,400 tons. Landings have been consistently lower during the last 30 years or so, except for a brief period during 1979-1981 (Table E.12). Herring landed in Maine in the past have also been used for fertilizer, for smoking and pickling, as fresh herring (whole or fillets), and for reduction purposes (fish meal and oil). Currently, most of the herring landed in Maine are canned or used for lobster bait.

Most herring caught along the Maine coast since sardine canning began in 1875 were juveniles of age 2 (about 17cm, or 6.7 inches, total length) and have ranged from age groups 1 to 3. Until the early 1960's, the capture of adult fish was of minor importance. As the availability of small fish decreased, large herring were used increasingly in canned sardine products; most recently a domestic market for canned specialties, such as steaks and tidbits, has developed. The increased utilization of larger herring by the canning sector was accompanied by an increased use of purse seines in the near shore areas.

An adult herring fishery developed in the western Gulf of Maine (Jeffreys Ledge area) in 1967-1968, with U.S., Canadian and German vessels taking 30-40,000 mt a year between 1968 and 1972. U.S. landings from this fishery reached 20,000 mt during 1970-72 (Anthony and Waring 1980). The fishery in this and other inshore areas was supported by a limited number of U.S. filleting/freezing plants that shipped herring to West German markets. There was also a reduction plant in Gloucester, MA during the 1970's that provided an additional market for herring. Landings in southern New England (mostly in Rhode Island) and the mid-Atlantic states did not exceed 5,000 mt a year until 1995.

(Table E.12). In more recent years, herring landed in Massachusetts, southern New England, and the Mid-Atlantic states have either been trucked to canneries in Maine and New Brunswick, or sold as bait, primarily for the lobster fishery. An undetermined amount of herring landed in U.S. ports is also converted into fish meal in Canada and utilized for salmon feed.

A foreign fishery for herring began in the early 1960s on Georges Bank and intensified during the latter part of the decade as the foreign fishing effort increasingly turned to resources other than the traditional groundfish species. During 1961, the Soviet herring fleet on Georges Bank totaled 100 vessels, catching over 67,000 mt (Table E.9). By 1965, 200-250 Soviet vessels were fishing for herring, red and silver hake, haddock, and cod on Georges Bank and off southern New England, and over the period 1961-1965, reporting herring catches of 43,000 to 152,000 mt a year. By 1967, the Soviets were joined by vessels from the Federal Republic of Germany (FRG), the German Democratic Republic (GDR), Poland, Japan, Romania, and Canada. The total catch from Georges Bank, Nantucket Shoals and southern New England reached a maximum of 374,000 mt in 1968. From 1965 to 1972, the total number of foreign fishing vessels sighted in waters off the U.S. coast from Georges Bank to Cape Hatteras increased from about 450 to over 1,000, thereafter declining in response to reduced fish stocks and increasing catch restrictions. Much of this distant water fleet activity was directed towards herring. As many as 200 large Soviet stern trawlers were active in the New York Bight winter herring fishery, while more than 100 Soviet side trawlers rigged for purse seining conducted a summer fishery on Georges Bank. Polish stern trawlers fished for herring in conjunction with a winter mackerel fishery and exploited herring on Georges Bank during the summer and fall. GDR vessels followed a similar pattern. It should be noted that historic catch statistics for the foreign fishery on Georges Bank include catches from Nantucket Shoals and the areas south of New England.

The intense fishing pressure during the 1970s is believed to have led to the collapse of the George bank stock. Estimated age 3+ stock size dropped from 1.2-1.35 million mt in the late 1960s to about 400,000 mt in the mid 1970s (Anthony and Waring 1980). In 1977, with the U.S. withdrawal from the International Commission for the Northwest Atlantic Fisheries (ICNFA) and the implementation of the Magnuson Fishery Conservation and Management Act, foreign fishing for herring became completely controlled by the U.S. and regulated through the provisions of the Preliminary Fishery Management Plan prepared by the Department of Commerce, and then, in 1978, under the provisions of the Council's FMP for herring. Directed foreign fishing ceased when approval of this FMP was withdrawn in 1982.

Since 1982, there have been several significant shifts in the coastal fishery. The Maine fixed gear fishery (stop seines and weirs), which harvested over 44,000 mt in 1981, has averaged only 1,600 mt annually since 1984 and has produced less than 1,000 mt since 1994. An increasing portion of the catch has been harvested by purse seines, and, especially in the last five years, by mid-water trawl vessels. Another change has been the increase in herring used for bait. As the lobster fishery has expanded, at least half the herring catch is now sold for lobster bait. Some bait herring is also used in the tuna

fishery. These shifts in fishing patterns have been reflected in the catch at age. Estimates of juvenile harvest show a steady decline in numbers during the last ten years (NEFSC 1996). In recent years, a few mid-water trawl vessels have returned to George Bank, though catches from this area remained below 3,000 mt in 1996 and 1997 (Table E.9). Catches from this area, however, are increasing. Overall, domestic landings of Atlantic herring have increased in recent years, with the largest catch from the Gulf of Maine. In 1996, 81,000 mt of herring were taken from the Gulf of Maine, an increase of almost 20,000 mt over the previous year. Landings in southern New England, particularly Rhode Island, also increased substantially in 1995, 1996, and 1997 (Table E.12).

The other significant change in the U.S. herring fishery during the last 10-15 years was the development of Internal Waters Processing (IWP) operations in the Gulf of Maine and southern New England (see section E.6.4.3.2). Operating under provisions in the Magnuson-Stevens Act, foreign-owned processing ships anchored in U.S. internal waters receive herring caught by U.S. fishermen, subject to annual allocations made by the Commission and the states (ASMFC 1994). Total IWP "landings" reached 11,000-12,000 mt in 1989, 1990 and 1996 and averaged 7,850 mt a year between 1989 and 1996. This relatively small harvest has represented an important supplementary market for new vessels trying to break into the fishery, enabling them to also supply shoreside markets. Herring processed aboard IPW vessels is sold overseas.

In addition, a small amount of herring caught in the Gulf of Maine (average 1,858 mt between 1992 and 1997) is transferred at sea to Canadian carriers and landed in New Brunswick. These transfers (see section E.6.4.3.3) are part of a larger reciprocal U.S.-Canada trade in which herring move freely by truck across the border between Maine and New Brunswick, supplying canneries and lobster bait in both countries.

E.6.4.2 The Commercial and Recreational Herring Fishery

E.6.4.2.1 The Recreational Herring Fishery

A very small recreational fishery for Atlantic herring exists, providing late fall to early spring fishing opportunities for both shore and boat anglers. Landings, however, are negligible (NMFS 1998c). Most Atlantic herring catches are reported during March-April and November-December, with some catches reported from September-October. The Marine Recreational Fishery Statistics Survey (MRFSS) does not sample during January-February in the north or mid-Atlantic sub-regions and since herring may be taken during this period, total catch may be underestimated. The herring caught by hook and line anglers are taken as a secondary species in a mixed fishery in conjunction with Atlantic mackerel (*Scomber scombrus*).

A recreational fishery for herring in the northern one third of New Jersey is associated with the Atlantic mackerel and silver hake fisheries. The catch of herring is an incidental catch in these two directed recreational fisheries. The herring are taken on small "teasers" (plastic tubes covering a long shanked hook) used for mackerel, as well as small bucktails

and metal jigs. Most of the fish are kept for home consumption, being pickled or smoked, or used as bait, either cut or whole. The great majority of the recreational fishery is conducted from party boats, and to a lesser extent, from charter boats that operate between November and April.

Herring is also used as bait in the recreational tuna fisheries. While bait herring can be purchased from dealers or other boats, some tuna vessels are known to catch herring for use as live bait in this fishery. The use of small pelagic gillnets to catch herring for this purpose is authorized under the Northeast Multispecies Plan. There are no statistics on the extent of this practice or the amount of herring that is taken for this purpose. Some industry participants have estimated that 50 to 90 percent of the vessels fishing for tuna in New England waters may catch herring for bait.

E.6.4.2.2 The Commercial Herring Fisheries

E.6.4.2.2.1 Directed Fishery

The commercial herring fishery has changed significantly over the past twenty years. When the Council drafted its original fishery management plan in 1978, there were two distinct commercial fisheries: a harvest for juveniles, primarily using fixed gear but supplemented by purse seine vessels, and a fishery for adult herring that supplied the European market with herring for fillets and freezing. In 1976, there were 27 weirs, 65 stop seines, and only 15 purse seine vessels active in the Maine juvenile herring fishery. Thirty three vessels (mid-water and pair trawlers) targeted herring for the adult fishery (NEFMC 1978). There is no charter fishery that specifically targets herring, though herring may be caught coincidental to other operations.

Domestic landings of Atlantic herring increased since 1986. In 1997, domestic landings (excluding IWPs and Canadian transshipments) totaled over 95,700 mt worth \$11.5 million (Table E.10). Average ex-vessel prices have remained nearly constant (declining in real terms), as the 1986 ex-vessel value was about 5.4 cents per pound and the 1997 value was 5 cents per pound (Table E.8). Estimated potential ex-vessel revenues from this fishery, should the entire U.S. harvest of 270,000 mt be caught (based on B_{MSY} and F_{Target} , with a 30,000 mt allowance for expected Canadian catches), is over \$35 million. This estimate is based on an ex-vessel price of 6 cents per pound; development of higher value products may increase this revenue.

The current domestic herring fishery is not clearly defined by a fishery for juveniles and a fishery for adults. As mentioned earlier, the proportion of juveniles harvested has declined. The fishery is primarily a mobile gear fishery, as landings from the fixed gear sector have declined significantly. Since the demise of the Maine fixed gear fishery in the early 1980's, purse seine vessels have accounted for most of the catch, but in recent years mid-water trawlers have increased their proportion of the landings, reaching 41% between 1995 and 1997 (Table E.13). This table also shows renewed interest in mid-water pair trawling in recent years. Some herring is also taken by small bottom trawl vessels that use various small mesh whiting fishery exemptions to target herring at certain times of the year. While

only a small part of the annual herring catch, this is an important seasonal fishery to these fishermen.

Another shift that has taken place is the location of the catch. In the 1970's, the majority of the catch was taken in state waters, reflecting the predominance of the fixed gear fishery. In recent years the majority of the catch has been taken outside of state waters, a result of the increased importance of the mobile gear fisheries (Table E.11). Because the majority of the under-exploited resource is in federal waters, the importance of this fishery is likely to increase.

While herring is caught over a wide range (a description of the range is provided in the Council's Essential Fish Habitat amendment), there is a definite seasonal pattern to the fishery. During the winter months (December-March) the fishery is usually active in the coastal waters south of New England, as adults migrate to this area. In some years, there has been an active winter fishery north of Cape Cod, but this has not occurred since 1993. As spring approaches, the fishery moves north into the offshore waters in the Gulf of Maine (e.g., Jeffreys Ledge). In late summer/early fall, the focus of the fishery is on the coastal waters of Maine, New Hampshire, and Massachusetts as herring move into these areas prior to spawning. Landings from these areas usually begin to decline in November and the fishery moves south of New England again. Catches on Georges Bank in recent years have been made in the summer and early fall. There have also been some recent landings from the area just east of Nantucket Shoals in the late summer. These patterns vary over time. A review of landings from Management Areas 1 and 2 over the past twenty years shows that the percent of annual landings from these areas taken in any given month has shown varied considerably from year to year (Table E.15 and Table E.16).

A detailed review of 1997 herring catches by NMFS statistical area and month (Figure E.12 through Figure E.14) shows the temporal and spatial distribution of fishing effort during the year. Fishing activity was concentrated in nearshore Rhode Island waters in January, with some fishing west of Block Island and off Montauk Point and offshore of the Rhode Island and Massachusetts coast. In February, more herring were caught off Long Island and off the Rhode Island/Massachusetts coast than inshore, with some additional catches off New Jersey. March catches were spread over several statistical areas, but area 537 remained the most important area. In April, the fleet moved north into the Gulf of Maine where it remained through November. The majority of the catch at this time of year came from areas 512 and 513. By December, winter conditions again prevailed: there was still some fishing in the Gulf of Maine, but most of the catch came from Rhode Island.

The fishery is dominated by a relatively small group of vessels, though a broader group of vessels lands some herring in small amounts (Table E.14). In 1997, nearly 98 percent of the landings were made by 21 vessels, and 10 boats accounted for 92% of the catch. This same year, only 61 vessels averaged more than 2,000 pounds of herring on trips that reported landing herring. Nine boats were active in the Gulf of Maine summer-fall fishery in 1997 and ten fished in the Gulf of Maine and in southern New England and the mid-Atlantic region in the winter. Three of the boats that fished all year also harvested small

amounts of herring on Georges Bank in 1997. Six of these 19 boats were purse seiners, ten were mid-water trawlers (operating as either single boats or paired with a second boat), and two used both types of gear, switching from a seine in the summer-fall fishery to a trawl in the winter. Vessels that fish during the winter and offshore are larger. A total of four vessels were equipped with either refrigerated sea water systems or were freezer trawlers; these systems allow them to stay at sea longer and still bring in a high quality product. Several of the larger mid-water trawlers also harvested mackerel in the winter or squid during the spring and summer. Average landings per trip for the group of eleven primary vessels in 1997 (Table E.14) was about 77 mt (170,000 lbs); the highest average landings per trip for any vessel in this group was 157 mt. One small group of fishermen target herring using small mesh bottom trawls under several different groundfish exemptions. Typically, these boats make less than 10 –15 herring trips each year, with total landings of less than 250 mt in 1997. A further description of these boats is contained in section E.7.3.4.3.

Most herring fishing trips in all areas were about one day in length, with the exception of a small number of trips by freezer trawlers that were 5 to 7 days long. This is probably due to two factors: the fishery is primarily prosecuted near shore, and there is a need to get the herring to market rapidly before it decomposes. In some instances, vessels fished close enough to shore that they were able to make more than one trip in a day. An examination of the number of days that each boat lands herring (using the Maine DMR database) helps to give an understanding of the intensity of fishing effort in the different management areas during different seasons, and the impact of mandatory days out of the fishery. The only segment of the industry this does not accurately capture is the effort by freezer trawlers, who fish for several days before offloading. In 1997, this represented a small portion of the total landings and trips.

In Management Area 1, the weeks with the most landings of herring occurred from July through October, reflected in the high landings rate during this time of year (Figure E.23). This coincides with the aggregation of spawning herring in the Gulf of Maine, but also with a rise in demand to support the peak season for the lobster fishery. A total of 38 boats reported landing more than one metric ton of herring from Management Area 1 a total of 1,145 days in 1997. 12 of these boats landed less than ten mt during the year. In 1997, only 13 boats ever landed herring on more than 4 days a week. Of the 38 boats, only three ever landed herring every day of the week (Sunday through Saturday) at any time during the year. These three boats fished every day of the week during a total of six occasions, accounting for 42 of days with landings of one metric ton or more. Nine boats landed herring on six days of the week, doing so during a total of 20 weeks (120 of the days with landings of one mt or more). 13 boats landed herring on five days of the week on 58 occasions (290 of the instances), and 14 landed herring on four days of the week (98 instances). In other words, in 1997 48% of the days that individual vessels landed one mt or more of herring came during weeks the vessel fished for 1 to three days. The next most common fishing practice in Management Area 1 was for boats to land herring on five days of the week, accounting for 35% of the days with herring landings of more than 1 mt by an individual vessel.

In Management Area 2, the weeks with the most landings of herring were January, February, and December, reflecting the winter nature of this fishery and the movement of herring into the mid-Atlantic area. 36 boats reported landing at least one trip of one metric ton in 1997; 6 of these boats landing less than 10 mt for the year. The intensity of fishing effort is far less than in Management Area 1, as would be expected by the lower landings reported from this area. There were landings of more than one mt by a vessel on 529 occasions in Management Area 2. Only one boat ever landed herring on all seven days of a week, doing so during two separate weeks (14 days with landings of more than 1 mt by a vessel). On 12 occasions, 3 boats landed herring on each of six days of the week (84 days total). 3 boats landed herring on five days of the week on 5 occasions (25 total), and 8 boats landed herring on four days of the week on a total of 22 occasions (88 total). In this area, the most common fishing practice was to land herring on less than four days of a week, accounting for nearly 60% of the days with landings of one mt or more from an individual vessel.

Most landings of herring are made in Maine, harvested by four different gear types: weirs and stop seines (fixed gear), purse seines and mid-water trawls (mobile gear). During the first half of this century the fishery harvested mostly juvenile two year-old herring (“sardines”) using fixed gear. Weirs were by far the most common gear used until the 1940's, mostly in eastern Maine, where strong tides and the presence of long, shallow bays make this method of fishing most suitable. By the 1950's, the fish had become more common in the central section of the coast and stop seines had become the dominant gear type. Purse seines accounted for a growing percentage of the catch after 1960 and are the most important gear used in this fishery since they can be used more or less selectively to catch a variety of ages and sizes of herring. The increased use of purse seines and mid-water trawls, a growing demand for adults as canned “steaks”, for bait, and for sale to foreign processing ships, and the scarcity of juveniles in nearshore waters in recent years have caused a shift from a fishery dominated by juveniles to one that is more evenly divided between ages 2, 3, and 4+. The catch has been composed primarily of adults in recent years (75% age 3+ since 1986). Primary landings ports are Rockland and Portland (see section E.6.4.2.4).

Fixed gear have accounted for only a small percentage of the total Maine herring landings since 1983. In 1992, there were 16 fishermen in Maine using purse seines, 24 using stop seines, and only 5 using weirs. The reduced use of stop seines and weirs since the late 1970's and early 1980's has been dramatic (78 fishermen were reported using stop seines in 1981 and 88 using weirs in 1984), owing to the absence of herring in nearshore waters. Fixed gear landings in Maine dropped from 45,000 mt in 1981 to 11,000 mt in 1982 and then to 2,500 mt in 1983, and have remained below 5,000 mt since then. Fixed gear landings during 1994-1997 were less than 500 mt a year (Scully et al. 1998).

Most purse seiners supply more than one market depending on price, the availability of different sizes or qualities of herring, and demand. Sales to the canneries are preferred because the price is higher (they also demand a better quality product). While most of the purse seine vessels are independently owned, two are owned by one of the packing companies.

Herring are caught in Maine coastal waters between June and November. In recent years, catches from the western and central areas of the coast have predominated with very little coming from eastern Maine. Some herring landed in Maine are caught in Massachusetts and New Hampshire coastal waters, primarily on Jeffreys Ledge. Total domestic landings in 1997 were 52,040 mt (114,750 lbs) with a landed value of \$6.3 million and an average value of \$121 per metric ton (or 0.055cents a pound). The sardine industry in Maine currently generates over \$40 million a year in sales of canned products (see section E.1.1.1).

The Atlantic herring fishery in New Hampshire has been minimal according to records kept since 1879. Early fishery statistics show annual landings around the turn of the century that range from 10 to 160 metric tons. The years from 1908 to 1976 are not well documented, but it is supposed that the actual landings during these years were similarly low. Commencing in 1977, annual landings of Atlantic herring were recorded except for 1978-79. One year, 1980, shows an unusually high landing of 3,000 mt. This unusual record was the result of a regulatory inconsistency between New Hampshire and the other Atlantic coast states. Following that event, New Hampshire adopted regulations to prevent this from continuing. In recent years, the otter trawl herring fishery in New Hampshire has been limited to a few vessels that supply bait for local lobstermen and the bluefin tuna fishery. Occasionally, landings of herring are trucked to Maine for processing. No processing of herring other than bait preparation is currently conducted in New Hampshire. Landings in New Hampshire have averaged less than 400 mt annually since 1990 (Table E.12).

Purse seines, pair trawls, otter trawls and fish traps are used to harvest sea herring in Massachusetts waters. Purse seines are responsible for the majority of herring landings with most of the seiners being from other states, especially Maine. Most of the seiners fish on grounds outside of Massachusetts waters except in those years when for whatever reason (e.g. favorable water temperatures) fish are abundant and available fairly close to shore such as during the winter and early spring of 1989-90, in Cape Cod Bay. Herring are landed primarily in Gloucester (see E.6.4.2.4)

During some years, seiners have taken advantage of overwintering, smaller fish in Massachusetts Bay by offloading and trucking fish from Gloucester, which supplies cannery and bait markets on the U.S. Atlantic coast and eastern Canada. Massachusetts shoreside plants also are supplied with herring, although shoreside demand is minimal except for use as bait and food for zoos. The greatest demand for herring shoreside was in the late 1970's and early 1980's, when the overseas market for filleted fish was strong, and Gloucester had a fish meal plant. With the loss of the plant and the absence of an overseas market during the latter part of the 1980's and early 1990's, internal waters processing operations took on great importance for the state.

Massachusetts herring landings peaked in 1971 from previous low landings of many years, decreased in the mid-1970's, and then steadily increased with a peak of 30,330 mt in 1980 with a value of \$3,787,000 (average \$155.60/metric ton). Landings decreased dramatically

from 1980 to 1983 (Table E.10). Only 4,075 mt were landed in 1983. It was caused by a markedly reduced demand for U.S. herring owing to (a) a resurgence of North Sea herring stocks to meet the needs of the European economic community markets, especially in Germany; (2) other species (e.g. mackerel) became a preferred alternative to herring since herring were scarce and consumers switched to more available species; and (3) a strong U.S. dollar created a lower demand for U.S. herring (e.g. in 1982 the U.S. dollar was stronger than the Canadian dollar by 20%, therefore, U.S. herring cost more than Canadian herring). By 1988, shoreside landings had returned to more than 20,000 mt and remained between 20,000 and 28,000 mt until 1992. Landings dropped in the next three years, then returned to 22-24,000 mt in 1996 and 1997 (Table E.12).

The Atlantic herring fishery of Rhode Island developed during the late 19th century. Landings were negligible (under 2,000 pounds/year) during the early years of the fishery, but catches increased dramatically in the early 1900's, with 100 mt landed in 1908. Rhode Island's herring landings have been extremely variable since then, ranging from 15 mt in 1944, to a high of 330 mt in 1973. At times, the landings from one year to the next have changed by as much as 1,500 mt (Table E.12).

Early in this century, floating traps dominated the state's fishing industry. Otter trawls were introduced to the state in the early 1930's; however, herring sometimes swim too high off of the ocean floor to be caught with traditional otter trawls. In 1968, the URI Marine Advisory Service introduced wing trawls (which have higher openings) to Point Judith's fishermen, and catches increased. In 1971, The MAS introduced the pelagic pair trawl, which remained in use for about ten years. Currently, most of the herring landed in Rhode Island is caught with mid-water trawls, although purse seines are also used in the winter fishery. Most of the vessels participating in the winter fishery in southern New England and the mid-Atlantic region spend the summer and fall fishing in the Gulf of Maine.

Shoreside landings have increased dramatically in Rhode Island during the last three years, reaching 20,000 mt in 1997. Principal ports are Point Judith, Portsmouth, and Davisville. Herring landed in RI during the winter are trucked as far as the mid-Atlantic states and Canada to supply cannery and bait markets. A fish dehydrating plant once operated in Galilee, R.I. The Rhode Island Atlantic herring season extends from November through March. Internal Waters Processing operations based in RI in 1990-91 and 1996-97 provided an additional market for U.S. fishermen. The IWP catch was 4,163 mt in 1996 and less than 1,000 mt in 1997 (E.6.4.3.2).

In Connecticut, Atlantic herring are taken principally by trawl, and to a lesser extent, in pound nets and gill nets. Catches within state waters are limited by seasonal (Nov-May) mesh size restrictions in the trawl fishery (4.5 in mesh codend) and a year-round 3 inch minimum mesh size for gillnets fished in marine waters. The trawl fishery takes herring mixed with mackerel outside of Long Island Sound between November and April. The pound net fishery typically took Atlantic herring from mid-March through April. However, catches have declined in recent years presumably due to fluctuations in local abundance. The gill net fishery takes herring as an incidental bycatch.

Atlantic herring fisheries in New York have not been of major importance over the years, but they have been fairly constant. Landings in the domestic fishery have ranged from as low as 3 mt to as high as 2,907 mt. The domestic fishery in New York is predominantly a bait fishery because there is no local market for any other product. The market is extremely limited and there is little demand.

The primary gears used in the domestic herring fishery are the trawl and seine. There have also been landings from the pound net and gill net fisheries but these are limited. In 1991, however, New York fishermen participated in an Internal Waters Processing operation for herring. The gear used was a pair trawl and the landings from this operation were significant for the New York fishery. Over 1,000 mt were taken. New York does not currently have any management restrictions directed at herring.

In New Jersey, from the late 1800's to the mid-1900's, Atlantic herring were taken mostly in state waters from pound nets during late fall to early winter, and again in early spring. While these stationary nets were set from spring to late fall, they were taken up during winter because of severe weather. Catches varied from year to year but were usually less than 250 mt and most of this was sold for bait, though some was salted or pickled for food. During those years, otter trawl vessels accounted for less than ten percent of the total herring catch.

Since the late 1950's, the commercial fishery in New Jersey was almost exclusively conducted by otter trawl vessels which operated from two miles off the coast (New Jersey's law did not allow otter trawl vessels to operate closer to shore than this distance) and offshore over the entire breadth of the continental shelf. Catches in New Jersey during the 1970s and 1980s were very sparse. Landings increased to 3,750 mt in 1992 and 1,390 mt in 1993, but since then have declined again. The principal herring port is Cape May. There is also a considerable but unknown by-catch of herring taken in other fisheries, especially the mackerel fishery. At times, the discard of herring equals or exceeds the directed catch of other species. The commercial season normally extends from late November through mid-March, the period when Atlantic herring frequent middle Atlantic waters. There was a small IWP operation in Cape May in 1992, and a second operation targeting mackerel took a small amount of herring in 1997.

As was indicated above, the herring were often taken incidental to the mackerel fishery. But with increased abundance of herring and growing market for its sale, there has developed a directed fishery for this species. It should be noted that the catch of Atlantic herring and the river herrings, including alewives and blueback herring, *Alosa* spp., were often grouped into the same category for reporting purposes. Any herrings caught at sea were often recorded as "sea herring" and were listed as Atlantic herring. Recent information indicates that much of New Jersey's catches made during April and May and reported as Atlantic herring were probably blueback herring or alewives. The existing market structure for herrings now dictates that the various species be distinguished so that Atlantic herring are reported as *Clupea harengus*, whereas the species category "alewives", includes both *Alosa* species.

Domestic landings of herring in Virginia and North Carolina reached 400-700 mt in 1995-1997 (Table E.12).

Table E.9 - Total Gulf of Maine (GOM), Southern New England (SNE), Middle Atlantic (MAT) and New Brunswick, Canada (NB) herring catch, 1960-1996 (metric tons). (Includes IWP operations and at-sea transfers to Canadian carriers in the Gulf of Maine) (Source: SAW-27, NEFSC 1998a)

YEAR	GB¹	GOM²	SNE³	MAT⁴	NB⁵	TOTAL
1960	0	60237	261	152	34304	94954
1961	67655	25548	197	101	8054	101555
1962	152242	69980	131	98	20698	243149
1963	97968	67736	195	78	29366	195343
1964	131438	27226	200	148	29432	188444
1965	42882	34104	303	208	3346	80843
1966	142704	29167	3185	176	35805	211037
1967	218743	35417	247	524	30032	284963
1968	373598	62425	245	122	33145	469535
1969	310758	53420	2104	193	26539	393014
1970	247294	41786	1037	189	15840	306146
1971	267347	52129	1318	1151	12660	334605
1972	174190	61664	2310	409	32699	271272
1973	202335	32492	4249	233	19935	259244
1974	149525	37356	2918	200	20602	210601
1975	146096	37187	4119	117	30819	218338
1976	43502	50808	191	57	29206	123764
1977	2157	50730	301	33	23487	76708
1978	2059	49316	1730	46	38842	91993
1979	1270	63492	1341	31	37828	103962
1980	1700	82244	1200	21	13525	98690
1981	672	64324	749	16	19080	84841
1982	1378	32157	1394	20	25963	60912
1983	53	24824	72	21	11383	36353
1984	58	33958	79	10	8698	42803
1985	316	27157	196	13	27863	55545
1986	586	27942	632	20	27883	57063
1987	11	39970	376	87	27320	67764
1988		39568	1307	365	33421	74661
1989		52774	269	39	44112	97194
1990		54192	2761	48	38778	95779
1991		50984	3947	402	24576	79909
1992		55948	716	4564	31968	93196
1993		53929	1829	1347	31572	88677
1994	474	51413	1935	502	22241	76565
1995	64	64593	10866	612	18248	94383
1996	1758	80925	20177	803	15913	119576
1997	6262	70171	21382	456	20552	118823

¹ 1961-1987: foreign catches from 5Z and 6, including some US landings; 1994-1997: catch from NMFS statistical areas 521, 522, 526, 561, 562;. ² ME, MA & NH landings + foreign catches from Jeffreys Ledge (1967-1978) – GB catch; ³ RI, CT, NY landings; ⁴ NJ, DE, MD, VA landings; ⁵ Fixed gear catch only

Year	Landings ('000 pounds)	Value ('000 dollars)
1986	79,381	4,314
1987	84,536	4,368
1988	90,397	5,229
1989	89,657	5,041
1990	113,095	5,746
1991	107,067	6,339
1992	122,993	6,821
1993	109,645	6,511
1994	100,997	5,816
1995	147,181	8,654
1996	197,124	11,194
1997	211,010	11,543

Table E.10 - U. S. commercial herring landings and value (excluding IWP, JV, and Canadian transshipments) (Source: Fisheries of the United States (series))

Herring Landings by Distance Offshore (mt / %)							
Year	0-3 Miles		3-200 Miles		>200 miles		Total
1981	49,168	78%	13,922	22%		0	63,090
1982	26,229	79%	6,859	21%		0	33,088
1983	16,195	70%	7,053	30%		0	23,248
1984	20,697	62%	12,765	38%		0	33,462
1985	18,420	71%	7,490	29%		0	25,911
1986	24,589	68%	11,418	32%		0	36,007
1987	19,406	51%	18,939	49%	0	0	38,345
1988	16,694	41%	24,306	59%	3	0	41,003
1989	13,887	26%	39,255	74%		0	53,142
1990	14,403	28%	36,896	72%	0	0	51,300
1991	29,169	48%	31,714	52%	0	0	60,884
1992	20,138	34%	39,783	66%	3	0	59,924
1993	32,512	58%	23,587	42%	293	0	56,392
1994	N/A		N/A		N/A		N/A
1995	31,201	41%	45,314	59%	0	0	76,516
1996	39,766	38%	64,224	62%	0	0	103,990
1997	30,023	31%	67,693	69%	0	0	97,716

Table E.11- Herring landings by distance offshore (Source: Fisheries of the U. S. (series))

State											
Year	CT	DE	ME	MD	MA	NH	NJ	NY	RI	VA	Total
1976	1		31858	3	18025		54	12	178	0	50130
1977	0		33135		17113	25	33	8	293	0	50607
1978	29		30343	3	18393		43	13	1688	0	50513
1979	2		40540	1	23038		30	58	1281	0	64951
1980	0		48908	1	30322	3010	14	104	1096	6	83462
1981	12		51979	0	12300	48	16	49	688		65092
1982	13	7	23207	2	7123	581	11	18	1363	1	32323
1983	6		18161	1	4057	943	20	20	46		23254
1984			21263		12146	82	10	30	48		33580
1985	1		14570		11128	2	11	46	154	2	25914
1986	3		19797		11543	1	20	49	583		31997
1987	9		20484		18498	0	23	52	311	64	39441
1988	0		16531		22800		23	216	1091	342	41004
1989			15625		24497	284	31	55	214	8	40715
1990	0		22582	1	28085	167	48	3	757	0	51644
1991	4		24327	27	21706	173	367	124	2042	14	48783
1992	0		28049	48	22975	255	3749	9	707	0	55791
1993	2		34750	10	11213	351	1391	8	1821	204	49750
1994	1		35326	4	7306	197	470	27	1910	569	45811
1995	2		43025		14238	148	199	27	10865		68505
1996	55		50357		21882	15	286	47	15999	137	88778
1997	63		55990		24224	69	134	37	14921		96923

Table E.12 - Domestic herring landings by state (does not include IWP, JVP, or transfers to Canadian herring carriers) Personal communication from the National Marine Fisheries Service, Fisheries Statistics and Economics Division,
<http://remora.ssp.nmfs.gov/commercial/landings>)

Gear	Year														
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997*	
Floating Traps (Shallow)	16	8	23	13	21	5	15	0	0	8	3	0	2	.085	
Gill Nets. Drift. Other		1	0	0	1		5	1	1	0	3	8	11	9	
Gill Nets. Other	5	1	0	3	20	2.629	5	12	3	12	19				
Gill Nets. Sink/Anchor. Other											12	30	3	39	
Lines Long Set With Hooks							0		45		0				
Not Coded											1	55			
Otter Trawl Bottom. Fish	491	249	870	1.345	1.389	692	944	1.955	4.836	2.513	2.894	2.003	1.886	1.203	
Otter Trawl Bottom. Other										4					
Otter Trawl Bottom. Shrimpn	4	3	17	16	19	14	0	5	2	0	0	318			
Otter Trawl Midwater					774				1.939	6.114	7.164	30.644	31.585	41.311	
Pots And Traps. Lobster Inshore						0			0		51		0		
Pound Nets. Fish	8		4		16	0	2	18	7	2	1	0	3	1	
Pound Nets. Other					201				0	1					
Purse Seines. Herring	29.428	21.004	29.012	36.515	36.266	35.846	50.032	44.708	45.118	38.432	34.546	34.608	54.695	51.240	
Purse Seines. Mackerel	12										82				
Purse Seines. Other											8				
Stop Seines	70	3.739	1.645	1.225	732	763	216	918	3.443	2.290	293		438		
Trawl Bottom. Paired	8		0					2							
Trawl Midwater. Paired	1.349	2			282		2	1.108		59		839		1.373	
Weirs	228	860	382	311	1.202	765	422	50	393	56	168		18	170	
Grand Total	31 619	25 867	31 954	39 428	40 925	40 714	51 644	48 778	55 787	49 492	45 247	68 504	88 641	95 348	

Table E.13 - Landings by major gear type (metric tons), 1986-1997 (Personal communication from the National Marine Fisheries Service, Fisheries Statistics and Economics Division, <http://remora.ssp.nmfs.gov/commercial/landings>; 1997 data is preliminary)

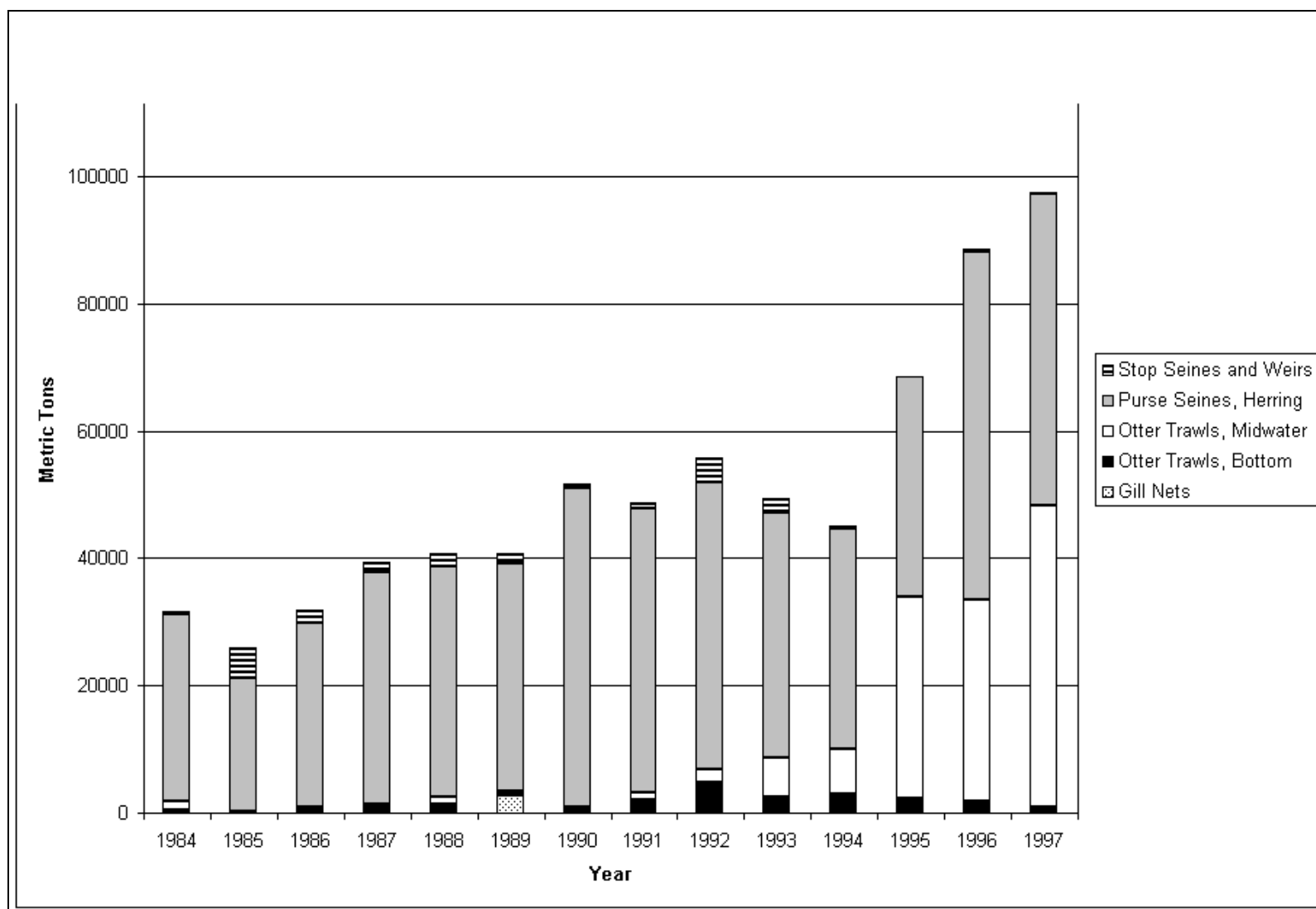


Figure E.11 - Herring landings by major gear type, 1984 – 1997 (does not include IWP/JVP catches, or transshipments to Canada)

Summary of 1997 Landings								
Vessels (ranked by annual herring landings)	Total Landings		Number of Trips			Average Pounds/Trip		Average Annual Revenues/ Vessel (\$.05/lb)
	MT	%	Mean	Lo	Hi	Mean	Hi	
1 – 10	25	<0.1%	1	1	1	5,424	7,938	\$271
11 - 20	66	<0.1%	2	1	6	9,150	14,994	\$721
21 – 30	206	0.2%	4	1	10	14,716	29,988	\$2,270
31 – 40	549	0.6%	3.6	1	12	59,525	114,660	\$6,053
41 – 50	5,873	5.9%	20.8	2	44	108,179	404,066	\$64,753
51 – 61	90,295	92%	115.5	8	191	170,054	347,011	\$905,005
Total Identified Landings	97,013	98.7%						

Table E.14 – Summary of 1997 landings. Total 1997 landings: 98,271 mt. Only vessels that averaged more than 2,000/lbs trip are included. (Maine DMR summary of NMFS statistics)

	Jan	Feb	Mar	Anr	Mav	Jun	Jul	Aug	Sen	Oct	Nov	Dec
1976	2	4	10	17	18	33	49	64	79	92	100	100
1977	5	13	20	26	30	37	55	73	84	96	99	100
1978	6	16	24	24	25	30	47	69	83	90	98	100
1979	5	13	20	26	30	37	55	73	84	96	99	100
1980	1	6	13	13	13	18	39	61	84	98	100	100
1981	2	5	6	7	7	14	31	57	78	98	100	100
1982	2	5	5	5	6	9	22	53	72	89	96	100
1983	2	5	5	6	7	12	29	64	78	89	99	100
1984	3	12	19	23	24	25	38	62	80	92	97	100
1985	4	14	22	27	27	36	51	66	77	89	94	100
1986	5	14	25	28	30	31	42	54	79	87	94	100
1987	5	14	25	29	33	38	51	64	76	86	91	100
1988	7	18	33	39	40	45	55	66	78	84	95	100
1989	7	17	30	44	44	49	57	68	78	85	95	100
1990⁽³⁾	8	17	32	37	43	49	60	70	77	84	93	100
1991⁽³⁾	6	11	15	21	21	30	44	52	63	72	88	100
1992	8	12	18	28	29	36	46	55	67	81	94	100
1993	3	3	3	5	11	21	31	45	63	80	92	100
1994⁽⁴⁾	0	0	0	4	9	20	38	52	66	85	96	100
1995⁽⁵⁾	1	1	1	9	17	27	45	63	75	88	98	100
1996⁽⁶⁾	0	0	0	3	14	29	40	57	72	88	99	100
Average 76-96	3.9	9.5	15.5	20.0	22.8	29.9	44.1	61.4	75.8	88.0	96.1	100.0

Table E.15- Annual landings distribution (percent each month), Management Area 1 (NMFS VTR database)

Notes: (1) Management area 1 includes statistical areas 511, 512, 513, 514, 515.

(2) Domestic landings only (does not include IWP, JVP, or foreign catches) as cumulative per cent of annual landings.

(3) 1990 and 1991 include some landings not reported by month.

(4) 13.9% of annual landings not reported by area; these landings are not included in this table.

(5) 0.3% of annual landings not reported by area; these landings are not included in this table.

(6) 2.1% of annual landings not reported by area; these landings are not included in this table.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	5	19	22	31	91	91	91	91	100	100	100	100
1977	19	73	97	99	99	99	99	99	100	100	100	100
1978	1	66	95	99	100	100	100	100	100	100	100	100
1979	1	11	90	96	96	96	97	97	97	97	97	100
1980	1	53	84	100	100	100	100	100	100	100	100	100
1981	71	90	92	95	96	96	96	99	99	99	99	100
1982	13	48	96	98	100	100	100	100	100	100	100	100
1983	23	29	52	69	70	71	71	71	81	84	88	100
1984	7	20	47	71	72	72	72	75	77	79	98	100
1985	3	15	39	56	58	59	59	59	59	99	99	100
1986	13	35	87	90	96	99	99	99	99	99	99	100
1987	3	23	66	90	91	91	92	92	94	94	98	100
1988	6	33	69	70	70	70	71	71	72	73	99	100
1989	16	22	38	42	44	45	46	46	46	46	46	85
1990	58	63	69	70	70	70	70	70	70	70	76	100
1991	13	51	57	60	61	61	61	61	61	61	93	97
1992	34	77	94	98	98	98	98	98	98	98	98	100
1993	26	38	54	58	58	58	58	58	58	58	58	59
1994	30	60	87	99	99	99	99	100	100	100	100	100
1995	37	66	87	89	89	89	89	89	89	89	89	100
1996	32	49	65	71	72	72	72	72	72	72	78	100
Average	19.6	44.9	70.8	78.6	82.4	82.7	82.8	83.1	84.3	86.5	91.1	97.2

Table E.16 - Annual landings distribution (percent each month), Management Area 2 (Note: In 1989 and 1993, significant landings from Area 2 were not reported by month)