APPENDIX VI

Essential Fish Habitat Section:

Gear Descriptions of Gears Used in Northeast U.S.

Gear Descriptions of Gears Used in Northeast U.S.

1 Introduction

Descriptions are included in this appendix for the following general gear categories used in state and federal waters of the Northeast region of the U.S: Bottom tending mobile gear, bottom tending static gear, pelagic gear, and other gears. The Northeast region falls within the jurisdiction of the NEFMC and MAFMC as well as the individual states from Maine to North Carolina which are represented by the Atlantic States Marine Fisheries Commission (ASMFC). These jurisdictions are responsible for the management of many different fisheries extending from the upper reaches of the rivers and estuaries out to 200 miles offshore at the limit of the Exclusive Economic Zone (EEZ).

2 Fisheries Landing Data and Gear Usage Information

Sixty categories of fishing gear were identified as having been associated with landings of federal or state managed species based on a review of the National Marine Fisheries Service commercial fisheries landings data for 1999 and an ASMFC report on gear impacts to submerged aquatic vegetation (Stephan *et al.* 2000).

Fishing gears considered in this report are those used to land any amount of any species managed by either the NEFMC or MAFMC (**Error! Reference source not found.**) as well as gears that contributed 1% or more of any individual state's total landings for all species (Table 2). Although certain gear types are not managed under the auspices of the MSA, this methodology recognizes that certain gear utilized in state waters may have adverse impacts to EFH that is designated in nearshore, estuarine and riverine areas. Table 3 provides the list of all 60 gears considered and indicates whether the gear is utilized in estuaries, coastal waters (0-3 miles), or offshore waters (3-200 miles). Since the seabed is the location of the habitat types most susceptible to gear disturbances, Table 3 also indicates whether the gear contacts the bottom and if the use of the gear is regulated under a federal FMP. This report considers gear to be regulated under a federal FMP if it is typically utilized to harvest fish under a federal vessel or operators permit.

	NORTHEAST SPECIES																														
GEAR	DOGFISH	BLUEFISH	BUTTERFISH	SURFCLAM	OCEAN QUAHOG	COD, ATLANTIC	RED CRAB	SUMMER FLNDR	WINDOWPANE FLNDR	WINTER FLNDR	WITCH FLNDR	YELLOWTAIL FLNDR	MONKFISH	HADDOCK	HAKE, RED	HAKE, SILVER	HAKE, WHITE	HALIBUT, ATLANTIC	HERRING, ATLANTIC	MACKEREL, ATLANT	PLAICE, AMERICAN	POLLOCK	OCEAN POUT	REDFISH	SCALLOP, SEA	SCUP	BLACK SEA BASS	SKATES	SQUID, LOLIGO	SQUID, ILLEX	TILEFISH
Bag Nets			-																											-	
Beam Trawls, Other		-	-		-					-	-	-	-		-	-									-	-			-		
Cast Nets		-						-																		-					
Combined Gears		-																									-				-
Diving Outfits, Other																									-	-					
Dredge Clam				92	100			-		-			-												-	-					
Dredge Conch								-																				-			
Dredge Scallop, Bay										-	-		-												-						
Dredge Scallop, Sea		-	-			-		2	-	-	-	1	16			-	-				-	-			90	-	-	-	-	-	-
Floating Traps (Shallow)		1	-			-		-		-			-			-			-	2		-				9	-	-	-		
Fyke And Hoop Nets,		-	-					-	-	-	-	-	-															-			
Gill Nets, Drift, Other	-	9	-					-		-		-	-		-	-			-	-			-			-	-	-	-		
Gill Nets, Drift,		5	-																												
Gill Nets, Other		5	-					-					-							-							-	-			
Gill Nets, Sink/Anchor,	60	16	-			20		-	-	4	2	6	29	7	-	-	35	8	-	1	2	55	3	16	-	-	-	12	-	-	-
Gill Nets, Stake	-	-	-					-					-						-	-											
Haul Seines, Beach	-	1	-					-		-					-	-			-	-								-			
Haul Seines, Long		-	-																												
Haul Seines,						-				-	-	-	-	-		-	-				-	-		-				-			
Lines Hand, Other	-	5	-			5		2	-	-	-	-	-	-	-	-	-		-	-	-	-	4	-		12	14	-	-		2
Lines Long Set With	-	-	-			17		-		-	-	-	-	2	-	-	5	-		-	-	2	7	-	-	-	-	-	-		61
Lines Long, Reef Fish																															32
Lines Troll, Other		-	-					-																			-				-
Lines Troll With Baits								-																							
Otter Trawl Bottom, Fish	38	20	93			57		92	98	95	97	92	53	91	98	99	58	89	2	93	97	42	77	83	-	66	25	86	99	100	4
Otter Trawl Bottom,		-				-		-		-	-	-	-	-							-	-			9		-	-	-		
Otter Trawl Midwater																			53	-											
Pots And Traps, Conch		-	-			-																	-				-				
Pots And Traps, Crab,		-	-					-																			-				
Pots and Traps, Crab,		-																													
Pots And Traps, Crab,		-					60	-																							
Pots And Traps, Fish		-	-			-		-		-			-		-	-	-		-	-		-	7	-		5	53	-	-		-
Pots And Traps, Lobster		-	-			-		-		-			-	-	-	-	-			-		-	-	-	-	-	-	-	-		
Pots And Traps, Lobster		-	-			-	40	-		-			-		-		-						-	-		-	-		-		-
Pots And Traps, Other		-						-																		-	3				
Pound Nets, Crab		-						-																							
Pound Nets, Fish		5	3			-		2	-	-		-	-		-	-			-	-						-	-	-	-		
Pound Nets, Other		-	-					-		-										2						2	-		-		
Purse Seines, Herring																			31												
Purse Seines, Other		3																													
Reel, Electric or																											-				
Rod and Reel																											-				
Scottish Seine		-	-			-		-	-	-	-	-	-	-	-	-	-			-	-	-	-			-	-	-	-		
Scrapes								-																							
Spears		-																									-				
Stop Seines																			-												
Trawl Midwater, Paired																			14												
Weirs																			-												

"-" Indicates there was less than 1% landings associated with this gear type for this species

"Blank" Indicates there were no landings recorded for this gear type for this species

Table 1 - Percentage of Landings for Federally Managed Species by Fishing Gear Type Used in Northeast Region in 1999

	Percent of Landings (1% or more) for All Species by State											
Gear	**CT**	**DE**	**MA**	**MD**	**ME**	**NC**	**NH**	**NJ**	**NY**	**RI**	**VA**	**% Landings All States Combined**
By Hand, Other		18										
Diving Outfits, Other					5							1
Dredge Clam			9	10				39	1	1		6
Dredge Crab		11									1	
Dredge Mussel					1							
Dredge Other					3							
Dredge Scallop, Sea	7		10		1		1	2			1	2
Dredge Urchin, Sea					1							
Floating Traps (Shallow)										1		
Fyke And Hoop Nets, Fish				2								
Gill Nets, Drift, Other		4		3				2				1
Gill Nets, Drift, Runaround						1						
Gill Nets, Other						14						1
Gill Nets, Sink/Anchor,			12	5	1		42	5	5	4	3	4
Gill Nets, Stake		7										
Haul Seines, Beach				2							1	
Haul Seines, Long						1						
Hoes					1							
Lines Hand, Other		1	2	1		1	1		1			1
Lines Long Set With Hooks			4			1		1	4			1
Lines Long, Shark						1						
Lines Troll, Other						1						
Lines Trot With Baits				17								1
Not Coded	16				1			1	30			2
Otter Trawl Bottom, Shrimp					1	6	3					1
Otter Trawl Midwater			11		21		8			18		6
Pots And Traps, Conch		2										
Pots And Traps, Crab, Blue		51		36		36		3			6	8
Pots And Traps, Crab, Other			2							1		
Pots And Traps, Eel		2		1								
Pots And Traps, Fish		1		3								
Pots And Traps, Lobster Inshore	13		5		25		9			4		5
Pots And Traps, Lobster Offshore	2		4				9	1		2		1
Pots And Traps, Other			1		1							
Pound Nets, Crab				1								
Otter Trawl Bottom, Crab						1						
Otter Trawl Bottom, Fish	61		38	3	9	7	26	26	58	56	2	18
Pound Nets, Fish				14		1			1		4	2
Purse Seines, Herring			1		23							4
Purse Seines, Menhaden						27		18			74	28
Purse Seines, Other											7	2

Table 2 - Principal Fishing Gears Used in Each State in the Northeast Region in 1999

GEAR	Estuary or Bay	Coastal 0-3 Miles	Offshore 3-200 Miles	Contacts Bottom	Federally Regulated
Bag Nets	X	X	X		X

Beam Trawls	X	X	X	X	X
By Hand	X	X			X
Cast Nets	X	X	X		
Clam Kicking	X			X	
Diving Outfits	X	X	X		
Dredge Clam	X	X	X	X	X
Dredge Conch	X			X	
Dredge Crab	X	X		X	
Dredge Mussel	X	X		X	
Dredge Oyster, Common	X			X	
Dredge Scallop, Bay	X			X	
Dredge Scallop, Sea		X	X	X	X
Dredge Urchin, Sea		X	X	X	
Floating Traps (Shallow)	X	X		X	X
Fyke And Hoop Nets, Fish	X	X		X	
Gill Nets, Drift, Other			X		X
Gill Nets, Drift, Runaround			X		X
Gill Nets, Sink/Anchor, Other	X	X	X	X	X
Gill Nets, Stake	X	X	X	X	X
Haul Seines, Beach	X	X		X	
Haul Seines, Long	X	X		X	
Haul Seines, Long(Danish)		X	X	X	X
Hoes	X			X	
Lines Hand, Other	X	X	X		X
Lines Long Set With Hooks		X	X	X	X
Lines Long, Reef Fish		X	X	X	X
Lines Long, Shark		X	X		X
Lines Troll, Other		X	X		X
Lines Trot With Baits		X	X		X
Otter Trawl Bottom, Crab	X	X	X	X	
Otter Trawl Bottom, Fish	X	X	X	X	X
Otter Trawl Bottom, Scallop		X	X	X	X
Otter Trawl Bottom, Shrimp	X	X	X	X	X
Otter Trawl Midwater		X	X		X
Pots And Traps, Conch	X	X		X	
Pots and Traps, Crab, Blue Peeler	X	X		X	
Pots And Traps, Crab, Blue	X	X		X	
Pots And Traps, Crab, Other	X	X	X	X	X
Pots And Traps, Eel	X	X		X	
Pots and Traps, Lobster Inshore	X	X		X	
Pots and Traps, Lobster Offshore			X	X	X
Pots and Traps, Fish	X	X	X	X	X
Pound Nets, Crab	X	X		X	
Pound Nets, Fish	X	X		X	
Purse Seines, Herring		X	X		X
Purse Seines, Menhaden		X	X		
Purse Seines, Tuna		X	X		X
Rakes	X			X	
Reel, Electric or Hydraulic		X	X		X
Rod and Reel	X	X	X		X
Scottish Seine		X	X	X	X
Scrapes	X			X	
Spears	X	X	X		
Stop Seines	X			X	
Tongs and Grabs, Oyster	X			X	
Tongs Patent, Clam Other	X			X	
Tongs Patent, Oyster	X			X	
Trawl Midwater, Paired		X	X		X
Weirs	X			X	

Includes all gears that accounted for 1% or more of any state's total landings and all gears that harvested any amount of any federally managed species, based upon 1999 NMFS landings data and ASMFC Gear Report (ASMFC 2000). Shaded rows represent gears that are federally managed and contact the bottom.

Table 3 - Fishing Gears Used in Estuaries and Bays, Coastal Waters, and Offshore Waters of the EEZ, from Maine to North Carolina.

3 Description of Gear Types

3.1 BOTTOM-TENDING MOBILE GEAR

3.1.1 Otter Trawls

Trawls are classified by their function, bag construction, or method of maintaining the mouth opening. Function may be defined by the part of the water column where the trawl operates (e.g., bottom) or by the species that it targets (Hayes 1983). There is a wide range of otter trawl types used in the Northeast as a result of the diversity of fisheries prosecuted and bottom types encountered in the region (NREFHSC 2002). The specific gear design used is often a result of the target species (whether they are found on or off the bottom) as well as the composition of the bottom (smooth versus rough and soft versus hard). There are two three components of the otter trawl that come in contact with the sea bottom: the doors, the ground cables and bridles which attach the doors to the wings of the net, and the sweep (or foot-rope) which runs along the bottom of the net mouth. Bottom trawls are towed at a variety of speeds, but average about 5.5 km/hr (3 knots or nmi/hr).

3.1.1.1 Doors

The traditional otter board is a flat, rectangular wood structure with steel fittings and a stell “shoe” along the bottom that prevents the bottom of the door from damage and wear as it drags over the bottom. Other types include the V-type (steel), polyvalent (steel), oval (wood), and slotted spherical otter board (steel) (Sainsbury 1996). It is the spreading action of the doors resulting from the angle at which they are mounted that creates the hydrodynamic forces needed to push them apart. These forces also push them down towards the sea floor. On fine-grained sediments, the doors also function to create a silt cloud that aids in herding fish into the mouth of the net (Carr and Milliken 1998). In shallow waters, light-weight doors are typically used to ensure that the doors and the net spread fully. In these cases, light, foam filled doors can be used (Sainsbury 1996). Vessels fishing large nets in deeper water require very large spreading forces from the doors. In these cases, a 15 m^2 (49 ft^2) V-door weighing 640 kg (1480 lbs) can provide 9 metric tons of spreading force (Sainsbury 1996).

3.1.1.2 Ground Cables and Bridles

Steel cables are used to attach the doors to the wings of the net. The ground cables run along the bottom from each door to two cables (the “bridle”) that diverge to attach to the top and bottom of the net wing. The bottom portion of the bridle also contacts the bottom. In New England, fixed rubber discs (“cookies”) or rollers are attached to the ground cables and lower bridle. In general, bridles vary in length from 9 m to 73 m (30 - 200 ft) while ground cables can be from 0 to 73 m (200 ft) depending upon bottom conditions and towing speed (Sainsbury 1996). The length of these cables can therefore increase the area swept by the trawl by as much as three fold.

3.1.1.3 Sweeps

On smooth bottoms, the sweep may be a steel cable weighted with chain, or may be merely rope wrapped with wire. On rougher bottoms, rubber discs (“cookies”) or rollers are attached to the sweep to assist the trawl's passage over the bottom (Sainsbury 1996). There are two main types of sweep used in smooth bottom in New England (Mirarchi 1998). In the traditional chain sweep, loops of chain are suspended from a steel cable, with only 2-3 links of the chain touching bottom. Contact of the chain with the bottom reduces the buoyancy of the trawl – which would otherwise be negatively buoyant – to the point where it skims along just a few inches above the bottom to catch species like squid and scup that swim slightly above the bottom. The other type of sweep is heavier and is used on smooth bottom to catch flounder. Instead of a cable, rubber cookies stamped from automobile tires are attached to a heavy chain. This type of sweep is always in contact with the bottom. Cookies vary in diameter from 1.5 to 6.5 cm (4 to 16 inches) and do not rotate (Carr and Milliken 1998).

An important consideration in understanding the relative effects of different otter trawl configurations is their weight in water relative to their weight in air. Rockhopper gear is not the heaviest type of ground gear used in this region since it loses 80% of its weight in water (i.e., a rockhopper sweep that weighs 1000 pounds on land may only weigh 200 pounds in water) (NREFHSC 2002). Streetsweeper gear is much heavier in the water due to the use of steel cores in the brush components. Plastic-based gear has the smallest weight in water to weight in air ratio (approximately 5%) (NREFHSC 2002). For the same reasons, steel doors are much heavier in water than wooden doors (Mirarchi 1998).

Roller sweeps and rockhoppers are used on irregular bottom (Carr and Milliken 1998). Vertical rubber rollers rotate freely and are as large as 14.5 cm (36 inches) in diameter. In New England, the rollers have been largely replaced with "rockhopper" gear that uses larger fixed rollers and are designed to “hop” over rocks as large as 1 meter in diameter. Small rubber “spacer” discs are placed in between the larger rubber discs in both types of sweep. Rockhopper gear is no longer used exclusively on hard bottom habitats, but is actually quite versatile and used in a variety of habitat types (NREFHSC 2002). “Street-sweepers” were first used in Massachusetts in 1995, replacing heavier rockhopper gear, and consist of circular brushes up to 12.5 cm (31 inches) in diameter. They are lighter than rubber rockhopper gear and can probably fish much rougher bottom than other sweep designs (Carr and Milliken 1998).

Flatfish are primarily targeted with a mid-range mesh flat net that has more ground rigging and is designed to get the fish up off the bottom. A high rise or fly net with larger mesh is used to catch demersal fish that rise higher off the bottom than flatfish (NREFHSC 2002). Crabs, scallops, and lobsters are also harvested in large mesh bottom trawls.

Small mesh bottom trawls are used to capture northern and southern shrimp, whiting, butterfish and squid and usually employ a light chain sweep. Small-mesh trawls are designed, rigged, and used differently than large-mesh fish trawls. Bottom trawls used to catch northern shrimp in the Gulf of Maine, for example, are smaller than most fish trawls and are towed at slower speeds (<2 knots versus 4 knots or so for a fish trawl). Footropes range in length from 12 m to over 30 m (40 - 100 ft), but most are 15 to 27 m (50 - 90 ft). Because shrimp inhabit flatter bottom than many fish do, roller gear tend to be smaller in diameter on shrimp nets because they are not towed over rough bottom (Dan Schick, Maine Dept. of Marine Resources, personal communication). Because shrimp can not be herded in the same manner as fish, footropes on shrimp trawls are bare (no cookies) and are limited to 27 m (90 ft) in length (D. Schick, personal communication). Northern shrimp trawls are also equipped with Nordmore grates in the funnel of the net to reduce the by-catch of groundfish. Southern shrimp trawlers that catch brown and white shrimp typically tow 2-4 small trawls from large booms extended from each side of the vessel (DeAlteris 1998). Northern shrimp trawlers tow a single net astern.

The raised-footrope trawl was designed especially for fishing for whiting, red hake, and dogfish. It was designed to provide vessels with a means of continuing to fish for small mesh species without catching groundfish. In this type of trawl, 1 m (42 inches) long chains connect the sweep to the footrope, which results in the trawl fishing about 0.45 to 0.6 m (1.5-2 ft) above the bottom (Carr and Milliken 1998). The raised footrope and net allows complete flatfish escapement, and theoretically travels over codfish and other roundfish (whiting and red hake tend to swim slightly above the other groundfish). Although the doors of the trawl still ride on the bottom, Carr and Milliken (1998) report that studies have confirmed that the raised footrope sweep has much less contact with the sea floor than does the traditional cookie sweep that it replaces.

3.1.2 Beam Trawls

The beam trawl is much like an otter trawl except the net is spread horizontally by a steel beam that runs the horizontal width of the net rather than with otter boards. The net is spread vertically by heavy steel trawl heads that generally have skid-type devices with a heavy shoe attached (Sainsbury 1996). Beam trawls currently in use in Europe are up to 12 m (40 ft) in width and very heavy, increasing in weight from 3.5 mt (7,700 lbs) in the 1960s to as much as 10 mt (22,000 lbs) in the 1980s (Rogers *et al*. 1998). Despite the weight of the gear, increased towing power and size of trawlers have allowed towing speeds to reach 14.8 km/hr (8 knots or nmi/hr).

It is believed that beam trawls are not currently used in the Northeast U.S. (NREFHSC 2002). A few beam trawls were used in the 1970s to catch monkfish, but the fishery was unsuccessful. In the mid 1990s, a number of boats off New Bedford, MA used what were referred to as beam trawls, but the gear more closely resembled a scallop dredge rather than the traditional, European beam trawls. There are a few boats that are currently recorded as using beam trawls in the NMFS fishery landings database, but it is believed these were most likely mis-characterized and are actually otter trawls being deployed from the side of the vessels (NREFHSC 2002).

It is unlikely that fishermen would begin using beam trawls in the Northeast U.S. Beam trawls are prevalent in the North Sea where the water is dark and murky and the fisheries target flatfishes, which sit slightly under the sediments. In these fisheries, the beam trawl acts to sieve the fish up off the seafloor. The lack of conventional herding effect and small mouth opening of the beam trawl would not be effective for harvesting U.S. target species. Furthermore, most vessels being used in the Northeastern U.S. do not have the size or power required to handle a beam trawl (NREFHSC 2002). Therefore, beam trawls will not be considered further in this report as a gear type potentially impacting marine habitats off the Northeastern U.S.

3.1.3 Clam Dredges

3.1.4 Hydraulic Clam Dredge

Hydraulic clam dredges have been used in the surfclam (*Spisula solidissima*) fishery for over five decades and in the ocean quahog (*Arctica islandica*) fishery since its inception in the early 1970s. These dredges are highly sophisticated and are designed to: 1) be extremely efficient (80 to 95% capture rate); 2) produce a very low bycatch of other species; and 3) retain very few undersized clams (NREFHSC 2002).

The typical dredge is 3.7 m (12 feet) wide and about 6.7 m (22 feet) long and uses pressurized water jets to wash clams out of the seafloor. Towing speed at the start of the tow is about 4.5 km/hr (2.5 knots or nmi/hr) and declines as the dredge accumulates clams. The dredge is retrieved once the vessel speed drops below about 3 km/hr (1.5 knots), which can be only a few minutes in very dense beds. However, a typical tow lasts about 15 minutes. The water jets penetrate the sediment in front of the dredge to a depth of about 20 - 25 cm (8 - 10 inches), depending on the type of sediment and the water pressure. The water pressure that is required to fluidize the sediment varies from 50 pounds per square inch (psi) in coarse sand to 110 psi in finer sediments. The objective is to use as little water as possible since too much pressure will blow sediment into the clams and reduce product quality. The “knife” (or “cutting bar”) on the leading bottom edge of the dredge opening is 14 cm (5.5 inches) deep for surfclams and 8.9 cm (3.5 inches) for ocean quahogs. The knife “picks up” clams that have been separated from the sediment and guides them into the body of the dredge (“the cage”). If the knife size is not appropriate, clams can be cut and broken, resulting in significant mortality of clams left on the bottom. The downward pressure created by the runners on the dredge is about 1 psi (NREFHSC 2002).

The high water pressure associated with the hydraulic dredge can cause damage to the flora and fauna associated with bottom habitats. However, water pressure greater than that required for harvesting will reduce the quality of the clams by loading them with sand and increase the rate of clam breakage. Therefore higher, more damaging water pressures are usually not used.

Before 1990, two types of hydraulic dredges were common in the fishery, stern rig dredges and side rig dredges. A side rig dredge has a chain bag that drags behind the dredge and smooths out the trench created by the dredge. The chain bag results in significantly more damage to small clams and other bycatch than occurs with the stern rig dredge. Currently, most of the dredges in the fishery are stern rig dredges, which are basically giant sieves. Small clams and bycatch fall through the bottom of the cage into the trench and damage or injury to benthic organisms is minimal. Improvements in gear efficiency have reduced bottom time and helped to confine the harvest of surfclams to a relatively small area in the mid-Atlantic Bight (NREFHSC 2002).

Hydraulic clam dredges can be operated in areas of large grain sand, fine sand, sand and small grain gravel, sand and small amounts of mud, and sand and very small amounts of clay. Most tows are made in large grain sand. Dredges are not fished in clay, mud, pebbles, rocks, coral, large gravel greater than one half inch, or seagrass beds (NREFHSC 2002).

In the soft-clam (*Mya arenaria*) fishery, the dredge manifold and blade are located just forward of an escalator, or conveyor belt, that carries the clams to the deck of the vessel. These vessels are restricted to water depths less than one-half the length of the escalator and are typically operated from 15 m (49ft) vessels in water depths of 2-6 m (6.6 - 20 ft) (DeAlteris, 1998). The escalator dredge is not managed under federal fishery management plans. A variation of this type of dredge, the suction dredge, is used in Europe to harvest several bivalve species. Sediment and clams that are dislodged by water pressure are sucked through a hose to the vessel. These dredges are also restricted to shallow water.

3.1.4.1 Quahog Dredge

Ocean quahogs are also harvested in eastern Maine coastal waters using a non-hydraulic dredge that is essentially a large metal cage on skis with 15 cm (6 inch) long teeth projecting at an angle off the leading bottom edge (Pete Thayer, Maine Dept. of Marine Resources, personal communication). Maine state regulations limit the length of the cutter bar to 91 cm (36 inches). The teeth rake the bottom and lift the quahogs into the cage. This fishery takes place in small areas of sand and sandy mud found among bedrock outcroppings in depths of 9 to > 76 m (30 - 250 ft) in state and federal coastal waters north of 43°20' N latitude. These dredges are used on smaller boats, about 9 - 12 m long (30 to 40 ft) and are pulled through the seabed using the boat's engine (NREFHSC 2002). This fishery is managed under the MAFMC Surf Clam and Ocean Quahog FMP (MAFMC).

3.1.5 Sea Scallop Dredges

3.1.5.1 New Bedford Scallop Dredge

The New Bedford (or "chain sweep") dredge is the primary gear used in the Northeast U.S. sea scallop (*Placopecten magellanicus*) fishery and is very different than scallop dredges utilized in Europe and the Pacific because it is a toothless dredge.

The forward edge of the New Bedford dredge includes the cutting bar, which rides above the surface of the substrate, creating turbulence that stirs up the substrate and kicks objects (including scallops) up from the surface of the substrate into the bag. Shoes on the cutting bar are in contact with and ride along the substrate surface (NREFHSC 2002). A sweep chain is attached to each shoe and to the bottom of the ring bag (Smolowitz 1998). The bag is made up of metal rings with chafing gear on the bottom and twine mesh on the top, and drags on the substrate when fished. Tickler chains run from side to side between the frame and the ring bag and, in hard bottom, a series of rock chains run from front to back to prevent large rocks from getting into the bag (Smolowitz 1998). New Bedford dredges are typically 4.3 m (14 feet) wide; two of them are towed by a single vessel at speeds of 4 to 5 knots. Chain sweep dredges used along the Maine coast are smaller.

In the Northeast region, scallop dredges are used in high and low energy sand environments, and high energy gravel environments. Although gravel exists in low energy environments of deepwater banks and ridges in the Gulf of Maine, the fishery is not prosecuted there (NREFHSC 2002).

3.1.5.2 Toothed Scallop Dredges

The leading edge of scallop dredges used in Europe, Australia, and New Zealand to catch other species of scallop that "dig" into the bottom have teeth which dig into the substrate. This type of dredge is used by smaller vessels that are not able to tow a non-toothed dredge fast enough (4-5 knots) to fish effectively (NREFHSC 2002). Some of the European scallop dredges are spring-loaded so that the cutting bar flexes backward when it contacts a hard object on the bottom, then springs back when the dredge passes over the obstacle. These dredges are approximately 0.75 m (2.5 ft) wide and may be fished in gangs of 3-9 dredges on either side of the vessel (Kaiser *et al.* 1996a). A typical tooth bar bears 9 teeth, 11 cm (4.3 inches) long, spaced about 8 cm (3 inches) apart. French dredges, 2 m (6.6 ft) wide, are not spring-loaded and generally are fished on cleaner ground. They are fitted with a diving vane to improve penetration of the bottom. Scallop dredges used in Australia and New Zealand are heavy, rigid, wire mesh "boxes" that do not have a chain bag (McLoughlin *et al.* 1991).

3.1.6 Other Non-Hydraulic Dredges

3.1.6.1 Oyster or Crab Dredge/Scrape/Mussel Dredge

The oyster dredge is a toothed dredge consisting of a steel frame 0.5-2.0 m (1.6 -6.6 ft.) in width, a tow chain or wire attached to the frame, and a bag to collect the catch. The bag is constructed of rings and chain-links on the bottom to reduce the abrasive effects of the seabed, and twine or webbing on top. The dredge is towed slowly (<1 m/sec) in circles, from vessels 7 to 30 m (23 - 98 ft.) in length (DeAlteris 1998). Crabs are harvested with dredges similar to oyster dredges. Stern-rig dredge boats (approximately 15 m (49') in length) tow two dredges in tandem from a single chain warp. The dredges are equipped with 10 cm (4 inch) long teeth that rake the crabs out of the bottom. (DeAlteris 1998). The toothed dredge is also used for harvesting mussels (Hayes 1983). These dredging activities are not managed under federal fishery management plans

3.1.6.2 Bay Scallop Dredge

Bay scallops usually reside on the bottom. The bay scallop dredge may be 1 to 1.5 m (3.3 - 4.9 ft.) wide and about twice as long. The simplest bay scallop dredge can be just a mesh bag attached to a metal frame that is pulled along the bottom. For bay scallops that are located on sand and pebble bottom, a small set of raking teeth are set on a steel frame, and skids are used to align the teeth and the bag (Sainsbury 1996). This dredging activity is not managed under federal fishery management plans.

3.1.6.3 Sea Urchin Dredge

Similar to a simple bay scallop dredge, the sea urchin dredge is designed to avoid damaging the catch. It has an up-turned sled-like shape at the front that includes several leaf springs tied together with a steel bar. A tow bail is welded to one of the springs and a chain mat is rigged behind the mouth box frame. The frame is fitted with skids or wheels. The springs act as runners, enabling the sled to move over rocks without hanging up. The chain mat scrapes up the urchins. The bag is fitted with a codend for ease of emptying. This gear is generally only used in waters up to 100 m (330 ft.) deep (Sainsbury 1996). This dredging activity is not managed under federal fishery management plans.

3.1.6.4 Clam "Kicking"

Clam kicking is a mechanical form of hard clam harvest practiced in North Carolina which involves the modification of boat engines so that the propeller is directed downwards instead of backwards (Guthrie and Lewis 1982). In shallow water the propeller wash is powerful enough to suspend bottom sediments and clams into a plume in the water column, which allows them to be collected in a trawl net towed behind the boat (Stephan *et al.* 2000). This activity is not managed under federal fishery management plans.

3.1.7 Seines

3.1.7.1 Haul Seines

Haul seining is a general term describing operations where a net is set out between the surface and sea bed to encircle fish. It may be undertaken from the shore (beach seining), or away from shore in the shallows of rivers, estuaries or lakes (Sainsbury 1996). Seines typically contact the sea bottom along the lead line. Additionally the net itself may scrape along the bottom as it is dragged to shore or the recovery vessel. This activity is not managed under federal fishery management plans.

3.1.7.2 Beach Haul Seines

The beach seine resembles a wall of netting of sufficient depth to fish from the sea surface to the sea bed, with mesh small enough that the fish do not become gilled. A floatline runs along the top to provide floatation and a leadline with a large number of weights attached ensures that the net maintains good contact with the bottom. Tow lines are fitted to both ends. The use of a beach seine generally starts with the net on the beach. One end is pulled away from the beach, usually with a small skiff or dory, and is taken out and around and finally back in to shore. Each end of the net is then pulled in towards the beach, concentrating the fish in the middle of the net. This is eventually brought onshore as well and the fish removed. This gear is generally used in relatively shallow inshore areas. (Sainsbury 1996). This activity is not managed under federal fishery management plans

3.1.7.3 Long Haul Seines

The long haul seine is set and hauled in shallow estuarine and coastal areas from a boat typically 15 m (49 ft.) long. The net is a single wall of small mesh webbing less than 5 cm (2 inches), and is usually greater than 400 m (1440 ft.) in length and about 3 m (9.8 ft.) in depth. The end of the net is attached to a pole driven into the bottom, and the net is set in a circle so as to surround fish feeding on the tidal flat. After closing the circle, the net is hauled into the boat, reducing the size of the circle, and concentrating the fish. Finally, the live fish are brailed or dip-netted out of the net. (DeAlteris 1998). This activity is not managed under federal fishery management plans

3.1.7.4 Stop Seines

These are seines that are used in coastal embayments to close off the opening to a small cove or bight. This method is used in Maine to harvest schools of juvenile herring (Everhart and Youngs 1981). This activity is not managed under federal fishery management plans

3.1.7.5 Danish and Scottish Seines

Danish or Long seining or anchor dragging was developed in the 1850s prior to the advent of otter trawling. The Danish seine is a bag net with long wings, that includes long warps set out on the seabed enclosing a defined area. As the warps are retrieved, the enclosed area (a triangle) reduces in size. The warps dragging along the bottom herd the fish into a smaller area, and eventually into the net mouth. The gear is deployed by setting out one warp, the net, then the other warp. On retrieval of the gear, the vessel is anchored. This technique of fishing is aimed at specific schools of fish located on smooth bottom. In contrast to Danish seining, if the vessel tows ahead while retrieving the gear, then this is referred to as Scottish seining or fly-dragging. This method of fishing is considered more appropriate for working small areas of smooth bottom, surrounded by rough bottom. Scottish and Danish seines have been used experimentally in U.S. demersal fisheries. Space conflicts with other mobile and fixed gears, have precluded the further development of this gear in the U.S., as compared to Northern Europe (DeAlteris 1998). This activity is managed under federal fishery management plans.

3.2 Bottom-Tending Static Gear

3.2.1 **Pots**

Pots are portable, rigid devices that fish and shellfish enter through small openings, with or without enticement by bait (Everhart and Youngs 1981; Hubert 1983). They are used to capture lobsters, crabs, black sea bass, eels and other bottom dwelling species seeking food or shelter (Everhart and Youngs 1981; Hubert 1983). Pot fishing can be divided into two general classifications: 1) inshore potting in estuaries, lagoons, inlets and bays in depths up to about 75 m (250 ft.) and; 2) Offshore pottting using larger and heavier vessels and gear in depths up to 730 m (2400 ft.) or more (Sainsbury 1996).

3.2.1.1 Lobster Pots

Lobster pots are typically rectangular and are divided into two sections, the chamber and the parlor. The chamber has an entrance on both sides of the pot and is usually baited. Lobsters then move to the parlor via a tunnel (Everhart and Youngs 1981). Escape vents are installed in both areas of the pot to minimize the retention of sub-legal sized lobsters (DeAlteris 1998).

Lobster pots are fished as either 1) a single pot per buoy (although two pots per buoy are used in Cape Cod Bay, and three pots per buoy in Maine waters), or 2) a "trawl" or line with up to 100 pots. According to NREFHSC (2002) important features of lobster pots and their use are the following:

- About 95% of lobster pots are made of plastic-coated wire.
- Floating mainlines may be up to 7.6 m (25 ft.) off bottom.
- Sinklines are sometimes used where marine mammals are a concern – neutrally buoyant lines may soon be required in Cape Cod Bay.
- Soak time depends on season and location - usually 1-3 days in inshore waters in warm weather, to weeks in colder waters.
- Offshore pots are larger (more than 1 m (4 ft) long) and heavier (~ 100 lb or 45 kg), with an average of ~ 40 pots/trawl and 44 trawls/vessel. They have a floating mainline and are usually deployed for a week at a time.
- There has been a three-fold increase in lobster pots fished since the 1960s, with more than four million pots now in use.

Although the offshore component of the fishery is regulated under federal rules, American lobster is not managed under a federal fishery management plan.

3.2.1.2 Fish Pots

Black sea bass pots are similar in design to lobster pots. They are usually fished singly or in trawls of up to 25 pots, in shallower waters than the offshore lobster pots or red crab pots. Pots may be set and retrieved 3-4 times/day when fishing for scup (NREFHSC 2002). This activity is managed under a federal fishery management plan. Hagfish pots (40 plastic gallon barrels) are fished in deep waters, on mud bottoms. Cylindrical pots are typically used for capturing eels in Chesapeake Bay, however, half-round and rectangular pots are also used and all are fished in a manner similar to that of lobster pots (Everhart and Youngs 1981). Hagfish and eel activities are not managed under a federal fishery management plan.

3.2.1.3 Crab Pots

Crabs are often fished with pots consisting of a wire mesh. A horizontal wire partition divides the pot into an upper and lower chamber. The lower chamber is entered from all four sides through small wire tunnels. The partition bulges upward in a fold about 20 cm (8 inches) high for about one third of its width. In the top of the fold are two small openings that give access to the upper chamber (Everhart and Youngs 1981).

Crab pots are always fished as singles and are hauled by hand from small boats, or with a pot hauler in larger vessels. Crab pots are generally fished after an overnight soak, except early and late in the season (DeAlteris 1998). These pots are also effective for eels (Everhart and Youngs 1981). This activity is not managed under a federal fishery management plan.

Deep sea red crab pots are typically wood and wire traps 1.2 m by 0.75 m (48 by 30 inches) with top entry. Pots are baited and soak for about 22 hours before being hauled. Currently, vessels are using an average of 560 pots in trawls of 75- 180 pots per trawl along the continental slope at depths from 400 to 800 m (1300 - 2600 ft). These vessels are typically 25 - 41 m (90 - 150 ft) in length. Currently there are about 6 vessels engaged in this fishery (NEFMC 2002). This activity is managed under a federal fishery management plan.

3.2.2 Traps

A trap is generally a large scale device that uses the seabed and sea surface as boundaries for the vertical dimension. The gear is installed at a fixed location for a season, and is passive, as the animals voluntarily enter the gear. Traps are made of a leader or fence, that interrupts the coast parallel migratory pattern of the target prey, a heart or parlor that leads fish via a funnel into the bay or trap section that serves to hold the catch for harvest by the fishermen. The non-return device is the funnel linking the heart and bay sections (DeAlteris 1998). This activity is not managed under a federal fishery management plan.

3.2.2.1 Fish Pound Nets

Pound nets are constructed of netting staked into the sea bed by driven piles (Sainsbury 1996). Pound nets have three sections: the leader, the heart, and the pound. The leader (there may be more than one) may be as long as 400 m (1300 ft) and is used to direct fish into the heart(s). One or more hearts are used to further funnel fish into the pound and prevent escapement. The pound may be 15 m (49 ft) square and holds the fish until the net is emptied. These nets are generally fished in waters less than 50 m (160 ft) deep. Pound nets are also used to catch crabs. This activity is not managed under a federal fishery management plan.

3.2.2.2 Fyke and Hoop Nets

Constructed of wood or metal hoops covered with netting, hoop nets are 2.5 to 5 m (8.2 - 16 ft) long, "Y-shaped" nets, with wings at the entrance and one or more internal funnels to direct fish inside, where they become trapped. Occasionally, a long leader is used to direct fish to the entrance. Fish are removed by lifting the rear end out of the water and loosening a rope securing the closed end. These nets are generally fished to about 50 m (160 ft) deep (Sainsbury 1996). A common fyke net is a long bag mounted on one or several hoops which keep the net from collapsing as well as provide an attachment for the base of the net funnels to prevent the fish from escaping. This gear is used in shallow water and extensively in river fisheries. (Everhart and Youngs 1981). This activity is not managed under a federal fishery management plan.

3.2.2.3 Weirs

A weir is a simple maze that intercepts species that migrate along the shoreline. Brush weirs are used in the Maine sardine/herring fishery. These are built of wooden stakes and saplings driven into the bottom in shallow waters. The young herring encounter the lead which they follow to deeper water, finally passing into an enclosure of brush or netting. The concentrated fish are then removed with a small seine (Everhart and Youngs 1981). This activity is not managed under a federal fishery management plan.

3.2.2.4 Shallow Floating Traps

In New England, much of the shoreline and shallow subtidal environment is rocky and stakes can not be driven into the bottom. Therefore, the webbing of these traps is supported by floats at the sea surface, and held in place with large anchors. These traps are locally referred to as "floating traps." The catch, design elements and scale of these floating traps is similar to pound nets (DeAlteris 1998).

The floating trap is designed to fish from top to bottom, and is built especially to suit its location. The trap is held in position by a series of anchors and buoys. The net is usually somewhat "T-shaped," with the long portion of the net (the leader net) designed to funnel fish into a box of net at the top of the T. The leader net is often made fast to a ring bolt ashore (Sainsbury 1996). This activity is not managed under a federal fishery management plan.

3.2.3 Sink Gill Nets and Bottom Longlines

3.2.3.1 Sink/Anchor Gill Nets

Individual gill nets are typically 91 m (300 feet) long, and are usually fished as a series of 5-15 nets attached end-to-end. Gill nets have three components: leadline, webline and floatline. Fishermen are now experimenting with two leadlines. Leadlines used in New England are ~65 lb (30 kg.)/net; in the Middle Atlantic leadlines may be heavier. Weblines are monofilament, with the mesh size depending on the target species. Nets are anchored at each end, using materials such as pieces of railroad track, sash weights, or Danforth anchors, depending on currents. Anchors and leadlines have the most contact with the bottom. Some nets may be tended several times/day, (e.g., when fishing for bluefish in the Middle Atlantic). For New England groundfish, frequency of tending ranges from daily to biweekly (NREFHSC 2002). These activities are managed under federal fishery management plans.

3.2.3.2 Stake Gill Nets

Generally a small boat is used inshore so that a gill net is set across a tidal flow and is lifted at slack tide to remove fish. Wooden or metal stakes run from the surface of the water into the sediment and are placed every few meters along the net to hold it in place. When the net is lifted, the stakes remain in place. These nets are generally fished from the surface to about 50 meters deep (Sainsbury 1996). These activities are not managed under federal fishery management plans.

3.2.3.3 Bottom Longlines

Longlining for bottom species on continental shelf areas and offshore banks is undertaken for a wide range of species including cod, haddock, dogfish, skates, and variuos flatfishes (Sainsbury 1996). A 9.5 m (31 ft) vessel can fish up to 2500 hooks a day with a crew of one and double that with 2 crew members. Mechanized longlining systems fishing off larger vessels up to 60 m (195 ft) can fish up to 40,000 hooks per day (Sainsbury 1996).

In the Northeast up to six individual longlines are strung together, for a total length of about 460 m (1500 ft), and are deployed with 20-24 lb (9 - 11 kg) anchors. The mainline is parachute cord or sometimes stainless steel wire. Gangions (lines from mainline to hooks) are 38 cm (15 inches) long and 1-2 m (3-6 ft) apart. The mainline, hooks, and gangions all come in contact with the bottom. Circle hooks are potentially less damaging to habitat features than other hook shapes. These longlines are usually set for only a few hours at a time (NREFHSC 2002). Longlines used for tilefish are deployed in deep water, may be up to 40 km (25 miles) long, are stainless steel or galvanized wire, and are set in a zig-zag fashion (NREFHSC 2002). These activities are managed under federal fishery management plans.

3.3 PELAGIC GEAR

3.3.1 Mid-Water Otter Trawl

The mid-water trawl is used to capture pelagic species that school between the surface and the sea bed throughout the water column. The mouth of the net can range from 110 m to 170 m (360 - 560 ft.) and requires the use of large vessels (Sainsbury 1996). Successful mid-water trawling requires the effective use of various electronic aids to find the fish and maneuver the vessel while catching them (Sainsbury 1996). This activity is managed under federal fishery management plans. This gear is not expected to have contact with or impacts upon bottom habitats.

3.3.2 Paired Mid-Water Trawl

Pair-trawling is used by smaller vessels which herd small pelagics such as herring and mackerel into the net (Sainsbury 1996). Large pelagic species are also harvested with a huge pelagic pair trawl towed at high speed near the surface. The nets have meshes exceeding 10 m (33 ft.) in length in the jibs and first belly sections, and reduce to cod-end mesh sizes of 20 cm (8 inches) (DeAlteris 1998). This activity is managed under federal fishery management plans. This gear is not expected to have contact with or impacts upon bottom habitats.

3.3.3 Purse Seines

Purse seines are very efficient for taking pelagic schooling species. The purse seine is a continuous deep ribbon of web with corks on one side and leads on the other. Rings are fastened at intervals to the lead line and a purse line runs completely around the net through the rings (Everhart and Youngs 1981). One end of the net is fastened to the vessel and the other end to a skiff. The vessel then encircles a school of fish with the net, the net pursed and hauled back to the vessel. Purse seines vary in size according to the vessel size, the size of the mesh, the species sought and the depth to be fished. Tuna seines are nearly one kilometer (0.6 miles) long and fish from 55 - 640 m (180 - 2100 ft.) (Everhart and Youngs 1981) . Due to the large depth of the net for tuna purse seines, they have been shown to contact and interact with the sea bottom when fishing in some shallow water locations such as Massachusetts Bay and vicinity (NMFS 2001). However, these interactions are unintended and rare. This activity is managed under federal fishery management plans.

3.3.4 Drift Gill Nets

Gillnets operate principally by wedging and gilling fish, and secondarily by entangling (DeAlteris 1998). The nets are a single wall of webbing, with float and lead lines. Drift gillnets are designed so as to float from the sea surface and extend downward into the water column and are used to catch pelagic fish. In this case the buoyancy of the floatline exceeds the weight of the leadline. Drift gillnets may be anchored at one end or set-out to drift, usually with the fishing vessel attached at one end (DeAlteris 1998). This activity is managed under federal fishery management plans. This gear is not expected to have contact with or impacts upon bottom habitats.

3.3.5 Pelagic Longline Gear

The pelagic or subsurface longline is a technique directed mostly towards tunas, swordfish, sailfish, dolphin (dorado), and sharks. The gear is typically set at depths from the surface to around 330 m (1100 ft.). The gear can also be set with a main line hanging in acrs below the bouy droplines to fish a band of depths (Sainsbury 1996). The gear is set across an area of known fish concentration or movement, and may be fished by day or night depending upon the species being sought (Sainsbury 1996). The length of the mainline can vary up to108 km (67 miles) depending on the size of the vessel. If the mainline is set level at a fixed depth, then the leader or gangion lengths vary from 2-40 m (6.6 - 130 ft.), so as to ensure the hooks are distributed over a range of depths (DeAlteris 1998). If a line-shooter is used to set the mainline in a catenary shape with regard to depth, then the gangions are usually a single minimal length, but are still distributed by depth (DeAlteris 1998). Each gangion typically contains a baited hook and chemical night stick to attract the fish. Traditional or circle hooks may be used. Swordfish vessels typically fish 20 to 30 hooks per 1.6 km (1 mile) of mainline between 5 and 54 km (3 - 34 miles) in length (Sainsbury 1996). This activity is managed under federal fishery management plans. This gear is not expected to have contact with or impacts upon bottom habitats.

3.3.6 Troll Lines

Trolling involves the use of a baited hook or lure maintained at a desired speed and depth in the water (Sainsbury 1996). Usually, two to four or more lines are spread to varying widths by the use of outrigger poles connected to the deck by hinged plates. Line retrieval is often accomplished by means of a mechanized spool. Each line is weighted to reach the desired depth and may have any number of leaders attached, each with a hook and bait or appropriate lure. This gear is generally fished from the surface to about 20 meters (Sainsbury 1996). This activity is managed under federal fishery management plans. This gear is not expected to have contact with or impacts upon bottom habitats.

3.4 OTHER GEAR

3.4.1 Rakes

A bull rake is manually operated to harvest hard clams and consists of a long shaft with a rake and basket attached. The length of the shaft can be variable but usually does not exceed three times the water depth. The length and spacing of the teeth as well as the openings of the basket are regulated to protect juvenile clams from harvest (DeAlteris 1998). Rakes are typically fished off the side of a small boat. This activity is not managed under federal fishery management plans

3.4.2 Tongs

Tongs are a more efficient device than rakes for harvesting shellfish. Shaft-tongs are a scissor-like device with a rake and basket at the end of each shaft. The fisherman stands on the edge of the boat and progressively opens and closes the baskets on the bottom gathering the shellfish into a mound. The tongs are closed a final time, brought to the surface, and the catch emptied on the culling board for sorting. The length of the shaft must be adjusted for water depth. Oysters are traditionally harvested with shaft tongs in water depths up to 6 m (21 ft.), with shaft tongs 8 m (29 ft.) in length (DeAlteris 1998). Patent tongs are used to harvest clams and oysters and are opened and closed with a drop latch or with a hydraulic ram and require a mechanized vessel with a mast or boom and a winch (DeAlteris 1998). Patent tongs are regulated by weight, length of teeth, and bar spacing in the basket. This activity is not managed under federal fishery management plans

3.4.3 Line Fishing

3.4.3.1 Hand Lines

The simplest form of hook and line fishing is the hand line. It consists of a line, sinker, leader and at least one hook. The line is usually stored on a small spool and rack and can vary in length. The line varies in material from a natural fiber to synthetic nylon. The sinkers vary from stones to cast lead. The hooks are single to multiple arrangements in umbrella rigs. An attraction device must be incorporated into the hook, usually a natural bait and artificial lure (DeAlteris 1998). Although not typically associated with bottom impacts, this gear can be fished in such as manner so as to hit bottom and bounce or be carried by currents until retrieved. This activity is managed under federal fishery management plans.

3.4.3.2 Mechanized Line Fishing

Mechanized line hauling systems have been developed to allow more lines to be worked by smaller crews and use electrical or hydraulic power to work th elines on the spools or jigging machines (Sainsbury 1996). These reels, often termed bandits, are mounted on the vessel bulwarks and have a spool around which the mainline is wound (Sainsbury 1996). Each line may have a number of branches and baited hooks, and the line is taken from the spool over a block at the end of a flexible arm. This gear is used to target several species of groundfish, especially cod and pollock and it has the advantage of being effective in areas where other gears cannot be used. Jigging machine lines are generally fished in waters up to 600 m (2000 ft) deep (Sainsbury 1996). This gear may also have the ability to contact the bottom depending upon the method selected to fish. This activity is managed under federal fishery management plans.

3.4.4 Hand Hoes

Intertidal flats are frequently harvested for clams and baitworms using hand-held hoes. These are short handled rake-like devices, which are often modified gardening tools (Creaser et. al. 1983). Baitworm hoes have 5 to 7 tines, 21 to 22 cm (8.3 - 8.7 ft) in length for bloodworms and 34 to 39 cm (13 - 15 inches) for sandworms. Clam hoes in Maine typically have 4 to 5 tines, 15 cm (6 inches) long (Wallace 1997). This activity is not managed under federal fishery management plans.

3.4.5 Diving

By either free diving or using SCUBA, divers collect crustaceans, mollusks and some reef fish in shallow water. Most often a support vessel is used to transport the diver(s) to the fishing site and carry the landings to port. In deeper waters, helmet diving systems are used and the diver is tethered to the vessel with air pumped from the surface. This method is most often used by sea urchin divers and some lobster divers. Divers normally use small rakes or hoes to scrape creatures off rocks or dig them out of the seabed. Generally, the catch is placed in bags which are either towed to the surface by the boat or floated to the surface using an air source and a lift bag. Divers rarely work deeper than about 20 m (66 ft) (Sainsbury 1996). This activity is not managed under federal fishery management plans.

3.4.6 Spears

Spears came into use when it was found that a pole or shaft with a point on it could be used by a fisherman operating from shore, floating raft, or boat to capture animals previously out-of-reach (DeAlteris 1998). However, the single prong spear required an accurate aim, and fish easily escaped. With the addition of a barb, fish retention was improved; and spears with multi-prong heads increased the likelihood of hitting the target. Spears were initially hand-held, then thrown, then placed in launching devices including cross-bows, spear guns for divers, etc. Spears with long shafts (gigs) are used by fishermen in small boats at night in the Carolina sounds for flounder, through the ice for eels in New England bays, and by divers for fish in coastal waters (DeAlteris 1998). This activity is not managed under federal fishery management plans.