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DRAFT – January 2020

6.0 AFFECTED ENVIRIONMENT

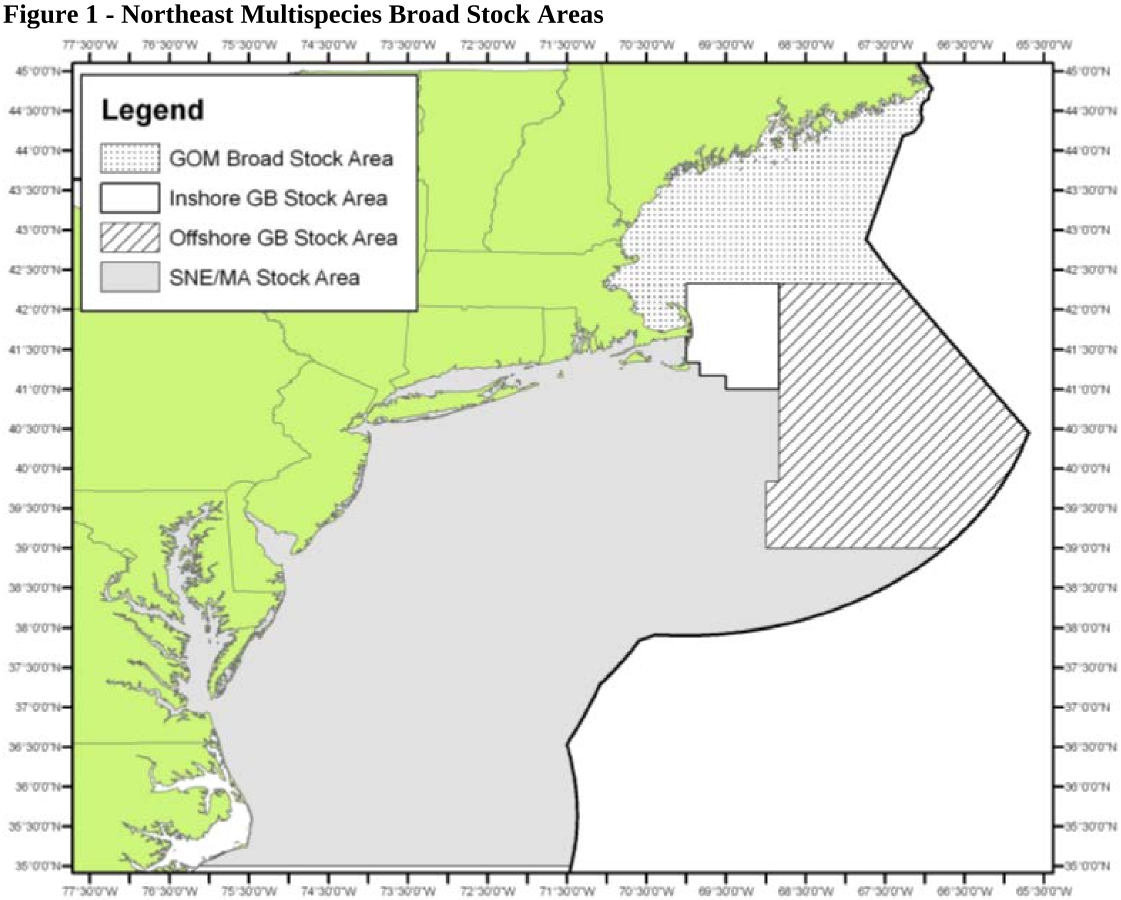
The Valued Ecosystem Components (VECs) affected by the Alternatives include regulated groundfish species, non-groundfish species/bycatch, the physical environment and Essential Fish Habitat (EFH), protected resources, and human communities, which are described below.

6.1 REGULATED GROUNDFISH SPECIES

This section describes the life history and stock population status for each allocated fish stock harvested under the Northeast Multispecies FMP. Figure 1 identifies the four broad stock areas used in the fishery. Further information on life history and habitat characteristics of the stocks managed in this FMP can be found in the Essential Fish Habitat Source Documents at http://www.nefsc.noaa.gov/nefsc/habitat/efh/.

The allocated target stocks for the Northeast Multispecies FMP are: GOM Cod, GB Cod, GOM Haddock, GB Haddock, American Plaice, Witch Flounder, SNE/MA Winter Flounder, GOM Winter Flounder, GB Winter Flounder, Cape Cod/GOM Yellowtail Flounder, GB Yellowtail Flounder, SNE/MA Yellowtail Flounder, Redfish, Pollock and White Hake.

Figure 1 - Northeast Multispecies Broad Stock Areas



The Northeast Multispecies FMP also manages Atlantic halibut, ocean pout, windowpane flounder (GB/GOM- northern and SNE/MA- southern stocks), and wolffish. While OFLs, ABCs, and ACLs are specified for these stocks, they were not allocated to sectors through Amendment 16. These species are discussed in Sections 6.1.16 - 6.1.20.

The following discussions have been adapted from the most recent stock assessment reports (NEFSC 2017). Table 1 summarizes the status of the northeast groundfish stocks as of the most recent operational assessments, noting which groundfish stocks are overfished or are experiencing overfishing.

Table 1 - Current status of Northeast Groundfish stocks and status based on 2019 assessment results[1]

	Current Status		**2019 Assessments**	
Stock	Overfishing?	Overfished?	Overfishing?	Overfished?
Georges Bank Cod	Yes	Yes	Yes	Yes
Gulf of Maine Cod	Yes	Yes	Yes	Yes
Georges Bank Haddock	No	No	No	No
Gulf of Maine Haddock	No	No	No	No
Georges Bank Yellowtail Flounder	Yes	Yes	Yes	Yes
Southern New England/Mid-Atlantic Yellowtail Flounder	Yes	Yes	No	Yes
Cape Cod/Gulf of Maine Yellowtail Flounder	Yes	Yes	No	No
American Plaice	No	No	No	No
Witch Flounder	Unknown	Yes	Unknown	Yes
Georges Bank Winter Flounder	No	Yes	No	Yes
Gulf of Maine Winter Flounder	No	Unknown	-	-
Southern New England/Mid-Atlantic Winter Flounder	No	Yes	-	-
Acadian Redfish	No	No	-	-
White Hake	No	No	No	Yes
Pollock	No	No	No	No
Northern Windowpane Flounder	No	Yes	No	Yes
Southern Windowpane Flounder	No	No	No	No
Ocean Pout	No	Yes	-	-
Atlantic Halibut	No	Yes	No	Yes
Atlantic Wolffish	No	Yes	-	-

[1] Includes current NMFS-determined stock status.

Table 2 and Table 3 provide the updated numerical estimates of the status determination criteria for all groundfish stocks, based on the 2019 operational assessments. The M-S Act requires that every fishery management plan specify “objective and measurable criteria for identifying when the fishery to which the plan applies is overfished.” Guidance on this requirement identifies two elements that must be specified: a maximum fishing mortality threshold (or reasonable proxy) and a minimum stock size threshold.

The M-S Act also requires that FMPs specify the maximum sustainable yield and optimum yield for the fishery. The NEFSC conducted assessments for 15 groundfish stocks in 2019. The peer review recommended updated numerical values are provided in Table 3, for information purposes only.

The Council received a letter from NMFS on August 31, 2017 regarding stock status for several groundfish stocks and identifying stocks making inadequate rebuilding progress. In the letter, NMFS explains its status determination on GB cod, Atlantic halibut, and witch flounder, which differ from the table above. Based on the letter, existing SDCs remain for these three stocks.

NMFS determined that the stock status for GB cod will remain overfished, with overfishing occurring, consistent with the determination from the 2013 GB cod benchmark assessment, and that the status for Atlantic halibut will remain overfished, with overfishing not occurring, consistent with the 2012 assessment update for this stock. NMFS explains that witch flounder remains overfished. However, it is now unknown whether the stock is subject to overfishing, consistent with the 2016 benchmark assessment. According to NMFS, these status determinations will remain until an assessment can provide new reference points and/or numerical estimates of existing status determination criteria or the Council implements alternative status determination criteria. NMFS also determined that the stock status for GB yellowtail flounder will remain overfished, with overfishing occurring.

Table 2 - Status determination criteria.

Stock	Biomass Target (SSB_{MSY} or proxy)	Minimum Biomass Threshold	Maximum Fishing Mortality Threshold (F_{MSY} or proxy)
Georges Bank Cod	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Gulf of Maine Cod	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Georges Bank Haddock	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Gulf of Maine Haddock	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Georges Bank Yellowtail Flounder	Unknown	Unknown	Unknown
Southern New England/Mid-Atlantic Yellowtail Flounder	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Cape Cod/Gulf of Maine Yellowtail Flounder	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
American Plaice	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Witch Flounder	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Georges Bank Winter Flounder	SSBMSY	½ Btarget	F_{MSY}
Gulf of Maine Winter Flounder	Unknown	Unknown	F40% MSP
Southern New England/Mid-Atlantic Winter Flounder	SSBMSY	½ Btarget	F_{MSY}
Acadian Redfish	SSBMSY: SSB/R (50% MSP)	½ Btarget	F50% MSP
White Hake	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Pollock	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP
Northern Windowpane Flounder	External	½ Btarget	Rel F at replacement
Southern Windowpane Flounder	External	½ Btarget	Rel F at replacement
Ocean Pout	External	½ Btarget	Rel F at replacement
Atlantic Halibut	Internal	½ Btarget	$F_{0.1}$
Atlantic Wolffish	SSBMSY: SSB/R (40% MSP)	½ Btarget	F40% MSP

Table 3 - Current numerical estimates of SDCs.

Stock	Model/ Approach	B_{MSY} or Proxy (mt)	F_{MSY} or Proxy	MSY (mt)
Georges Bank Cod	empirical	NA	NA	NA
Gulf of Maine Cod	ASAP M=0.2	42,692	0.173	7,580
	ASAP M-ramp	63,867	0.175	11,420
Georges Bank Haddock	VPA	138,924	0.33	30,489
Gulf of Maine Haddock	ASAP	7,993	0.369	1,597
Georges Bank Yellowtail Flounder	empirical	NA	NA	NA
Southern New England/Mid-Atlantic Yellowtail Flounder	ASAP	1,779	0.355	492
Cape Cod/Gulf of Maine Yellowtail Flounder	VPA	3,439	0.32	1,138
American Plaice	VPA	15,293	0.258	3,301
Witch Flounder	empirical area swept	NA	NA	NA
Georges Bank Winter Flounder	VPA	8,910	0.519	4,260
Gulf of Maine Winter Flounder	empirical area swept	NA	0.23 (exploitation rate)	NA
Southern New England/Mid-Atlantic Winter Flounder	ASAP	24,687	0.34	7,532
Acadian Redfish	ASAP	247,918	0.038	9,318
White Hake	ASAP	31,828	0.1677	4,601
Pollock	ASAP	124,639	0.272	19,856
Northern Windowpane Flounder	AIM	3.489 kg/tow	0.185 c/i	647
Southern Windowpane Flounder	AIM	0.187 kg/tow	1.780 c/i	333
Ocean Pout	index	4.94 kg/tow	0.76 c/i	3,754
Atlantic Halibut	FSD	NA	NA	NA
Atlantic Wolffish	SCALE	1,612	0.222	232

6.1.1 Gulf of Maine Cod

Life History. The Atlantic cod, *Gadus morhua*, is a demersal gadoid species found on both sides of the North Atlantic. In the western North Atlantic, cod occur from Greenland to North Carolina. In U.S. waters, cod are assessed and managed as two stocks: Gulf of Maine (GOM) and Georges Bank (GB). GOM cod attain sexual maturity at a later age than GB cod due to different growth rates between the two stocks. The greatest concentrations of cod off the U.S. Northeast coast are on rough bottoms 33 - 492 ft (10 - 150 m) deep and at 32 - 50°F (0 - 10°C). Spawning occurs year-round near the ocean bottom, with a peak in winter and spring. Peak spawning corresponds to 41 - 45°F (5 - 7°C) water. It is delayed until spring when winters are severe, and peaks in the winter when winters are mild. Eggs are pelagic, buoyant, spherical, and transparent. They drift for 2 - 3 weeks before hatching. The larvae are pelagic for about three months until reaching 1.6 - 2.3 in (4 - 6 cm), when they descend to the seafloor. Most remain on the bottom, and there is no evidence of a subsequent diel, vertical migration. Adults tend to move in schools, usually near the bottom, but also occur in the water column (NEFSC 2011c).

Population Status. The inshore GOM stock appears to be relatively distinct from the offshore cod stocks on the banks of the Scotian Shelf and Georges Bank based on tagging studies. GOM cod spawning stock biomass is estimated to have been just over 22,000 mt in 1982. After a period of decline in the 1980's, SSB returned to roughly 20,000 mt in 1990 before decreasing again in the 1990's. The use of separate assessment models (M=0.2 and M-ramp) in the last three assessments yield two estimates for SSB in recent years, though both indicate a sharp decline in SSB since 2010, when SSB was estimated at 8,638 mt and 10,645 mt (respectively). The stock remains low relative to historic levels and is subject to a formal stock rebuilding plan. The 2018 SSB estimates (M=0.2 and M-ramp models) are 3,752 mt and 3,838 mt (respectively), which are 9% and 6% (respectively) of the biomass target. The 2018 fully selected fishing mortality was estimated to be 0.188 and 0.198, which is 109% and 113% of the F_{MSY} proxy (respectively) (NEFSC 2019). Recreational catch estimates were re-estimated in this update by using the re-calibrated Marine Recreational Intercept Program (MRIP) data. In general, inclusion of the re-calibrated data resulted in an increase in SSB, F, and recruitment (NEFSC 2019). Currently, the GOM cod stock is overfished and overfishing is occurring (NEFSC 2019). The stock shows a truncated size and age structure, consistent with a population experiencing high mortality. Additionally, there are only limited signs of incoming recruitment, continued low survey indices, and the current spatial distribution of the stock is considerably less than its historical range within the Gulf of Maine (NEFSC 2019).

6.1.2 Georges Bank Cod

Life History. Georges Bank cod, *Gadus morhua*, is the most southerly cod stock in the world. The greatest concentrations off the Northeast coast of the U.S. are on rough bottoms in waters between 33 and 492 ft (10 - 150 m) and at temperatures between 32 and 50° F (0 - 10°C). Spawning occurs year-round, near the ocean bottom, with a peak in winter and spring. Peak spawning corresponds to water temperatures between 41 and 45°F (5 - 7°C). It is delayed until spring when winters are severe, and peaks in the winter when winters are mild. Eggs are pelagic, buoyant, spherical, and transparent. They drift for 2 to 3 weeks before hatching. The larvae are pelagic for about 3 months until reaching 1.6 to 2.3 in (4 - 6 cm), at which point they descend to the seafloor. Afterwards, most remain on the bottom, and there is no evidence of a subsequent diel, vertical migration. Adults tend to move in schools, usually near the bottom, but also occur in the water column (NEFSC 2011c).

Population Status. GB cod is a transboundary stock co-managed by the U.S. and Canada. The GB cod stock underwent a benchmark assessment in 2012 (SAW55, NEFSC 2013a), which indicated that the stock is overfished and overfishing is occurring. The 2015 peer review concluded that the GB cod model was not acceptable as a scientific basis for catch advice, and that stock status and catch advice should be based an alternative approach, but did conclude that the stock was qualitatively determined to be overfished based on poor stock condition. The update to the ASAP model was rejected, not the underlying benchmark formulation from SAW 55. Because a stock assessment model framework is lacking, no historical estimates of biomass, fishing mortality rate, or recruitment can be calculated. Status determination relative to reference points is not possible because reference points cannot be defined. Overfishing status is considered unknown and the peer review concluded that evidence suggests this stock should still be considered overfished due to poor stock condition (NEFSC 2017). NMFS determined that the stock status for GB cod will remain overfished, with overfishing occurring, consistent with the determination from the 2013 GB cod benchmark assessment. Based on the 2019 assessment, overfishing status is considered unknown and stock status remains overfished based on a qualitative evaluation of poor stock condition (NEFSC 2019). Recreational catch estimates were re-estimated in this update by using the re-calibrated MRIP data, which results in higher average total catch (NEFSC 2019). The GB cod stock continues to show a truncated age structure. The most recent survey values remain below the mean of their time series. The 2013 year class was larger than recent year classes, but has not continued to be large as it ages and is below the average from the 1970s at every age in both surveys (NEFSC 2019).

6.1.3 Gulf of Maine Haddock

Life History. Haddock, *Melanogrammus aeglefinus*, is a demersal gadoid species found in the North Atlantic Ocean, occurring from Cape May, New Jersey to the Strait of Belle Isle, Newfoundland. Six distinct haddock stocks have been identified, and the two which occur in U.S. waters are associated with Georges Bank and the Gulf of Maine. Haddock are highly fecund broadcast spawners, spawning over various substrates including rocks, gravel, smooth sand, and mud. In the Gulf of Maine, spawning occurs from early February to May, usually peaking in February to April. Haddock release their eggs near the ocean bottom in batches where a courting male then fertilizes them. Fertilized eggs become buoyant and rise to the surface water layer and remain in the water column to development. Larvae metamorphose into juveniles in roughly 30 to 42 days at lengths of 0.8 to 1.1 in (2 - 3 cm). Juveniles initially live in the epipelagic zone and remain in the upper water column for 3 - 5 months, but they visit the seafloor in search of food. They settle into a demersal existence once they locate suitable habitat. Haddock do not make extensive migrations, but prefer deeper waters in the winter and tend to move shoreward in summer. The GOM haddock have lower weights at age than the GB stock and the age at 50% maturity was also lower for GOM haddock than GB haddock (NEFSC 2011c).

Population Status. The GOM haddock underwent a benchmark assessment in 2014 at SAW 59, which indicated that the stock was not overfished and overfishing was not occurring. The 2013 SSB was estimated at 4,153 mt, above the <2,452 mt overfishing threshold, a change from the 2012 assessment update when the stock was experiencing overfishing (NEFSC 2014). As of the 2019 groundfish operational assessments, the stock is not overfished and overfishing is not occurring, with 2018 SSB estimated to be at 82,763 mt, which is 1,035% of the biomass target (NEFSC 2019). Recreational catch estimates were re-estimated in this update by using the re-calibrated MRIP data. In general, inclusion of the re-calibrated data resulted in an increase in SSB, F, and recruitment. The GOM haddock stock has experienced several large recruitment events since 2010. The population biomass is currently at an all time high and overall, the population is experiencing low mortality (NEFSC 2017).

6.1.4 Georges Bank Haddock

Life History. The life history of GB haddock, *Melanogrammus aeglefinus*, is comparable to the GOM haddock (Section 6.1.3). On Georges Bank, spawning occurs from January to June, usually peaking from February to early-April. This is the principal haddock spawning area in the Northeast U.S. Shelf Ecosystem, concentrating on the northeast peak of Georges Bank. Median age and size of maturity differ slightly between the GB and GOM haddock stocks (NEFSC 2011c).

Population Status. The GB haddock stock is a transboundary stock co-managed by the U.S. and Canada. The stock is not overfished and overfishing is not occurring (NEFSC 2019). There has been a steady increase in SSB from ~15,000 mt in the early 1990s, to about 252,000 mt in 2007. The dramatic increase 2005 - 2007 is due to the exceptionally large 2003 year class reaching maturity. From 2007 - 2010, SSB decreased 35% as that 2003 year class decreased due to natural and fishing mortality. The fishing mortality rate for this stock has been low in recent years. The retrospective adjusted 2018 SSB was estimated to be at 507,130 mt, which is 365% of the biomass target (NEFSC 2019). The GB haddock stock shows a broad age structure, and broad spatial distribution. This stock has produced several exceptionally strong year classes in the last 15 years, leading to record high SSB in recent years. Catches in recent years have been well below the total quota (US+Canada). While all survey indices support the finding that this stock is at an all-time high, weights at age have been declining since the large 2003 year class, and show further declines with the most recent data (NEFSC 2019).

6.1.5 American Plaice

Life History. American plaice, *Hippoglossoides platessoides*, is an arctic-boreal to temperate-marine pleuronectid (righteye) flounder that inhabits the continental shelves of the North Atlantic. Off the U.S. coast, American plaice are managed as a single stock in the Gulf of Maine and Georges Bank regions. American plaice are batch spawners, releasing eggs in batches every few days over the spawning period. Adults spawn and fertilize their eggs at or near the bottom. Buoyant eggs lack oil globules and drift into the upper water column. Eggs hatch at the surface and the time between fertilization and hatching varies with water temperature. Transformation of the larvae and migration of the left eye begins when the larvae are ~0.8 in (20 mm). Dramatic physiological transformations occur during the juvenile stage; the body shape flattens and widens. As the migration of the left eye across the top of the head to the right side reaches completion, descent towards the seafloor begins. In U.S. and Canadian waters, adult American plaice are sedentary, migrating only for spawning and feeding (NEFSC 2011c).

Population Status. In the Gulf of Maine and Georges Bank, the American plaice is not overfished and overfishing is not occurring (NEFSC 2019). The stock is in a rebuilding plan, but based on the 2019 assessment, the stock is now considered rebuilt (NEFMC 2019). The retrospective adjusted spawning stock biomass in 2018 was estimated to be at 17,748 mt, which is 116% of the biomass target The 2018 fully selected fishing mortality was estimated to be 0.089, which is 34% of the FMSY proxy (NEFSC 2019). The current fishing mortality rate is relatively low, and so recent above average recruitment has resulted in an increase in SSB. SSB is projected to decrease in the short term, however, even at current fishing rates (NEFSC 2019).

6.1.6 Witch Flounder

Life History. Witch flounder, *Glyptocephalus cynoglossus*, is a demersal flatfish distributed on both sides of the North Atlantic. In the western North Atlantic, the species ranges from Labrador southward, and closely associates with mud or sand-mud bottom. In U.S. waters, witch flounder are common throughout the Gulf of Maine, in deeper areas on and adjacent to Georges Bank, and along the shelf edge as far south as Cape Hatteras, North Carolina. Witch flounder is managed as a unit stock. Spawning occurs at or near the bottom; however, the buoyant eggs rise into the water column where subsequent egg and larval development occurs. The pelagic stage of witch flounder is the longest among the species of the family *Pleuronectidae*. Descent to the bottom occurs when metamorphosis is complete, at 4 - 12 months of age. There has been a decrease in both the age and size of sexual maturity in recent years. Witch flounder spawn from March to November, with peak spawning occurring in summer. The general trend is for spawning to occur progressively later from south to north. In the Gulf of Maine-Georges Bank region, spawning occurs from April to November, and peaks from May to August. Spawning occurs in dense aggregations that are associated with areas of cold water. Witch flounder spawn at 32 - 50 °F (0 – 10 °C) (NEFSC 2011c).

Population Status. Witch flounder is overfished and overfishing status is unknown (NEFSC 2019). The 2016 benchmark assessment (SARC 62) peer review panel did not accept the analytical assessment models for witch flounder (NEFSC 2016). Because a stock assessment model framework is lacking, no historical estimates of biomass, fishing mortality rate, or recruitment can be calculated. Status determination relative to reference points is not possible because reference points cannot be defined. An area-swept empirical approach indicates the stock condition remains poor (NEFSC 2019). NMFS determined that the stock status for witch flounder will remain overfished, with overfishing unknown, consistent with the 2016 benchmark assessment for this stock. Based on the 2017 peer review, witch flounder was overfished and overfishing was unknown (NESFC 2017). The 2019 assessment did not recommend a change to the stock status. The fishery landings and survey catch by age indicate a truncation of age structure and a reduction in the number of older fish in the population. NEFSC relative indices of abundance and biomass remain below their time series average (NEFSC 2019).

6.1.7 Gulf of Maine Winter Flounder

Life History. Winter flounder, *Pseudopleuronectes americanus,* is a demersal flatfish distributed in the western North Atlantic from Labrador to Georgia. Important U.S. commercial and recreational fisheries exist from the Gulf of Maine to the Mid-Atlantic Bight. Winter flounder is managed and assessed in U.S. waters as three stocks: Gulf of Maine, southern New England/Mid-Atlantic, and Georges Bank. Adult GOM winter flounder migrate inshore in the fall and early winter and spawn in late winter and early spring. Peak spawning occurs in Massachusetts Bay and south of Cape Cod during February and March, and somewhat later along the coast of Maine, continuing into May. After spawning, adults typically leave inshore areas when water temperatures exceed 59°F (15°C), although some remain inshore year-round. Winter flounder eggs are demersal, adhesive, and cluster together. Larvae are initially planktonic, but 5 - 6 weeks after hatching become increasingly bottom-oriented with metamorphosis, as the left eye migrates to the right side of the body and the larvae become "flounder-like." This finishes by the time the larvae are 0.3 - 0.4 in (8 - 9 mm) long at ~8 weeks old. Newly metamorphosed young-of-the-year winter flounder reside in shallow water where individuals may grow to ~4 in (100 mm) within the first year (NEFSC 2011c).

Population Status. Gulf of Maine winter flounder overfished status is unknown, and overfishing is not occurring. The overfished status remains unknown because a biomass reference point or proxy cannot be determined without an assessment model, and an analytical assessment model has not been accepted since the last benchmark (NEFSC 2017). In the absence of an assessment model, an area-swept empirical approach is used to estimate the abundance of 30+ cm biomass based on state and federal surveys, which was estimated at 2,585 mt for 2016 biomass (NEFSC 2017). The GOM winter flounder stock has relatively flat survey indices with little change in the size structure over time. There have been large declines in the commercial and recreational removals since the 1980s. However, this large decline over the time series does not appear to have resulted in a response in the stock's size structure within the catch and surveys nor has it resulted in a change in the survey indices of abundance (NEFSC 2017).

6.1.8 Georges Bank Winter Flounder

Life History: The life history of Georges Bank winter flounder, *Pseudopleuronectes americanus*, is comparable to the Gulf of Maine winter flounder life history, which is described in Section 6.1.9. GB winter flounder growth is different than either GOM or SNE winter flounder stocks, with winter flounder on Georges Bank growing larger in size than the inshore stocks of winter flounder.

Population Status: Georges Bank winter is overfished and overfishing is not occurring (NEFSC 2019). This is a change from the 2017 operational assessment, in which GB winter flounder was not overfished (NEFSC 2017). The retrospective adjusted spawning stock biomass in 2018 was estimated to be 2,175 mt, which is 24% of SSB_{MSY}. The 2018 fully selected fishing mortality was estimated to be 0.223, which is 43% of the F_{MSY} proxy (NEFSC 2019). Fishing mortality declined rapidly between 2013 and 2017 where it was at the lowest level of the time series, and was only slightly higher in 2018. Recruitment declined after 2008 and reached a time series low in 2018. Although fishing mortality rates were at the lowest levels of the time series during 2015-2018, SSB remained near the SSB_{MSY} threshold during 2004-2015 and then declined to the lowest level on record in 2018. Recruitment increased in 2019 and was similar to the 2017 value, but the 2019 estimate is uncertain (NEFSC 2019).

6.1.9 Southern New England/Mid-Atlantic Winter Flounder

Life History: The life history of SNE/MA winter flounder, *Pseudopleuronectes americanus*, is comparable to the Gulf of Maine winter flounder life history, which is described in Section 6.1.8.

Population Status: Based on the 2017 operational assessment, the SNE/MA winter flounder stock is overfished but overfishing is not occurring. The 2016 spawning stock biomass was estimated to be 4,360 mt, which is 18% of SSB_{MSY} (NEFSC 2017). The SNE/MA winter flounder stock shows an overall declining trend in SSB over the time series, with current estimates near the time series low. Estimates of fishing mortality have remained steady since 2012 and recruitment has steadily increased since an all time low in 2013. Current recruitment estimates are above the ten year average and are the highest since 2008 (NEFSC 2017).

6.1.10 Cape Cod/Gulf of Maine Yellowtail Flounder

Life History: The yellowtail flounder, *Limanda ferruginea*, is a demersal flatfish that occurs from Labrador to Chesapeake Bay. It generally inhabits depths between 131 to 230 ft. (40 and 70 m). NMFS manages three stocks off the U.S. coast including the CC/GOM, GB, and SNE/MA stocks. Spawning occurs in the western North Atlantic from March through August at temperatures of 41 to 54 °F (5 to 12°C). Spawning takes place along continental shelf waters northwest of Cape Cod. Yellowtail flounder spawn buoyant, spherical, pelagic eggs that lack an oil globule. Pelagic larvae are brief residents in the water column with transformation to the juvenile stage occurring at 0.5 to 0.6 in (11.6 to 16 mm) standard length. There are high concentrations of adults around Cape Cod in both spring and autumn. The median age at maturity for females is 2.6 years off Cape Cod.

Population Status: Based on the 2019 operational assessment, the CC/GOM yellowtail flounder stock is not overfished and overfishing is not occurring. This is a change from the 2017 assessment update when the stock was overfished and was experiencing overfishing (NEFSC 2017). The retrospective adjusted 2018 spawning stock biomass was estimated to be 2,125 mt, which is 62% of the biomass target. The 2018 fully selected fishing mortality was estimated to be 0.092, which is 29% of the F_{MSY} proxy (NEFSC 2019). The change in status is supported by an above average estimated 2016 incoming year class coupled with very low exploitation of the fishery resource. The estimated 2018 catch was the lowest in the time series. There is an above average estimated 2016 incoming year class which has contributed to the increase in total biomass. The reductions in fishing mortality and above average 2016 year class has resulted in the stock biomass to increase. However, SSB is projected to decrease in the short-term if fished at $F_{40\%}$ (NEFSC 2019).

6.1.11 Georges Bank Yellowtail Flounder

Life History: The general life history of the GB yellowtail flounder, *Limanda ferruginea*, is comparable to the CC/GOM yellowtail described in Section 6.1.10. The median age at maturity for females is 1.8 years on Georges Bank. Spawning takes place along continental shelf.

Population Status: The GB yellowtail flounder stock is a transboundary stock co-managed by the U.S. and Canada. The GB yellowtail flounder stock status is unknown due to a lack of biological reference points. Because a stock assessment model framework is lacking, no historical estimates of biomass, fishing mortality rate, or recruitment can be calculated. Status determination relative to reference points is not possible because reference points cannot be defined. In the absence of an assessment model, an empirical approach based on survey catches indicates stock condition is poor, given a declining trend in survey biomass despite reductions in catch to historical low levels. Total catch has declined in recent years and is among the lowest values in the time series. The stock has been experiencing below average recruitment and a truncation of age structure. Stock biomass is low and productivity is poor (TRAC 2019). NMFS determined that the stock status for GB yellowtail flounder is overfished, with overfishing occurring.

6.1.12 Southern New England Yellowtail Flounder

Life History: The general life history of the SNE/MA yellowtail flounder, *Limanda ferruginea*, is comparable to the Cape Cod/GOM yellowtail described in Section 6.1.10. The median age at maturity for females is 1.6 years in southern New England.

Population: Based on the 2019 operational assessment, the SNE/MA yellowtail flounder stock is overfished and overfishing is not occurring (NEFSC 2019). This is a change from the 2017 assessment update when the stock was experiencing overfishing (NEFSC 2017). The retrospective adjusted 2018 spawning stock biomass was estimated to be 90 mt, which is 5% of the biomass target. The 2018 fully selected fishing mortality was estimated to be 0.259, which is 73% of the F_{MSY} proxy (NEFSC 2019). The 2018 total catch for SNE/MA yellowtail flounder was estimated to be the lowest on record. In 2017, the relatively strong incoming year class has resulted in a moderate increase in SSB in 2018, but remains well below SSB_{MSY}. In the short term, SSB is projected to increase due to another estimated incoming year class in 2018, but the projected increase is still below the biomass reference point (NEFSC 2019).

6.1.13 Acadian Redfish

Life History: The Acadian redfish, *Sebastes fasciatus Storer*, and the deepwater redfish, *S. mentella Travin*, are virtually indistinguishable from each other based on external characteristics. Deepwater redfish are less prominent in the more southerly regions of the Scotian Shelf and appear to be virtually absent from the Gulf of Maine. Conversely, Acadian redfish appear to be the sole representative of the genus Sebastes. NMFS manages Acadian redfish inhabiting the U.S. waters of the Gulf of Maine and deeper portions of Georges Bank and the Great South Channel as a unit stock. The redfish are a slow growing, long-lived, ovoviviparous species with an extremely low natural mortality rate. Redfish fertilize their eggs internally. The eggs develop into larvae within the oviduct, and are released near the end of the yolk sac phase. The release of larvae lasts for 3 to 4 months with a peak in late May to early June. Newly spawned larvae occur in the upper 10 m of the water column; at 0.4 to 1.0 in (10 to 25 mm). The post-larvae descend below the thermocline when about 1 in (25 mm) in length. Young-of-the-year are pelagic until reaching 1.6 to 2.0 in (40 to 50 mm) at 4 to 5 months old. Therefore, young-of-the-year typically move to the bottom by early fall of their first year. Redfish of 9 in (22 cm) or greater are considered adults. In general, the size of landed redfish positively correlates with depth. This may be due to a combination of differential growth rates of stocks, confused species identification, size-specific migration, or gender-specific migration (females are larger). Redfish make diurnal vertical migrations linked to their primary euphausiid prey.

Population Status: Based on the 2017 operational assessment, the redfish stock is not overfished and overfishing is not occurring. The retrospective adjusted spawning stock biomass in 2016 was estimated to be 359,970 mt, which is 145% of the biomass target (NEFSC 2017). Total removals of Acadian redfish generally have increased since the early 2000s. Fall survey data suggests the existence of relatively strong year classes in 2008 and 2009. Fall survey data suggests that older fish have begun to reappear in the stock since the 1990s (NEFSC 2017).

6.1.14 Pollock

Life History: Pollock, *Pollachius virens*, occur on both sides of the North Atlantic. In the western North Atlantic, the species is most abundant on the western Scotian Shelf and in the Gulf of Maine. There is considerable movement of pollock between the Scotian Shelf, Georges Bank, and the Gulf of Maine. Although some differences in meristic and morphometric characters exist, there are no significant genetic differences among areas. As a result, pollock are assessed as a single unit. The principal pollock spawning sites in the western North Atlantic are in the western Gulf of Maine, Great South Channel, Georges Bank, and on the Scotian Shelf. Spawning takes place from September to April. Spawning time is more variable in northern sites than in southern sites. Spawning occurs over hard, stony, or rocky bottom. Spawning activity begins when the water column cools to near 46 °F (8°C) and peaks when temperatures are approximately 40 to 43 °F (4.5 to 6°C). Thus, most spawning occurs within a comparatively narrow range of temperatures. Pollock eggs are buoyant and rise into the water column after fertilization. The pelagic larval stage lasts for 3 to 4 months. At this time the small juveniles or "harbor pollock" migrate inshore to inhabit rocky subtidal and intertidal zones. Pollock then undergo a series of inshore-offshore movements linked to temperature until near the end of their second year. At this point, the juveniles move offshore where the pollock remain throughout the adult stage. Pollock are a schooling species and occur throughout the water column. With the exception of short migrations due to temperature changes and north-south movements for spawning, adult pollock are fairly stationary in the Gulf of Maine and along the Nova Scotian coast. Male pollock reach sexual maturity at a larger size and older age than females.

Population Status: Based on the 2019 operational assessment, the pollock stock is not overfished and overfishing is not occurring. There are two population assessment models brought forward from the 2017 operational assessment: the base model (dome-shaped survey selectivity), which is used to provide management advice; and the flat sel sensitivity model (flat-topped survey selectivity), which is included for the sole purpose of demonstrating the sensitivity of assessment results to survey selectivity assumptions. The retrospective adjusted spawning stock biomass in 2018 was estimated to be 212,416 mt under the base model and 71,322 under the flat sel sensitivity model (respectively), which are 170% and 101% (respectively) of the biomass target (NEFSC 2019). Total removals of pollock have declined since 2008. Fishery and survey data suggests the existence of a relatively strong 2013 year class, which has just begun to enter the commercial fishery. Survey data suggests that older fish have begun to reappear in the stock since the 1990s (NEFSC 2019).

6.1.15 White Hake

Life History: The white hake, *Urophycis tenuis*, occurs from Newfoundland to southern New England and is common on muddy bottom throughout the Gulf of Maine. The depth distribution of white hake varies by age and season. Juvenile white hake typically occupy shallower areas than adults, but individuals of all ages tend to move inshore or shoalward in summer and disperse to deeper areas in winter. The northern spawning group of white hake spawns in late summer (August-September) in the southern Gulf of St. Lawrence and on the Scotian Shelf. The timing and extent of spawning in the Georges Bank - Middle Atlantic spawning group has not been clearly determined. The eggs, larvae, and early juveniles are pelagic. Older juvenile and adult white hake are demersal. The eggs are buoyant. Pelagic juveniles become demersal at 2.0 to 2.4 in (50 - 60 mm) total length. The pelagic juvenile stage lasts about two months. White hake attain a maximum length of 53 in (135 cm) and weigh up to 49 lbs (22 kg). Female white hake are larger than males (NEFSC 2013b).

Population Status: Based on the 2019 operational assessment, the white hake stock is overfished and overfishing is not occurring. This is a change from the 2017 operational assessment, in which white hake was not overfished (NEFSC 2017). The retrospective adjusted 2018 spawning stock biomass is estimated to be 15,891 mt, which is 50% of the biomass target. The 2018 fully selected fishing mortality was estimated to be 0.129, which is 77% of the F_{MSY} proxy (NEFSC 2019). The stock shows no truncation of age structure. Estimates of commercial landings and discards have decreased over time. The rebuilding deadline for this stock was 2014, and the stock is not yet rebuilt and is now likely overfished. (NEFSC 2019).

6.1.16 Gulf of Maine/Georges Bank Windowpane Flounder

Life History: Windowpane flounder or sand dab, *Scophthalmus aquosus*, is a left-eyed, flatfish species that occurs in the northwest Atlantic from the Gulf of St. Lawrence to Florida (Collette & Klein-MacPhee 2002). Windowpane prefer sandy bottom habitats and occur at depths from the high water mark to 656 ft (200 m), with the greatest abundance at depths < 180 ft (55 m), and at temperatures of 32º-80ºF (0º-26.8ºC) (Moore 1947). On Georges Bank, it is most abundant at depths < 60 m during late spring through autumn but overwintering occurs in deeper waters to 366 m (Chang et al. 1999). Windowpane flounders are assessed and managed as two stocks: Gulf of Maine-Georges Bank (GOM/GB or northern) and Southern New England-Mid-Atlantic Bight (SNE/MA or southern) due to differences in growth rates, size at maturity, and relative abundance trends. Windowpane generally reach sexual maturity between ages 3 and 4 (Moore 1947), though males can mature at age 2 (Grosslein & Azarovitz 1982). On Georges Bank, median length at maturity is nearly the same for males (8.7 in, 22.2 cm) and females (8.9 in, 22.5 cm) (O'Brien et al. 1993). Spawning occurs on Georges Bank during July and August and peaks again between October and November at temperatures of 55º- 61ºF (13º-16ºC) (Morse & Able 1995). Eggs incubate for 8 days at 50º-55ºF (10º-13ºC) and eye migration occurs approximately 17- 26 days after hatching (Collette & Klein-MacPhee 2002). During the first year of life, spring-spawned fish have significantly faster growth rates than autumn-spawned fish, which may result in differential natural mortality rates between the two cohorts (Neuman et al. 2001). Young windowpanes settle inshore and then move offshore to deeper waters as they grow. Windowpane on Georges Bank aggregate in shallow water during summer and early fall and move offshore in the winter and early spring (Grosslein & Azarovitz 1982).

Population Status: Initial results from the 2019 operational assessment indicated that the northern windowpane flounder stock is overfished and overfishing is occurring. This is a change from the 2017 assessment update when the stock was not experiencing overfishing (NEFSC 2017). However, the peer review panel did not recommend accepting the F_{MSY} proxy produced for the 2019 assessment and recommended instead using the F_{MSY} proxy from the 2017 Operational Assessment for status determination. This changed the recommended status to overfished with no overfishing occurring, consistent with the 2017 assessment results. The stock was scheduled to be rebuilt by 2017, but the stock still remains below the biomass threshold despite recent catch estimates being the very lowest in the time series. Since the year 2000, the northern windowpane flounder stock has shown decreasing survey indices despite reductions in catch (NEFSC 2019).

6.1.17 Southern New England/Mid-Atlantic Windowpane Flounder

Life History: The life history of Southern New-England/Mid-Atlantic Bight (southern) windowpane flounder, *Scophthalmus aquosus*, is comparable to Northern Windowpane Flounder (Section 6.1.16). In Southern New England, median length at maturity is nearly the same for males (8.5 in, 21.5 cm) and females (8.3 in, 21.2 cm) (O'Brien, et al. 1993). A split spawning season occurs between Virginia and Long Island with peaks in spring and fall (Chang, et al. 1999). Spawning occurs in the southern Mid-Atlantic during April and May and then peaks again in October or November (Morse & Able 1995).

Population Status: Based on the 2019 operational assessment, the southern windowpane flounder stock is not overfished and overfishing is not occurring. Since 2012, survey biomass indices have declined by half, however, the larger trend has been upward since the series low in 1993. Catch and relative F have been stable (NEFSC 2019).

6.1.18 Ocean Pout

Life History: Ocean pout, *Zoarces americanus*, is a demersal eel-like species found in the northwest Atlantic from Labrador to Delaware. Ocean pout are most common on sand and gravel bottom (Orach-Meza 1975) at depths of 49-262 ft (15-80 m) and temperatures of 43º-48º F (6º-9º C) (Scott 1982). In US waters, ocean pout are assessed and managed as a unit stock from the Gulf of Maine to Delaware. In the Gulf of Maine, median length at maturity for males and females is 11.9 in (30.3 cm) and 10.3in (26.2 cm), respectively. Median length at maturity for males and females from Southern New England is 12.6 in (31.9 cm) and 12.3in (31.3 cm), respectively (O'Brien, et al. 1993). According to tagging studies conducted in Southern New England, ocean pout appear not to migrate, but do move between different substrates seasonally. In Southern New England-Georges Bank they occupy cooler rocky areas in summer, returning in late fall (Orach-Meza 1975). In the Gulf of Maine, they move out of inshore areas in the late summer and then return in the spring. Spawning occurs between September and October in Southern New England (Olsen & Merriman 1946) and in August and September in Newfoundland (Keats et al. 1985). Adults aggregate in rocky areas prior to spawning. Eggs are internally fertilized (Mercer et al. 1993; Yao & Crim 1995) and females lay egg masses encased in a gelatinous matrix that they then guard during the incubation period of 2.5-3 months (Keats, et al. 1985). Ocean pout hatch as juveniles on the bottom and are believed to remain there throughout their lives (Methven & Brown 1991; Yao & Crim 1995).

Population Status: Based on the 2017 operational assessment, ocean pout is overfished but overfishing is not occurring. The stock is not rebuilding as expected, despite low catch. Discards comprise most of the catch since the no possession regulation was implemented in May 2010. The NEFSC survey indices remain at near-record low levels; there are few large fish in the population. The ocean pout stock remains in poor condition. (NEFSC 2017).

6.1.19 Atlantic Halibut

Life History: Atlantic halibut, *Hippoglossus hippoglossus*, is the largest species of flatfish in the northwest Atlantic Ocean. This long-lived, late-maturing flatfish is distributed from Labrador to southern New England (Collette & Klein-MacPhee 2002). They prefer sand, gravel, or clay substrates at depths up to 1000 m (Miller et al. 1991; Scott & Scott 1988). Along the coastal Gulf of Maine, halibut move to deeper water in winter and shallower water in summer (Collette & Klein-MacPhee 2002). Atlantic halibut reach sexual maturity between 5 to 15 years and the median female age of maturity in the Gulf of Maine-Georges Bank region is 7 years (Sigourney et al. 2006). In general, Atlantic halibut spawn once per year in synchronous groups during late winter through early spring (Neilson et al. 1993) and females can produce up to 7 million eggs per year depending on size (Haug & Gulliksen 1988). Spawning is believed to occur in waters of the upper continental slope at depths below 200 m (Scott & Scott 1988). Halibut eggs are buoyant but drift suspended at water depths of 54 - 90 m (Taning 1936). Incubation times are 13 - 20 days depending on temperature (Blaxter et al. 1983); how long halibut live in the plankton after hatching is not known.

Population Status: The stock assessment model framework for Atlantic halibut was not accepted as best scientific advice by the review panel at the 2015 operational assessments (NEFSC 2015). The 2010 benchmark assessment and 2012 assessment update concluded that the stock was overfished and that was overfishing was occurring (NEFSC 2012; NEFSC 2010). All information available in the 2015 assessment update, including the long-term exploitation history of the stock and survey trends, indicated that stock size had not increased, and that the condition of the stock was still poor. The 2015 peer review concluded that the Atlantic halibut stock status is unknown due to a lack of biological reference points. Because a stock assessment model framework is lacking, no historical estimates of biomass, fishing mortality rate, or recruitment can be calculated. Status determination relative to reference points is not possible because reference points cannot be defined. The Council worked closely with the NEFSC to hire a contractor to explore data-limited assessment approaches for Atlantic halibut for 2017. The approach, known as the First Second Derivative (FSD) model, uses a combination of fishery dependent and fishery independent data sources to assess recent changes to the relative condition of the halibut resource. The peer review concluded that all information in the 2017 update indicates that while there have been recent increases in stock size, the condition of the stock is still poor. Overfishing status is considered unknown for halibut and the peer review concluded that evidence suggests that this stock should still be considered overfished (Rago 2017). NMFS determined that the stock status for Atlantic halibut will remain overfished, with overfishing not occurring, consistent with the 2012 assessment update for this stock. Based on the 2019 assessment update, stock status for Atlantic halibut cannot be determined analytically due to a lack of biological reference points associated with the FSD method (NEFSC 2019). There are indications that abundance has increased significantly over the last decade (Rago 2017), which would support a hypothesis that the stock was not experiencing overfishing during that period. It should be noted however, that the FSD model has recently recommended reducing catch, which might be an indication that the stock no longer increasing.

6.1.20 Atlantic Wolffish

Life History: Atlantic wolffish, *Anarhichas lupus*, is a benthic fish distributed on both sides of the North Atlantic Ocean. In the northwest Atlantic, the species occurs from Davis Straits off of Greenland to Cape Cod and sometimes in southern New England and New Jersey waters (Collette & Klein-MacPhee 2002). In the Georges Bank-Gulf of Maine region, abundance is highest in the southwestern portion at depths of 263 - 394 ft (80 - 120 m), but wolffish are also found in waters from 131 - 787 ft (40 - 240 m) (Nelson & Ross 1992) and at temperatures of 29.7º - 50.4º F (-1.3º - 10.2º C) (Collette & Klein-MacPhee 2002). They prefer complex benthic habitats with large stones and rocks (Pavlov & Novikov 1993). Atlantic wolffish are mostly sedentary and solitary, except during mating season. There is some evidence of a weak seasonal shift in depth between shallow water in spring and deeper water in fall (Nelson & Ross 1992). Most individuals mature by age 5-6 when they reach ~18.5 in (47 cm) total length (Nelson & Ross 1992; Templeman 1986). Northern wolffish mature at smaller sizes than faster growing southern fish. Peak spawning is believed to occur from September to October for Gulf of Maine-Georges Bank wolffish (Collette & Klein-MacPhee 2002), though laboratory studies have shown that wolffish can spawn most of the year (Pavlov & Moksness 1994). Eggs are laid in masses, and males are thought to brood for several months. Incubation time is dependent on water temperature and may be 3 - 9 months. Larvae and early juveniles are pelagic between 20 - 40 mm TL, with settlement beginning by 50 mm TL (Falk-Petersen & Hansen 1991).

Population Status: Based on the 2017 operational assessment, Atlantic wolfish is overfished but overfishing is not occurring. The 2016 spawning stock biomass is estimated to be 652 mt, which is 40% of the biomass target (NEFSC 2017). Catch has been limited almost exclusively to discards since the implementation of the no possession rule in May 2010. No age 1 recruits have been caught in the NEFSC spring survey since 2004 (NEFSC 2017).

6.2 NON-GROUNDFISH SPECIES

6.2.1 Spiny Dogfish

Life History. Spiny dogfish, *Squalus acanthias*, occurs in the northwest Atlantic from Labrador to Florida. Spiny dogfish is considered to be a unit stock in the northwest Atlantic. In summer, dogfish migrate northward to the Gulf of Maine-Georges Bank region and into Canadian waters. They return southward in autumn and winter. Recent research has suggested that migratory patterns may be more complex (Carlson et al 2014). Spiny dogfish tend to school by size and, when mature, by sex. The species bears live young, with a gestation period of 18 – 22 months, and produce 2 - 15 pups (average of 6). Size at maturity for females is ~31 in (80 cm), but can vary from 31 - 33 in (78 - 85 cm) depending on the abundance of females (NEFSC 2013h).

Population and Management Status. The NEFMC and MAFMC jointly manage spiny dogfish FMP for federal waters and the Atlantic States Marine Fisheries Commission (ASMFC) has a state waters plan. Spawning stock biomass of spiny dogfish declined rapidly in response to a directed fishery during the 1990's. NFMS initially implemented management measures adopted by the Councils for spiny dogfish in 2001. These measures have been effective in reducing landings and fishing mortality. At the 2010 TRAC, managers agreed to determine stock status using the model from SAW 43 (2006) and NEFSC spring survey data through 2009. NMFS declared the spiny dogfish stock rebuilt for the purposes of federal management in May 2010 (TRAC 2010). As of the 2018 update, the stock was not overfished, and overfishing was not occurring, but the population declined to 67% of the target (Sosebee and Rago 2018) so quotas were lowered from 2018 to 2019 but then are scheduled to increase somewhat in 2020 and 2021. A benchmark assessment is expected in 2022.

6.2.2 Skates

Life History. There are seven species in the Northeast Region skate complex: little skate (*Leucoraja erinacea*), winter skate (*L. ocellata*), barndoor skate (*Dipturus laevis*), thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). Barndoor skate is the most common skate in the Gulf of Maine, on Georges Bank, and in southern New England. Georges Bank and southern New England is the center of distribution for little and winter skates in the Northeast Region. Thorny and smooth skates typically occur in the Gulf of Maine. Clearnose and rosette skates have a more southern distribution, and occur primarily in southern New England and the Chesapeake Bight. Skates are not known to undertake large-scale migrations, but move seasonally with changing water temperature; they move offshore in summer and early autumn and then return inshore during winter and spring. Skates lay eggs enclosed in a hard, leathery case commonly called a mermaid's purse. Incubation time is 6 - 12 months, with the young having the adult form at the time of hatching. Catches of these species are largely interrelated with the NE multispecies, monkfish, and scallop fisheries (NEFSC 2011c).

Population and Management Status. NMFS implemented the Northeast Skate Complex Fishery Management Plan (Skate FMP) in September 2003. The FMP required both dealers and vessels to report skate landings by species. Framework Adjustment 2 modified the VTR and dealer reporting codes to further improve species specific landing reports. Possession prohibitions of barndoor, thorny, and smooth skates in the Gulf of Maine were also provisions of the FMP. The FMP implemented a trip limit of 10,000 lbs (4,536 kg) for winter skate, and required fishermen to obtain a Letter of Authorization to exceed trip limits for the little skate bait fishery. In 2010, Amendment 3 to the Skate FMP implemented a rebuilding plan for smooth skate and established an ACL and annual catch target for the skate complex, total allowable landings for the skate wing and bait fisheries, and seasonal quotas for the bait fishery. Possession limits were reduced, in-season possession limit triggers were implemented, as well as other measures to improve management of the skate fisheries. Due to insufficient information about the population dynamics of skates, there remains considerable uncertainty about the status of skate stocks. Based on NEFSC bottom trawl survey data through autumn 2018/spring 2019, one skate species remains overfished (thorny) and overfishing is not occurring in any of the seven skate species. Barndoor skate is considered to be rebuilt for the purposes of federal management as of August 2016. Smooth skate is also considered rebuilt. Recent skate landings have fluctuated between approximately 30 and 40 million pounds. The landings and catch limits proposed by Amendment 3 have an acceptable probability of promoting biomass growth and achieving the rebuilding (biomass) targets for thorny skates. A stabilization of total catch below the median relative exploitation ratio should cause skate biomass and future yield to increase.

6.2.3 Monkfish

Life History. Monkfish, *Lophius americanus*, (i.e., "goosefish"), occur in the western North Atlantic from the Grand Banks and northern Gulf of St. Lawrence south to Cape Hatteras, North Carolina. Monkfish occur from inshore areas to depths of at least 2,953 ft (900 m). Monkfish undergo seasonal onshore-offshore migrations, which may relate to spawning or possibly to food availability. Female monkfish begin to mature at age 4 with 50% of females maturing by age 5 (~17 in [43 cm]). Males generally mature at slightly younger ages and smaller sizes (50% maturity at age 4.2 or 14 in [36 cm]). Spawning takes place from spring through early autumn. It progresses from south to north, with most spawning occurring during the spring and early summer. Females lay a buoyant egg raft or veil that can be as large as 39 ft (12 m) long and 5 ft (1.5 m) wide, and only a few mm thick. The larvae hatch after 1 - 3 weeks, depending on water temperature. The larvae and juveniles spend several months in a pelagic phase before settling to a benthic existence at a size of ~3 in (8 cm; NEFSC 2011c).

Population and Management Status. NMFS implemented the Monkfish FMP in 1999 (NEFMC 1998) and the fishery is jointly managed by the NEFMC and MAFMC. The FMP included measures to stop overfishing and rebuild the stocks through a number of measures. These measures included:

- Limiting the number of vessels with access to the fishery and allocating DAS to those vessels;
- Setting trip limits for vessels fishing for monkfish; minimum fish size limits;
- Gear restrictions;
- Mandatory time out of the fishery during the spawning season; and
- A framework adjustment process.

The Monkfish FMP defines two management areas for monkfish (northern and southern), divided roughly by an east-west line bisecting Georges Bank. As of 2013 data, monkfish in both management areas are not overfished and overfishing is not occurring (NEFSC 2013c). Operational assessments for monkfish were conducted in 2016 and 2019, but it was recommended that stock status not be updated during these data updates due to a lack of biological reference points (Richards 2016, XX 2019). According to the 2019 assessment, strong recruitment in 2015 fueled an increase in stock biomass in 2016-2018, though abundance has since declined as recruitment returned to average levels. Biomass increases were greater in the northern area than in the southern area, and biomass has declined somewhat in the south, as abundance of the 2015 year class declined. In the north, landings and catch have fluctuated around a steady level since 2009, but increased after 2015, with discards increasing only slightly. In the south, landings and catch had been declining since around 2000, but catch increased after 2015 due to discarding of a strong 2015 year class, with almost a doubling of the discard rate.

6.2.4 Summer Flounder

Life History. Summer flounder, *Paralichthys dentatus*, occur in the western North Atlantic from the southern Gulf of Maine to South Carolina. Summer flounder are concentrated in bays and estuaries from late spring though early autumn, when an offshore migration to the outer continental shelf is undertaken. Spawning occurs during autumn and early winter, and the larvae are transported toward coastal areas by prevailing water currents. Development of post larvae and juveniles occurs primarily within bays and estuarine areas. Most fish are sexually mature by age 2. The largest fish are females, which can attain lengths over 90 cm (36 in) and weights up to 11.8 kg (26 lbs.; NEFSC 2011c). Recent NEFSC trawl survey data indicate that while female summer flounder grow faster (reaching a larger size at the same age), the sexes attain about the same maximum age (currently age 15 at 56 cm for males, and age 14 at 76 cm for females). Unsexed commercial fishery samples currently indicate a maximum age of 20 for a 57 cm fish (NEFSC 2019b).

Population and Management Status. The FMP was developed by the MAFMC in 1988, and scup and black sea bass were later incorporated into the FMP. Amendment 2, implemented in 1993, established a commercial quota allocated to the states, a recreational harvest limit, minimum size limits, gear restrictions, permit and reporting requirements, and an annual review process to establish specifications for the coming fishing year. In 1999, Amendment 12 revised the overfishing definitions for all three species, established rebuilding programs, addressed bycatch and habitat issues and established a framework adjustment procedure for the FMP to allow for a streamlined process for relatively minor changes to management measures. Results from the 2018 benchmark assessment indicate that the summer flounder stock was not overfished, and overfishing was not occurring in 2017 relative to the biological reference points as revised through the SAW 66 benchmark assessment (NEFSC 2019a). The estimated SSB in 2017 was 44,552 mt, which is 78% of the target biomass. Fully selected fishing mortality was estimated to be 0.334 in 2017, which is 75% of the F_{MSY} proxy (NEFSC 2019a).

6.2.5 American Lobster

Life History. American lobster, *Homarus americanus*, occurs in continental shelf waters from Maine to North Carolina. There are two biological stock units: the Gulf of Maine/Georges Bank stock, and Southern New England stock. The American lobster is long-lived and known to reach more than 40 pounds in body weight (Wolff 1978). Lobsters are encased in a hard exoskeleton that is periodically cast off (molted) for growth and mating to occur. Eggs are carried under the female's abdomen during a 9 - 11 month incubation period. Larger lobsters produce eggs with greater energy content and thus, may produce larvae with higher survival rates (Attard & Hudon 1987). Seasonal timing of egg extrusion and larval hatching is somewhat variable among areas and may also vary due to seasonal weather patterns. Hatching tends to occur over a five month period from May – September, occurring earlier and over a longer period in the southern part of the range. The pelagic larvae molt four times before they resemble adults and settle to the bottom. Lobsters molt more than 20 times over 5 - 8 years before they reach the minimum legal harvest size.

Population and Management Status. The states, in cooperation with NMFS, manage the American lobster resource through the ASMFC under the provisions of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). States have jurisdiction for implementing measures in state waters, while NMFS implements complementary regulations in federal waters. Over the last four decades, landings in the lobster fishery have exponentially increased, with 39.1 million pounds landed in 1981 and 159.36 million pounds landed in 2016. Preliminary landings in 2017 were 137.0 million pounds. Most of this increase in landings can be attributed to the Gulf of Maine, which has accounted for over 90% of coastwide landings since 2006. In contrast, landings in the Southern New England stock have declined in conjunction with a decrease in stock health. Results of the 2015 Benchmark Stock Assessment showed a mixed picture, with increasing abundance in the Gulf of Maine/Georges Bank (GOM/GBK) stock and a sharp decline in abundance for the Southern New England (SNE) stock. In particular, the Stock Assessment concluded that the SNE stock is experiencing recruitment failure with estimates of recent recruitment near zero (ASMFC, 2015). Overall, the SNE stock is considered depleted but overfishing is not occurring; the GOM/GBK unit is not overfished and overfishing is not occurring, though consistent declines in the young-of-year surveys have been observed in the GOM/GBK stock since 2012. (ASMFC 2015).

6.2.6 Whiting (Silver Hake)

Life History. Silver hake, also known as whiting, *Merluccius bilinearis*, range primarily from Newfoundland to South Carolina. Silver hake are fast swimmers with sharp teeth, and are important fish predators that also feed heavily on crustaceans and squid (Lock & Packer 2004). In U.S. waters, two stocks have been identified based on differences of head and fin lengths (Almeida 1987), otolith morphometrics (Bolles & Begg 2000), otolith growth differences, and seasonal distribution patterns (Lock & Packer 2004). The northern silver hake stock inhabits Gulf of Maine - Northern Georges Bank waters, and the southern silver hake stock inhabits Southern Georges Bank - Middle Atlantic Bight waters. Silver hake migrate in response to seasonal changes in water temperatures, moving toward shallow, warmer waters in the spring. They spawn in these shallow waters during late spring and early summer and then return to deeper waters in the autumn (Brodziak et al. 2001). The older, larger silver hake especially prefer deeper waters. During the summer, portions of both stocks can be found on Georges Bank, whereas during the winter fish in the northern stock move to deep basins in the Gulf of Maine, while fish in the southern stock move to outer continental shelf and slope waters. Silver hake are widely distributed, and have been observed at temperature ranges of 2-17° C (36-63° F) and depth ranges of 11-500 m (36-1,640 ft). However, they are most commonly found between 7-10º C (45-50º F) (Lock & Packer 2004).

Population and Management Status. Due to their abundance and availability, silver hake have supported important U.S. and Canadian fisheries as well as distant-water fleets. Landings increased to 137,000 mt in 1973 and then declined sharply with increased restrictions on distant-water fleet effort and implementation of the Magnuson Fishery Conservation and Management Act (MFCMA) in 1977. U.S. landings during 1987-1996 were relatively stable, averaging 16,000 mt per year, but have gradually declined to a historic low of 6,035 mt in fishing year 2017. The small-mesh otter trawl remains the principal gear used in the U.S. fishery, and recreational catches have been low since 1985. Fishing in the Gulf of Maine and Georges Bank regulated mesh areas are managed via six exemption areas, each having specific specifications for gear, possession limits for incidental species, and boundaries (see NEFMC 2017 for details). In the northern management area, all but the Cultivator Shoals Area require vessels to use a more selective raised footrope trawl when using small-mesh trawls.

Silver hake are managed under the NEFMC's Northeast Multispecies FMP ("non-regulated multispecies" category). In 2000, the NEFMC implemented Amendment 12 to this FMP, and placed silver hake into the “small mesh multispecies” management unit, along with red hake and offshore hake. This amendment established retention limits based on net mesh size, adopted overfishing definitions for northern and southern stocks, identified essential fish habitat for all life stages, and set requirements for fishing gear (NEFMC 2000). As of the last assessment in 2017, silver hake is not overfished and overfishing is not occurring in the northern or southern management area (NEFMC 2018). Biomass in the northern management area has increased, but biomass in the southern management area has been declining. As a result, the Council adjusted the annual catch specifications for 2018-2020, increasing by 27% in the northern area and decreasing by 35% in the southern area (NEFMC 2017), reflecting changes in the three-year average survey biomass estimate which is a major component of the specification-setting procedures.

6.2.7 Loligo Squid

Life History. Longfin inshore squid (*Doryteuthis (Amerigo) pealeii*) are distributed primarily in continental shelf waters located between Newfoundland and the Gulf of Venezuela (Cohen 1976; Roper et al. 1984). In the northwest Atlantic Ocean, longfin squid are most abundant in the waters between Georges Bank and Cape Hatteras where the species is commercially exploited. The management unit is all longfin squid under U.S. jurisdiction (i.e. U.S. east coast). Distribution varies seasonally. North of Cape Hatteras, squid migrate offshore during autumn to overwinter in warmer waters along the shelf edge and slope, and then return inshore during the spring where they remain until late autumn (Jacobson 2005). The species lives for 6-8 months, grows rapidly, and spawns year-round with peaks during late spring and autumn. Individuals hatched in summer grow more rapidly than those hatched in winter and males grow faster and attain larger sizes than females (Brodziak & Macy III 1996).

Population and Management Status. Based on a new biomass reference point from a 2010 SAW-SARC assessment, the longfin squid stock was not overfished in 2009, but overfishing status was not determined because no overfishing threshold was recommended (though the assessment did describe the stock as “lightly exploited”). The assessment was updated in 2017 with 2016 data and the findings were the same (stock was 174% of the target biomass in 2016). The domestic fishery occurs primarily in Southern New England and Mid-Atlantic waters, but some fishing also occurs along the edge of Georges Bank. Fishing patterns reflect seasonal distribution patterns and effort is generally directed offshore during October through April and inshore during May through September. The fishery is dominated by small-mesh otter trawlers, but some near-shore pound net and fish trap fisheries occur during spring and summer. Summer or winter landings may dominate in any given year. The stock is managed by the MAFMC under the Atlantic Mackerel, Squid, and Butterfish FMP. Management measures include annual TACs, which have been partitioned into 3 four-month seasonal trimesters since 2007. There is a moratorium on directed and incidental fishery permits (an open access permit with a low trip limit may still be acquired for free). A minimum codend mesh size of 2 1/8 inches applies from September-April and 1 7/8 inches from May-August. The fishery can also be closed if butterfish discards exceed a discard cap (via in-season monitoring).

6.2.8 Atlantic Sea Scallops

Life History. Sea scallops, *Placopecten magellanicus,* are distributed in the northwest Atlantic Ocean from Newfoundland to North Carolina, mainly on sand and gravel sediments where bottom temperatures remain below 20º C (68º F). North of Cape Cod, concentrations generally occur in shallow water <40 m (22 fathoms) deep. South of Cape Cod and on Georges Bank, sea scallops typically occur at depths 25 - 200 m (14 - 110 fathoms), with commercial concentrations generally 35 - 100 m (19 - 55 fathoms). Sea scallops are filter feeders, feeding primarily on phytoplankton, but also on microzooplankton and detritus (Hart & Chute 2004). Sea scallops grow rapidly during the first several years of life. Between ages 3 and 5, they commonly increase 50 - 80% in shell height and quadruple their meat weight. Sea scallops have been known to live more than 20 years. They usually become sexually mature at age 2, but individuals younger than age 4 probably contribute little to total egg production. Sexes are separate and fertilization is external. Spawning usually occurs in late summer and early autumn; spring spawning may also occur, especially in the Mid-Atlantic Bight. Sea scallops are highly fecund; a single large female can release hundreds of millions of eggs annually. Larvae remain in the water column for four to seven weeks before settling to the bottom. Sea scallops attain commercial size at about four to five years old, though historically, three year olds were often exploited. Sea scallops have a somewhat uncommon combination of life-history attributes: low mobility, rapid growth, and low natural mortality (NEFSC 2011c).

Population and Management Status. The commercial fishery for sea scallops is conducted year round, primarily using New Bedford style and turtle deflector scallop dredges. A small percentage of the fishery employs otter trawls, mostly in the Mid-Atlantic. The principal U.S. commercial fisheries are in the Mid-Atlantic (from Virginia to Long Island, New York) and on Georges Bank and neighboring areas, such as the Great South Channel and Nantucket Shoals. There is also a small, primarily inshore fishery for sea scallops in the Gulf of Maine. The NEFMC established the Scallop FMP in 1982. The scallop resource was last assessed through a benchmark assessment in 2018, and it was not overfished, and overfishing was not occurring (NEFSC 2018).

6.2.9 Scup

Life History. Scup are found in a variety of habitats in the Mid-Atlantic. Essential fish habitat (EFH) for scup includes demersal waters, areas with sandy or muddy bottoms, mussel beds, and sea grass beds from the Gulf of Maine through Cape Hatteras, North Carolina. Scup undertake extensive seasonal migrations between coastal and offshore waters. They are mostly found in estuaries and coastal waters during the spring and summer. In the fall and winter, they move offshore and to the south, to outer continental shelf waters south of New Jersey. Scup spawn once annually over weedy or sandy areas, mostly off of southern New England. Spawning takes place from May through August and usually peaks in June and July (Steimle et al. 1999). About 50% of scup are sexually mature at two years of age and about 17 cm (about 7 inches) total length. Nearly all scup older than three years of age are sexually mature. Scup reach a maximum age of at least 14 years. They may live as long as 20 years; however few scup older than age 7 are caught in the Mid-Atlantic (DPSWG 2009, NEFSC 2015).

Population and Management Status. The scup fishery is cooperatively managed by the MAFMC and the ASMFC under the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan (FMP). The primary commercial fishery management measure is a quota that is distributed to three trimester periods and to individual states. Other federal regulations include minimum mesh size, gear restricted areas, and a minimum fish size. States typically restrict harvest to their quota using seasons and trip limits. Scup were under a formal rebuilding plan from 2005 through 2009. NMFS declared the scup stock rebuilt in 2009 based on the findings of the Data Poor Stocks Working Group (DPSWG 2009). The most recent stock assessment update indicates that scup was not overfished and overfishing was not occurring in 2016, relative to the biological reference points from the 2015 benchmark assessment. SSB has declined since its peak in 2011 but remains very high and increased slightly in 2016. Estimated SSB in 2016 was 396.60 million pounds (179,898 mt), 2.1 times SSB at maximum sustainable yield (SSB_{MSY} = 192.47 million pounds, or 87,302 mt). The fishing mortality rate in 2016 was 0.139, which is 37% below the fishing mortality threshold reference point ($F_{MSY\ PROXY}$ = F40%) of 0.220. Fishing mortality has been below the $F_{MSY\ PROXY}$ reference point for the last 17 years. The average recruitment from 1984 to 2016 is 121 million fish at age 0. The 2015 year class is estimated to be 252 million fish, the largest on record, while the 2016 year class is estimated to be below average at 65 million fish (NEFSC 2017).

6.2.10 Atlantic Herring

Life History. Atlantic herring is widely distributed in continental shelf waters of the Northeast Atlantic, from Labrador to Cape Hatteras. Herring is in every major estuary from the northern Gulf of Maine to the Chesapeake Bay. They are most abundant north of Cape Cod and become increasingly scarce south of New Jersey (Kelly & Moring 1986). Spawning occurs in the summer and fall, starting earlier along the eastern Maine coast and southwest Nova Scotia (August – September) than in the southwestern GOM (early to mid-October in the Jeffreys Ledge area) and GB (as late as November - December; Reid et al. 1999). In general, GOM herring migrate from summer feeding grounds along the Maine coast and on GB to SNE/MA areas during winter, with larger individuals tending to migrate farther distances. Atlantic herring play an important role as forage in the Northeast U.S. shelf ecosystem. They are eaten by a wide variety of fish, marine mammals, birds, and (historically) by humans in the region.

Population and Management Status. The Atlantic herring fishery is cooperatively managed by both the NEFMC and ASMFC. Presently, herring from the GOM (inshore) and GB (offshore) stock components are combined for assessment purposes into a single coastal stock complex. The fishery uses quotas by area and season. Prosecuted primarily by mid water trawls (single and paired), purse seines, and a lesser degree bottom trawls, management measures include restrictions on the incidental catch of haddock and other regulated groundfish. Mid-water trawls are allowed access to the groundfish closed areas as an exempted fishery but their use of the areas is subject to numerous regulatory restrictions. The Atlantic herring stock was last assessed in 2018 and was not overfished and overfishing was not occurring through 2017 (NEFSC, 2018). However, recruitment has been below average and four of the six lowest annual recruitment estimates have occurred in recent years. Therefore, future projections of biomass are relatively low in the near term, putting the stock at relatively high risk of becoming overfished. According to the 2018 Stock Assessment, SSB in 2017 is estimated to be 141,473 mt. Catch limits are expected to be much lower in 2019-2021 compared to current levels set in the last specification package (2016-2018) and earlier. For example, catch limits proposed for 2020 are well under 20,000 mt compared to catch limits over 100,000 mt that were in place for the handful of years before.

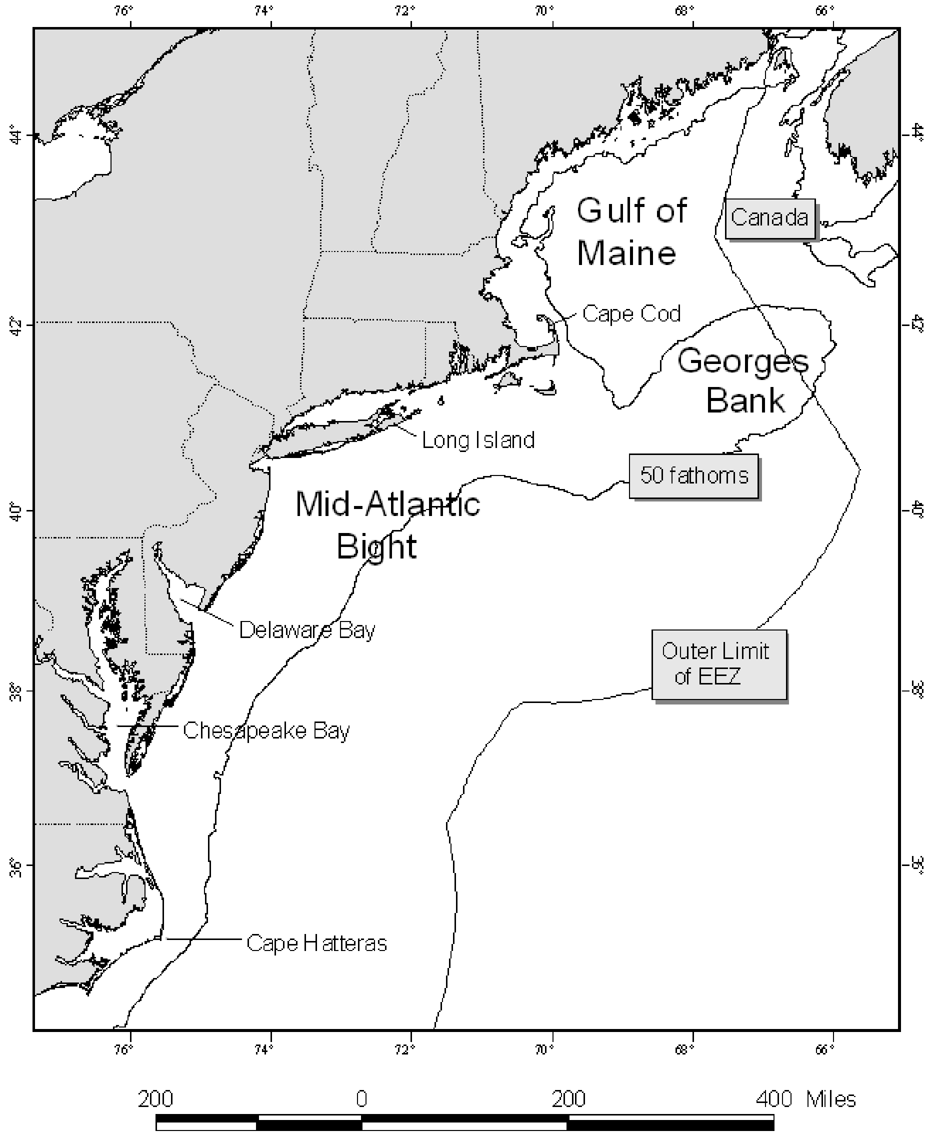
6.2.11 Bycatch

The MSA defines bycatch as fish which are harvested in a fishery, but which are not sold or kept for personal use, including economic discards and regulatory discards. Fish released alive under a recreational catch and release fishery management program are not included. The MSA requires that, to the extent practicable, bycatch and the mortality of bycatch that cannot be avoided should both be minimized. To consider whether these objectives are being met, bycatch must be reported and assessed. To this end, the MSA requires that a standardized reporting methodology assess the amount and type of bycatch occurring in a fishery. The primary tools used to report bycatch in the multispecies fishery are the Vessel Trip Report system (VTR), the NEFSC Observer Program (NEFOP), and the groundfish sector At-Sea Monitoring Program (ASM). Each federally permitted groundfish vessel is required to report discards and landings on every trip from each statistical area they fish in. The sea sampling/observer program places personnel on boats to observe and estimate the amount of discards on a haul-by-haul basis. More information on bycatch may be found at: http://www.greateratlantic.fisheries.noaa.gov/.

6.3 PHYSICAL ENVIRONMENT/EFH

The Northeast U.S. Shelf Ecosystem (Figure 2) includes the area from the Gulf of Maine south to Cape Hatteras, extending from the coast seaward to the edge of the continental shelf, including the slope sea offshore to the Gulf Stream (Sherman et al. 1996). The continental slope includes the area east of the shelf, out to a depth of 6,562 ft (2,000 m). Four distinct sub-regions are identified, including the Gulf of Maine, Georges Bank, the Mid-Atlantic Bight, and the continental slope. The groundfish fishery primarily occurs in the inshore and offshore waters of the Gulf of Maine, Georges Bank, and the Southern New England/Mid-Atlantic areas. Therefore, the description of the physical environment focuses on these sub-regions. The distinctive features of Southern New England are included in the sections describing Georges Bank and the Mid-Atlantic Bight.

Figure 2 - Northeast U.S. Shelf Ecosystem

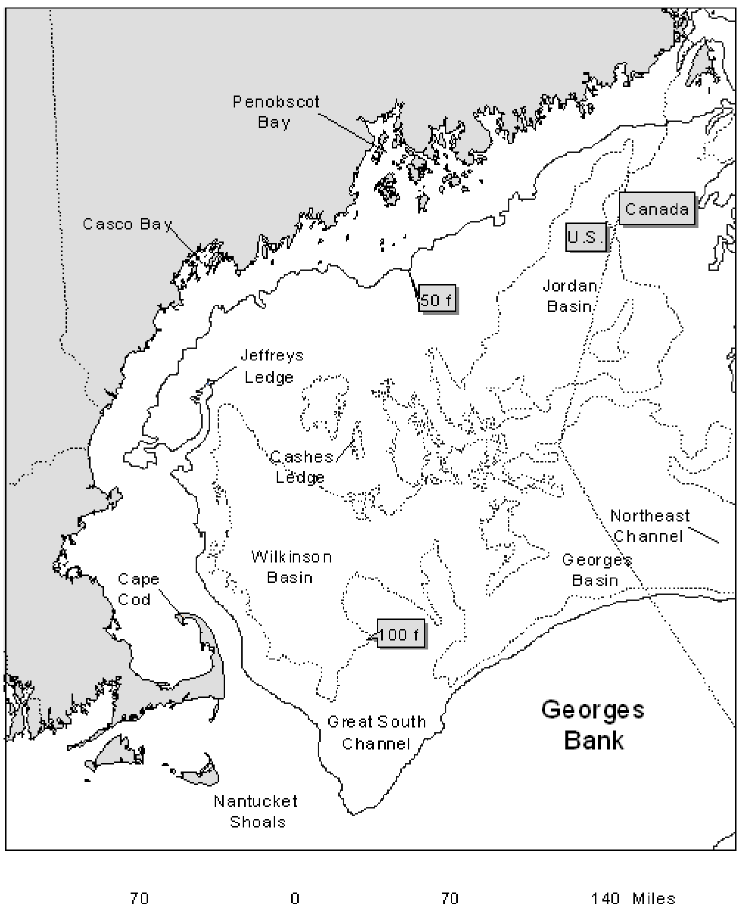


Source: Stevenson et al. (2004).

6.3.1 Gulf of Maine

The Gulf of Maine is an enclosed coastal sea, glacially derived, bounded on the east by Browns Bank, on the north by the Nova Scotia (Scotian) Shelf, on the west by the New England states, and on the south by Cape Cod and Georges Bank (Figure 3). The Gulf of Maine is a boreal environment characterized by relatively cold waters and deep basins, with a patchwork of various sediment types, topographically diverse from the rest of the continental border along the U.S. Atlantic coast. There are 21 distinct basins separated by ridges, banks, and swells. Depths in the basins exceed 820 ft. (250 m), with a maximum depth of 1,148 ft (350 m) in Georges Basin, just north of Georges Bank. High points within the Gulf of Maine include irregular ridges, such as Cashes Ledge, which peaks at 30 ft (9 m) below the surface.

Figure 3 - Gulf of Maine



Source: Stevenson et al. (2004).

Very fine sediment particles created and eroded by the glaciers have collected in thick deposits over much of the seafloor of the Gulf of Maine, particularly in its deep basins. In the basins, these mud deposits blanket and obscure the irregularities of the underlying bedrock, forming topographically smooth terrains, although localized rocky features are present, for example in Jordan Basin (see the Council's Draft Deep-Sea Coral Amendment). In the rises between the basins, other materials are usually at the surface.

Unsorted glacial till covers some morainal areas, sand predominates on some high areas, and gravel,[1] sometimes with boulders, predominates others. Bedrock is the predominant substrate along the western edge of the Gulf of Maine, north of Cape Cod in a narrow band out to a water depth of about 197 ft. (60 m). Mud predominates in coastal valleys and basins that often abruptly border rocky substrates. Gravel, often mixed with shell, is common adjacent to bedrock outcrops and in fractures in the rock. Gravel is most abundant at depths of 66 - 131 ft. (20 - 40 m), except off eastern Maine where a gravel-covered plain exists to depths of at least 328 ft. (100 m). Sandy areas are relatively rare along the inner shelf of the western Gulf of Maine, but are more common south of Casco Bay, especially offshore of sandy beaches (Stevenson, et al. 2004). Stellwagen Bank offshore Massachusetts includes large areas of sand sediment, in addition to gravel sediments and boulder ridges (Valentine et al. 2005, Valentine and Gallea 2015).

The geologic features of the Gulf of Maine, coupled with the vertical variation in water properties (e.g., salinity, depth, temperature), provide a great diversity of habitat types that support a rich biological community. A brief description of benthic invertebrates and demersal (i.e., bottom-dwelling) fish that occupy the Gulf of Maine is provided below. Additional information is provided in Stevenson et al. (2004), which is incorporated by reference.

The most common groups of benthic invertebrates in the Gulf of Maine reported by Theroux and Wigley (1998) in terms of numbers collected were annelid worms, bivalve mollusks, and amphipod crustaceans. Bivalves, sea cucumbers, sand dollars, annelids, and sea anemones dominated biomass. Watling (1998) identified seven different bottom assemblages that occur on the following habitat types:

1. Sandy offshore banks: fauna are characteristically sand dwellers with an abundant interstitial component;
2. Rocky offshore ledges: fauna are predominantly sponges, tunicates, bryozoans, hydroids, and other hard bottom dwellers;
3. Shallow [<197 ft. (60 m)] temperate bottoms with mixed substrate: fauna population is rich and diverse, primarily comprised of polychaetes and crustaceans;
4. Primarily fine muds at depths of 197 - 459 ft. (60 - 140 m) within cold Gulf of Maine Intermediate Water:[2] fauna are dominated by polychaetes, shrimp, and cerianthid anemones;
5. Cold deep water, muddy bottom: fauna include species with wide temperature tolerances which are sparsely distributed, diversity low, dominated by a few polychaetes, with brittle stars, sea pens, shrimp, and cerianthids also present;
6. Deep basin, muddy bottom, overlaying water usually 45 - 46°F (7 - 8°C): fauna densities are not high, dominated by brittle stars and sea pens, and sporadically by tube-making amphipods; and
7. Upper slope, mixed sediment of either fine muds or mixture of mud and gravel, water temperatures always >46°F (8°C): upper slope fauna extending into the Northeast Channel.

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[1] The term "gravel," as used in this analysis, is a collective term that includes granules, pebbles, cobbles, and boulders in order of increasing size. Therefore, the term "gravel" refers to particles larger than sand and generally denotes a variety of "hard bottom" substrates.

[2] Maine Intermediate Water is described as a mid-depth layer of water that preserves winter salinity and temperatures, and is located between more saline Maine bottom water and the warmer, stratified Maine surface water. The stratified surface layer is most pronounced in the deep portions of the western GOM.

Two studies (Gabriel 1992; Overholtz & Tyler 1985) reported common[3] demersal fish species by assemblages in the Gulf of Maine and Georges Bank:

- Deepwater/Slope and Canyon: offshore hake, blackbelly rosefish, Gulf stream flounder;
- Intermediate/Combination of Deepwater Gulf of Maine-Georges Bank and Gulf of Maine-Georges Bank Transition: silver hake, red hake, goosefish (monkfish);
- Shallow/Gulf of Maine-Georges Bank Transition Zone: Atlantic cod, haddock, pollock;
- Shallow water Georges Bank-southern New England: yellowtail flounder, windowpane flounder, winter flounder, winter skate, little skate, longhorn sculpin;
- Deepwater Gulf of Maine-Georges Bank: white hake, American plaice, witch flounder, thorny skate; and
- Northeast Peak/Gulf of Maine-Georges Bank Transition: Atlantic cod, haddock, pollock.

6.3.2 Georges Bank

Georges Bank is a shallow (10 - 492 ft. [3 - 150 m depth]), elongated (100 mi.(161 km) wide by 20 mi (322 km) long) extension of the continental shelf that was formed during the Wisconsinian glacial episode (Figure 2). It has a steep slope on its northern edge, a broad, flat, gently sloping southern flank, and steep submarine canyons on its eastern and southeastern edges. It has highly productive, well-mixed waters and strong currents. The Great South Channel lies to the west. Natural processes continue to erode and rework the sediments on Georges Bank. Erosion and reworking of sediments by the action of rising sea level as well as tidal and storm currents may reduce the amount of sand and cause an overall coarsening of the bottom sediments (Valentine & Lough 1991).

Bottom topography on eastern Georges Bank consists of linear ridges in the western shoal areas; a relatively smooth, gently dipping seafloor on the deeper, easternmost part; a highly energetic peak in the north with sand ridges up to 30 m high and extensive gravel pavement; and steeper and smoother topography incised by submarine canyons on the southeastern margin. The central region of Georges Bank is shallow, and the bottom has shoals and troughs, with sand dunes superimposed within. The area west of the Great South Channel, known as Nantucket Shoals, is similar in nature to the central region of Georges Bank. Currents in these areas are strongest where water depth is shallower than 164 ft. (50 m). Sediments in this region include gravel pavement and mounds, some scattered boulders, sand with storm-generated ripples, and scattered shell and mussel beds. Tidal and storm currents range from moderate to strong, depending upon location and storm activity.

Oceanographic frontal systems separate the water masses of the Gulf of Maine and Georges Bank from oceanic waters south of Georges Bank. These water masses differ in temperature, salinity, nutrient concentration, and planktonic communities. These differences influence productivity and may influence fish abundance and distribution.

Georges Bank has historically had high levels of both phytoplankton and fish production. Common demersal fish species in Georges Bank are offshore hake, blackbelly rosefish, Gulf Stream flounder, silver hake, red hake, goosefish (monkfish), Atlantic cod, haddock, pollock, yellowtail flounder, windowpane flounder, winter flounder, winter skate, little skate, longhorn sculpin, white hake, American plaice, witch flounder, and thorny skate. In terms of benthic invertebrates, the most common groups in terms of numbers collected were amphipod crustaceans and annelid worms, while sand dollars and bivalves

[3] Other species were listed as found in these assemblages, but only the species common to both studies are listed.

dominated the overall biomass (Theroux & Wigley 1998). Using Theroux and Wigley database, Theroux and Grosslein (1987) identified four macrobenthic invertebrate assemblages that occur on similar habitat type:

1. The Western Basin assemblage is found in comparatively deep water (492 - 656 ft. [150 - 200 m]) with relatively slow currents and fine bottom sediments of silt, clay, and muddy sand. Fauna are comprised mainly of small burrowing detritivores and deposit feeders, and carnivorous scavengers.
2. The Northeast Peak assemblage is found in variable depths and current strength and includes coarse sediments, consisting mainly of gravel and coarse sand with interspersed boulders, cobbles, and pebbles. Fauna tend to be sessile (coelenterates, brachiopods, barnacles, and tubiferous annelids) or free-living (brittle stars, crustaceans, and polychaetes), with a characteristic absence of burrowing forms.
3. The Central Georges Bank assemblage occupies the greatest area, including the central and northern portions of Georges Bank in depths <328 ft. (100 m). Medium-grained shifting sands predominate this dynamic area of strong currents. Organisms tend to be small to moderately large with burrowing or motile habits. Sand dollars are most characteristic of this assemblage.
4. The Southern Georges Bank assemblage is found on the southern and southwestern flanks at depths from 262 - 656 ft. (80 - 200 m), where fine-grained sands and moderate currents predominate. Many southern species exist here at the northern limits of their range. Dominant fauna include amphipods, copepods, euphausiids, and starfish.

6.3.3 Southern New England/Mid-Atlantic Bight

The Mid-Atlantic Bight includes the shelf and slope waters from Georges Bank south to Cape Hatteras, and east to the Gulf Stream (Figure 2). The northern portion of the Mid-Atlantic Bight is sometimes referred to as southern New England. It generally includes the area of the continental shelf south of Cape Cod from the Great South Channel to Hudson Canyon. The Mid-Atlantic Bight consists of the sandy, relatively flat, gently sloping continental shelf from southern New England to Cape Hatteras, North Carolina. The shelf slopes gently from shore out to 62 - 124 ft (100 - 200 km) offshore, where it transforms to the slope (328 - 656 ft. [100 - 200 m water depth]) at the shelf break. In both the Mid-Atlantic Bight and on Georges Bank, numerous canyons incise the slope, and some cut up onto the shelf itself (Stevenson, et al. 2004). Like the rest of the continental shelf, sea level fluctuations during past ice ages largely shaped the topography of the Mid-Atlantic Bight. Since that time, currents and waves have modified this basic structure.

The sediment type covering most of the shelf in the Mid-Atlantic Bight is sand, with some relatively small, localized areas of sand-shell and sand-gravel. Silty sand, silt, and clay predominate on the slope. Permanent sand ridges occur in groups with heights of about 33 ft. (10 m), lengths of 6 - 31 mi (10 - 50 km), and spacing of 1 mi (2 km). The sand ridges are usually oriented at a slight angle towards shore, running in length from northeast to southwest. Sand ridges are often covered with smaller similar forms such as sand waves, megaripples, and ripples. Sand waves are usually found in patches of 5 - 10 with heights of about 7 ft. (2 m), lengths of 164 - 328 ft. (50 - 100 m), and 0.6 - 1 mi (1 - 2 km) between patches. Sand waves are temporary features that form and re-form in different locations. They usually occur on the inner shelf. Because tidal currents southwest of Nantucket Shoals and southeast of Long Island and Rhode Island slow significantly, there is a large mud patch on the seafloor where silts and clays settle out.

Artificial reefs are another important Mid-Atlantic Bight habitat. These localized areas of hard structure have been formed more recently than other seabed types by shipwrecks, lost cargoes, disposed solid materials, shoreline jetties and groins, submerged pipelines, cables, and other materials (Steimle & Zetlin 2000). In general, reefs are important for attachment sites, shelter, and food for many species. In addition, fish predators, such as tunas, may be drawn by prey aggregations or may be behaviorally attracted to the reef structure. Estuarine reefs, such as blue mussel beds or oyster reefs, are dominated by epibenthic organisms, as well as crabs, lobsters, and sea stars. These reefs are hosts to a multitude of fish, including gobies, spot, bass (black sea and striped), perch, toadfish, and croaker. Coastal reefs consist of exposed rock, wrecks, kelp, or other hard material. Boring mollusks, algae, sponges, anemones, hydroids, and coral generally dominate these coastal reefs. These reef types also host lobsters, crabs, sea stars, and urchins, as well as a multitude of fish, including; black sea bass, pinfish, scup, cunner, red hake, gray triggerfish, black grouper, smooth dogfish, and summer flounder. These epibenthic organisms and fish assemblages are similar to the reefs farther offshore, which generally consist of rocks and boulders, wrecks, and other types of artificial reefs. There is less information available for reefs on the outer shelf, but the fish species associated with these reefs include tilefish, white hake, and conger eel.

While substrate is the primary factor influencing demersal species distribution in the Gulf of Maine and Georges Bank, latitude and water depth are the primary influence in the Mid-Atlantic Bight area.
In terms of numbers, amphipod crustaceans and bivalve mollusks dominate the benthic fauna of this primarily sandy environment. Mollusks (70%) dominate the biomass (Stevenson, et al. 2004). Pratt (1973) identified three broad faunal zones related to water depth and sediment type:

1. The "sand fauna" zone is dominated by polychaetes and was defined for sandy sediments (≤1% silt) that are at least occasionally disturbed by waves, from shore out to a depth of about 164 ft. (50 m).
2. The "silty sand fauna" zone is dominated by amphipods and polychaetes and occurs immediately offshore from the sand fauna zone, in stable sands containing a small amount of silt and organic material.
3. Silts and clays become predominant at the shelf break and line the Hudson Shelf Valley supporting the "silt-clay fauna."

Colvocoresses and Musick (1984) identified the following assemblages in the Mid-Atlantic sub region during spring and fall.[4]

- Northern (boreal) portions: hake (white, silver, red), goosefish (monkfish), longhorn sculpin, winter flounder, little skate, and spiny dogfish;
- Warm temperate portions: black sea bass, summer flounder, butterfish, scup, spotted hake, and northern sea robin;
- Water of the inner shelf: windowpane flounder;
- Water of the outer shelf: fourspot flounder; and
- Water of the continental slope: shortnose greeneye, offshore hake, blackbelly rosefish, and white hake.

[4] Other species were listed as found in these assemblages, but only the species common to both spring and fall seasons are listed.

6.3.4 Essential Fish Habitat Designations

The Sustainable Fisheries Act defines EFH as "[t]hose waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The proposed action could potentially affect EFH for benthic life stages of species that are managed under the Northeast Multispecies FMP; as well as EFH for species managed under the Atlantic Sea Scallop; Monkfish; Northeast Skate Complex; Atlantic Herring; Summer Flounder, Scup, and Black Sea Bass; Golden Tilefish; Atlantic Mackerel, Squid, and Butterfish; and Atlantic Surfclam and Ocean Quahog FMPs. EFH for deep-sea red crab is designated beyond the operating depths of the multispecies fishery. EFH for the species managed under these FMPs includes a wide variety of benthic habitats in state and federal waters throughout the Northeast U.S. shelf ecosystem.

Table 4 - Summary of Geographic distributions and habitat characteristics of Essential Fish Habitat designations for benthic fish and shellfish species managed by the New England and Mid-Atlantic fishery management councils in the Greater Atlantic region, as of October 2019.

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
Acadian redfish	Juveniles	Gulf of Maine and the continental slope north of 37°38'N	50-200 in Gulf of Maine, to 600 on slope	Sub-tidal coastal and offshore rocky reef substrates with associated structure-forming epifauna (e.g., sponges, corals), and soft sediments with cerianthid anemones
	Adults	Gulf of Maine and the continental slope north of 37°38'N	140-300 in Gulf of Maine, to 600 on slope	Offshore benthic habitats on finer grained sediments and on variable deposits of gravel, silt, clay, and boulders
American plaice	Juveniles	Gulf of Maine and bays and estuaries from Passamaquoddy Bay to Saco Bay, Maine and from Massachusetts Bay to Cape Cod Bay, Massachusetts Bay	40-180	Sub-tidal benthic habitats on mud and sand, also found on gravel and sandy substrates bordering bedrock
	Adults	Gulf of Maine, Georges Bank and bays and estuaries from Passamaquoddy Bay to Saco Bay, Maine and from Massachusetts Bay to Cape Cod Bay, Massachusetts Bay	40-300	Sub-tidal benthic habitats on mud and sand, also gravel and sandy substrates bordering bedrock
Atlantic cod	Juveniles	Gulf of Maine, Georges Bank, and Southern New England, including nearshore waters from eastern Maine to Rhode Island and the following estuaries: Passamaquoddy Bay to Saco Bay; Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	Mean high water-120	Structurally-complex intertidal and sub-tidal habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna
	Adults	Gulf of Maine, Georges Bank, Southern New England, and the Mid-Atlantic to Delaware Bay, including the following estuaries: Passamaquoddy Bay to Saco Bay; Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	30-160	Structurally complex sub-tidal hard bottom habitats with gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae, also sandy substrates and along deeper slopes of ledges
Atlantic halibut	Juveniles & Adults	Gulf of Maine, Georges Bank, and continental slope south of Georges Bank	60-140 and 400-700 on slope	Benthic habitats on sand, gravel, or clay substrates

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
Atlantic wolffish	Eggs	U.S. waters north of 41˚N latitude and east of 71˚W longitude	<100	Sub-tidal benthic habitats under rocks and boulders in nests
	Juveniles	U.S. waters north of 41˚N latitude and east of 71˚W longitude	70-184	Sub-tidal benthic habitats
	Adults	U.S. waters north of 41˚N latitude and east of 71˚W longitude	<173	A wide variety of sub-tidal sand and gravel substrates once they leave rocky spawning habitats, but not on muddy bottom
Haddock	Juveniles	Inshore and offshore waters in the Gulf of Maine, on Georges Bank, and on the continental shelf in the Mid-Atlantic region	40-140 and as shallow as 20 in coastal Gulf of Maine	Sub-tidal benthic habitats on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel
	Adults	Offshore waters in the Gulf of Maine, on Georges Bank, and on the continental shelf in Southern New England	50-160	Sub-tidal benthic habitats on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel and adjacent to boulders and cobbles along the margins of rocky reefs
Ocean pout	Eggs	Georges Bank, Gulf of Maine, and the Mid-Atlantic, including certain bays and estuaries in the Gulf of Maine	<100	Sub-tidal hard bottom habitats in sheltered nests, holes, or rocky crevices
	Juveniles	Gulf of Maine, on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and including certain bays and estuaries in the Gulf of Maine	Mean high water-120	Intertidal and sub-tidal benthic habitats on a wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel
	Adults	Gulf of Maine, Georges Bank, on the continental shelf north of Cape May, New Jersey, and including certain bays and estuaries in the Gulf of Maine	20-140	Sub-tidal benthic habitats on mud and sand, particularly in association with structure forming habitat types; i.e. shells, gravel, or boulders
Pollock	Juveniles	Inshore and offshore waters in the Gulf of Maine (including bays and estuaries in the Gulf of Maine), the Great South Channel, Long Island Sound, and Narragansett Bay, Rhode Island	Mean high water-180 in Gulf of Maine, Long Island Sound, and Narragansett Bay; 40-180 on Georges Bank	Intertidal and sub-tidal pelagic and benthic rocky bottom habitats with attached macroalgae, small juveniles in eelgrass beds, older juveniles move into deeper water habitats also occupied by adults
	Adults	Offshore Gulf of Maine waters, Massachusetts Bay and Cape Cod Bay, on the southern edge of Georges Bank, and in Long Island Sound	80-300 in Gulf of Maine and on Georges Bank; <80 in Long Island Sound, Cape Cod Bay, and Narragansett Bay	Pelagic and benthic habitats on the tops and edges of offshore banks and shoals with mixed rocky substrates, often with attached macro algae
White hake	Juveniles	Gulf of Maine, Georges Bank, and Southern New England, including bays and estuaries in the Gulf of Maine	Mean high water - 300	Intertidal and sub-tidal estuarine and marine habitats on fine-grained, sandy substrates in eelgrass, macroalgae, and un-vegetated habitats

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
	Adults	Gulf of Maine, including coastal bays and estuaries, and the outer continental shelf and slope	100-400 offshore Gulf of Maine, >25 inshore Gulf of Maine, to 900 on slope	Sub-tidal benthic habitats on fine-grained, muddy substrates and in mixed soft and rocky habitats
Windowpane flounder	Juveniles	Estuarine, coastal, and continental shelf waters from the Gulf of Maine to northern Florida, including bays and estuaries from Maine to Maryland	Mean high water - 60	Intertidal and sub-tidal benthic habitats on mud and sand substrates
	Adults	Estuarine, coastal, and continental shelf waters from the Gulf of Maine to Cape Hatteras, North Carolina, including bays and estuaries from Maine to Maryland	Mean high water - 70	Intertidal and sub-tidal benthic habitats on mud and sand substrates
Winter flounder	Eggs	Eastern Maine to Absecon Inlet, New Jersey (39° 22´N) and Georges Bank	0-5 south of Cape Cod, 0-70 Gulf of Maine and Georges Bank	Sub-tidal estuarine and coastal benthic habitats on mud, muddy sand, sand, gravel, submerged aquatic vegetation, and macroalgae
	Juveniles	Coastal Gulf of Maine, Georges Bank, and continental shelf in Southern New England and Mid-Atlantic to Absecon Inlet, New Jersey, including bays and estuaries from eastern Maine to northern New Jersey	Mean high water - 60	Intertidal and sub-tidal benthic habitats on a variety of bottom types, such as mud, sand, rocky substrates with attached macro algae, tidal wetlands, and eelgrass; young-of-the-year juveniles on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks
	Adults	Coastal Gulf of Maine, Georges Bank, and continental shelf in Southern New England and Mid-Atlantic to Absecon Inlet, New Jersey, including bays and estuaries from eastern Maine to northern New Jersey	Mean high water - 70	Intertidal and sub-tidal benthic habitats on muddy and sandy substrates, and on hard bottom on offshore banks; for spawning adults, also see eggs
Witch flounder	Juveniles	Gulf of Maine and outer continental shelf and slope	50-400 and to 1500 on slope	Sub-tidal benthic habitats with mud and muddy sand substrates
	Adults	Gulf of Maine and outer continental shelf and slope	35-400 and to 1500 on slope	Sub-tidal benthic habitats with mud and muddy sand substrates
Yellowtail flounder	Juveniles	Gulf of Maine, Georges Bank, and the Mid-Atlantic, including certain bays and estuaries in the Gulf of Maine	20-80	Sub-tidal benthic habitats on sand and muddy sand
	Adults	Gulf of Maine, Georges Bank, and the Mid-Atlantic, including certain bays and estuaries in the Gulf of Maine	25-90	Sub-tidal benthic habitats on sand and sand with mud, shell hash, gravel, and rocks
Silver hake	Juveniles	Gulf of Maine, including certain bays and estuaries, and on the continental shelf as far south as Cape May, New Jersey	40-400 in Gulf of Maine, >10 in Mid-Atlantic	Pelagic and sandy sub-tidal benthic habitats in association with sand-waves, flat sand with amphipod tubes, shells, and in biogenic depressions
	Adults	Gulf of Maine, including certain bays and estuaries, the southern portion of Georges Bank, and the outer	>35 in Gulf of Maine, 70-400 on Georges Bank	Pelagic and sandy sub-tidal benthic habitats, often in bottom depressions or in association with

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
		continental shelf and some shallower coastal locations in the Mid-Atlantic	and in the Mid-Atlantic	sand waves and shell fragments, also in mud habitats bordering deep boulder reefs, on over deep boulder reefs in the southwest Gulf of Maine
Offshore hake	Juveniles	Outer continental shelf and slope from Georges Bank to 34° 40'N	160-750	Pelagic and benthic habitats
	Adults	Outer continental shelf and slope from Georges Bank to 34° 40'N	200-750	Pelagic and benthic habitats
Red hake	Juveniles	Gulf of Maine, Georges Bank, and the Mid-Atlantic, including Passamaquoddy Bay to Cape Cod Bay in the Gulf of Maine, Buzzards Bay and Narragansett Bay, Long Island Sound, Raritan Bay and the Hudson River, and lower Chesapeake Bay	Mean high water-80	Intertidal and sub-tidal soft bottom habitats, especially those that that provide shelter, such as depressions in muddy substrates, eelgrass, macroalgae, shells, anemone and polychaete tubes, on artificial reefs, and in live bivalves (e.g., scallops)
	Adults	In the Gulf of Maine, the Great South Channel, and on the outer continental shelf and slope from Georges Bank to North Carolina, including inshore bays and estuaries as far south as Chesapeake Bay	50-750 on shelf and slope, as shallow as 20 inshore	Sub-tidal benthic habitats in shell beds, on soft sediments (usually in depressions), also found on gravel and hard bottom and artificial reefs
Monkfish	Juveniles	Gulf of Maine, outer continental shelf in the Mid-Atlantic, and the continental slope	50-400 in the Mid-Atlantic, 20-400 in the Gulf of Maine, and to 1000 on the slope	Sub-tidal benthic habitats on a variety of habitats, including hard sand, pebbles, gravel, broken shells, and soft mud, also seek shelter among rocks with attached algae
	Adults	Gulf of Maine, outer continental shelf in the Mid-Atlantic, and the continental slope	50-400 in the Mid-Atlantic, 20-400 in the Gulf of Maine, and to 1000 on the slope	Sub-tidal benthic habitats on hard sand, pebbles, gravel, broken shells, and soft mud, but seem to prefer soft sediments, and, like juveniles, utilize the edges of rocky areas for feeding
Smooth skate	Juveniles	Offshore Gulf of Maine, some coastal bays in Maine and New Hampshire, and on the continental slope from Georges Bank to North Carolina	100-400 offshore Gulf of Maine, <100 inshore Gulf of Maine, to 900 on slope	Benthic habitats, mostly on soft mud in deeper areas, but also on sand, broken shells, gravel, and pebbles on offshore banks in the Gulf of Maine
	Adults	Offshore Gulf of Maine and the continental slope from Georges Bank to North Carolina	100-400 offshore Gulf of Maine, to 900 on slope	Benthic habitats, mostly on soft mud in deeper areas, but also on sand, broken shells, gravel, and pebbles on offshore banks in the Gulf of Maine
Thorny skate	Juveniles	Offshore Gulf of Maine, some coastal bays in the Gulf of Maine, and on the continental slope from Georges Bank to North Carolina	35-400 offshore Gulf of Maine, <35 inshore Gulf of Maine, to 900 on the slope	Benthic habitats on a wide variety of bottom types, including sand, gravel, broken shells, pebbles, and soft mud
	Adults	Offshore Gulf of Maine and on the continental slope from Georges Bank to North Carolina	35-400 offshore Gulf of Maine, <35 inshore Gulf	Benthic habitats on a wide variety of bottom types, including sand, gravel, broken shells, pebbles, and soft mud

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
			of Maine, to 900 on the slope	
Little skate	Juveniles	Coastal waters in the Gulf of Maine, Georges Bank, and the continental shelf in the Mid-Atlantic region as far south as Delaware Bay, including certain bays and estuaries in the Gulf of Maine	Mean high water-80	Intertidal and sub-tidal benthic habitats on sand and gravel, also found on mud
	Adults	Coastal waters in the Gulf of Maine, Georges Bank, and the continental shelf in the Mid-Atlantic region as far south as Delaware Bay, including certain bays and estuaries in the Gulf of Maine	Mean high water-100	Intertidal and sub-tidal benthic habitats on sand and gravel, also found on mud
Winter skate	Juveniles	Coastal waters from eastern Maine to Delaware Bay, including certain bays and estuaries from eastern Maine to Chincoteague Bay, Virginia, and on Georges Bank and the continental shelf in Southern New England and the Mid-Atlantic	0-90	Sub-tidal benthic habitats on sand and gravel substrates, are also found on mud
	Adults	Coastal waters from eastern Maine to Delaware Bay, including certain bays and estuaries in Maine and New Hampshire, and on Georges Bank and the continental shelf in Southern New England and the Mid-Atlantic	0-80	Sub-tidal benthic habitats on sand and gravel substrates, are also found on mud
Barndoor skate	Juveniles and adults	Primarily on Georges Bank and in Southern New England and on the continental slope	40-400 on shelf and to 750 on slope	Sub-tidal benthic habitats on mud, sand, and gravel substrates
Clearnose skate	Juveniles	Inner continental shelf from New Jersey to the St. Johns River in Florida and certain bays and certain estuaries including Raritan Bay, inland New Jersey bays, Chesapeake Bay, and Delaware Bays	0-30	Sub-tidal benthic habitats on mud and sand, but also on gravelly and rocky bottom
	Adults	Inner continental shelf from New Jersey to the St. Johns River in Florida and certain bays and certain estuaries including Raritan Bay, inland New Jersey bays, Chesapeake Bay, and Delaware Bays	0-40	Sub-tidal benthic habitats on mud and sand, but also on gravelly and rocky bottom
Rosette skate	Juveniles and adults	Outer continental shelf from approximately 40˚N to Cape Hatteras, North Carolina	80-400	Benthic habitats with mud and sand substrates
Atlantic herring	Eggs	Coastal Gulf of Maine, Georges Bank, and Southern New England	5-90	Sub-tidal benthic habitats on coarse sand, pebbles, cobbles, and boulders and/or macroalgae
Atlantic sea scallop	Eggs	Gulf of Maine coastal waters and offshore banks, Georges Bank, and the Mid-Atlantic, including the following estuaries: Passamaquoddy Bay to Sheepscot River; Casco Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Inshore and offshore benthic habitats (see adults)

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
	Larvae	Gulf of Maine coastal waters and offshore banks, Georges Bank, and the Mid-Atlantic, including the following estuaries: Passamaquoddy Bay to Sheepscot River; Casco Bay, Massachusetts Bay, and Cape Cod Bay	No information	Inshore and offshore pelagic and benthic habitats: pelagic larvae ("spat"), settle on variety of hard surfaces, including shells, pebbles, and gravel and to macroalgae and other benthic organisms such as hydroids
	Juveniles	Gulf of Maine coastal waters and offshore banks, Georges Bank, and the Mid-Atlantic, including the following estuaries: Passamaquoddy Bay to Sheepscot River; Casco Bay, Great Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Benthic habitats initially attached to shells, gravel, and small rocks (pebble, cobble), later free-swimming juveniles found in same habitats as adults
	Adults	Gulf of Maine coastal waters and offshore banks, Georges Bank, and the Mid-Atlantic, including the following estuaries: Passamaquoddy Bay to Sheepscot River; Casco Bay, Great Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Benthic habitats with sand and gravel substrates
Deep-sea red crab	Eggs	Outer continental shelf and slope throughout the region, including two seamounts	320-640	Benthic habitats attached to female crabs
	Juveniles	Outer continental shelf and slope throughout the region, including two seamounts	320-1300 on slope and to 2000 on seamounts	Benthic habitats with unconsolidated and consolidated silt-clay sediments
	Adults	Outer continental shelf and slope throughout the region, including two seamounts	320-900 on slope and up to 2000 m on seamounts	Benthic habitats with unconsolidated and consolidated silt-clay sediments
Summer flounder	Juveniles	Continental shelf and estuaries from Cape Cod, Massachusetts, to Cape Canaveral, Florida	To maximum 152	Benthic habitats, including inshore estuaries, salt marsh creeks, seagrass beds, mudflats, and open bay areas
	Adults	Continental shelf from Cape Cod, Massachusetts, to Cape Canaveral, Florida, including shallow coastal and estuarine waters during warmer months	To maximum 152 in colder months	Benthic habitats
Scup	Juveniles	Continental shelf between southwestern Gulf of Maine and Cape Hatteras, North Carolina and in nearshore and estuarine waters between Massachusetts and Virginia	No information	Benthic habitats, in association with inshore sand and mud substrates, mussel and eelgrass beds
	Adults	Continental shelf and nearshore and estuarine waters between southwestern Gulf of Maine and Cape Hatteras, North Carolina	No information, generally overwinter offshore	Benthic habitats
Black sea bass	Juveniles and adults	Continental shelf and estuarine waters from the southwestern Gulf of Maine and Cape Hatteras, North Carolina	Inshore in summer and spring	Benthic habitats with rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas, also offshore clam beds and shell patches in winter

Species	Life Stage	Geographic Area	Depth (meters)	Habitat Type and Description
Golden tilefish	Juveniles and adults	Outer continental shelf and slope from U.S.-Canada boundary to the Virginia-North Carolina boundary	100-300	Burrows in semi-lithified clay substrate, may also utilize rocks, boulders, scour depressions beneath boulders, and exposed rock ledges as shelter
Longfin inshore squid	Eggs	Inshore and offshore waters from Georges Bank southward to Cape Hatteras	Generally <50	Bottom habitats attached to variety of hard bottom types, macroalgae, sand, and mud
Spiny dogfish	Juveniles	Primarily the outer continental shelf and slope between Cape Hatteras and Georges Bank and in the Gulf of Maine	Deep water	Pelagic and epibenthic habitats
	Female sub-adults	Throughout the region	Wide depth range	Pelagic and epibenthic habitats
	Male sub-adults	Primarily in the Gulf of Maine and on the outer continental shelf from Georges Bank to Cape Hatteras	Wide depth range	Pelagic and epibenthic habitats
	Female adults	Throughout the region	Wide depth range	Pelagic and epibenthic habitats
	Male adults	Throughout the region	Wide depth range	Pelagic and epibenthic habitats
Atlantic surfclam	Juveniles and adults	Continental shelf from southwestern Gulf of Maine to Cape Hatteras, North Carolina	Surf zone to about 61, abundance low >38	In substrate to depth of 3 ft
Ocean quahog	Juveniles and adults	Continental shelf from southern New England and Georges Bank to Virginia	9-244	In substrate to depth of 3 ft

6.3.5 Gear Types and Interaction with Habitat

A variety of gears are used in the multispecies fishery (Table 5). Groundfish vessels fish for target species with: trawl, gillnet, and hook and line gear (including jigs, handline, and non-automated demersal longlines). This section discusses the characteristics of each of the gear types, as well as the typical impacts to the physical habitat associated with each of these gear types. In general, EFH for species and life stages that rely on the seafloor for shelter (e.g., from predators), reproduction, or food is vulnerable to disturbance by bottom tending gear. The most vulnerable habitat is more likely to be hard or rough bottom with attached epifauna. The Council’s recently published Omnibus Habitat Amendment 2 includes an assessment of relative habitat vulnerability to the gear types used in the northeast region. This analysis was recently updated (NEFMC 2019).

Table 5 - Description of the gear types used by the multispecies fishery

	Trawl	Sink/Anchor Gillnets	Bottom Longlines	Hook and Line
Total Length	Varies	295 ft. (90 m) long per net	~1,476 ft. (451 m)	Varies by target species
Lines	N/A	Leadline and floatline with webbing (mesh) connecting	Mainline is parachute cord. Gangions (lines from mainline to hooks) are 15 in (38 cm) long, 3 - 6 in (8 to 15 cm) apart, and made of shrimp twine	One to several with mechanical line fishing
Nets	Rope or large-mesh size, depends upon target species	Monofilament, mesh size depends on the target species (groundfish nets minimum mesh size of 6.5 in [16.5 cm])	No nets, but 12/0 or larger circle hooks are required	No nets, but single to multiple hooks, “umbrella rigs”
Anchoring	N/A	22 lbs (10 kg) Danforth-style anchors are required at each end of the net string	20-24 lbs (9-11 kg) anchors, anchored at each end, using pieces of railroad track, sash weights, or Danforth anchors, depending on currents	No anchoring, but sinkers used (stones, lead)
Frequency/ Use Duration	Tows last for several hours	Frequency of tending changes from daily (when targeting groundfish) to semi-weekly (when targeting monkfish and skate)	Usually set for a few hours at a time	Depends upon cast/target species

6.3.5.1 Trawl Gear

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). Mid-water trawls are designed to catch pelagic species in the water column and do not normally contact the bottom; however, mid-water trawls are prohibited in the Northeast multispecies fishery. Bottom trawls are designed to be towed along the seafloor and to catch a variety of demersal fish and invertebrate species.

Bottom otter trawls account for nearly all commercial bottom trawling activity. A wide range of otter trawls are used in the northeast due to the diversity of fisheries and bottom types encountered in the region (NEFSC 2002c). The specific gear design is often a result of the target species (whether found on or off the bottom) as well as the composition of the bottom (smooth versus rough and soft versus hard). Fishermen tow bottom trawls at a variety of speeds, but average about 5.6 km/hour (3 knots). Several federal FMPs manage the use of this gear. Bottom trawling is also subject to a variety of state regulations throughout the region.

A flatfish trawl is a type of bottom otter trawl designed with a low net opening between the headrope and the footrope and more ground rigging on the sweep. This type of trawl is designed so that the sweep follows the contours of the bottom. As flounders lie in contact with the seafloor, these animals respond to the bottom-tending sweep by swimming up off the bottom where they can be entrained into net. Flatfish trawls are used on smooth mud and sand bottoms. In contrast, a high-rise or fly net with larger mesh has a wide net opening and is used to catch demersal fish that tend to rise higher off the bottom than flatfish (NEFSC 2002).

Bottom otter trawls are rigged with rockhopper gear for use on "hard" bottom (i.e., gravel or rocky bottom), or on mud or sand bottom with occasional boulders. This type of gear seeks to sweep over irregularities in the bottom without damaging the net. The sweep in trawls rigged for fishing on smooth bottoms looks to herd fish into the path of the net (Mirarchi 1998).

The raised-footrope trawl was designed to provide vessels with a means of continuing to fish for small-mesh species without catching groundfish. Raised-footrope trawls fish about 1.6 - 2.0 ft. (0.5 - 0.6 m) above the bottom. Although the doors of the trawl still ride on the bottom, underwater video and observations in flume tanks have confirmed that the sweep in the raised-footrope trawl has much less contact with the seafloor than the traditional cookie sweep (Carr & Milliken 1998).

The haddock separator trawl and Ruhle trawl (bottom trawls) are used to minimize the catch of cod. The design of these gears considers the behavior of fish in response to gear. A haddock separator trawl is a groundfish trawl modified to a vertically oriented trouser trawl configuration. It has two extensions arranged one over the other. A codend is attached to the upper extension and the bottom extension is left open with no codend attached. A horizontal large mesh separating panel constructed with a minimum of 6-inch diamond mesh must be installed between the selvedges joining the upper and lower panels [648.85(a)(3)(iii)(A)]. Haddock generally swim to the upper part of a net and cod swim to the lower part of the net. By inserting a mesh panel in the net, and using two codends, the net effectively divides the catch. The cod can escape if the codend on the lower part of the net is left open (NEFMC 2003). Overall, the haddock separator trawl has had mixed results in commercial fishing operations. The expected ratios of haddock to cod have not been realized. Catches of other demersal species, such as flounders, skates, and monkfish, have also been higher than expected. However, the separator trawl has reduced catches of these species compared to normal fishing practices (NEFMC 2009b).

The Ruhle trawl (previously known as the haddock rope trawl or eliminator trawl) is a four-seam bottom groundfish trawl with a rockhopper. It is designed to reduce the bycatch of cod while retaining or increasing the catch of haddock and other healthy stocks [648.85(b)(6)(iv)(J)(3)]. NMFS approved the Ruhle trawl for use in the DAS program and in the Eastern U.S./Canada Haddock SAP on July 14, 2008 (73 FR 40186) after nearly two years of testing to determine efficacy. Experiments comparing traditional and the new trawl gear showed that the Ruhle trawl reduced bycatch of cod and flounders, while simultaneously retaining the catch of healthier stocks, primarily haddock. The large, 8-foot mesh in the forward end (the wings) of the Ruhle trawl net allows cod and other fish to escape because of their body shapes and unique behavior around the netting.

6.3.5.2 Gillnet Gear

In addition to trawl gear, the fishery is also prosecuted using gillnets. A bottom gillnet is a large wall of netting equipped with floats at the top and lead weights along the bottom. Bottom gillnets are anchored or staked in position. Fish are caught while trying to pass through the net mesh. The meshes of individual gillnets are uniform in size and shape, and therefore are highly selective for a particular size of fish (Jennings et al. 2001). Bottom gillnets are fished in two different ways, as "standup" and "tiedown" nets (Williamson 1998). Standup nets typically catch Atlantic cod, haddock, pollock, and hake and are soaked (duration of time the gear is set) for 12 - 24 hours. Tiedown nets are set with the floatline tied to the leadline at 6-ft (1.8 m) intervals, so that the floatline is close to the bottom and the net forms a limp bag between each tie. They are left in the water for 3-4 days, and are used to catch flounders and monkfish.

Individual sink/anchor gillnets are about 295 ft. (90 m) long. They are usually fished as a series of 5 - 15 nets attached end-to-end. A vast majority of “strings” consist of 10 gillnets. Gillnets typically have three components: the leadline, webbing, and floatline. In New England, leadlines are approximately 66 lbs/net

(30 kg/net). Webs are monofilament, with the mesh size depending on the species of interest. 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. For Northeast groundfish, gillnets are tended daily to semiweekly (NEFSC 2002c).

6.3.5.3 Fish Traps and Pots

Fish traps, pots, and lobster pots are similar. A non-lobster trap could be a trap that is configured with small mesh or small entrances that effectively exclude lobsters, or a floating trap that is fished off the bottom. If a fish pot or trap is configured in such a way that it is not capable of catching lobster, then NMFS would not consider it to be a lobster trap, and the vessel would not be subject to the lobster trap gear specifications. NMFS has determined that the floating Norwegian fish pots are not lobster traps.

The Norwegian-design pots are collapsible two-chamber rectangular pots made of netting, with a single bridle with anchor along the short end of the pot, allowing it to float and to turn with the current, adapted from Furevik et al. (2008). They have one entrance at the opposite end as the bridle, and are made of 50 mm black poly mesh for the trap body and 50 mm white poly for the entrances (into the pot and between chambers). Three frames per pot are constructed of 2 cm diam. PVC electrical conduit, with 13 cm radius corners, glued with cement. The frame sizes are approx. 1.5 m x 1 m (4.79 ft x 3.28 ft), hung 0.7 m (2.3 ft) apart forming two chambers with a widemouth entrance in between. The bridles are anchored with >5 kg links of chain. The PVC pipes are then perforated and 11 deep-water gillnet floats are added along the upper frame to achieve proper orientation. During a tank study (Furevik et al. 2008), the top of the Norwegian pot was measured to be 3 m off bottom; the bottom of the pot was 1.5 m off-bottom.

6.3.5.4 Hook and Line Gear

6.3.5.4.1 Hand Lines/Rod and Reel

Fishermen use hand lines as well as rods and reels in the Northeast Region to catch a variety of demersal species. Handlines are the simplest form of hook and line fishing. It may be fished using a rod and reel or simply “by hand.” The gear consists of a line, sinker (weight), gangion, and at least one hook. The line is typically stored on a small spool and rack and varies in length. The sinkers vary from stones to cast lead. The hooks can vary from single to multiple arrangements in “umbrella” rigs. Fishermen use an attraction device such as natural bait or an artificial lure with the hook. Handlines can be carried by currents until retrieved or fished in such a manner as to hit bottom and bounce (Stevenson, et al. 2004).

6.3.5.4.2 Mechanized Line Fishing

Mechanized line-hauling systems use electrical or hydraulic power to work the lines on the spools. They allow smaller fishing crews to work more lines. Fishermen mount the reels, also called “bandits,” on the vessel bulwarks with the mainline wound around a spool. They take the line from the spool over a block at the end of a flexible arm. Each line may have a number of branches and baited hooks.

Fishermen use jigging machines to jerk a line with several unbaited hooks up in the water to attract a fish. Fishermen generally use fish jigging machine lines in waters up to 1,970 ft. (600 m) deep. Hooks and sinkers can contact the bottom. Depending upon the way the gear is used, it may catch a variety of demersal species.

6.3.5.4.3 Bottom Long Lines

This gear consists of a long length of line to which gangions carrying baited hooks are attached. Longlining is undertaken for a wide range of bottom species. Bottom longlines typically have up to six individual longlines strung together for a total length of more than 1,476 ft. (450 m) and are deployed with 20 - 24 lbs (9 - 11 kg) anchors. The mainline is a parachute cord. Gangions are typically 16 in (40 cm) long and 3 - 6 in (1 - 1.8 m) apart and are made of shrimp twine. These bottom longlines are usually set for a few hours at a time (NEFSC 2002c).

All hooks must be 12/0, or larger, circle hooks. A circle hook is a hook with the point turned back towards the shank. The barbed end of the hook may be displaced (offset) relative to the parallel plane of the eyed-end or shank of the hook when laid on its side or may be in-line. Habitat impacts from bottom long lines are negligible.

6.3.5.5 Gear Interaction with Habitat

The Council has included habitat impacts assessments in its fishery management plans since the early 2000s. Amendment 13 (NEFMC 2003) included a comprehensive evaluation of gear effects on habitat. The amendment described the general effects of bottom trawls on benthic marine habitats. This analysis primarily used an advisory report prepared for the International Council for the Exploration of the Seas (ICES 2000). The report generally concluded that: (1) low-energy environments are more affected by bottom trawling; and (2) bottom trawling affects the potential for habitat recovery (i.e., after trawling ceases, benthic communities and habitats may not always return to their original pre- impacted state).

The Committee on Ecosystem Effects of Fishing for the National Research Council's Ocean Studies Board (NRC 2002) prepared an evaluation of the habitat effects of trawling and dredging that was also evaluated during Amendment 13. This report identified four general conclusions regarding the types of habitat modifications caused by bottom trawls:

- Trawling reduces habitat complexity;
- Repeated trawling results in discernible changes in benthic communities;
- Bottom trawling reduces the productivity of benthic habitats; and
- Fauna that live in low natural disturbance regimes are generally more vulnerable to fishing gear disturbance.

In 2002, NEFMC and MAMFC convened a regional workshop to evaluate the existing scientific research on the effects of fishing gear on benthic habitats; determine the degree of impact from various Northeast gear types; specify the type of evidence that is available to support the conclusions made about the degree of impact; rank the relative importance of gear impacts to various habitat types; and provide recommendations on measures to minimize those adverse impacts. The panel was provided with a summary of available research studies relating to the effects of bottom otter trawls, bottom gillnets, and bottom longlines. Relying on this information plus professional judgment, the panel identified the effects and the degree of impact of these gears on mud, sand, and gravel/rock habitats.

In general, the panel determined that impacts from trawling are greater in gravel/rock habitats with attached epifauna. The panel ranked impacts to biological structure higher than impacts to physical structure. Effects of trawls on major physical features in mud (deep water clay-bottom habitats) and gravel bottom were described as permanent. Impacts to biological and physical structure were given recovery times of months to years in mud and gravel. Impacts of trawling on physical structure in sand were estimated to be of shorter duration (days to months) given the exposure of most continental shelf sand habitats to strong bottom currents and/or frequent storms. Impacts of sink gillnets and bottom longlines on sand and gravel habitats were estimated to be less than bottom trawl impacts. The duration of impacts to physical structures from these gear types would be expected to last days to months on soft mud, but could be permanent on hard bottom clay structures along the continental slope. Impacts to mud would be caused by gillnet lead lines and anchors. Physical habitat impacts from sink gillnets and bottom longlines on sand would not be expected. The workshop report (NEFSC 2002c) noted that factors such as frequency of disturbance from fishing and from natural events are important when evaluating impacts.

The Council's Omnibus Essential Fish Habitat Amendment 2 (OHA2) evaluated existing habitat management areas and developed new habitat management areas. To assist with this effort, the Council developed an analytical approach to characterize and map habitats and to assess the extent to which different habitat types are vulnerable to different types of fishing activities. This body of work, termed the Swept Area Seabed Impact approach, includes a quantitative, spatially-referenced model that overlays fishing activities on habitat through time to estimate both potential and realized adverse effects to EFH. The approach is summarized in Volume 1 of the FEIS and detailed in Appendix D. Both documents are available at http://www.nefmc.org/library/omnibus-habitat-amendment-2. The SASI approach builds on previous fishing impacts assessments including the 2002 workshop, and reached similar conclusions, but made the assessment more explicitly spatial. This spatial approach facilitated the use of the assessment when developing management areas. In 2018-2019, the Council updated SASI with additional years of fishing effort data and sediment data, and some changes to the structure of the model. The updated analysis is referred to the Fishing Effects Model, or FE Model. A version of the FE Model was previously developed for the North Pacific region of the U.S. (Smeltz et al. 2019). The FE model includes many elements of SASI as well as elements from another model developed for the North Pacific region (Fujioka 2006). The FE Model report is available at https://www.nefmc.org/library/fishing-effects-model. The discussion below summarizes both the SASI and FE models.

The spatial domain of the models is U.S. waters from Cape Hatteras to the U.S.-Canada border. SASI included federal waters (3-200 miles) only, but FE includes state waters as well. Within this region, habitats were defined based on natural disturbance regime and dominant substrate, given previous assessments that natural disturbance may mask or interact with human-caused disturbance. Energy at the seabed was inferred from an oceanography model (flow) and a coastal relief model (depth) and was binned into two categories, either high or low energy. Substrate type is an important determinant of habitat because it influences the distribution of managed species, structure-forming epifauna, and prey species by providing spatially discrete resources such as media for burrowing organisms, attachment points for vertical epifauna, etc. The dominant substrate map used in SASI/FE was composed of thousands of visual and grab-sample observations, with grid size based on the spacing of the observations. The underlying spatial resolution of the substrate grid is much higher on Georges Bank and on the tops of banks and ledges in the Gulf of Maine than it is in deeper waters. Habitat definitions for both SASI and FE are based on five sediment grain sizes, mud, sand, pebble, cobble, and boulder. The FE model adds a steep and deep habitat category to account for areas of high relief where deep-sea coral ecosystems occur.

One of the outputs of the model is habitat vulnerability, which is related in part to the characteristics of the habitat itself, and part to the quality of the impact. Because of a general need for attachment sites, epifauna that provided a sheltering function for managed species tend to be more diverse and abundant in habitats containing larger grain sized substrates. Consistent with previous findings, the literature review completed to support the SASI and FE models found that structurally complex and/or long-lived epifaunal species are more susceptible to gear damage and slower to recover to impacts from mobile gears, including trawls and dredges. Recovery rates were assumed to be slower in low energy areas, such that overall vulnerability (susceptibility + recovery) of low energy areas is greater than high energy areas, other factors being equal. Of the mobile gears, hydraulic dredges were estimated to have the greatest per unit area impact, with lower and similar per unit area impacts associated with bottom otter trawls and scallop dredges. Although the literature on fixed gear impacts is relatively sparse, it was estimated that mobile gears have a greater per-unit area swept impact than fixed gears. Again, this was consistent with previous findings. Combining the SASI/FE vulnerability assessment and spatial model, gravel habitats on Georges Bank and in the Gulf of Maine were identified as vulnerability hotspots for all gear types, with moderate vulnerability in deeper, low energy habitats in the Gulf of Maine and along the continental margin, and lower vulnerability in sand habitats on Georges Bank, in Southern New England, and in the Mid-Atlantic Bight. Steep and deep habitats are also more vulnerable to impact.

The FE model in particular emphasizes the realized impacts of fishing by modeling how the magnitude of fishing in different locations across the model domain influences patterns of habitat disturbance. Habitat impacts are expressed as percent disturbance in 5 km by 5 km grid cells. The model is run continuously over time, with monthly changes in fishing effort by gear type. As time progresses and habitats begin to recover from previous impacts, new fishing impacts can continue to affect the condition of the seabed. Thus, the percent disturbance at a given time and location represents a combination of current and prior habitat impacts.

6.4 PROTECTED SPECIES

6.4.1 Species Present in the Area

Numerous protected species inhabit the environment within the Northeast multispecies FMP management unit (Table 6) and have the potential to be affected by the proposed action (i.e., there have been observed/documented interactions in the fishery or with gear type(s) similar to those used in the fishery (bottom trawl or gillnet gear)). These species are under NMFS jurisdiction and are afforded protection under the Endangered Species Act (ESA) of 1973 and/or the Marine Mammal Protection Act (MMPA) of 1972.

Table 6 - Species protected under the ESA and/or MMPA that may occur in the affected environment of the Northeast multispecies fishery. Marine mammal species (cetaceans and pinnipeds) italicized and in bold are considered MMPA strategic stocks.[1]

Species	Status[2]	Potentially affected by this action?
Cetaceans		
North Atlantic right whale (Eubalaena glacialis)	***Endangered***	***Yes***
Humpback whale, West Indies DPS (*Megaptera novaeangliae*)[3]	Protected (MMPA)	Yes
Fin whale (Balaenoptera physalus)	***Endangered***	***Yes***
Sei whale (Balaenoptera borealis)	***Endangered***	***Yes***
Blue whale (Balaenoptera musculus)	***Endangered***	***No***
Sperm whale (Physeter microcephalus)	***Endangered***	***No***
Minke whale (*Balaenoptera acutorostrata*)	Protected (MMPA)	Yes
Pilot whale (Globicephala spp.)[3]	Protected (MMPA)	Yes
Risso's dolphin (*Grampus griseus*)	Protected (MMPA)	Yes
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected (MMPA)	Yes
Short Beaked Common dolphin (*Delphinus delphis*)	Protected (MMPA)	Yes
Spotted dolphin (*Stenella frontalis*)	Protected (MMPA)	No
Bottlenose dolphin (Tursiops truncatus)[4]	***Protected (MMPA)***	***Yes***
Harbor porpoise (*Phocoena phocoena*)	Protected (MMPA)	Yes
Sea Turtles		
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Yes
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Yes
Green sea turtle, North Atlantic DPS (*Chelonia mydas*)	Threatened	Yes

Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Ocean DPS	Threatened	Yes
Hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	No
Fish		
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered	No
Atlantic salmon (*Salmo salar*)	Endangered	Yes
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS,	Endangered	Yes
Carolina DPS & South Atlantic DPS		
Cusk (*Brosme brosme)*	Candidate	Yes
Pinnipeds		
Harbor seal (*Phoca vitulina*)	Protected (MMPA)	Yes
Gray seal (*Halichoerus grypus*)	Protected (MMPA)	Yes
Harp seal (*Phoca groenlandicus*)	Protected (MMPA)	Yes
Hooded seal (*Cystophora cristata*)	Protected (MMPA)	Yes
Critical Habitat		
North Atlantic Right Whale	ESA (Protected)	No
Northwest Atlantic DPS of Loggerhead Sea Turtle	ESA (Protected)	No

Notes:
[1] A strategic stock is defined under the MMPA as a marine mammal stock for which: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; and/or (3) is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA (Section 3, 1972).

[2] The status of the species is defined by whether the species is listed under the ESA as endangered (species are at risk of extinction) or threatened (species at risk of endangerment), or protected under the MMPA. Note, marine mammals listed under the ESA are also protected under the MMPA. Candidate species are those species in which ESA listing may be warranted.

[3] There are two species of pilot whales: short finned (*G. melas melas*) and long finned (*G. macrorhynchus*). Due to the difficulties in identifying the species at sea, they are often just referred to as *Globicephala spp*.

[4] This includes the following Stocks of Bottlenose Dolphins: Western North Atlantic Offshore, Northern Migratory Coastal (strategic stock), and Southern Migratory Coastal (strategic stock).

Cusk are NMFS "candidate species" under the ESA. Candidate species are those petitioned species for which NMFS has determined that listing may be warranted under the ESA and those species for which NMFS has initiated an ESA status review through an announcement in the Federal Register. If a species is proposed for listing the conference provisions under Section 7 of the ESA apply (see 50 CFR 402.10); however, candidate species receive no substantive or procedural protection under the ESA. Thus, this species will not be discussed further in this action; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed action. Additional information on cusk is at: https://www.fisheries.noaa.gov/endangered-species-conservation/candidate-species-under-endangered-species-act.

6.4.2 Species and Critical Habitat Not Likely Affected by the Proposed Action

Based on available information, it has been determined that this action is not likely to affect multiple ESA listed and/or marine mammal protected species or any designated critical habitat (Table 6). This determination has been made because either the occurrence of the species is not known to overlap with the area primarily affected by the action and/or there have never been documented interactions between the species and the primary gear type (i.e., gillnet and bottom trawl) used to prosecute the multispecies fishery (see https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; NMFS NEFSC FSB 2019; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). In the case of critical habitat, this determination has been made, because the action will not affect the essential physical and biological features of North Atlantic right whale or loggerhead (NWA DPS) critical habitat and therefore, will not result in the destruction or adverse modification of any species critical habitat (NMFS 2014a).

6.4.3 Species Potentially Affected by the Proposed Action

Table 6 has a list of protected species of sea turtle, marine mammal, and fish species present in the affected environment of the multispecies fishery, and that may also be affected by the operation of this fishery; that is, have the potential to become entangled or bycaught in the fishing gear used to prosecute the fishery. To aid in the identification of MMPA protected species potentially affected by the action, the MMPA List of Fisheries and marine mammal stock assessment reports for the Atlantic Region were referenced (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region ; https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries). To help identify ESA listed species potentially affected by the action, the 2013 Biological Opinion issued by NMFS on the operation of seven commercial fisheries, including the multispecies) FMP, and its impact on ESA listed species was referenced (NMFS 2013). The 2013 Opinion, which considered the best available information on ESA listed species and observed or documented ESA listed species interactions with gear types used to prosecute the 7 FMPs (e.g., gillnet, bottom trawl, and pot/trap), concluded that the seven fisheries may adversely affect, but was not likely to jeopardize the continued existence of any ESA listed species. The Opinion included an incidental take statement (ITS) authorizing the take of specific numbers of ESA listed species of sea turtles, Atlantic salmon, and Atlantic sturgeon.[5] Reasonable and prudent measures and terms and conditions were also issued with the ITS to minimize impacts of any incidental take.

[5] The 2013 Opinion did not authorize take of ESA listed species of whales because (1) an incidental take statement cannot be lawfully issued under the ESA for a marine mammal unless incidental take authorization exists for that marine mammal under the MMPA (see 16 U.S.C. § 1536(b)(4)(C)), and (2) the incidental take of ESA- listed whales by the black seabass fishery has not been authorized under MMAP Section 101(a)(5). However, the 2013 BiOp assessed interaction risks to these species and concluded that 7 FMPs assessed, may affect but would not jeopardize the continued existence of any ESA listed species of whales (NMFS 2013).

Up until recently, the 2013 Opinion remained in effect; however, new information indicates that North Atlantic right whale abundance has been in decline since 2010 (Pace et al. 2017). This new information is different from that considered and analyzed in the 2013 Opinion and; therefore, may reveal effects from this fishery that were not previously considered. As a result, per an October 17, 2017, ESA 7(a)(2)/7(d) memorandum issued by NMFS, the 2013 Opinion, as well as several other fishery Opinions, has been reinitiated. However, the October 17, 2017, ESA 7(a)(2)/7(d) memo issued by NMFS, determined ".....For the consultations being reinitiated..…. Allowing these fisheries to continue during the reinitiation period will not increase the likelihood of interactions with these species above the amount that would otherwise occur if consultation had not been reinitiated, because allowing these fisheries to continue does not entail making any changes to any fishery during the reinitiation period that would cause an increase in interactions with whales, sea turtles, sturgeon, or Atlantic salmon. Because of this, the continuation of these fisheries during the reinitiation period would not be likely to jeopardize the continued existence of any whale, sea turtle, Atlantic salmon, or sturgeon species." Until replaced, the multispecies FMP is currently covered by the October 17, 2017, memo.

As the primary concern for both MMPA protected and ESA listed species is the potential for the fishery to interact (e.g., bycatch, entanglement) with these species it is necessary to consider (1) species occurrence in the affected environment of the fishery and how the fishery will overlap in time and space with this occurrence; and (2) data and observed records of protected species interaction with particular fishing gear types, to understand the potential risk of an interaction. Information on species occurrence in the affected environment of the multispecies fishery is below, information on protected species interactions with specific fishery gear is in Section 6.4.4**.**.

6.4.3.1 Sea Turtles

This section contains a brief summary of the occurrence and distribution of leatherback and hard-shelled sea turtles (i.e., green (North Atlantic DPS), loggerhead (Northwest Atlantic Ocean DPS), Kemp's ridley) in the affected environment of the Northeast multispecies fishery. Three of the four species are considered hard-shelled turtles (i.e., green, loggerhead, and Kemp's ridley). Additional background information on the range-wide status of the other four species, as well as a description and life history of the species, is in several published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995; Turtle Expert Working Group [TEWG] 1998, 2000, 2007, 2009; Conant *et al*. 2009; NMFS and USFWS 2013; NMFS
and USFWS 2015; Seminoff *et al*. 2015), and recovery plans for the loggerhead sea turtle (Northwest Atlantic DPS; NMFS and USFWS 2008), leatherback sea turtle (NMFS and USFWS 1992), Kemp's ridley sea turtle (NMFS *et al.* 2011), and green sea turtle (NMFS and USFWS 1991).

Hard-shelled sea turtles

In U.S. Northwest Atlantic waters, hard-shelled turtles commonly occur throughout the continental shelf from Florida to Cape Cod, Massachusetts, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Mitchell *et al.* 2003; Braun-McNeill *et al.* 2008; TEWG 2009). While hard-shelled turtles are most common south of Cape Cod, MA, they are known to occur in the Gulf of Maine. Loggerheads, the most common hard-shelled sea turtle in the Greater Atlantic Region, feed as far north as southern Canada. Loggerheads have been observed in waters with surface temperatures of 7 °C to 30 °C, but water temperatures ≥11 °C are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). Sea turtle presence in U.S. Atlantic waters is also influenced by water depth. While hard-shelled turtles occur in waters from the beach to beyond the continental shelf, they are most commonly found in neritic waters of the inner continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2002; Morreale and

Standora 2005; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009; Hawkes *et al.* 2011; Griffin *et al.* 2013).

Hard-shelled sea turtles occur year-round in waters off Cape Hatteras, North Carolina and south. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the southeast United States and also move up the Atlantic Coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2002; Morreale and Standora 2005; Griffin *et al.* 2013), occurring in Virginia foraging areas as early as late April and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by September, but some remain in Mid-Atlantic and Northeast areas until late fall. By December, sea turtles have migrated south to waters offshore of NC, particularly south of Cape Hatteras, and further south (Shoop and Kenney 1992; Epperly *et al.* 1995b; Hawkes *et al.* 2011; Griffin *et al.* 2013).

Leatherback sea turtles

Leatherbacks, a pelagic species, are known to use coastal waters of the U.S. continental shelf and to have a greater tolerance for colder water than hard-shelled sea turtles (James *et al.* 2005; Eckert *et al.* 2006; Murphy *et al.* 2006; NMFS and USFWS 2013b; Dodge *et al.* 2014). Leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (NMFS and USFWS 1992; James *et al.* 2005; James *et al*. 2006; Dodge *et al.* 2014). They are found in more northern waters (i.e., Gulf of Maine) later in the year (i.e., similar time frame as hard-shelled sea turtles), with most leaving the Northwest Atlantic shelves by mid-November (James *et al.* 2005; James *et al*. 2006; Dodge *et al.* 2014). Leatherback sea turtles also engage in routine migrations between northern temperate and tropical waters (NMFS and USFWS 1992; James *et al*. 2005; James *et al*. 2006; Dodge *et al*. 2014).

6.4.3.2 Marine Mammals

6.4.3.2.1 Large Whales

North Atlantic right, humpback, fin, sei, and minke whales are found throughout the waters of the Northwest Atlantic Ocean. In general, these species follow an annual pattern of migration between low latitude (south of 35ºN) wintering/calving grounds and high latitude spring/summer foraging grounds (primarily north of 41ºN; Hayes *et al.* 2019; NMFS 1991, 2005, 2010, 2011, 2012). This, however, is a simplification of whale movements, particularly as it relates to winter movements. It remains unknown if all individuals of a population migrate to low latitudes in the winter, although, increasing evidence suggests that for some species (e.g., right and humpback whales), some portion of the population remains in higher latitudes throughout the winter (Hayes *et al.* 2019; Khan *et al*. 2009, 2010, 2011, 2012; Brown *et al*. 2002; NOAA 2008; Cole *et al*. 2013; Clapham *et al*. 1993; Swingle *et al*. 1993; Vu *et al*. 2012).Although further research is needed to provide a clearer understanding of large whale movements and distribution in the winter, the distribution and movements of large whales to foraging grounds in the spring/summer is well understood. Movements of whales into higher latitudes coincide with peak productivity in these waters. As a result, the distribution of large whales in higher latitudes is strongly governed by prey availability and distribution, with large numbers of whales coinciding with dense patches of preferred forage (Mayo and Marx 1990; Kenney *et al*. 1986, 1995; Baumgartner *et al*. 2003; Baumgartner and Mate 2003; Payne *et al*.1986, 1990; Brown *et al.* 2002; Kenney and Hartley 2001; Schilling *et al.* 1992). For additional information on the biology, status, and range wide distribution of each whale species refer to: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.

To further assist in understanding how the multispecies fishery may overlaps in time and space with the occurrence of large whales, a general overview on species occurrence and distribution in the area of operation for the multispecies fishery is in Table 7.

Table 7 - Large whale occurrence, distribution, and habitat use in the affected environment of the multispecies fishery (SNE=Southern New England; GOM=Gulf of Maine; GB=Georges Bank).

Species	Occurrence/Distribution/Habitat Use in the Affected Environment
North Atlantic Right Whale	• Occur and are distributed throughout all continental shelf waters along the U.S. eastern seaboard throughout the year. Although whales can be found consistently in particular locations throughout their range, there is a high interannual variability in right whale use of some habitats. • Starting in 2010, acoustic and visual surveys indicate an apparent shift in habitat use patterns (e.g., shift from previously prevalent northern grounds (greater GOM) to spending more time in the Mid-Atlantic regions (waters off south of Martha's Vineyard and Nantucket Islands, New Jersey, and Virginia); increased use of Cape Cod Bay and decreased use of Great South Channel). • New England waters = **Foraging Grounds.** Seasonally important aggregating/foraging grounds include, but not limited to: › Massachusetts and Cape Cod Bays; › Great South Channel; › Jordan Basins; and, › Georges Basin (along the northeastern edge of GB). • Mid-Atlantic waters: Migratory corridor to/from northern (high latitude) foraging and southern calving grounds. • Passive acoustic and telemetry data shows excursions into deeper water off the continental shelf (e.g., shelf edge along southern Georges Bank and Mid-Atlantic) • Location of much of the population unknown in winter; however, increasing evidence of wintering areas (~November – January) in: › Cape Cod Bay; › Jeffreys and Cashes Ledges; › Jordan Basin; and › Massachusetts Bay (e.g., Stellwagen Bank).
Humpback Whale	• Distributed throughout all continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB throughout the year. • New England waters (GOM and GB regions) = **Foraging Grounds** (~March-November). • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern (West Indies) calving grounds.

Species	Occurrence/Distribution/Habitat Use in the Affected Environment
	• Increasing visual and acoustic evidence of whales remaining in mid- and high-latitudes throughout the winter. (e.g., *Mid-Atlantic*: waters near Chesapeake and Delaware Bays, peak presence about January through March; *Massachusetts Bay*: peak presence about March-May and September-December).
Fin	• Distributed throughout all continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB throughout the year. • Mid-Atlantic waters: › Migratory pathway to/from northern (high latitude) foraging and southern (low latitude) calving grounds; and › Possible offshore calving area (October-January). • New England (GOM and GB)/SNE waters = **Foraging Grounds** (greatest densities March-August; lower densities September-November). Important foraging grounds include: › Massachusetts Bay (esp. Stellwagen Bank); › Great South Channel; › Waters off Cape Cod (~40-50 meter contour); › GOM; › Perimeter (primarily eastern) of GB; and › Mid-shelf area off the east end of Long Island. • Evidence of wintering areas in mid-shelf areas east of New Jersey (NJ), Stellwagen Bank; and eastern perimeter of GB.
Sei	• Uncommon in shallow, inshore waters of the Mid-Atlantic (SNE included), GB, and GOM; however, occasional incursions during peak prey availability and abundance. • Primarily found in deep waters along the shelf edge, shelf break, and ocean basins between banks. • Spring through summer, found in greatest densities in offshore waters of the GOM and GB; sightings concentrated along the northern, eastern (into Northeast Channel) and southwestern (in the area of Hydrographer Canyon) edge of GB.
Minke	• Widely distributed within the U.S. EEZ. • Spring to Fall: widespread (acoustic) occurrence on the continental shelf; however, most abundant in New England waters during this period of time. • September to April: high (acoustic) occurrence in deep-ocean waters.

Species	Occurrence/Distribution/Habitat Use in the Affected Environment
***Sources*:** Baumgartner et al. 2007; Baumgartner *et al*. 2011; Baumgartner and Mate 2005; Bort et al. 2015; Brown *et al*. 2002; CETAP 1982; Clapham *et al*. 1993; Cole *et al*. 2013; Davis et al. 2017; Good 2008; Hain *et al.* 1992; Hamilton and Mayo 1990; Hayes et al. 2017, 2018, 2019; Kenney et al. 1986, 1995; Khan *et al*. 2009, 2010, 2011, 2012; Leiter et al. 2017; Mate et al. 1997; McLellan *et al*. 2004; NMFS 1991, 2005, 2010, 2011, 2012; 2015; NOAA 2008; Pace and Merrick 2008; Payne *et al*. 1984; Payne *et al*.1990; Pendleton et al. 2009; Record et al. 2019; Risch *et al*. 2013; Schevill *et al*. 1986; Swingle *et al*. 1993; Vu *et al*. 2012; Watkins and Schevill 1982; Winn *et al.* 1986; 50 CFR 224.105; 81 FR 4837 (January 27, 2016).	

6.4.3.2.2 Small Cetaceans

Atlantic white sided dolphins, short and long finned pilot whales, Risso's dolphins, short beaked common dolphins, harbor porpoise, and several stocks of bottlenose dolphins are found throughout the year in the Northwest Atlantic Ocean (Hayes *et al*. 2017; Hayes *et al.* 2018; Hayes *et al.* 2019). Within this range, however, there are seasonal shifts in species distribution and abundance. To further assist in understanding how fisheries may overlap in time and space with the occurrence of small cetaceans, a general overview of species occurrence and distribution in the area of operation for the multispecies fishery is in Table 8. For additional information on the biology, status, and range wide distribution of each species refer to: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region

Table 8 - Small cetacean occurrence in the area of operation of the multispecies fishery.

Species	Prevalence and Month of Occurrence
Atlantic White Sided Dolphin	• Distributed throughout the continental shelf waters (primarily to 100 m) of the Mid-Atlantic (north of 35ºN), SNE, GB, and GOM; however, most common in continental shelf waters from Hudson Canyon (~ 39ºN) to GB, and into the GOM. • **January-May**: low densities found from GB to Jeffreys Ledge. • **June-September**: Large densities found from GB, through the GOM. • **October-December**: intermediate densities found from southern GB to southern GOM. • South of GB (SNE and Mid-Atlantic), particularly around Hudson Canyon, low densities found year-round, • Virginia (VA) and North Carolina (NC) waters represent southern extent of species range during winter months.
Short Beaked Common Dolphin	• Regularly found throughout the continental shelf-edge-slope waters (primarily between the 100-2,000 m) of the Mid-Atlantic, SNE, and GB (esp. in Oceanographer, Hydrographer, Block, and Hudson Canyons). • Less common south of Cape Hatteras, NC, although schools have been reported as far south as the Georgia/South Carolina border.

Species	Prevalence and Month of Occurrence
	• **January-May**: occur from waters off Cape Hatteras, NC, to GB (35º to 42ºN). • **Mid-summer-autumn**: Occur in the GOM and on GB; *Peak abundance* found on GB in the autumn.
Risso's Dolphin	• **Spring through fall**: Distributed along the continental shelf edge from Cape Hatteras, NC, to GB. • **Winter**: distributed in the Mid-Atlantic Bight, extending into oceanic waters. • Rarely seen in the GOM; primarily a Mid-Atlantic continental shelf edge species (can be found year-round).
Harbor Porpoise	• Distributed throughout the continental shelf waters of the Mid-Atlantic, SNE, GB, and GOM. • **July-September**: Concentrated in the northern GOM (waters <150 meters); low numbers can be found on GB. • **October-December**: widely dispersed in waters from New Jersey (NJ) to Maine (ME); seen from the coastline to deep waters (>1,800 meters). • **January-March**: intermediate densities in waters off NJ to NC; low densities found in waters off New York (NY) to GOM. • **April-June**: widely dispersed from NJ to ME; seen from the coastline to deep waters (>1,800 meters).
Bottlenose Dolphin	**<u>Western North Atlantic Offshore Stock</u>** • Distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic from GB to Florida (FL). • Depths of occurrence: ≥40 meters **<u>Western North Atlantic Northern Migratory Coastal Stock</u>** • Most common in coastal waters <20 m deep. • Warm water months (e.g., July-August): distributed from the coastal waters from the shoreline to about the 20 m depth between the Assateague, VA, to Long Island, NY. • Late summer and fall, and during cold water months (e.g., January-March): stock occupies coastal waters from Cape Lookout, NC, to the NC/VA border. **<u>Western North Atlantic Southern Migratory Coastal Stock</u>** • Most common in coastal waters <20 m deep. • **October-December**: appears stock occupies waters of southern NC (south of Cape Lookout)

Species	Prevalence and Month of Occurrence
	• **January-March**: appears stock moves as far south as northern FL. • **April-June**: stock moves north to waters of NC. • **July-August**: stock is presumed to occupy coastal waters north of Cape Lookout, NC, to the eastern shore of VA (as far north as Assateague).
Pilot Whales: *Short- and Long-Finned*	**Short- Finned Pilot Whales** • Except for area of overlap (see below), primarily occur south of 40ºN (Mid-Atlantic and SNE waters); although low numbers have been found along the southern flank of GB, but no further than 41ºN. • May through December (about): distributed primarily near the continental shelf break of the Mid-Atlantic and SNE; individuals begin shifting to southern waters (i.e., 35ºN and south) beginning in the fall. **Long-Finned Pilot Whales** • Except for area of overlap (see below), primarily occur north of 42ºN. • Winter to early spring (November - April): primarily distributed along the continental shelf edge-slope of the Mid-Atlantic, SNE, and GB. • Late spring through fall (May - October): movements and distribution shift onto/within GB, the Great South Channel, and the GOM. **Area of Species Overlap:** between approximately 38ºN and 40ºN.
Notes: Information is representative of small cetacean occurrence in the Northwest Atlantic continental shelf waters out to 2,000 m depth ***Sources*:** Hayes *et al*. 2017; Hayes *et al.* 2018; Hayes *et al.* 2019; Payne and Heinemann 1993; Payne *et al.* 1984; Jefferson *et al*. 2009.	

6.4.3.2.3 Pinnipeds

Harbor, gray, harp, and hooded seals will occur in the affected environment of the multispecies fishery (Table 9). Specifically, pinnipeds are found in the nearshore, coastal waters of the Northwest Atlantic Ocean. They are primarily found throughout the year or seasonally from New Jersey to Maine; however, increasing evidence indicates that some species (e.g., harbor seals) may be extending their range seasonally into waters as far south as Cape Hatteras, North Carolina (35ºN) (Waring *et al*. 2007; Hayes *et al.* 2019). To help understand how the multispecies fishery may overlap in time and space with the occurrence of pinnipeds, a general overview of species occurrence and distribution in the area of operation of the multispecies fishery is provided in the following table (Table 9). Waring *et al*. (2007), and Hayes *et al.* (2019) have additional information on the biology, status, and range wide distribution of each species.

Table 9 - Pinniped occurrence in the area of operation of the multispecies fishery.

Species	Prevalence
Harbor Seal	• Primarily distributed in waters from New Jersey to Maine; however, increasing evidence indicates that their range is extending into waters as far south as Cape Hatteras, NC (35ºN). • **Year Round**: Waters of Maine • **September-May**: Waters from MA to NJ.
Gray Seal	• **Year Round**: Waters from Maine to just south of Cape Cod, MA. • **September-May**: Waters from southern MA to NJ. • Stranding records: Southern NJ to Cape Hatteras, NC
Harp Seal	• Winter-Spring (approx.. January-May): Waters from New Jersey to Maine.
Hooded Seal	• Winter-Spring (approx. January-May): Waters of New England.

***Sources*:** Waring *et al*. 2007 (for hooded seals); Hayes *et al.* 2019.

6.4.3.3 Atlantic Sturgeon

Table 6 lists the 5 DPSs of Atlantic sturgeon that occur in the affected environment of the multispecies fishery and that may be affected by the operation of this fishery. The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. All five DPSs of Atlantic sturgeon have the potential to be located anywhere in this marine range; in fact, results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast (ASSRT 2007; Dovel and Berggren 1983; Dadswell *et al*. 1984; Kynard *et al*. 2000; Stein *et al*. 2004a; Dadswell 2006; Laney *et al*. 2007; Dunton *et al*. 2010; Dunton *et al*. 2012; Dunton *et al*. 2015; Erickson *et al*. 2011; Wirgin *et al*. 2012; O'Leary *et al*. 2014; Waldman *et al.* 2013; Wirgin *et al*. 2015a,b; ASMFC 2017).

Based on fishery-independent and -dependent data, as well as data collected from tracking and tagging studies, in the marine environment, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Stein *et al*. 2004 a,b; Erickson *et al*. 2011; Dunton *et al.* 2010); however, Atlantic sturgeon are not restricted to these depths, as excursions into deeper continental shelf waters have been documented (Timoshkin 1968; Collins and Smith 1997; Stein *et al*. 2004a,b; Dunton *et al*. 2010; Erickson *et al*. 2011). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Erickson *et al.* 2011; Dunton *et al*. 2010; Wipplehauser 2012). For instance, tagging and tracking studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 m, during winter and spring, while in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson *et al.* 2011).

Within the marine range of Atlantic sturgeon, several marine aggregation areas have been identified adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina, Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries); depths in these areas are generally no greater than 25 meters (Bain *et al.* 2000; Savoy and Pacileo 2003; Stein *et al*. 2004a; Laney *et al*. 2007; Dunton *et al*. 2010; Erickson *et al*. 2011; Oliver *et al*. 2013; Waldman *et al.* 2013; O'Leary *et al*. 2014; Wipplehauser 2012; Wipplehauser and Squiers 2015). Although additional studies are still needed to clarify why these sites are chosen by Atlantic sturgeon, there is some indication that they may serve as thermal refuge, wintering sites, or marine foraging areas (Stein *et al*. 2004a; Dunton *et al*. 2010; Erickson *et al*. 2011).

6.4.3.4 Atlantic Salmon (Gulf of Maine DPS)

The wild populations of Atlantic salmon are listed as endangered under the ESA. Their freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, while the marine range of the GOM DPS extends from the GOM (primarily northern portion of the GOM), to the coast of Greenland (Fay *et al.* 2006; NMFS & USFWS 2005, 2016). In general, smolts, post- smolts, and adult Atlantic salmon may be present in the GOM and coastal waters of Maine in the spring (beginning in April), and adults may be present throughout the summer and fall months (Baum 1997; Fay *et al.* 2006; Hyvarinen *et al.* 2006; Lacroix & Knox 2005; Lacroix & McCurdy 1996; Lacroix *et al.* 2004; NMFS & USFWS 2005; Reddin 1985; Reddin & Friedland 1993; Reddin & Short 1991). For additional information on the on the biology, status, and range wide distribution of the GOM DPS of Atlantic salmon, refer to NMFS and USFWS (2005, 2016); and Fay et al. (2006). Thus, as the multispecies fishery operates throughout the year, and operates in the GOM, the fishery could overlap in time and space with Atlantic salmon migrating northeasterly between U.S. and Canadian waters.

6.4.4 Interactions Between Gear and Protected Species

Protected species are vulnerable to interactions with various types of fishing gear, with interaction risks associated with gear type, quantity, and soak or tow time. Available information on gear interactions with a given species (or species group) is in the sections below. These sections are not a comprehensive review of all fishing gear types known to interact with a given species; emphasis is only being placed on the primary gear types used to prosecute the multispecies fishery (i.e., sink gillnet and bottom trawl gear).

6.4.4.1 Marine Mammals

Depending on species, marine mammals have been observed seriously injured or killed in bottom trawl and/or sink gillnet gear. Pursuant to the MMPA, NMFS publishes a List of Fisheries (LOF) annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injuries and/or mortalities of marine mammals in each fishery (i.e., Category I=frequent; Category II=occasional; Category III=remote likelihood or no known interactions). In the Northwest Atlantic, the 2019 LOF (83 FR 5349 (May 16, 2019)) categorizes commercial gillnet fisheries (Northeast or Mid-Atlantic) as Category I fisheries and commercial bottom trawl fisheries (Northeast or Mid-Atlantic) as Category II fisheries.

6.4.4.1.1 Large Whales

Bottom Trawl Gear

With the exception of minke whales, there have been no observed interactions with large whales and bottom trawl gear (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; https://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries; https://www.nefsc.noaa.gov/publications/crd/). Since 2008, serious injury and mortality records for minke whales in U.S. waters have shown zero interactions with bottom trawl (northeast or Mid-Atlantic) gear (Henry et al. 2016; Henry et al. 2017; Hayes et al. 2019; Waring et al. 2015; 84 Federal Register 22051). Based on this information, large whale interactions with bottom trawl gear are expected to rare to nonexistent. For further information on bottom trawl interactions with minke whales, see Framework 58.

Fixed Fishing Gear (e.g., Sink Gillnet Gear)

The greatest entanglement risk to large whales is posed by fixed fishing gear (e.g., trap/pot gear, sink gillnet gear) with vertical or ground lines that rise into the water column (Kenney and Hartley 2001; Knowlton and Kraus 2001; Hartley *et al*. 2003; Johnson *et al*. 2005;Whittingham *et al*. 2005a,b; Cassoff et al. 2011; Knowlton et al. 2012; NMFS 2014; Henry et al. 2015; Henry et al. 2016; Henry et al. 2017; Henry et al. 2019; see Marine Mammal Stock Assessment Reports: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region). Any line can become entangled in the mouth (baleen), flippers, and/or tail of the whale when the animal is transiting or foraging through the water column (Johnson *et al*. 2005; NMFS 2014; Kenney and Hartley 2001; Hartley *et al*. 2003; Whittingham *et al*. 2005a, b; Henry et al. 2015; Henry et al. 2016; Henry et al. 2017; Henry et al. 2019). The effects of entanglement to large whales range from no injury to death. The risk of injury or death in the event of an entanglement may depend on such things as the characteristics of the whale involved (species, size, age, health, etc.), the nature of the gear (e.g., whether the gear incorporates weak links designed to help a whale free itself), human intervention (i.e., the feasibility or success of disentanglement efforts), or other variables (Angliss and Demaster 1998; Johnson *et al*. 2005; Cassoff et al. 2011; Moore and Van der Hoop 2012; NMFS 2014; van der Hoop et al. 2016; Pettis et al. 2017; van der Hoop et al. 2017). Although the interrelationships among these factors are not fully understood, and the data needed to provide a more complete characterization of risk are not available, to date, available data indicate that entanglement in fishing gear is a significant source of serious injury or mortality for Atlantic large whales (Cassoff et al. 2011; NMFS 2014; Henry et al. 2015; van der Hoop et al. 2016; Henry et al. 2016; Henry et al. 2017; Pettis et al. 2017; van der Hoop et al. 2017; Henry et al. 2019; Sharp et al. 2019; see Marine Mammal Stock Assessment Reports: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region). For further information on injury and mortality to large whales due to entanglement in fishing gear, see Framework 58.

In response to its obligations under the MMPA (section 118(f)(1)), in 1996, NMFS established the Atlantic Large Whale Take Reduction Team (ALWTRT) to develop a plan (Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan)) to reduce serious injury to, or mortality of large whales, specifically, humpback, fin, and North Atlantic right whales, due to incidental entanglement in U.S. commercial fishing gear.[6] In 1997, the ALWTRP was implemented; however, since 1997, the Plan has been modified;

[6] The measures identified in the ALWTRP are also beneficial to the survival of the minke whale, which are also known to be incidentally taken in commercial fishing gear.

recent adjustments include the Sinking Groundline Rule and Vertical Line Rules (72 FR 57104, October 5, 2007; 79 FR 36586, June 27, 2014; 79 FR 73848, December 12, 2014; 80 FR 14345, March 19, 2015; 80 FR 30367, May 28, 2015). The Plan consists of regulatory (e.g., universal gear requirements, modifications, and requirements; area- and season- specific gear modification requirements and restrictions; time/area closures) and non- regulatory measures (e.g., gear research and development, disentanglement, education and outreach) that, in combination, seek to assist in the recovery of North Atlantic right, humpback, and fin whales by addressing and mitigating the risk of entanglement in gear employed by commercial fisheries, specifically trap/pot and gillnet fisheries (http://www.greateratlantic.fisheries.noaa.gov/Protected/whaletrp/; 73 FR 51228; 79 FR 36586; 79 FR 73848; 80 FR 14345; 80 FR 30367). The Plan recognizes trap/pot and gillnet Management Areas in Northeast, Mid-Atlantic, and Southeast regions of the U.S, and identifies gear modification requirements and restrictions for Category I and II gillnet and trap/pot fisheries in these regions; these Category I and II fisheries must comply with all regulations of the Plan.[7] For further details on the ALWTRP, see: http://www.greateratlantic.fisheries.noaa.gov/Protected/whaletrp/.

6.4.4.1.2 Small Cetaceans and Pinnipeds

Sink Gillnet and Bottom Trawl Gear

Small cetaceans and pinnipeds are vulnerable to interactions with sink gillnet and bottom trawl gear (Read *et al*. 2006; Lyssikatos 2015; Chavez-Rosales et al. 2017; Hayes *et al*. 2017; Hayes et al. 2018; Hayes et al. 2019; 84 FR 22051 (May 16, 2019)). Based on the most recent Marine Mammal List of Fisheries (LOF) issued on May 16, 2019 (84 FR 22051), Table 10 provides a list of species that have been observed (incidentally) seriously injured and/or killed by MMPA LOF Category I (frequent interactions) gillnet and/or Category II (occasional interactions) bottom trawl fisheries that operate in the affected environment of the multispecies fishery. Of the species provided in Table 10, gray seals, followed by harbor seals, harbor porpoises, short beaked common dolphins, and harp seals are the most frequently bycaught small cetacean and pinnipeds in sink gillnet gear in the Greater Atlantic Region (GAR; Hatch and Orphanides 2014, 2015, 2016, 2019). In terms of bottom trawl gear, short-beaked common dolphins and Atlantic white-sided dolphins are the most frequently observed bycaught marine mammal species in the GAR, followed by gray seals, long-finned pilot whales, Risso's dolphins, bottlenose dolphin (offshore), harbor porpoise, harbor seals, and harp seals (Lyssikatos 2015; Chavez-Rosales et al. 2017).

Table 10 - Small cetacean and pinniped species observed seriously injured and/or killed by Category I and II sink gillnet or bottom trawl fisheries in the affected environment of the multispecies fisheries.

Fishery	Category	Species Observed or reported Injured/Killed
Northeast Sink Gillnet	I	Bottlenose dolphin (offshore)
		Harbor porpoise
		Atlantic white sided dolphin
		Short-beaked common dolphin
		Risso's dolphin
		Long-finned pilot whales
		Harbor seal
		Hooded seal
		Gray seal

[7] The fisheries currently regulated under the ALWTRP include: Northeast/Mid-Atlantic American lobster trap/pot; Atlantic blue crab trap/pot; Atlantic mixed species trap/pot; Northeast sink gillnet; Northeast anchored float gillnet; Northeast drift gillnet; Mid-Atlantic gillnet; Southeastern U.S. Atlantic shark gillnet; and Southeast Atlantic gillnet (NMFS 2014c).

		Harp seal
Mid-Atlantic Gillnet	I	Bottlenose dolphin (Northern Migratory coastal)
		Bottlenose dolphin (Southern Migratory coastal)
		Bottlenose dolphin (offshore)
		Harbor porpoise
		Short-beaked common dolphin
		Risso's dolphin
		Harbor seal
		Harp seal
		Gray seal
Northeast Bottom Trawl	II	Harp seal
		Harbor seal
		Gray seal
		Long-finned pilot whales
		Short-beaked common dolphin
		White-sided dolphin
		Harbor porpoise
		Bottlenose dolphin (offshore)
		Risso's dolphin
Mid-Atlantic Bottom Trawl	II	White-sided dolphin
		Short-beaked common dolphin
		Risso's dolphin
		Bottlenose dolphin (offshore)
		Gray seal
		Harbor seal
Source: MMPA LOF 84 FR 22051 (May 16, 2019).		

As noted above, numerous species of small cetaceans and pinnipeds interact with Category I and II fisheries in the GAR; however, several species (Table 10) have experienced such great losses to their populations due to interactions with Category I and/or II fisheries that they are now considered strategic stocks under the MMPA (Table 6). These include several stocks of bottlenose dolphins, pilot whales, and until recently, the harbor porpoise.[8] MMPA Section 118(f)(1) requires the preparation and implementation of a TRP for any strategic marine mammal stock that interacts with Category I or II fisheries. Thus, the Harbor Porpoise TRP (HPTRP) and the Bottlenose Dolphin TRP (BDTRP) were developed and implemented for these species.[9] Also, due to the incidental mortality and serious injury of small cetaceans, incidental to bottom and midwater trawl fisheries operating in both the Northeast and Mid- Atlantic regions, the Atlantic Trawl Gear Take Reduction Strategy (ATGTRS) was

[8] In a recent U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment (Hayes et al. 2018); harbor porpoise is no longer designated as a strategic stock.

[9] Although a recent U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment (Hayes et al. 2018) no longer designates harbor porpoise as a strategic stock, HPTRP regulations are still in place per the mandates provided in Section 118(f)(1).

implemented. Additional information on each TRP or Strategy is at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-take-reduction-plans-and-teams.

6.4.4.1.3 Sea Turtles

Bottom Trawl Gear

Although sea turtle interactions with trawl gear have been observed in the Gulf of Maine, Georges Bank, and the Mid-Atlantic, most observed interactions have occurred in the Mid-Atlantic (see Murray 2011; Warden 2011a, b; Murray 2015a, Murray 2015b). As few sea turtle interactions have been observed in the Gulf of Maine and Georges Bank, there is insufficient data available to conduct a robust model-based analysis on sea turtle interactions with trawl gear in these regions or produce a bycatch estimate for these regions. As a result, the bottom trawl bycatch estimates are based on interactions observed in the Mid-Atlantic.

Green, Kemp's ridley, leatherback, loggerhead, and unidentified sea turtles have been documented interacting with bottom trawl gear. However, estimates are available only for loggerhead sea turtles. Most recently, Murray (2015) estimated that from 2009-2013, the total average annual loggerhead interactions in bottom trawl gear in the Mid-Atlantic was 231 (CV=0.13, 95% CI=182-298); this equates to about 33 adult equivalents (Murray 2015). Bycatch estimates by Warden (2011a) and Murray (2015b) are a decrease from the average annual loggerhead bycatch in bottom otter trawls during 1996-2004, which Murray (2008) estimated at 616 sea turtles (CV=0.23, 95% CI over the nine-year period: 367-890). For more information on bottom trawl interactions with sea turtles, see Framework 58.

Sink Gillnet Gear

Murray (2018) conducted an assessment of loggerhead, Kemp's ridley, leatherback, and unidentified hard-shell sea turtle interactions in Mid-Atlantic and Georges Bank gillnet gear during 2012-2016. Based on Northeast Fisheries Observer Program, At-Sea Monitoring Program, and Vessel Trip Report data from 2012-2016, total estimated bycatch of sea turtles in commercial sink gillnet gear in the Mid-Atlantic and Georges Bank regions was 705 loggerheads (equivalent to 19 adults), 145 Kemp's ridleys, 27 leatherbacks, and 112 unidentified hard-shelled sea turtles (Murray 2018). Depending on species, sea turtles were observed captured in nets with mesh sizes ranging from 3.25 inches to 12 inches.

6.4.4.1.4 Atlantic Sturgeon

Sink Gillnet and Bottom Trawl Gear

Atlantic sturgeon interactions (i.e., bycatch) with sink gillnet and bottom trawl gear have been observed since 1989; these interactions have the potential to result in the injury or mortality of Atlantic sturgeon (NMFS NEFSC FSB 2019). Although Atlantic sturgeon were observed to interact with trawl and gillnet gear with various mesh sizes, Miller and Shepard (2011) concluded that, based on NEFOP observed sturgeon mortalities, gillnet gear, in general, posed a greater risk of mortality to Atlantic sturgeon than did trawl gear. Estimated mortality rates in gillnet gear were 20.0%, while those in otter trawl gear were 5.0% (Miller and Shepard 2011; NMFS 2013). Similar conclusions were reached in Stein et al. (2004b) and ASMFC (2007) reports; after review of observer data from 1989-2000 and 2001-2006, both studies concluded that observed mortality is much higher in gillnet gear than in trawl gear. However, an important consideration to these findings is that observed mortality is considered a minimum of what occurs and therefore, the conclusions reached by Stein et al. (2004b), ASMFC (2007), and Miller and Shepard (2011) are not reflective of the total mortality associated with either gear type. To date, total Atlantic sturgeon mortality associated with gillnet or trawl gear remains uncertain. For further information on sink gillnet and bottom trawl gear interactions with Atlantic sturgeon, see Framework 58.

6.4.4.1.5 Atlantic Salmon

Sink Gillnet and Bottom Trawl Gear

Atlantic salmon interactions (i.e., bycatch) with gillnet and bottom trawl have been observed since 1989; in many instances, these interactions have resulted in the injury and mortality of Atlantic salmon (NMFS NEFSC FSB 2019). According to the Biological Opinion issued by NMFS Greater Atlantic Regional Fisheries Office (GARFO) on December 16, 2013 and Northeast Fisheries Science Center's (NEFSC) Northeast Fisheries Observer and At-Sea Monitoring Programs documented a total of 15 individual salmon incidentally caught on more than 60,000 observed commercial fishing trips from 1989 through August 2013 (NMFS 2013; Kocik *et al*. 2014). Since 2013, no additional Atlantic salmon have been observed in gillnet or bottom trawl gear (NMFS NEFSC FSB 2019). Based on the above information, specifically the very low number of observed Atlantic salmon interactions in gillnet and trawl gear reported in the Northeast Fisheries Observer Program's database (which includes At-Sea Monitoring data), interactions with Atlantic salmon are likely rare events (Kocik *et al*. 2014; NMFS NEFSC FSB 2019). For further information on sink gillnet and bottom trawl gear interactions with Atlantic salmon, see Framework 58.

6.5 HUMAN COMMUNITIES

This EA considers and evaluates the effect management alternatives may have on people's way of life, traditions, and community. These economic and social impacts may be driven by changes in fishery flexibility, opportunity, stability, certainty, safety, and/or other factors. While it is possible that these impacts could be solely experienced by individual fishermen, it is more likely that impacts would be experienced across communities, gear types, and/or vessel size classes.

This section reviews the Northeast multispecies fishery and describes the human communities potentially impacted by the Proposed Action. This includes a description of the sector, common pool, and recreational participants' groundfish fishing and the important port communities in the fishery. Table 11 contains a summary of major trends in the groundfish fishery, reproduced in figures as well (Figure 4 - Figure 8). Additional information may be found in the FY2010, FY2011, FY2012, FY2013, and FY2015 performance reports for this fishery by the NEFSC (Kitts et al. 2011; Murphy et al. 2012; Murphy et al. 2014; Murphy et al. 2015; Murphy et al. 2018).

Table 11 - Summary of major trends in the Northeast multispecies fishery.

		Groundfish Pounds landed	Non-groundfish pounds landed	Groundfish gross revenue ($)	Non-groundfish gross revenue ($)	Total gross revenue ($)	Groundfish average price	Non-groundfish average	Number of active vessels*	Number of groundfish trips	Number of days absent on
2010	Common Pool	1,229,389	3,878,253	2,231,897	4,801,899	7,033,796	1.82	1.24	129	2,081	1,488
	Sector Vessels	56,186,534	17,804,994	91,647,335	21,070,317	112,717,652	1.63	1.18	299	10,779	16,455
	Total	**57,415,923**	**21,683,247**	**93,879,232**	**25,872,216**	**119,751,449**	**1.64**	**1.19**	**428**	**12,860**	**17,943**
2011	Common Pool	444,881	4,691,894	814,888	6,241,572	7,056,460	1.83	1.33	117	2,191	1,432
	Sector Vessels	60,928,002	23,013,923	99,552,448	29,555,458	129,107,906	1.63	1.28	299	13,504	19,801
	Total	**61,372,883**	**27,705,817**	**100,367,336**	**35,797,030**	**136,164,365**	**1.64**	**1.29**	**414**	**15,695**	**21,233**
2012	Common Pool	233,598	3,714,441	503,035	4,475,987	4,979,022	2.15	1.21	97	1,582	982
	Sector Vessels	46,860,313	23,744,265	76,500,828	24,809,352	101,310,180	1.63	1.04	302	12,884	18,898
	Total	**47,093,911**	**27,458,707**	**77,003,863**	**29,285,339**	**106,289,203**	**1.64**	**1.07**	**398**	**14,466**	**19,881**
2013	Common Pool	594,735	2,944,385	1,075,712	3,471,186	4,546,898	1.81	1.18	97	1,472	1,016
	Sector Vessels	41,477,942	17,042,770	61,829,659	21,605,909	83,435,568	1.49	1.27	245	9,110	16,348
	Total	**42,072,677**	**19,987,155**	**62,905,370**	**25,077,095**	**87,982,465**	**1.5**	**1.25**	**342**	**10,582**	**17,364**
2014	Common Pool	489,851	2,487,653	923,100	2,659,978	3,583,079	1.88	1.07	76	1,094	806
	Sector Vessels	42,508,531	22,429,142	62,061,088	26,451,472	88,512,561	1.46	1.18	228	8,672	15,902
	Total	**42,998,382**	**24,916,795**	**62,984,189**	**29,111,451**	**92,095,639**	**1.46**	**1.17**	**304**	**9,766**	**16,709**
2015	Comon Pool	669,002	3,565,794	1,337,144	1,294,451	2,631,595	2	0.36	64	934	657
	Sector Vessels	40,771,574	19,309,159	57,335,587	22,212,568	79,548,156	1.41	1.15	213	7,392	14,381
	Total	**41,440,576**	**22,874,953**	**58,672,731**	**23,507,020**	**82,179,751**	**1.42**	**1.03**	**277**	**8,326**	**15,038**
2016	Common Pool	327,598	2,552,724	842,692	1,051,616	1,894,309	2.57	0.41	59	816	536
	Sector Vessels	33,499,549	21,126,203	50,923,669	24,131,178	75,054,847	1.52	1.14	209	6,507	12,083
	Total	**33,827,147**	**23,678,927**	**51,766,362**	**25,182,794**	**76,949,156**	**1.53**	**1.06**	**268**	**7,323**	**12,620**
2017	Common Pool	185,881	1,962,866	447,448	764,856	1,212,304	2.41	0.39	54	594	377
	Sector Vessels	37,051,935	22,102,456	46,559,703	21,930,341	68,490,044	1.26	0.99	198	6,757	11,269
	Total	**37,237,816**	**24,065,322**	**47,007,151**	**22,695,197**	**69,702,348**	**1.26**	**0.94**	**252**	**7,351**	**11,646**
2018	Common Pool	149,761	1,914,364	293,839	824,340	1,118,179	1.96	0.43	54	558	361
	Sector Vessels	44,121,586	20,601,070	49,205,249	21,227,857	70,433,106	1.12	1.03	179	7,135	10,542
	Total	**44,271,347**	**22,515,434**	**49,499,088**	**22,052,197**	**71,551,286**	**1.12**	**0.98**	**233**	**7,693**	**10,904**

Notes: Data includes all vessels with a valid limited access multispecies permit that made at least one groundfish trip (declared into the fishery and landed >1 pound of any stock). Revenue and price reported in real 2018 dollars. “Trips" refer to commercial trips in the northeast Exclusive Economic Zone (EEZ).
*Sector plus common pool vessel counts may exceed total vessel count because vessels may switch between sector and common pool eligibilities during the FY.
From: GARFO DMIS Database. Accessed August 13, 2019.

Figure 4 - Trends in groundfish pounds landed (2010-2018).

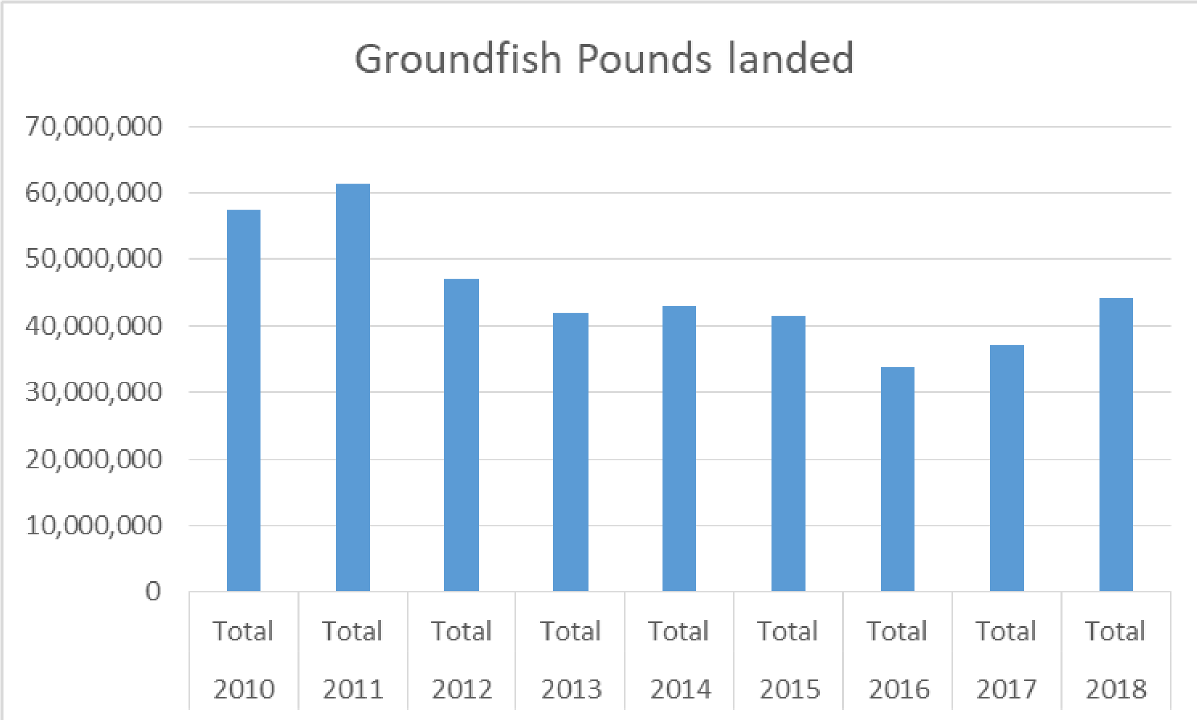


Figure 5 - Trends in groundfish gross revenues (2010-2018).

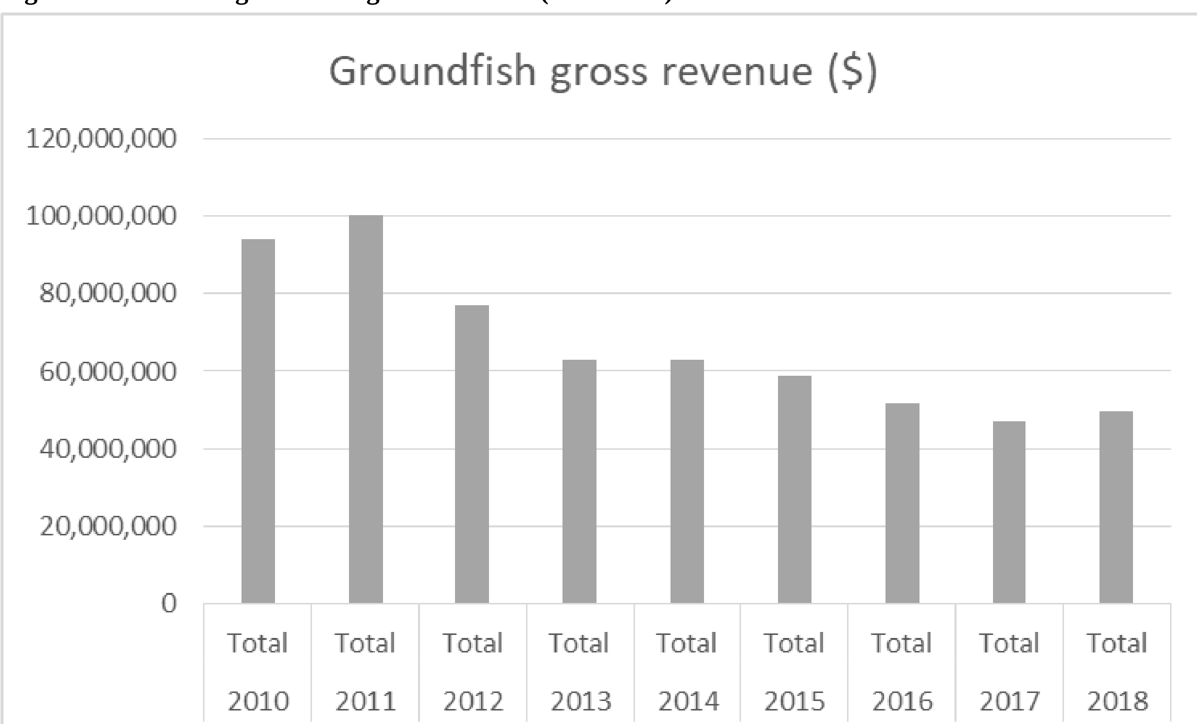
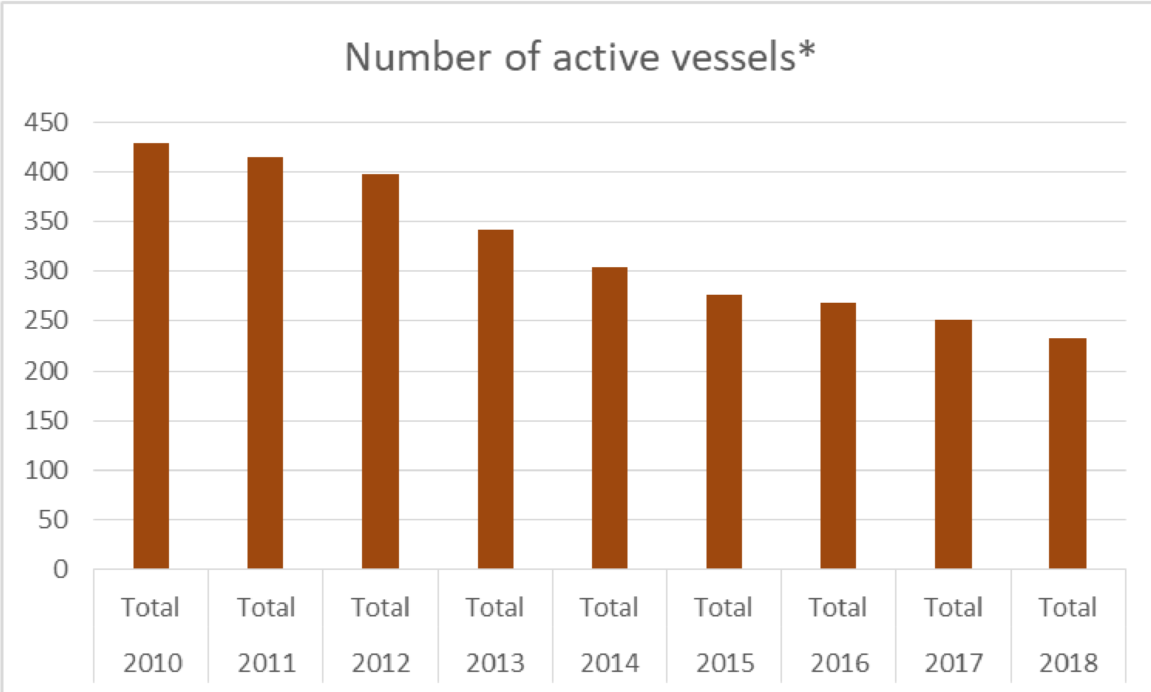


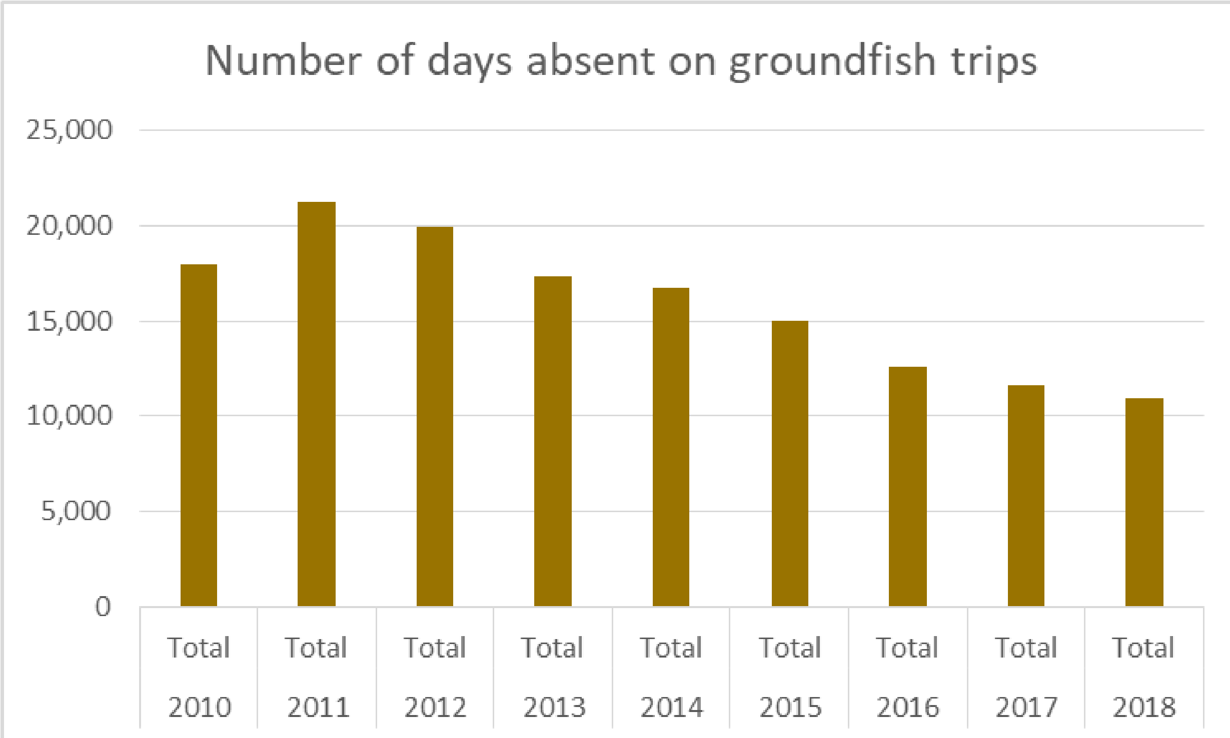
Figure 6- Trends in number of active groundfish vessels (2010-2018).



* Vessels with a valid limited access multispecies permit that made at least one groundfish trip (declared into the fishery and landed >1 pound of any stock).

Figure 7 - Trends in groundfish trips (2010-2018).

Figure 8 - Trends in days absent on groundfish trips (2010-2018).



6.5.1 Groundfish Fishery Overview

Amendment 16 to the Northeast Multispecies FMP was implemented for the New England groundfish fishery starting on May 1, 2010, the start of the 2010 fishing year. There were two substantial changes meant to adhere to the catch limit requirements and stock rebuilding deadlines of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSA). The first change developed "hard quota" annual catch limits (ACLs) for all 20 stocks in the groundfish complex. The second change expanded the use of Sectors, which are allocated subdivisions of ACLs called Annual Catch Entitlements (ACE) based on each sector's collective catch history.[10] Sectors received ACE for nine of 13 groundfish species (14 stocks + quotas for Eastern US/Canada cod and haddock; 16 ACEs) in the FMP and became exempt from many of the effort controls previously used to manage the fishery.

During the first year of sector management, 17 sectors operated, each establishing its own rules for using its allocations. Vessels with limited access permits that joined sectors were allocated 98% of the total commercial groundfish sub-ACL, based on their collective level of historical activity in the groundfish fishery. Approximately half (45%) of the limited access groundfish permits opted to remain in the common pool (Table 12). Common pool vessels act independently of one another, with each vessel constrained by the number of DAS it can fish, by trip limits, and by all of the time and area closures. These restrictions help ensure that the groundfish catch of common pool vessels does not exceed the common pool's portion of the commercial groundfish sub- ACL for all stocks (about 2% for 2010) before the end of the fishing year.

In the second year of sector management, 58% of limited access permits enrolled in one of 16 sectors or one of two lease-only sectors. This proportion of vessels has remained stable over time, with around 42% to 44% of permits enrolling in the common pool between 2011 and 2018 (Table 12).

In this section, "groundfish trips", unless otherwise stated, are defined as vessels with a limited access groundfish permit that landed at least 1 pound of any stock on a trip that declared into the groundfish fishery. Groundfish landings only refer to landing stocks that are allocated species in the Northeast Multispecies plan (cod, haddock, pollock, redfish, yellowtail flounder, witch flounder, American plaice, etc.), but may have been caught on either sector or common pool trips. Non-groundfish landings include all other species caught, including whiting, lobster, skates, dogfish, and any other federally reported catch.

6.5.2 Fleet Characteristics

The overall trend since the start of sector management has been a slow decline in the number of vessels with a limited access groundfish permit, from 1248 in 2010 and 882 in 2011with a low of 878 vessels in FY 2014 (Table 12). Of those vessels, those with revenue from at least one groundfish trip have also declined, to only 225 in FY 2018. The proportion of vessels affiliated with a sector increased each year since FY 2010 until FY 2013, but has remained relatively constant over the last four fishing years. A key aspect of Amendment 16 is the ability of a sector to jointly decide how its ACE will be harvested, through redistribution within a sector and/or transferring ACE between sectors. Because inactive sector vessels may benefit if they lease their allocation, changes in the number of inactive vessels may result from a transfer of allocation and not necessarily vessels exiting the fishery. Since FY 2010, 55-66% of sector

[10] To determine the ACE, the sum of all of the sector members' potential sector contributions (PSCs) (a percentage of the ACL) are multiplied by the ACL.

vessels were inactive (no landings), while 79-86% of vessels in the common pool were inactive in any given year.

Table 12 - Number of vessels by fishing year.

Year	Fleet	LA permitted Vessels*	Any landings	Landed groundfish	% No landings
2010	Common Pool	565	117	79	79%
	Sector	683	289	279	58%
	Total	**1248**	**406**	**358**	**67%**
2011	Common Pool	387	75	60	81%
	Sector	495	208	201	58%
	Total	**882**	**283**	**261**	**68%**
2012	Common Pool	375	73	60	81%
	Sector	507	226	217	55%
	Total	**882**	**299**	**277**	**66%**
2013	Common Pool	372	77	61	79%
	Sector	507	195	184	62%
	Total	**879**	**272**	**245**	**69%**
2014	Common Pool	379	64	48	83%
	Sector	499	184	175	63%
	Total	**878**	**248**	**223**	**72%**
2015	Common Pool	382	62	58	84%
	Sector	496	181	172	64%
	Total	**878**	**243**	**230**	**72%**
2016	Common Pool	377	59	58	84%
	Sector	501	183	174	63%
	Total	**878**	**242**	**232**	**72%**
2017	Common Pool	383	51	48	87%
	Sector	496	187	177	62%
	Total	**879**	**238**	**225**	**73%**
2018	Common Pool	382	55	54	86%
	Sector	497	170	161	66%
	Total	**879**	**225**	**215**	**74%**

*On May 1st of the fishing year the number of LA vessels will equal to the number of eligibilities not in Confirmation of Permit History (CPH. These numbers exclude groundfish limited access eligibilities held as CPH. Starting in 2010, Amendment 16 authorized CPH owners to join Sectors and to lease DAS. For purposes of comparison, CPH vessels are not included in the data for either Sector or Common Pool.

**Active vessels in this report received revenue from any species while fishing under a limited access groundfish permit, specifically on any trip where the vessel declared into the groundfish fishery.

Source: GARFO DMIS Database and MQRS data tables accessed 8/14/2019.

6.5.3 Effort

The groundfish fishery has traditionally been made up of a diverse fleet, comprised of a range of vessel sizes and gear types. The number of active vessels has generally declined across all years and size classes during the sector program (Table 13). From FY 2010 to 2018, the 30’ to < 50’ vessel size category, which has the largest number of active groundfish sector vessels, declined from 160 to 100 active vessels, with a low of 93 active vessels in 2015. 85 vessels in the same size class were active in the common pool in 2010 while only 33 were active in 2018. Only one sector vessel in the <30’ vessel size category has ever participated and only between 2011-2014, while common pool vessels declined from 16 to 9 vessels. Active vessels in the 50’ to <75’ vessel size category and 75’ and above vessel size category have also declined, from a maximum of 94 50’-75' vessels in 2012 to 51 in 2018. Between 2011 and 2016, only 15% fewer 75’ vessels were participating, but 13 fewer vessels participated in 2018 than in 2017.

Primary gear types in the groundfish fishery are trawls (primarily otter trawls) and gillnet, but several other gear types including handline, longline, and pot gear may be used on groundfish trips, even if not used primarily to target groundfish stocks (Table 14). Historically, effort has been mostly evenly distributed across trawl and gillnet gears, with approximately 4,000 total trips each in 2010, but while the number of sector trawl trips was around 3,800 in 2018, only 1,400 sector gillnet trips were made in the same year. The number of sector handline trips has increased in recent years, from 182 sector trips in 2010 to 226 in 2018. Common pool trips utilizing other gear types other than trawl, including extra-large mesh (ELM) gear, have decreased significantly while the number of trips utilizing trawl gear has remained relatively constant despite large reductions in the number of active vessels.

Table 13 - Vessel activity by size class: Number of Vessels fishing under a groundfish LA permit 2010-2018

Fishing Year	Fleet	<30 ft	30 to 50 ft	50 to 75 ft	>75 ft
2010	Common Pool	16	85	25	3
	Sector	0	160	89	50
2011	Common Pool	16	72	24	5
	Sector	1	156	91	51
2012	Common Pool	13	58	21	5
	Sector	1	156	94	51
2013	Common Pool	15	60	19	3
	Sector	1	119	80	45
2014	Common Pool	13	44	19	0
	Sector	1	105	79	43
2015	Common Pool	12	34	16	2
	Sector	0	93	77	43
2016	Common Pool	12	38	8	1
	Sector	0	97	69	43
2017	Common Pool	9	37	7	1
	Sector	0	98	59	41
2018	Common Pool	9	33	11	1
	Sector	0	100	51	28

Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 14 - Number of trips and gear types used while fishing under a groundfish LA permit 2010-2018

Fishing Year	Fleet	Trawl	Sep. Trawl	Gillnet	ELM	Handline	Longline	Pot	Other
2010	Common Pool	372	10	334	1183	182	29	21	1
	Sector	4253	241	3914	2243	142	470	1	1
2011	Common Pool	296	15	133	1316	410	20	24	0
	Sector	5557	205	5420	2273	151	717	0	0
2012	Common Pool	200	0	215	997	159	11	20	0
	Sector	5971	87	4935	1841	23	746	21	0
2013	Common Pool	409	0	85	832	152	4	6	0
	Sector	4508	84	2882	1896	19	114	6	0
2014	Common Pool	281	0	128	520	173	1	1	0
	Sector	3980	330	2830	2272	17	33	1	2
2015	Common Pool	570	0	129	44	186	0	8	0
	Sector	3967	207	1836	2177	76	39	11	26
2016	Common Pool	460	0	40	58	253	0	5	0
	Sector	3349	134	1779	2076	98	151	3	0
2017	Common Pool	413	0	38	15	126	1	3	0
	Sector	3526	70	1380	2254	269	126	8	0
2018	Common Pool	340	0	57	73	92	0	1	0
	Sector	3728	62	1432	2280	226	159	14	0

Note: trips do not sum to total groundfish trips since multiple gear types may be used on the same trip.
Source: GARFO DMIS tables. Accessed 8/14/2019.

6.5.3.1 Dealer Activity

All federally permitted groundfish vessels are required to sell to a federally permitted dealer. Federally permitted dealers are required to report all purchases of seafood, regardless of whether the vessels held a Federal or state-waters only permit. Dealers may obtain product from many other sources, so the groundfish activity levels are likely to capture only a portion of business activity by seafood wholesalers.

Since 2010, the number of dealers that reported buying groundfish from any groundfish trips (any vessel that declared into the groundfish fishery) has increased somewhat, but is lower than the maximum number of dealers which occurred in 2013, where 295 dealers reported purchasing from groundfish trips whereas in 2018 there were 224 (Table 15). It is possible to look at dealer activity in two ways: by where dealers are registered (Table 15), and by where they purchase, or receive, landings (Table 16). Economically, each may represent different pieces of information. Where the dealer is registered, similar to homeport, may better represent where revenue ultimately flows in the country, while the location of sale best represents where fish is landed, either to a truck, an auction, or a processing facility.

Table 15 shows the number of dealers by state of sale, specifically those buying any species from groundfish trips. Massachusetts by far has the most registered dealers, with 56 in 2018 alone, and no other state has more than 35 in any year between 2010 and 2018. New York and Rhode Island each had 18 in 2018, while Maine had around 15 dealers in recent years. New Hampshire had 13 registered dealers in 2018, the most in a five year period while Connecticut and New Jersey each had 11 and 9 registered dealers, respectively.

Table 16 shows the number of registered dealers by state of sale that reported buying any allocated groundfish species.[11] Similar to the trend for registered dealers, Massachusetts has more dealers that purchase groundfish in the state than any other state, at 38 in 2018. New York, Rhode Island, and Maine each had between 12 and 13 dealers which reported buying groundfish in 2018, while Connecticut and New Hampshire had 7 and 8, respectively. Virginia has had few dealers reported buying groundfish.

[11] Again, defined here as any stock that is allocated to sectors such as cod or haddock, does not include other non-allocated, but regulated, groundfish species such as whiting.

Table 15 - Number of registered dealers (by registered state) buying any species from groundfish trips.

Registered State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	5	9	10	10	6	15	11	10	11
MA	63	65	80	72	59	62	56	55	56
MD	2	2	4	3	3	NA	NA	NA	NA
ME	10	13	17	12	18	16	12	16	13
NC	NA	NA	NA	5	6	10	6	5	5
NH	12	11	12	6	7	6	10	13	13
NJ	8	11	11	14	13	14	4	5	9
NY	28	34	35	35	27	27	25	21	18
RI	26	26	28	34	28	24	21	16	18
VA	4	5	11	10	8	9	5	3	6
TOTAL*	158	176	208	201	175	183	150	144	149

Note: NA indicates no data were available.
*total does not indicate distinct dealer entities since dealers may purchase landings across multiple states.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 16- Number of registered dealers (by sale state) reporting buying groundfish stocks from groundfish trips.

Sale State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	2	5	3	4	5	10	9	7	7
MA	40	39	48	45	43	42	39	39	38
MD	1	1	1	1	NA	NA	NA	NA	NA
ME	7	8	10	9	15	15	8	10	12
NC	NA	NA	NA	1	4	4	2	2	NA
NH	8	9	7	4	4	5	8	9	8
NJ	3	4	2	8	4	10	3	3	4
NY	18	19	21	21	18	22	19	15	12
RI	16	15	19	21	17	15	14	10	13
VA	NA	1	5	3	3	5	1	1	2
TOTAL*	95	101	116	117	113	128	103	96	96

Note: NA indicates no data were available.
*total does not indicate distinct dealer entities since dealers may purchase landings across multiple states.
Source: GARFO DMIS tables. Accessed 8/14/2019.

6.5.4 Landings and Revenue

Table 11 summarizes major landings and revenues trends for the groundfish fishery. While total landed groundfish and non-groundfish pounds have decreased some over the sector period (from around 80 million pounds to 60 million pounds), the value of the groundfish fishery has declined more rapidly from nearly a $140 million dollar fishery in 2011 to less than $70 million dollars in 2017. This is reflected in the average price for groundfish, which declined from $1.64 per pound in 2011 to $1.12 per pound in 2018.

Table 17 shows the distribution of groundfish landings by dealer state. . In 2018, Massachusetts by far makes up the majority share of groundfish landings (92%), followed by Maine (5%), New Hampshire (1%), and Rhode Island (1%). While Massachusetts has consistently received the majority of all groundfish pounds since 2010, the share has fluctuated across years; decreasing from 89% in 2010 to 82% in 2012 but rebounding to greater than 90% from 2016 to 2018. New Hampshire and Rhode Island have both experienced declines in their shares of groundfish landings in recent years. In 2012, Maine landings increased from 7% to 11% of total groundfish landings, but has declined in every year since 2015. Similarly, New Hampshire also had a larger share of landings in 2011-2012, between 4% and 5%, but has fallen to 1% in each year between 2015 and 2018.

When looking at the distribution of fishing revenue by state, Massachusetts again accounts for the majority share of groundfish revenue, fluctuating between 81% in 2012 and 89% in 2018 (Table 18). Maine, New Hampshire, and Rhode Island make up the bulk of the remaining share of groundfish revenue, but all three states have experienced a decline over the past five years. In comparison to changes in volume, the distribution of revenue the distribution of revenue is more evenly spread across states than pounds; in 2018, Maine accounted for 8% of groundfish revenue, New Hampshire accounted for 2%, while Connecticut and Rhode Island each accounted for approximately 1% of total groundfish revenue. Other states, including New York, New Jersey, Virginia, Maryland, and North Carolina each had positive landings and revenue in most years but the share of groundfish revenue was less than half a percent in any given year. More detailed information on groundfish landings and revenue by state is provided in Section 6.5.6.

Table 17 - Share of GF landings by dealer sale state.

State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	0%	0%	0%	0%	0%	0%	0%	0%	1%
MA	89%	86%	82%	83%	85%	87%	91%	92%	92%
MD	0%	0%	0%	0%	NA	NA	NA	NA	NA
ME	5%	7%	11%	9%	10%	8%	7%	6%	5%
NC	NA	NA	NA	0%	0%	0%	0%	0%	NA
NH	3%	5%	4%	3%	2%	1%	1%	1%	1%
NJ	0%	0%	0%	0%	0%	0%	0%	0%	0%
NY	0%	0%	0%	1%	0%	1%	0%	0%	0%
RI	2%	2%	2%	3%	2%	2%	1%	1%	1%
VA	NA	0%	0%	0%	0%	0%	0%	0%	0%

Note: NA indicates no data were available.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 18 - Share of GF revenue by dealer sale state.

State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	0%	0%	0%	0%	0%	0%	0%	0%	1%
MA	89%	86%	82%	81%	82%	83%	86%	88%	88%
MD	0%	0%	0%	0%	NA	NA	NA	NA	NA
ME	5%	7%	10%	11%	12%	10%	9%	8%	8%
NC	NA	NA	NA	0%	0%	0%	0%	0%	NA
NH	4%	5%	5%	4%	3%	1%	1%	2%	2%
NJ	0%	0%	0%	0%	0%	0%	0%	0%	0%
NY	0%	0%	0%	1%	1%	1%	1%	0%	0%
RI	2%	2%	2%	4%	3%	4%	3%	2%	1%
VA	NA	0%	0%	0%	0%	0%	0%	0%	0%

Note: NA indicates no data were available in that year.
Source: GARFO DMIS tables. Accessed 8/14/2019.

6.5.5 ACE Leasing [*to be updated*]

Starting with allocations in FY2010, each sector was given an initial ACE determined by the pooled potential sector contribution (PSC) from each entity joining that sector. Every limited access groundfish permit also has a tracking identification number called a Moratorium Right Identifier (MRI). PSC is technically allocated to MRIs, which are subsequently linked to vessels through Northeast Multispecies limited access fishing permits. A vessel's PSC is a percentage share of the total allocation for each allocated groundfish stock based on that vessel's fishing history. Once a sector roster and associated PSC is set at the beginning of a fishing year, each sector is then able to distribute its ACE among its members. By regulation, ACE is pooled within sectors, however most sectors seem to follow the practice of assigning catch allowances to member vessels based on PSC allocations. This is an important assumption because vessels catching more than their allocation of PSC must have leased additional quota, either as PSC from within the sector or as ACE from another sector.

During FY2010, 282 sector-affiliated MRIs had catch that exceeded their individual PSC allocations for at least one stock. These vessels are then assumed to have leased in an additional 22M pounds of ACE and/or PSC with an approximate value of $13.5M. In FY2011, 256 sector-affiliated vessels had catch that exceeded their individual PSC allocations. These vessels are then assumed to have leased in 31M pounds of quota. Although the number of vessels leasing ACE fell by 9% the estimated number of pounds leased was almost 41% greater in FY2011 than in FY2010 (Murphy, et al. 2012). There were 241 sector-affiliated MRIs had catch that exceeded individual PSC allocations for at least one stock. These MRIs leased in >23M pounds of ACE and/or PSC in FY2012 (Murphy, et al. 2014). In FY2013, 224 sector-affiliated MRIs had catch that exceeded individual PSC allocations for at least one stock in 2013, down from 242 in FY 2012. These MRIs leased in nearly 21 million pounds of ACE and/or PSC in FY 2013 (Murphy, et al. 2015).

6.5.6 Fishing Communities

There are over 400 communities that have been the homeport or landing port to one or more Northeast groundfish fishing vessels since 2008. These ports occur throughout the New England and Mid-Atlantic. Consideration of the economic and social impacts on these communities from proposed fishery regulations is required by the National Environmental Policy Act (NEPA 1970) and the M-S Act. Before any agency of the federal government may take "actions significantly affecting the quality of the human environment," that agency must prepare an Environmental Assessment (EA) that includes the integrated use of the social sciences (NEPA Section 102(2)(C)). National Standard 8 of the MSA stipulates that "conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities" (16 U.S.C. § 1851(a)(8)).

A "fishing community" is defined in the Magnuson-Stevens Act, as amended in 1996, as "a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community" (16 U.S.C. § 1802(17)). Determining which fishing communities are "substantially dependent" on and "substantially engaged" in the groundfish fishery can be difficult.

Although it is useful to narrow the focus to individual communities in the analysis of fishing dependence, there are a number of potential issues with the confidential nature of the information. There are privacy concerns with presenting the data in such a way that proprietary information (landings, revenue, etc.) can be attributed to an individual vessel or a small group of vessels. This is particularly difficult when presenting information on ports that may only have a small number of active vessels. Table 19-Table 28 summarize trends by community, when possible, showing the number of dealers, vessels, trips landing in that community or state, as well as the associated groundfish and non-groundfish volume and revenue. As discussed in Section 6.5.4, Massachusetts has the largest share of groundfish landings and revenue in the region in every year 2010 to 2018 and has several communities that each have high levels of groundfish landings and revenue. At the top, New Bedford and Gloucester each have been the highest grossing community over the years; in the early years (2010 to 2012) each community has roughly equivalent gross revenue, with $31.4 million dollars of groundfish landed in Gloucester in 2010 and approximately $32 million landed in New Bedford in the same year (Table 19), or a little less than a third of total gross groundfish revenue in the same year (Table 11). Over time, revenue in both ports declined, but more slowly in New Bedford than in Gloucester; in 2014, New Bedford grossed over $21 million while Gloucester grossed around $15.5 million. But in recent years Gloucester has surpassed New Bedford as the top grossing groundfish port at nearly $18 million in 2018 while New Bedford had around $10.4 million.

Boston is consistently the third highest grossing port in the region, grossing anywhere between $9.8 and $13.27 million dollars in any given fishing year, though few dealers in the port (three or fewer in recent years) constrain the ability to report information, due to confidentiality restrictions. In addition, few vessels deliver to Boston considering the volume it receives; in FY 2018, over 12 million pounds were landed by 21 vessels. This is in comparison to ports like Chatham, where 27 vessels landed less than a half million dollars worth of groundfish, in part because majority of the catch being landed on groundfish trips in this port is not groundfish. In 2018, vessels landing in Chatham earned almost 11.5 times as much from non-groundfish stocks than groundfish stocks (Table 19). This trend has been apparent in most fishing years during the sector program. However, this consolidation of revenue is striking even in comparison to ports where the majority of revenue landed on groundfish trips comes from groundfish stocks, for example Portland, Maine, where 29 vessels landed $2.8 million dollars worth of groundfish in 2018 and only $0.6 million dollars worth of non-groundfish to twice as many dealers as Boston (Table 21).

Table 20 shows that despite there being 30 to 50 vessels fishing on groundfish trips landing in Point Judith, revenue from groundfish stocks have not exceeded $1 million since 2016 and have only barely exceeded $2 million three times during the sector period. Fishery landings are highly concentrated in Point Judith compared to the rest of the state, with roughly 97% of groundfish landings (280,000 pounds) going to roughly 15 different dealers. This is also true in Maine, where the majority of groundfish revenue is landed in Portland in recent years, but a slightly larger share of revenue is landed in other ports (10-20% in most years), but no other ports could be separated out, due to confidentiality concerns. Total groundfish revenue in other Maine ports was less than $1 million since 2013 and generally around half a million, except revenue increased to almost three-quarters of a million dollars in 2018. Portland gross revenue has been around $3 million over the last three fishing years, but was highest in 2014 with nearly $6.78 million dollars (Table 21).

Due to confidentiality reasons, no New Hampshire communities could be individually separated, in part because of limited activity in the state, compared to other areas. Less than 20 vessels have reported landings on groundfish trips since 2014, declining from a high of 31 in 2010 (Table 22). In addition, less than a million dollars worth of groundfish revenue has been landed in the state over the last four fishing years, which is down from $4.71 million in FY 2011. Generally, majority of total revenue landed on groundfish trips comes from groundfish stocks, especially in the early years of the sector program, but near equal amounts of revenue have been generated from non-groundfish stocks in recent years.

Unlike many of the port areas discussed, Connecticut has increased its presence in the groundfish fishery over time—groundfish revenue has increased from roughly $10,000 dollars in 2010 to $390,000 in 2018, despite the number of dealers and vessels remaining relatively constant, if not declining somewhat from early sector years (Table 23). In early years, majority of revenue on groundfish trips was derived from non-groundfish stocks, but in 2018 the ratio of revenue from groundfish to non-groundfish was closer to 1:1, with just over a half million dollars in revenue coming from non-groundfish stocks.

Finally, groundfish revenue from groundfish trips in other port areas south of Connecticut, from New Jersey to North Carolina, has been minimal over the sector period. An exception is Montauk, where $410,000 of groundfish revenue and $240,000 in non-groundfish revenue was landed in 2015, but recently, less than $50,000 in groundfish revenue has been landed in that port in any year since 2016. For all other southern-most states, less than $5,000 in groundfish revenue has been landed in most years, though for many groundfish trips landing non-groundfish is more common; approximately $1.9 million in non-groundfish stocks were landed across these states in 2018, whereas only $428,000 in groundfish was landed in the same states that year (Table 24-Table 28).

Table 19 - Massachusetts communities. Highly engaged communities separated, when data confidentiality allows.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
Boston	# dealers	6	5	3	3	3	3	c	c	3
	# vessels	26	26	20	20	23	21	c	c	21
	# trips	458	504	448	382	440	379	c	c	426
	GF revenue	12.80	13.27	11.81	10.14	11.52	9.82	c	c	11.51
	GF pounds	8.59	8.97	8.53	7.61	8.92	7.85	c	c	12.37

	NGF revenue	2.49	2.88	2.10	2.17	2.36	2.25	c	c	2.45
	NGF pounds	0.72	0.96	0.79	0.79	0.81	0.85	c	c	1.16
Chatham	# dealers	5	10	9	9	5	8	8	8	6
	# vessels	33	29	27	27	19	25	25	28	27
	# trips	1648	1988	1807	1270	1533	1334	1488	1494	1779
	GF revenue	2.47	2.68	1.10	0.82	0.56	0.55	0.23	0.46	0.37
	GF pounds	1.40	1.32	0.47	0.41	0.28	0.26	0.10	0.19	0.17
	NGF revenue	2.59	3.90	2.92	2.26	4.18	2.36	3.42	3.37	4.23
	NGF pounds	4.17	5.62	5.89	3.37	5.97	4.97	8.42	8.19	8.33
Gloucester	# dealers	19	23	24	29	23	25	25	29	34
	# vessels	123	110	98	85	74	69	67	65	62
	# trips	4450	5193	4376	2418	2034	1885	1677	1827	1919
	GF revenue	31.47	32.79	22.70	16.08	15.44	15.41	17.67	17.30	17.72
	GF pounds	19.06	20.85	15.31	11.75	11.45	12.80	14.41	17.04	18.88
	NGF revenue	5.12	5.93	4.51	3.72	4.20	4.02	4.72	5.04	4.28
	NGF pounds	3.25	3.05	3.53	1.83	2.61	2.18	2.28	2.63	1.95
New Bedford	# dealers	17	20	24	21	19	19	20	23	18
	# vessels	90	90	85	64	61	73	58	52	28
	# trips	1150	1346	1265	1011	1176	1048	847	649	393
	GF revenue	31.99	32.61	22.79	19.30	21.21	19.00	14.28	9.75	10.41
	GF pounds	20.08	19.26	12.13	12.76	14.24	12.84	8.06	6.22	7.12
	NGF revenue	5.72	9.00	7.03	5.80	6.62	5.75	5.99	4.47	3.65
	NGF pounds	3.04	4.76	4.11	2.96	3.61	3.31	3.05	3.08	2.03
Scituate	# dealers	11	13	17	12	10	10	8	8	7
	# vessels	11	13	15	8	7	7	10	6	11
	# trips	471	541	906	505	358	397	358	385	398
	GF revenue	0.83	1.14	1.32	0.87	0.50	0.68	0.70	0.70	0.72
	GF pounds	0.41	0.52	0.66	0.45	0.27	0.38	0.28	0.32	0.39
	NGF revenue	0.43	0.33	0.52	0.33	0.43	0.64	0.48	0.54	0.43
	NGF pounds	0.33	0.20	0.88	0.24	0.50	0.25	0.14	0.23	0.21
Other MA	# dealers	30	27	36	28	23	26	22	20	18
	# vessels	52	42	51	39	34	35	66	56	29
	# trips	594	737	557	363	246	341	638	732	332
	GF revenue	1.97	2.21	0.79	0.36	0.24	0.48	8.17	10.48	0.29
	GF pounds	0.88	1.00	0.41	0.19	0.11	0.23	6.08	9.05	0.14
	NGF revenue	0.50	0.66	0.69	0.56	0.66	0.84	3.51	3.41	1.20
	NGF pounds	0.45	0.69	0.85	0.66	0.49	0.76	1.57	1.46	0.60

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with ‘c’ was withheld due to confidentiality.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 20 - Rhode Island Communities. Highly engaged communities separated, when data confidentiality allows.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
Point Judith	# dealers	16	19	21	25	23	17	18	13	14
	# vessels	49	43	50	50	48	47	42	35	31
	# trips	753	868	966	1106	1017	1028	811	754	768
	GF revenue	1.70	2.08	1.72	2.16	1.90	2.00	1.24	0.87	0.63
	GF pounds	1.00	1.21	0.82	1.09	1.02	0.96	0.42	0.30	0.28
	NGF revenue	3.02	4.43	3.36	3.01	3.64	1.93	1.49	1.19	1.29
	NGF pounds	4.84	5.67	4.80	4.87	5.44	4.96	3.43	4.72	4.45
Other Rhode Island	# dealers	11	7	9	13	9	9	3	4	7
	# vessels	16	16	17	14	14	6	3	3	9
	# trips	318	482	434	328	156	73	56	35	42
	GF revenue	0.11	0.08	0.12	0.06	0.01	0.00*	0.01	0.00*	0.02
	GF pounds	0.06	0.04	0.05	0.02	0.00*	0.00*	0.00*	0.00*	0.01
	NGF revenue	1.12	2.00	1.55	1.02	0.50	0.16	0.16	0.12	0.08
	NGF pounds	1.04	1.83	1.40	1.02	0.50	0.15	0.21	0.12	0.16

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with 'c' was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 21 - Maine Communities. Highly engaged communities separated, when data confidentiality allows.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
Portland	# dealers	c	8	8	8	10	9	5	6	6
	# vessels	c	42	44	33	33	27	28	23	29
	# trips	c	753	778	734	695	447	366	394	417
	GF revenue	c	5.26	6.69	5.88	6.78	5.24	3.96	3.05	2.79
	GF pounds	c	3.62	4.57	3.52	4.06	3.08	1.91	1.85	1.94
	NGF revenue	c	0.84	0.85	0.67	0.60	0.62	0.48	0.65	0.59
	NGF pounds	c	0.38	0.31	0.26	0.26	0.25	0.22	0.40	0.41
Other Maine	# dealers	10	7	11	5	9	8	10	11	8
	# vessels	40	20	24	11	10	7	8	11	8
	# trips	774	449	373	178	226	159	156	171	225
	GF revenue	4.70	1.22	1.07	0.40	0.50	0.50	0.52	0.52	0.71
	GF pounds	2.99	0.76	0.63	0.22	0.26	0.26	0.20	0.21	0.34
	NGF revenue	0.53	0.27	0.28	0.08	0.08	0.10	0.06	0.10	0.13
	NGF pounds	0.36	0.24	0.30	0.12	0.24	0.03	0.02	0.04	0.06

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with 'c' was withheld due to confidentiality.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 22 – New Hampshire.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All New Hampshire	# dealers	12	11	12	6	7	6	10	13	13
	# vessels	31	31	28	24	17	15	16	17	18
	# trips	1242	1720	1735	1104	998	627	485	554	641
	GF revenue	3.43	4.71	3.72	2.19	1.56	0.72	0.70	0.71	0.96
	GF pounds	1.96	2.88	1.79	1.30	0.76	0.41	0.29	0.32	0.51
	NGF revenue	0.43	0.66	0.72	0.40	0.72	0.66	0.49	0.63	0.68
	NGF pounds	0.72	1.42	1.80	0.61	1.85	1.09	0.83	0.86	0.84

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 23 – Connecticut.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All Connecticut	# dealers	5	9	10	10	6	15	11	10	11
	# vessels	13	14	13	14	8	16	14	11	10
	# trips	94	197	170	143	52	230	196	162	180
	GF revenue	0.01	0.02	0.09	0.14	0.04	0.22	0.20	0.14	0.39
	GF pounds	0.01	0.01	0.04	0.10	0.02	0.11	0.08	0.05	0.24
	NGF revenue	0.34	0.76	0.88	0.45	0.23	0.71	0.54	0.40	0.55
	NGF pounds	0.51	0.53	0.54	0.37	0.13	1.61	1.74	1.15	1.13

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with 'c' was withheld due to confidentiality.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 24 - New York Communities. Highly engaged communities separated, when data confidentiality allows.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hampton Bays/ Shinnecock	# dealers	10	12	15	14	14	9	12	11	9
	# vessels	12	13	9	11	8	7	9	9	8
	# trips	202	203	200	214	408	120	205	254	222
	GF revenue	0.04	0.02	0.04	0.04	0.08	0.15	0.10	0.05	0.01
	GF pounds	0.02	0.01	0.02	0.02	0.04	0.08	0.04	0.02	0.01
	NGF revenue	0.38	0.51	0.49	0.45	1.07	0.16	0.59	0.78	0.67
	NGF pounds	0.19	0.25	0.30	0.29	0.35	0.07	0.13	0.13	0.11
Montauk	# dealers	18	20	24	26	16	18	16	13	13

	# vessels	19	23	27	20	13	21	20	15	11
	# trips	300	329	325	308	184	245	130	75	85
	GF revenue	0.19	0.06	0.16	0.39	0.23	0.41	0.15	0.06	0.01
	GF pounds	0.09	0.02	0.09	0.21	0.12	0.18	0.05	0.02	0.00*
	NGF revenue	0.81	1.12	1.25	0.77	0.54	0.24	0.19	0.14	0.14
	NGF pounds	0.59	0.70	0.79	0.57	0.35	0.15	0.12	0.08	0.17
Other NY	# dealers	8	8	3	6	5	5	c	c	c
	# vessels	7	8	3	9	5	5	c	c	c
	# trips	50	70	7	49	16	11	c	c	c
	GF revenue	0.00*	0.00*	0.00*	0.01	0.02	0.01	c	c	c
	GF pounds	0.00*	0.00*	0.00*	0.00*	0.01	0.00*	c	c	c
	NGF revenue	0.13	0.14	0.01	0.06	0.03	0.01	c	c	c
	NGF pounds	0.08	0.08	0.00*	0.04	0.03	0.00*	c	c	c

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with 'c' was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 25 – New Jersey.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All New Jersey	# dealers	8	11	11	14	13	14	4	5	9
	# vessels	25	24	13	20	19	14	4	6	9
	# trips	250	263	81	174	110	41	9	13	20
	GF revenue	0.02	0.02	0.03	0.12	0.02	0.03	0.01	0.00*	0.01
	GF pounds	0.01	0.02	0.02	0.06	0.01	0.02	0.00*	0.00*	0.00*
	NGF revenue	0.95	0.97	0.25	0.41	0.35	0.21	0.08	0.03	0.09
	NGF pounds	0.62	0.60	0.15	0.36	0.28	0.12	0.03	0.01	0.04

Notes: Millions of $2018 and millions of landed pounds where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with 'c' was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 26 – Maryland.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All Maryland	# dealers	c	c	4	3	c	c	c	c	c
	# vessels	c	c	4	3	c	c	c	c	c
	# trips	c	c	35	30	c	c	c	c	c
	GF revenue	c	c	0.00*	0.00*	c	c	c	c	c
	GF pounds	c	c	0.00*	0.00*	c	c	c	c	c
	NGF revenue	c	c	0.12	0.09	c	c	c	c	c

	NGF pounds	c	c	0.08	0.09	c	c	c	c	c

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with ‘c’ was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 27 – Virginia.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All Virginia	# dealers	4	5	11	10	8	9	5	3	6
	# vessels	11	10	16	19	19	14	9	4	5
	# trips	178	183	145	133	91	49	15	5	8
	GF revenue	0.00	0.00*	0.00*	0.02	0.00*	0.00*	0.00*	0.00*	0.00*
	GF pounds	0.00	0.00*	0.00*	0.01	0.00*	0.00*	0.00*	0.00*	0.00*
	NGF revenue	0.48	0.73	1.15	1.12	0.91	0.65	0.50	0.14	0.24
	NGF pounds	0.42	0.49	0.68	0.64	0.49	0.27	0.17	0.04	0.08

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with ‘c’ was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 28 - North Carolina.

Port	Metric	2010	2011	2012	2013	2014	2015	2016	2017	2018
All North Carolina	# dealers	c	c	c	5	6	10	6	5	5
	# vessels	c	c	c	7	11	12	10	8	4
	# trips	c	c	c	11	30	30	15	12	6
	GF revenue	c	c	c	0.00*	0.00*	0.00*	0.00*	0.00*	0.00
	GF pounds	c	c	c	0.00*	0.00*	0.00*	0.00*	0.00*	0.00
	NGF revenue	c	c	c	0.36	2.59	1.80	0.44	0.94	0.19
	NGF pounds	c	c	c	0.19	1.03	0.70	0.14	0.27	0.07

Notes: Millions of $2018 and millions of landed pounds, where GF is groundfish pounds and revenue and NGF is non-groundfish pounds and revenue from both sector and common pool trips. Data marked with ‘c’ was withheld due to confidentiality.
*indicates where is value is not truly zero, but is rounded to zero if less than 5,000 dollars/pounds.
Source: GARFO DMIS tables. Accessed 8/14/2019.

6.5.6.1 Community Fishing Engagement and Social Vulnerability Indicators

In addition to primary and secondary port classifications for groundfish landings and revenue, fishing communities can also be understood in terms of overall engagement in the commercial groundfish fishery and other social and economic community conditions. NOAA Fisheries social scientists produce indicators of commercial fishing engagement, reliance, and other community characteristics for virtually all fishing communities throughout United States, referred to as the Social Indicators of Fishing Community Vulnerability and Resilience (Colburn and Jepson 2012). The Social Indicators are composite indices of factors that comprise community-level latent constructs, such as commercial fishing engagement or social vulnerability. The strength of these indicators is that they provide greater depth and contextualization to our understanding of fishing communities than the more commonly utilized landings and revenue statistics. The Social Indicators provide a more comprehensive view of fishing communities by including social and economic conditions that can influence the viability of commercial fishing activities, such as gentrification pressure, poverty, and housing characteristics, among other factors.

6.5.6.1.1 2004-2018 Groundfish-Specific Commercial Engagement

The Groundfish-Specific Engagement Indicator is a numerical index that reflect the level of a community's engagement in the groundfish fishery relative to other communities in the Northeast. This index was generated using a principal components factor analysis (PCFA) of variables related to groundfish fishing activity from NOAA Fisheries regional datasets. PCFA is a common statistical technique used to identify factors that are related, yet linearly independent, and likely represent a latent or unobservable concept when considered together, such as factors that contribute to the level of a community's social vulnerability or engagement in commercial fishing. The variables that were identified to best reflect community engagement in the groundfish fishery were the value of groundfish landings (in dollars), the groundfish pounds landed, the number of federally permitted dealers that purchased at least one pound of groundfish, and the number of vessels with at least one category of large mesh groundfish permit (multiple permits on one vessel in a given year are not double counted). It should be noted that a high engagement score does not necessarily mean that a community or its fishery participants are solely dependent upon commercial groundfish fishing activities. There may be other commercial fishing or economic activities that may sustain the livelihoods of individuals or entities within these communities that have relied on groundfish historically.

Figure 9 displays the factor scores for the Groundfish-Specific Commercial Engagement Indicator for the ten communities that have the highest average commercial engagement with groundfish between 2004 and 2018. The index factor scores are commonly categorized from low to high based on the number of standard deviations from the mean, which is set at zero. Categories rank from 0.00 or below as "low", 0.00 – 0.49 as "medium," and 0.50 – 0.99 as "medium-high," and 1 standard deviation or above as "high." All of the ports displayed in Figure 9 have "high" commercial groundfish engagement, but New Bedford and Gloucester have had dramatically higher levels of engagement in commercial groundfish than other highly engaged ports over the last fifteen years.

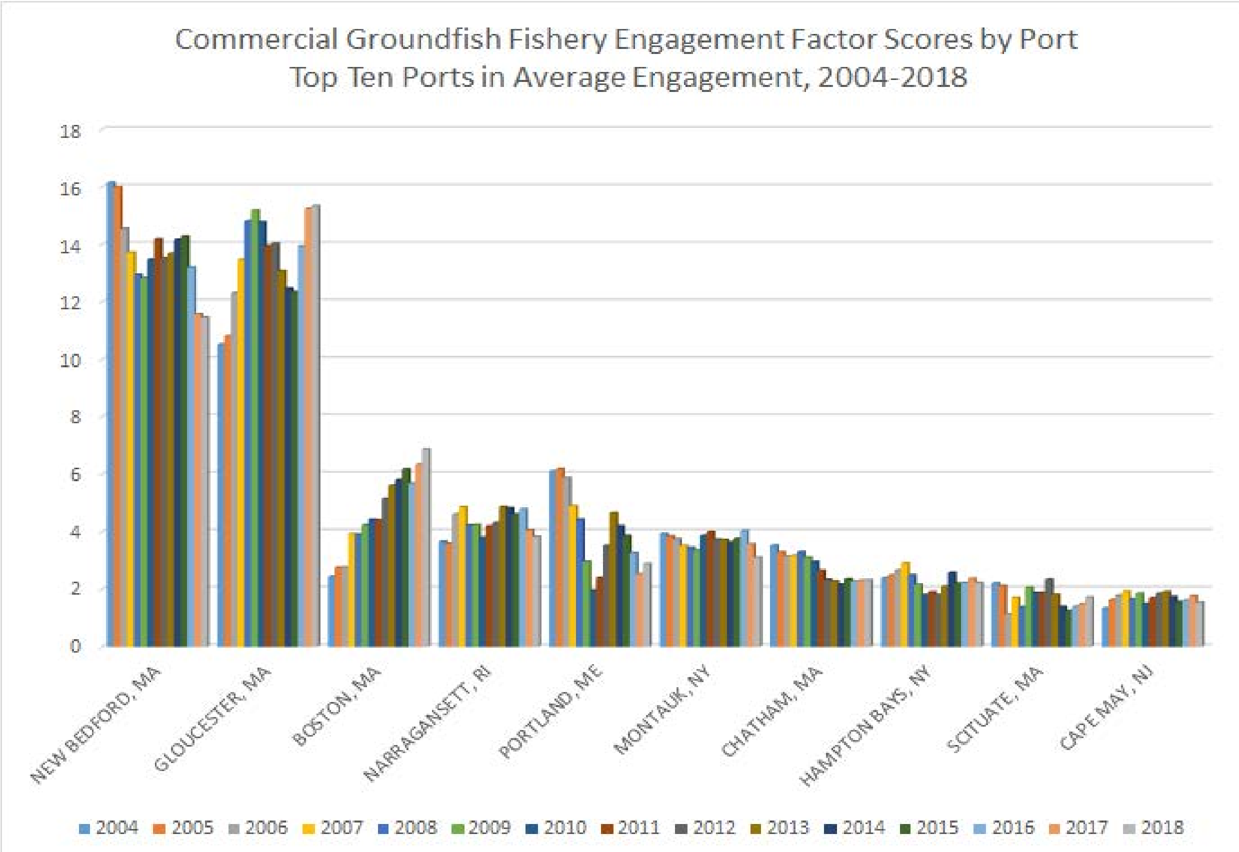


Figure 9 - Commercial Groundfish Fishery Engagement Scores

6.5.6.1.2 2012-2016 Community Social Vulnerability and Gentrification Pressure Indicators

The Community Social Vulnerability Indicators include indices of labor force structure, housing characteristics, poverty, population composition, and personal disruption. The labor force structure index measures the makeup of the labor force and is reversed scored so that a higher factor score represents fewer employment opportunities and greater labor force vulnerability. The housing characteristics index measures vulnerability related to infrastructure and home and rental values. It is also reversed score so that a higher score represents more vulnerable housing infrastructure. The poverty index captures multiple different factors that contribute to an overall level of poverty in a given area. A higher poverty index score would indicate a greater level of vulnerability due to a higher proportion of residents receiving public assistance and below federal poverty limits. The population composition index measures the presence of vulnerable populations (i.e., children, racial/ethnic minorities, and/or single-parent, female-headed households) and a higher score would indicate that a community's population is composed of more vulnerable individuals. Finally, the personal disruption index considers variables that affect individual-level vulnerability primarily and include factors such as low individual-level educational attainment or unemployment. Higher scores of personal disruption likely indicate greater levels of individual vulnerability within a community, which can in turn impact the overall level of community social vulnerability.

Gentrification Pressure Indicators include housing disruption, urban sprawl, and retiree migration. The Housing Disruption Index combines factors that correspond to unstable or shifting housing markets in which home values and rental prices may cause residents to become displaced. The Urban Sprawl Index indicates the extent of population increase due to migration from urban centers to suburban and rural areas, which often results in cost of living increases and gentrification in the destination communities. The Retiree Migration Index characterizes communities by the concentration of retirees or individuals above retirement age whose presence often raises the home values and rental rates, as well as increase the need for health care and other services.

Data used to develop these indices come from multiple secondary data sources, but primarily the U.S. Census American Community Survey (ACS) at the place level (Census Designated Place (CDP) and Minor Civil Division (MCD)). More information about the data sources, methods, and other background details can be found online at https://www.st.nmfs.noaa.gov/humandimensions/social-indicators/.

Table 29 - Community Social Vulnerability Indicator Categorical Scores

Community	Total Population	Poverty	Labor Force	Housing Characteristics	Population Composition	Personal Disruption
New Bedford, MA	94,988	High	Low	Med-High	Med-High	Med-High
Gloucester, MA	29,546	Low	Low	Medium	Low	Low
Boston, MA	658,279	Med-High	Low	Low	Med-High	Medium
Narragansett, RI	15,672	Low	Medium	Low	Low	Low
Portland, ME	66,649	Med-High	Low	Medium	Low	Low
Montauk, NY	3,510	Low	Medium	Low	Low	Low
Chatham, MA	1,429	Medium	Med-High	Medium	Low	Low
Hampton Bays, NY	13,040	Low	Low	Low	Low	Low
Scituate, MA	18,390	Low	Low	Low	Low	Low
Cape May, NJ	3,529	Low	High	Medium	Low	Low

Table 30 - Community Gentrification Pressure Indicator Categorical Scores

Community	Housing Disruption	Retiree Migration	Urban Sprawl
New Bedford, MA	Medium	Low	Med-High
Gloucester, MA	Medium	Low	Medium
Boston, MA	Med-High	Low	High
Narragansett, RI	Med-High	Medium	Low
Portland, ME	Med-High	Low	Medium
Montauk, NY	High	Med-High	Med-High
Chatham, MA	Medium	High	Medium
Hampton Bays, NY	High	Medium	Med-High
Scituate, MA	Med-High	Low	Med-High
Cape May, NJ	High	High	Low

6.5.6.2 Employment

Along with the restrictions associated with presenting confidential information, there is also limited quantitative socio-economic data upon which to evaluate the community-specific importance of the multispecies fishery. In addition to the direct employment of captains and crew, the industry is known to support ancillary businesses such as gear, tackle, and bait suppliers; fish processing and transportation; marine construction and repair; and restaurants. Regional economic models do exist that describe some of these inter-connections at that level (Clay et al. 2007; NMFS 2010c; Olson & Clay 2001; Thunberg 2007).

Throughout the Northeast, many communities benefit indirectly from the multispecies fishery, but these benefits are often difficult to attribute. The direct benefit from employment in the fishery can be estimated by the number of crew positions. However, crew positions do not equate to the number of jobs in the fishery and do not make the distinction between full and part-time positions. In FY 2018, vessels with limited access groundfish permits provided 1,877 crew positions, with 46% coming from vessels with homeports in Massachusetts (Table 31). Since at least FY 2010, the total number of crew positions provided by limited access groundfish vessels has declined by 17.6%. Changes in crew positions vary across homeport states.

A crew day[12] is a measure of employment that incorporates information about the time spent at sea earning a share of the revenue. Conversely, crew days can be viewed as an indicator of time invested in the pursuit of "crew share" (the share of trip revenues received at the end of a trip). The time spent at sea has an opportunity cost. For example, if crew earnings remain constant, a decline in crew days would reveal a benefit to crew in that less time was forgone for the same amount of earnings. In FY 2018, vessels with limited access groundfish permits used 144,400 crew days, with 46% coming from vessels with homeports in Massachusetts (Table 31). Since at least FY 2010, the total number of crew days used by limited access groundfish vessels across the Northeast has declined, with a slight increase from FY 2014 to FY 2016. The number of crew positions and crew days give some indication of the direct benefit to communities from the multispecies fishery through employment. But these measures, by themselves, do not show the benefit or lack thereof at the individual level. Many groundfish captains and crew are second- or third-generation fishermen who hope to pass the tradition on to their children. This occupational transfer is an important component of community continuity as fishing represents a valued occupation in many of the smaller port areas.

[12] Similar to a "man-hour," a "crew day" is calculated by multiplying a vessel's crew size by the days absent from port. Since the number of trips affects the crew-days indicator, the indicator is also a measure of work opportunity.

Table 31 - Number of crew positions and crew days on active vessels by homeport and state

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2016	FY 2018
CT	positions	38	41	39	39	46	50	44	44	41
	days	4016	3002	4478	3576	2946	3412	3616	3309	3519
MA	positions	1134	1070	1050	984	979	950	963	930	886
	days	81848	84021	81687	73646	73782	76411	75355	66523	65823
ME	positions	252	228	243	223	220	185	189	199	189
	days	15475	14781	16546	15270	14309	12344	12928	12528	10572
NH	positions	107	105	96	87	77	57	72	66	72
	days	3883	4939	5166	4512	4070	3306	3146	2741	3249
NJ	positions	149	145	149	153	149	155	157	169	162
	days	10084	9906	10333	9664	9334	10219	11603	12071	11803
NY	positions	209	217	209	194	192	173	170	178	168
	days	15802	16048	15114	14636	14365	13658	14579	14738	14314
RI	positions	253	248	232	224	225	223	216	225	221
	days	26769	25165	24258	25629	23107	23699	23707	23532	24447
Other	positions	130	128	128	134	131	138	145	139	139
	days	11867	11597	11648	11199	9567	11521	11900	11837	10673
Total	**Total crew positions**	2271	2183	2147	2038	2019	1931	1956	1950	1877
	Total crew days	169744	169459	169231	158132	151479	154570	156835	147280	144400

Source: GARFO DMIS tables. Accessed 8/14/2019.

6.5.6.2.1 Crew Characteristics

The Socio-Economic Survey of Hired Captains and Crew in New England and Mid-Atlantic Commercial Fisheries (hereafter referred to as the Crew Survey) is an ongoing effort conducted by the Social Sciences Branch (SSB) of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Northeast Fisheries Science Center (NEFSC) intended to gather general information about the characteristics and experiences of commercial fishing crew members (including hired captains) because little is known about this critical segment of the commercial fishing industry. Information collected by the survey include demographic information, wage calculations systems, well-being, fishing practices, job satisfaction, job opportunities, and attitudes towards fisheries management, among other subjects. There have been two waves of Crew Survey data collection thus far – Wave 1 in 2012-13 and Wave 2 in 2018-19.

The 2012 implementation of the Crew Survey began in the fall of 2012 and lasted approximately one year. Given the lack of a registry or population database to draw a crew sample from, the Crew Survey was conducted mainly through in-person interviews using an intercept method at the docks of sampled ports. Ports from Maine to North Carolina were randomly sampled based on a stratified sampling design that took into consideration seasonally-based fishing activity and geographic diversity in the region's fisheries (Henry and Olson 2014). A sample size of 1,330 was calculated from an estimated crew population of 30,000. Population estimates were derived from prior SSB research utilizing data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages and the Bureau of Economic Analysis Regional Economic Information System (Henry and Olson 2014; Steinback and Thunberg 2006). Crew members were interviewed using an intercept method with interviewers approaching crew on the docks and entering survey responses into Nook tablet computers. The random intercept method is commonly used to maximize response rates among hard-to-reach populations, such as crew, who are transient and for whom contact information is unavailable (Miller et.al. 1997; Kitner 2006). Prior survey research of fishermen in this region have achieved response rates of up to 90 percent (Pollnac et al. 2014). The final number of completed surveys was 359, with 42 incompletes and 654 refusals (Henry and Olson 2014).

A variety of factors contributed to the difficulty SSB had in obtaining a higher response rate, including scheduling problems related to the arrival and departure times being at odd/random hours and outright refusals to participate. The ports with the largest number of respondents were (in descending order) New Bedford, MA (n = 58), Gloucester, MA (n = 48), Cape May, Newport News, VA (n = 29), NJ (n = 27), Point Judith, RI (n = 27), Chatham, MA (n = 17), Rockland, ME (n = 14), Portland, ME (n = 14), Montauk, NY (n = 14), and Wanchese, NC (n = 14), and Portsmouth, NH (n = 11).

The 2018-19 Wave 2 sample for the Crew Survey was again collected using an intercept method, but a different sampling strategy than the 2012 design was used to derive a sample of ports at which to conduct intercept interviews. Prior to port-level sampling, a target sample of 452 respondents was calculated using Cochran's (1977) formula for categorical data with a 20% buffer to accommodate nonresponse due to the logistical challenges of the intercept method. This sample size calculation was based on an estimated 21,616 employed in commercial fishing in the Northeast and Mid-Atlantic. To establish a list of ports to visit for intercepts, a quasi-random sample of fishing ports was selected from the universe of ports in the Northeast and Mid-Atlantic states. In order to ensure that the most active ports were selected, a probability proportional to size (PPS) sampling method was applied in order to purposively add weight in the selection process to ports with more fishing activity. Under the PPS approach a port's probability of being selected into the sample is related to the "size" of the port, with larger ports being more likely to be selected into the sample. The PPS approach was necessary to ensure that selected ports were more active and thus, more likely to result in completed crew surveys. Port size was assessed using a commercial fishing engagement index from the 2014 NOAA Fisheries Social Indicators (Jepson and Colburn 2013). This index is reported by community and was generated from a principal component factor analysis of variables associated with fishing activity. The “community level” here refers to data at the level of Census Designated Place (CDP) nested within a set of counties designated as “coastal” by their connection to the ocean through a coastline, river, bay, or estuary. The variables used to determine commercial fishing engagement included the number of commercial fishing permits, the value of landings, dealers with landings, and the total landings in pounds. A sample of fifty CDPs containing moderately and highly engaged ports throughout the Northeast and the Mid-Atlanitc was drawn using the PPS method.

6.5.6.2.2 Crew Demographics

In this section, descriptive statistics for demographic variables from both Waves 1 and 2 of the Crew Survey are reported. Demographic variables reported in this section include respondents’ primary fishery, age, race and ethnicity, annual income from fishing, educational attainment, health insurance coverage status, and marital status. Descriptive statistics for these data are also provided in Table 32 – Table 33. According to these data, the total number of crew respondents primarily targeting groundfish dropped 13% between 2012 and 2018. In 2012, about 20% of respondents reported that they primarily targeted groundfish, whereas only 7% of respondents primarily targeted groundfish in 2018. This decline in groundfish targeting is likely the result of a multitude of confounding factors, including changes in management, market, and ecosystem conditions, but does roughly correspond to the catch share period under review and may be in part due to the transition to this system of management in particular. While these data do not track whether specific crew members who previously targeted groundfish shifted to targeting another fishery or left the commercial fishing industry altogether, the other two most common primary fisheries targeted among crew have been scallop (28% in 2012 and 32% in 2018) and lobster (20% in 2012 and 18% in 2018).

The mean age for all respondents increased from 38 in 2012 to 40 in 2018. Groundfish-targeting crew were slightly older than crew in other fisheries and that age difference increased between 2012 and 2018 – the average age of groundfish-targeting crew was 40 in 2012 and increased to 43 in 2018. The increasingly higher mean age among groundfish versus other crew may indicate that groundfish-targeting crew are undergoing a “graying of the fleet” phenomenon at a rate higher than crew targeting other fisheries. The large majority of crew across all fisheries in 2012 and 2018 identified as non-Hispanic, white. Groundfish-targeting crew were even more racially and ethnically homogenous than crew targeting other fisheries.

In 2012, about 90% of groundfish-targeting crew identified as non-Hispanic white versus about 83% of crew targeting other fisheries. While only about 10% of the sample identified as Hispanic or Latino overall, groundfish-targeting crew were significantly less likely to identify as Hispanic or Latino than crew in other fisheries (4% targeting groundfish versus 11% targeting other fisheries). The disparity in racial and ethnic representation by fishery increased in 2018, with about 94% of groundfish-targeting crew identifying as non-Hispanic white versus about 86% of crew targeting other fisheries.

Self-reported annual fishing incomes increased from 2012 to 2018 among crew across all fisheries. The mean self-reported income among crew across all fisheries in 2012 was between $50,000 and $59,999. In 2018 the mean self-reported income category jumped to between $80,000 and $89,999. While about three-quarters (75%) of groundfish-targeting crew reported incomes over $60,000 in 2018, a higher percentage of crew in other non-groundfish fisheries reported incomes above $90,000 (36% of groundfish-targeting versus 43% of all other crew). This may signal evidence for greater potential among crew in non-groundfish fisheries to reach substantially higher income categories than those fishing primarily for groundfish. Much of this difference may be explained by crew respondents in the scallop fishery, which is currently one of the most lucrative fisheries in the Northeast. While these data cannot identify individual-level changes in income because they do not track respondents between waves, it is possible that some of the crew in 2012 shifted their employment from groundfish to scallop vessels given the likely opportunity for higher earning potential in the scallop fishery. Educational attainment among crew remained virtually unchanged between 2012 and 2018, with the large majority in both samples having attained a high school education or less (76% in 2012 and 77% in 2018).

Health insurance coverage rates also did not shift very much from 2012 to 2018, but the percentage of groundfish-targeting crew without health insurance was substantially higher than crew in other fisheries and did increase from 2012. About 58% of all crew respondents reported that they had some kind of health insurance coverage, whereas about 42% of crew did not have health insurance. While these overall percentages are nearly identical to the 2012 wave results, the percent of groundfish-targeting crew without insurance increased about 6%, from 44% in 2012 to 50% in 2018. There were substantial percentage differences in sources of health insurance by fishery as well. Among those who reported they had coverage in 2018, about seven in ten (69%) groundfish-targeting crew said they had private health insurance. On the other hand, crew in other fisheries reported a wider variety of sources of health insurance coverage, including private insurance (45%), federal or state insurance (23%), a spouse's or partner's insurance (18%), or some other source of insurance (13%).

Very few crew respondents across all fisheries (about 1%) reported having insurance provided by their employer, the vessel owner. In 2012, the largest proportion of groundfish-targeting crew received insurance from a spouse's or partner's plan, whereas in 2018 the majority had purchased private insurance. Given the health risks associated with commercial fishing and the high average costs of private insurance, groundfish-targeting crew likely spend a considerable amount of their relatively moderate earnings on health insurance coverage. These costs might also help explain why such a large proportion of commercial fishermen overall (42%), and half of groundfish-targeting crew (50%), in 2018 reported that they do not have health insurance coverage at all. Finally, more than three-quarters (77%) of crew were either single and never married (40%) or married (37%) in 2018. Far fewer were either divorced (13%), living with an unmarried partner (7%), separated from their spouse (2%), or widowed (2%). There were no substantial differences between crew in groundfish versus other fisheries and these overall percentages changed little from 2012 to 2018.

Table 32 - 2012 Crew Survey Demographics

	Groundfish Crew	Other Crew	Total Crew
	N (%)	N (%)	N (%)
Total	72 (100%)	287 (100%)	359 (100%)
15 – 24	11 (15%)	52 (18%)	63 (18%)
25 – 34	21 (29%)	72 (25%)	93 (26%)
35 – 44	12 (17%)	82 (29%)	94 (26%)
45 – 54	14 (19%)	56 (20%)	70 (20%)
55 or above	14 (19%)	25 (9%)	39 (11%)
Hispanic	3 (4%)	31 (11%)	34 (9%)
Non-Hispanic	69 (96%)	256 (89%)	325 (91%)
White	66 (92%)	240 (84%)	306 (85%)
Black/African-American	0 (0%)	10 (3%)	10 (3%)
American Indian or Alaskan Native	1 (1%)	7 (2%)	8 (2%)
Asian	0 (0%)	0 (0%)	0 (0%)
Native Hawaiian or Pacific Islander	0 (0%)	0 (0%)	0 (0%)
Some Other Race	1 (1%)	17 (6%)	18 (5%)
Person of Two or More Races	1 (1%)	10 (3%)	11 (3%)
Don't Know/No Answer	3 (4%)	3 (1%)	6 (2%)
Less than $30,000	12 (17%)	69 (24%)	81 (23%)

$30,000 - $59,999	30 (42%)	92 (32%)	122 (34%)
$60,000 - $89,999	14 (19%)	47 (16%)	61 (17%)
$90,000 or More	16 (22%)	79 (28%)	95 (26%)
Less than High School	9 (13%)	51 (18%)	60 (17%)
High School or GED	44 (61%)	167 (58%)	211 (59%)
Associate's/Two-year Degree	9 (13%)	39 (14%)	48 (13%)
Bachelor's/Four-year Degree	5 (7%)	25 (9%)	30 (8%)
Graduate Degree	2 (3%)	1 (<1%)	3 (1%)
Don't Know/No Answer	3 (4%)	4 (1%)	7 (2%)
Health Insurance	38 (53%)	169 (59%)	207 (58%)
From Vessel Owner	*1 (1%)*	*8 (3%)*	*9 (3%)*
From Another Employer	*0 (0%)*	*3 (1%)*	*3 (1%)*
From Spouse/Partner	*15 (21%)*	*40 (14%)*	*55 (15%)*
Private Insurance	*10 (14%)*	*72 (25%)*	*82 (23%)*
Federal/State Insurance	*9 (13%)*	*29 (10%)*	*38 (11%)*
Other	*2 (3%)*	*13 (5%)*	*15 (4%)*
Don't Know/No Answer	*1 (1%)*	*4 (1%)*	*5 (1%)*
No Health Insurance	32 (44%)	115 (40%)	147 (41%)
Don't Know/No Answer	2 (3%)	3 (1%)	5 (1%)
Married	32 (44%)	126 (44%)	158 (44%)
Widowed	1 (1%)	0 (0%)	1 (<1%)
Divorced	8 (11%)	37 (13%)	45 (13%)
Separated	1 (1%)	6 (2%)	7 (2%)
Never Married	23 (32%)	101 (35%)	124 (35%)
Living with Partner	6 (8%)	16 (6%)	22 (6%)
No Answer	1 (1%)	1 (<1%)	2 (1%)

Table 33 - 2018 Crew Survey Demographics

	Groundfish Crew	Other Crew	Total Crew
	N (%)	N (%)	N (%)
Total	33 (100%)	446 (100%)	479 (100%)
18 – 24	4 (12%)	49 (11%)	53 (11%)
25 – 34	6 (18%)	146 (33%)	152 (32%)
35 – 44	10 (30%)	89 (20%)	99 (21%)
45 – 54	5 (15%)	99 (22%)	104 (22%)
55 or above	8 (24%)	63 (14%)	71 (15%)
Hispanic	0 (0%)	32 (7%)	32 (7%)
Non-Hispanic	33 (100%)	414 (93%)	447 (93%)
White	31 (94%)	392 (88%)	423 (88%)
Black/African-American	0 (0%)	6 (1%)	6 (1%)
American Indian or Alaskan Native	0 (0%)	1 (<1%)	1 (<1%)
Asian	0 (0%)	5 (1%)	5 (1%)
Native Hawaiian or Pacific Islander	0 (0%)	1 (<1%)	1 (<1%)
Some Other Race	0 (0%)	22 (5%)	22 (5%)
Person of Two or More Races	2 (6%)	7 (2%)	9 (2%)
Don't Know/No Answer	0 (0%)	12 (3%)	12 (3%)
Less than $30,000	2 (6%)	41 (9%)	43 (9%)
$30,000 - $59,999	5 (15%)	88 (20%)	93 (19%)
$60,000 - $89,999	13 (39%)	80 (18%)	93 (19%)
$90,000 or More	12 (36%)	191 (43%)	203 (42%)
No Answer	1 (3%)	46 (10%)	47 (10%)
Some High School	6 (18%)	59 (13%)	65 (14%)
High School or GED	20 (61%)	280 (64%)	300 (63%)
Associate's/Two-year Degree	1 (3%)	53 (12%)	54 (11%)

Bachelor's/Four-year Degree	6 (18%)	45 (10%)	51 (11%)
Graduate Degree	0 (0%)	3 (1%)	3 (1%)
Health Insurance	16 (48%)	262 (59%)	278 (58%)
From Vessel Owner	*1 (3%)*	*2 (<1%)*	*1 (3%)*
From Another Employer	*0 (0%)*	*1 (<1%)*	*1 (<1%)*
From Spouse/Partner	*1 (3%)*	*47 (11%)*	*48 (10%)*
Private Insurance	*11 (33%)*	*118 (26%)*	*129 (27%)*
Federal/State Insurance	*3 (9%)*	*61 (14%)*	*64 (13%)*
Other	*0 (0%)*	*32 (7%)*	*32 (7%)*
Don't Know/No Answer	*0 (0%)*	*1 (<1%)*	*1 (<1%)*
No Health Insurance	16 (48%)	184 (41%)	200 (42%)
Don't Know/No Answer	1 (3%)	0 (0%)	1 (<1%)
Married	12 (36%)	164 (37%)	176 (37%)
Widowed	1 (3%)	6 (1%)	7 (1%)
Divorced	6 (18%)	58 (13%)	64 (13%)
Separated	0 (0%)	11 (2%)	11 (2%)
Never Married	12 (36%)	177 (40%)	189 (39%)
Living with Partner	2 (6%)	29 (7%)	31 (6%)
No Answer	0 (0%)	1 (<1%)	1 (<1%)

6.5.6.2.3 Crew Employment Characteristics

In this section, descriptive statistics are presented for various aspects of crew employment. These include primary port, time employed in commercial fishing, number of days per trip and hours worked per day, average size of crew, owner-operator status, position on the vessel, path to employment, payment systems, and fishing expenses deducted from crew payment. Descriptive statistics for these data are also provided in Table 34 – Table 35.

Groundfish-targeting crew in 2012 were concentrated mostly in Gloucester (36%) and New Bedford (11%), but other ports with substantial groundfish crew included Portland, ME (8%), Boston, MA (8%), Portsmouth, NH (7%), and Montauk, NY (6%). By 2018, the vast majority of groundfish-targeting crew worked mostly in just three ports in 2018 – Gloucester, MA (33%), Boston, MA (27%), and Portland, ME (24%). Groundfish-targeting have been involved in commercial fishing longer than crew in other fisheries, but they tend to be employed on their current vessels for shorter durations. Crew overall in 2018 reported being employed in commercial fishing on average about 19 years and reported on average being employed on their current vessels for about 6 of those years. By contrast, groundfish-targeting crew were employed in commercial fishing on average about 22 years, but only reported on average having been employed for 4 years on their current vessels. About 28% of crew in 2018 worked on vessels that fished for single-day trips, whereas about 72% worked on vessels that fished on trips for multiple days. Among those on vessels that fished for multiple days per trip, respondents reported a mean of about 7 days per trip. Groundfish-targeting crew on reported slightly fewer days per trip with a mean of about 6 days. While their trips lasted less time than crew in other fisheries, groundfish-targeting crew reported working significantly more hours per day than crew in other fisheries. On average, groundfish-targeting crew reported working for about 17 hours per day, compared to about 15 working hours per day among crew in other fisheries. Longer working hours may correspond to smaller crew sizes. Groundfish-targeting crew in 2012 and 2018 reported working on vessels with fewer crew than those in other fisheries. In 2018, groundfish-targeting crew reported a mean of four crew members including captains, whereas crew in other fisheries reported a mean of five members.

About 57% of crew overall in 2018 worked on vessels that were not owner-operated, while about 43% worked on owner-operated vessels. Groundfish-targeting crew worked substantially more often on vessels that were not owner-operated – about 73% of groundfish crew worked on vessels that were not owner-operated. This represents a substantial decrease among groundfish crew working for owner-operators between 2012 and 2018 - about 56% of groundfish-targeting crew reported being employed on vessels that were owner-operated in 2012, whereas only about 27% did in 2018.

Table 34 - 2012 Crew Survey Job Characteristics

	Groundfish Crew	Other Crew	Total Crew
	N (%)	N (%)	N (%)
Total	72 (100%)	287 (100%)	359 (100%)
Years in the commercial fishing industry			
Less than 5	10 (14%)	56 (20%)	66 (18%)
5 to 15	20 (28%)	80 (28%)	100 (28%)
16 to 29	20 (28%)	89 (31%)	109 (30%)
30 or More	20 (28%)	61 (21%)	81 (23%)
Don't know/No answer	2 (3%)	1 (<1%)	3 (1%)
Years on current vessel			
Less than 5	39 (54%)	170 (59%)	209 (58%)
5 to 15	23 (32%)	91 (32%)	114 (32%)
16 to 29	8 (11%)	18 (6%)	26 (7%)
30 or more	2 (3%)	8 (3%)	10 (3%)
Trip Duration			
1 day	30 (42%)	121 (42%)	151 (42%)
2 to 4 days	11 (15%)	44 (15%)	55 (15%)
5 to 7 days	15 (21%)	34 (12%)	49 (14%)
More than 7 days	16 (22%)	88 (31%)	104 (29%)
Hours worked per day			
8 hours or less	4 (6%)	46 (16%)	50 (14%)
9 to 14 hours	26 (36%)	88 (31%)	114 (32%)
15 to 17 hours	19 (26%)	42 (15%)	61 (17%)
18 hours or more	23 (32%)	111 (39%)	134 (37%)
Owner-operator	40 (56%)	168 (59%)	208 (58%)
Hired Captain	32 (44%)	118 (41%)	150 (42%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
Position on vessel			
Captain	16 (22%)	52 (18%)	68 (19%)
Deckhand	37 (51%)	178 (62%)	215 (60%)
Other	4 (6%)	25 (9%)	29 (8%)
Multiple positions	15 (21%)	32 (11%)	47 (13%)
Payment system			
Share system	67 (93%)	238 (83%)	305 (85%)
Owner share, mean % (n)	*60% (57)*	*57% (225)*	*58% (282)*
Crew share, mean % (n)	*40% (57)*	*43% (225)*	*42% (282)*
Don't know/No Answer, (n)	*(15)*	*(62)*	*(77)*
Other payment system	5 (7%)	39 (14%)	44 (12%)
Multiple payment systems	0 (0%)	8 (3%)	8 (2%)
Don't know/No Answer	0 (0%)	2 (1%)	2 (1%)
Expenses deducted from share, N (discrete %)	67 (100%)	246 (100%)	313 (100%)
Fuel	27 (40%)	145 (59%)	172 (55%)
Food	30 (45%)	130 (53%)	160 (51%)
Ice	16 (24%)	78 (32%)	94 (30%)
Bait	3 (4%)	28 (11%)	31 (10%)
Supplies	20 (30%)	84 (34%)	104 (33%)
Fishing quota	8 (12%)	1 (<1%)	9 (3%)
Other	11 (16%)	43 (17%)	54 (17%)

Table 35 - 2018 Crew Survey Job Characteristics

	Groundfish Crew	Other Crew	Total Crew
	N (%)	N (%)	N (%)
Total	33 (100%)	446 (100%)	479 (100%)
Years in the commercial fishing industry			
Less than 5	5 (15%)	72 (16%)	77 (16%)
5 to 15	10 (30%)	159 (36%)	169 (35%)
16 to 29	6 (18%)	104 (23%)	110 (23%)
30 or More	12 (36%)	111 (25%)	123 (26%)
Years on current vessel			
Less than 5	23 (70%)	266 (60%)	289 (60%)
5 to 15	8 (24%)	141 (32%)	149 (31%)
16 to 29	2 (6%)	34 (8%)	36 (8%)
30 or more	0 (0%)	5 (1%)	5 (1%)
Trip Duration			
1 day	3 (9%)	131 (29%)	134 (28%)
2 to 4 days	8 (24%)	77 (17%)	85 (18%)
5 to 7 days	17 (52%)	87 (20%)	104 (22%)
More than 7 days	5 (15%)	150 (34%)	155 (32%)
No answer	0 (0%)	1 (<1%)	1 (<1%)
Hours worked per day			
8 hours or less	0 (0%)	50 (11%)	50 (10%)
9 to 14 hours	10 (30%)	128 (29%)	138 (29%)
15 to 17 hours	8 (24%)	119 (27%)	127 (27%)
18 hours or more	15 (45%)	149 (33%)	164 (34%)
Owner-operator	9 (27%)	198 (44%)	207 (43%)
Hired Captain	24 (73%)	247 (55%)	271 (57%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
Position on vessel			
Captain	10 (30%)	93 (21%)	103 (22%)
Deckhand	13 (39%)	231 (52%)	244 (51%)
Other	6 (18%)	78 (18%)	84 (18%)
Multiple positions	10 (12%)	44 (10%)	48 (10%)
Payment system			
Share system	31 (94%)	378 (85%)	409 (85%)
Owner share, mean % (n)	*57% (19)*	*55% (232)*	*55% (251)*
Crew share, mean % (n)	*43% (19)*	*45% (232)*	*45% (251)*
Don’t know/No Answer, (n)	*(12)*	*(146)*	*(158)*
Other payment system	2 (6%)	67 (15%)	69 (14%)
Don’t know/No Answer	0 (0%)	1 (<1%)	1 (<1%)
Expenses deducted from share, N (discrete %)			
Fuel	19 (58%)	324 (73%)	343 (72%)
Food	18 (55%)	264 (59%)	282 (59%)
Ice	17 (51%)	237 (53%)	254 (53%)
Bait	4 (12%)	86 (19%)	90 (19%)
Supplies	9 (27%)	139 (31%)	148 (31%)
Fishing quota	16 (48%)	23 (5%)	39 (8%)
Other	5 (15%)	24 (5%)	29 (6%)

Table 36 - 2012 Crew Survey Job Satisfaction

	Groundfish Crew	Other Crew	Total Crew
Total	72 (100%)	287 (100%)	359 (100%)
"Your actual earnings"			
Very satisfied	2 (3%)	48 (17%)	50 (14%)
Satisfied	27 (38%)	137 (48%)	164 (46%)
Neutral	10 (14%)	20 (7%)	30 (8%)
Dissatisfied	19 (26%)	58 (20%)	77 (21%)
Very Dissatisfied	12 (17%)	20 (7%)	32 (9%)
Don't know/No answer	2 (3%)	4 (1%)	6 (2%)
"Predictability of your earnings"			
Very satisfied	0 (0%)	13 (5%)	13 (4%)
Satisfied	9 (13%)	100 (35%)	109 (30%)
Neutral	11 (15%)	47 (16%)	58 (16%)
Dissatisfied	32 (44%)	84 (29%)	116 (32%)
Very Dissatisfied	18 (25%)	41 (14%)	59 (16%)
Don't know/No answer	2 (3%)	2 (1%)	4 (1%)
"Job safety"			
Very satisfied	11 (15%)	37 (13%)	48 (13%)
Satisfied	21 (29%)	135 (47%)	156 (43%)
Neutral	17 (24%)	54 (19%)	71 (20%)
Dissatisfied	20 (28%)	45 (16%)	65 (18%)
Very Dissatisfied	3 (4%)	14 (5%)	17 (5%)
Don't know/No answer	0 (0%)	2 (1%)	2 (1%)
"Time spent away from home"			
Very satisfied	6 (8%)	26 (9%)	32 (9%)
Satisfied	17 (24%)	104 (36%)	121 (34%)
Neutral	16 (22%)	54 (19%)	70 (20%)
Dissatisfied	21 (29%)	69 (24%)	90 (25%)
Very Dissatisfied	10 (14%)	33 (12%)	43 (12%)
Don't know/No answer	2 (3%)	1 (<1%)	3 (1%)
"Physical fatigue of the job"			
Very satisfied	2 (3%)	17 (6%)	19 (5%)
Satisfied	29 (40%)	92 (32%)	121 (34%)
Neutral	16 (22%)	75 (26%)	91 (25%)
Dissatisfied	18 (25%)	81 (28%)	99 (28%)
Very Dissatisfied	6 (8%)	19 (7%)	25 (7%)
Don't know/No answer	1 (1%)	3 (1%)	4 (1%)
"Healthfulness of the job"			
Very satisfied	7 (10%)	45 (16%)	52 (14%)
Satisfied	24 (33%)	100 (35%)	124 (35%)
Neutral	14 (19%)	53 (18%)	67 (19%)
Dissatisfied	23 (32%)	69 (24%)	92 (26%)
Very Dissatisfied	2 (3%)	15 (5%)	17 (5%)
Don't know/No answer	2 (3%)	5 (2%)	7 (2%)
"Adventure of the job"			
Very satisfied	36 (50%)	170 (59%)	206 (57%)
Satisfied	23 (32%)	97 (34%)	120 (33%)
Neutral	7 (10%)	10 (3%)	17 (5%)
Dissatisfied	4 (6%)	7 (2%)	11 (3%)
Very Dissatisfied	1 (1%)	2 (1%)	3 (1%)
Don't know/No answer	1 (1%)	1 (<1%)	2 (1%)
"Challenge of the job"			
Very satisfied	28 (39%)	110 (38%)	138 (38%)
Satisfied	31 (43%)	142 (50%)	173 (48%)
Neutral	6 (8%)	21 (7%)	27 (8%)
Dissatisfied	5 (7%)	11 (4%)	16 (4%)
Very Dissatisfied	1 (1%)	1 (<1%)	2 (1%)
Don't know/No answer	1 (1%)	2 (1%)	3 (1%)
"Opportunity to be your own boss"			

Very satisfied	15 (21%)	98 (34%)	113 (31%)
Satisfied	23 (32%)	96 (33%)	119 (33%)
Neutral	14 (19%)	43 (15%)	57 (16%)
Dissatisfied	13 (18%)	36 (13%)	49 (14%)
Very Dissatisfied	6 (8%)	10 (3%)	16 (4%)
Don’t know/No answer	1 (1%)	4 (1%)	5 (1%)

Table 37 - 2018 Crew Survey Job Satisfaction

	Groundfish Crew	Other Crew	Total Crew
Total	33 (100%)	446 (100%)	479 (100%)
“Your actual earnings”			
Very satisfied	10 (30%)	98 (22%)	108 (23%)
Satisfied	15 (45%)	259 (58%)	274 (57%)
Neutral	3 (9%)	59 (13%)	62 (13%)
Dissatisfied	4 (12%)	23 (5%)	27 (6%)
Very Dissatisfied	1 (3%)	6 (1%)	7 (1%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
“Predictability of your earnings”			
Very satisfied	0 (0%)	19 (4%)	19 (4%)
Satisfied	14 (42%)	212 (48%)	226 (47%)
Neutral	9 (27%)	113 (25%)	122 (25%)
Dissatisfied	7 (21%)	76 (17%)	83 (17%)
Very Dissatisfied	3 (9%)	25 (6%)	28 (6%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
“Job safety”			
Very satisfied	3 (9%)	72 (16%)	75 (16%)
Satisfied	21 (64%)	242 (54%)	263 (55%)
Neutral	6 (18%)	98 (22%)	104 (22%)
Dissatisfied	3 (9%)	26 (6%)	29 (6%)
Very Dissatisfied	0 (0%)	7 (2%)	7 (1%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
“Time spent away from home”			
Very satisfied	1 (3%)	20 (4%)	21 (4%)
Satisfied	5 (15%)	156 (35%)	161 (34%)
Neutral	6 (18%)	122 (27%)	128 (27%)
Dissatisfied	16 (48%)	113 (25%)	129 (27%)
Very Dissatisfied	5 (15%)	34 (8%)	39 (8%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
“Physical fatigue of the job”			
Very satisfied	0 (0%)	8 (2%)	8 (2%)
Satisfied	10 (30%)	185 (41%)	195 (41%)
Neutral	14 (42%)	149 (33%)	163 (34%)
Dissatisfied	7 (21%)	91 (20%)	98 (20%)
Very Dissatisfied	2 (6%)	12 (3%)	14 (3%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)
“Healthfulness of the job”			
Very satisfied	1 (3%)	27 (6%)	28 (6%)
Satisfied	14 (42%)	235 (53%)	249 (52%)
Neutral	8 (24%)	121 (27%)	129 (27%)
Dissatisfied	9 (27%)	52 (12%)	61 (13%)
Very Dissatisfied	1 (3%)	9 (2%)	10 (2%)
Don’t know/No answer	0 (0%)	2 (<1%)	2 (<1%)
“Adventure of the job”			
Very satisfied	18 (55%)	223 (50%)	241 (50%)
Satisfied	11 (33%)	160 (36%)	171 (36%)
Neutral	2 (6%)	54 (12%)	56 (12%)
Dissatisfied	2 (6%)	7 (2%)	9 (2%)
Very Dissatisfied	0 (0%)	1 (<1%)	1 (<1%)
Don’t know/No answer	0 (0%)	1 (<1%)	1 (<1%)

"Challenge of the job"			
Very satisfied	12 (36%)	157 (35%)	169 (35%)
Satisfied	17 (52%)	214 (48%)	231 (48%)
Neutral	3 (9%)	60 (13%)	63 (13%)
Dissatisfied	1 (3%)	14 (3%)	15 (3%)
Very Dissatisfied	0 (0%)	0 (0%)	0 (0%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Opportunity to be your own boss"			
Very satisfied	7 (21%)	124 (28%)	131 (27%)
Satisfied	12 (36%)	190 (43%)	202 (42%)
Neutral	8 (24%)	74 (17%)	82 (17%)
Dissatisfied	4 (12%)	36 (8%)	40 (8%)
Very Dissatisfied	2 (6%)	21 (5%)	23 (5%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)

Table 38 - 2012 Crew Survey Attitudes Toward Fisheries Management

	Groundfish Crew	Other Crew	Total Crew
Total	37 (100%)	163 (100%)	200 (100%)
"Have you ever participated in fisheries management?"			
Yes	13 (35%)	52 (32%)	65 (33%)
No	24 (65%)	111 (68%)	135 (68%)
Total	35 (100%)	124 (100%)	159 (100%)
"The rules and regulations change so quickly it's hard to keep up."			
Strongly Agree	13 (37%)	28 (23%)	41 (26%)
Agree	19 (54%)	43 (35%)	62 (39%)
Neutral	2 (6%)	10 (8%)	12 (8%)
Disagree	1 (3%)	35 (28%)	36 (23%)
Strongly Disagree	0 (0%)	2 (2%)	2 (1%)
Don't know/No answer	0 (0%)	6 (5%)	6 (4%)
"The fines that are associated with breaking the rules and regulations of my primary fishery are fair."			
Strongly Agree	0 (0%)	2 (2%)	2 (1%)
Agree	8 (23%)	27 (22%)	35 (22%)
Neutral	1 (3%)	16 (13%)	17 (11%)
Disagree	8 (23%)	26 (21%)	34 (21%)
Strongly Disagree	16 (46%)	21 (17%)	37 (23%)
Don't know/No answer	2 (6%)	32 (26%)	34 (21%)
"I feel that the regulations in my primary fishery are too restrictive."			
Strongly Agree	19 (54%)	29 (23%)	48 (30%)
Agree	8 (23%)	48 (39%)	56 (35%)
Neutral	3 (9%)	13 (10%)	16 (10%)
Disagree	4 (11%)	29 (23%)	33 (21%)
Strongly Disagree	0 (0%)	2 (2%)	2 (1%)
Don't know/No answer	1 (3%)	3 (2%)	4 (3%)

Table 39 - 2018 Crew Survey Attitudes Toward Fisheries Management

	Groundfish Crew	Other Crew	Total Crew
Total	33 (100%)	446 (100%)	479 (100%)
"Have you ever participated in fisheries management?"			
Yes	9 (27%)	181 (41%)	190 (40%)
No	24 (73%)	264 (59%)	288 (60%)
No answer	0 (0%)	1 (<1%)	1 (<1%)
"The rules and regulations change so quickly it's hard to keep up."			
Strongly Agree	13 (39%)	85 (19%)	98 (20%)
Agree	12 (36%)	187 (42%)	199 (42%)
Neutral			

Disagree Strongly Disagree Don’t know/No answer	2 (6%) 6 (18%) 0 (0%) 0 (0%)	94 (21%) 73 (16%) 5 (1%) 2 (<1%)	96 (20%) 79 (16%) 5 (1%) 2 (<1%)
“The fines that are associated with breaking the rules and regulations of my primary fishery are fair.” Strongly Agree Agree Neutral Disagree Strongly Disagree Don’t know/No answer	0 (0%) 9 (27%) 10 (30%) 6 (18%) 8 (24%) 0 (0%)	23 (5%) 190 (43%) 134 (30%) 56 (13%) 41 (9%) 2 (<1%)	23 (5%) 199 (42%) 144 (30%) 62 (13%) 49 (10%) 2 (<1%)
“I feel that the regulations in my primary fishery are too restrictive.” Strongly Agree Agree Neutral Disagree Strongly Disagree Don’t know/No answer	11 (33%) 10 (30%) 3 (9%) 7 (21%) 2 (6%) 0 (0%)	96 (22%) 130 (29%) 113 (25%) 97 (22%) 8 (2%) 2 (<1%)	107 (22%) 140 (29%) 116 (24%) 104 (22%) 10 (2%) 2 (<1%)

6.5.7 Consolidation and Redirection

The multiple regulatory constraints placed on common pool groundfish fishermen are intended to control their effort and catch per unit effort (CPUE) as a means to limit mortality. Exemptions from many of these controls, which have been granted to sectors, may increase the CPUE of sector participants. As a result, sector fishermen may have additional time that they could direct towards non-groundfish stocks, resulting in redirection of effort into other fisheries. Additionally, to maximize efficiency, fishermen within a single sector may be more likely to allocate fishing efforts such that some vessels do not fish at all. This is referred to as fleet consolidation.

Both redirection and consolidation have been observed when management regimes for fisheries outside the Northeast US shifted toward a catch share management regime such as sectors. For example, research following the rationalization of the halibut and sablefish fisheries by the North Pacific Fishery Management Council found individuals who received enough quota shares were able to continue fishing with less competition, greater economic certainty, and over a longer fishing season (Matulich & Clark 2001). However, individuals who did not receive enough of a catch share either bought or leased catch shares from other fishermen or sold their quota. Similarly, one year after implementation of the Bering Sea-Aleutian Island crab fishery Individual Transferable Quota (ITQ), a study found that about half of the vessels that fished the 2004/2005 Bering Sea Snow Crab fishery did not fish the following year. However, research on the ITQ plan for the British Columbia halibut fishery found efficiency gains were greatest during the first round of consolidation, and little incentive to increase efficiency (or continue consolidation) existed afterward (Pinkerton & Edwards 2009).

6.5.8 Regulated Groundfish Stock Catch

The Northeast Multispecies FMP specifies Annual Catch Limits (ACLs) for 20 stocks. Exceeding an ACL for a stock results in the implementation of Accountability Measures (AMs) to prevent overfishing. The ACL is sub-divided into different components. Those components that are subject to AMs are referred to as sub-ACLs. There are also components of the fishery that are not subject to AMs. These include state waters catches that are outside of federal jurisdiction, and a category referred to as “other sub-components” that combines small catches from various fisheries.

Table 40 - FY2018 Northeast Multispecies Percent of Annual Catch Limit Caught (%)

Stock	Components with ACLs and sub-ACLs: With Accountability Measures (AMs)								Sub-components: No AMs	
	Total	Groundfish Fishery	Sector	Common Pool	Recreational	Midwater Trawl Herring Fishery	Scallop Fishery	Small Mesh Fisheries	State Water	Other
	A to H	A+B+C	A	B	C	D	E	F	G	H
GB Cod	58.4	61.6	71.1	26.0					50.2	29.0
GOM Cod	75.7	75.7	86.7	48.8	66.8				80.7	51.8
GB Haddock	11.5	11.5	11.6	1.4		6.5			3.5	24.6
GOM Haddock	29.1	28.6	32.8	33.8	17.7	-			54.1	94.1
GB Yellowtail Flounder	19.7	14.7	14.9	-			87.5	2.5	NA	NA
SNE Yellowtail Flounder	22.3	19.6	19.9	18.1			79.7		9.8	20.5
CC/GOM Yellowtail Flounder	52.0	42.8	43.3	32.3					108.6	70.8
Plaice	69.6	68.3	68.6	49.1					66.9	131.7
Witch Flounder	95.6	95.6	97.9	96.7					66.6	112.7
GB Winter Flounder	59.1	57.5	57.9	-					NA	79.3
GOM Winter Flounder	54.6	25.7	26.7	6.4					200.9	189.4
SNE/MA Winter Flounder	56.9	48.4	50.1	35.6					21.8	120.5
Redfish	48.9	49.9	50.1	2.3					2.2	3.8
White Hake	75.6	76.7	77.2	8.1					1.3	54.1
Pollock	10.9	9.3	9.4	2.2					119.7	54.0
Northern Windowpane	65.9	52.8	NA	NA			123.7		20.3	22.9
Southern Windowpane	99.5	125.4	NA	NA			99.5		93.1	94.0
Ocean Pout	44.8	18.2	NA	NA					14.5	157.2
Halibut	103.3	91.9	NA	NA					147.4	80.9
Wolffish	1.9	1.8	NA	NA					3.9	5.5

Source: NMFS Greater Atlantic Regional Fisheries Office, November 22, 2019, run date of July 22, 2019

Table 41 - FY 2018 Northeast Multispecies Total Catch (mt)

Stock	**Total Catch**	Groundfish Fishery	Sector	Common Pool	Recreational	Midwater Trawl Herring Fishery	Scallop Fishery[1]	Small Mesh Fisheries	State Water	Other
	A to H	A+B+C	A	B	C	D	E	F	G	H
GB Cod	887.3	837.9	831.6	6.3					8.0	41.5
GOM Cod	504.5	461.9	309.2	5.8	146.9				37.9	4.7
GB Haddock	5,324.3	5,143.7	5,139.2	4.4		43.9			17.1	119.7
GOM Haddock	3,605.9	3,465.1	2,837.1	33.0	595.0	-			51.4	89.4
GB Yellowtail Flounder	40.5	27.6	27.6	-			12.7	0.1	-	0.0
SNE/MA Yellowtail Flounder	14.7	8.5	7.0	1.5			2.6		0.2	3.5
CC/GOM Yellowtail Flounder	254.7	170.3	164.8	5.5					55.4	29.0
Plaice	1,147.9	1,078.4	1,064.7	13.7					23.4	46.1
Witch Flounder	906.1	811.8	794.1	17.7					26.6	67.6
GB Winter Flounder	465.1	419.9	419.9	-					-	45.2
GOM Winter Flounder	233.9	91.7	90.6	1.1					134.6	7.6
SNE/MA Winter Flounder	398.0	250.7	228.7	22.0					15.9	131.3
Redfish	5,369.1	5,362.1	5,360.9	1.2					2.6	4.4
White Hake	2,113.1	2,097.1	2,095.4	1.7					0.4	15.7
Pollock	4,179.1	3,480.8	3,475.8	5.0					481.1	217.3
Northern Windowpane	56.7	33.3	33.0	0.3			22.3		0.4	0.7
Southern Windowpane	454.7	66.5	49.7	16.8			157.1		26.1	205.0
Ocean Pout	53.7	17.1	17.0	0.1					0.4	36.2
Halibut	103.3	70.8	70.1	0.7					31.0	1.6
Wolffish	1.6	1.5	1.4	0.1					0.0	0.1

[1] Based on scallop fishing year April 2018 through March 2019

Values in metric tons of live weight

Sector and common pool include estimate of missing dealer reports

Source: NMFS Greater Atlantic Regional Fisheries Office, November 22, 2019, run date of July 22, 2019

Any value for a non-allocated species may include landings of that stock or misreporting of species and/or stock area. These are northern windowpane, southern windowpane, ocean pout, halibut, and wolffish.

Table 42 - FY2018 Northeast Multispecies Other Sub-Component Catch Detail (mt)

Stock	Total	SCALLOP[1]	FLUKE	HAGFISH	HERRING	LOBSTER/ CRAB[2]	MACKEREL	MENHADEN	MONKFISH	REDCRAB	RESEARCH
GB Cod	41.5	7.6	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
GOM Cod	4.7	0.3	0.0	0.0	0.3	0.0	-	-	0.1	-	3.5
GB Haddock	119.7	13.4	2.8	-	0.5*	-	0.9	0.0	0.3	-	0.5
GOM Haddock	89.4	0.0	0.0	0.7	2.8*	-	0.2	-	0.0	-	20.7
GB Yellowtail Flounder	0.0	-*	0.0	0.0	0.0*	-	-	-	-	0.0	-
SNE Yellowtail Flounder	3.5	-*	0.4	-	0.0	-	0.0	0.0	0.3	-	0.0
CC/GOM Yellowtail Flounder	29.0	11.8	0.0	0.2	1.0	-	-	-	0.0	-	1.3
American Plaice	46.1	25.7	0.0	-	0.1	-	0.2	0.0	0.0	-	1.2
Witch Flounder	67.6	31.7	1.0	0.0	0.2	-	0.3	0.0	0.1	0.0	0.5
GB Winter Flounder	45.2	34.8	0.0	0.0	0.9	-	-	-	-	0.0	-
GOM Winter Flounder	7.6	2.7	0.0	0.0	0.9	0.0	-	-	0.0	-	0.9
SNE Winter Flounder	131.3	52.5	3.8	0.0	0.3	0.0	0.6	0.0	0.5	0.0	0.0
Redfish	4.4	0.0	0.0	-	0.0	-	0.0	0.0	0.0	-	3.5
White Hake	15.7	1.9	0.6	0.0	0.1	0.0	0.1	0.0	0.1	0.0	2.0
Pollock	217.3	0.4	-	-	0.0	-	0.0	0.0	0.3	-	0.9
Northern Windowpane	0.7	-*	0.0	0.0	0.0	-	-	-	0.0	0.0	0.0
Southern Windowpane	205.0	-*	23.6	-	0.5	-	0.9	0.0	1.1	-	0.0
Ocean Pout	36.2	4.8	0.7	0.0	0.2	-	0.2	0.0	0.0	0.1	0.0
Halibut	1.6	-	-	-	0.0	0.8	0.0	0.0	0.2	-	0.1
Wolffish	0.1	0.0	0.0	-	0.0	-	0.0	0.0	0.0	-	0.0

[1] Based on scallop fishing year April 2018 through March 2019
[2] Landings only. Discard estimates not applicable. Lobster/crab discards were not attributed to the ACL, consistent with the most recent assessments for these stocks used to set the respective quotas.
*Some or all catch attributed to separate sub-ACL as shown in Tables 1 through 5, and so is not included above.
Values in metric tons of live weight
Source: NMFS Greater Atlantic Regional Fisheries Office, November 22, 2019, run date of September 17, 2019

Continued.

Stock	Total	SCUP	SHRIMP	SQUID	SQUID/ WHITING	SURFCLAM	WHELK/ CONCH	WHITING	UNCATEGORIZED	RECREATIONAL
GB Cod	41.5	0.1	0.0	0.8	0.1	0.0	0.0	0.0	0.7	31.6
GOM Cod	4.7	-	-	0.0	0.0	0.0	0.0	0.0	0.3	-*
GB Haddock	119.7	2.9	0.1	73.3	7.2	1.0	-	0.2	16.8	
GOM Haddock	89.4	-	-	0.0	4.2	0.2	0.1	5.5	55.0	-*
GB Yellowtail Flounder	0.0	0.0	-*	0.0*	0.0	-	-	-	0.0*	
SNE Yellowtail Flounder	3.5	0.4	0.0	1.3	0.1	0.0	-	0.0	0.9	
CC/GOM Yellowtail Flounder	29.0	-	-	0.9	7.5	0.1	0.0	2.5	3.6	
American Plaice	46.1	0.0	0.0	14.0	1.4	0.2	-	0.1	3.0	
Witch Flounder	67.6	1.0	0.0	23.9	2.4	0.3	0.0	0.2	6.1	
GB Winter Flounder	45.2	0.0	-	4.1	5.3	-	-	-	0.0	
GOM Winter Flounder	7.6	-	-	0.0	0.2	0.0	0.0	0.3	0.8	1.8
SNE Winter Flounder	131.3	3.5	0.1	47.9	3.2	0.8	0.0	0.1	14.1	4.1
Redfish	4.4	0.0	0.0	0.6	0.1	0.0	-	0.0	0.2	
White Hake	15.7	0.6	0.0	6.2	0.7	0.1	0.0	0.0	3.3	
Pollock	217.3	-	0.0	0.6	0.1	0.0	-	0.0	0.4	214.7
Northern Windowpane	0.7	0.0	-	0.1	0.2	0.0	0.0	0.0	0.3	
Southern Windowpane	205.0	24.8	0.1	98.7	7.2	2.5	-	0.2	45.2	
Ocean Pout	36.2	0.8	0.0	21.2	2.2	0.3	0.1	0.2	5.3	
Halibut	1.6	-	0.0	0.3	0.1	0.0	-	0.0	0.2	
Wolffish	0.1	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	

Values in metric tons of live weight
*Some or all catch attributed to separate sub-ACL as shown in Tables 1 through 5, and so is not included above.
Source: NMFS Greater Atlantic Regional Fisheries Office, November 22, 2019, run date of September 17, 2019

6.5.9 Fishery Sub-Components

6.5.9.1 Sector Harvesting Component [*to be updated*]

In FY2010, the sector vessels landed the overwhelming majority of groundfish landed. Each sector receives a total amount of fish it can harvest for each stock, its Annual Catch Entitlement (ACE). Since the ACE is dependent on the amount of the ACL in a given fishing year, the ACE may be higher or lower from year to year even if the sector's membership remains the same. There have been substantial shifts in commercial groundfish sub-ACLs for various stocks between FY2010 and FY2015. There has been a general decrease in trips, and catch for sector vessels, and there has been a shift in effort out of the groundfish fishery into other fisheries. However, these changes may correlate to a certain extent with the decrease in ACL.

Combined, 138.7 million (live) pounds of ACE were allotted to the sectors in 2015 but only 47.1 million (live) pounds were landed. Of the 16 ACEs allocated to sectors in 2015, 5 stocks approached or exceeded the catch limit (>80% conversion) set by the total allocated ACE (Table 43). This is an increase from 2014 when the fleet caught over 80% of the allocation for 2 stocks. Overall, the fleet landed 34% of the total allocated ACE in 2015. As has been the case in previous years, Georges Bank haddock, particularly East GB haddock, accounted for a majority of the unrealized landings. East GB haddock comprises almost 24% of total allocated ACE, yet only 5% of total catch. In general, total allocations have decreased since 2010 and total catch has never been above 40% of the allocation.

Table 43 – Annual catch entitlement (ACE), catch, and utilization (live pounds) [*to be updated*]

	2010			2011			2012		
	Allocated ACE	Sector Catch	% Caught	Allocated ACE*	Sector Catch	% Caught	Allocated ACE*	Sector Catch	% Caught
GB Cod East	717,431	568,399	79.2%	431,348	357,402	82.9%	350,826	145,249	41.4%
GB Cod West	6,563,092	5,593,020	85.2%	9,544,288	6,826,211	71.5%	10,542,396	3,360,445	31.9%
GOM Cod	9,540,380	8,074,730	84.6%	11,357,667	9,663,695	85.1%	9,008,547	4,798,617	53.3%
GB Haddock East	26,262,687	4,131,306	15.7%	21,122,567	2,343,807	11.1%	15,126,206	813,955	5.4%
GB Haddock West	62,331,174	14,118,062	22.7%	54,741,822	6,191,370	11.3%	51,898,287	1,825,266	3.5%
GOM Haddock	1,761,196	845,909	48.0%	1,871,947	1,082,224	57.8%	1,599,126	539,838	33.8%
GB Yellowtail Flounder	1,770,443	1,637,353	92.5%	2,474,650	2,194,655	88.7%	802,645	472,983	58.9%
SNE/MA Yellowtail	517,366	335,628	64.9%	941,753	824,232	87.5%	1,422,806	942,096	66.2%
CC/GOM Yellowtail	1,608,077	1,268,597	78.9%	2,169,507	1,792,853	82.6%	2,448,231	2,100,705	85.8%
American Plaice	6,058,141	3,355,510	55.4%	7,302,366	3,614,121	49.5%	7,771,243	3,528,323	45.4%
Witch Flounder	1,824,114	1,568,774	86.0%	2,847,243	2,205,548	77.5%	3,409,449	2,162,764	63.4%
GB Winter Flounder	4,018,487	3,081,050	76.7%	4,796,100	4,261,052	88.8%	7,752,474	4,255,918	54.9%
GOM Winter Flounder	293,728	186,156	63.4%	716,979	351,182	49.0%	1,590,291	568,974	35.8%
SNE Winter Flounder	Not			Not allocated			Not allocated		
Redfish	14,894,611	4,717,742	31.7%	18,034,598	6,016,717	33.4%	19,933,111	9,748,226	48.9%
White Hake	5,522,667	5,023,212	91.0%	7,038,737	6,690,235	95.0%	7,527,504	5,397,291	71.7%
Atlantic Pollock	35,666,736	12,191,019	34.2%	34,096,301	16,743,220	49.1%	30,670,578	14,075,466	45.9%
Grand Total	**179,350,330**	**66,696,468**	**37.2%**	**179,487,873**	**71,158,525**	**39.6%**	**171,853,720**	**54,736,115**	**31.9%**

Table 43 cont.

	2013			2014			2015		
	Allocated ACE*	Sector Catch	% Caugh	Allocate d	Sector Catch	% Caught	Allocate d	Sector Catch	% Caught
GB Cod East	199,316	73,459	36.9%	320,115	151,481	47.3%	267,438	180,790	67.6%
GB Cod West	4,701,617	3,323,371	70.7%	3,711,231	2,856,702	77.0%	3,794,124	3,348,946	88.3%
GOM Cod	1,932,983	1,614,154	83.5%	1,942,248	1,438,207	74.0%	487,714	400,325	82.1%
GB Haddock East	8,249,374	1,276,536	15.5%	20,842,603	3,386,572	16.2%	33,169,495	2,332,376	7.0%
GB Haddock West	55,258,296	5,288,353	9.6%	18,772,954	8,619,232	45.9%	16,937,341	8,854,755	52.3%
GOM Haddock	549,390	372,967	67.9%	990,983	712,427	71.9%	2,176,822	1,601,081	73.6%
GB Yellowtail Flounder	336,520	123,102	36.6%	552,360	137,458	24.9%	438,775	84,653	19.3%
SNE/MA Yellowtail	1,203,202	625,321	52.0%	1,095,787	687,783	62.8%	1,090,289	384,410	35.3%
CC/GOM Yellowtail	1,245,854	830,842	66.7%	1,075,286	548,892	51.0%	1,016,665	819,382	80.6%
American Plaice	3,770,923	3,068,524	81.4%	3,150,789	2,847,669	90.4%	3,208,080	3,011,602	93.9%
Witch Flounder	1,334,426	1,409,406	105.6%	1,243,356	1,132,978	91.1%	1,384,796	1,153,367	83.3%
GB Winter Flounder	8,457,031	3,796,413	44.9%	7,630,025	2,533,764	33.2%	4,257,628	1,915,358	45.0%
GOM Winter Flounder	1,666,641	370,582	22.2%	1,589,104	272,652	17.2%	862,903	259,179	30.0%
SNE Winter Flounder	2,367,906	1,477,347	62.4%	2,483,812	1,078,323	43.4%	2,679,320	1,286,158	48.0%
Redfish	24,061,105	8,826,237	36.7%	24,420,595	10,361,980	42.4%	25,431,305	11,649,845	45.8%
White Hake	9,130,460	4,513,217	49.4%	9,861,411	3,840,528	38.9%	10,003,287	3,524,833	35.2%
Atlantic Pollock	30,933,568	10,755,436	34.8%	30,498,020	8,753,123	28.7%	31,543,570	6,342,462	20.1%
Grand Total	**155,398,612**	**47,745,266**	**30.7%**	**130,180,679**	**49,359,772**	**37.9%**	**138,749,552**	**47,149,522**	**34.0%**

*includes sector carryover
Catch amounts updated using the most recent available data.

Source: NMFS Greater Atlantic Regional Fisheries Office, Summary Tables for FY 2015 Northeast Multispecies Fishery, Accessed February 2018 (Table 31).

6.5.9.1.1 Trends in the sector fishery

This section summarizes data for vessels participating in groundfish sectors to help characterize fishing activity as well as basic information about the vessels and homeports. This section was specifically added to this action because it is important to understand the amount of time a vessel spends fishing, or days absent when considering catch monitoring. Vessels that make more trips under the groundfish fishery FMP, and/or fish for more time, will experience higher monitoring costs than those fishing less. Table 44 and Figure 10 show the number of vessels participating in this fishery by fishing year, disaggregated by categories of time spent fishing, while Table 45 shows the number of trips made under each of these categories. Since 2010, the overall number of active groundfish vessels has declined from just under 300 vessels to under 200 in 2018, but the fleet has remained relatively diverse in terms of activity levels measured in days absent.

Table 44 - Number of active vessels subject to at-sea monitoring requirements, by days absent category and fishing year.

FY	<=5	>5,<=20	>20,<=5	>50,<=8	>80,<=1	>160	N
2010	30	65	87	28	51	38	299
2011	13	62	81	35	45	62	298
2012	27	57	81	35	48	53	301
2013	24	55	58	24	42	42	245
2014	18	53	44	25	48	40	228
2015	18	49	50	18	41	37	213
2016	37	44	41	21	37	29	209
2017	30	48	42	19	22	37	198
2018	24	32	49	15	38	21	179

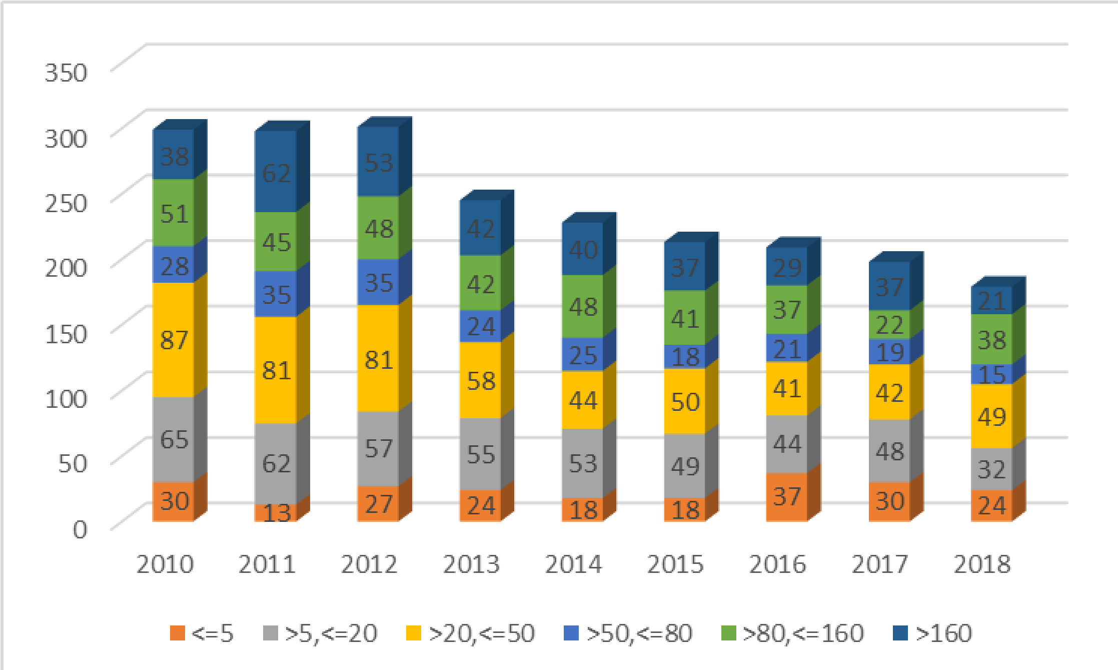


Figure 10 - Number of active vessels subject to at-sea monitoring requirements, by days absent category and fishing year.

Table 45 - Number of trips by vessels subject to at-sea monitoring requirements, by days absent category and fishing year.

FY	<=5	>5,<=20	>20,<=50	>50,<=80	>80,<=160	>160	N Trips
2010	183	1,569	4,044	1,035	2,587	1,361	10,779
2011	65	1,384	3,791	2,390	2,549	3,211	13,390
2012	237	1,370	3,784	2,096	2,223	3,171	12,881
2013	226	1,293	2,072	1,340	1,931	2,248	9,110
2014	384	1,184	1,847	1,675	1,838	1,744	8,672
2015	79	1,025	2,178	633	2,043	1,434	7,392
2016	163	909	1,549	839	1,616	1,431	6,507
2017	139	969	1,986	725	1,170	1,768	6,757
2018	99	624	2,451	1,049	1,894	1,018	7,135

Amendment 16 to the Groundfish FMP requires that sectors are responsible for the costs of monitoring and therefore sector-level costs are estimated. Table 46 and Table 47 show the number of vessels and trips made by vessels enrolled in each sector, by fishing year. The economic analyses in this document considers potential impacts by various metrics. Therefore, summary tables have been included here by vessel size class, vessel home port and, in some cases, trip landing port. The following tables (Table 48 - Table 53) summarize trends across these metrics, and the economic analyses presents potential costs of monitoring for these same metrics.

Table 46 - Number of active vessels subject to at-sea monitoring requirements, by home port and fishing year.

Home port	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT PORTS	3	c	3	3	4	3	3	3	c
OTHER MA PORTS	39	42	41	27	23	24	21	18	22
BOSTON	32	32	28	25	26	24	25	23	23
CHATHAM	29	30	29	23	20	22	22	26	25
GLOUCESTER	59	54	54	45	43	39	39	38	34
NEW BEDFORD	29	32	32	28	30	30	29	28	13
OTHER ME PORTS	21	23	26	17	14	10	10	12	13
PORTLAND	14	15	16	14	12	10	10	10	9
NH PORTS	25	22	20	18	15	11	12	11	12
NJ PORTS	1	1	2	2	2	0	0	0	0
NY PORTS	8	9	11	8	8	9	12	5	5
OTHER RI PORTS	6	4	6	7	6	5	4	4	3
POINT JUDITH	28	27	31	27	22	25	22	19	17
OTHER NORTHEAST PORTS	5	5	2	1	3	1	0	1	1
N Vessels	**299**	**298**	**301**	**245**	**228**	**213**	**209**	**198**	**179**

c – confidential data, less than three vessels

Table 47 - Number of trips by vessels subject to at-sea monitoring requirements, by vessel home port and fishing year.

Home port	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT PORTS	41	37	56	58	58	50	42	35	51
OTHER MA PORTS	1,498	1,884	1,828	797	596	621	459	597	598
BOSTON	946	1,129	1,078	938	994	847	714	680	670
CHATHAM	1,725	2,271	2,163	1,710	1,872	1,598	1,639	1,767	1,932
GLOUCESTER	2,724	3,517	3,089	1,768	1,668	1,502	1,281	1,337	1,490
N. BEDFORD	574	588	589	623	685	620	551	372	317
OTHER ME PORTS	701	938	958	480	469	317	265	360	472
PORTLAND	399	399	389	419	275	234	250	264	146
NH PORTS	1,354	1,666	1,668	1,092	902	548	403	432	587
NJ PORTS	3	3	6	25	18	0	0	0	0
NY PORTS	43	60	113	211	299	196	223	196	191
OTHER RI PORTS	99	72	105	147	135	71	67	45	16
POINT JUDITH	628	755	806	800	657	766	613	671	629
OTHER NORTHEAST PORTS	44	71	33	42	44	22	0	1	36
N Trips	**10,779**	**13,390**	**12,881**	**9,110**	**8,672**	**7,392**	**6,507**	**6,757**	**7,135**

Table 48 - Number of active vessels subject to at-sea monitoring requirements, by vessel size class and fishing year.

FY	<30'	30'to<50'	50'to<75'	75'+	N Vessels
2010	0	152	95	52	299
2011	1	147	97	53	298
2012	1	149	99	52	301
2013	1	115	83	46	245
2014	1	100	83	44	228
2015	0	89	80	44	213
2016	0	93	72	44	209
2017	0	95	61	42	198
2018	0	97	54	28	179

Table 49 - Number of trips by vessels subject to at-sea monitoring requirements, by vessel size class and fishing year.

FY	<30'	30'to<50'	50'to<75'	75'+	N Trips
2010	0	7,306	2,481	992	10,779
2011	15	9,391	2,999	985	13,390
2012	6	8,819	3,070	986	12,881
2013	8	5,671	2,455	976	9,110
2014	4	5,416	2,212	1,040	8,672
2015	0	4,242	2,178	972	7,392
2016	0	3,815	1,736	956	6,507
2017	0	4,123	1,803	831	6,757
2018	0	4,696	1,740	699	7,135

Table 50 - Number of active vessels subject to at-sea monitoring requirements, by sector and fishing year.

Sector Name	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northeast Fishery Sector II	40	37	38	30	28	25	26	26	25
Georges Bank Cod Fixed Gear Sector	30	28	28	22	19	23	20	24	24
Sustainable Harvest Sector	38	40	41	39	39	29	27	23	24
Maine Coast Community Sector	0	0	0	13	11	10	10	14	15
Northeast Fishery Sector V	28	22	23	22	19	20	22	15	15
Northeast Fishery Sector XIII	22	24	30	23	24	21	20	18	15
Northeast Fishery Sector XI	23	19	17	15	17	12	12	12	11
Northeast Fishery Sector III	34	32	30	25	21	15	15	14	10
Northeast Fishery Sector VIII	7	8	6	4	5	5	5	4	8
Sustainable Harvest Sector - Inshore	0	0	0	0	0	5	8	7	8
Northeast Fishery Sector VI	5	4	4	5	4	5	6	6	7
Northeast Fishery Sector X	19	22	21	11	9	9	5	4	7
Northeast Fishery Sector XII	3	6	6	5	0	0	5	6	7
Northeast Coastal Communities Sector	2	4	6	2	1	2	3	2	2
Northeast Fishery Sector VII	11	10	9	8	10	12	6	5	1
Northeast Fishery Sector IX	15	19	22	21	21	20	19	18	0
Port Clyde Community Groundfish Sector	16	17	18	0	0	0	0	0	0
Tristate Sector	6	6	2	0	0	0	0	0	0
n_vessels	**299**	**298**	**301**	**245**	**228**	**213**	**209**	**198**	**179**

Table 51 - Number of trips by vessels subject to at-sea monitoring requirements, by sector and fishing year.

Sector Name	2010	2011	2012	2013	2014	2015	2016	2017	2018
Georges Bank Cod Fixed Gear Sector	1,823	2,113	1,939	1,469	1,687	1,542	1,663	1,731	1,887
Northeast Fishery Sector II	1,495	2,028	1,874	988	746	902	947	1,141	1,320
Northeast Fishery Sector V	596	588	590	832	797	779	669	732	687
Sustainable Harvest Sector	995	1,001	1,178	1,122	1,072	805	701	636	577
Northeast Fishery Sector XI	1,332	1,505	1,559	1,065	1,086	629	465	478	569
Northeast Fishery Sector XII	57	269	302	201	0	0	396	410	422
Maine Coast Community Sector	0	0	0	432	453	248	136	259	338
Sustainable Harvest Sector - Inshore	0	0	0	0	0	160	143	231	263
Northeast Fishery Sector XIII	251	375	482	333	315	264	254	222	247

Sector Name	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northeast Fishery Sector III	2,208	2,753	2,162	1,176	1,097	647	393	247	218
Northeast Fishery Sector VIII	147	109	113	99	128	126	135	125	209
Northeast Coastal Communities Sector	11	73	20	10	4	12	14	112	175
Northeast Fishery Sector VI	107	121	118	125	95	90	67	112	143
Northeast Fishery Sector X	635	1,004	1,162	591	385	495	44	30	79
Northeast Fishery Sector VII	290	318	270	230	359	310	153	140	1
Northeast Fishery Sector IX	287	369	373	437	448	383	327	151	0
Port Clyde Community Groundfish Sector	464	714	625	0	0	0	0	0	0
Tristate Sector	81	50	114	0	0	0	0	0	0
n_trips	**10,779**	**13,390**	**12,881**	**9,110**	**8,672**	**7,392**	**6,507**	**6,757**	**7,135**

Table 52 - Number of active vessels subject to at-sea monitoring requirements, landing in port groups by fishing year (note: vessels may land in multiple ports).

Trip Port	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT PORTS	9	10	11	11	10	11	7	6	5
OTHER MA PORTS	41	39	48	34	32	34	48	41	35
BOSTON	25	24	20	19	23	21	20	19	21
CHATHAM	29	30	28	23	19	27	22	27	26
GLOUCESTER	102	95	90	77	66	61	60	60	55
NEW BEDFORD	75	78	78	56	54	70	54	48	26
OTHER ME PORTS	13	13	20	9	7	4	6	9	8
PORTLAND	26	39	40	29	31	26	26	23	29
NH PORTS	26	25	23	16	14	10	9	11	13
NJ PORTS	2	3	2	7	7	8	2	4	2
NY PORTS	8	8	10	8	7	7	11	6	5
OTHER RI PORTS	3	3	4	4	6	2	1	1	2
POINT JUDITH	44	38	46	41	36	36	33	25	23
OTHER NORTHEAST PORTS	8	8	15	19	18	14	11	9	5

Table 53 - Number of trips by vessels subject to at-sea monitoring requirements, landing in port groups by fishing year (note: trips may land in multiple ports).

Trip Port	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT PORTS	68	107	138	130	112	101	61	66	98
OTHER MA PORTS	912	1,164	1,400	810	590	754	664	706	729
BOSTON	462	534	499	435	490	436	367	425	461
CHATHAM	1,709	2,092	1,839	1,268	1,542	1,356	1,476	1,480	1,766
GLOUCESTER	3,978	4,986	4,308	2,375	1,928	1,792	1,588	1,753	1,856
NEW BEDFORD	1,062	1,229	1,205	1,012	1,161	1,132	980	746	452
OTHER ME PORTS	257	383	416	147	182	79	56	173	239
PORTLAND	432	707	745	740	689	460	362	400	425
NH PORTS	1,209	1,520	1,668	1,088	958	531	414	478	597
NJ PORTS	21	30	19	37	39	26	7	8	4
NY PORTS	64	60	101	209	277	176	219	207	196
OTHER RI PORTS	23	69	54	48	23	16	29	24	4
POINT JUDITH	702	829	931	947	880	877	684	671	660
OTHER NORTHEAST PORTS	120	141	116	131	102	77	32	17	14

6.5.9.2 Common Pool Harvesting Component

With the adoption of Amendment 16, most commercial groundfish fishing activity occurs under sector management regulations. Some vessels have elected to not join sectors, and continue to fish under the effort control system. Collectively, this part of the fishery is referred to as the “common pool.” These vessels fish under both limited access and open access groundfish fishing permits. Common pool vessels accounted for only a small amount of groundfish catch in FY2018 (Table 11).

Groundfish landings and revenue from common pool vessels have fluctuated over time (Table 11). Common pool vessels with limited access permits landed 1.2M lbs. (landed lbs.) of regulated groundfish in FY2010, worth $2.2M in ex-vessel revenues (Table 11). Landings declined to 445K lbs., worth about $815,000 in FY2011and declined again in FY2012 to 234K lbs., worth $503,000. In FY2013, groundfish landings and revenue from common pool vessels rose to 595Klbs, worth about $1.1M. In FY2014, groundfish landings and revenue from common pool vessels fell to 490Klbs., worth $923,000, followed by a rise in FY2015 to 670Klbs, worth $1.3M. Groundfish landings and revenue from common pool vessels have fallen in recent years, to 328Klbs. in FY2016, worth $843,000, and to the lowest point in FY2017, 186Klbs., worth $448,000.

6.5.9.3 Recreational Harvesting Component [*to be updated*]

The recreational fishery includes private anglers, party boat operators, and charter vessel operators. Several groundfish stocks are targeted by the recreational fishery, including GOM cod, GOM haddock, pollock, GOM winter flounder, and GB cod. GB haddock is targeted as well, but to a lesser extent. SNE/MA winter flounder and redfish are also target species. Amendment 16 (Section 6.2.5, NEFMC 2009) included a detailed overview of recreational fishing activity.

Table 54 provides a breakdown of the number of vessels active in the for-hire component of the recreational fishery for FY 1998 to FY 2018.

Table 54 - For-hire recreational vessels catching cod or haddock from the Gulf of Maine

Fishing Year	Party	Charter	Total*
1998	52	108	137
1999	53	100	129
2000	48	108	130
2001	63	117	153
2002	43	127	152
2003	58	130	164
2004	63	127	164
2005	57	133	165
2006	65	130	163
2007	51	128	153
2008	55	129	154
2009	53	130	161
2010	53	140	167
2011	46	127	150
2012	43	109	133
2013	40	114	134
2014	39	103	119
2015	34	74	92
2016	37	71	88
2017	52	59	91
2018	43	89	95

Notes: *Total may not sum due to vessels taking both categories of trips during the fishing year.

Based on vessel reporting via vessel log book.

Vessels landing or discarding cod or haddock from Gulf of Maine statistical areas based on vessel log book.

Source: NMFS Greater Atlantic Regional Fisheries Office, January 2020.

6.5.10 Groundfish Monitoring

6.5.10.1 Summary of Types of Groundfish Monitoring Data in the Current Monitoring Program

The current groundfish monitoring program collects fishery-dependent data from multiple sources including the vessel monitoring system (VMS), the interactive voice response (IVR) system, vessel trip reports (VTR), dealer reports, industry-funded at-sea monitors, and Northeast Fishery Observer Program (NEFOP) observers. Most groundfish vessels are required to have a VMS unit, although exemptions exist for a small proportion of the fleet (handgear B vessels, common pool small vessel category vessels fishing in a single broad stock area, and handgear A vessels fishing in a single stock area). Vessels exempt from the VMS requirement, or fishing any portion of their trip inside the VMS demarcation line, provide trip-level information via IVR rather than VMS. All groundfish vessels are required to submit VTRs for all trips on a weekly basis. All catch sold by a federally permitted vessel must be sold to a federally permitted dealer and dealers must submit reports on a weekly basis. As a result, dealer reports are considered a census of landings (with the exception of catch kept for home consumption or bait, misreported landings, or unreported landings). The at-sea monitoring program is specific to vessels fishing under the provisions of a sector operations plan, but all vessels may be assigned a NEFOP observer as part of the standardized bycatch reporting methodology (SBRM). Additionally, there are daily, weekly, and annual reporting requirements at the sector level. Collectively, these data sources are used by sectors to manage their operations; by GARFO to manage the common pool in-season; by GARFO to monitor ABCs, ACLs, and ACEs; by the NEFSC to conduct stock assessments; and by the NEFMC to manage the fishery.

VMS provides declarations of intent (fishery, area, gear, sector exemptions), positional information, real-time catch estimates (daily catch reports), and trip-level catch estimates (trip catch reports, trip end hails). The IVR system provides declarations of intent for vessels without VMS, or fishing inside the demarcation line, and allows declarations of blocks of time out of the fishery (spawning blocks, gillnet blocks). Fishermen also submit VTRs that include information on: the vessel, gear used, area fished, fishing effort, catch amounts (kept and discarded), dealers to whom catch was sold, and disposition of any catch not sold. VTR information is recorded at the sub-trip level (a new VTR is filled out each time the vessel changes statistical area, gear type, or mesh size during a trip), and VTRs are submitted weekly. Dealers report landings at the trip level using the VTR serial number to link dealer and vessel data for the same trip. At-sea monitors collect information on: gear type; gear size; gear amount; effort information including dates; times, and locations; catch information including species, market category, lengths, weights, disposition and reason, and catch estimation method; and information on takes of protected species. Observers providing coverage under the SBRM collect the same information as at-sea monitors, but also collect additional social and economic information; more detailed information on gear construction and configuration; bait; environmental conditions; marine mammal sightings; and additional biological information (sex, age, biological samples). Table 55 below contains a comparison of information collected by at-sea monitors and observers, and notes what information from those collections is available to sector managers to download from the Sector Information Management Module (SIMM).

Table 55 - Summary of the data collected and reported on groundfish trips.

Data Set	ASM Collection	Additional NEFOP Collection	SIMM Reporting
Vessel and Trip Information	Trip identifier, program code, sector/fleet, vessel information, ports and dates sailed and landed, trip costs, gear type used, target species	Home port, trip duration, crew size, fishing time lost, gear onboard and soaking, captain experience	All ASM fields
Trawl Gear Information	Gear code, gear number, net descriptors, codend and liner mesh sizes, excluder/separator and escape outlet presence	Doors, kites, construction material, fishing circle, length measurements, strengthener, chafing gear, ground gear, sweep gear, floats, gear mounted electronics details, excluder/ separator and escape outlet details	Gear code, gear number, mesh size category
Gillnet Gear Information	Gear code, gear number, number of nets, net length, net height, tie downs, marine mammal deterrents, mesh size	Hanging ratio, twine size, floats and floatline, anchors and leadline, spaces, droplines, net color, surface system, buoyline, groundline, weak links	Gear code, gear number, mesh size category
Longline Gear Information	Gear code, gear number, number of hooks, hook brand, hook model, hook size	Sections, mainline, leaders, anchors, gangions, surface system, buoyline, groundline, weak links, swivels, radar reflectors	Gear code, gear number
Haul Information	Haul number, gear code, gear number, haul observed, weather, wave height, gear condition, target species, soak duration; Dates, times, and locations: haul begin and end	On effort, marine mammal watch, catch exist, wind speed and direction, water temperature, depth, set method, set/tow speed, number of turns, wire out, bait; Dates, times, and locations: fixed gear set, mobile gear fishing begin and gear onboard	Haul number, gear code, haul observed, target species, statistical area, soak duration
Catch Information	Species name, market, weight, disposition (kept or discard) and reason, catch estimation method	Same as ASM	Species, market, stock area, weight, disposition (kept or discard), calculated live weight
Biological Sampling	Lengths: Species name, disposition and reason, sample weight, animal length, number at length	Lengths: sex, age sample type and number Age structures: scales, otoliths, vertebrae, and/or heads (species dependent)	None
Protected Species Interactions	Takes: Animal number, haul number, tag number (applied or existing), species name, entanglement situation, animal condition	Takes: Net number/position, time taken, pinger condition code, sex, sampling measurements, body temperature (mammals) Sightings: Event type, position, haul number, location, weather, wave height, species name, number of animals, how sighted, animal condition, animal behavior	Harbor porpoise takes: Porpoise number, tag number, entanglement situation, animal condition, location

Source: FSB 2015 Data Collection document

At the sector level, each sector must submit weekly ACE status reports (which become daily when 90 percent of a sector's ACE for a stock has been harvested) that summarize sector ACE balances. Sectors also submit a weekly detail report that provides sub-trip level details for each trip by each sector vessel. Detail reports combine data from VTR, dealer, ASM, and observer programs to calculate catch (landings and discards) for each trip by sector vessels as the basis for ACE monitoring. Sectors also submit a weekly trip issue report containing compliance or enforcement concerns, sector enforcement issues, enforcement actions, and incident or compliance reports. Each report is revised and expanded in subsequent iterations and is used to manage the sector and to reconcile data with NMFS. Details of the contents of each report are presented in Table 56 - Table 59.

Table 56 - Detail Report Fields

Column Order	Column Heading	Description	Data Type	Data Column Length
1	Week Ending Date	The Saturday ending the last week included in the report. This date should be the same in all rows of the report.	DATE	N/A
2	Sector Name	GARFO sector name as listed on SIMM.	TEXT	70
3	Vessel Permit No	Vessel permit number assigned by GARFO's Vessel Permit System (VPS).	NUMERIC	N/A
4	Trip ID	eVTR Trip ID or paper VTR serial number.	TEXT	14
5	Trip Observed	Flag indicating if trip was observed or not observed. Y = observed N = not observed	TEXT	1
6	Observer Data Quality Level	Reserved for future use. Value = NULL.	TEXT	3
7	Enforcement issues	Flag indicating if trip had any enforcement issues. Y = Yes N = No **If "Y", must be documented in Trip Issue Report.**	TEXT	1
8	Landing Source	Code for source of landing data (landed weight of catch). Values: ASU = assumed DLR = dealer VTR = vessel VMS = catch report	TEXT	3
9	Area Source	Code for source of area data (stock area fished and gear used). Values: ASU = assumed DLR = dealer VTR = vessel VMS = catch report	TEXT	3
10	Date Sold	The date of first sale of a sector trip's catch to a seafood dealer. Subsequent sales will be rolled up to this date to form a complete trip. **Date Sold** may originate from one of three sources but should be prioritized from: Dealer receipt / sold to date VTR date sold Observer reported landings	DATE	N/A

11	Species ITIS	The 6-digit Integrated Taxonomic Information System (ITIS) serial number for a species. ITIS codes are unique identifiers representing information for a species.	TEXT	11
12	Gear Code	The 3-character standard gear code from the VTR form.	TEXT	3
13	Mesh Cat	Gillnet gear: **ELM** = Extra Large Mesh (8 inches or greater) **LM** = Large Mesh (6 to less than 8 inches) Trawl gear (OTF, OHS, OTR, OTT): **SM** = Small Mesh (less than 3.99 inches) **MM** = Medium Mesh (3.99 inches to 5.74 inches) **LM** = Large Mesh (equal or greater than 5.75 inches) All other mesh are **NA**. Consistent with discard rate strata.	TEXT	6
14	Stock ID	An abbreviation for the Stock Area that incorporates both the species name and the area that species is assigned to. Includes Georges Bank East & West.	TEXT	15
15	Landed Weight	Landed weight (in pounds) of stock landed. The total weight should match dealer reported landings.	NUMERIC	N/A
16	Live Weight	Live weight (in pounds) of stock landed.	NUMERIC	N/A
17	Quantity Discard	Observed or calculated live pounds of species discarded.	NUMERIC	N/A
18	Harvested ACE	The cumulative number of live pounds of catch per stock caught on sector trips in current fishing year.	NUMERIC	N/A
19	Date Last Changed	Date last updated (NULL if new record).	DATE	N/A
20	DSM	Flag indicating if trip was observed by dockside monitor. NOT USED AT THIS TIME. Y = Yes N = No	TEXT	1
21	Discard Rate	The discard rate that applies for this trip. Provided to estimate discards on unobserved trips. Include 5 digits after the decimal point.	NUMERIC	N/A
22	Sector Kall	Total of all kept fish, excluding discards, in live pounds for the entire trip.	NUMERIC	N/A

Table 57 - Trip Issue Report Fields

Column Order	Column Heading	Description	Data Type	Data Column Length
1	*Trip Issue ID*	*Unique identifier assigned* by GARFO *to trip issue upon submission.*	*NUMERIC*	*N/A*
2	*Case ID*	*Unique identifier assigned* by GARFO *to the case upon submission. The same Case ID may be used to link the original submission and follow-up reports.*	*NUMERIC*	*N/A*
3	Week End Date	Saturday ending the last week included in the report. This date should be the same in all rows of the report.	DATE	N/A
4	Vessel Permit No	Vessel permit number assigned by GARFO's Vessel Permit System (VPS). Leave BLANK for general issues or actions.	NUMERIC	N/A
5	Trip ID/VTR Serial No.	eVTR Trip ID or paper VTR serial number, if applicable. Leave BLANK for general issues or actions.	NUMERIC	14
6	Event Date	Date that the issue, event, or corrective action occurred.	DATE	N/A
7	Issue Type	Drop-down menu with issue categories: Enforcement, Discrepancies, Monitoring, Other, and No Issue. Select the most appropriate category for each entry in the report.	LIST	N/A
8	Fishing Year	Select the appropiate fishing year from the drop-down menu.	DATE	N/A
9	Date Entered	Date assigned to issue upon submission.	DATE	N/A
10	Description	Short narrative describing the issue, event, or corrective action.	TEXT	2500

Table 58 - ACE Status Report Fields

Column Order	Column Heading	Description	Data Type	Data Column Length
1	Week Ending Date	Saturday ending the last week included in the report. This date should be the same in all rows of the report.	DATE	N/A
2	Sector Name	GARFO sector name as listed on SIMM.	TEXT	70
3	Stock ID	Abbreviation for the Stock Area that incorporates both the species name and the area that species is assigned to. Includes Georges Bank East & West.	TEXT	15
4	Initial Allocated ACE	The total number of (live) pounds of this stock allocated to the sector for all renewed permits in the current fishing year.	NUMERIC	N/A
5	Maximum Carryover	The amount, in live pounds, of unused ACE (up to the full 10% for an allowable stock) that is carried over from the previous fishing year for all renewed permits.	NUMERIC	N/A
6	De Minimis Carryover	The amount, in live pounds, of the *de minimis* carryover for an allowable stock	NUMERIC	N/A
7	In-Season ACE Adjustment	The adjusted amount (increase or decrease), in live pounds, applied to the Initial Allocated ACE of a stock allocated to a sector in season for all renewed permits.	NUMERIC	N/A
8	Total ACE With Maximum Carryover	The total number of live pounds of this stock initially allocated to the sector including the maximum carryover and In-Season ACE adjustment.	NUMERIC	N/A
9	Total ACE With De Minimis Carryover	The total number of live pounds of this stock initially allocated to the sector including the *de minimis* carryover and the In-Season ACE adjustment.	NUMERIC	N/A
10	Transfers In	The cumulative number of live pounds per stock transferred into the sector for the current fishing year.	NUMERIC	N/A
11	Transfers Out	The cumulative number of live pounds per stock transferred out of the sector for the current fishing year.	NUMERIC	N/A
12	Total Transfers	The sum, in live pounds, of the Transfers In and Transfers Out columns per stock transferred by the sector for the current fishing year.	NUMERIC	N/A

13	Conversions In	The cumulative number of live pounds of stock converted into Western GB ACE from Eastern GB ACE for the current fishing year.	NUMERIC	N/A
14	Conversions Out	The cumulative number of live pounds of stock converted from Eastern GB ACE into Western GB ACE for the current fishing year.	NUMERIC	N/A
15	Current ACE With Maximum Carryover	Total ACE, plus or minus Total Transfers, plus the values of Conversions In and Conversions Out, including the maximum carryover from the previous fishing year.	NUMERIC	N/A
16	Current ACE With De Minimis Carryover	Total ACE plus or minus Total Transfers, plus the values of Conversions In and Conversions Out, including the *de minimis* carryover from the previous fishing year.	NUMERIC	N/A
17	Harvested ACE	The cumulative number of live pounds o7f catch per stock caught on sector trips in current fishing year.	NUMERIC	N/A
18	Remaining ACE With Maximum Carryover	Current ACE With Maximum Carryover minus Harvested ACE.	NUMERIC	N/A
19	Remaining ACE With De Minimis Carryover	Current ACE With De Minimis Carryover minus Harvested ACE.	NUMERIC	N/A
20	Percent Harvested ACE To Date With Maximum Carryover	Harvested ACE divided by Current ACE With Maximum Carryover, expressed as a percentage.	NUMERIC	N/A
21	Percent Harvested ACE To Date With De Minimis Carryover	Harvested ACE divided by Current ACE With De Minimis Carryover, expressed as a percentage.	NUMERIC	N/A

Table 59 - Daily ACE Status Report Fields

Column Order	Column Heading	Description	Data Type	Data Column Length
1	Submission Date	Date the daily report is being submitted.	DATE	N/A
2	Sector Name	GARFO sector name as listed on SIMM.	TEXT	70
3	Stock ID	Abbreviation for the Stock Area that incorporates both the species name and the area that species is assigned to. Includes Georges Bank East & West.	TEXT	15
4	Initial Allocated ACE	Total number of (live) pounds of this stock allocated to the sector for all renewed permits in the current fishing year.	NUMERIC	N/A
5	Maximum Carryover	The amount, in live pounds, of unused ACE (up to the full 10% for an allowable stock) that is carried over from the previous fishing year for all renewed permits.	NUMERIC	N/A
6	De Minimis Carryover	Amount, in live pounds, of the *de minimis* carryover for an allowable stock	NUMERIC	N/A
7	In-Season ACE Adjustment	The adjusted amount (increase or decrease), in live pounds, applied to the Initial Allocated ACE of a stock allocated to a sector in season for all renewed permits.	NUMERIC	N/A
8	Total ACE With Maximum Carryover	The total number of live pounds of this stock initially allocated to the sector including the maximum carryover and In-Season ACE adjustment.	NUMERIC	N/A
9	Total ACE With De Minimis Carryover	The total number of live pounds of this stock initially allocated to the sector including the *de minimis* carryover and the In-Season ACE adjustment.	NUMERIC	N/A
10	Transfers In	The cumulative number of live pounds per stock transferred into the sector for the current fishing year.	NUMERIC	N/A
11	Transfers Out	The cumulative number of live pounds per stock transferred out of the sector for the current fishing year.	NUMERIC	N/A

12	Total Transfers	The sum, in live pounds, of the Transfers In and Transfers Out columns per stock transferred by the sector for the current fishing year.	NUMERIC	N/A
13	Conversions In	The cumulative number of live pounds of stock converted into Western GB ACE from Eastern GB ACE for the current fishing year.	NUMERIC	N/A
14	Conversions Out	The cumulative number of live pounds of stock converted from Eastern GB ACE into Western GB ACE for the current fishing year.	NUMERIC	N/A
15	Current ACE With Maximum Carryover	Total ACE, plus or minus Total Transfers, plus the values of Conversions In and Conversions Out, including the maximum carryover from the previous fishing year.	NUMERIC	N/A
16	Current ACE With De Minimis Carryover	Total ACE plus or minus Total Transfers, plus the values of Conversions In and Conversions Out, including the *de minimis* carryover from the previous fishing year.	NUMERIC	N/A
17	Harvested ACE	The cumulative number of live pounds o7f catch per stock caught on sector trips in current fishing year.	NUMERIC	N/A
18	Remaining ACE With Maximum Carryover	Current ACE With Maximum Carryover minus Harvested ACE.	NUMERIC	N/A
19	Remaining ACE With De Minimis Carryover	Current ACE With De Minimis Carryover minus Harvested ACE.	NUMERIC	N/A
20	Percent Harvested ACE To Date With Maximum Carryover	Harvested ACE divided by Current ACE With Maximum Carryover, expressed as a percentage.	NUMERIC	N/A
21	Percent Harvested ACE To Date With De Minimis Carryover	Harvested ACE divided by Current ACE With De Minimis Carryover, expressed as a percentage.	NUMERIC	N/A

Amendment 13 established the requirement that sectors submit annual year-end reports, and Amendment 16 expanded on those requirements. Current regulations require that approved sectors must submit an annual year-end report to NMFS and the Council, within 60 days of the end of the fishing year that summarizes the fishing activities of its members, including harvest levels of all species by sector vessels (landings and discards by gear type), enforcement actions, and other relevant information required to evaluate the performance of the sector. However, due to the time reconciliation takes, in the NMFS year-end report guidance the due date for the report is set as 14 days after the date final data tables are provided to the sectors by NMFS. The regulations require that the annual report must report the number of sector vessels that fished for regulated groundfish and the permit numbers of those vessels (except when this would violate protection of confidentiality), the number of vessels that fished for other species, the method used to estimate discards, the landing ports used by sector vessels while landing regulated groundfish, and any other information requested by the Regional Administrator. The annual report is intended to provide information necessary to evaluate the biological, economic, and social impacts of sectors and their fishing operations.

NMFS provides sectors with a guidance document detailing additional information required in the annual report, consistent with the regulatory authority, and specifications for submitting the report.[13] Sector annual year-end reports comprise two files: a MS Word file for descriptive information and a MS Excel file for table data.

Table 60 - Contents of the Descriptive Information File

Section Name	Description
Section 1: Fishing Effort Information	Fishing effort by sector vessels under sector rules
Section 2: Discard Estimation Method	A description of the method that was used and the sector's experience of using the method
Section 3: Violation Reports	Detailed reports of violations and how they were handled
Section 4: Other Relevant Information	Biological, social, and economic impact of sectors

Table 61 - Summary of Year-End Report Tables

Table	Table Contents
Table 1	Summary data by vessel
Table 2	Port landing data
Table 3	PSC and Initial ACE data
Table 4a	Groundfish Landings and ACE Transfer summary data
Table 4b	Groundfish Landings from Trawl Gear

[13] Preparing the Northeast Multispecies Sector Annual Year-end Report, 2016, GARFO, https://www.greateratlantic.fisheries.noaa.gov/sustainable/species/multispecies/sector/docs/fy2016/sectoryerguidefy2016rev70.pdf

Table	Table Contents
Table 4c	Groundfish Landings from Gillnet Gear
Table 4d	Groundfish Landings from Hook Gear
Table 5a	Other Species Landings Data from Sector Trips
Table 5b	Other Species Landings Data from Non-Sector Trips
Table 6	ACE Transfers to other sectors
Table 7	ACE Transfers from other sectors
Table 8	ACE Redistribution within sector
Table 9	ACE Conversion GB Haddock East to GB Haddock West

The source data for these tables come from various inputs including but not limited to VTRs, dealer reports, VMS catch reports, and Permits; these source data have been processed for quality by NMFS.

The Draft Fishery Data for Stock Assessment Working Group Report (see Appendix II) provides a more detailed summary of the data components used in groundfish assessments, including the fishery-dependent and fishery-independent data sources that contribute to each of those data components and a description of the information provided by these data sources. Table 3 from that document is included below as a reference (Table 62).

Table 62 - A general description of data components used in SAW/SARC assessments, the data sources that contribute to each of those components, and a description of the information provided by those data sources.

Data Component	Source	Description
Fishery-Dependent		
Commercial landings at age	Dealer reports	Landings
	VTR	Area allocation
	Port biological samples	Lengths and ages
Commercial discards at age	ASM	Discards
	NEFOP	Discards
	NEFSC surveys	Borrowed age-length keys
	Port biological samples	Borrowed age-length keys
Recreational landings at age	Angler intercept survey	Landings

	Coastal household survey NEFSC surveys Port biological samples	Angler effort Borrowed age-length keys Borrowed age-length keys
Recreational discards at age	Angler intercept survey Coastal household survey NEFSC surveys Port biological samples	Discards Angler effort Borrowed age-length keys Borrowed age-length keys
Catch weights at age	Port biological samples NEFSC surveys	Lengths and ages Length-weight relationship
Fishery-Independent		
Indices at age	NEFSC surveys	Survey catch Survey effort Lengths and ages
	State surveys	Survey catch Survey effort Lengths and ages
Maturity	NEFSC surveys	Maturity
Natural mortality	Varies by stock	Natural mortality

Notes: Age data typically are not available for commercial discards or recreational landings and discards. Therefore, age-length keys are borrowed from other sources for those components. The Canadian Department of Fisheries and Oceans (DFO) provides Canadian catch and survey indices.
Source: Draft Fishery Data for Stock Assessment Working Group Report, November 2018, Table 3

The various data collection and reporting requirements have been developed, implemented, and modified over time. Amendment 13 adopted the concept that sectors are responsible for monitoring sector catch, but provided few details for that requirement. Amendment 16 was a major overhaul of the monitoring system and included additional details for the sector monitoring program. Amendment 16 also created a dockside monitoring program for sectors and common pool vessels to verify landings of a vessel at the time it is weighed by a dealer and to certify the landing weights are accurate as reported on the dealer report (see section 6.5.10.1.1 'Summary of Types of Groundfish Monitoring Data in the Previous Dockside Monitoring Program').

Framework 45 modified the dockside and at-sea monitoring programs. This action exempted vessels issued a handgear A, handgear B, or small vessel category permit from the dockside monitoring requirement, but also implemented a requirement that dockside monitors inspect fish holds. However, NMFS disapproved a Framework 45 measure to delay industry responsibility for at-sea monitoring costs. Framework 48 eliminated the dockside monitoring requirement and clarified the goals and performance standards for groundfish monitoring programs. NMFS approved the removal of the dockside monitoring program because it believed at that time that dealer reporting combined with dockside intercepts by enforcement personnel were sufficient to ensure reliable landings data.

Framework 48 also included provisions for cost-sharing of monitoring costs between the industry and NMFS, and a provision to delay industry responsibility for funding at-sea monitoring until fishing year 2014, but those provisions were not approved by NMFS. NMFS disapproved a delay in industry's responsibility to fund monitoring in both Framework 45 and Framework 48 because it determined the delay would be inconsistent with the requirements of the FMP and the Magnuson-Stevens Act. NMFS determined in those actions that relying on NMFS appropriations to determine at-sea monitoring coverage rates would not ensure sufficient coverage to monitor sector ACEs or to meet the purpose and goals of the sector monitoring program. NMFS concluded that if sector at-sea monitoring depended on NMFS funding alone, and that funding fell short of required coverage levels, NMFS would not be able to reliably estimate total catch, undermining the effectiveness of ACLs and sector ACEs to prevent overfishing and facilitate the rebuilding of groundfish stocks as required by National Standard 1 and section 303(a)(1) of the Magnuson-Stevens Act. NMFS disapproved the cost sharing provision in Framework 48 because it was not consistent with the Anti-Deficiency Act and other appropriations laws that prohibit Federal agencies from obligating the Federal government except through appropriations and prohibit sharing the payment of government obligations with private entities.

Framework 55 adjusted the ASM program to ensure the likelihood that discards for all groundfish stocks are monitored at a 30-percent coefficient of variation while making the program more cost effective. The changes in Framework 55 removed ASM coverage for a certain subset of sector trips, use multiple years of discard information to predict ASM coverage levels, and based the target coverage level on the predictions for stocks that would be at a higher risk for an error in the discard estimate. None of the adjustments removed the requirement under Amendment 16 and Framework 48 to ensure sufficient ASM coverage to achieve a 30-percent CV for all stocks, nor the requirement to monitor catch sufficiently to prevent overfishing.

The primary goal of the groundfish sector at-sea monitoring program is to verify area fished, catch, and discards by species, by gear type; and meeting these primary goals should be done in the most cost effective means practicable (FW 55). All other goals and objectives of groundfish monitoring programs at §648.11(l) are considered equally-weighted secondary goals. The goals and objectives of the groundfish monitoring program are included in Section 3.3.2 of this action.

6.5.10.1.1 Groundfish Monitoring Data in Previous Dockside Monitoring Program

The dockside monitoring program in Amendment 16 was created to verify landings of a vessel at the time it is weighed by a dealer and to certify the landing weights are accurate as reported on the dealer report. Trip start hails and trip end hails were required to coordinate the deployment of dockside or roving monitors. Dockside monitors met vessels upon landing and validated the dealer report and/or offload to a truck. The dockside monitoring program was also to apply to common pool vessels beginning in 2013 when the trimester TAC and associated AMs became effective.

Dealer-reported fish weights are used as the principle source to monitor commercial landings. Dockside monitor reports recorded the dealer weights observed by the monitor. Monitoring providers were required to keep an electronic record of the information collected and make that available to NMFS. However, in practice the information were stored as digital scans of paper documents, rather than formatted data in a queriable database, which reduced the utility of the information.

Dockside monitors collected copies of vessel VTRs; recorded whether dealer scales were certified by the state; observed and recorded whether ice and fish tote weights were tared by the dealer before catch was added or obtained the estimated weight of ice and fish tote used by the dealer; recorded the captain's estimated weight of each species being retained for home use or retained on the vessel for other reasons; and either the dealer or dockside monitor recorded the weight of offloaded fish in a report signed and kept by the dockside monitor. Information was provided to sectors within 24 hours.

Trip Start and Trip End hails were implemented to facilitate the logistics of the dockside monitoring program. The hails were retained after the end of the dockside monitoring program to facilitate enforcement. All trips must submit Trip End hails, but only a subset of trips are required to submit Trip Start hails.

Trip Start hails must include vessel permit number; trip ID number in the form of the VTR serial number of the first VTR page for that trip; an estimate of the date and time of arrival to port; and any other information as instructed by the Regional Administrator. Trip End hails must include vessel permit number; VTR serial number; intended offloading location(s), including the dealer name/offload location, port/harbor, and state for the first dealer/facility where the vessel intends to offload catch and the port/harbor, and state for the second dealer/facility where the vessel intends to offload catch; estimated date/time of arrival; estimated date/time of offload; and the estimated total amount of all species retained, including species managed by other fishery management plans, on board at the time the vessel first offloads its catch from a particular trip.

See Appendix III (Groundfish PDT Dockside Monitoring Discussion Paper) for more information on the previous DSM program, as well as case studies of DSM programs in other regions, and discussion from the PDT on considerations for developing a DSM program.

6.5.10.1.2 Current Dockside Monitoring Data

As more fully described in Appendix IV (Electronic Monitoring Programs in the Northeast Multispecies (Groundfish) Fishery), NMFS is operating a DSM program as part of an exempted fishing permit (EFP) for a project developing a maximized retention in conjunction with electronic monitoring (EM). Dockside monitors have three primary functions: (1) Inspect fish holds to ensure complete offload of catch; (2) conduct biological sampling on undersized groundfish catch; and (3) verify dealer weights. Data from the DSM program is used to estimate discards for sector management and is included in the 2019 stock assessments.

6.5.10.1.3 Electronic Monitoring Data

Amendment 16 authorized the use of EM in place of actual observers if NMFS deems the technology sufficient for a specific trip type based on gear type and area fished. NMFS has issued multiple EFPs to interested stakeholders since fishing year 2016 to develop EM technologies and explore implementation of EM. These EFPs allow commercial vessels to use EM as part of official catch monitoring protocols, facilitating the development of fleet-wide implementation. As more fully described in Appendix IV, the two primary approaches to EM being developed for groundfish are an audit model and a maximized retention model.

At the core of the protocols is a multi-camera video system used to record vessel operations that follow predefined catch handling procedures. The recorded video is then reviewed by trained video reviewers to determine whether the catch handling procedures were followed (e.g., regulatory compliance) and, for audit-model protocols, to annotate the size/weight of groundfish species discarded. Vessel captains are required to report haul-level effort and catch information (including discards) through electronic Vessel Trip Reports (eVTR), producing finer-scale fishery-dependent data useful for science and management. Video footage is used to track discard and catch retention compliance for both models. Vessels in the audit program use discards reported on eVTRs that are confirmed with the video footage. Vessels in the maximized retention model have discard estimates derived from dockside monitoring. Discard information from EM vessels is used for sector management and the dockside monitoring data from the maximized retention model is included in the 2019 stock assessments.

6.5.10.2 Summary of Monitoring Coverage Rates

Minimum monitoring coverage levels for the Northeast multispecies (groundfish) sector fishery must meet the coefficient of variation as specified in the Standardized Bycatch Reporting Methodology (SBRM). The total monitoring coverage for the Northeast multispecies sector fishery is specified to achieve the required Coefficient of Variation of 30 percent (CV30) or better precision of the discard estimates for each Northeast multispecies stock for all sectors and gears combined, using the same target coverage level for each sector. GARFO's Analysis and Program Support Division, in consultation with Sustainable Fisheries Division staff, performs analysis to recommend the total monitoring coverage for Northeast multispecies sectors annually. The recommended coverage level is expected to sufficiently monitor and enforce catch levels for Northeast multispecies sectors each year. The recommendation relies on an analysis of past performance to provide a reasonable expectation of meeting the requirement of achieving the CV30 or better precision at the overall stock level for each groundfish stock. For further information on this analysis, see the "Summary of Analyses Conducted to Determine At-Sea Monitoring Requirements for Multispecies Sectors FY2019":
https://www.greateratlantic.fisheries.noaa.gov/aps/monitoring/nemultispecies.html

As described above in Section 6.5.10.1, the Fisheries Sampling Branch (FSB) at the Northeast Fisheries Science Center manages two separate but related monitoring programs: the Northeast Fisheries Observer Program (NEFOP) and the At-Sea Monitoring (ASM) Program. The coverage level recommendation specifies the "total monitoring coverage," whether provided by NEFOP or ASM. Coverage from NEFOP is combined with coverage by ASM to achieve the total monitoring coverage level. Sectors are required to design, implement, and pay their costs for any portion of the coverage not funded by the agency through NEFOP coverage. In previous years, FSB has provided GARFO with an estimate of the NEFOP coverage they expect to provide sector vessels in the upcoming fishing year. Beginning in FY 2019, however, NMFS initiated use of a new method for selecting groundfish fishing trips for NEFOP observation which will still implement the combined target coverage level for the groundfish fishery, but uses the SBRM fleet-based stratification to allocate NEFOP coverage rather than a flat rate across sectors. Differences in the sectors' SBRM fleet type compositions result in differential NEFOP coverage levels across sectors, and so an overall estimate of NEFOP coverage for sectors is unavailable.

As described above in section 6.5.10.1, the monitoring requirements for Northeast multispecies sectors have been modified several times since they were established in Amendment 16 to the Northeast Multispecies Fishery Management Plan, most recently in Framework 55, which became effective on May 1, 2016. The updated regulations at 50 C.F.R. § 648.87(b)(1)(v)(B)(1)(i) govern the monitoring coverage levels that may be required to monitor sector operations, to the extent practicable, to reliably estimate overall catch by sector vessels. These regulations require NMFS to specify coverage levels sufficient to at least achieve a CV of 30 at the overall stock level for each groundfish stock. NMFS is required to use the most recent 3-year average of the total required coverage level necessary to achieve the CV30 threshold. The target coverage level is the maximum stock-specific rate after considering criteria that allow for removing healthy stocks (no overfishing occurring and not overfished) with low relative catch and discards (<75% catch of previous year's sector sub-ACL or <10% discards) from being used to determine the coverage rate. If the target coverage level resulting from this screening is too low to achieve the CV30 standard, NMFS may set a different target coverage level to achieve the required standard.

When determining what stock-specific rate is necessary, NMFS is required to take into account the primary goal of the at-sea monitoring program of verifying area fished and catch and discards by species and gear type by the most cost-effective means practicable. Other considerations include the equally weighted secondary groundfish monitoring goals and objectives, the MSA's national standards, and any other relevant factors. The total monitoring coverage ultimately should reasonably produce catch estimates that are accurate enough to ensure that overfishing is prevented while there is sufficient fishing opportunity to achieve optimum yield. To that end, additional uncertainty buffers are established when setting ACLs to help make up for any lack of absolute precision and accuracy in estimating overall catch by sector vessels.

While a total monitoring coverage target level is expected to meet the CV30 standard on discard estimates, there is no guarantee that the required coverage level will be met or result in a 30-percent CV across all stocks due to changes in fishing effort and observed fishing activity that may happen in a given fishing year. Due to fluctuations in fishing activity over the year, it is difficult to deploy observers throughout the year and ensure that target coverage levels are attained. Additionally, Pre-Trip Notification System (PTNS) non-compliance is another reason why target coverage levels may not be attained. As Table 63 indicates, the realized level of coverage was below the target for most years, aside from FY 2016.

The timeline for when total monitoring coverage level information is available has varied over time (Table 63). Currently, NMFS publishes the total monitoring coverage level once the necessary analysis is completed. Typically, analysis to determine the total at-sea monitoring coverage level has been available sooner than the SBRM analysis used to determine the NEFOP coverage level.

Current regulations set December 1 as the deadline for sectors to submit preliminary rosters, but grant NMFS flexibility to set a different date. For example, in FY 2013, managers asked for a later date, and they agreed on March 29, 2013. Beginning in FY 2014, NMFS established a standard deadline of four weeks after potential sector contribution (PSC) letters are sent out, although in several years, there have been agreed-upon extensions. There have been several years when the date sector rosters were due occurred before the date the total monitoring coverage rate was announced (Table 63) which can complicate groundfish fishery participant's business planning as the decision of whether or not to participate in sectors for the upcoming fishing year may be influenced by the monitoring coverage rate for a given year.

Table 63 - Target and realized observer (NEFOP and ASM) coverage levels for the groundfish fishery and dates when analyses to determine coverage rates available for Fishing Years 2010-2019.

Fishing Year	NEFOP target coverage level	ASM target coverage level	Total target coverage level	Realized coverage level	Date analysis posted by GARFO to determine total coverage rate	Date total coverage rate announced	Date sector rosters were due
FY 2010	8 %	30 %	38 %	32 %			
FY 2011	8 %	30 %	38 %	27 %			12/1/2010
FY 2012	8 %	17 %	25 %	22 %			12/1/2011
FY 2013	8 %	14 %	22 %	20 %	4/12/2013	3/14/2013	3/29/2013
FY 2014	8 %	18 %	26 %	25.7%	2/21/2014	2/18/2014	3/6/2014
FY 2015	4 %	20 %	24 %	19.8%	3/2/2015	2/26/2015	2/25/2015
FY 2016	4 %	10 %	14 %	14.8%	5/6/2016	3/22/2016	3/15/2016
FY 2017	8 %	8 %	16 %	14.1%	3/15/2017	3/15/2017	3/16/2017
FY 2018	5 %	10 %	15 %	n/a	1/25/2018	1/25/2018	3/26/2018
FY 2019	n/a	n/a	31 %	n/a*	3/28/2019	3/28/2019	3/8/2019

"n/a" indicates that the information is not available.
*Realized coverage not available; fishing year still underway.
Source: Summary of analyses conducted to determine at-sea monitoring requirements for multispecies sectors, FY2019, GARFO; and personal communication with GARFO staff

6.5.10.3 Funding for At-Sea Monitoring Coverage

Beginning in 2012, Amendment 16 required that the at-sea monitoring program would be industry funded. However, since then NMFS has had sufficient funding to be able to pay for all or some of industry's sampling costs of the groundfish at-sea monitoring program. From FY 2012 through FY 2014, NMFS fully covered the sampling costs for the at-sea monitoring program. In FY 2015, NMFS fully covered sampling costs for the at-sea monitoring program until funds were expended in March 2016, at which point industry became responsible for the cost of at-sea monitoring. From July 2016 through April 2018, NMFS partially reimbursed sector participants for at-sea monitoring costs through a grant with the Atlantic States Marine Fisheries Commission (ASMFC). Sectors were reimbursed 85% of their ASM costs for July 2016-April 2017. For FY 2017, sectors were reimbursed 60% of their ASM costs. At the end of the 2017 fishing year, there were remaining funds from the original grant, and to fully disburse those funds, sectors were reimbursed the remainder, effectively bringing the 2017 reimbursement rate for ASM-covered trips up to approximately 85%.

For FY 2018 and FY 2019, NMFS has reimbursed industry for 100 percent of its at-sea monitoring costs through a grant with the ASMFC. It is anticipated that once these appropriated funds are used, sampling costs of at-sea monitoring would be fully paid for by industry, unless additional NMFS funds are available.

6.5.10.4 Summary of PDT Monitoring Analyses

The PDT prepared four analyses to support the development of Amendment 23. Specifically, PDT members analyzed discard incentives, observer effects, catch ratios, and developed models to predict groundfish catch on unobserved trips using observed trip information (see Appendix V for more information on each analysis). These four analyses were reviewed by a subgroup of the SSC in April 2019 (see SSC sub-panel report, in Appendix V) in order to determine the scientific rigor of each approach as well as the sufficiency of each analysis to inform the development of Amendment 23 and analysis of different alternatives (see Terms of Reference, SSC sub-panel report, page 21, in Appendix V).

6.5.10.4.1 Discard Incentives for New England Stocks

This analysis modelled the incentive to discard each allocated groundfish stock based on the economic incentives to retain or discard the catch. This analysis looks at incentives at the trip-level and from the perspective of a hired captain, or someone who is able to calculate expected costs associated with landing each individual fish as well as expected revenues. The model calculates the incentive to discard as the difference between the costs of landing and discarding each stock in each quarter of each fishing year between 2007 and 2017. Expected costs of landing include quota costs (modelled ACE lease prices), labor costs, and landing fees. Then the expected costs of discarding, specifically discarding legal sized fish which otherwise need to be retained, is the forgone revenue (ex-vessel price) as well as the probability that the illegal activity (discarding) will be discovered and the likely sanction.

Conclusions:

- Stocks landed with a positive discard incentive may indicate bias in the total catch estimate for that stock.
- In general, yellowtail flounder and cod stocks have the highest modeled discard incentives over time, but these are highly variable on a year to year basis.
    - All three (Georges Bank, Southern New England/Mid-Atlantic, and Gulf of Maine) yellowtail flounder stocks had higher discard incentives in earlier years (2010, 2012).
    - Both (Gulf of Maine and Georges Bank) cod stocks had higher discard incentives in recent years (2015-2017).
- Stocks with consistently low discard incentives include those with relatively low quota price to ex-vessel price ratios, including pollock, redfish, and Georges Bank haddock.
- Quota prices as a ratio of ex-vessel price drives modelled discard incentives. This ratio is the strongest theoretical predictor of bias.
- Utilization (catch: annual catch limit) is weakly related to quota price and varies by stock.
- The model can only identify when landings or trips comply with the discarding prohibition, even when it may not be economically rational to do so. The model cannot quantify the proportion of trips or catch that does not comply with the discarding prohibition.
- More precise estimates of quota prices will enhance the ability to model discard incentives under current conditions.
- There may be other social, cultural, or normative factors that may influence individuals' decisions to comply with discard rules that we do not account for in this analysis.

6.5.10.4.2 Observer effects in the groundfish fishery

This analysis demonstrates that fishing vessels in the groundfish fishery alter their behavior in response to human observers. The analysis looked at eight measures: namely (1) trip duration, (2) kept catch, (3) kept groundfish, (4) kept non-groundfish, (5) total revenue, (6) groundfish average price, (7) opportunity cost of quota, and (8) number of groundfish market categories included in kept catch. These measures cover a broad range of impacts that are relevant for observer-related fisheries management policy. The analyses were conducted separately for four stanzas (one pre-sector stanza and three post-sector stanzas) and also by fishing gear (gillnet and trawl).

Conclusions:

- This analysis demonstrates that fishing vessels in the Northeast multispecies (groundfish) fishery alter their behavior in response to human observers (distinct from selection bias/observer deployment effects). The analysis documents a consistent pattern of different fishing behaviors when an observer is on board.
- Data generated on observed trips are not representative of the whole fleet.
- Generally, the most pronounced effects are seen across trip duration, kept catch, kept groundfish, and trip revenue.
- Observer presence has the smallest effect on the number of groundfish market categories and non-groundfish average prices, but even in these instances differences are observed.
- The data show a trend for three key metrics, in almost all circumstances, such that when an observer is onboard, vessels appear to:
    1. Retain fewer fish,
    2. Fish for less time and,
    3. Obtain lower revenues.
- Persistent differences such as higher average groundfish prices with an observer on board (trawl vessels) and emerging differences like a greater number of market categories retained with an observer (gillnet vessels) indicate that the composition of catch on observed trips is different than unobserved trips.

6.5.10.4.3 Predicting groundfish catch in the presence of observer bias

This method used observed trips in the Gulf of Maine (GOM) stock area to model expected cod catch while accounting for typical effort attributes (e.g., total kept catch, vessel size, trip length) in addition to spatial and temporal covariance in catch. The approach creates a predictive model, which was used to predict total cod catch (kept + discarded) on observed trips, to test the performance of the model. The predictive model was then used to predict catch for unobserved trips. Both predictions were compared to the summed predictions across a fishing season to the catch estimates for sectors reported by NMFS. By modeling patterns of cod catch across space, time, and other attributes of fishing effort on observed trips, predictions of expected catch on unobserved trips were compared to the reported catch on these trips.

Conclusions:

- For gillnet trips, predicted cod catch was increasingly higher than reported catch from 2013 to 2017. Differences between predicted and reported catch on trawl trips were variable across time without an apparent trend.
- For both gear types, the proportion of total catch consisting of cod decreased over time, suggesting less targeting.
- There is some evidence that the magnitude of unreported cod catch (potentially illegal discarding) could have been >60% of reported catch on unobserved trips.
- An important caveat is that conclusions depend on validity of the model structure and predictions. If unmeasured attributes of effort (e.g. tow speed) and/or relationships between effort predictors and catch outcomes differ between observed and unobserved trips, predictions may not be valid. Differences in catch outcomes are assumed to be attributed to post-catch behavior (compliance, or lack thereof, with discarding regulations) and not pre-catch behavior (how the gear was fished).
- Results from models for pollock suggested a lack of model fit compared to those for cod, making conclusions equivocal for this species.

6.5.10.4.4 Methods to evaluate groundfish catch ratios

The objective of the study was to compare ratios of stock-specific landings to effort and total catch on observed and unobserved trips in the multispecies groundfish fishery to determine whether there is evidence of an observer effect. The hypothesis of the study was that if constraining stocks lead to illegal discards, this should be evident in differences in the stock specific ratios of landings to effort and total catch between observed and unobserved trips. The study assumes that differences are due to the observer effect (i.e., observed trips do not represent unobserved trips) and not due to the deployment effect (i.e., observers are not randomly distributed among fishing trips). Landings ratios were characterized at an aggregate level by gear type and broad stock area over an annual time step for both observed and unobserved trips.

Conclusions:

- Discrepancies exist between observed and unobserved trips, when comparing landing to effort ratios. Differences in the landing ratios between observed and unobserved trips suggest that observed trips are not representative of unobserved trips.
- This analysis assumes there are no observer deployment effects.
- For the Gulf of Maine broad stock area, this analysis demonstrates there were slightly more cod landings seen on observed trips relative to unobserved trips despite incentives to avoid cod on observed trips due to low ACLs from 2015 to 2017. This difference was consistent across effort metrics (K_{all} and DA[14]) and gear types.
- For the Offshore Georges Bank broad stock area and Inshore Georges Bank broad stock area (Statistical Reporting Area 521), more haddock are consistently landed on unobserved trips relative to observed trips. The differences in the haddock ratios may have less to do with the influences of haddock which was not constraining but perhaps more a function of other potentially constraining stocks on these trips targeting haddock.
- Documented differences in the stock landing to effort relationships reflects differences in discarding of legal sized fish on unobserved trips relative to observed trips.
- Interpretation of the magnitude of these differences is uncertain due to the potential inherent biases caused by incentives to avoid limiting stocks on observed trips.
- The magnitude of the differences in the landings to effort relationships between observed and unobserved trips is likely not an accurate estimation of the true extent of the potential missing removals.

6.5.10.4.5 Overall Conclusions

- All three analyses that compare observed and unobserved trip data conclude that observed trips are not representative of unobserved trips. The dimensions where observed trips differ from unobserved trips include:
  - Gulf of Maine cod catch rates,
  - Groundfish landings to effort ratios,
  - Trip duration,
  - Pounds of kept groundfish,
  - Pounds of total kept catch, and
  - Trip revenue.
- Documented differences in the stock landing to effort relationships reflect differences in discarding of legal sized fish on unobserved trips relative to observed trips.
- Despite removing Sector IX data from some of these analyses, fishery-wide bias is still demonstrated.

[14] Kall = sum of kept catch of all species, similar to how effort is defined for discard estimation in monitoring and assessments; DA = days absent on a trip, a proxy for relative trip effort

- The discard incentive model describes one mechanism to explain differences between observed and unobserved trips: the sector system increases the incentive to illegally discard legal-sized fish on unobserved trips.
- Discard incentives have varied across time and stock area. After full sector implementation, the accountability of discards and the application of sector/gear specific discard rates to unobserved trips, together with the potential catch of constraining stocks, increased the incentive to not comply with retention regulations.
- Given these conclusions, the current precision standard is not an appropriate method to set at-sea monitoring coverage levels because the assumption that observed trips are representative of unobserved trips is false.
- These analyses cannot quantify the differences between observed and unobserved trips in a way that allows for either a mathematical correction to the data or a survey design that resolves bias.
- Non-compliance with the requirement to land legal-sized fish of allocated stocks (excluding LUMF[15]) undermines any sampling design and should be addressed.
- While direct evidence of the incidence and magnitude of non-compliance is not captured, the documented differences in behavior are substantial enough to warrant concern that noncompliance is occurring, especially in view of incentives to be non-compliant while unobserved.
- Revisions to the monitoring program should consider ways to increase compliance or account for non-compliance. Substantially increasing the management uncertainty buffer might account for this non-compliance but would not improve our understanding of true removals and would result in foregone revenue for the fishery. Alternatively, increased monitoring and catch accounting may be one way to increase compliance and may be necessary to provide accuracy of catch.
- The analyses support more comprehensive monitoring in the fishery.

6.5.10.5 Summary of Groundfish Monitoring Cost Reports [*to be provided*]

Monitoring cost efficiency analysis (Appendix VI) and ASM costs report (Appendix VII).

[15] LUMF = legal-sized un-marketable fish