DRAFT

AFFECTED ENVIRONMENT AND INITIAL IMPACTS OF MEASURES TO ADDRESS POTENTIAL LOCALIZED DEPLETION AND USER CONFLICTS

Amendment 8

to the

Atlantic Herring Fishery Management Plan

Updated November 2017

AP – Please review the draft impacts (Sections 2.0 – 5.0)
and consider specific input for the eight questions on page 165
related to potential effort shifts.

1.0 AFFECTED ENVIRONMENT

The Affected Environment is described in this document based on valued ecosystem components (VECs), including: target species, non-target species, predator species, physical environment and Essential Fish Habitat (EFH), protected resources, and human communities. VECs represent the resources, areas and human communities that may be affected by the management measures under consideration in this amendment. VECs are the focus, since they are the "place" where the impacts of management actions are exhibited.

1.1 TARGET SPECIES

This section describes the life history and stock population status for Atlantic herring, as well as herring's role as forage in the ecosystem. The Council manages the Atlantic herring fishery under the Atlantic Herring FMP. A complete description of the Atlantic herring resource is in Section 7.1 of the FEIS for Amendment 1 to the Herring FMP. Updated information is in the Amendment 5 EIS and Framework 2 to the Herring FMP (which includes the 2013-2015 Atlantic herring fishery specifications). The following subsections update information through 2013/2014 where possible and summarize the stock status and recent biological information for Atlantic herring. Based on the best available science, the Atlantic herring resource is not overfished at this time and overfishing is not occurring (the stock is considered rebuilt).

The Atlantic herring (*Clupea harengus*), 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. Presently, herring from the GOM (inshore) and GB (offshore) stock components are combined for assessment purposes into a single coastal stock complex.

1.1.1 Distribution and Life History

The Atlantic herring, Clupea harengus, is widely distributed in continental shelf waters of the Northeast Atlantic, from Labrador to Cape Hatteras. Herring can be found 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) with the largest and oldest fish found in the southern most portion of the range (Munro 2002). Adult Atlantic herring are found in shallow inshore waters, 20 meters deep, to offshore waters up to 200 meters deep (Munroe 2002; NEFMC 1999), but seldom migrate to depths more than 50 fathoms (300 ft or 91.4 meters; Kelly & Moring 1986). They prefer water temperatures of 5^{o} – 9^{o} C (Munroe 2002; Zinkevich 1967), but may overwinter at temperatures as low as 0^{o} C (Reid et al. 1999).

Spawning occurs in the summer and fall, starting earlier along the eastern Maine coast and southwest Nova Scotia (August – September) than in the southwestern Gulf of Maine (early to mid-October in the Jeffreys Ledge area) and Georges Bank (as late as November – December;

Reid et al. 1999). Herring are synchronous spawners, with mature fish producing eggs once a year. Male and female herring grow at about the same rate and become sexually mature beginning at age 2, with most maturing by age 4 (Munroe 2002; O'Brien et al. 1993). Growth rates vary greatly from year to year, and to some extent from stock to stock, and appear to be influenced by many factors, including temperature, food availability, and population size.

In the past, the herring resource along the east coast of the United States was divided into the Gulf of Maine and Georges Bank stocks (Anthony & Waring 1980). Currently, however, no methods are available to identify stock of origin for fish caught in the mixed stock fishery or during fishery-independent surveys. Consequently, herring from the Gulf of Maine and Georges Bank components are combined for assessment purposes into a single coastal stock complex.

1.1.1 Migration

In general, Gulf of Maine herring migrate from summer feeding grounds along the Maine coast and on Georges Bank to southern New England and Mid-Atlantic areas during winter, with larger individuals tending to migrate farther distances. Tagging experiments provide evidence of intermixing of Gulf of Maine, Georges Bank, and Scotian Shelf herring during different phases of the annual migration, which is described in greater detail in Amendment 1.

For example, in 2009, Maine DMR worked on a tagging project that showed seasonal movements of Atlantic herring from SNE in the winter to Nova Scotia in the summer (Kanwit & Libby 2009). The tag recoveries showed a clear pattern of short term residency during the summer feeding and spawning period, which was then followed by a long distance migration through time. Most were recaptured close to the point of release close to a year later in the GOM (only 6 recoveries were after one year at large, however). In comparison, those tagged in SNE during the winter feeding time period did not stay in the area for as long, but were back in the same area quicker than those released in the GOM. This study concurs with several other studies in similar areas at similar times.

1.1.2 Stock Definition

Currently, the Atlantic Herring resource is managed as a single coastal stock complex, although three spawning stock components occupy three fairly distinct locations in the Gulf of Maine region in the Gulf of Maine region: the southwest Nova Scotia-Bay of Fundy, the coastal waters of the Gulf of Maine, and Georges Bank. A more detailed description of this stock definition can be found in Amendment 1. A thesis by Bolles (2006) used morphometrics to investigate mixing rates between these three spawning components during spawning times.

Truss network analysis, which is a systematic set of morphometric distances, was used in combination with image analysis and multivariate procedures to build on work done by Cadrin and Armstrong in 2001. Canadian herring were sampled using commercial purse seines, and Gulf of Maine and Georges Bank were sampled using mid water trawls. Sampling took place during the 2003 and 2004 summer and autumn spawning periods.

Results showed that Canadian herring could be more correctly classified than Gulf of Maine and Georges Bank herring. Some differences in morphological variables were observed between the eastern and western Gulf of Maine herring. The models produced by this work could be used in future research to better determine the mixing rates of the three spawning stock components in non-spawning times. This information may be reviewed if stock structure, as a larger topic, is explored in future benchmark stock assessments for herring.

1.1.3 Trends in Abundance and Biomass

The Atlantic herring stock was last assessed as a benchmark during the 54th Stock Assessment Workshop using data through 2011 (NEFSC 2012). Data were updated through 2014 for an operational assessment in 2015. The three surveys used as indices of abundance are the NMFS spring, fall and summer shrimp bottom trawl survey. The spring survey has dropped since the 2011 all-time high, the fall survey has varied without trend near the average, and the summer survey has been near or below the average for some time (Map 1).

Trends in SSB, recruitment and fishing mortality are summarized in Map 2 from the update assessment. SSB generally declined from 1965 to a time series low of 56,509mt in 1978. SSB generally increased from 1978 through the mid-90s SSB declined from 1997 to 347,675mt in 2010, but then increased to the time series high of 1,041,500 mt in 2014. The point estimate of unexploited SSB equaled 845,176mt. Age-1 recruitment in 2009 was estimated to be the largest in the time series, followed by 2012 age-1 recruitment. Finally, fishing mortality was reported to be stable and low since 2009, equaling the time series low of 0.10 in 2014.

Figure 1 – NMFS spring, fall and summer shrimp bottom trawl survey indices for Atlantic herring (plus/minus 1 standard deviation). The horizontal dashed line is the average value from 1985-2014 for each survey.

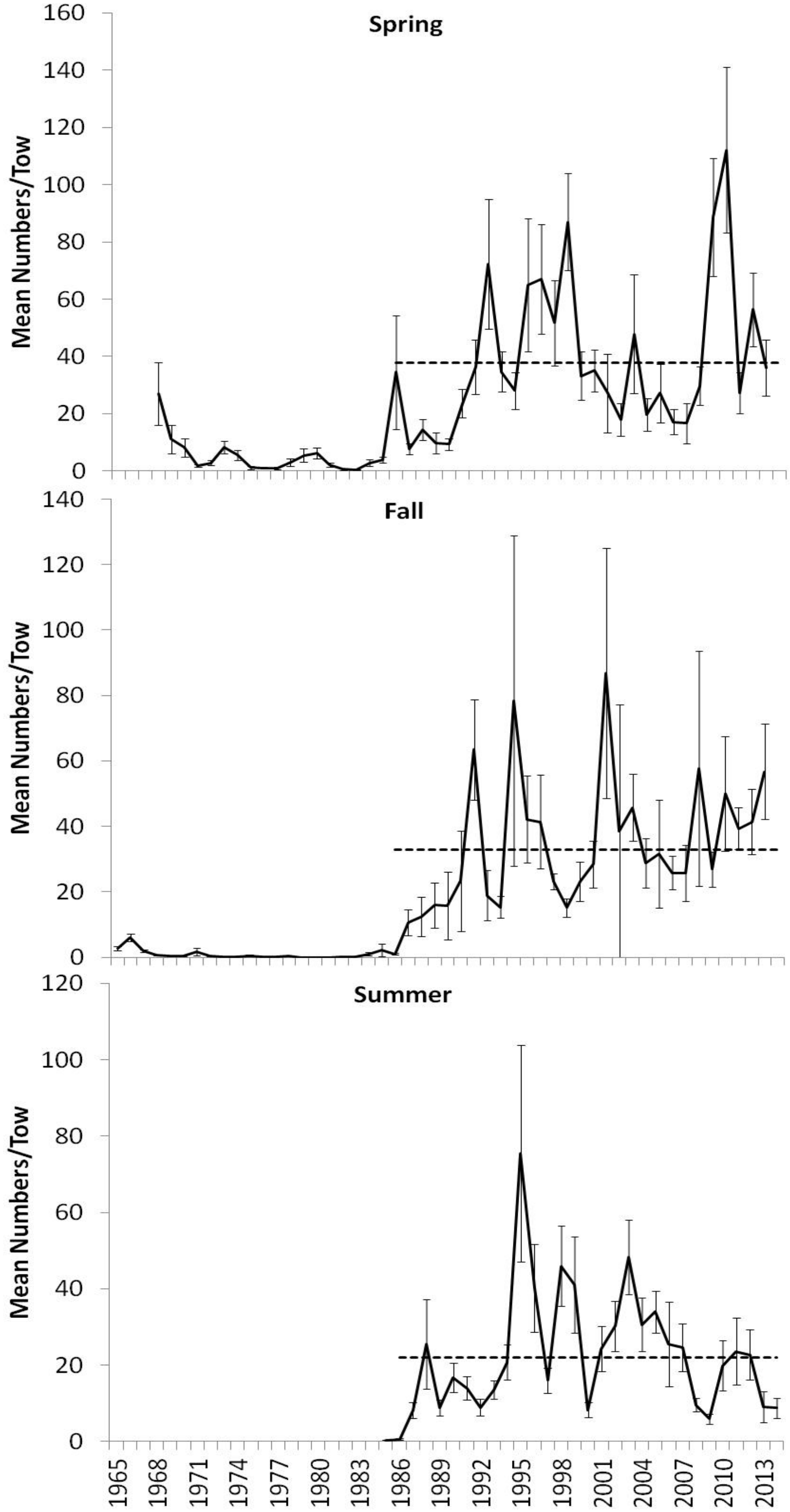
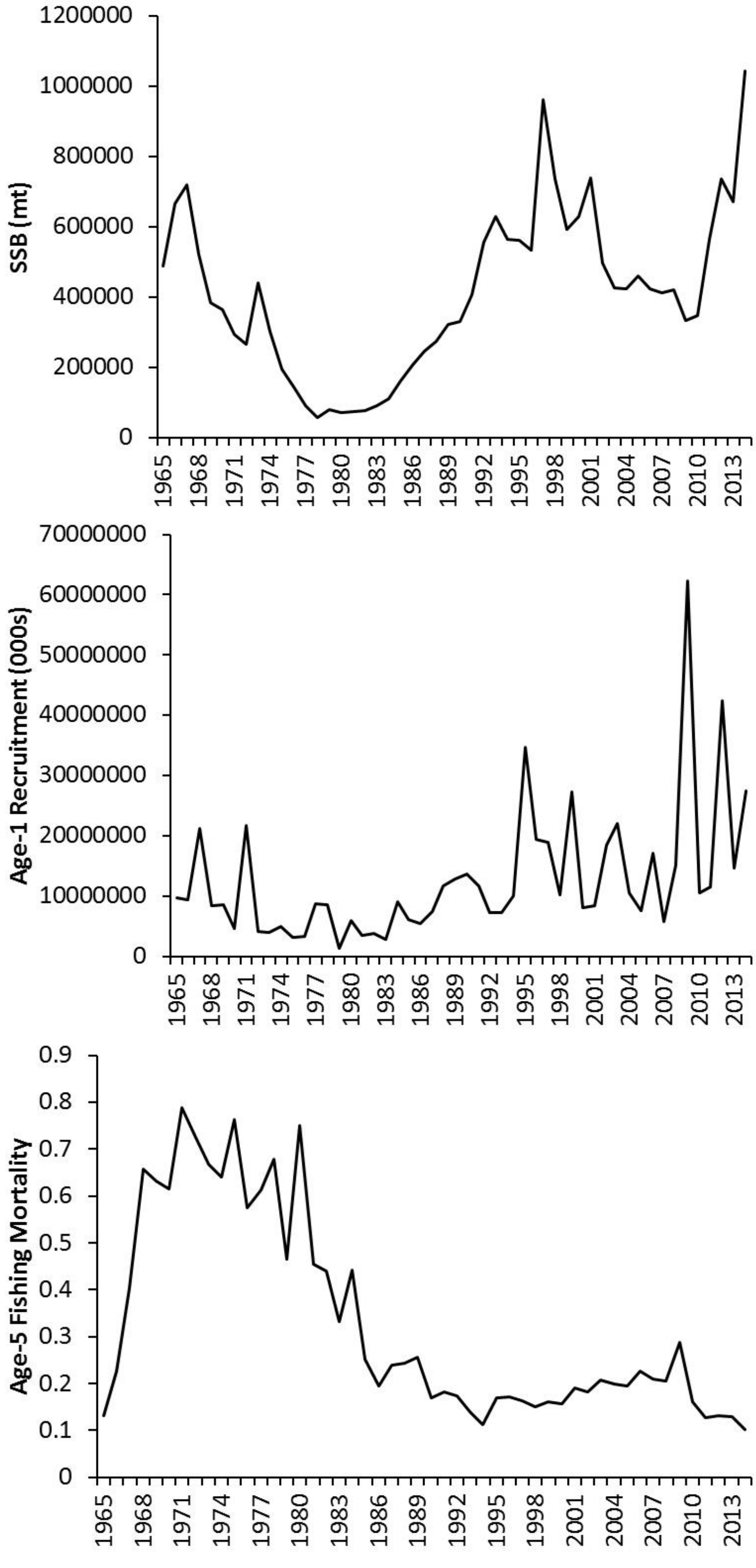


Figure 2 – Estimate of SSB (mt), age-1 recruitment, and age-5 fishing mortality for the Atlantic herring (NEFSC 2015)



1.1.4 Spawning

While Atlantic herring reproduce in the same general season each year, the onset, peak and duration of spawning may vary by several weeks annually (Winters and Wheeler, 1996) due to changing oceanographic conditions (e.g, temperature, plankton availability, etc.). Atlantic herring are believed to return to natal spawning grounds throughout their lifetime to spawn (Ridgeway, 1975; Sinderman, 1979; NEFMC, 2005). Amendment 3 to the ASMFC plan for Atlantic herring implemented seasonal spawning closures that vary based on the observation of spawning fish (

Map 2; http://www.massmarinefisheries.net/herring/). Samples of herring are collected from the commercial fishery and processed to record individual length and gonadal somatic index (GSI) of maturing females. Once sufficient samples have been processed showing a significant increase in GSI30, the area closes for four weeks. If there is insufficient data (< 3 samples) to forecast a closure date, a default closure date will apply. If additional samples show greater than 25% of fish in spawning condition once an area re-opens, the area will re-close for an additional 2 weeks. Additional background about spawning herring is summarized below from ASMFC Amendment 3 and the last benchmark assessment.

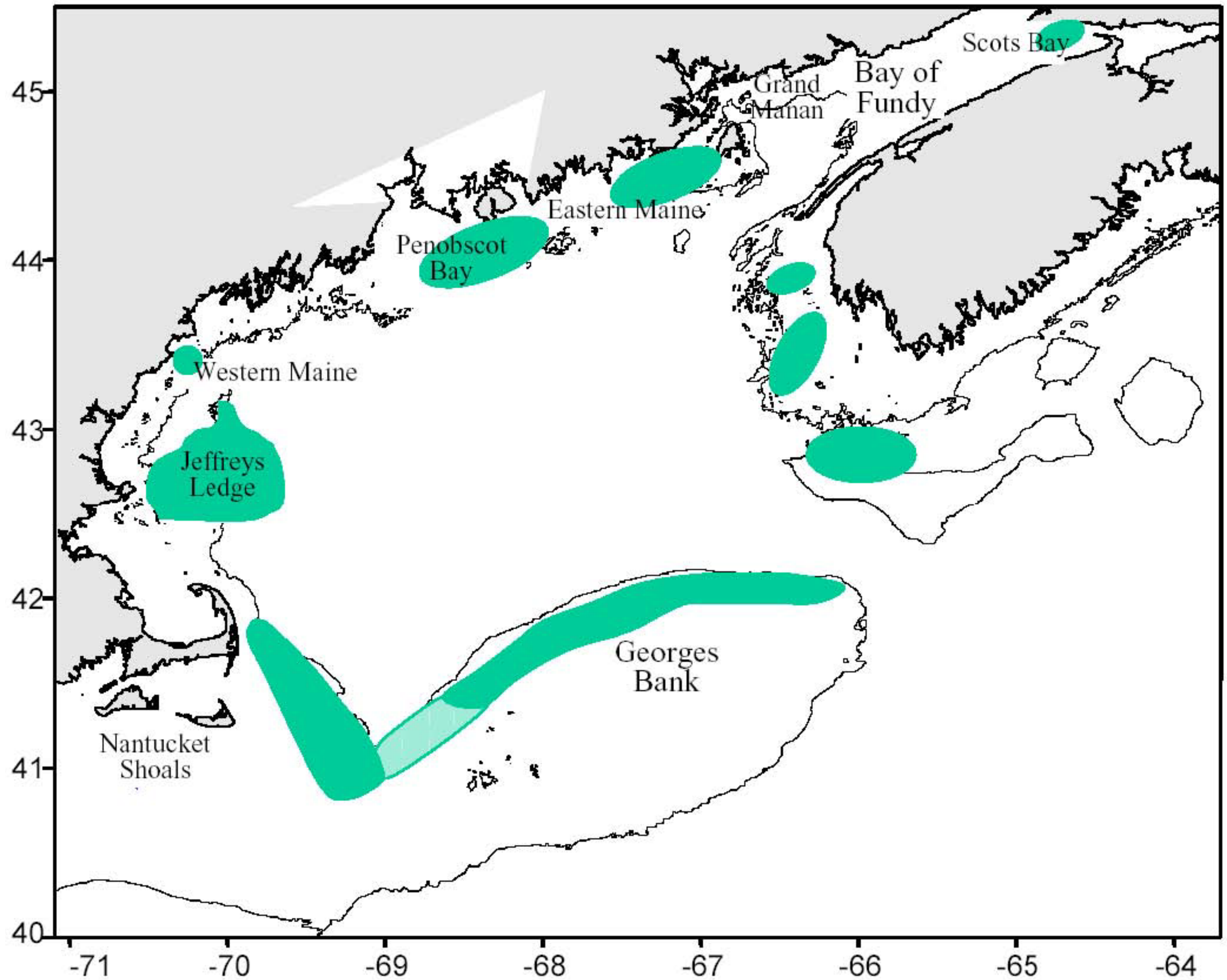
Spawning occurs at specific locations in the Gulf of Maine in depths of 20-50 meters (about 60-300 feet), on coastal banks such as Jeffreys Ledge and Stellwagen Bank located 8-40 km offshore, along the eastern Maine coast between the U.S.-Canada border and at various other locations along the western Gulf of Maine. In some cases, the same spawning sites are used repeatedly, sometimes more than once a year (Stevenson 1989; NEFMC 2005). Jeffreys Ledge appears to be the most important spawning ground in the Gulf of Maine based on the number of spawning and near-spawning adults found there (Boyar et al. 1973). Map 1 summarized the general locations of major herring spawning areas in the GOM and GB.

Herring also spawn on Nantucket Shoals and Georges Bank, but not further south. In Canada, spawning occurs south of Grand Manan Island (in the entrance of the Bay of Fundy) and on various banks and shoals south of Nova Scotia (Map 1 – Map 4). Spawning occurs in the summer and fall, starting earlier along the eastern Maine coast and southwest Nova Scotia (August-September) than in the southwestern Gulf of Maine (early to mid-October in the Jeffreys Ledge area and as late as November-December on Georges Bank) (Reid et al. 1999)(NEFMC, 2005). Eggs are laid in layers and form mats as thick as 4-5 cm. Herring in the Gulf of Maine region usually reproduce at relatively high temperatures (10-15°C) and at high salinities (NEFMC, 2005). Herring do not spawn in brackish water.

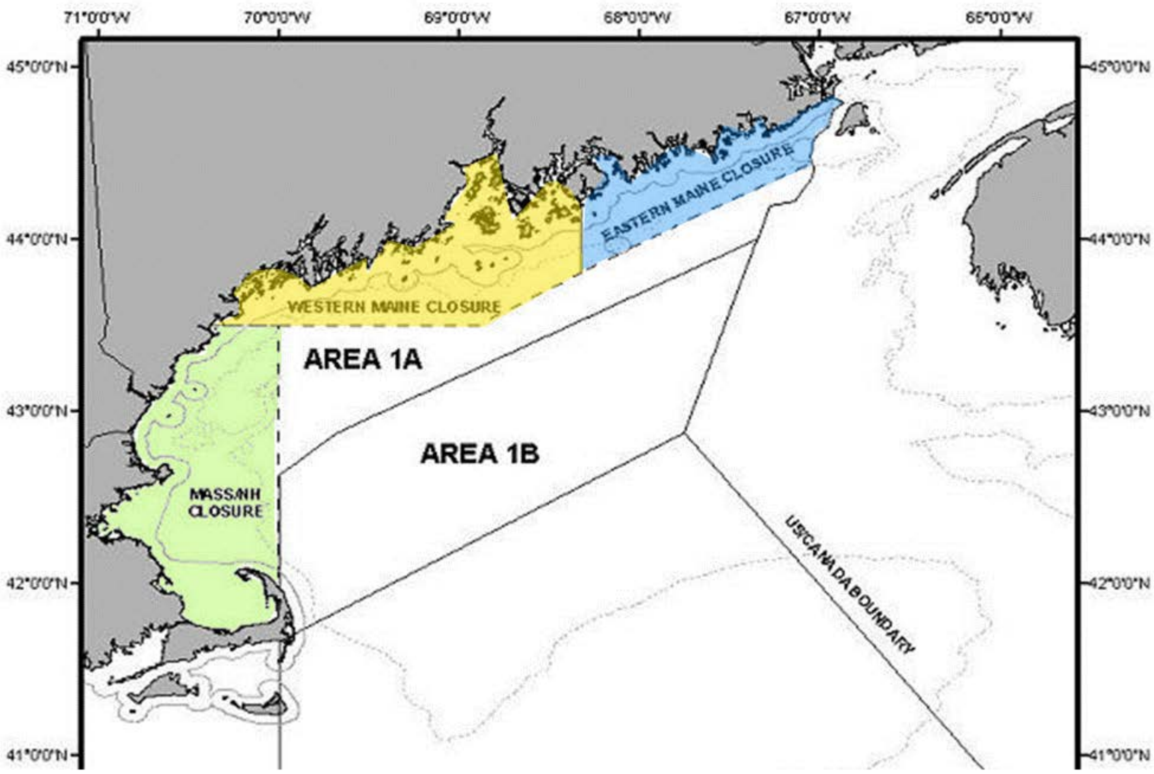
Atlantic herring spawn on the bottom in discrete locations by depositing adhesive eggs that stick to any stable bottom substrate, including lobster pots and anchor lines. Eggs are laid in layers and form mats or carpets. In the Gulf of Maine region, egg mats as thick as 4-5 cm have been observed in discrete egg beds that have varied in size from 0.3-1.4 km2. One very large egg bed surveyed on Georges Bank in 1964 covered an area of about 65 km2 (Noskov and Zinkevich, 1967).

Atlantic herring are synchronous spawners, producing eggs once a year after they reach maturity. Depending on their size and age, female herring can produce from 55,000 to 210,000 eggs (Kelly and Stevenson, 1983). Once they are laid on the bottom, herring eggs are preyed upon by a number of fish species, including cod, haddock, red hake, sand lance, winter flounder, smelt, tomcod, cunner, pollock, sculpins, skates, mackerel and even herring themselves (Munroe, 2002; NEFMC, 2005). Egg predation and adverse environmental conditions often result in high egg mortalities.

Map 1 - Generalized view of the current major herring spawning areas in the GOM and on GB (from Overholtz et al. 2004)



Map 2 - Atlantic herring spawning closures implemented by ASMFC (ASMFC graphic)



1.1.5 Atlantic Herring Stock Status

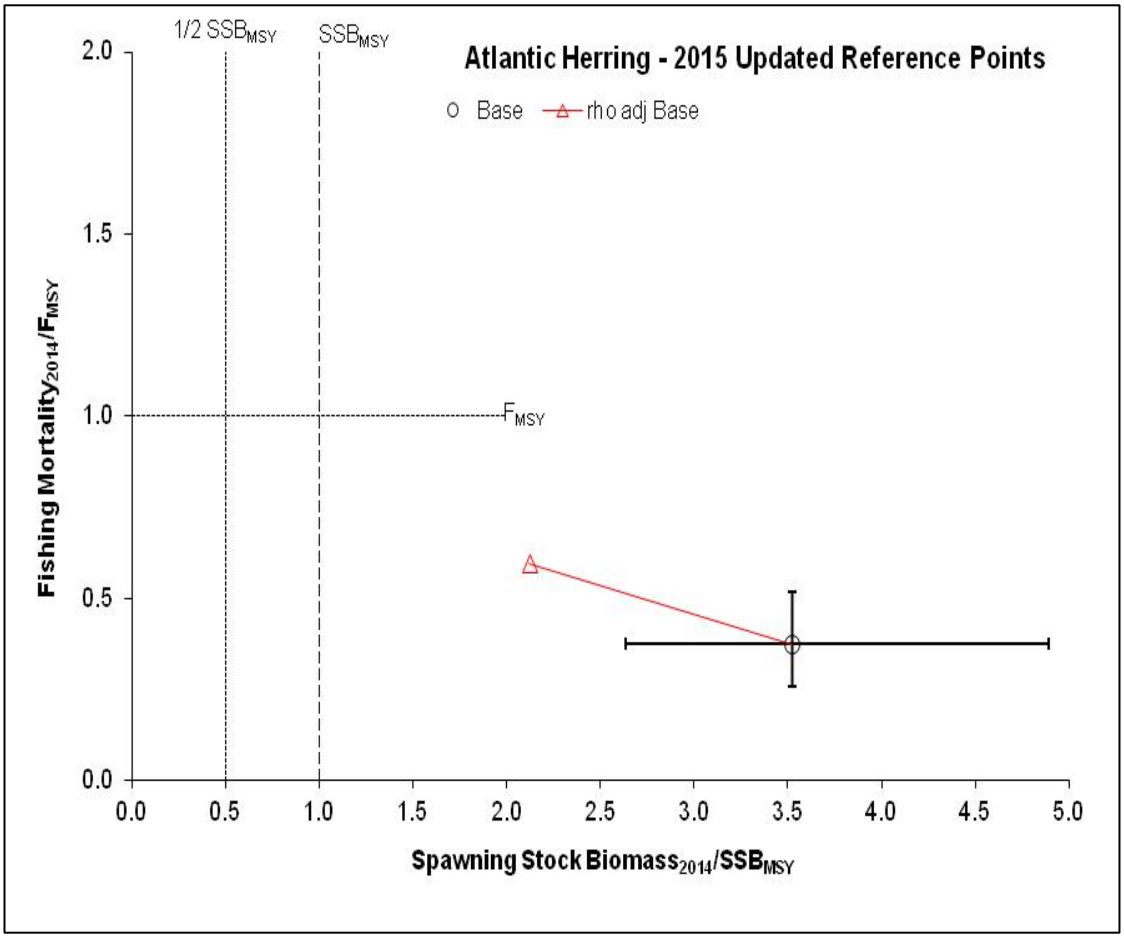
The Atlantic herring operational (update) assessment meeting was held in Woods Hole, MA on April 8-9, 2015. This assessment serves as an update to the SAW/SARC 54 benchmark assessment conducted in 2012.

Overall, the updated assessment indicates that the Atlantic herring resource continues to remain well above its biomass target (rebuilt), and fishing mortality remains well below the F_{MSY} threshold (not overfishing). A retrospective pattern re-emerged when updating the assessment model, which suggests that Atlantic herring spawning stock biomass (SSB) is likely to be overestimated and fishing mortality (F) is likely to be underestimated in the terminal year of the assessment. Resolution of a technical error in the contribution of recruitment to the objective function (i.e., negative log-likelihood) of the assessment model also affected the severity of the retrospective pattern. As a result, the assessment review panel applied a retrospective adjustment to the SSB and F values for the terminal year (2014) using Mohn's Rho. The retrospective adjustments resulted in approximately a 40% decrease in the terminal year (2014) SSB estimate and a 60% increase in the 2014 F estimate. Even with the retrospective adjustments, the Atlantic herring stock complex remains above the biomass target and below the fishing mortality threshold (Table 1, Figure 3).

Table 1 - Atlantic herring reference points and terminal year SSB/F estimates from the Benchmark Assessment (2012) and Update Assessment (2015)

	2012 SAW 54 Benchmark	2015 Update (Non-Adjusted)	2015 Update (Retro-Adjusted)
Terminal Year SSB	518,000 mt (2011)	1,041,500 mt (2014)	**622,991 mt (2014)**
Terminal Year F	0.14 (2011)	0.10 (2014)	**0.16 (2014)**
SSB_{MSY}	157,000 mt	311,145 mt	
F_{MSY}	0.27	0.24	
MSY	53,000 mt	77,247 mt	

Figure 3 - Atlantic herring operational assessment: 2014 fishing mortality and SSB relative to F_{MSY} and SSB_{MSY} reference points, including retrospective adjustment (red line)



Note: Error bars represent 10th and 90th percentiles of 2014 F/SSB estimates.

The results of the 2015 operational assessment form the basis of the SSC and Council recommendations for the 2016-2018 specifications of OFL and ABC. The operational assessment report and the May 20, 2015 SSC report contain more detailed information.

1.1.6 Considerations Related to Scientific Uncertainty

With respect to the 2015 Atlantic herring operational assessment, the re-emerging retrospective pattern, assumptions about natural mortality (M), and the mismatch between implied consumption and estimated consumption appear to be the primary sources of uncertainty (see discussion in following subsections).

The size/strength of the 2011 year class and other sources of uncertainty were also identified in the assessment report. However, signals related to the 2011 year class (possibly the second-largest on record) are similar to those for the 2008 year class that were noted in the 2012 Atlantic herring benchmark stock assessment. The update assessment indicates that the 2008 year class has persisted through the fishery as the strongest on record.

1.1.6.1 Retrospective Pattern

Since the benchmark assessment, an issue with the contribution of recruitment to the negative log likelihood in the assessment framework, ASAP, was discovered. This issue was resolved for the operational assessment. Differences in results and diagnostics between the benchmark and the update are partially attributable to the likelihood issue. Resolving the likelihood issue had the effect of changing the scale of estimates (e.g., increasing abundance estimates), particularly in recent years. Regardless of the likelihood issue, diagnostic problems (e.g., retrospective patterns) were present in the update assessment. Resolving the likelihood issue only amplified these diagnostic problems (e.g., worsening retrospective patterns). To account for retrospective bias, the assessment review panel made a retrospective adjustment to the terminal year (2014) estimates of SSB (40%) and F (60%). The retrospective-adjusted estimates of SSB, F, and numbers-at-age are utilized for the short-term (2016-2018) catch projections. No retrospective adjustment was applied to the benchmark terminal year (2011) biomass and fishing mortality estimates that were utilized in the projections for the 2013-2015 Atlantic herring fishery specifications.

The reemergence of the retrospective pattern suggests a fundamental diagnostic problem with the assessment model that remains a cause for concern. However, it appears that the stock would remain above the biomass target and below the fishing mortality thresholds even if the 80% confidence intervals (i.e., 90^{th} and 10^{th} percentiles) associated with the terminal year estimates of F and SSB (Figure 3, p. 16) are applied to the retrospective-adjusted estimates (i.e., stock status would not change, 2014 F would remain below the threshold, and 2014 SSB would remain above the target).

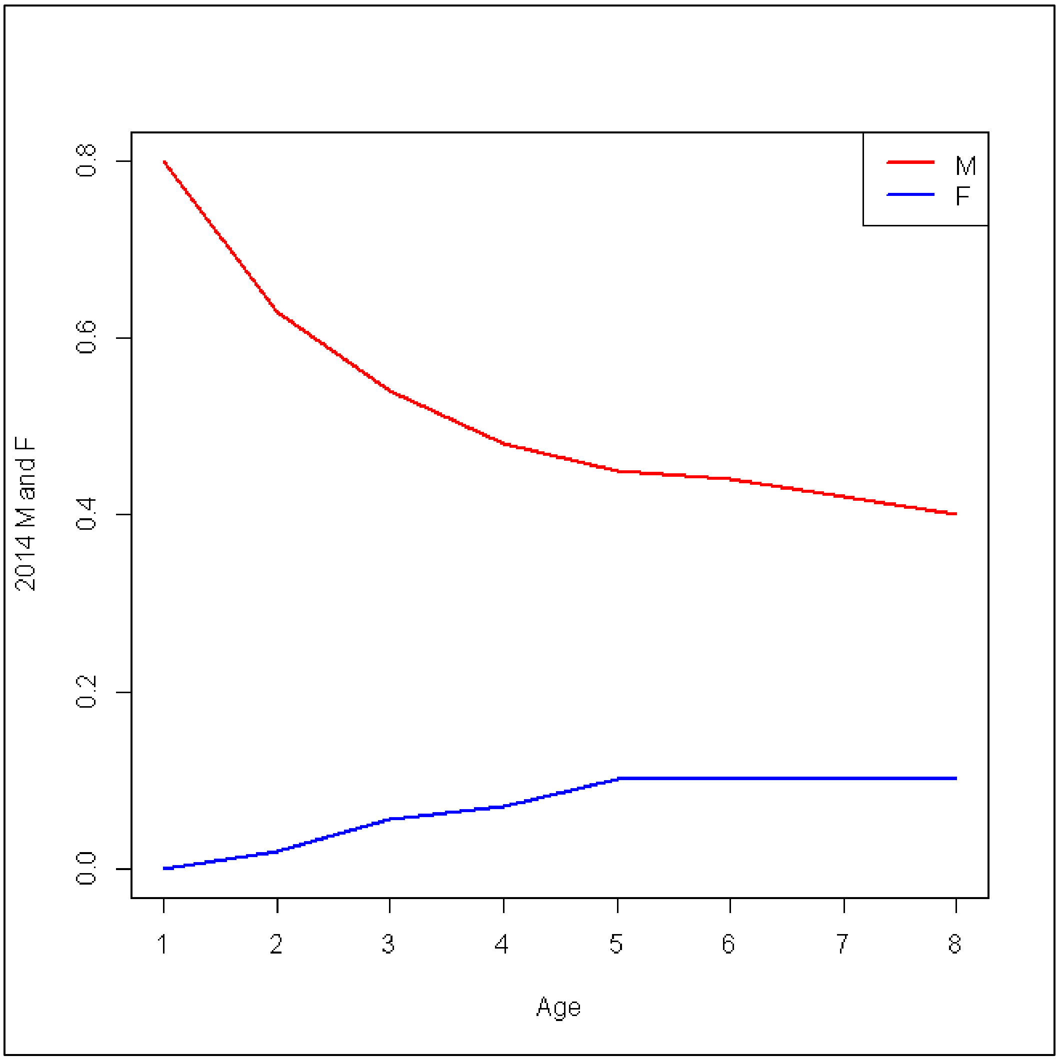
1.1.6.2 Natural Mortality and Consumption

Additional uncertainty is associated with the treatment of natural mortality (M) in the assessment model and the divergence between NMFS' consumption estimates (based on stomach content data) and levels of consumption implied by the input M values in the assessment model. The mismatch between estimated and implied consumption became apparent when the assessment model was updated. This may not be of significant concern because of the possible inaccuracy of consumption estimates derived from the food habits data. These data can be extremely sensitive to presence/absence of herring in just a few stomach samples. While food habits data are used to estimate consumption by teleost predators (fish), estimates of consumption by marine mammals, seabirds, and some larger predators (e.g., tuna) are derived from prior research and assumed to be constant in recent years; these data may not be complete. Moreover, consumption of Atlantic herring and other species may change due to factors other than M (e.g., herring abundance, spatial overlap).

The assessment model assumes a significant amount of natural mortality on Atlantic herring, particularly at younger ages, before the fish experience mortality from the fishery. Figure 4shows how the assessment model treats natural mortality (red line) and fishing mortality (blue line) by age class in 2014. Thus, the model assumes that M is a much higher fraction of total mortality than fishing mortality.

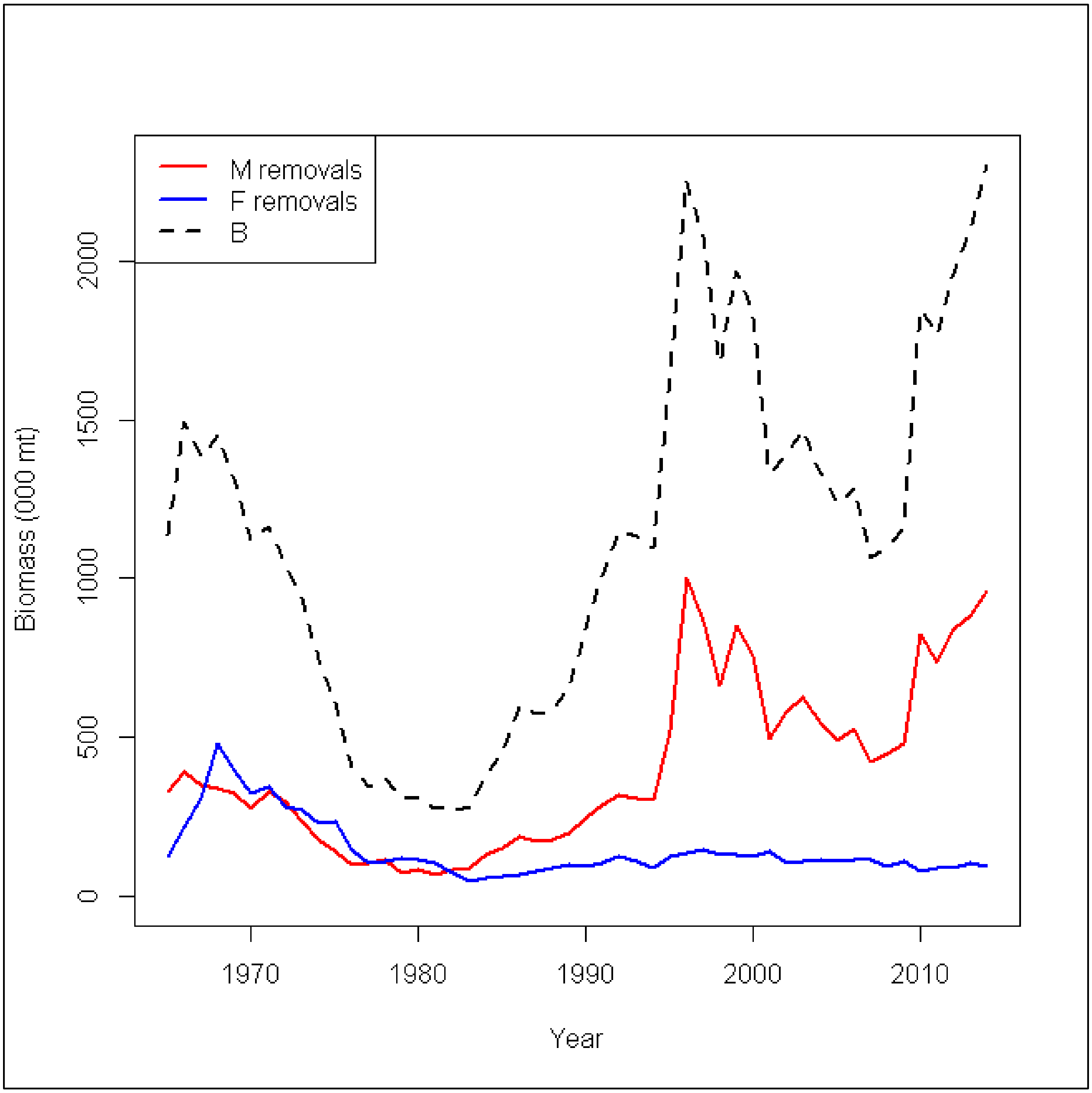
Figure 5 illustrates removals from fishing mortality and natural mortality estimated from the assessment model relative to total biomass over the entire time series.

Figure 4 - Atlantic Herring Operational Assessment: 2014 estimated natural mortality (M) and fishing mortality (F) by age



Source: Atlantic Herring Operational Assessment Meeting, April 8-9, 2015.

Figure 5 - Atlantic Herring Operational Assessment: Estimated removals from natural mortality (M) and fishing mortality (F) relative to total estimated biomass (B)



Source: Atlantic Herring Operational Assessment Meeting, April 8-9, 2015.

1.1.7 Importance of Herring as Forage

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. The structure of the Northeast U.S. shelf ecosystem features multiple forage species rather than a single dominant forage species. Herring share the role of forage here with many other species including sandlance, mackerels, squids, and hakes, although herring are distinguished by a high energy density (caloric content) relative to other pelagic prey in the ecosystem. This diversity of forage options leads to a complex and diverse food web supporting many different predators. The relative importance of herring as forage varies by predator group, due to differences in predator life history, foraging style, and bioenergetics. Therefore, predator responses to changing herring populations vary, and depend on the extent to which other forage is available.

In the Northeast Fisheries Science Center fish food habits database, Atlantic herring are found most often in the stomachs of spiny dogfish, Atlantic cod, and silver hake. Although these three species most commonly have herring in their diets, herring make up no more than 20% of the diet composition for any of these predators; these are generalist predators (Link & Almeida 2000; Smith & Link 2010). Similarly, diet estimates for marine mammals show that herring are important, but not dominant, generally comprising 10-20% of diets for baleen whale, toothed whales, and pinnipeds (Smith et al. 2015). Juvenile hake and herring are important forage for puffins in the Gulf of Maine, along with sandlance, and recently, juvenile haddock and redfish (Kress et al. 2016). Common and Arctic tern chicks in the Gulf of Maine were fed primarily juvenile herring and juvenile hake in equal amounts, followed by sandlance, and other fish (Hall et al. 2000). Endangered Species Act-listed Atlantic salmon, as adults at sea, feed on forage fishes such as herring, mackerel, sandlance, and capelin (off Greenland; Renkawitz et al. 2015). Large adult bluefin tuna are one of the few potentially herring-dependent predators (~half of the diet is herring) in the Northeast U.S. shelf ecosystem (Chase 2002; Logan et al. 2015). However, recent studies suggest that bluefin tuna may require large herring, rather than abundant herring, to maintain body condition (Golet et al. 2015).

In some ecosystems, pelagic schooling fishes are major predators of the pelagic eggs and larvae of other fish. However, fish eggs and larvae appear to be only a small component of Atlantic herring diet in federal waters of the Northeast U.S. shelf. Invertebrates (copepods, krill, amphipods, and other zooplankton) make up the majority (68%) of identified herring prey in the NEFSC food habits database, while fish larvae, eggs, and all other vertebrates combined make up less than 5% of herring diet (27% of stomach contents could not be identified). This database reflects mainly adult herring food habits on the continental shelf of the Northeast U.S. from 1992-the present. Limited information also suggests that juvenile herring primarily eat invertebrates and only rarely fish eggs and larvae in nearshore Gulf of Maine waters (Sherman & Perkins 1971).

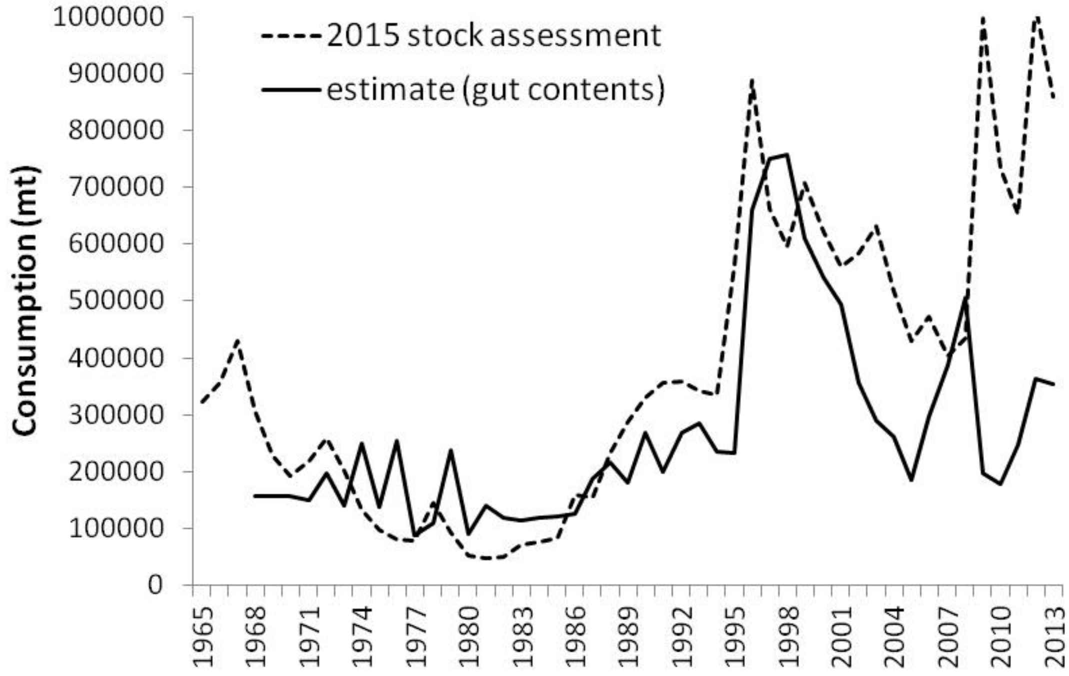
Climate and environmental conditions can be major drivers of pelagic fish dynamics. In the Northeast U.S., Atlantic herring and other pelagics have lower biological sensitivity to climate risks than other species in the region due to high mobility, but as a result, have a high potential to change distribution. Overall, experts have rated the impact of climate change on Atlantic herring in this ecosystem to be negative to neutral relative to other Northeast species. All Northeast U.S. species have high or very high exposure to climate change risks, as this ecosystem is changing more rapidly than much of the world ocean (Hare et al. 2016).

In the Atlantic herring stock assessment, the amount of herring assumed to be taken by predators (e.g., piscivorous fish, seabirds, highly migratory species, marine mammals) has varied annually (Figure 1, dashed line). The 2015 stock assessment assumed that, during 2009-2013, an annual average of 852,000 mt of Atlantic herring was eaten by predators, which equaled 44% of average total biomass (1.92M mt) over the same period. The amount of herring assumed to be consumed by predators in the assessment is based on natural mortality rates and estimates of herring consumption largely based on gut contents data, which also vary annually (Figure 1, solid line), with an annual average of 268,000 mt during that time. The gut contents data are from NMFS surveys, and are highly imprecise and likely biased. The short-term projections used to provide catch advice (overfishing limit, acceptable biological catch) assume a similar amount of herring are consumed as assumed in the stock assessment. More information is available in the 2015 Atlantic Herring Operational Assessment report (Deroba 2015).

The Ecosystem-Based Fishery Management PDT report on scientific advice for accounting for ecosystem forage requirements (NEFMC 2015) and assessment reports (e.g., Deroba 2015) may be referenced for sample estimates of predator consumption. In recent years, marine mammal consumption of herring is similar to commercial fishery landings, averaging 105,000 mt/year. Bluefin tuna and blue sharks have recently consumed 20-25,000 mt/year. Seabirds consume a relatively small amount of herring, conservatively estimated at about 3-5 mt/year. According to the NEFSC diet database, herring constitutes roughly 20% of the diet of cod and spiny dogfish. There is also some evidence which suggest it is not just volume of herring available, but the age structure of that forage base that is important in the energy budgets of predators (Diamond & Devlin 2003; Golet et al. 2015).

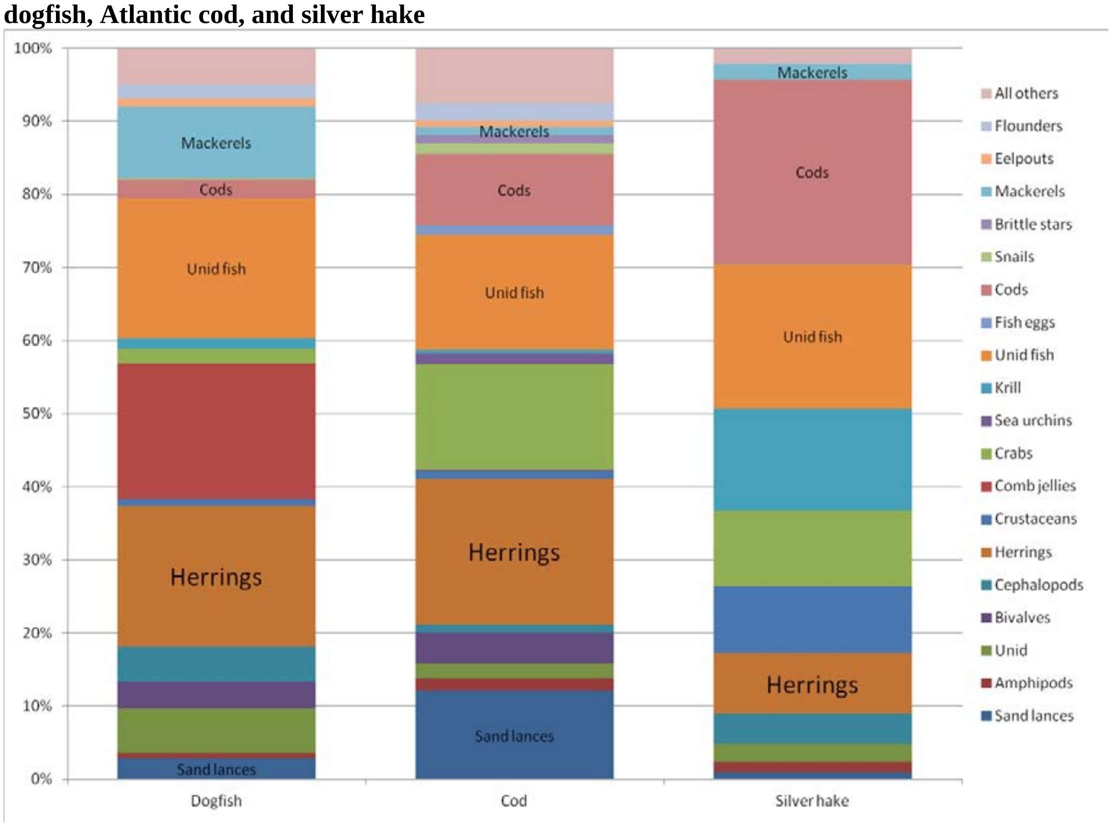
The amount of Atlantic herring needed for forage is the amount below which predators are negatively impacted. Estimates of this need do not currently exist and would vary by the abundance of predators and other prey. To summarize, consumption estimates can be generated, but that is different than what is necessary – which is a difficult question to answer definitively.

Figure 6 - Atlantic herring consumption by predators



Source: Deroba (2015).

Figure 7 - Estimated diet from Gulf of Maine, Georges Bank, and southern New England combined for spiny dogfish, Atlantic cod, and silver hake



Source: NEFSC diet database, 1973-2012.

1.2 NON-TARGET SPECIES (BYCATCH)

Non-target species refers to species other than Atlantic herring which are caught/landed by federally permitted vessels while fishing for herring. The MSA defines *bycatch* as fish that are harvested in a fishery, but are not retained (sold, transferred, or kept for personal use), including economic discards and regulatory discards (16 U.S.C. § 1802(2)). The MSA mandates the reduction of *bycatch*, as defined, to the extent practicable (16 U.S.C.§ 1851(a)(9)). Incidental catch, on the other hand, is typically considered to be non-targeted species that are harvested while fishing for a target species and is retained and/or sold. In contrast to bycatch, there is no statutory mandate to reduce incidental catch. When non-target species are encountered in the Atlantic herring fishery, they are either discarded (bycatch) or they are retained and sold as part of the catch (incidental catch). The majority of catch by herring vessels on directed trips is Atlantic herring, with extremely low percentages of bycatch (discards). Atlantic mackerel is targeted in combination with Atlantic herring during some times of the year in the southern New England and Mid-Atlantic area and is therefore not considered a non-target species.

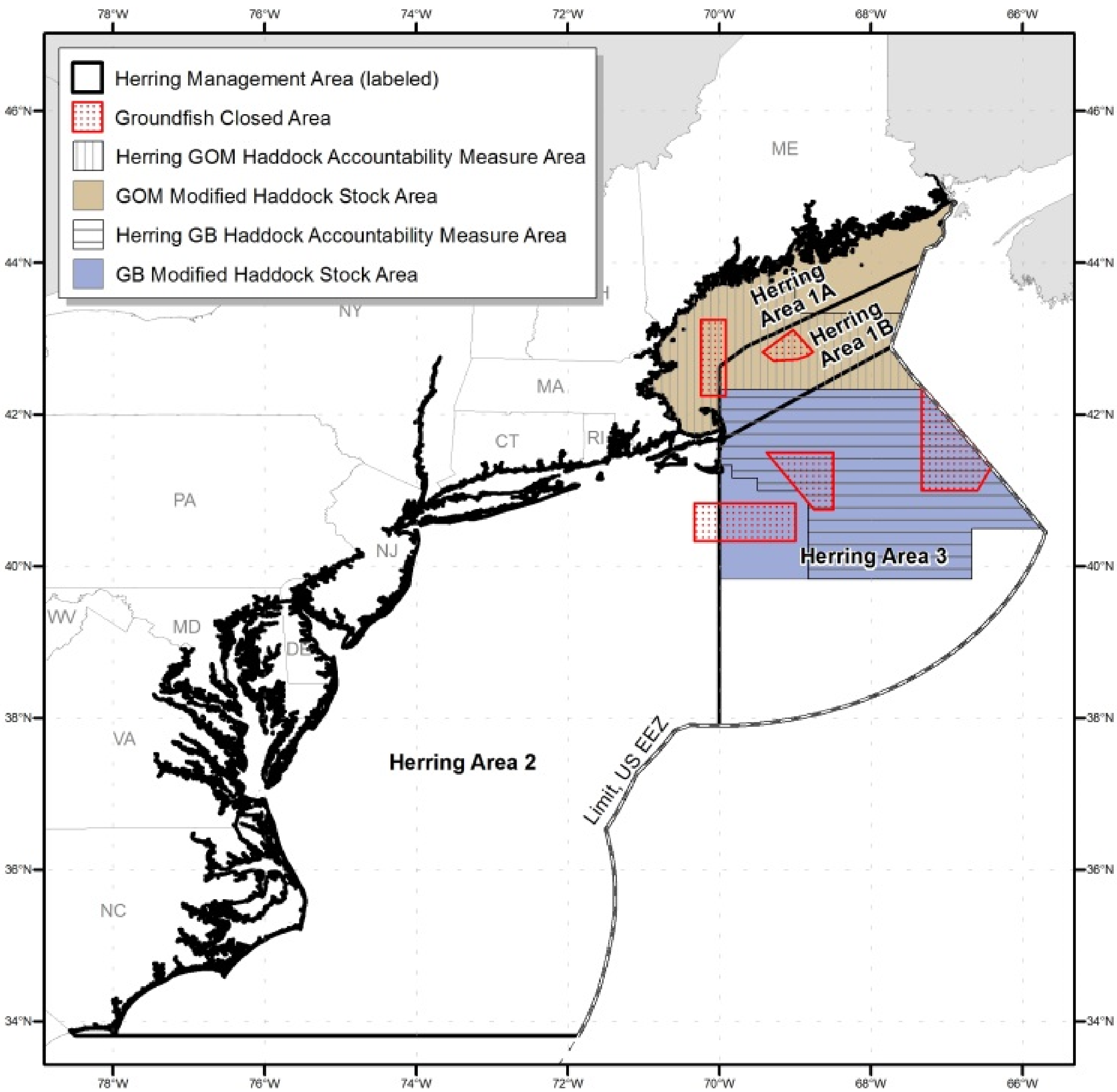
Due to the high-volume nature of the Atlantic herring fishery, non-target species, including river herring (blueback herring and alewives), shad (hickory shad and American shad), and some groundfish species (particularly haddock), are often retained once the fish are brought on board (Amendment 5 FEIS, p. 173). The catch of non-target species in the directed Atlantic herring fishery can be identified through sea sampling (observer) data collected by the Northeast Fisheries Observer Program (NEFOP). Portside sampling data collected by MADMF and MEDMR can be utilized to estimate catch of any non-target species that are landed. Dealer and VTR data can be used to identify/cross-check incidental landings of some non-target species that may be separated from Atlantic herring.

The primary non-target species in the directed Atlantic herring fishery are **groundfish (particularly haddock)** and the **river herring/shad (RH/S) species**. Dogfish, squid, butterfish, Atlantic mackerel are also common non-target species in the directed Atlantic herring fishery (mackerel and some other non-target species catch is often landed and sold). Comprehensive information about the catch of these species in the Atlantic herring fishery is in Section 5.2 of Amendment 5 and Sections 3.2 and 3.3 of Framework 3 to the Atlantic Herring FMP.

1.2.1 Haddock

There are accountability measures in place for both haddock and river herring/shad if the MWT fishery exceeds their sub-ACL. The herring fishery is currently allocated 1.5% of the GB haddock and 1% of the GOM haddock ABC. When the haddock incidental catch cap for a particular haddock stock (GOM or GB) has been caught, all herring vessels fishing with mid-water trawl gear will be prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in that particular haddock accountability measure area (GOM or GB) for the remainder of the multispecies fishing year (Figure 8).

Figure 8 – GOM and GB haddock stock areas (shaded) with Herring MWT accountability measures (hatched)



Insert update on stock status from GF FW58 as well as updated allocations

Framework Adjustment 56 increased the midwater trawl Atlantic herring fishery sub-ACL for Georges Bank haddock to 1.5% (up from 1%). The measure aims to incentivize the midwater trawl fleet to minimize the incidental catch of GB haddock to the extent practicable in the midwater trawl Atlantic herring fishery while providing the opportunity for the fleet to fully harvest its herring sub-ACL for Herring Management Areas 1B and 3. The measure would reduce the potential for negative impacts on the herring and Atlantic mackerel fisheries caused by reductions in fishing opportunities in Areas 1B and 3, and avoid potential market interruptions for the supply of herring as bait for the lobster fishery. The GB haddock AMs for the midwater trawl Atlantic herring fishery (i.e., pound for pound payback provision and in-season closure) remain unchanged. GOM haddock catches have been relatively low; therefore, the focus of potential impacts on haddock is relative to GB haddock. Table 2 is a summary of recent allocations and catches of GB haddock in the MWT herring fishery. Accountability measures were triggered in 2015, closing most of GB to the herring fleet for a large portion of the fishing year.

Table 2 – Summary of recent catches (mt) of Georges Bank haddock by the midwater trawl Atlantic herring fishery, groundfish FY 2010- FY 2016. Sources: Groundfish FY2010 – FY2015 final year-end catch reports, FY2016 preliminary in-season report through 3/8/2017, GARFO, and CV and observer coverages rates for FY 2011- FY 2016 from GARFO personal communication November 3, 2017

	Midwater Trawl- Georges Bank Haddock						
Groundfish FY	**Sub-ACL**	**Landings**	**Discards**	**Catch**	**Percentage of sub-ACL**	**CV on Catch**	**Observer Coverage % Trips**
2010	84	69.2	0	69.2	82.3%		
2011	318	101.8	0	101.8	32.0%	17.6%	41.7%
2012	286	271.9	16.7	288.6	100.9%	12.3%	62.9%
2013	273	272.7	17.2	290	106.2%	21.3%	35.6%
2014	162	113.5	0	113.5	70.1%	20.5%	27.2%
2015	227	235.0	0.6	235.5	103.9%	61.4%	4.9%
2016	512	115.3	3.6	118.9	23.2%	42.9%	20.1%

1.2.2 River herring / Shad

River herring are primarily managed under Amendment 2 (2009) to the ASMFC FMP for Shad and River Herring, which addresses concerns regarding declining river herring populations. Similarly to shad, the Amendment requires that states and jurisdictions develop Sustainable Fishery Management Plans (SFMPs) in order to maintain a commercial and/or recreational river herring fishery past January 2012. By 2016, the only approved River Herring SFMPs in effect were: Maine, New Hampshire, Massachusetts, New York, and South Carolina. The remaining states and jurisdictions have closed their commercial and recreational fisheries.

In 2017, there was an updated river herring assessment that concluded,

> *"Of the 54 in-river stocks of river herring for which data were available, 16 experienced increasing trends over the ten most recent years of the update assessment data time series, 2 experienced decreasing trends, 8 were stable, 10 experienced no discernible*

trend/high variability, and 18 did not have enough data to assess recent trends, including 1 that had no returning fish. The coastwide meta-complex of river herring stocks on the US Atlantic coast remains depleted to near historic lows. A depleted status indicates that there was evidence for declines in abundance due to a number of factors, but the relative importance of these factors in reducing river herring stocks could not be determined. Overfished and overfishing status could not be determined for the coastwide stock complex, as estimates of total biomass, fishing mortality rates and corresponding reference points could not be developed."[1]

ASMFC reported that while status on a coastwide basis remains unchanged, there are some positive signs of improvement for some river systems, with increasing abundance trends for a number of rivers in the Mid-Atlantic throughout New England region. While abundance in these river systems are still at low levels, dam removals and improvements to fish passage have had a positive impact on run returns (http://www.asmfc.org/uploads/file/59839543pr35RiverHerringStockAssmtUpdate.pdf).

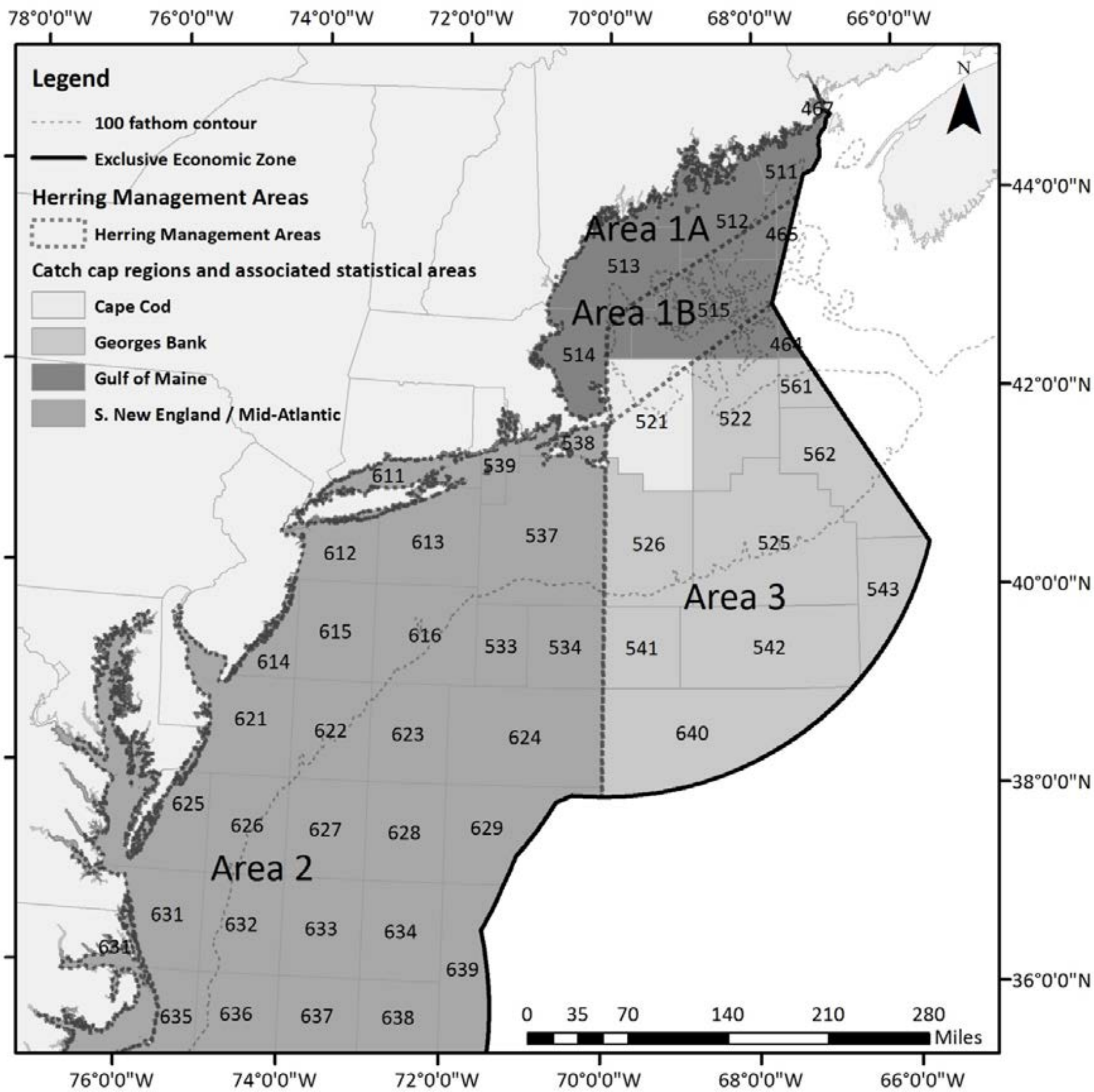
There are several federal management measures in place to manage river herring intended to reduce commercial fisheries interactions in federal waters. The types of management measures currently in place or being considered fall into five general categories:

1. Limitations on total river herring and shad catch;
2. improvements to at-sea sampling by fisheries observers;
3. river herring avoidance program;
4. increased monitoring of Atlantic herring and mackerel fisheries; and
5. including river herring in a Federal fishery management plan.

In December 2014, NMFS implemented river herring and shad catch caps for the Atlantic herring fishery for 2014 and 2015. Catch of river herring and shad on fishing trips that land more than 6,600 lb of herring count towards the caps. Caps are area and gear specific. If NMFS determines that 95 percent of a river herring and shad cap has been harvested, a 2,000-lb herring possession limit for that area and gear will become effective for the remainder of the fishing year. This low possession limit essentially turns the area into a closed area for directed herring fishing until the start of the next fishing year. The river herring catch caps for 2017 are: 32.4mt for Cape Cod MWT cap, 76.7 mt for GOMMWT cap, 122.3 mt for SNE BT cap, and 129.6 mt for SNE MWT cap. Bycatch is monitored and reported on the GARFO website at: https://www.greateratlantic.fisheries.noaa.gov/aps/monitoring/riverherringshad.html .

[1] ASMFC Reiver Herring Stock Assessment Update (Volume I: Coastwide summary) http://www.asmfc.org/uploads/file/59b1b81bRiverHerringStockAssessmentUpdate_Aug2017.pdf

Figure 9 – River herring/shad catch cap areas in the herring fishery



1.2.3 Observer data

Table 3 summarizes all the bycatch species recorded from at-sea observers for the MWT fishery that listed herring as target species 1 or 2. There are a handful of species with relatively larger amounts of total estimated bycatch (over 5,000 pounds in one year), but the bycatch rates are not very high due to the large volume nature of this fishery (shaded rows in Table 3). The species with the highest bycatch rates are: haddock, whiting, and mackerel.

<u>Note about table</u>: Catch ratio calculated using observed total catch of each species (kept and discarded) divided by the total kept catch weight (KALL) for the year. Records for Fish, NK were not included. Fish,NK used to categorize catch that could not be sampled by the observer, species mix unknown.

Table 3 – Summary of bycatch for herring MWT vessels (2014-2016)

	2014			2015			2016		
Species	Lbs Disc	Lbs Kept	Ratio	Lbs Disc	Lbs Kept	Ratio	Lbs Disc	Lbs Kept	Ratio
ALEWIFE	4.1	4,975	0.000103	3.1	1,369	0.00028	47.2	4,232	0.000232
BUTTERFISH	0.1	705	1.45E-05	0	534	0.00011	23	963	5.35E-05
COD, ATLANTIC	0	149.2	3.07E-06	0	0	0	0	4.1	2.22E-07
DEBRIS	20	0	4.12E-07	2,000	0	0.00041	60	0	3.25E-06
DOGFISH	2,353.4	4.4	4.86E-05	2,489	1,240	0.00076	8,614.5	0	0.000467
DORY, BUCKLER (JOHN)	0	0	0	0	0	0	2.4	0	1.3E-07
EEL, SAND LANCE, NK	0	0	0	0	0	0	8.7	0	4.72E-07
FLOUNDER, AMERICAN PLAICE	0.8	0	1.65E-08	0	0	0	0	0	0
HAKE, RED (LING)	1.5	0	3.09E-08	0	0	0	33	0	1.79E-06
HADDOCK	0	153,039.4	0.003152	50.6	21,937.5	0.00447	1,569.5	58,887.7	0.003278
HAKE, NK	0	71	1.46E-06	0	0	0	0	0	0
HAKE, SILVER (WHITING)	2.9	151,815.7	0.003127	0	8,020	0.00163	267	34,976	0.001911
HERRING, ATLANTIC	3,565.4	46,921,000	0.966479	296.3	4,866,907	0.9891	18,813.7	17,251,248	0.936502
HERRING, BLUEBACK	619.3	8,666	0.000191	3.3	2,153	0.00044	1.6	7,606	0.000413
HERRING, NK	0	0	0	225	0	4.6E-05	0	0	0
JELLYFISH, NK	0	0	0	0	0	0	12.3	0	6.67E-07
LAMPREY, NK	1.3	0	2.68E-08	0	0	0	0	0	0
MACKEREL, ATLANTIC	15.8	1,223,457.1	0.025199	22.8	16,643	0.00339	32.7	989,976	0.053685
MENHADEN, ATLANTIC	12,046.6	476	0.000258	0	0	0	14.7	6,822	0.000371
MONKFISH (GOOSEFISH)	7	46.7	1.11E-06	0	11.4	2.3E-06	0	0	0
POLLOCK	84.4	48	2.73E-06	239.7	0	4.9E-05	51	53.2	5.65E-06
RAVEN, SEA	3.5		7.21E-08	0	0	0	0	0	0
REDFISH, NK (OCEAN PERCH)	640.9	20,432.8	0.000434	23.9	1,403	0.00029	2.2	2,293	0.000124
SHAD, AMERICAN	3.1	1,355.4	2.8E-05	0	0	0	34	678	3.86E-05
SQUID, ATL LONG-FIN	0	587.1	1.21E-05	0	603	0.00012	0	1,636	8.87E-05
SQUID, SHORT-FIN	0.3	6,977.9	0.000144	0	19	3.9E-06	14.3	1,659	9.07E-05
GRAND TOTAL	583,303.4	48,552,090.7		7,785.7	4,920,839.9		293,935.8	18,441,034	

1.3 NON-PROTECTED PREDATOR SPECIES THAT FORAGE ON HERRING

This section includes a description of the life history and stock population status for the major predators of Atlantic herring, which are not protected under the Endangered Species Act and/or the Marine Mammal Protection Act such as whales and sea birds. Section 1.4 summarizes the life history and stock status information for species that are protected under various environmental laws including marine mammals, protected fish species, sea turtles, and seabirds. This section focuses on other key predators of Atlantic herring such as tuna, some species managed under the Groundfish FMP, and striped bass.

1.3.1 Bluefin Tuna

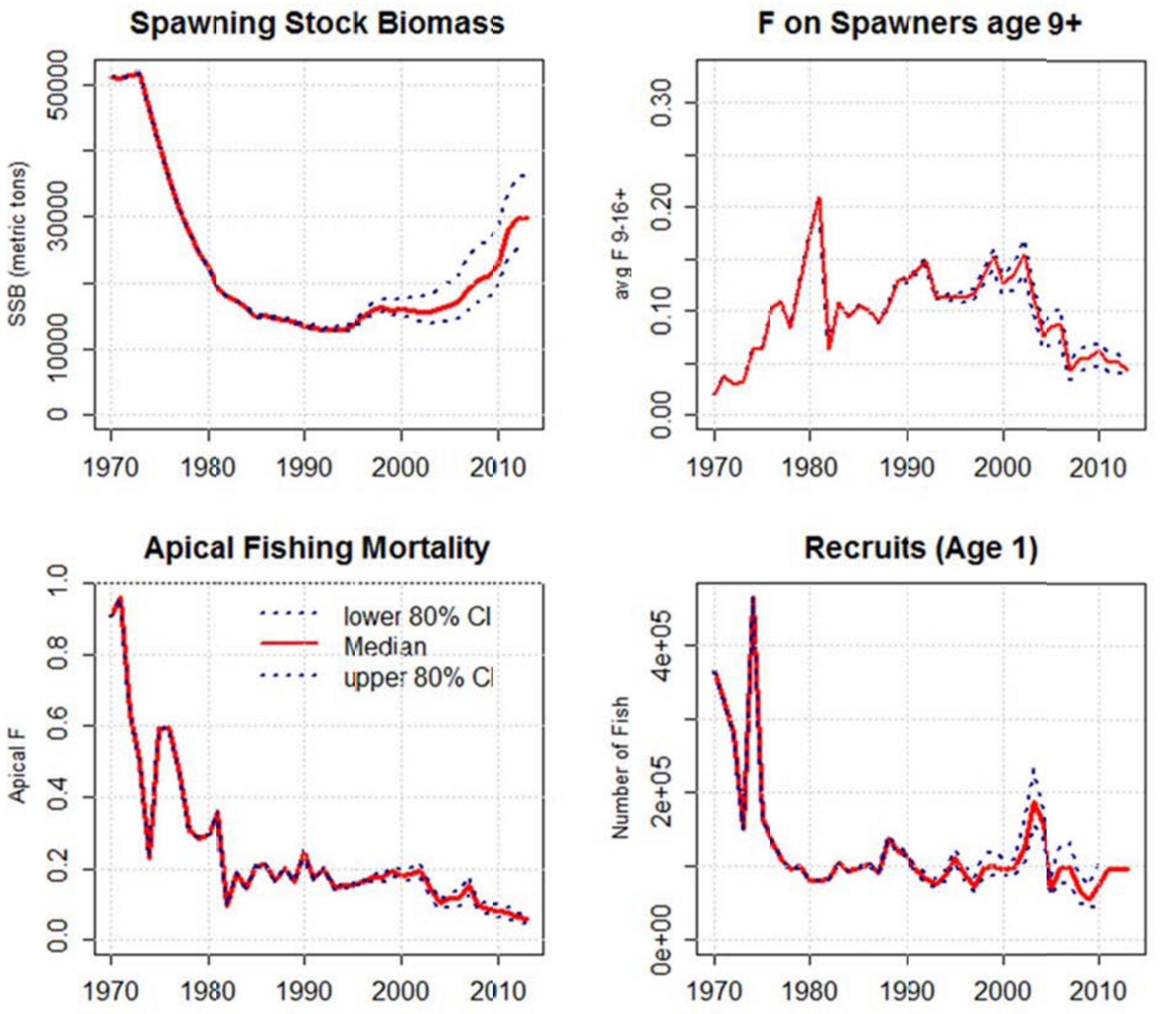
Population status: Atlantic bluefin tuna (*Thunnus thynnus*) is both a commercially and recreationally important species across the temperate waters of the Atlantic Ocean. They are long lived (up to 40 years) and large in size, reaching 13 ft in length and weights up to 2000 lb. Bluefin tuna are a pelagic species, and although they spend most of their time near the ocean surface, they are capable of diving to depths over 1000 m. They are found in Atlantic waters from the Gulf of Mexico north to Newfoundland, and west to the Mediterranean Sea, and are able to thrive in a wide range of conditions due in part to their ability to maintain a consistent body temperature across cold and warm water temperatures (SCRS 2013).

Bluefin tuna are opportunistic feeders with a diet that consists of various species of fish, crustaceans, mollusks, jellyfish, planktonic tunicates, and sponges. Juveniles tend to rely heavily on crustaceans, fish, and cephalopods, while adults primarily eat available baitfish. During spawning season in the Gulf of Mexico (April-June), bluefin feed on both passive (tunicates) and active (fishes, mollusks, crustaceans) prey. When bluefin enter the Gulf of Maine in May and June, their diet centers around Atlantic herring and other fish including sand lance (Chase, 2002), while more northerly individuals rely heavily on herring and Atlantic mackerel (Pleizier et al., 2012). Sharks, large fish, and marine mammals prey upon bluefin tuna (HMS Amendment 7, 2014).

Recruitment estimates for bluefin were very high in the early 1970s (

Figure 10). From about 1977 to 2011, recruitment varied without trend, except for exceptionally large classes in 2002-03. Stock assessment results indicate the SSB for bluefin tuna peaked at over 300,000 mt in the late 1950s and early 1970s. SSB steadily declined until the early 1990, where it stabilized at between 25-30% of 1970 levels until 2002. Stocks rebounded upon implementation of the rebuilding plan in 1998/1999. Beginning in 2003, there was a steady rise from about 32% of the 1970 SSB to about 55% in 2013. By 2015, bluefin SSB has risen by over 70% since the rebuilding plan began in 1998. Additionally, fishing mortality on both juveniles (age 2-5) and large spawners (age 9+) is down substantially since 2003.

Figure 10 - Bluefin tuna biomass, fishing mortality, and recruitment, 1970-2012



Notes: Median estimates of spawning biomass (age 9+), fishing mortality on spawners, apical fishing mortality (F on the most vulnerable age class) and recruitment for the base VPA model from the 2014 stock assessment. The 80% confidence intervals are indicated with dotted lines. The recruitment estimates for the last three years of the VPA are considered unreliable and have been replaced by the median levels corresponding to the low recruitment scenario. (SCRS 2016 with data from 1970 through 2014.

Management measures for bluefin tuna have been based on the premise that there are two Atlantic bluefin stocks (eastern and western), which are divided by the 45°W meridian. Bluefin tuna are oviparous and iteroparous batch spawners, and females may produce up to 10 million eggs per year. Eastern bluefin stocks are thought to mature at around 25 kg, which generally occurs around age 4. The stock assessments used in developing management measures use the assumptions that western bluefin mature around 145 kg (age 9), spawn only in the Gulf of Mexico and Florida Straits, and demonstrate homing behavior to spawning sites. Although a recent study by Richardson, et al. 2016 (detailed at the bottom of this section) disproves some of these assumptions, a new model has not been developed to account for bluefin life history as is currently understood. Thus, this section provides information based on knowledge at the time of the 2014 stock assessment.

It should be noted that ICCAT and NMFS apply different thresholds for stock status determination of bluefin tuna as follows:

- ICCAT considers overfishing to be occurring when Fyear/FMSY > 1.0. NMFS considers overfishing to be occurring when Fyear > FMSY. These two definitions are functionally equal.
- ICCAT considers bluefin stocks to be overfished when $SSB_{current}/SSB_{MSY}$ is less than 1. NMFS considers bluefin to be overfished when $SSB_{current}/SSB_{MSY}$ is less than 0.86.

In 2014, the SCRS conducted an update of the 2012 stock assessments for both the western and eastern BFT stocks using data collected through 2013. A key factor in determining BFT stock status is the estimation of maximum sustainable yield (MSY)-related benchmarks, which depend largely on the relationship between spawning stock biomass (SSB) and recruitment. There are two competing stock-recruitment relationships that are currently considered for western BFT: the two-line (low recruitment potential) scenario and the Beverton-Holt (high recruitment potential) scenario. Similar to prior western BFT stock assessments and updates, the SCRS presented status and projection information based on the two divergent stock recruitment scenarios and stated that it has insufficient evidence to favor either scenario over the other. The SCRS' findings did not permit specification of a single MSY level. Generally, under the low recruitment scenario, it is assumed that the stock is not as productive as it once was (i.e., prior to the 1970s) and therefore the MSY is fairly low. Under the high recruitment scenario, it is assumed that the stock can be much more productive as it recovers and the MSY target is much higher. It is important to note that the estimate of current and past SSB is independent of the recruitment scenario. Note that the recruitment assumption (low vs. high recruitment) only affects *future* SSB projections.

The SSB trends estimated in the 2014 update were consistent with previous analyses in that SSB declined steadily from 1970 to 1992 and has since fluctuated around 25 to 30 percent of the 1970 level for about the next decade. In recent years, however, there appears to have been a gradual increase in SSB from 32 percent of the 1970 level in 2003 to an estimated 55 percent in 2013, with a more rapid increase in recent years. Since 1998, when the rebuilding plan was adopted, the SSB has increased by 70 percent. The stock has experienced different levels of fishing mortality over time, depending on the size of fish targeted by various fleets. Fishing mortality on spawners (ages 9 and older) declined markedly after 2003.

Since 1977, recruitment has varied from year to year without trend, with the exception of strong year-classes in 2002 and 2003. The 2014 assessment suggests that both the 2002 and 2003 year classes were large; but the estimate of a strong 2002 year class may be an artifact of the lack of direct observations of the age of fish in the catch and recent regulations in the United States that limited the take of fish in that size range. Under the current maturity assumptions (age 9 and older), the 2002/2003 year classes started to contribute to the spawning biomass in 2011/2012. The SCRS noted that the strong 2002/2003 year classes and recent reduction in fishing mortality have contributed to the more rapid increase in SSB in recent years.

Under the low recruitment scenario, the fishing mortality rate (F) for 2010-2012 was 36 percent of F_{MSY} and the SSB for 2013 was 225 percent of the SSB that can support maximum sustainable yield (SSB_{MSY}). The MSY estimate was 3,050 mt, with an SSB_{MSY} of 13,226 mt. The means the stock is not overfished or subject to overfishing, the current SSB > SSB_{MSY}, and substantial growth in TAC levels cannot happen.

Under the high recruitment scenario, the fishing mortality rate (F) for 2010-2012 was 88 percent of F_{MSY} and the SSB for 2013 was 48 percent of $SSB_{MSY.}$ The MSY estimate was 5,316 mt, with an SSB_{MSY} of 63,102 mt. This means that the stock is not subject to overfishing, but is overfished. The stock would not rebuild by the end of the rebuilding period even with no catch. Once rebuilt, however, future TACs could be much higher than under the low recruitment scenario. This was the first assessment in which the stock was estimated to not be undergoing overfishing under both recruitment scenarios.

The SCRS advised that annual catches of less than 2,250 mt would have a 50-percent probability of allowing the SSB to be at or above its current (2013) level by 2019. The SCRS also advised that maintaining catch at current levels (1,750 mt) would be expected to allow the spawning stock biomass to increase more quickly, which may help resolve the issue of low and high recruitment potential. SCRS advised that annual catches of 2,000 mt would continue to allow for stock growth under both recruitment scenarios.

As in the past, the SCRS noted that management actions taken for the eastern Atlantic and Mediterranean stock likely will impact the recovery of the western BFT stock, given evidence that indicates that the productivity of western BFT fisheries is linked to the eastern Atlantic and Mediterranean stock. The SCRS continues to caution that the conclusions of the western BFT assessment do not fully capture the degree of uncertainty in the assessments and projections (e.g., mixing, maturity at age, recruitment, natural mortality, lack of representative samples of otoliths, conflicting and/or biologically implausible abundance indices). The next full stock assessment was delayed from 2015 to 2017, in order to conduct the necessary preparatory work to incorporate new data and methodologies. Further, to help support the next stock assessment, western harvesters are planning to collaborate in the development of combined indices of abundance.

Taking this information into consideration and following protracted negotiations, ICCAT adopted a two-year measure that increased the TAC to 2,000 mt and maintained key provisions of the previous recommendation, including the allocations to Contracting Parties. This TAC is expected to allow for continued stock growth under both low and high stock recruitment scenarios. A new SCRS stock assessment was conducted in 2017; it is expected to incorporate new data from the research conducted by the Atlantic-wide BFT Research Program and related activities, and to utilize new methodologies and an assessment peer review process.

As mentioned above, a 2016 study by Richardson et al. provided evidence that the premises used in the stock assessment was flawed. The Richardson study found unequivocal evidence that western stocks also spawn in the Slope Sea, an area on the Atlantic coast north of the Gulf Stream and northeast of the U.S. continental shelf. In addition to finding a substantial number of larval bluefin in this area, endocrine testing of tuna caught in the Gulf of Maine and adjacent

Slope Sea indicated that all bluefin greater than 131 cm FL (age-5) were fully mature. The study also found that spawning area was likely partitioned by size, with larger bluefin (500 lb+) generally spawning in the Gulf of Mexico and smaller fish (80-500 lb) spawning in the Slope Sea. The study suggested that bluefin may alternately spawn in the Slope Sea and the Gulf of Mexico in different years. In addition, this study indicated that the population structure of bluefin tuna is likely more complex than previously thought, as spawners from the Slope Sea may originate from both the western and eastern population stocks. Stable isotope analysis has demonstrated that while little mixing occurs in bluefin found in the Gulf of Mexico or in the Mediterranean Sea, other areas (e.g. North Carolina winter fishing grounds, Canadian Maritimes, Central North Atlantic) showed a substantial amount of stock mixing (Secor 2015). Recent and currently ongoing studies are attempting to come to a better understanding of stock structure and mixing, which may lead to better estimates of fishing mortality.

There is a great deal of uncertainty associated with the state of bluefin stocks. The amount of mixing that occurs between eastern and western stocks is not well understood, and varies based on the type of data used in mixing estimations (e.g. tagging, isotope analysis) and the modeling assumptions. The assumptions used in estimating mixing, spawning age and potential, and recruitment are uncertain, which likely skews estimates used in stock assessments. In addition, many indices used in the 2014 stock assessment update show conflicting trends, and individual indices may unduly influence estimates. In some cases, removal of just one of the indices may shift the overall biomass estimate for a stock by up to 33% (SCRS 2013). Collection of more data and incorporation of recently collected data into future stock assessment is necessary to improve estimates of parameters used in bluefin management.

Management: U.S. Atlantic bluefin tuna fisheries are managed under the 2006 Consolidated Highly Migratory Species (HMS) Fishery Management Plan (FMP) and regulations at 50 CFR part 635, pursuant to the authority of the Magnuson-Stevens Act, and Atlantic Tunas Convention Act (ATCA). Under ATCA, the Secretary of Commerce shall promulgate such regulations as may be necessary and appropriate to carry out International Commission for the Conservation of Atlantic Tunas (ICCAT) recommendations. ICCAT is an inter-governmental fishery organization responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and its adjacent seas.

The following information has been obtained from: http://www.iccat.es/en/introduction.htm, and further information can be found therein. The Convention entered formally into force in 1969, and there are currently 48 Contracting Parties, including the U.S., Canada, and various other nations from the U.N., Africa, and Asia. ICCAT coordinates research and develops scientific-based management advice on behalf of its members for tuna and tuna-like species. In accordance with the Convention, ICCAT also compiles bycatch information caught during tuna fishing in the Convention area.

In 1998, ICCAT adopted a 20-year international recovery plan to rebuild stocks of bluefin tuna and in 1999, NOAA implemented the recovery plan into an FMP. The rebuilding plan continued under the 2006 Consolidated HMS FMP. The rebuilding plan takes into account scientific uncertainties associated with the status of the bluefin stock. Most recently, NOAA implemented Amendment 7 to the 2006 Consolidated HMS FMP in 201 with the following objectives:

1) Prevent overfishing and rebuild bluefin tuna, achieve on a continuing basis optimum yield, and minimize bluefin bycatch to the extent practicable by ensuring that domestic bluefin tuna fisheries continue to operate within the overall TAC set by ICCAT consistent with the existing rebuilding plan;

2) Optimize the ability for all permit categories to harvest their full bluefin quota allocations; account for mortality associated with discarded bluefin in all categories; maintain flexibility of the regulations to account for the highly variable nature of the bluefin fisheries; and maintain fairness among permit/quota categories;
3) Reduce dead discards of bluefin tuna and minimize reductions in target catch in both directed and incidental bluefin fisheries to the extent practicable
4) Improve the scope and quality of catch data through enhanced reporting and monitoring to ensure that landings and dead discards do not exceed the quota and to improve accounting for all sources of fishing mortality;
5) Adjust other aspects of the 2006 Consolidated HMS FMP as necessary and appropriate.

ICCAT manages bluefin tuna through a quota system. Quotas are divided between eastern and western bluefin stocks, and the US receives 54% of the western bluefin tuna quota. US regulations further subdivide the quota into recreational and commercial categories, and by gear types (Table 4). Catch in bluefin fisheries is managed by gear restrictions, minimum fish sizes, closed areas, trip limits, and other tools.

Table 4 - U.S. bluefin tuna quota subdivision among recreational and commercial categories.

U.S. Bluefin Tuna Quota*	Recreational Category	Commercial Categories					
	Angling	General	Longline	Purse Seine	Harpoon	Trap	Reserve
Percentage	19.7	47.1	8.1	18.6	3.9	0.1	2.5
MT	195.2	466.7	80.3 + 68 + 25 = 173.3	184.3	38.6	1.0	24.8

*Based on an annual quota of 1,058 mt, where 68 mt is subtracted and allocated to the Longline category before percentages are applied. An additional 25 mt is also allocated to the Longline category to account for catches in the vicinity of the East/West management boundary.

Tuna Reliance on Herring Important linkages do exist between bluefin tuna and herring (Golet et al. 2013; Golet et al. 2015). Aggregations of bluefin and herring are associated with each other, though not all herring aggregations have bluefin present (Schick et al. 2004; Schick & Lutcavage 2009). The bluefin tuna fishery is located throughout the entire Gulf of Maine, which is an important tuna foraging ground (Mather, et al. 1995). The large bluefin tuna that are targeted in commercial fisheries generally enter the Gulf of Maine beginning in May and June of each year. Bluefin spend up to six months in this area feeding on high energy prey such as Atlantic herring (Chase 2002). Historically, large catches of bluefin have been landed in the Kettle, Cape Cod Bay, Stellwagen Bank, Jeffreys Ledge, Great South Channel, Ipswich Bay, Platts Bank, Cashes Ledge, Georges Bank, Wilkinson's Basin, and the Schoodic Ridges. This is not a comprehensive list, rather a highlight of some of the areas which have yielded large landings.

Bluefin rely on herring for a substantial portion of their diet and come to the Gulf of Maine specifically to feed on herring as a lipid source (Golet et al. 2013; Logan et al. 2015). They are highly dependent upon herring, which comprises up to an estimated 70% of their diet (Logan, et al. 2015). Bluefin body condition has historically increased during this feeding period (Marin, et al. 2015). Recently, a trend has emerged in which these tuna have difficulty in acquiring the lipids needed to improve body condition late in the season. Thus, they are often found in relatively lean condition. A study by Golet et al. (2015) found that in spite of high herring abundance, bluefin body condition was low. The authors asserted that a shift in the size structure of Atlantic herring with fewer older and larger fish was to blame for the decline in bluefin condition, and suggested that bluefin body condition is sensitive to the size (and thus lipid content) of prey even when prey is abundant.

Declines in herring weight and size-at-age have been drastic recently, as average herring weight has declined by 55% between 1981 and 2010. The herring population in the Gulf of Maine show a strong inverse relationship between the number of adult herring and mean length-at-age, with indications that this relationship is a function of overall herring stock numbers (Melvin and Stephenson, 2007). In addition, Greene et al. (2013) found that bottom-up changes in Gulf of Maine ecosystems may be impacting herring growth. Low rates of fishing mortality (Deroba, 2015) and historic changes in herring harvest patterns by fleet indicate that changes in the weight and size-at-age for herring are due to population level changes, not fleet selectivity (Golet, et al. 2015).

The decline in bluefin condition in the Gulf of Maine may have wide-ranging impacts ecologically. Because bluefin fecundity is influenced by weight, smaller bluefin body conditions may result in decreased egg production and reproductive potential (Medina, et al. 2002). In addition, fewer large bluefin may remain in the Gulf of Maine because the smaller herring in this area may not improve or maintain body condition. Instead, these fish may forage in areas where herring body condition has not declined and thus larger herring are more prevalent (e.g. Scotian Shelf, Gulf of St. Lawrence). In this manner, the herring condition decline has changed the historical distribution of bluefin tuna (Golet, et al. 2015). The decline in bluefin condition may also negatively affect users of the bluefin resource economically. Because of the decline in bluefin condition, foreign and domestic buyers and consumers may find smaller, leaner bluefin less desirable, resulting in a decline in ex-vessel values from captured tuna. In addition, fishers may have to travel greater distances to fishing grounds to capture the larger, fattier, more profitable tuna that no longer forage in the Gulf of Maine.

1.3.2 Large Mesh Multispecies (Groundfish)

There are 13 species managed under the Northeast Multispecies Fishery Management Plan (FMP) as large mesh (groundfish) species, based on fish size and type of gear used to harvest the fish: American plaice, Atlantic cod, Atlantic halibut, Atlantic wolffish, haddock, pollock, redfish, ocean pout, yellowtail flounder, white hake, windowpane flounder, winter flounder, and witch flounder. Several large mesh species are managed as two or more stocks based on geographic region. The NMFS food habits data indicate that herring contributes to diet of several groundfish species: Atlantic cod, haddock, white hake, pollock, Atlantic halibut (<10% per species; Smith & Link 2010). The commercial fishery catches all of these species, but the recreational fishery focuses on GOM cod and GOM haddock (NEFMC 2017).

Population status: Of the seven groundfish stocks, for which herring is an important prey item, three are considered overfished and overfishing is occurring for two – as of the 2015 stock assessments (Table 5; NEFMC 2016).

Management: Groundfish has been managed since 1977 with the adoption of a groundfish plan for cod, haddock, and yellowtail flounder. This plan first relied on hard quotas, but the quota system ended in 1982 with the adoption of the Interim Groundfish Plan, which controlled fishing mortality with minimum fish sizes and codend mesh regulations. The Northeast Multispecies FMP replaced this plan in 1986, initially continuing to control fishing mortality with gear restrictions and minimum mesh size, and used biological targets based on a percentage of maximum spawning potential. The FMP has had many revisions in subsequent years. Since 2010, the vast majority of the fishery has been managed with a catch share program, in which self-selected groups of commercial fishermen (i.e., sectors) are allocated a portion of the available catch.

Table 5 – Status of selected Northeast groundfish stocks for FY2016

Stock	**2015 Assessments**	
	Overfishing?	**Overfished?**
Gulf of Maine cod	Yes	Yes
Georges Bank cod	Unknown	Yes
Georges Bank haddock	No	No
Gulf of Maine haddock	No	No
White hake	No	No
American plaice	No	No
Pollock	No	No
Atlantic halibut	Unknown	Yes
Source: Groundfish Framework 56 (NEFMC 2017).		

1.3.3 Striped Bass

Population status: [to be completed]

Management: [to be completed]

1.4 PROTECTED SPECIES: FISH, SEA TURTLES, MARINE MAMMALS, SEABIRDS

Protected species are those afforded protections under the Endangered Species Act (ESA; species listed as threatened or endangered under the ESA) and/or the Marine Mammal Protection Act (MMPA). Table 6 provides a list of protected species that occur in the affected environment of the Atlantic herring FMP and the potential for the fishery to impact the species, specifically via interactions with Atlantic herring fishing gear. A summary of the life history and stock status of seabirds has been added to this section as well (Section 1.4.4). Some species of seabirds are protected under the ESA, and others are not but are predator species of Atlantic herring. Because Atlantic herring was identified as an important predator species of some seabirds in this ecosystem during development of this action, this VEC was expanded to include information about seabirds that prey on Atlantic herring in this region. The human communities, namely birdwatching ecotourism, has been included in the Human Communities section as well.

Table 6 - Species protected under the ESA and/or MMPA that may occur in the affected environment of the herring FMP

Species	Status[2]	*Potential to interact with Atlantic herring fishing gear?*
Cetaceans		
North Atlantic right whale (Eubalaena glacialis)	***Endangered***	***No***
Humpback whale, West Indies DPS, (*Megaptera novaeangliae*)	Protected (MMPA)	Yes
Fin whale (Balaenoptera physalus)	***Endangered***	***Yes***
Sei whale (Balaenoptera borealis)	***Endangered***	***Yes***
Blue whale (Balaenoptera musculus)	***Endangered***	***No***
Sperm whale (Physeter macrocephalus	***Endangered***	***No***
Minke whale (*Balaenoptera acutorostrata*)	Protected (MMPA)	Yes
Pilot whale (Globicephala spp.)[3]	***Protected (MMPA)***	***Yes***
Pygmy sperm whale (*Kogia breviceps*)	Protected (MMPA)	No
Dwarf sperm whale (*Kogia sima*)	Protected (MMPA)	No
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
Atlantic Spotted dolphin (*Stenella frontalis*)	Protected (MMPA)	No
Striped dolphin (*Stenella coeruleoalba*)	Protected (MMPA)	No
Beaked whales (*Ziphius and Mesoplodon spp*)[4]	Protected (MMPA)	No
Bottlenose dolphin (Tursiops truncatus)[5]	***Protected (MMPA)***	***Yes***
Harbor porpoise (*Phocoena phocoena*)	Protected (MMPA)	Yes
Pinnipeds		
Harbor seal (*Phoca vitulina*)	Protected (MMPA)	Yes
Gray seal (*Halichoerus grypus*)	Protected (MMPA)	Yes

Species	**Status**[2]	***Potential to interact with Atlantic herring fishing gear?***
Harp seal (*Phoca groenlandicus*)	Protected (MMPA)	Yes
Hooded seal (*Cystophora cristata*)	Protected (MMPA)	No
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		
Atlantic salmon	Endangered	Yes
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Critical Habitat		
Northwest Atlantic DPS of Loggerhead Sea Turtle	ESA (Protected)	No
North Atlantic Right Whale Critical Habitat	ESA (Protected)	No

Notes:

Marine mammal species (cetaceans and pinnipeds) italicized and in bold are considered MMPA strategic stocks.[1] Shaded rows indicate species who prefer continental shelf edge/slope waters (i.e., >200 meters).

[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 of the MMPA of 1972).

[2] Status is defined by whether the species is listed under the ESA as endangered (i.e. at risk of extinction) or threatened (i.e. at risk of endangerment), or protected under the MMPA. Marine mammals listed under the ESA are also protected under the MMPA. Candidate species are those species for which ESA listing may be warranted.

[3] There are 2 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 referred to as *Globicephala spp*.

[4] There are multiple species of beaked whales in the Northwest Atlantic. They include the cuvier's (*Ziphius cavirostris*), blainville's (*Mesoplodon densirostris*), gervais' (*Mesoplodon europaeus*), sowerbys' (*Mesoplodon bidens*), and trues' (*Mesoplodon mirus*) beaked whales. Species of *Mesoplodon* are difficult to identify at sea, therefore, much of the available characterization for beaked whales is to the genus level only.

[5] This includes the Western North Atlantic Offshore, Northern Migratory Coastal, and Southern Migratory Coastal Stocks of Bottlenose Dolphins.

Cusk are a 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. As a result, this species will not be discussed further in this and the following sections; 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 can be found at: http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm.

1.4.1 Protected Species and Critical Habitat Not Likely to be Affected (via interactions with gear or destruction of essential features of critical habitat) by the Atlantic Herring FMP

Based on available information, it has been determined that this action is not likely to affect (via interactions with gear or destruction of essential features of critical habitat) multiple ESA listed and/or marine mammal protected species or any designated critical habitat (see 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 used to prosecute the Atlantic herring fishery (i.e., purse seine, bottom otter trawl (small mesh), mid-water (including pair) trawl; Waring et al. 2014; 2015; Waring et al. 2016) (Hayes *et al*. 2017; NMFS NEFSC FSB 2015, 2016; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). In the case of critical habitat, this determination has been made because operation of the Atlantic herring fishery 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 2014) (NMFS 2015a,b).

1.4.2 Protected Species Potentially Affected by the Proposed Action

1.4.2.1 Sea Turtles

Kemp's ridley, leatherback, the North Atlantic DPS of green and the Northwest Atlantic DPS of loggerhead sea turtle are the four ESA-listed species of sea turtles that occur in the affected environment of the Atlantic herring fishery. Three of the four species are hard-shelled turtles (i.e., green, loggerhead, and Kemp's ridley). Additional background information on the range-wide status, descriptions, and life histories of these four species can be found in a number of published documents, including sea turtle status reviews and biological reports (Conant et al. 2009; Hirth 1997; NMFS & USFWS 1995; 2007a; b; 2013; TEWG 1998; 2000; 2007; 2009); NMFS and USFWS 2015; Seminoff et al. 2015), and recovery plans for the loggerhead sea turtle (Northwest Atlantic DPS; NMFS & USFWS 2008), leatherback sea turtle (NMFS & USFWS 1992; 1998b), Kemp's ridley sea turtle (NMFS & USFWS 2011), and green sea turtle (NMFS & USFWS 1991; 1998a).

A general overview of sea turtle occurrence and distribution in waters of the Northwest Atlantic Ocean is provided below to assist in understanding how the Atlantic herring fishery overlaps in time and space with sea turtles. Maps depicting the range wide distribution and occurrence of sea turtles in the Greater Atlantic Region can be found at the following websites: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/listing/index.html; http://marinecadastre.gov/; and, http://seamap.env.duke.edu/.

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 (Braun-McNeill et al. 2008; Braun & Epperly 1996; Epperly et al. 1995a; Epperly et al. 1995b; Mitchell et al. 2003; Shoop & Kenney 1992; 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 (Epperly et al. 1995b; Shoop & Kenney 1992). 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 (Blumenthal et al. 2006; Griffin et al. 2013; Hawkes et al. 2006; Hawkes et al. 2011; Mansfield et al. 2009; McClellan & Read 2007; Mitchell et al. 2003; Morreale & Standora 2005) (Braun-McNeill and Epperly 2002).

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; Epperly et al. 1995b; Epperly et al. 1995c; Griffin et al. 2013; Morreale & Standora 2005) (Braun-McNeill and Epperly 2002), 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 & 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 (Epperly et al. 1995b; Griffin et al. 2013; Hawkes et al. 2011; Shoop & Kenney 1992).

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 (Dodge et al. 2014; Eckert et al. 2006; James et al. 2005; Murphy et al. 2006; NMFS & USFWS 2013). Leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (Dodge et al. 2014; James et al. 2005; James et al. 2006; NMFS & USFWS 1992). 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 (Dodge et al. 2014; James et al. 2005; James et al. 2006).

1.1.1.1. Large Whales

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 35°N) wintering/calving grounds and high latitude spring/summer foraging grounds (primarily north of 41N; NMFS 1991; 2010a; b; Waring et al. 2014; 2015; Waring et al. 2016) (Hayes et al. 2017). 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., humpback whales), some portion of the population remains in higher latitudes throughout the winter (Clapham et al. 1993; Swingle et al. 1993; Vu et al. 2012; Waring et al. 2014; 2015; Waring et al. 2016) (Hayes et al. 2017). 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 (Payne et al. 1986; Payne et al. 1990; Schilling et al. 1992; Waring et al. 2014; 2015; Waring et al. 2016) (Hayes et al. 2017). For additional information on the biology, status, and range-wide distribution of each whale species refer to: Waring et al. (2014), Waring et al. (2015), Waring et al. (2016), Hayes et al. (2017); NMFS (1991; 2010a; 2011a).

To further assist in understanding how the Atlantic herring fishery may overlap 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 Atlantic herring fishery is provided in the following table (Table 7).

Table 7 - Large whale occurrence in the affected environment of the Atlantic herring fishery

Species	Prevalence and Approximate Months of Occurrence
Humpback	• Distributed throughout all continental shelf waters of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank throughout the year. • New England waters (Gulf of Maine and Georges Bank regions) = **Foraging Grounds** (approximately March-November). • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern (West Indies) calving grounds. • Increasing evidence of whales remaining in mid- and high- latitudes throughout the winter. Specifically, increasing evidence of wintering areas (for juveniles) in Mid-Atlantic (e.g., waters in the vicinity of Chesapeake and Delaware Bays; peak presence approximately January through March) and Southeastern coastal waters.
Fin	• Distributed throughout all continental shelf waters of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank throughout the year. • Mid-Atlantic waters: o Migratory pathway to/from northern (high latitude) foraging and southern (low latitude) calving grounds; and o Possible offshore calving area (approximately October-January). • New England (Gulf of Maine and Georges Bank/ Southern New England) waters = **Foraging Grounds** (greatest densities spring through summer; lower densities fall through winter). Important foraging grounds include: o Massachusetts Bay (esp. Stellwagen Bank); o Great South Channel; o Waters off Cape Cod (~40-50 meter contour); o Gulf of Maine; Perimeter (primarily eastern) of Georges Bank; and o Mid-shelf area off the east end of Long Island. • Evidence of wintering areas in mid-shelf areas east of New Jersey Stellwagen Bank; and eastern perimeter of Georges Bank.

Species	Prevalence and Approximate Months of Occurrence
Sei	• Uncommon in shallow, inshore waters of the Mid-Atlantic (SNE included), Georges Bank, and Gulf of Maine; 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 Gulf of Maine and Georges Bank; sightings concentrated along the northern, eastern (into Northeast Channel) and southwestern (in the area of Hydrographer Canyon) edge of Georges Bank.
Minke	• Widely distributed throughout continental shelf waters (<100m deep) of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank. • Most common in the EEZ from spring through fall, with greatest abundance found in New England waters; fall through spring widespread and common in deep-ocean waters.
Sources: NMFS (1991; 2010a; 2011a), Hain et al. (1992), Payne et al. (1984; 1990), CETAP (1982), Clapham et al. (1993), Swingle et al. (1993), Vu et al. (2012), Risch et al. (2013), Waring et al. (2014; 2015; 2016), Hayes et al. 2017.	

1.1.1.2. Small Cetaceans and Pinnipeds

Small cetaceans can be found throughout the year in waters of the Northwest Atlantic Ocean (Waring et al. 2014; 2015; Waring et al. 2016) (Hayes *et al*. 2017). Within this range, however, there are seasonal shifts in species distribution and abundance. In regards to pinnipeds, species 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; Waring et al. 2014; 2015; Waring et al. 2016) (Hayes *et al*. 2017).

To further assist in understanding how Atlantic herring fishery may overlap in time and space with the occurrence of small cetaceans and pinnipeds, a general overview of species occurrence and distribution in the affected environment of this amendment is provided in Table 8.

Table 8 - Small cetacean and pinniped occurrence in the affected environment of the Atlantic herring fishery

Species	Prevalence and Approximate Months of Occurrence
Atlantic White-Sided Dolphin	• Distributed throughout the continental shelf waters (primarily to 100 meter isobath) of the Mid-Atlantic (north of 35ºN), Southern New England, Georges Bank, and Gulf of Maine; however, most common in continental shelf waters from Hudson Canyon (~ 39ºN) to Georges Bank, and into the Gulf of Maine. • **January-May**: low densities found from Georges Bank to Jeffreys Ledge. • **June-September**: large densities found from Georges Bank through the Gulf of Maine.

Species	Prevalence and Approximate Months of Occurrence
	• **October-December**: intermediate densities found from southern Georges Bank to southern Gulf of Maine. • South of Georges Bank (Southern New England and Mid-Atlantic), low densities found year round, with waters off Virginia and NC representing 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 meter isobaths) of the Mid-Atlantic, Southern New England, and Georges Bank (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. • **January-May**: occur from waters off Cape Hatteras, NC, to Georges Bank (35^{o} to 42^{o}N). • **Mid-summer-fall**: occur primarily on Georges Bank with small numbers present in the Gulf of Maine; Peak abundance found on Georges Bank in the autumn.
Risso's Dolphin	• **Spring through fall**: Distributed along the continental shelf edge from Cape Hatteras, NC, to Georges Bank. • **Winter**: distributed in the Mid-Atlantic Bight, extending into oceanic waters. • Rarely seen in the Gulf of Maine; 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 (north of 35^{o}N), Southern New England, Georges Bank, and Gulf of Maine. • **July-September**: concentrated in the northern Gulf of Maine (waters < 150 meters); low numbers can be found on Georges Bank. • **October-December**: widely dispersed in waters from NJ to Maine; 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 NY to Gulf of Maine. • **April-June**: widely dispersed from NJ to ME; seen from the coastline to deep waters (>1,800 meters).
Bottlenose Dolphin	**Western North Atlantic Offshore Stock** • Distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic from Georges Bank to FL. • Depths of occurrence: ≥40 meters **Western North Atlantic Northern Migratory Coastal Stock** • Warm water months (e.g., July-August): distributed from the coastal waters from the shoreline to approximately the 25-meter isobaths between the Chesapeake Bay mouth and Long Island, NY.

<table>
<tr><th>Species</th><th>Prevalence and Approximate Months of Occurrence</th></tr>
<tr><td></td><td>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>
October-December: stock occupies waters of southern NC (south of Cape Lookout)
January-March: 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.</td></tr>
<tr><td>Pilot Whales:
Short- and Long-Finned</td><td><u>Short-Finned Pilot Whales</u>
Except for area of overlap (see below), primarily occur south of 40°N
May through December (approximately): distributed primarily near the continental shelf break of the Mid-Atlantic and Southern New England; beginning in the fall, individuals appear to shift to southern waters (i.e., 35°N and south).
<u>Long-Finned Pilot Whales</u>
Except for area of overlap (see below), primarily occur north of 42°N.
Winter to early spring: primarily distributed along the continental shelf edge-slope.
Late spring through fall (: movements and distribution shift onto/within Georges Bank, the Great South Channel, and Gulf of Maine.
<u>Area of Species Overlap:</u> between approximately 38°N and 41°N.</td></tr>
<tr><td>Harbor Seal</td><td>Primarily distributed in waters from NJ to ME; however, increasing evidence indicates that their range is extending into waters as far south as Cape Hatteras, NC (35°N).
Year Round: waters of ME
September-May: waters from New England to NJ.</td></tr>
<tr><td>Gray Seal</td><td>Distributed in waters from NJ to ME.
Year Round: waters from ME to MA.
September-May: waters from Rhode Island to NJ.</td></tr>
<tr><td>Harp Seal</td><td>Winter-Spring (approximately January-May): waters from ME to NJ.</td></tr>
<tr><td>Hooded Seal</td><td>Winter-Spring (approximately January-May): waters of New England.</td></tr>
<tr><td colspan="2">Notes: Information presented in table is representative of small cetacean occurrence in the Northwest Atlantic continental shelf waters out to the 2,000 m isobath.

Sources: Waring et al. (2007; 2014; 2015; 1992; 2016), Hayes et al. (2017), Payne and Heinemann (1993), Payne et al. (1984), Jefferson et al. (2009).</td></tr>
</table>

1.1.1.3. Atlantic Sturgeon

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. Atlantic sturgeon from all five DPSs have the potential to be located anywhere in this marine range (ASSRT 2007; Dadswell 2006; Dadswell et al. 1984; Dovel & Berggren 1983; Dunton et al. 2010; Erickson et al. 2011; Kynard et al. 2000; Laney et al. 2007; O'Leary et al. 2014; Stein et al. 2004a; Waldman et al. 2013; Wirgin et al. 2015; Wirgin et al. 2012) (Dunton et al. 2012; Dunton et al. 2015; Wirgin et al. 2 2015b). 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 m depth contour (Dunton et al. 2010; Erickson et al. 2011; Stein et al. 2004a; b); however, Atlantic sturgeon are not restricted to these depths, as excursions into deeper continental shelf waters have been documented (Collins & Smith 1997; Dunton et al. 2010; Erickson et al. 2011; Stein et al. 2004a; b; Timoshkin 1968). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton et al. 2010; Erickson et al. 2011) (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 m (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, and 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 m (Bain et al. 2000; Dunton et al. 2010; Erickson et al. 2011; Laney et al. 2007; O'Leary et al. 2014; Oliver et al. 2013; Savoy & Pacileo 2003; Stein et al. 2004a; Waldman et al. 2013) (Wipplehauser 2012; Whipplehauser and Squiers 201). Although additional studies are still needed to clarify why these particular sites are chosen by Atlantic sturgeon, they may serve as thermal refuge, wintering sites, or marine foraging areas (Dunton et al. 2010; Erickson et al. 2011; Stein et al. 2004a).

1.1.1.4. Atlantic Salmon

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 Gulf of Maine DPS extends from the Gulf of Maine (primarily northern portion of the Gulf of Maine) to the coast of Greenland (Fay et al. 2006; NMFS & USFWS 2005)(NMFS and USFWS 2016). In general, smolts, post-smolts, and adult Atlantic salmon may be present in the Gulf of Maine 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; Sheehan et al. 2012) (USASAC 2004; NMFS and USFWS 2016). For additional information on the on the biology, status, and range-wide distribution of the Gulf of Maine DPS of Atlantic salmon refer to NMFS and USFWS (2005)(2016); Fay et al. (2006).

1.4.3 Gear Interactions with Protected Species

Several protected species are vulnerable to interactions with various types of fishing gear. Interaction risks vary by gear type, quantity, and soak or tow time. Available information on gear interactions with a given protected species (or species group) is provided in the sections below. These sections are not a comprehensive review of all fishing gear types known to interact with a given species; focus is placed on interaction risks associated with purse seines, bottom (small mesh) trawls, or midwater trawls, the primary gear types used in landing Atlantic herring.

1.4.3.1 Gear Interactions with Sea Turtles

Bottom Otter Trawl. Sea turtle interactions with bottom trawl gear have been observed on Georges Bank, and in the Mid-Atlantic; however, most of the observed interactions have occurred in the Mid-Atlantic (Warden 2011a; b) (Murray 2015). As no sea turtle interactions with bottom trawl gear have been observed in the Gulf of Maine, and few sea turtle interactions have been observed on Georges Bank, there is insufficient data available to conduct a robust model-based analysis on sea turtle interactions with bottom trawl gear in these regions or produce a bycatch estimate for these regions. As a result, the bycatch estimates and discussion below are for bottom trawl gear in the Mid-Atlantic.

Bottom trawl gear poses an injury and mortality risk to sea turtles, specifically due to forced submergence (Sasso and Epperly 2006). Green, Kemp's ridley, leatherback, loggerhead, and unidentified sea turtles have been documented interacting (e.g., bycaught) with bottom trawl gear. However, estimates are available only for loggerhead sea turtles. Warden (2011a; b) estimated that from 2005-2008, the average annual loggerhead interactions in bottom trawl gear in the Mid-Atlantic[2] was 292 (CV=0.13, 95% CI=221-369), with an additional 61 loggerheads (CV=0.17, 95% CI=41-83) interacting with trawls, but released through a Turtle Excluder Device (TED).[3] The 292 average annual observable loggerhead interactions equates to approximately 44 adult equivalents (Warden 2011a; b). Most recently, Murray (2015) estimated that from 2009-2013, the total average annual loggerhead interactions in bottom trawl gear in the Mid-Atlantic[4] was 231 (CV=0.13, 95% CI=182-298); this equates to approximately 33 adult equivalents (Murray 2015). Bycatch estimates provided in Warden (2011a) and Murray (2015) 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). This decrease is likely due to decreased fishing effort in high-interaction areas (Warden 2011a; b).

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[2] Warden (2011a) defined the Mid-Atlantic as south of Cape Cod, Massachusetts, to about the North Carolina/South Carolina border.

[3] TEDs allow sea turtles to escape the trawl net, reducing injury and mortality resulting from capture in the net. Approved TEDs are required in the shrimp and summer trawl fishery. For further information on TEDs see 50 CFR 223.206 and 68 FR 8456 (February 21, 2003).

[4] Murray (2015b) defined the Mid-Atlantic as the boundaries of the Mid-Atlantic Ecological Production; roughly waters west of 71^{o}W to the North Carolina/South Carolina border)

Mid-Water Trawl: NEFOP and ASM observer data from 1989 to 2015 show five leatherback sea turtle interactions with mid-water trawl gear; the primary species landed during these interactions was tuna (NMFS NEFSC FSB 2015, 2016). These takes were in the early 1990s in an experimental HMS fishery that no longer operates. No takes have been documented in other mid-water trawl fisheries operating in the Greater Atlantic Region. Based on this and the best available information, sea turtle interactions in mid-water trawl gear in the Greater Atlantic Region are expected to be rare.

Purse Seine: Sea turtle interactions with this gear type are possible; however, based on available information (NMFS NEFSC FSB 2015, 2016), the risk of a sea turtle interacting with purse seine is expected to be low. Sea turtle may be capture in the net and could become entangled in the mesh. Captured turtles can be released alive if they are quickly retrieved and removed from the net.

1.4.3.2 Gear Interactions with Atlantic Sturgeon

Bottom Otter Trawl: Atlantic sturgeon interactions (i.e., bycatch) with 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 2015, 2016). Three documents, covering three time periods, that use data collected by the Northeast Fisheries Observer Program to describe bycatch of Atlantic sturgeon in bottom trawl gear: Stein et al. (2004b) for 1989-2000; ASMFC (2007) for 2001-2006; and Miller and Shepard (2011) for 2006-2010; none of these documents provide estimates of Atlantic sturgeon bycatch by Distinct Population Segment. Miller and Shepard (2011), the most recent of the three documents, analyzed fishery observer data and VTR data to estimate the average annual number of Atlantic sturgeon interactions in otter trawl in the Northeast Atlantic that occurred from 2006 to 2010. This timeframe included the most recent, complete data and as a result, Miller and Shepard (2011) is considered to be the most accurate predictor of annual Atlantic sturgeon interactions in the Northeast bottom trawl fisheries (NMFS 2013).

Based on the findings of Miller and Shepard (2011), NMFS (2013) estimated that the annual bycatch of Atlantic sturgeon in bottom trawl gear to be 1,342 sturgeon. Miller and Shepard (2011) reported observed Atlantic sturgeon interactions in trawl gear with small (< 5.5 in) and large (≥ 5.5 in) mesh sizes and concluded that, based on NEFOP observed sturgeon mortalities, relative to gillnet gear, bottom trawl gear posed less risk of mortality to Atlantic sturgeon. Estimated mortality rates in gillnet gear were 20.0%, while those in otter trawl gear were 5.0% (Miller & 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 actually 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.

Mid-Water Trawl: To date, there have been no observed/documented interactions with Atlantic sturgeon in mid-water trawl gear (NMFS NEFSC FSB 2015, 2016). Based on this information, mid-water trawl gear is not expected to pose an interaction risk to any Atlantic sturgeon and therefore, is not expected to be source of injury or mortality to this species.

Purse Seine: Capture of sturgeon in purse seine gear type is possible; however, interactions have been extremely rare over the past 26 years. NEFOP and ASM observer data from 1989-2015 show two Atlantic sturgeon interactions with purse seine gear targeting Atlantic herring in the Gulf of Maine (NMFS NEFSC FSB 2015, 2016); these interactions were recorded in 2004 and 2005, prior to the listing of Atlantic sturgeon under the ESA. Based on this information, although Atlantic sturgeon interactions with purse seine gear are possible, the risk of an interaction is expected to be low.

1.4.3.3 Gear Interaction with Atlantic Salmon

Bottom Otter Trawl: Atlantic salmon interactions (i.e., bycatch) with 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 2015, 2016). According to the Biological Opinion issued by NMFS Greater Atlantic Regional Fisheries Office on December 16, 2013, NMFS 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 (Kocik et al. 2014) (NMFS 2013); of those 15 salmon, four were observed caught in bottom trawl gear (Kocik (NEFSC), pers. comm (February 11, 2013) in NMFS 2013).The genetic identity of these captured salmon is unknown; however, the NMFS 2013 Biological Opinion considers all 15 fish to be part of the Gulf of Maine Distinct Population Segment, although some may have originated from the Connecticut River restocking program (i.e., those caught south of Cape Cod, Massachusetts). Since 2013, no additional Atlantic salmon have been observed in bottom trawl gear (NMFS NEFSC FSB 2015, 2016). Based on the above information, bottom trawl interactions with Atlantic salmon are likely rare (NMFS 2013) (Kocik et al. 2014).

Purse Seine and Mid-Water Trawl: To date, there have been no observed/documented interactions with Atlantic salmon and mid-water trawl or purse seine gears (NMFS NEFSC FSB 2015, 2016). Based on this information, mid-water trawls or purse seines are not expected to pose an interaction risk to any Atlantic salmon and therefore, are not expected to be source of injury or mortality to this species.

1.4.3.4 Gear Interactions with Marine Mammals

Depending on species, marine mammal interactions have been observed in bottom trawl, purse seine, and/or mid-water trawl 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 2017 LOF (82 FR 3655 (January 12, 2017)) categorizes the Gulf of Maine herring purse seine fishery as a Category III fishery and commercial bottom trawl (Northeast and Mid-Atlantic) and mid-water trawl fisheries (Northeast or Mid-Atlantic) as Category II fisheries.

1.4.3.4.1 Large Whales

Bottom Otter and Mid-Water Trawls: With the exception of one species, there have been no observed interactions with large whales and trawl (bottom or mid-water) gear. The one exception is minke whales, which have been observed seriously injured and killed in both types of trawl gear. Over the past 10 years, there have been two observed minke whales incidentally taken in mid-water trawl gear. These occurred in 2009 and 2013, with the 2009 incident resulting from entanglement in NOAA research mid-water trawl gear (whale released alive, but seriously injured), and the 2013 incident resulting from entanglement in a Northeast mid-water trawl (including pair trawl) fishery (whale was dead, moderately decomposed) (http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; Henry et al. 2015; Waring et al. 2016). Based on the latter incident, as provided in Waring et al. (2016), the estimated annual average minke whale mortality and serious injury from the Northeast mid-water trawl (including pair trawl) fishery from 2009 to 2013 is 0.2; Hayes et al. (2017) provided the same estimated annual average minke whale mortality and serious injury from the Northeast mid-water trawl (including pair trawl) fishery from 2010 to 2014.

In bottom trawl gear, to date, interactions have only been observed in the northeast bottom trawl fisheries. From the period of 2008-2012, the estimated annual mortality attributed to this fishery was 7.8 minke whales for 2008 and zero minke whales from 2009-2012; no serious injuries were reported during this time. Based on this information, from 2008-2012, the estimated annual average minke whale mortality and serious injury attributed to the northeast bottom trawl fishery was 1.6 (CV=0.69) whales (Waring et al. 2015). Lyssikatos (2015) estimated that from 2008-2013, mean annual serious injuries and mortalities from the northeast bottom trawl fishery were 1.40 (CV=0.58) minke whales. Serious injury and mortality records for minke whales in U.S. waters from 2010-2014 showed zero interactions with bottom trawl (northeast or Mid-Atlantic) gear (Henry et al. 2016; Hayes et al. 2017).

Based on above information, trawl gear is likely to pose a low interaction risk to any large whale species. Should an interaction occur, serious injury or mortality to any large whale is possible; however, relative to other gear types discussed below (i.e., fixed gear), trawl gear represents a low source serious injury or mortality to any large whale.

Purse Seine: Since 2008, three humpback whales and one fin/sei whale have been documented as interacting with purse seines, specifically those operating in the Gulf of Maine targeting Atlantic herring. All interactions, however, resulted in the animals being released from the nets unharmed (Henry et al. 2015; Waring et al. 2016) (Hayes *et al*. 2017; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). Based on this information, although interactions are possible with large whales, purse seines are not expected to pose a serious injury or mortality risk to these species.

1.4.3.4.2 Small Cetaceans and Pinnipeds

Bottom and Mid-Water Trawl Gear: Small cetaceans and pinnipeds are vulnerable to interactions with bottom and/or mid-water trawl gear (Waring et al. 2014; 2015; Waring et al. 2016)(Read *et al*. 2006; Hayes *et al*. 2017; 82 FR 3655 (January 12, 2017)).[5] Based on the most recent five years of observer data (2010-2014), Table 9 provides a list of species that have been observed (incidentally) seriously injured and/or killed by List of Fisheries Category II trawl fisheries that operate in the affected environment of the Atlantic herring fishery (Hayes *et al*. 2017; 82 FR 3655 (January 12, 2017)).

[5] For additional information on small cetacean and pinniped interactions prior to those provided in Waring et al. 2014a, see: http://www.nmfs.noaa.gov/pr/sars/region.htm

Table 9 - Small cetacean and pinniped species observed seriously injured and/or killed by Category trawl fisheries in the affected environment of the Atlantic herring fishery

Fishery	Category	Species Observed or reported Injured/Killed
Mid-Atlantic Mid-Water Trawl-Including Pair Trawl	II	White-sided dolphin
		Gray seal
		Harbor seal
Northeast Mid-Water Trawl-Including Pair Trawl	II	Short-beaked common dolphin
		Long-finned pilot whales
		Gray seal
		Harbor 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
Sources: Hayes *et al*. 2017; MMPA LOF 82 FR 3655 (January 12, 2017).		

In 2006, based on observed mid-water trawl interactions with long-finned pilot whales, short - finned pilot whales, common dolphins, and white sided dolphins, the Atlantic Trawl Gear Take Reduction Team (ATGTRT) was convened to address the incidental mortality and serious injury of these species incidental to bottom and mid-water trawl fisheries operating in both the New England and Mid-Atlantic regions. Because none of the marine mammal stocks of concern to the ATGTRT are classified as a "strategic stock", nor do they currently interact with a Category I fishery,[6] it was determined that development of a take reduction plan was not necessary. In lieu of a take reduction plan, the ATGTRT agreed to develop an Atlantic Trawl Gear Take Reduction Strategy (ATGTRS). The ATGTRS identifies informational and research tasks, as well as education and outreach needs the ATGTRT believes are necessary to provide the basis for decreasing mortalities and serious injuries of marine mammals to insignificant levels

[6] Category I fisheries have frequent incidental mortality and serious injury of marine mammals.

approaching zero. The ATGTRS also identifies several voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals.[7]

Purse Seine: There have been no observed small cetacean interactions with purse seines used to prosecute any Greater Atlantic Region fishery (primarily Gulf of Maine Atlantic herring). As a result, this gear type is not expected to pose an interaction risk with small cetacean species, and therefore, is not expected to be source of serious injury or mortality to any small cetacean.

Purse seines; however, specifically those operating in the Gulf of Maine targeting Atlantic herring, are known to interact with pinniped species. Since 2004, pinniped species have been observed in purse seine gear; none of these interactions have resulted in mortality or confirmed serious injury to the seal (Table 10; Waring *et al*. 2014b; Hayes *et al*. 2017; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). As a result, although interactions are possible with seals, we do not expect purse seines to pose a serious injury or mortality risk to these species. This conclusion is further supported by the fact that the List of Fisheries has identified the Gulf of Maine Atlantic herring purse seine fishery as a Category III fishery, that is, a fishery that causes a remote to no likelihood of causing serious injury or mortality to marine mammals.

Table 10 - 2004-2014 Observed gray and harbor seal interactions with the Gulf of Maine Atlantic herring purse seine fishery

Seal Species	Number of Observed Interactions	Released Alive (No Serious Injury or Mortality)
Unknown	16	Yes
Harbor Seal	21	Yes
Gray Seal	114	Yes

1.4.4 Seabirds

This action includes more emphasis on seabirds as an element of the protected species valued ecosystem component than previous herring management actions due to concerns raised during scoping for this action. Some seabirds in the northeast utilize herring as prey for parts of their lifecycle, and some species are caught incidentally during herring fishing operations. In addition, seabird ecotourism is an important element of the human community in terms of tourism and recreational opportunities throughout the Northeast. More information about seabird ecotourism is summarized in Section ???.

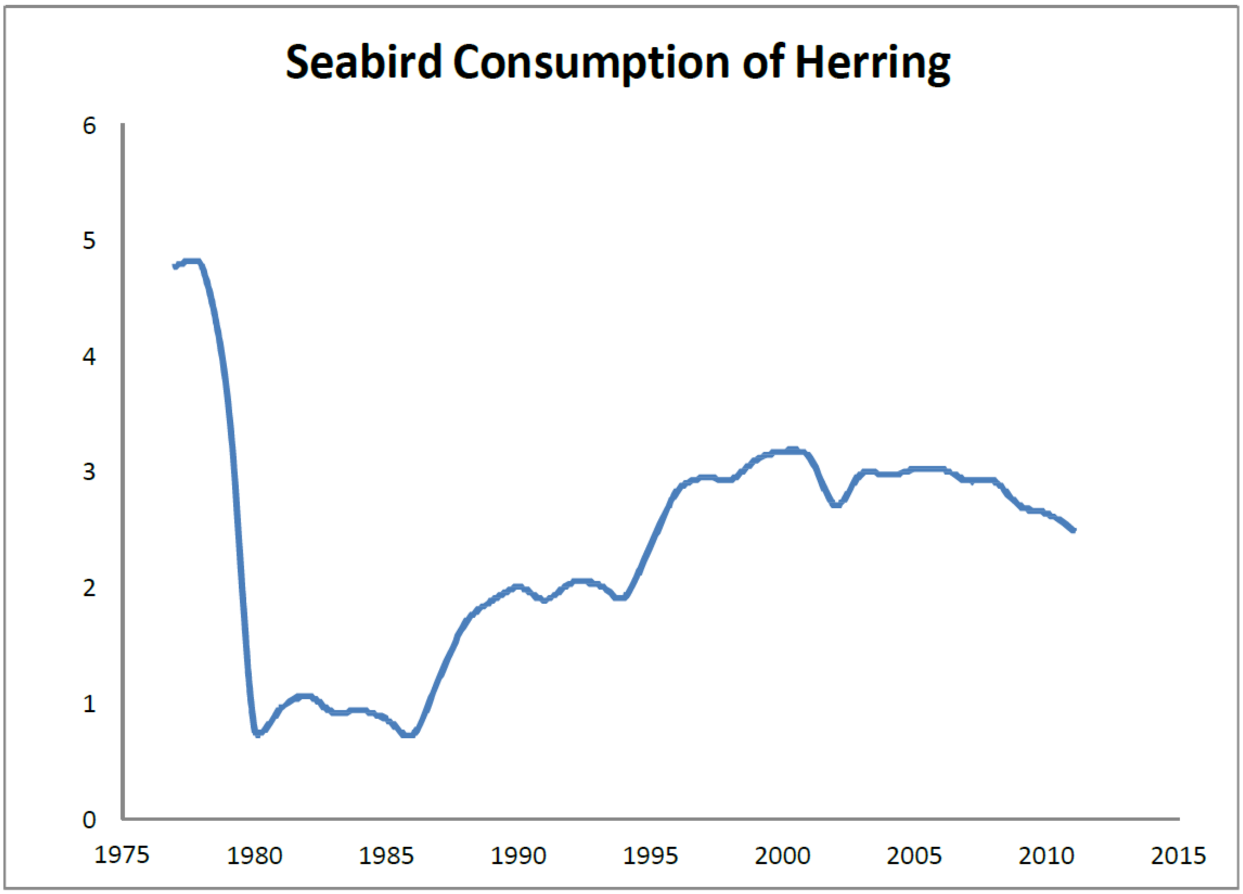
During the early development phase of Amendmnet 8, the EBFM PDT did some work on seabird forage of Atlantic herring in this region. Approximately 20 species of seabird are found in the Northeast Shelf ecosystem, and most are moderately abundant, especially over Georges Bank (Schneider and Heinemann, 1996). However, no large-scale surveys of seabird populations have been conducted in the area since 1988. The NES LME region is generally thought of as seasonal feeding areas, with few species actually nesting locally. Eight seabird species are important

[7] For additional details on the ATGTRS, visit: http://www.greateratlantic.fisheries.noaa.gov/Protected/mmp/atgtrp/

predators of herring: northern fulmar (Fulmarus glacialis), blacklegged kittiwake (Rissa tridactyla), northern gannet (Morus bassanus), herring gull (Larus argentatus), great black-backed gull (L. marinus), and shearwaters (greater shearwater P. gravis, sooty shearwater P. griseus, and Cory's shearwater Calonectris diomedae). As the three species of shearwater are similar in size and greater shearwaters are by far the most abundant species in the region, their abundance was combined into one aggregate group. Quarterly estimates of seabird numbers, daily ration, and the proportion of herring in seabird diets were the variables that were estimated with an uncertainty framework. The approach presented in SAW 54 (NEFSC 2012) is an extension of the Overholtz et al. (2008) and Overholtz and Link (2007) method.

Results indicate that on average these seabirds consume a relatively small amount herring per year, on the order 3-5 mt (Figure 12). This should be viewed as a lower bound estimate as several factors, namely seabird abundance, are understood to be conservative values.

Figure 11 - Annual estimates of consumption of Atlantic herring by seabirds.



For the most part, seabirds can be fairly opportunistic in their foraging, capitalizing on whatever prey species is available at a given time. Therefore, it is likely that herring makes up a portion of many species' diets, but this proportion is variable. The US Fish and Wildlife Service is responsible for the conservation and management of seabirds. The Atlantic Marine Bird

Cooperative has developed a priority list of seabirds for state wildlife action planning. Partners at USFWS have identified a subset of this priority list that are known to consume herring. The species with the highest conservation concern are listed in this table.

Table 11 – Marine Bird Species Priority List (adapted from the Atlantic Marine Bird Conservation Cooperative Priority List by USFWS experts in August 2017)

High Conservation Concern	**Medium Conservation Concern**
Least Tern	Arctic Tern
Roseate Tern	Black-legged Kittiwake
Black Skimmer	Great Shearwater
Northern Gannet	Manx Shearwater
Red-throated Loon	Cory's Shearwater
Common Loon	
Atlantic Puffin	**Low Conservation Concern**
Razorbill	Laughing Gull - Mid-Atlantic
Common Murre	
Audubon's Shearwater	

Some life history information for several of these seabirds has been included in the tables below as background (Table 12 and Table 13). Common tern was identified at the MSE stakeholder workshops as the recommended seabird herring predator because it has more extensive data available and a generally higher proportion of herring in its diet based on that data. The NOAA Northeast Ocean Data Portal has mapping tools characterizing the predicted distribution and abundance for 29 marine mammal species, 40 bird species, and the surveyed biomass of 82 fish species. Figure 12 is one example of the relative abundance of common tern during summer months. Based on this figure there are several hotspots along the coast in the Northeast where common terns are found before they begin their migration south.

Insert more from Nisbet et al

MARINE BIRDS OF THE EASTERN UNITED STATES AND THE BAY OF FUNDY: DISTRIBUTION, NUMBERS, TRENDS, THREATS, AND MANAGEMENT

Table 12 – Alcid life history summary

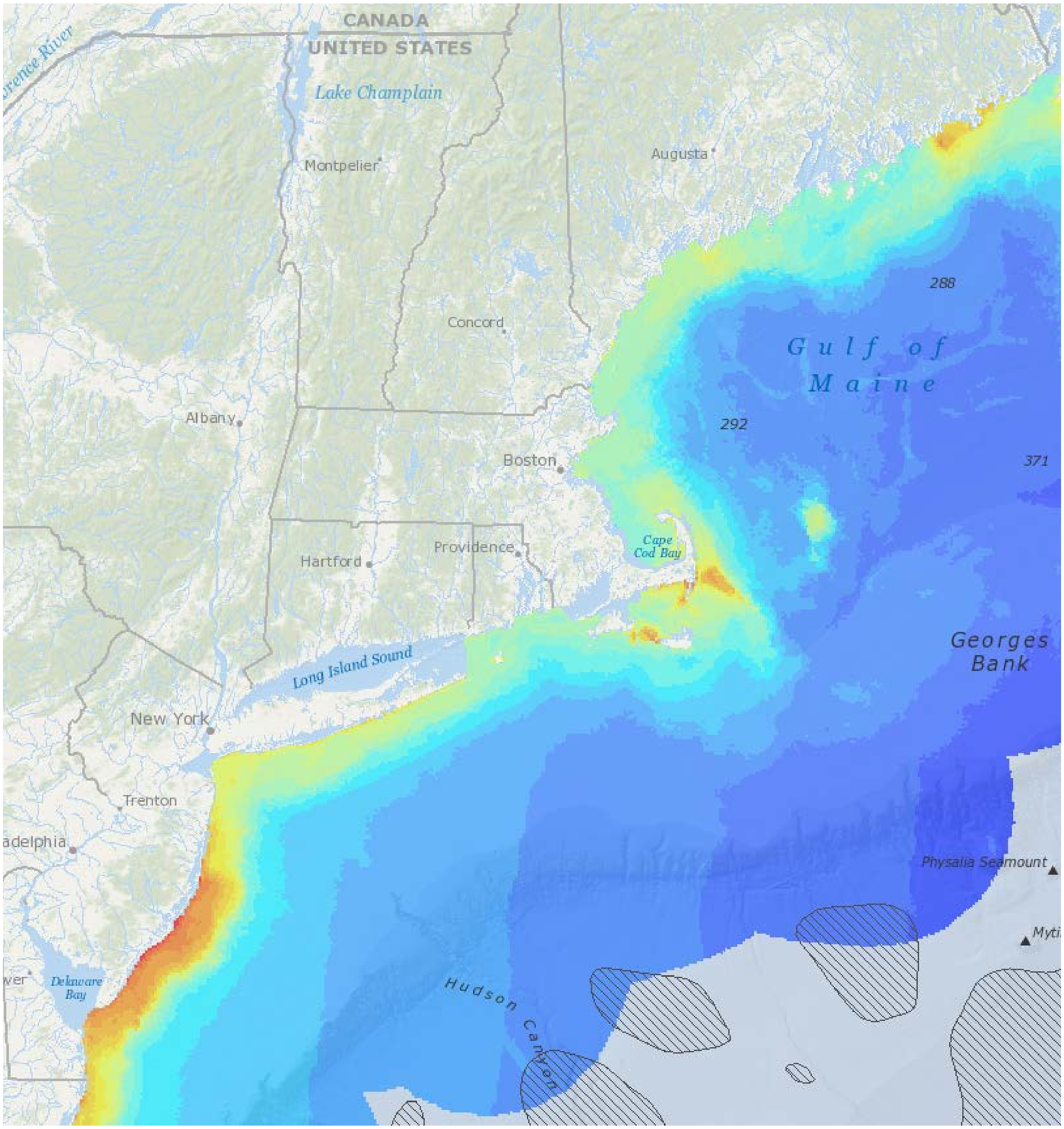
	Razorbill	**Atlantic Puffin**
North American Breeding Range	Boreal & sub-Arctic waters of Atlantic	Offshore islands from Maine to Greenland, and across the Atlantic to Europe
North American population size	500,000 -700,000 (worldwide)	11.8 million worldwide (6% in eastern North America)
Gulf of Maine Population	3,575 pairs	6,500 pairs
Winter Range	waters off of Newfoundland, Nova Scotia, New Brunswick, and the Gulf of Maine (major area near Grand Manan)	- far offshore, rarely seen during winter - large population off of Newfoundland
Life Span	??	30+ years
Adult Survival	approx 90%	approx 90-95%
Size of Adults	~720g	~390g (males) ~360g (females) males slightly larger, especially the bill
Colony size	up to 750,000 (NW Iceland)	up to 225,000 pairs (Witless Bay, Newfoundland)
Juvenile Survival	~ 40%	30 - 40%
Age at first breeding	4-5 years	as early as 3 years, but normally 6 years
Breeding Habitat	crevices on cliffs or among boulders and talus	Nests among boulders or in sod burrows (on islands with sufficient soil)

Table 13 – Tern life history summary

	Common Tern	Arctic Tern	Roseate Tern
North American Breeding Range	Coastal Newfoundland to Caribbean, and inland (esp. Great Lakes)	MA to insular Newfoundland, and northwest through Canadian Arctic to Bering Sea	- 2 discrete populations: Nova Scotia to Long Island, and Caribbean
Northeast (ME-NY) population size	41,500 pairs	2,360 pairs	4,085 pairs
Winter Range	Caribbean, South America to Brazil, occasionally Argentina	edge of Antarctic pack ice	Caribbean and South America to Brazil
Migration	Many stage on Cape Cod for 4-6 weeks in late summer, fly south over open ocean through Caribbean to South America	Flies northeast to Nova Scotia, crosses over to western Europe, south to western Africa, south to Antarctic - returns via South America (89,000 km/ round trip)	travels mainly over ocean, probably migrates with common terns
Life Span	up to 30 years	34 years	up to 30 years
Adult Survival	> 80%	85-90%	~75- 80%
Size of Adults	100 - 130g	100 - 120g	95-130g
Colony size	up to 10,000 pairs	up to 2,250 pairs	up to 1,500 pairs
Age at first breeding	3 (rarely 2)	3-4 years	3-4 years
Breeding Habitat	fresh & saltwater beaches and marshes, treeless islands & barrier beaches	sandy & rocky islands, sand or gravel beaches, dunes ,and tundra	almost exclusively on islands, uses sand, rock and tall vegetation - always with COTE
Nest	simple scrape to intricate nest (> 90% visible from above) frequently adjacent to vegetation or rock	scrape to bare rock - generally less architecture than COTE	Sheltered site in tall vegetation with shallow scape, shrubs, or rock (<30% visible from above)

Clutch size	up to 3 eggs	2-3 eggs (usually 2)	1- 4 eggs (usually 1)
Parental care	both parents share in incubation and feeding	both parents share in incubation and feeding	both parents share in incubation and feeding
Incubation period	21 -29 days, depending on disturbance (usually 22)	usually 21 days	usually 21 days
Chick diet	small pelagic schooling fish, and some invertebrates	small pelagic schooling fish, and some crustaceans	small pelagic schooling fish
Age at fledging	27 - 30 days	21 - 24 days	22-30 days (mobile at 2-4 days)
Breeding success	0 - 2.1 chicks / pair	0 - 1.7 chicks / pair	ave = 1.1 chicks /pair
Adult foraging strategy	plunge diving from 1- 6 meters	plunge diving from 1-6 meters	plunge diving or surface dipping, tends to fly into wind, hover, & dive (Usually from 1-6m)
Foraging habitat	usually shallow, inshore waters 20-40 km from breeding colony (average distance = 5.5km)	May forage 20-40 km from colony, averaging foraging distance = 3km, forage in a variety of habitats including: deep water, along rocky shores, and tide rips	Forages over shallow sandbars, tide rips, or shoals for schooling fish. May feed closer to shore than COTE. May travel 25-30km to forage.

Figure 12 – Relative abundance of common tern (during the summer only) produced by NOAA National Centers for Coastal Ocean Science (NCCOS).



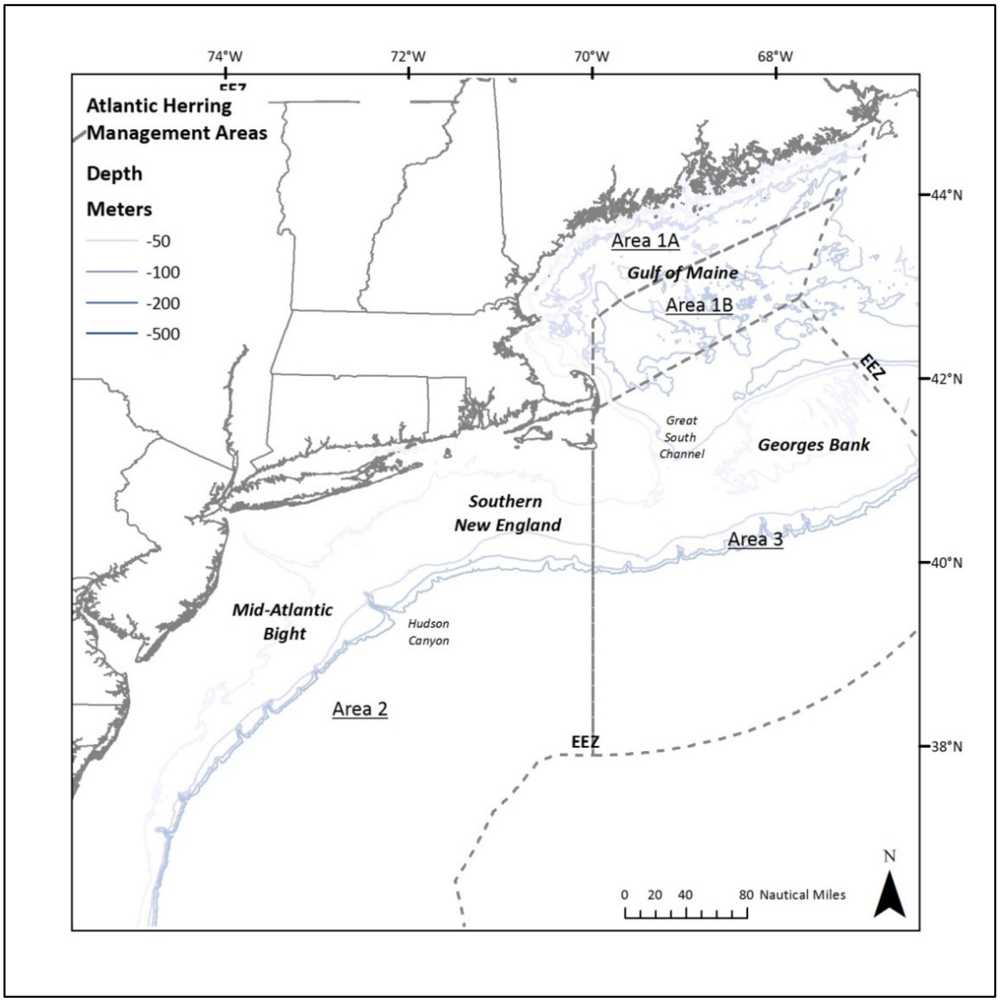
Source: http://www.northeastoceandata.org/data-explorer/?birds

1.5 PHYSICAL ENVIRONMENT AND ESSENTIAL FISH HABITAT

1.1.1 Physical Environment

The Atlantic herring fishery is prosecuted in four areas defined as Areas 1A, 1B, 2, and 3 (Figure 13). These areas collectively cover the entire northeast U.S. shelf ecosystem, which has been defined as the Gulf of Maine south to Cape Hatteras, North Carolina, extending from the coast seaward to the edge of the continental shelf, including offshore to the Gulf Stream (Sherman et al. 1996). Three distinct sub-regions, the Gulf of Maine, Georges Bank, and the southern New England/Mid-Atlantic region, were described in the Affected Environment section of Amendment 5 to the Atlantic Herring FMP, based on a summary compiled for the gear effects technical memo authored by Stevenson et al. (2004). Roughly, Areas 1A and 1B cover the Gulf of Maine, Area 2 covers southern the New England/Mid-Atlantic region, and Area 3 covers Georges Bank.

Figure 13 – Atlantic Herring Management Areas and the Northeast U.S. shelf ecosystem



1.1.2 Essential Fish Habitat

1.5.1.1 Essential Fish Habitat for Atlantic Herring

The original EFH designation for Atlantic herring was developed as part of EFH Omnibus Amendment 1 in 1998. Omnibus Habitat Amendment 2, which includes updates to the EFH designation for herring, as well as for other Council-managed species, is undergoing review and should be published during 2017 or 2018. The new designations for adults and juveniles identify nearly the entire Gulf of Maine as EFH, and designate additional areas on the southern half of Georges Bank. The updated larval designation will be similar to the current one. The updated egg designation is the most different from the original, with many additional areas identified as EFH based on the distribution of very small larvae. The updated EFH designation for herring is provided below. Interactive maps of EFH for each species and life stage are available on NOAA EFH Mapper http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html. The mapper will be updated to reflect changes proposed in OHA2 once the amendment is published. Additional details are provided in Volume 2 (designations), Appendix A (designation methods), and Appendix B (supplementary information) of Omnibus Habitat Amendment 2 (http://www.nefmc.org/library/omnibus-habitat-amendment-2).

Eggs: Inshore and offshore benthic habitats in the Gulf of Maine and on Georges Bank and Nantucket Shoals in depths of 5-90 meters on coarse sand, pebbles, cobbles, and boulders and/or macroalgae at the locations shown in Map 3. Eggs adhere to the bottom, often in areas with strong bottom currents, forming egg “beds” that may be many layers deep.

Larvae: Inshore and offshore pelagic habitats in the Gulf of Maine, on Georges Bank, and in the upper Mid-Atlantic Bight, as shown on Map 4, and in the bays and estuaries listed in Table 14. Atlantic herring have a very long larval stage, lasting 4-8 months, and are transported long distances to inshore and estuarine waters where they metamorphose into early stage juveniles (“brit”) in the spring.

Juveniles: Intertidal and sub-tidal pelagic habitats to 300 meters throughout the region, as shown on Map 5, including the bays and estuaries listed in Table 14. One and two-year old juveniles form large schools and make limited seasonal inshore-offshore migrations. Older juveniles are usually found in water temperatures of 3 to 15°C in the northern part of their range and as high as 22°C in the Mid-Atlantic. Young-of-the-year juveniles can tolerate low salinities, but older juveniles avoid brackish water.

Adults: Sub-tidal pelagic habitats with maximum depths of 300 meters throughout the region, as shown on Map 5, including the bays and estuaries listed in Table 14. Adults make extensive seasonal migrations between summer and fall spawning grounds on Georges Bank and the Gulf of Maine and overwintering areas in southern New England and the Mid-Atlantic region. They seldom migrate beyond a depth of about 100 meters and – unless they are preparing to spawn – usually remain near the surface. They generally avoid water temperatures above 10°C and low salinities. Spawning takes place on the bottom, generally in depths of 5-90 meters on a variety of substrates (see eggs).

Table 14 – Atlantic herring EFH designation for estuaries and embayments.

Estuaries and Embayments	Larvae	Juveniles	Adults
Passamaquoddy Bay	S,M	S,M	S,M
Englishman/Machias Bay	S,M	S,M	S,M
Narraguagus Bay	S,M	S,M	S,M
Blue Hill Bay	S,M	S,M	S,M
Penobscot Bay	S,M	S,M	S,M
Muscongus Bay	S,M	S,M	S,M
Damariscotta River	S,M	S,M	S,M
Sheepscot River	S,M	S,M	S,M
Kennebec / Androscoggin	S,M	S,M	S,M
Casco Bay	S,M	S,M	S
Saco Bay	S,M	S,M	S
Wells Harbor	S,M	S,M	S
Great Bay	S,M	S,M	S
Hampton Harbor*	S,M	S,M	S
Merrimack River	M	M	
Plum Island Sound*	S,M	S,M	S
Massachusetts Bay	S	S	S
Boston Harbor	S	S,M	S,M
Cape Cod Bay	S	S	S
Buzzards Bay		S,M	S,M
Narragansett Bay	S	S,M	S,M
Long Island Sound		S,M	S,M
Gardiners Bay		S	S
Great South Bay		S	S
Hudson River / Raritan Bay	S,M	S,M	S,M
Barnegat Bay		S,M	S,M
New Jersey Inland Bays		S,M	S,M

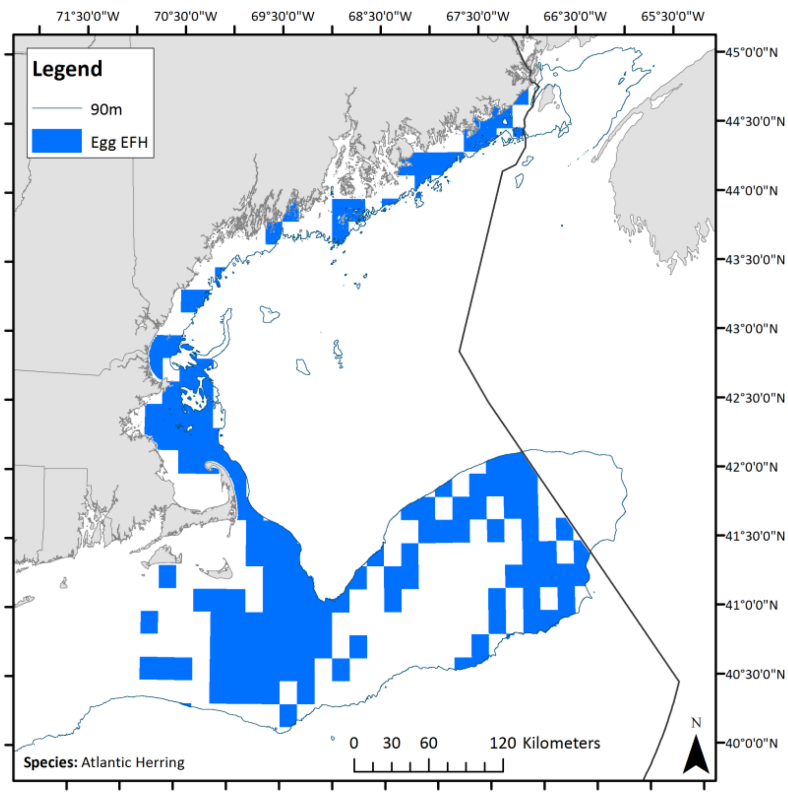
Estuaries and Embayments	Larvae	Juveniles	Adults
Delaware Bay		S,M	S
Chesapeake Bay			S

S ≡ The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).

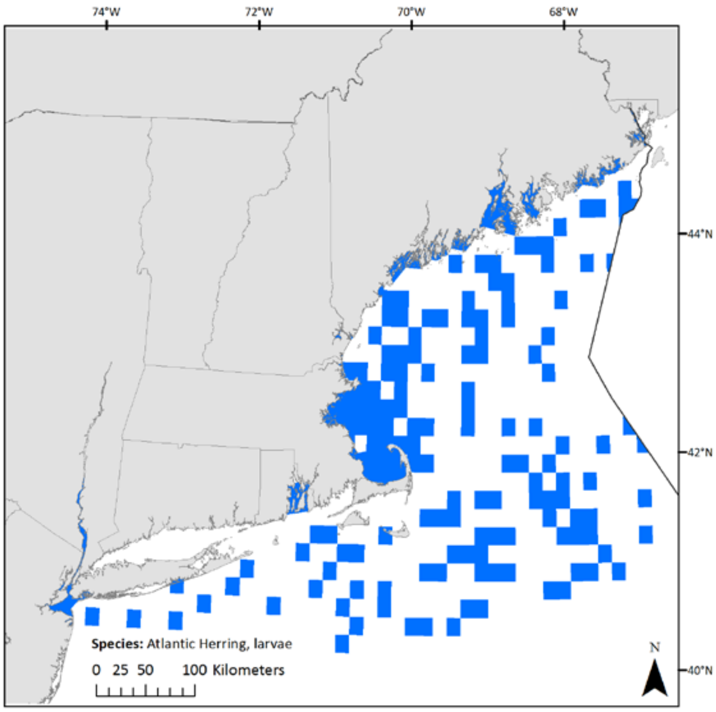
M ≡ The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).

** = This water body was not included in the original ELMR reports, but it was included in the salinity zone maps that were appended to all the relevant fishery management plans and amendments which implemented the no action EFH designations; EFH designations were inferred in these locations if there were ELMR-based designations in the adjacent north and south locations.*

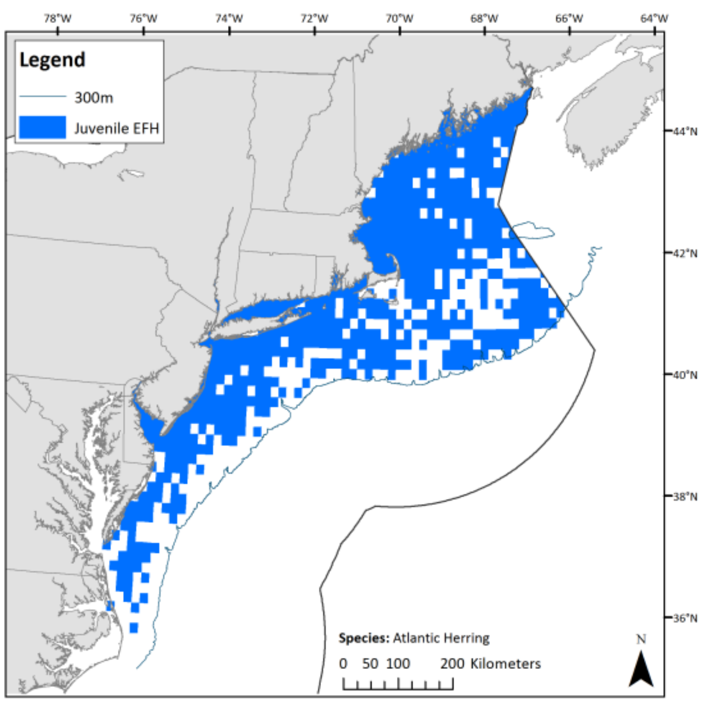
Map 3 – Atlantic herring egg EFH.



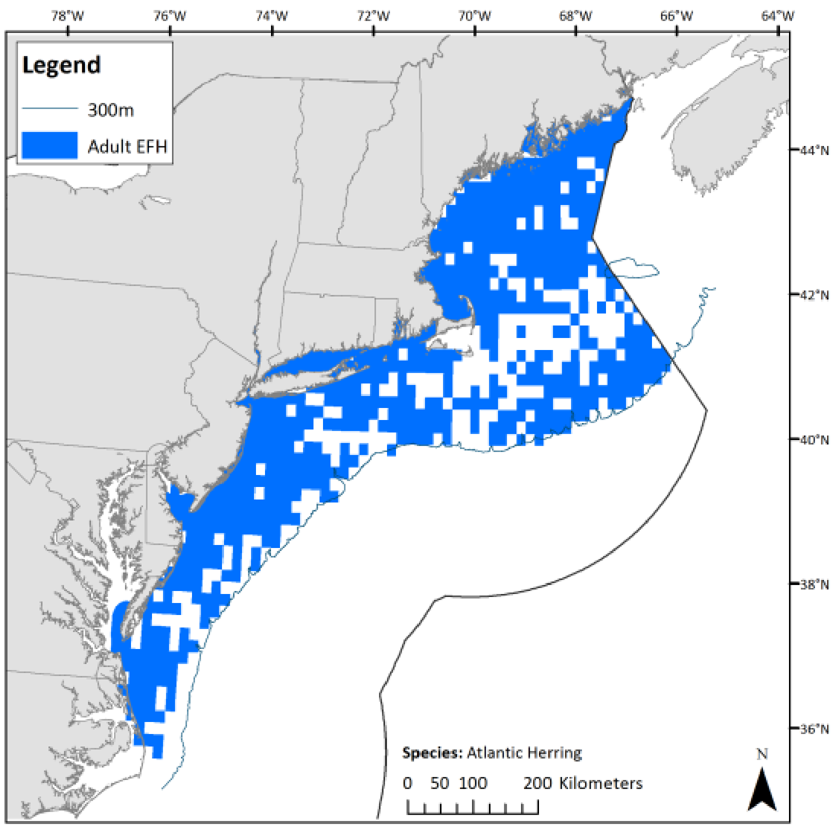
Map 4 – Atlantic herring larval EFH.



Map 5 – Atlantic herring juvenile EFH.



Map 6 – Atlantic herring adult EFH.



1.5.1.2 Essential Fish Habitat for Other Species

The environment that could potentially be affected by the Proposed Action has been identified as EFH for the benthic life stages of the species listed in Table 15. Additional information is in the FMP document that most recently updated each species' EFH designation (last column in Table 15), or on the EFH mapper referenced above. Note that the Mid-Atlantic Fishery Management Council is currently reviewing their EFH designations. Updated designations could be available prior to completion of Amendment 8, depending on the timing of the amendment and the EFH review.

Table 15 - Sources for current EFH designation information. OHA2 = Omnibus Habitat Amendment 2.

Species	Authority	Plan Managed Under	Last update
Monkfish	NEFMC, MAFMC	Monkfish	OHA2
Atlantic herring	NEFMC	Atlantic Herring	OHA2
Atlantic salmon	NEFMC	Atlantic salmon	OHA2
Atlantic sea scallop	NEFMC	Atlantic Sea Scallop	OHA2
American plaice	NEFMC	NE Multispecies	OHA2
Atlantic cod	NEFMC	NE Multispecies	OHA2
Atlantic halibut	NEFMC	NE Multispecies	OHA2
Atlantic wolffish	NEFMC	NE Multispecies	OHA2
Haddock	NEFMC	NE Multispecies	OHA2
Ocean pout	NEFMC	NE Multispecies	OHA2
Offshore hake	NEFMC	NE Multispecies	OHA2
Pollock	NEFMC	NE Multispecies	OHA2
Red hake	NEFMC	NE Multispecies	OHA2
Redfish	NEFMC	NE Multispecies	OHA2
Silver hake	NEFMC	NE Multispecies	OHA2
White hake	NEFMC	NE Multispecies	OHA2
Windowpane flounder	NEFMC	NE Multispecies	OHA2
Winter flounder	NEFMC	NE Multispecies	OHA2
Witch flounder	NEFMC	NE Multispecies	OHA2
Yellowtail flounder	NEFMC	NE Multispecies	OHA2
Barndoor skate	NEFMC	NE Skate Complex	OHA2
Clearnose skate	NEFMC	NE Skate Complex	OHA2
Little skate	NEFMC	NE Skate Complex	OHA2
Rosette skate	NEFMC	NE Skate Complex	OHA2
Smooth skate	NEFMC	NE Skate Complex	OHA2
Thorny skate	NEFMC	NE Skate Complex	OHA2
Winter skate	NEFMC	NE Skate Complex	OHA2
Red crab	NEFMC	Red Crab	OHA2
Spiny dogfish	MAFMC/NEFMC	Spiny Dogfish	Original FMP
Atlantic surfclam	MAFMC	Atlantic Surfclam Ocean Quahog	Amendment 12
Ocean quahog	MAFMC	Atlantic Surfclam Ocean Quahog	Amendment 12
Bluefish	MAFMC	Bluefish FMP	Amendment 1
Atlantic mackerel	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Butterfish	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Longfin squid	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Shortfin squid (*Illex*)	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Black sea bass	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Scup	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Summer flounder	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Tilefish	MAFMC	Tilefish	Amendment 1

1.6 HUMAN COMMUNITIES

Amendment 8 considers and evaluates the effect management alternatives may have on people's economy, way of life, traditions, and community. These social and economic impacts may be driven by changes in fishery flexibility, opportunity, stability, certainty, safety, and/or other factors. While it is possible that social and economic impacts could be solely experienced by individuals, it is more likely that impacts would be experienced across communities, gear types, and/or vessel size classes.

Summarized here are the fisheries and human communities most likely to be impacted by the Alternatives under Consideration. Social, economic and fishery information presented herein is useful in describing the response of the fishery to past management actions and predicting how the Amendment 8 alternatives may affect human communities. Additionally, this section establishes a descriptive baseline for the fishery with which to compare actual and predicted future changes that result from management actions.

1.6.1 Herring Fishery

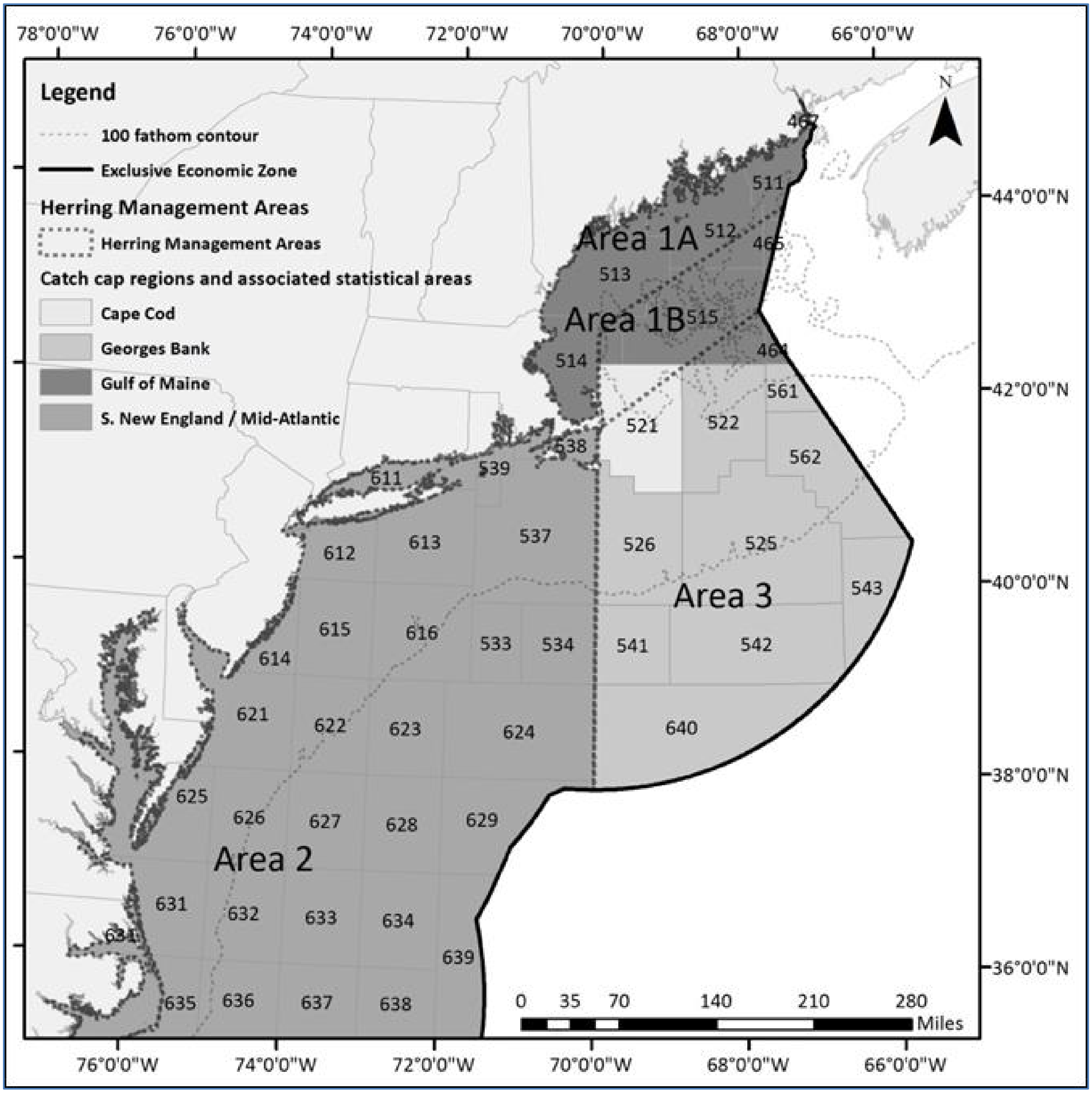
1.6.1.1 Background Information

Atlantic herring has been integral to New England's industry and culture since at least the 1700s (Smylie 2004, p. 76-84). Today, the U.S. Atlantic herring fishery occurs over the Northwest Atlantic shelf region from Cape Hatteras to Maine, including an active fishery in the inshore Gulf of Maine and seasonally on Georges Bank (Map 7). The Atlantic herring resource is managed as one stock complex, but this stock is thought to be comprised of inshore and offshore components that segregate during spawning. In recognition of the spatial structure of the herring resource, the Atlantic herring Annual Catch Limit (ACL) is divided into sub-ACLs and assigned to four herring management areas. Area 1 is the Gulf of Maine (GOM) divided into an inshore (Area 1A) and offshore section (Area 1B); Area 2 is located in the coastal waters between MA and NC (generally referred to as southern New England/Mid-Atlantic), and Area 3 is on Georges Bank (GB).

The Atlantic herring fishery is generally prosecuted south of New England in Area 2 during the winter (January-April), and oftentimes as part of the directed mackerel fishery. There is overlap between the herring and mackerel fisheries in Area 2 and in Area 3 during the winter months, although catches in Area 3 tend to be relatively low. The herring summer fishery (May-August) is generally prosecuted throughout the GOM in Areas 1A, 1B and in Area 3 (GB) as fish are available. Restrictions in Area 1A have pushed the fishery in the inshore GOM to later months (late summer). The midwater trawl (single and paired) fleet is restricted from fishing in Area 1A in the months of January through September because of the Area 1A sub-ACL split (0% January-May) and the purse seine-fixed gear only area (all of Area 1A) that is effective June-September. A sub-ACL split for Area 1B (0% January – April, 100% May – December) is effective for all vessels during the 2014 and 2015 fishing years.

Fall and winter fishing (September-December) tends to be more variable and dependent on fish availability; the Area 1A sub-ACL is always fully used, and the inshore GOM fishery usually closes around November. As the 1A and 1B quotas are taken, larger vessels become increasingly dependent on offshore fishing opportunities (Georges Bank, Area 3) when fish may be available. Atlantic herring is also caught in state waters and in the New Brunswick weir fishery.

Map 7 - Atlantic Herring Management Areas and RH/S Catch Cap Areas



1.6.1.2 Atlantic Herring Catch

The Atlantic herring stockwide ACL and management area sub-ACLs are tracked/ monitored based on the ***total catch – landings and discards***, which is provided and required by herring vessels through the vessel monitoring system (VMS) catch reports and vessel trip reports (VTRs) as well as through Federal/state dealer data. Atlantic herring harvesters are required to report discards in addition to landed catch through these independent reporting methods.

NMFS' catch estimation methods for the Atlantic herring fishery are described in detail in both Framework Adjustment 2 and Framework Adjustment 3 to the Atlantic Herring FMP (Section 3.6.1 of Framework 3, NEFMC 2014). The following bullets briefly describe how catch estimates have been derived:

- 2004-2006 Atlantic herring catch estimates are provided from quota management implemented by NMFS through the Atlantic Herring FMP and are based on interactive voice reporting (IVR) data from the call-in system used to monitor TACs. Reported herring discards are included in the totals.
- 2007-2009 Atlantic herring catch estimates are based on IVR data supplemented with dealer data. Reported herring discards are included in the totals.
- 2010-current Atlantic herring catch estimates are based on a comprehensive methodology developed by NMFS in response to Amendment 4 provisions and the need to better monitor sub-ACLs. Catch estimates are based on landings data obtained from dealer reports (Federal and State), supplemented with VTRs and VMS catch reports (Federal and State of Maine) with the addition of discard data from extrapolated observer data.

The vast majority of the Atlantic herring resource is harvested in Federal waters (

Table 16). Catch by Federal permit holders that occurs in State waters is reported and counted against the sub-ACLs. Catch by state-only permit holders is monitored by the ASMFC and is not large enough to substantially affect management of the Federal fishery and the ability to remain under the sub-ACLs (Section 1.6.1.13). Catch in the New Brunswick weir fishery is accounted for under the management uncertainty buffer (Section 1.6.1.14).

Atlantic herring catch has been variable from 2004-2016, averaging 90,000 mt, with the highest catch in 2009 (103,943 mt) and lowest in 2016 (64,801 mt; Table 17; Figure 14). However, the quota allocated to the fishery (stockwide ACL) has decreased during this time. Consequently, the Atlantic herring fishery has become more fully used in recent years, with the exception of 2015 when the fishery became constrained by the Georges Bank Haddock catch cap accountability measure. Total catch is substantially lower today than during the late 1960s to mid-1970s, during the years of foreign fishing (peak at 477,767 mt in 1968; Deroba 2015).

Examination of catch by area suggests a marked change in removals by area (Figure 51). Post 2007 catches in the offshore areas (Areas 2 & 3) increased while catches inshore decreased. This is likely due to a number of factors, including the reduction in Area 1A quota from ~60,000 mt in 2005 to ~27,000 by 2010.

The temporal and spatial variability of the Atlantic herring fishery may be understood by examining the quota use in each management area on a monthly basis over the course of the fishing year. In general, the fishery concentrates in Area 2 during the first few months of the year, then effort shifts towards Area 1A through the summer and fall, as well as into Area 3 during the fall and early winter. Area 1B is used throughout the year as fish and markets are available. These trends are illustrated in Figure 16 and Figure 17, which show average monthly catch by management area during the years 2007-2009 and 2010-2012, respectively. This dichotomy is provided, because the ACL was substantially higher in 2007-2009 than in 2010-2012. Despite this difference, area usage was roughly similar, though Area 3 became more important in 2010-2012.

Table 16 - Atlantic herring catch (mt), 1970-2014

Year	U.S. Catch			NB weir	Total catch
	Mobile	Fixed	Total		
1970	302,107	4,316	**306,423**	15,070	**321,493**
1971	327,980	5,712	**333,692**	12,136	**345,828**
1972	225,726	22,800	**248,526**	31,893	**280,419**
1973	247,025	7,475	**254,500**	19,053	**273,553**
1974	203,462	7,040	**210,502**	19,020	**229,522**
1975	190,689	11,954	**202,643**	30,816	**233,459**
1976	79,732	35,606	**115,338**	29,207	**144,545**
1977	56,665	26,947	**83,612**	19,973	**103,585**
1978	52,423	20,309	**72,732**	38,842	**111,574**
1979	33,756	47,292	**81,048**	37,828	**118,876**
1980	57,120	42,325	**99,445**	13,526	**112,971**
1981	26,883	58,739	**85,622**	19,080	**104,702**
1982	29,334	15,113	**44,447**	25,963	**70,410**
1983	29,369	3,861	**33,230**	11,383	**44,613**
1984	46,189	471	**46,660**	8,698	**55,358**
1985	27,316	6,036	**33,352**	27,864	**61,216**
1986	38,100	2,120	**40,220**	27,885	**68,105**
1987	47,971	1,986	**49,957**	27,320	**77,277**
1988	51,019	2,598	**53,617**	33,421	**87,038**
1989	54,082	1,761	**55,843**	44,112	**99,955**
1990	54,737	670	**55,407**	38,778	**94,185**
1991	78,032	2,133	**80,165**	24,574	**104,739**
1992	88,910	3,839	**92,749**	31,968	**124,717**
1993	74,593	2,288	**76,881**	31,572	**108,453**
1994	63,161	539	**63,700**	22,242	**85,942**
1995	106,179	6	**106,185**	18,248	**124,433**
1996	116,788	631	**117,419**	15,913	**133,332**
1997	123,824	275	**124,099**	20,551	**144,650**
1998	103,734	4,889	**108,623**	20,092	**128,715**
1999	110,200	654	**110,854**	18,644	**129,498**
2000	109,087	54	**109,141**	16,830	**125,971**
2001	120,548	27	**120,575**	20,210	**140,785**
2002	93,176	46	**93,222**	11,874	**105,096**
2003	102,320	152	**102,472**	9,008	**111,480**
2004	94,628	96	**94,724**	20,685	**115,409**

2005	93,670	68	**93,738**	13,055	**106,793**
2006	102,994	1,007	**104,001**	12,863	**116,864**
2007	81,116	403	**81,519**	30,944	**112,463**
2008	84,650	31	**84,681**	6,448	**91,129**
2009	103,458	98	**103,556**	4,031	**107,587**
2010	67,191	1,263	**68,454**	10,958	**79,412**
2011	82,022	421	**82,443**	3,711	**86,154**
2012	87,164	9	**87,173**	504	**87,677**
2013	95,182	9	**95,191**	6,431	**101,622**
2014	92,651	518	**93,169**	2,149	**95,318**
Source: Deroba (2015). *Note:* The NB weir catch includes the shutoff fishery.					

Table 17 - Atlantic herring sub-ACL allocations and catch by year and management area, 2004-2016

Year	Sub-Area	sub-ACL (mt)	Catch (mt)	% Harvested
2004	1A	60,000	60,095	100%
	1B	10,000	9,044	90%
	2	50,000	12,992	26%
	3	60,000	11,074	18%
2005	1A	60,000	61,102	102%
	1B	10,000	7,873	79%
	2	30,000	14,203	47%
	3	50,000	12,938	26%
2006	1A	60,000	59,989	100%
	1B	10,000	13,010	130%
	2	30,000	21,270	71%
	3	50,000	4,445	9%
2007	1A	50,000	49,992	100%
	1B	10,000	7,323	73%
	2	30,000	17,268	58%
	3	55,000	11,236	20%
2008	1A	43,650	42,257	97%
	1B	9,700	8,671	89%
	2	30,000	20,881	70%
	3	60,000	11,431	19%
2009	1A	43,650	44,088	101%
	1B	9,700	1,799	19%
	2	30,000	28,032	93%
	3	60,000	30,024	50%
2010	1A	26,546	28,424	107%
	1B	4,362	6,001	138%
	2	22,146	20,831	94%
	3	38,146	17,596	46%

2011	1A	29,251	30,676	105%
	1B	4,362	3,530	81%
	2	22,146	15,001	68%
	3	38,146	37,038	97%
2012	1A	27,668	24,302	88%
	1B	2,723	4,307	158%
	2	22,146	22,482	102%
	3	38,146	39,471	103%
2013	1A	29,775	29,820	100%
	1B	4,600	2,458	53%
	2	30,000	27,569	92%
	3	42,000	37,833	90%
2014	1A	33,031	32,898	100%
	1B	2,878	4,399	153%
	2	28,764	19,626	68%
	3	39,415	36,323	92%
2015	1A	30,580	29,406	96%
	1B	4,922	2,889	59%
	2	32,100	15,214	47%
	3	44,910	33,256	74%
2016	1A	30,524	27,806	91%
	1B	2,844	3,624	127%
	2	31,227	14,594	47%
	3	42,765	18,777	44%

Note: Shaded rows are sub-ACL overages.
Source: GARFO

Figure 14 – Atlantic herring sub-ACLs (solid lines) and catch (dashed lines) by year and management area, 2004-2016

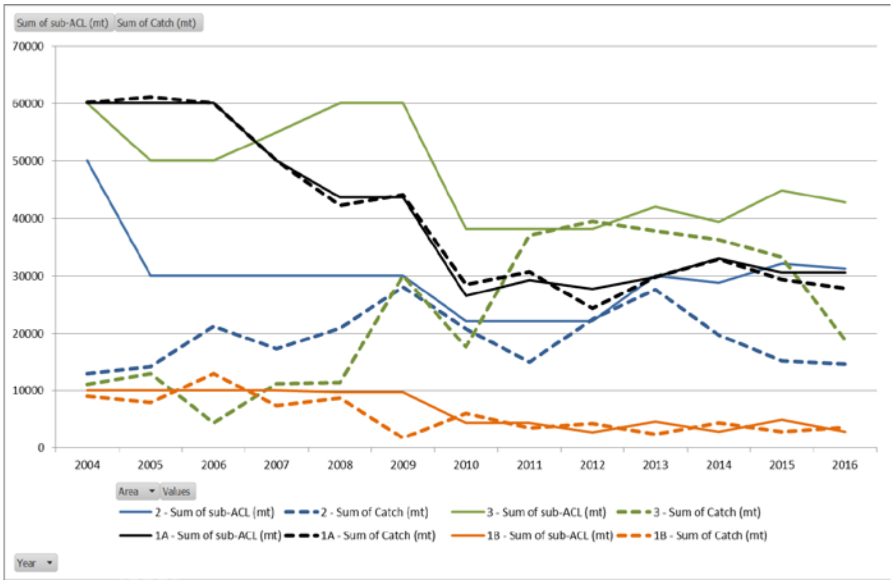
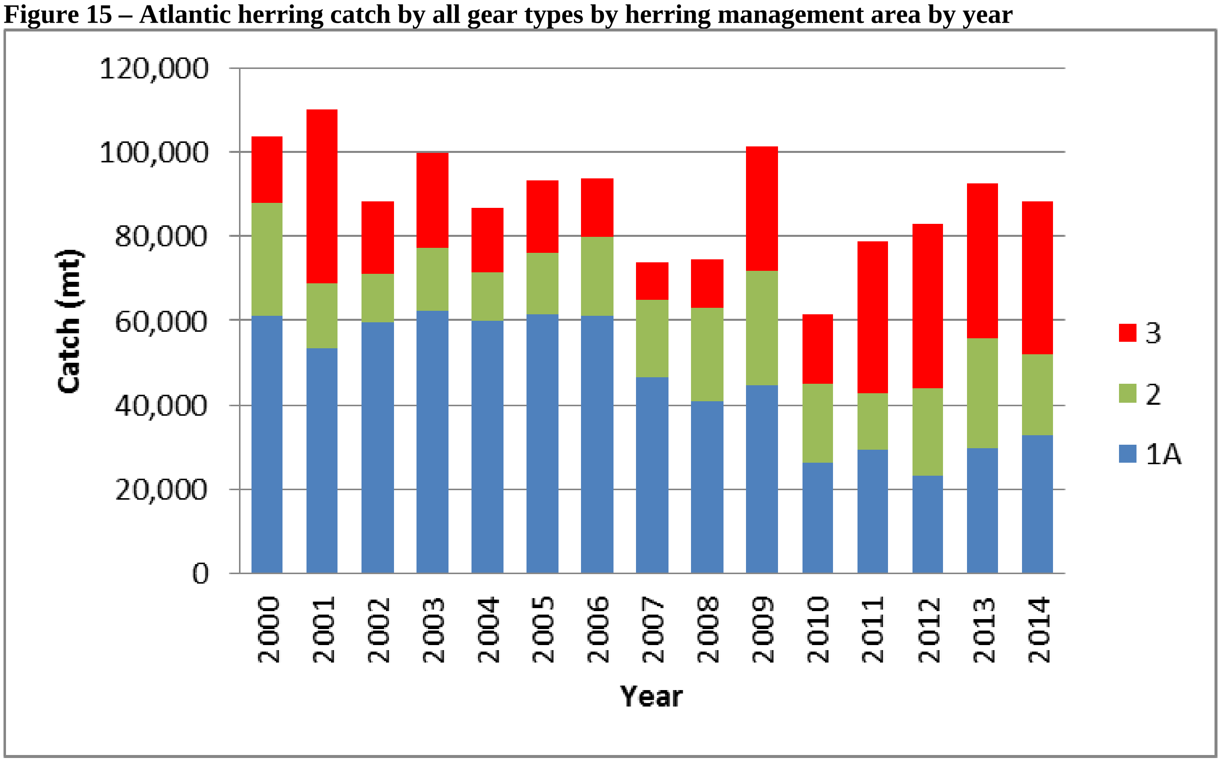
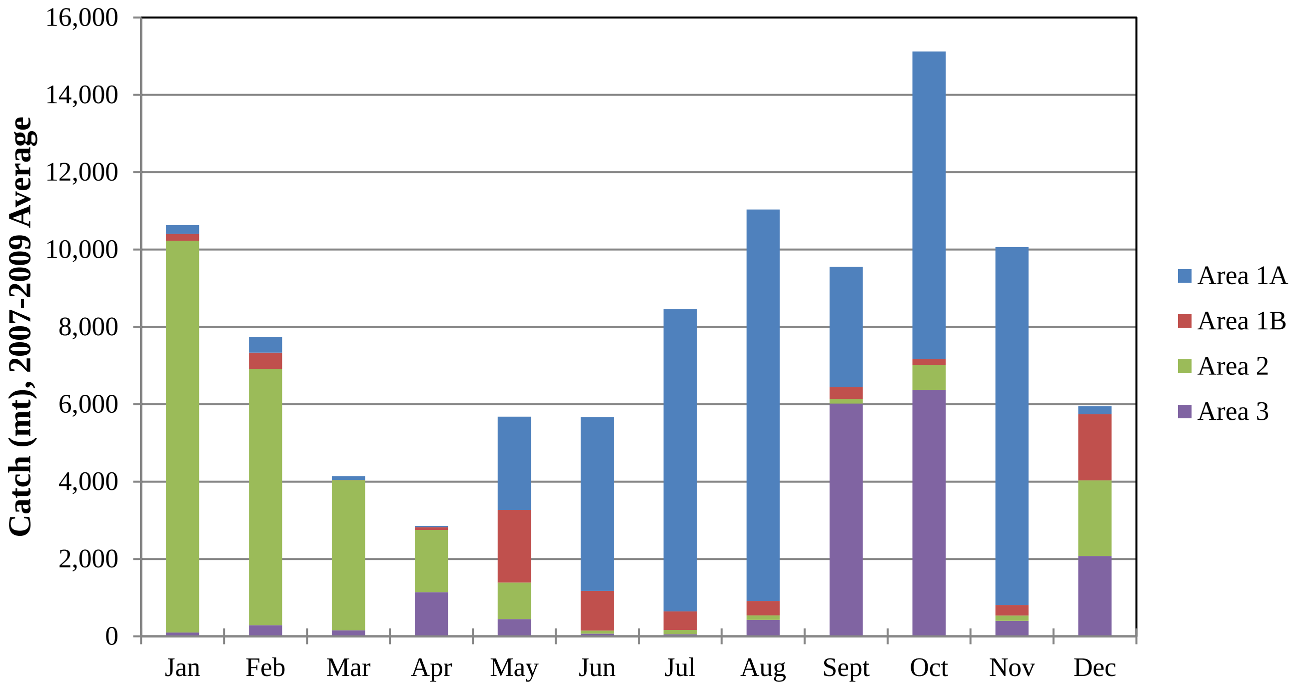


Figure 15 – Atlantic herring catch by all gear types by herring management area by year



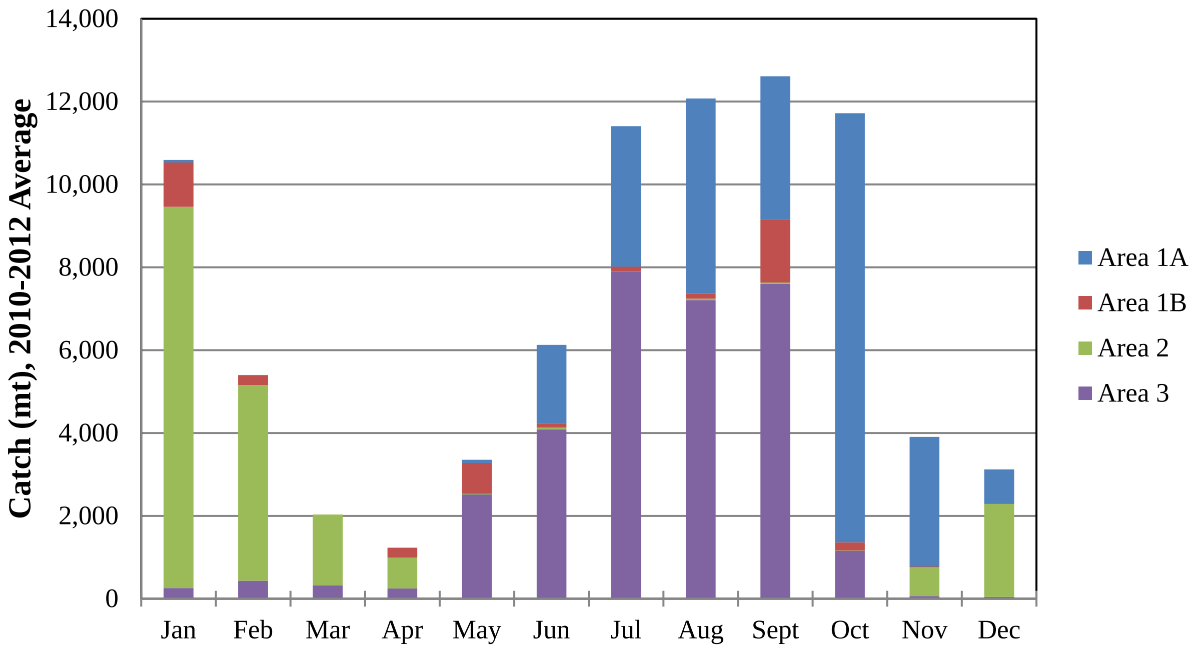
Note: Only catches >6,600 lbs are included. Area 1B excluded.

Figure 16 - Average monthly catch by management area, 2007-2009



Source: NERO DIMS database, queried 12/7/2012.

Figure 17 , 2010-2012 Average monthly catch by management area



Source: NERO DIMS database, queried 12/7/2012.

1.6.1.3 Current Specifications

The Atlantic herring ABC for 2016-2018 is at the level recommended by the SSC (111,000 mt, Table 18, Table 19) and maintains the 2013-2015 specification of management uncertainty for 2016-2018. The management uncertainty buffer is specified at 6,200 mt to account for catch in the New Brunswick weir fishery. All other Atlantic herring fishery specifications for 2016-2018 are unchanged, including set-asides and the seasonal (monthly) distribution of sub-ACLs (Table 2). There is a provision that would allow for 1,000 mt of Atlantic herring to be returned to the Area 1A fishery from the management uncertainty buffer if certain conditions are met.

Table 18 - 2016-2018 Atlantic herring fishery specifications

Specification	2016-2018
OFL	2016 – 138,000 2017 – 117,000 2018 – 111,000
ABC	111,000
Management Uncertainty	6,200 (Value in 2015)
ACL/OY	104,800[1]
DAH	104,800
DAP	100,800
USAP	0
BT	4,000
Area 1A Sub-ACL (28.9%)	30,300
Area 1B Sub-ACL (4.3%)	4,500
Area 2 Sub-ACL (27.8%)	29,100
Area 3 Sub-ACL (39%)	40,900
RSA	3%
FGSA	295

[1]***NB Weir Payback Provision –*** If, by considering landings through ***October 1,*** NMFS determines that under 4,000 mt has been caught in the NB weir fishery, NMFS will allocate an additional 1,000 mt to the Area 1A sub-ACL to be made available to the directed herring fishery as soon as possible, through the remainder of the fishing year (until the AM is triggered). If this occurs, the stockwide Atlantic herring ACL would increase to **105,800 mt**.

Table 19 - Seasonal (monthly) sub-ACL divisions, 2016-2018

Area	Seasonal sub-ACL division
1A	0% January-May; 100% June-December
1B	0% January-April; 100% May-December

These specifications include the Council's recommendations for river herring/shad catch caps in the directed Atlantic herring fishery for the 2016-2018 fishing years (Table 20). The proposed RH/S catch caps would continue to apply to midwater trawl vessels in the Gulf of Maine and Cape Cod Catch Cap Areas, and to both midwater trawl and small mesh bottom trawl vessels in the southern New England/Mid-Atlantic Catch Cap Area (see RH/S Catch Cap Areas, Map 766) on all trips landing over 6,600 pounds of Atlantic herring. No RH/S catch cap would be adopted for the GB Catch Cap Area.

Table 20 - River herring/shad catch caps, 2016-2018

RH/S Catch Cap Area	2016-2018 RH/S Catch Cap (mt)
GOM	Midwater Trawl – 76.7
CC	Midwater Trawl – 32.4
SNE/MA	Midwater Trawl – 129.6 Bottom Trawl – 122.3
GB	0

1.6.1.4 Atlantic Herring Permit Categories

Amendment 1 to the Herring FMP established a limited access program in the herring fishery with three limited access (A, B, C) and one open access (D) permit category (Table 21). The Category E Atlantic herring permit was established through Amendment 5 (implemented March 2014). Vessels that have not been issued a limited access herring permit, but that have been issued a limited access mackerel permit, are eligible for this permit.

Table 21 - Atlantic herring permit categories

	Category	Description
Limited Access	A	Limited access in all management areas.
	B	Limited access in Areas 2 and 3 only.
	C	Limited access in all management areas, with a 25 mt (55,000 lb) Atlantic herring catch limit per trip and one landing per calendar day.
Open Access	D	Open access in all management areas, with a 3 mt (6,600 lb) Atlantic herring catch limit per trip and one landing per calendar day.
	E	Open access in Areas 2 and 3 only, with a 9 mt (20,000 lb) Atlantic herring catch limit per trip and landing per calendar day.

1.6.1.5 Atlantic Herring Vessels

The following describes the vessels participating in the Atlantic herring fishery from 2008-present, including nominal revenues for herring trips. Here, an active herring trip is defined liberally as any trip in which at least one pound of Atlantic herring is retained. Since 2008, the number of vessels with an Atlantic herring permit has decreased annually (Table 22 - Fishing vessels with federal Atlantic herring permits, permit years 2008-2016 (May-April)). This includes a decrease in the limited access directed fishery vessels (Categories A and B), with 36 permitted in 2016. In 2015, X% of the limited access vessels were active (defined broadly as landing at least one pound of Atlantic herring during the fishing year).

Table 22 - Fishing vessels with federal Atlantic herring permits, permit years 2008-2016 (May-April)

		Atlantic Herring Permit Year (May-April)								
Permit Category		2008	2009	2010	2011	2012	2013	2014	2015	2016
Limited Access	A	47 (57.4%)	46 (63%)	43 (60.5%)	42 (59.5%)	42 (57.1%)	39 (66.7%)	40 (62.5%)	42 (50%)	39 (56.4%)
	BC	5 (60%)	4 (75%)	4*	4*	4*	4 (75%)	4*	4*	4*
	C	53 (18.9%)	51 (31.4%)	50 (28%)	47 (23.4%)	47 (31.9%)	44 (29.5%)	42 (23.8%)	41 (26.8%)	41 (24.4%)
	Total	105 (38.1%)	101 (47.5%)	97 (43.3%)	93 (40.9%)	93 (44.1%)	87 (48.3%)	86 (43%)	87 (39.1%)	84 (40.5%)
Open Access	D	2408 (3.6%)	2393 (3.8%)	2307 (3.9%)	2147 (3.9%)	2065 (3.5%)	1957 (3.3%)	1838 (3.6%)	1762 (3.4%)	1776 (2.9%)
	DE						6*	52 (9.6%)	54 (5.6%)	53 (5.7%)
	E						0	1*	1*	1*
	Total	2408 (3.6%)	2393 (3.8%)	2307 (3.9%)	2147 (3.9%)	2065 (3.5%)	1963 (3.3%)	1891 (3.8%)	1817 (3.5%)	1830 (3%)

Source: GARFO Permit database and DMIS as of 2017-11-13.
() Percent active vessels listed in parentheses
*Confidential vessel activity data

Many of the Category A, B, and C vessels are also active in the Atlantic mackerel fishery (managed by the MAFMC). For the open access vessels, just 3-5% of the Category D permits have been active since 2008. The Category E permit was implemented during permit year 2013 (May-April). In 2014, there were 53 E permits issued, mostly to vessels with a D permit as well. About 11% of the E permits were active that year.

Although there have been far fewer active limited access versus open access vessels, the limited access vessels account for about 97% of annual Atlantic herring landings and revenues (Table 23).

Table 23 – Percent contribution of herring vessels by permit category to total landings, 2013-2016 (Jan.-Dec.)

Permit Category		Fishing Year (Jan-Dec)			
		2013	2014	2015	2016
Limited Access	A and BC	96.9%	98.0%	99.0%	98.7%
	C	2.6%	1.7%	0.9%	1.0%
	D, DE, and E	0.1%	0.1%	0.1%	0.2%
Source: GARFO Permit database and DMIS as of 2017-11-13.					

1.6.1.5.1 Limited Access Category A Vessels

The Category A vessels comprise the majority of fishery landings (Table 23). In 2016, these vessels ranged in length from 21' to 146' (including inactive vessels), and 72% are over 80' (Table 24).

Table 24 - Vessel length for vessels with a Category A herring permit, 2014-2016

Year		2013	2014	2015	2016
Vessel length	<60	2	3	5	2
	60-80	7	8	8	8
	>80	30	29	29	26
	Total	**39**	**40**	**42**	**36**
Source: NMFS Permit database: https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html. Data as of September 2016.					

Table 25 reports the landings by species and in Herring Management Areas of Category A herring vessels. Category A permit holders caught menhaden and squid primarily in Area 2.

Table 25 – Landings by species for vessels with a Category A herring permit, 2013-2016

Area	Species	2013	2014	2015	2016
1A	Herring	[update]			
	Mackerel				
	Menhaden				
	Squid				
	Other				
1B	Herring				
	Mackerel				
	Menhaden				

	Squid				
	Other				
2	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
3	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
Total	**Herring**				
	Mackerel				
	Menhaden				
	Squid				
	Other				
Source: NMFS VTR data C = Confidential.					

1.6.1.5.2 Limited Access Category B/C and C Vessels

In 2016, vessels with a Category B/C or C permit ranged in length from 34' to 94' (including inactive vessels), and just 15% are over 80', primarily in the 60-80' range (Table 26). There are no vessels currently with just a Category B permit. Vessels either carry a B/C combination or just a C permit (limited access incidental catch). Thus, other fisheries are important to these vessels, more so than the Category A vessels.

Table 26 - Vessel length for vessels with a Category B/C or C herring permit, 2013-2016

Year		2013	2014	2015	2016
Vessel length	<60	17	16	16	14
	60-80	26	24	23	21
	>80	5	5	6	6
	Total	**48**	**45**	**45**	**41**
Source: NMFS Permit database: https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html. Data as of September 2016.					

Table 27 reports the landings of Category B/C and C permit vessel, summarized by the species caught and the area in which they were fished for. Category C permit holders caught menhaden, squid, and "Other" species primarily in Area 2, although some "Other" were caught in areas 1A and 3.

Table 27 - Herring Category B/C and C vessel landings by species, 2013-2016

Area	Species	2013	2014	2015	2016
1A	Herring	[update]			
	Mackerel				
	Menhaden				
	Squid				
	Other				
1B	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
2	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
3	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
Total	**Herring**				
	Mackerel				
	Menhaden				
	Squid				
	Other				

Source: NMFS VTR data
C = Confidential.

1.6.1.5.3 Open Access Category Vessels (D and E)

In 2016, vessels with a Category D and/or E permit ranged in length from 6' to 159' (including inactive vessels), and just 15% are over 80', primarily in the 60-80' range (Table 26). Other fisheries are important to these vessels, more so than the limited access vessels.

Table 28 - Vessel length for vessels with a Category D and/or E herring permit, 2013-2016

Year		2013	2014	2015	2016
Vessel length	<60	1,383	1,324	1,259	1,139
	60-80	348	346	338	329
	>80	210	200	205	202
	Total	**1,941**	**1,870**	**1,802**	**1,670**

Source: NMFS Permit database
https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html.
Data as of September 2016.

Unlike Categories A-C, Category D and E vessels (open access incidental catch) are numerous and participate in a wide variety of fisheries throughout the Northeast region. Category D vessels only land a small amount of herring. Table 29 reports the landings of Category D and E permit vessels, summarized by the species caught and the area in which they were fished for.

Table 29 - Herring Category D and E vessel landings by species, 2013-2016

Area	Species	2013	2014	2015	2016
1A	Herring	[update]			
	Mackerel				
	Menhaden				
	Squid				
	Other				
1B	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
2	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
3	Herring				
	Mackerel				
	Menhaden				
	Squid				
	Other				
Total	**Herring**				
	Mackerel				
	Menhaden				
	Squid				
	Other				
Source: NMFS VTR data C = Confidential.					

1.6.1.6 Fishery Effort

Atlantic herring vessels primarily use purse seines, single midwater trawls or midwater pair trawls for fishing gear, with the midwater pair trawl fleet harvesting the majority of landings since 2008 (Table 30, Table 31). Some herring vessels use multiple gear types during the fishing year. Single and pair trawl vessels generally fish in all areas (October-December in Area 1A), though Areas 1A and 1B account for less of their overall landings in recent years. The purse seine fleet fishes primarily in Area 1A and to a lesser extent, Areas 1B and Area 2, though in recent years, purse seines have not been active in Area 2. The single midwater trawl has been most active in Area 3. Small mesh bottom trawl vessels represented 5% of herring landings since

2008; other gear types (e.g., pots, traps, shrimp trawls, hand lines) comprise under 0.5% of the fishery. [include spatial distribution of effort]

Table 30 - Atlantic herring landings by fishing gear type and area, 2008-2011

Gear Type	Area 1A (mt)	Area 1B (mt)	Area 2 (mt)	Area 3 (mt)	Total
Bottom Trawl	463 (0.3%)	1 (0%)	14,288 (16%)	117 (0.1%)	**14,869 (4%)**
Single Midwater Trawl	6,340 (5%)	3,246 (17%)	4,886 (5%)	12,830 (14%)	**27,302 (8%)**
Midwater Pair Trawl	56,769 (43%)	12,612 (64%)	68,336 (76%)	78,518 (86%)	**216,235 (65%)**
Purse Seine	69,074 (52%)	3,696 (19%)	2,221 (2%)	0 (0%)	**74,991 (22%)**
Other	817 (0.6%)	0 (0%)	17 (0%)	1 (0%)	**834 (0.2%)**
Total	**133,463 (100%)**	**19,555 (100%)**	**89,748 (100%)**	**91,466 (100%)**	**334,231 (100%)**

Source: VTR database. September 2012.
Note: Data include all vessels that landed one pound or more of Atlantic herring.

Table 31 - Atlantic herring landings by fishing gear type and area, 2012-2014

Gear Type	Area 1A (mt)	Area 1B (mt)	Area 2 (mt)	Area 3 (mt)	Total
Bottom Otter Trawl	534 (1%)	16,967 (64%)	0 (0%)	267 (0%)	**17,768 (7%)**
Single and Pair Midwater Trawl	14,677 (18%)	9,068 (34%)	44,746 (100%)	110,227 (100%)	**178,718 (67%)**
Purse Seine	68,409 (82%)	310 (1%)	0 (0%)	0 (0%)	**68,719 (26%)**
Other	3 (0%)	0 (0%)	3 (0%)	0 (0%)	**6 (0%)**
Total	**83,623 (100%)**	**26,345 (100%)**	**44,749 (100%)**	**110,494 (100%)**	**265,211 (100%)**

Source: VTR database. August 2015. [update through 2016]
Note: Data include all vessels that landed one pound or more of Atlantic herring. Single and pair midwater trawl data are combined due to data confidentiality restrictions.

Table 32 - Average daily catch, trip length and costs for the purse seine fleet, 2011-2015

Year	Catch (mt/day)	Trip length (days)	Cost per day			Trips	
			Low	High	Raw	Observed	VTR
2011	65.5	0.9	$1,454	$1,927	$1,667	79	264
2012	77.5	1.1	$1,149	$1,520	$1,290	40	278
2013	91.7	0.8	$1,115	$1,500	$1,279	50	312
2014	99.4	1.1	$1,156	$1,556	$1,330	24	316
2015	105.4	1.1	$1,068	$1,437	$811	14	243
ALL	**87.5**	**1.0**	**$1,249**	**$1,664**	**$1,396**	**207**	**1,413**
Source: Catch and trip length from VTR data. Costs from observer data.							

Table 33 - Average daily catch, trip length, and costs for the midwater trawl fleet, 2011-2015

Year	Catch (mt/day)	Trip length (days)	Cost per day			Trips	
			Low	High	Raw	Observed	VTR
2011	69.9	2.6	$4,011	$5,232	$4,520	149	354
2012	64.8	3.0	$4,108	$5,287	$4,608	179	392
2013	53.9	3.5	$3,364	$4,472	$3,954	103	470
2014	66.1	2.4	$3,672	$4,865	$4,182	123	409
2015	55.2	2.5	$3,904	$5,124	$3,001	19	380
ALL	**61.4**	**2.9**	**$3,833**	**$5,009**	**$4,315**	**573**	**2,005**
Source: Catch and trip length from VTR data. Costs from observer data.							

Error! Not a valid bookmark self-reference. characterizes the fishing days, number of trips taken, and thousands of pounds landed by the area that was fished, the Category permit held, and the year. The number of fishing days for Category D vessels increased considerably between 2008 and 2010, likely due to changes in regulations of other fisheries, such as Amendment 16 to the Multispecies FMP. The number of trips and days fell in 2009 in Area 1B for Category A vessels but rebounded in 2010, while rising in Area 2 in 2009. [update]

Table 35 characterizes the fishing days, number of trips taken, and thousands of pounds landed by the area that was fished, the gear type, and the year. Area 2 has seen an increase in the number of bottom and midwater trawls fishing in the area, and Area 1B has had the number of purse seines fishing within vary over the last three years. Area 2 and 3 has had fluctuating numbers of vessels fishing within them over the past three years.

Table 34 - Herring trips, days, and herring landed (thousands of pounds) by area caught and category permit, 2008-2010 [update]

		Area 1A			Area 1B			Area 2			Area 3		
		2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Category A	Days at Sea	727	768	703	153	80	181	797	930	748	230	523	435
	Number of Trips	275	279	250	57	25	51	182	249	171	53	119	105
	000's of Pounds Landed	88,392	94,043	54,417	20,133	5,534	12,127	47,874	57,152	38,538	24,964	65,673	36,576
Category BC	Days at Sea							34	67	55			
	Number of Trips							31	62	48			
	000's of Pounds Landed							1,305	3,144	1,624			
Category C	Days at Sea	98	133	193	7			83	112	152		10	12
	Number of Trips	98	108	140	2			43	50	74		3	3
	000's of Pounds Landed	126	910	1,132	*C			23	196	522		*C	*C
Category D	Days at Sea	194	141	382	1		3	324	406	444	12		10
	Number of Trips	186	129	376	1		1	257	334	334	2		3
	000's of Pounds Landed	927	154	834	*C		*C	37	43	89	*C		*C

Source: NMFS VTR data
BC permits are vessels that had both B and C permits during the same year; C permits are vessels that only had a C permit during a year.
**C denotes a value for which under 3 boats reported, and cannot be reported for confidentiality reasons.*

Table 35 - Herring trips, days, and herring landed (thousands of pounds) by area caught and gear type, 2008-2010 [update]

		Area 1A			Area 1B			Area 2			Area 3		
		2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Bottom Trawl	Days at Sea	227	149	280	7		3	516	600	743	12	25	20
	Number of Trips	227	138	269	2		1	264	362	336	2	5	4
	000's of Pounds Landed	267	239	320	*C		*C	4,487	9,327	8,278	*C	200	1
Midwater Trawl	Days at Sea	17	46	32	31	13	40	49	129	75	22	64	103
	Number of Trips	4	18	11	10	3	10	11	22	18	5	13	24
	000's of Pounds Landed	2,506	4,565	4,643	2,984	*C	2,279	1,214	3,446	3,259	2,113	5,218	9,670
Pair Trawl	Days at Sea	222	203	298	71	46	103	562	634	405	208	444	330
	Number of Trips	66	79	89	27	13	26	131	162	97	48	104	80
	000's of Pounds Landed	32,496	41,838	33,644	11,574	3,494	7,708	43,535	47,756	29,221	22,851	60,259	26,765
Purse Seine	Days at Sea	498	578	464	52	21	38						2
	Number of Trips	211	215	205	21	9	15						1
	000's of Pounds Landed	53,605	48,304	16,439	5,606	1,395	2,140						*C

Source: VTR data
BC permits are vessels that had both B and C permits during the same year; C permits are vessels that only had a C permit during a year.
**C denotes a value for which under 3 boats reported, and cannot be reported for confidentiality reasons*

1.6.1.7 Fishery Employment

As in most fisheries in the country, the crew members of vessels do not receive a set wage; instead, they are compensated through the share system. Currently, crew share is usually 30-40%, and there is some variability in the way expenses are paid. For example, sometimes the variable costs are deducted "off the top." In this case, variable costs are subtracted from gross revenues and crew receives their share of those net proceeds. In other systems, the crew receives their share of gross revenues minus all of the variable costs. About 15 years ago, the shares were divided evenly with 50% to the owner, 50% split among the crew. Slowly, however, that ratio has changed.

Average crew sizes for Category A and B permit holders rage from four to ten people (Table 36 and Table 37), based on VTR reported crew sizes, by the home port listed in permit data and the gear used as listed in the VTR data, respectively.

Table 36 - Average crew size (including captain) by homeport for Category A and B vessels, 2008-2010 [update]

		2008	2009	2010	Average Across Years
MA	BOSTON	6	6	6	6
	GLOUCESTER	6	6	6	6
	NEW BEDFORD	5	5	5	5
	Average for MA	6	6	6	6
ME	BATH	6	5	4	5
	CUNDYS HARBOR	6	6	6	6
	HAMPDEN	7	7	7	7
	OWLS HEAD		5	4	5
	PORTLAND	6	6	6	6
	Average for ME	6	6	6	6
NH	NEWINGTON	6	5	5	6
	Average for NH	6	5	5	6
NJ	CAPE MAY	4	5	5	5
	Average for NJ	4	5	5	5
RI	DAVISVILLE	10	10	10	10
	NEWPORT	4	3	3	3
	POINT JUDITH	4	4	4	4
	Average for RI	5	4	5	5

Source: NMFS VTR data

Table 37 - Average crew size (including captain) by gear category (A and B), 2008-2010 [update]

	Gear	2008	2009	2010
Category A	Bottom trawl	6	5	6
	Mid-water trawl	5	6	5
	Pair trawl	5	5	5
	Purse Seine	6	7	6
	Average	6	6	5
Category B	Bottom trawl	4	4	3
Source: NMFS VTR data.				

Average crew sizes for Category C permit vessels range from two to five people (Table 38 and Table 39), based on VTR reported crew sizes, by the home port listed in permit data and the gear used as listed in the VTR data, respectively. The larger crews tend to come from ports in Massachusetts, New Jersey and New York.

Table 38 - Average crew size (including captain) by homeport for category C vessels, 2008-2010 [update]

		2008	2009	2010	Average Across Years
MA	GLOUCESTER	4	4	4	4
	NEWBURYPORT			3	3
	ROCKLAND		3	3	3
	Average for MA	4	4	4	4
ME	NEW HARBOR		5		5
	SOUTH BRISTOL		5	5	5
	Average for ME		5	5	5
NH	HAMPTON	2	2	3	2
	PORTSMOUTH	2		2	2
	RYE	2	2	2	2
	SEABROOK	2		2	2
	Average for NH	2	2	2	2
NJ	CAPE MAY	3		4	4
	Average for NJ	3		4	4
NY	MONTAUK	3	4	4	4
	Average for NY	3	4	4	4
RI	POINT JUDITH	2	2	2	2
	Average for RI	2	2	2	2

Source: NMFS Permit and VTR data

Table 39 - Average crew size (including captain) by gear type for Category C vessels, 2008-2010 [update]

Gear	2008	2009	2010
Bottom trawl	2	3	3
Purse seine		5	5
Average	2	4	4
Source: NMFS VTR data.			

1.6.1.8 Atlantic Herring Carrier Vessels

The Letters of Authorization (LOAs) issued by NMFS for the Atlantic herring fishery currently allow an unlimited amount of herring (or up to the amount allowed by the vessels' herring permit) to be transferred at-sea: (a) from herring catcher vessels to carriers; (b) between federally permitted herring vessels; and (c) from herring catcher vessels to non-permitted vessels for personal use as bait. Purse seine vessels are required to report what amount of catch is transferred to a carrier vessel, so those landings can be attributed to purse seine. It is difficult to determine if MWT vessels are the primary carrier vessels for purse seines. Carrier trips are no longer required to report on a VTR, and also gear is not static for each fishing vessels.

Table 40In 2010, 50 vessels received a LOA carrier exemption, doubling the number issued in 2006 (Table 25). Carrier activity, as reported in VTRs, was down though, from 58 reports in 2009 to 49 in 2010 (Table 41). Vessels can be issued both exemption types within one fishing year.

The list of vessels wanting to engage in carrier activities will change from year to year, and some of the vessels with Category D permits may already have VMS required by multispecies and scallop permits. The number of D vessels with LOAs increased from 11 in 2008 to 21 in 2010. These tables also illustrate the number of smaller vessels (under 50 feet) already have VMS, required by the herring permit that they possess.

Table 40 - Total herring vessels that received a letter of authorization by year and type of exemption

Year	Transfer at sea LOA (#)	Carrier LOA (#)	Total LOA
2006	19	6	25
2007	27	16	43
2008	26	13	39
2009	23	18	41
2010	35	15	50
2011	40	18	58
2012	44	16	60
2013	42	19	61
2014	39	22	61
2015	35	19	54
2016	44	19	63

Source: NMFS permit data.
Herring carrier vessels identified by Herring Carrier LOA issuance prior to 2014, or combination of LOA issuance and VMS declaration for 2014 and beyond

Table 41 - Total VTR herring carrier reports by year, 2007-2013

Year	Total VTR reports
2007	46
2008	33
2009	56
2010	30
2011	38
2012	80
2013	109

Note: The implementation of Amendment 5 in March, 2014 eliminated VTR reporting requirements on carrier trips, precluding accurate activity counts for 2014-2016.

1.6.1.9 Atlantic Herring Dealers and Processors

The number of Atlantic herring dealers has remained fairly constant since 2012 at just over 280 (Table 42). Dealer permits can be issued and cancelled throughout the year, so at any given time, the number of active dealer permits could fluctuate from the totals reported. Most of the Atlantic herring dealers are based in Maine, Massachusetts, Rhode Island, New York, and New Jersey.

Processing, with respect to the Atlantic herring fishery, is defined in the regulations as *the preparation of Atlantic herring to render it suitable for human consumption, bait, commercial uses, industrial uses, or long-term storage, including but not limited to cooking, canning, roe extraction, smoking, salting, drying, freezing, or rendering into meat or oil.* The definition of processing does not include trucking and/or transporting fish.

In many cases, a dealer of Atlantic herring is also involved in processing. Here, dealer activity is described followed by profiles of several business typical of the approximately 280 current dealers (and processors).

Table 42 - Atlantic herring dealer permits issued, 2012-2016 [update]

	2012	**2013**	**2014**	**2015**	**2016**
United States					
ME	76	83	84	85	77
NH	8	7	7	8	8
MA	57	61	60	62	67
RI	35	32	27	26	29
CT	2	2	3	3	4
VT	1	1	1	1	1
NY	52	50	50	48	49
NJ	26	26	26	28 (1)*	29(1)*
PA	2	2	2	2	4
DE	1		1	1	1
MD	3	3	3	2	2
VA	7	7	8	8	7
NC	9	8	8	8	8
GA	1	1	0	0	0
Canada					
NB	1	1	1	1	1
NS	1	3	3	3	3
Total					
	282	**287**	**284**	**286(1)**	**286(1)**

Source: GARFO permit database as of 7/31/2015. 2016 data as of September 2016.
Notes: 2015 permit counts are preliminary due to ongoing issuance. Individual entities may possess more than one permit type, i.e., total permits issued not equal to total number of dealers.
* One at-sea dealer permit has been issued in 2015 and 2016.

1.6.1.9.1 Dealer Activity

Table 43 shows the percent of herring dealers that purchased herring by the state that they purchased herring and the state in which they are registered. For instance, in 2010, dealers that were registered in Massachusetts bought 90% of their total herring purchases from landings within the state of Massachusetts, but purchased 7% of their herring from landings in Maine. They purchased no herring from New Jersey or New York, and 2% of their herring purchased was from landings that occurred within the state of Rhode Island. For the most part dealers purchased herring where were landed in their state, but Massachusetts and Maine had some out-of-state purchases. The significant numbers of dealers in Maine likely reflects the numbers and dispersal of small lobster fishing communities along the Maine coast that rely on herring as lobster bait.

Table 43 - Percent of herring purchased by federally permitted dealers, by state of registration, 2007-2010 [update]

2007		State of Purchase						
		MA	ME	NJ	NY	RI	Other	Total Revenue
State of Registration	MA	**82%**	9%	0%	0%	9%	0%	4,603
	ME	22%	**75%**	0%	0%	2%	1%	10,585
	NJ	2%	0%	**98%**	0%	0%	0%	421
	NY	2%	0%	1%	**98%**	0%	0%	18
	RI	1%	0%	0%	0%	**99%**	0%	372
	Other	32%	24%	0%	0%	0%	**44%**	118

2008		State of Purchase						
		MA	ME	NJ	NY	RI	Other	Total Revenue
State of Registration	MA	**91%**	7%	0%	0%	2%	0%	7,188
	ME	29%	**69%**	0%	0%	1%	0%	11,161
	NJ	6%	0%	**89%**	0%	0%	4%	468
	NY	0%	0%	0%	**99%**	0%	1%	36
	RI	8%	0%	0%	0%	**92%**	0%	330
	Other	56%	15%	0%	0%	0%	**29%**	255

2009		State of Purchase						
		MA	ME	NJ	NY	RI	Other	Total Revenue
State of Registration	MA	**96%**	2%	0%	0%	2%	0%	8,439
	ME	27%	**70%**	0%	0%	3%	1%	10,594
	NJ	0%	0%	**100%**	0%	0%	0%	1,168
	NY	12%	0%	0%	**88%**	0%	0%	24
	RI	5%	0%	0%	0%	**95%**	0%	603
	Other	50%	17%	0%	0%	0%	**33%**	468

2010		State of Purchase						
		MA	ME	NJ	NY	RI	Other	Total Revenue
State of Registration	MA	**90%**	7%	0%	0%	2%	0%	5,576
	ME	22%	**77%**	0%	0%	1%	0%	10,414
	NJ	0%	0%	**99%**	0%	1%	0%	246
	NY	0%	0%	9%	**91%**	0%	0%	9
	RI	2%	0%	0%	0%	**98%**	0%	630
	Other	7%	16%	0%	0%	0%	**77%**	279

Source: NMFS Dealer data

Note: "Other" includes the states of Connecticut, Delaware, Maryland, North Carolina, New Hampshire, and Virginia, to protect confidentiality.

1.6.1.9.2 Example Dealers and Processors [finish update]

The businesses summarized provide a snapshot of typical business involved in dealing and/or processing Atlantic herring. This information has been voluntarily provided by the businesses and has not been verified by the Herring PDT through any independent sources of information. Information was provided between November 2016 and May 2017.

BBS Lobster Trap Co. (Machiasport, ME)

Established in 1972 in Bourne, MA, Lobster Trap is a wholesale seafood distributor with facilities in Bourne, MA, Machiasport and Steuben, ME, as well as various storage locations in Canada. The subsidiary BBS Lobster Trap Company (http://www.lobstertrap.com/bbslobster) owns four lobster pounds and two buying stations in Machiasport and Steuben. The Maine locations service more than 40 lobster boats providing bait, fuel, and supplies. While considered secondary to their primary purpose, bait is a large operation, with storage capacity of 2 million pounds. Fresh and frozen whole herring, cuttings, and other varieties are sold in both retail and wholesale quantities (D. Walsh, pers. comm., 2017).

Cape Seafoods (Gloucester, MA)

Largely family-owned and operated, Cape Seafoods was established in 2001 specifically to process herring and mackerel. The products include frozen food grade herring and mackerel (blast frozen, whole round), sold domestically and internationally. In addition, Cape Seafoods' wholesale bait shop makes fresh, salted and frozen bait available, primarily for lobstermen but also tuna fishermen. The company's semi-automatic equipment packs whole round 20kg boxes. It has blast freezing capacity for up to 250 mt per day, cold-storage for about 4,000 pallet spaces, and a facility to store 300 tons of salted herring for bait. Bait is trucked all over and the drivers tend to be from Gloucester or nearby.

Prior to the drop in quotas, Cape Seafoods typically handled 25,000-30,000 tons of both species per year, but now only about 13,000 tons. Prior to the seasonal closure (January-April) of Area 1B, a significant percentage of the year's herring was landed January through March, though February weather could constrain vessels, and in March, the herring could start getting "feedy." The vessels target mackerel in March, but haddock accountability measures constrain their searches for mackerel. Herring from Georges Bank (Area 3) is usually caught in May until the quota is harvested (typically by mid-summer). In October and November, the vessels fish in Area 1A and in December in Area 2.

Employee numbers range from 25 to 50, depending on the volume of fish received. There are usually 24 seasonal employees supplied by an agency. When work was more predictable, many of the same employees would return each year.

In 1998, Cape Seafoods' partner company, Western Sea Fishing, owned three fishing vessels that fished half the year as scallopers and half as midwater trawlers. After Cape Seafoods opened in 2001, one vessel was sold and the other two enlarged to carry 450mt per vessel. Since then, these vessels have worked exclusively as herring and mackerel midwater trawlers. A third vessel was built due to market demand, strong quotas, and access to fish. With the three vessels, Western Sea employed 25 full-time, year-around. With the series of regulatory changes, one vessel was sold, the Cape Seafoods facility was down-sized, staff was significantly reduced, catch dropped at least 50%, the company lost market share and has been operating at a loss. For the first time, survival of Cape Seafoods Inc. and Western Sea Fishing Company, along with their employees and infrastructure, is truly threatened.

Channel Fish Co., Inc. (East Boston, MA)

For more than 50 years, Channel Fish Company (http://channelfishco.com/) has been supplying the seafood industry with fresh and frozen fish products. A family-owned business, Channel Fish employs nearly 100 people in East Boston (MA), where it produces seafood for many markets, including frozen and salted fish for human consumption, animal feed, and lobster bait. Today, they are a leading supplier of frozen fish products to the pet food industry. Some of the major species processed are Atlantic herring, Atlantic mackerel, Atlantic menhaden, and Loligo squid. Channel Fish's pumping station on the Chelsea Creek in Boston Harbor is currently the only active pier in Boston for unloading small pelagic species. Channel Fish also trucks fresh herring and other species to its facility from points ranging from Downeast Maine to Cape May (NJ).

Connor Brothers (Blacks Harbour, NS)

In the late 1800's, two brothers fished from an open skiff off Blacks Harbour, then built a fishing weir to catch sardine-sized herring. A few years later, they started canning the small herring, eventually becoming the world's largest producer of canned sardines. Today, Connors Bros. Clover Leaf Seafoods Company produces a variety of shelf-stable seafood, most of which is sold under the Brunswick label (T. Hooper, pers. comm., 2017).

Lund's Fisheries, Incorporated (Cape May, NJ)

This family-owned company, established in 1954, purchases, produces and distributes nearly 75 M lbs. of fresh and frozen fish annually. Currently, the company concentrates on mackerel, herring, illex and loligo squid and menhaden, although scup, butterfish, black sea bass, summer flounder, sea scallops, croaker, sea trout, bluefish and monkfish are also produced.

Herring, represents only about 10% of their production today, an amount that has declined in recent years due to several regulatory challenges that have limited landings. The fish are landed primarily between October and April and 75% of that is sold fresh for lobster bait or in blast or sea-frozen packs for lobster and other bait. Lund's herring is used in the King crab fishery and longline fishery on the West coast and the blue crab and crawfish fisheries on the East coast and Gulf of Mexico. Food for zoos and aquariums comprises about 5% of the production and about 10% is usually sold for pet food. Fresh and frozen seafood is sold for human consumption both domestically and internationally. Africa, in particular, is a potential market, with demand for herring, menhaden or chub mackerel if sufficient quota is available for export. In fact, it has been estimated that 60,000 people survived for a year on the million pounds of chub mackerel that Lund's exported to Africa in a recent year. All of these markets, regardless of the intended use, demand high quality, food-grade herring.

The company employs about 200 people (approximately 100 full-time including the employees in the affiliated freezer facility, the rest part-time). Despite paying higher than minimum wage, the plant relies on companies that also supply temporary workers for local farms, to hire individuals willing to work in the processing plant and cold storage facility.

Lund's owns 15 vessels, another 15 typically deliver a variety of species of seafood to the facility year-round. Though the majority are home-ported in Cape May, other independently-owned vessels land in Rhode Island, New York, Virginia and North Carolina. Seven company-owned tractors and trailers deliver seafood from Maine to Texas.

While herring, mackerel and squid vessels use refrigerated seawater (RSW), Lund's ice plant produces 40 tons daily with a storage capacity of 100 tons for use by the vessels for other species. Lund's has a daily freezing capacity of 500 metric tons. An affiliated company, Shoreline Freezers in Bridgeton (NJ) can store up to 12,000 tons of frozen products. Lund's also has a West Coast production facility that freezes 5 to 15 M lbs. of loligo squid annually, which is primarily exported to Asia.

The company long ago diversified, which has contributed to its ability to stay viable. Its location in the mid-Atlantic has helped since vessels can target both cold and warmer water species. The company's forward-thinking culture has also contributed to its resilience with their investment in up-graded processing equipment and the pursuit of both Fair Trade and MSC (Marine Stewardship Council) certification. The company is a founding member of the Science Center for Marine Fisheries, a National Science Foundation industry-government-academic partnership funding applied science to minimize uncertainty in fish stock assessments.

Nevertheless, herring management continues to challenge the company. The midwater trawl fishery on Georges Bank is shut down if 1.5% of the haddock quota is landed. (Other small-mesh fisheries on Georges can land up to 5 percent of the haddock quota.) However, only 3.5 percent of the total haddock quota for Georges Bank was landed by the directed fisheries last year. Because of the potential for early closures in the herring fishery, Lund's boats sought squid instead this summer, leading to some tightening of the lobster bait market. In addition, herring fishing in the groundfish closed areas requires 100% observer coverage, but no observers are available to the herring boats because the NOAA Fisheries has insufficient funding to pay their share of the cost. Significant amounts of herring were in these areas, and inaccessible, during the 2017 summer fishery.

The Northern Pelagic Group (NORPEL, New Bedford, MA)

NORPEL was established in 2002 as a pelagic processing plant, focusing primarily on herring (70%) and mackerel (30%). Herring is processed year around, while mackerel is primarily January-April. Norpel owns one fishing vessel, though it is not currently fishing. In addition, a variety of other boats deliver to the facility. Norpel exports herring to Nigeria for human consumption and provides herring for the bait market. Customers for bait include local lobstermen and tuna fishermen, but occasionally an unanticipated market opens to fulfill an emergency need for herring or mackerel. In the last year, the company started grinding a specific combination of fish species to supply a pet food company, and bought one reefer truck to accommodate the grinding operation.

The company employs about 70 individuals when freezing herring and mackerel (including full and part time positions). Most seasonal employees are of Central American descent. Six to eight engineers and managers work for the processing plant full-time.

Processing capacity is 320 mt per day; freezing 2,240 mt per week in 40 vertical plate freezers. For a time, the company processed 30,000 to 40,000 mt annually; however, last year only 5,500 mt was frozen, due to the regulations that lead to the loss of a number of herring boats and the abundance of haddock that is a "choke" species for herring fishermen. On-site storage capacity of fresh fish in RSW holding tanks was about 600 mt, but now only 240 mt can be held in the tanks. There is additional cold storage available in an adjacent facility.

Purse Line Bait (Sebasco Estates, ME)

Purse Line Bait has been purchasing Atlantic herring for lobster bait since about 1993. Herring is purchased from purse seiners and trawl vessels landing in Maine and Massachusetts, pogies from New Jersey, and redfish and other species from around New England. The fish is trucked to their main facility in Sebasco Estates (ME) where it is salted and barreled, then sold to about 40 lobster buyers between Harpswell and Rockland (ME). Purse Line has two freezer facilities, in Sebasco and Harpswell, where about 2M pounds of product can be stored for the times when no product is coming in. Americold Cold Storage in Portland (ME) is used for overflow. Eighty-five percent of their sales are to lobster buyers, with the remainder sold off dump trucks. Of about 20M pounds in overall sales per year, 12M are herring, 5M are pogies, and 3M are redfish and other species. In addition to purchasing from herring vessels, Purse Line Bait also purchases herring from Cape Seafoods in Gloucester (MA), O'Hara Corporation in Rockland (ME) and from other sources. Purse Line Bait owns 10 trucks, employs about 8 or 9 people full-time, year around and 4 or 5 more seasonally.

Seafreeze, Ltd. (N. Kingstown, RI)

Seafreeze was established in 1984 by two fishermen. The company fishes and freezes at sea herring, mackerel, illex and loligo squid, and butterfish. Two high-capacity freezer trawlers, with 350 mt holding capacity, together can freeze about 110 mt of seafood per day in their plate freezers. While herring is primarily a back-up fishery, since it is available year around; most of the other species have a season. Mackerel's season is usually December to May, illex is May to October, loligo is September to April and butterfish is December to March. Seafreeze sells frozen product domestically (30%) and internationally (70%), including bait to longline fleets. Eastern Europe and Asia purchase from Seafreeze; Canada purchases mackerel for bait; illex is used domestically for bait in groundfish, swordfish and tuna fisheries, as well as in the lobster and crab fisheries. Zoos and aquariums also purchase Seafreeze products. The company's cold storage facility capacity is 12,000 mt. The plant employs 60 full-time people including 10 administrative and managerial staff; 20 fishing vessel crew working rotating shifts; and 15 individuals in the storage facility.

Regulatory changes in the loligo fishery and groundfish have required shifts among the fisheries. The company has found it essential to diversify so that they are not too dependent on any one species. They have also increased their cold storage facility, allowing them to operate as a public cold storage facility.

1.6.1.10 Border Transfer

"Border Transfer" is U.S.-caught herring shipped to Canada via Canadian carrier vessels and used for human consumption. This specification is not a set-aside; rather, it is a maximum amount of Atlantic herring caught from Area 1A that can be transshipped to Canadian vessels for human consumption. GARFO tracks BT use through a separate dealer code. Specification of BT has remained at 4,000 mt since the implementation of the Atlantic Herring FMP. Table 44 indicates a decrease in BT from 1994-2013, with 2011 using 838 mt (21% of 4,000 border transfer mt). No BT occurred from 2008-2010, but some amount occurred in 2011-2013.

Table 44 - Herring catch in Area 1A shipped to Canada via Canadian carrier vessels (i.e., border transfer), 1994 – 2013 [update]

Year	Border transfer (mt)
1994	2,456
1995	2,117
1996	3,690
1997	1,280
1998	1,093
1999	839
2000	1,546
2001	445
2002	688
2003	1,311
2004	184
2005	169
2006	653
2007	53
2008	0
2009	0
2010	0
2011	946
2012	788
2013	838
Source: NMFS.	

1.6.1.11 Fishery Economics

Prices. Between 2008-2014, Atlantic herring catch ranged from 72,852-103,943 mt annually, while nominal prices generally ranged from about $160-350 per mt (Figure 18 and Figure 19). Overall, Atlantic herring prices have been increasing over time, with a peak in 2013. Atlantic herring caught in the Northeast U.S. is eaten by consumers worldwide and used as lobster bait. There are likely to be good substitutes for both uses; therefore, prices are likely insensitive to quantity changes.

In general, prices will decrease when quantity supplied increases, and prices will increase when quantity supplied decreases. The extent to which prices are responsive to changes in quantities supplied (and therefore by changes in ACLs and sub-ACLs) depends on the availability of good substitutes. If good substitutes are available, then prices will not be sensitive to changes in quantity supplied. However, if good substitutes are not available, then prices will be quite sensitive to changes in quantity supplied.

Figure 18 - Average nominal price per metric ton of Atlantic herring, 2008-2012 [update]

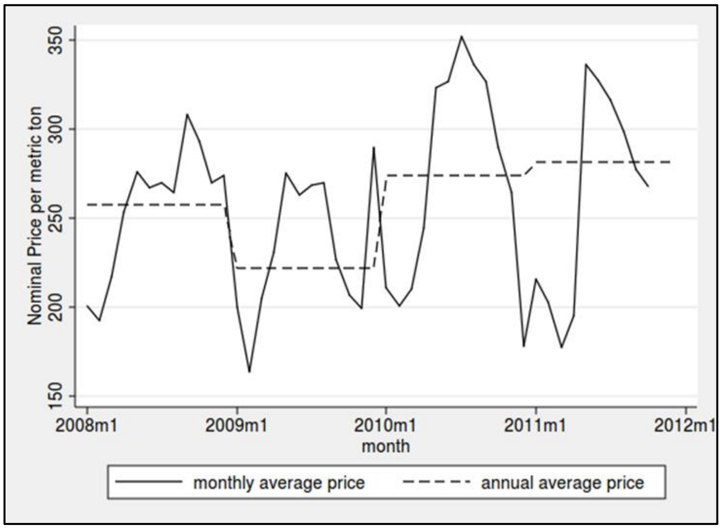
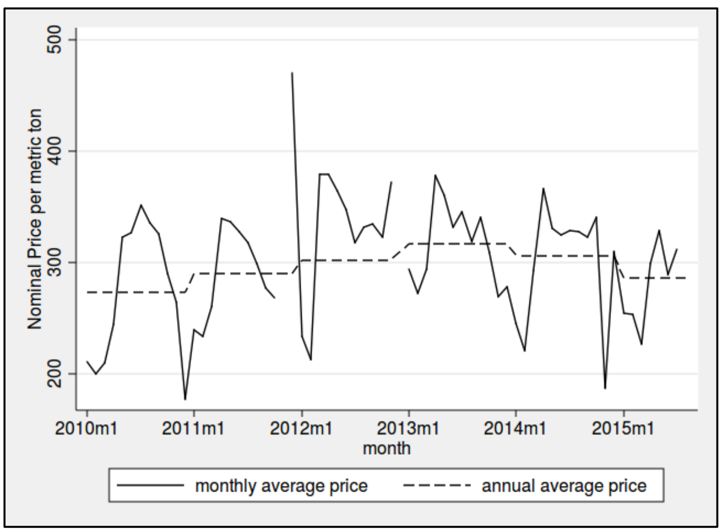


Figure 19 - Average nominal price per metric ton of Atlantic herring, 2010-2015



Revenue by state. [insert]

Revenue by permit category. Table 45 has percentage of total revenue from Atlantic herring by the total revenue for each permit category from 2008-2011 for trips landing Atlantic herring, showing the contribution of Atlantic herring revenues to those trips. Category A vessels catching Atlantic herring in Areas 1A, 1B, and 3 are catching herring almost exclusively (e.g., Category A vessels in Area 1A derived 98% of revenue from herring when landing herring). However, when these vessels catch herring in Area 2, a substantial portion of revenues (nearly 40%) are attributable to other species. Category C and D vessels have derived relatively small amounts of revenue from herring trips. The remainder of the revenue for these vessels is derived from other species (e.g., whiting).

Table 45 - Percent of total revenue from Atlantic herring by total revenue for each permit category and management area for trips landing Atlantic herring, 2008-2011

	Category A	Category B/C	Category C	Category D
Area 1A	99.9%		55.1%	32.8%
Area 1B	99.7%			
Area 2	61.6%	94.8%	6.7%	2.5%
Area 3	96.8%			1.2%
Total	**86.4%**	**94.8%**	**30.3%**	**11.2%**

Table 46 updates Table 45 for 2012-2014, showing the importance of each management area to vessels of the different permit categories. Category A vessels caught Atlantic herring almost exclusively in all areas, more so than in 2008-2011 (Table 45). Area 2 continues to be important for Category B and C vessels. The open access permit vessels (Category D and E) still derive relatively little revenue from Atlantic herring (14% overall).

Table 46 - Importance of Atlantic herring for each permit category and management area, 2012-2014

<table>
<tr><th></th><th>Category A</th><th>Category B or C</th><th>Category D or E</th></tr>
<tr><td>Area 1A</td><td>98%</td><td>42%</td><td>26%</td></tr>
<tr><td>Area 1B</td><td colspan="2">85%</td><td>minimal*</td></tr>
<tr><td>Area 2</td><td>85%</td><td>77%</td><td>9%</td></tr>
<tr><td>Area 3</td><td colspan="2">92%</td><td>minimal*</td></tr>
<tr><td>Total</td><td>92%</td><td>69%</td><td>14%</td></tr>
<tr><td colspan="4">Note: “Importance” measured as the percentage of total revenue derived from Atlantic herring for trips that retained herring.

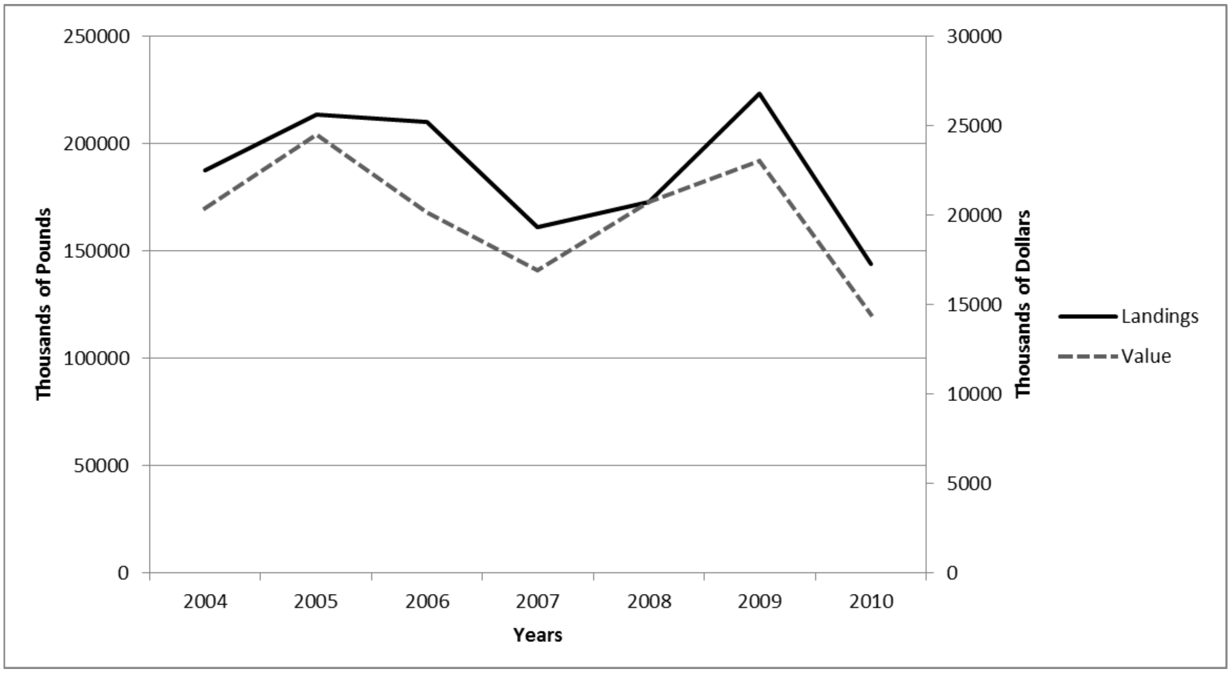
* There was a very small amount of herring revenue for the D/E vessels in these areas.</td></tr>
</table>

Note: The information provided in this section is based on herring VTR and Dealer data through 2010, however 2010 data are preliminary at the time of this writing; final 2010 catch totals will be provided by NMFS when available. Where noted, economic values have been adjusted for inflation using the Bureau of Labor Statistics Producer Price Index for Unprocessed Finfish, with the base set to January 2009. [update]

Figure 20 contains the total annual landings, in thousands of pounds, and value, in thousands of 2009 dollars, on a yearly scale. There is a slight downward trend, although 2005 and 2009 showed a slight increase from 2004 and 2008, respectively. Fishery value peaked in 2005 at a little over $27M for the over 200M pounds landed, however landings peaked in 2009. In 2010, there were 143,666,029 pounds of Atlantic herring were sold by federally permitted dealers for a total ex-vessel value of $17,918,000. This represents a 22% decrease in revenues from the 2009 fishing year, primarily due to the implementation of the 2010-2012 fishery specifications, which included significant reductions in herring catch limits. Figure 21 shows the total landings, in thousands of pounds, and the average real price per pound, in dollars, from 2005 to 2010, on a monthly time scale. Prices are cyclical and tend to be higher in the summer months and lower during the winter. This may be related to demand for herring as bait in the lobster fishery.

Categories A and B vessels specialize in small pelagics (herring, mackerel, and squid) while most of the C and D vessels catch herring either incidentally or seasonally in smaller amounts.

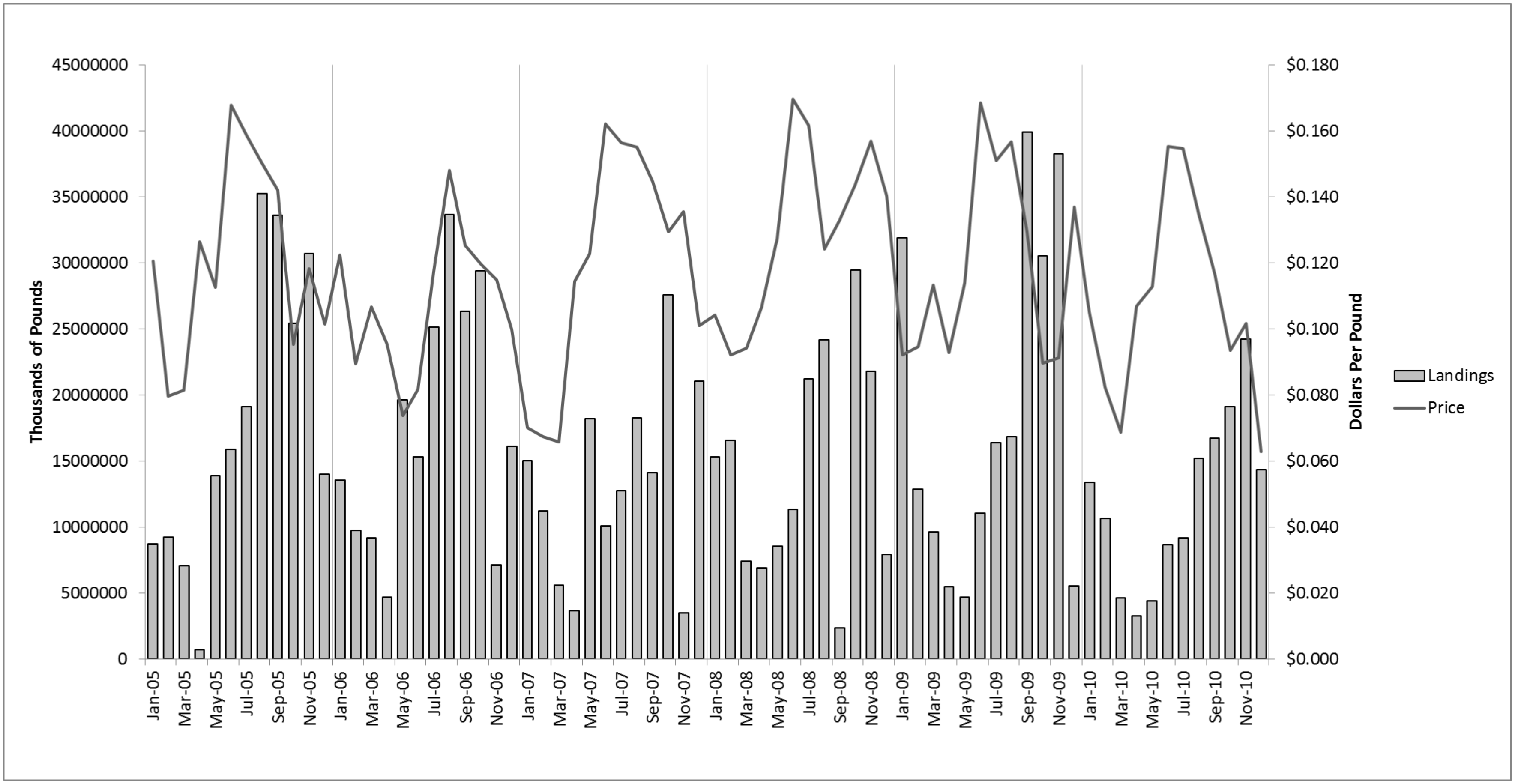
Figure 20 - Total annual landings (thousands of pounds) and value of herring (thousands of 2009 dollars), 2004 - 2010[update]



Source: Dealer data
Note: Numbers have been adjusted for inflation based on 2009 data.

Table 47 reports revenue and landings broken down by species, and the permit category to which the boat belonged from 2007 to 2010. For 2007, vessels were classified into the “new” Amendment 1 limited access categories (A/B/C/D), instead of the pre-Amendment 1 (1/2) categories.

Figure 21 - Total landings (thousands of pounds) and average price per pound (dollars), 2005 – 2010 [not needed?]



Source: NMFS dealer data.

Note: numbers have been adjusted for inflation based on 2009 data.

Table 47 - Total revenue (thousands of nominal dollars) and landings (thousands of pounds), by species caught and vessel category, 2007-2010 [update]

		Herring		Menhaden		Mackerel		Squid		Other	
	Category	Revenue	Landings	Revenue	Landings	Revenue	Landings	Revenue	Landings	Revenue	Landings
2007	A and B	19,102	167,077	364	6,300	6,908	60,690	9,739	22,745	12,850	8,142
	C	245	1,726	658	10,189	41	133	1,968	2,535	13,483	8,414
	D	457	4,745	1,383	21,096	362	3,350	16,583	20,304	485,582	190,375
2008	A and B	21,723	182,606	1,598	16,482	6,162	48,438	10,845	29,138	11,385	7,529
	C	26	152	791	11,959	47	150	4,172	7,014	20,054	12,451
	D	129	1,000	2,286	28,508	139	601	18,745	22,733	483,974	192,250
2009	A and B	23,919	225,651	361	3,752	8,409	49,135	10,008	34,813	10,778	6,196
	C	183	1,112	530	7,632	62	226	3,778	4,875	18,856	13,525
	D	33	215	1,359	17,334	217	923	14,802	21,205	481,273	195,363
2010	A and B	18,449	142,627	451	4,518	3,158	21,103	11,591	30,549	15,857	9,331
	C	322	1,655	673	10,291	44	157	3,170	4,593	21,725	13,896
	D	150	916	1,237	16,350	84	322	12,974	15,007	550,708	195,078

Source: NMFS Dealer data.

Note: The species category "Other" includes any other federally permitted species besides herring, menhaden, mackerel and squid.

The dependence of Category A and B vessels on small pelagics is illustrated in Table 48, which reports the fraction of revenue for the four permit Categories from 2007 to 2010. Category C vessels derived at 81.9% of their total revenues from species which were not small pelagics, while category D vessels derived over 97% of their revenue from those species. Clearly, the Category C and D vessels are not relying on the herring fishery for a large fraction of their fishery income – herring composes 1.9% and 0.2% of total revenue for those two permit categories.

Table 48 - Percent dependence of herring vessels on different species by permit category, calculated using revenue

		2007	2008	2009	2010	Average Across All Years
Category A	Herring	36%	44%	49%	44%	43%
	Menhaden	1%	3%	1%	2%	2%
	Mackerel	19%	14%	13%	7%	13%
	Squid	12%	15%	14%	18%	15%
	Other	32%	25%	23%	30%	27%
Category B	Herring	*C	*C	17%	13%	13%
	Menhaden	*C	*C	*C	*C	0%
	Mackerel	5%	1%	*C	0%	2%
	Squid	38%	42%	40%	29%	37%
	Other	45%	49%	41%	57%	48%
Category C	Herring	2%	0%	2%	3%	2%
	Menhaden	2%	3%	3%	2%	2%
	Mackerel	0%	0%	0%	0%	0%
	Squid	7%	13%	12%	13%	11%
	Other	88%	84%	83%	82%	84%
Category D	Herring	0%	0%	0%	0%	0%
	Menhaden	0%	0%	0%	0%	0%
	Mackerel	0%	0%	0%	0%	0%
	Squid	2%	2%	2%	2%	2%
	Other	97%	97%	97%	97%	97%

Source: NMFS Dealer data.

Note: The species category "Other" includes any other federally permitted species besides herring, menhaden, mackerel and squid.

*C = confidential

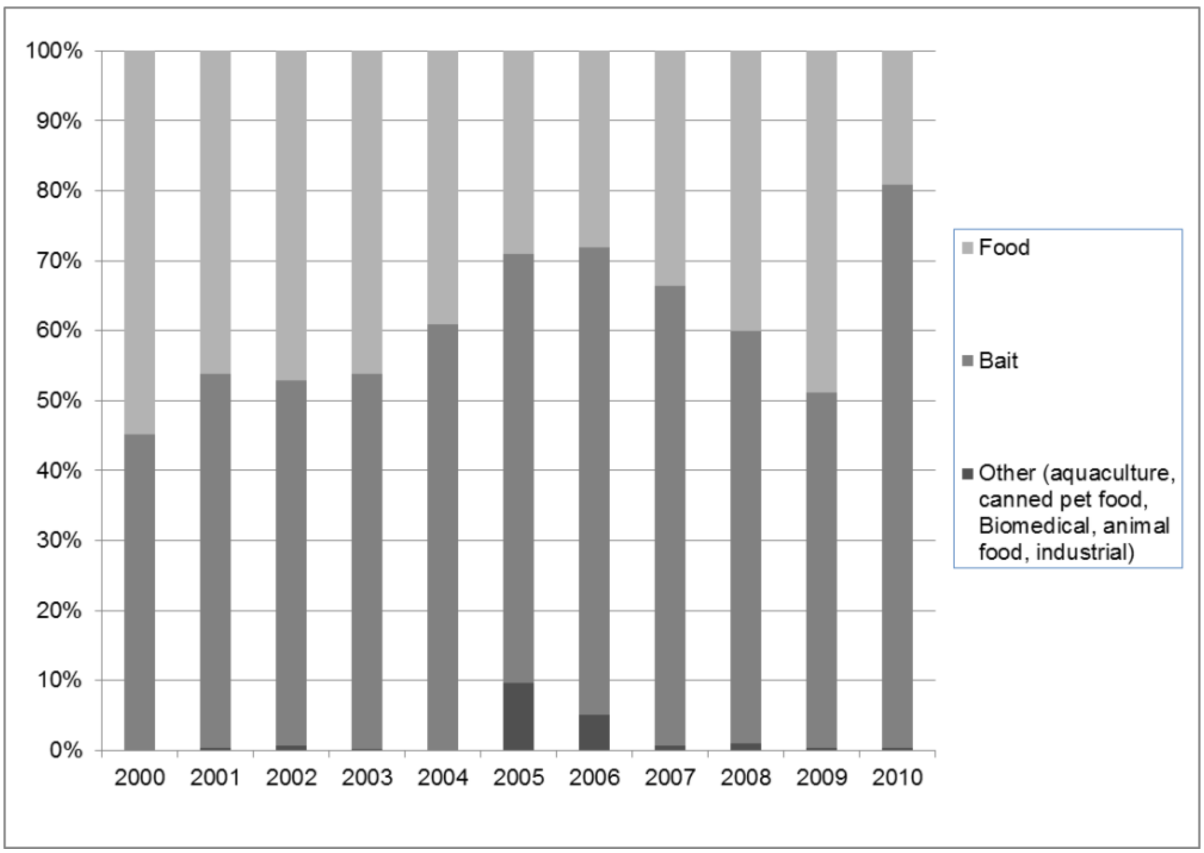
Vessel Costs. [update]

1.6.1.12 Use of Atlantic Herring and Substitute Goods

Used as bait: A large proportion of herring catch is used as bait. NMFS collects ex-vessel prices and does not systematically collect information about bait prices. Figure 22 has the percentage of reported herring landings used for bait and food from the dealer database during 2000-2010. Since 2001, over 50% of herring landings are sold for bait on an annual basis. Herring landings that were used as bait increased steadily from 2000 to 2006, from under 50% to over 70%. From 2007 -2009, the percentage of herring being used as bait decreased to about 50%, however in 2010 over 80% of the herring catch was used as bait. A small amount of the herring catch is used for non-food and non-bait purposes; this peaked in 2005 at nearly 10% and has declined steadily since that time. For ports in Maine (61%) and Massachusetts (36%), 97% of all herring landed was used for bait (NMFS dealer data).

Herring is used as bait for many fisheries, such as lobster, tuna, and various recreational fisheries. Generally, the herring used for bait goes through a large wholesale dealer to smaller dealers and lobster wharfs along the coast. The wholesale dealers generally have facilities where they sort, barrel, freeze and store bait for redistribution. The locations and processing and selling techniques also vary. For a more detailed description of herring as bait, and some the various ways in which herring are processed and sold, see Amendments 1 and 5.

Figure 22 - Herring landings reported for food, bait, and other uses, 2000-2010 [update]



Source: NMFS Dealer Data

The lobster industry, particularly in Maine, is dependent on herring as a bait source, though it depends on price and availability. A 2008 survey of 6,832 lobster license holders in Maine revealed that 58% of respondents answered “very much” to the question “Could the supply or price of herring for bait impact your decisions on how to fish?” (MEDMR 2008). For lobstermen surveyed from Maine, New Hampshire and Massachusetts who harvest in Lobster Conservation Management Area A (inshore Gulf of Maine), herring is the predominant bait source (Table 49). South of Massachusetts, lobstermen tend to use skate or other bait, as herring tends to break down in warmer water.

Table 49 - Bait use in the inshore Gulf of Maine lobster fishery

	Maine							NH	MA
	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G		
Herring	90%	86%	73%	73%	84%	37%	75%	60%	76%
Pogies	3%	2%	0%	15%	14%	39%	11%	4%	13%
Redfish	1%	8%	12%	4%	1%	19%	8%	0%	0%
Racks	1%	2%	1%	2%	0%	1%	1%	26%	6%
Alewives	1%	1%	0%	1%	0%	0%	0%	0%	0%
Other	4%	2%	13%	5%	0%	4%	4%	9%	4%
Source: Dayton et al. (2014).									

New Hampshire vessels may be less dependent on herring as a bait source than the aforementioned survey indicates. Atlantic herring is a small percentage of the bait used by these vessels (Table 50), ranging between 1.8% in 2010 and 4.6% in 2005. In terms of herring per trap just in Lobster Management Area (LMA) 1, the most used was in 2005 and the least in 2010. This correlates with overall high and low points in the percent of herring bait used. Historically, Atlantic herring is used for bait by smaller inshore vessels more than larger offshore vessels, because it is typically less expensive; in addition, alternative bait options like skates tend to be preferred for longer soaks in offshore waters.

Table 50 - Bait use in the lobster fishery in New Hampshire, 2005-2011

Year	Herring Bait (lbs)	Other Bait (lbs)	Total Bait (lbs)	% Herring of all Bait	# Types of Bait	Herring Per Trap LMA 1 (lbs)
2005	8,200	169,725	177,925	4.6%	11	0.33
2006	9,700	293,125	302,825	3.2%	13	0.20
2007	8,300	226,350	234,650	3.5%	10	0.18
2008	7,658	247,000	254,658	3.0%	12	0.16
2009	8,825	189,690	198,515	4.4%	11	0.25
2010	3,350	181,728	185,078	1.8%	11	0.14
2011	6,100	249,900	256,000	2.4%	9	0.21
Source: NH Fish & Game Department.						

In the bait market, Atlantic menhaden, managed by the Atlantic States Marine Fisheries Commission, is one substitute for Atlantic herring. Use of menhaden for bait has increased in importance relative to fish meal and oil. Between 2001 and 2012, the percent of total menhaden landings that were used for bait rose from 13% to a high of 28% in 2012 (63,540 mt). In 2013, bait harvest was about 22% of the total menhaden harvest. Menhaden landings for bait have recently dipped due to reductions in allowable catch; landings in 2013 were 35,043 mt, 34% below the average landings during 2010-2012 (52,900 mt) (ASMFC 2015c). During 2008-2011, *ex-vessel* menhaden prices ranged from $139-$169 per mt. This is about 33-50% lower than *ex-vessel* herring prices. If the quantity of Atlantic herring supplied into the bait market declines dramatically, more menhaden may be used as bait, moderating the increases in herring prices. Menhaden is primarily used to produce fish meal and oil. However, the Atlantic Herring FMP prohibits use of herring for fish meal, so herring is not a substitute in the production of those goods.

Used as food: Limited amounts of Atlantic herring are consumed as food domestically. In the world market, there is likely one substitute: European herring. U.S. production of Atlantic herring is quite small relative to the worldwide production. Since total U.S. landings of Atlantic herring have been near 100,000 mt annually, while total worldwide landings of Atlantic herring are near 2,000,000 mt. Therefore, U.S. producers of herring as human food are likely to be price takers on the world market. This means that moderate changes in the quantity of herring produced for food are unlikely to have an effect on price of herring.

1.6.1.13 State Waters Catch of Atlantic Herring

The vast majority of the Atlantic herring resource is harvested in Federal waters. Catch by Federal permit holders that occurs in State waters is reported and counted against the sub-ACLs. Catch by state-only permit holders is monitored by the ASMFC and is not large enough to substantially affect management of the Federal fishery and the ability to remain under the sub-ACLs (Table 51). Total Atlantic herring catch by vessels fishing in state waters was about 19 mt in 2015. The recent state-only permitted commercial landings of Atlantic herring are by fishermen in Maine, about three using fixed gear and about three using purse seines.

The Council specifies a set-aside for West of Cutler fixed gear fishermen (FGSA), currently 295 mt. The unused portion of the FGSA is returned to the Area 1A fishery after November 1. The ASMFC's requirement that fixed gear fishermen must report through IVR (and therefore have catch counted against the sub-ACL) has reduced any management uncertainty associated with State waters landings to an unsubstantial amount. Additionally, MEDMR requires the Maine state commercial fixed gear fishermen to comply with the federal IVR weekly reporting requirements and regulations as well as reporting monthly to MEDMR.

Table 51 - Atlantic herring landings from fixed gear fishery, before and after November 1 rollover date

Year	Sub-ACL Closure Date	Area 1A Sub-ACL (mt)	Cumulative Catch (mt) by Dec 31	Fixed Gear Landings (mt)	
				Jan-Oct	Nov-Dec
2004	11/19/2004	60,000	60,095	49	0
2005	12/2/2005	60,000	61,102	53	0
2006	10/21/2006	50,000	59,989	528	0
2007	10/25/2007	50,000	49,992	392	0
2008	11/14/2008	43,650	42,257	24	0
2009	11/26/2009	43,650	44,088	81	0
2010	11/17/2010	26,546	28,424	823	0
2011	10/27/2011	29,251	30,676	23	0
2012	11/5/2012	27,668	24,302	0	0
2013	10/15/2013	29,775	29,820	6	0
2014	10/26/2014	33,031	32,898	8	0
2015	11/2/2015	30,580	29,406	15	0
2016	10/18/2016	30,524	27,806	2	0
Source: GARFO, ASMFC.					

1.6.1.14 Canadian Catch of Atlantic Herring

Catch of the Atlantic herring stock complex in Canadian waters consists primarily of fish caught in the New Brunswick (NB) weir fishery. During the benchmark stock assessment for Atlantic herring (2012), the SARC 54 Panel noted that the contribution of the Atlantic herring stock on the Scotian Shelf region is unknown. It is generally assumed that juvenile fish (age 1 and 2) caught in the NB weir fishery are from the inshore (GOM) component of the Atlantic herring stock complex, while adult fish (age 3+) caught in the NB weir fishery are from the SW Nova Scotia stock complex (4WX). NB weir fishery catch is not tracked in-season against the U.S. Atlantic herring ACL. Rather, the annual expected catch in the NB weir fishery is estimated and then subtracted from the ABC, as an element of the management uncertainty buffer, to calculate the stockwide Atlantic herring ACL for the U.S. fishery. The NB weir catch estimates only include weir catch and not catch from the shutoff fishery. Catch from shutoffs generally represent a small component of the total NB weir fishery catch.

The overall trend in landings since 1990 has been downward (

Table 16), and landings from 2000 have dropped from 20,209 mt in 2001 to 4,031 mt in 2009, but increased in 2010 back to 10,958 mt. The same trend can also be seen in the NB weir landings from 1964 to 2011 (Table 52).

- The NB weir fishery catch is quite variable and dropped to just under 6,500 mt in 2008. The NB weir fishery landings totaled about 30,944 mt in 2007 and 6,448 mt in 2008.
- The most recent five-year average of NB weir landings (2007–2011) is 11,218 mt, and the most recent ten-year average (2002-2011) is 12,358 mt.
- Extremely low landings during the 2008 fishing year decreased these moving averages, especially the ten-year average.

- The 2010 fishing year had NB weir landings of 10,958 mt and decreased in 2011 to 3,711 mt.

Table 53 has the herring landings by month for weirs located in New Brunswick from 1978 to 2014. Landings from the NB weir fishery have always been somewhat variable; however, the fishery occurs primarily during the late summer and fall months (June-October). The NB weir fishery is dependent on many factors including weather, fish migration patterns, and environmental conditions. Over the time series, catch from the NB weir fishery occurring after October averaged under 4% of the total reported for the year from the fishery.

Table 52 - Number of active weirs and the catch per weir in the New Brunswick, Canada fishery, 1978-2014

Year	NB Weir Catch (mt)	No. Active Weirs	Catch Per Weir (mt)
1978	33,570	208	162
1979	32,477	210	155
1980	11,100	120	92
1981	15,575	147	102
1982	22,183	159	140
1983	10,594	143	88
1984	8,374	116	72
1985	26,724	156	171
1986	27,515	105	262
1987	26,622	123	216
1988	32,554	191	200
1989	43,475	171	255
1990	38,224	154	258
1991	23,713	143	166
1992	31,899	151	212
1993	31,431	145	216
1994	20,622	129	160
1995	18,198	106	172
1996	15,781	101	156
1997	20,416	102	200
1998	19,113	108	181
1999	18,234	100	191
2000	16,472	77	213
2001	20,064	101	199
2002	11,807	83	142
2003	9,003	78	115
2004	20,620	84	245
2005	12,639	76	166
2006	11,641	89	131
2007	30,145	97	311
2008	6,041	76	79
2009	3,603	38	95
2010	10,671	77	139
2011	2,643	37	71
2012	494	4	124
2013	5,902	49	120
2014	1,571	26	60
Long-Term	18,962 mt	110 weirs	163 mt
3-Year	2,656 mt	26	101 mt
5-Year	4,256 mt	39	103 mt
10-Year	8,535 mt	57	130 mt

Source: Department of Fisheries and Oceans Canada.

Table 53 - Monthly weir landings (mt) for weirs located in New Brunswick, 1978-2014

	MONTH												
YEAR	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Total
1978	3	0	0	0	512	802	5,499	10,275	10,877	4,972	528	132	33,599
1979	535	96	0	0	25	1,120	7,321	9,846	4,939	5,985	2,638	74	32,579
1980	0	0	0	0	36	119	1,755	5,572	2,352	1,016	216	0	11,066
1981	0	0	0	0	70	199	4,431	3,911	2,044	2,435	1,686	192	14,968
1982	0	17	0	0	132	30	2,871	7,311	7,681	3,204	849	87	22,181
1983	0	0	0	0	65	29	299	2,474	5,382	3,945	375	0	12,568
1984	0	0	0	0	6	3	230	2,344	2,581	3,045	145	0	8,353
1985	0	0	0	0	22	89	4,217	8,450	6,910	4,814	2,078	138	26,718
1986	43	0	0	0	17	0	2,480	10,114	5,997	6,233	2,564	67	27,516
1987	39	21	6	12	10	168	2,575	10,893	6,711	5,362	703	122	26,621
1988	0	12	1	90	657	287	5,993	11,975	8,375	8,457	2,343	43	38,235
1989	0	24		95	37	385	8,315	15,093	10,156	7,258	2,158	0	43,520
1990	0	0	0	0	93	20	4,915	14,664	12,207	7,741	168	0	39,808
1991	0	0	0	0	57	180	4,649	10,319	6,392	2,028	93	0	23,717
1992	0	0	0	15	50	774	5,477	10,989	9,597	4,395	684	0	31,981
1993	0	0	0	0	14	168	5,561	14,085	8,614	2,406	470	10	31,328
1994	0	0	0	18	0	55	4,529	10,592	3,805	1,589	30	0	20,618
1995	0	0	0	0	15	244	4,517	8,590	3,956	896	10	0	18,228
1996	0	0	0	0	19	676	4,819	7,767	1,917	518	65	0	15,781
1997	0	0	0	8	153	1,017	6,506	7,396	5,316	0	0	0	20,396
1998	0	0	0	0	560	713	3,832	8,295	5,604	525	0	0	19,529
1999	0	0	0	0	690	805	5,155	9,895	2,469	48	0	0	19,063
2000	0	0	0	0	10	7	2,105	7,533	4,940	1,713	69	0	16,376
2001	0	0	0	0	35	478	3,931	8,627	5,514	1,479	0	0	20,064
2002	0	0	0	0	84	20	1,099	6,446	2,878	1,260	20	0	11,807
2003	0	0	0	0	257	250	1,423	3,554	3,166	344	10	0	9,003
2004	0	0	0	0	21	336	2,694	8,354	8,298	913	3	0	20,620
2005	0	0	0	0	0	213	802	7,145	3,729	740	11	0	12,639
2006	0	0	0	0	8	43	1,112	3,731	3,832	2,328	125	462	11,641
2007	182	0	20	30	84	633	3,241	11,363	7,637	6,567	314	73	30,145
2008	0	0	0	0	0	81	1,502	2,479	1,507	389	49	32	6,041
2009	0	0	0	0	5	239	699	1,111	1,219	330	0	0	3,603
2010	0	0	0	6	64	1,912	2,560	3,903	1,933	247	46	0	10,671
2011	0	0	0	0	0	250	656	1,097	500	140	0	0	2,643
2012	0	0	0	0	29	140	5	5	98	217	0	0	494
2013	0	0	0	0	7	612	1,517	1,797	1,051	919	0	0	5,902
2014	0	0	0	0	0	70	130	147	449	774	0	0	1,571

1.6.1.15 Imports/Exports[insert]

1.6.1.1 Shoreside Support

Beaver Enterprises Inc. (Rockland, ME)

In 2009, Beaver Enterprises Inc., founded in 1975, sold their plant to Linda Bean, a lobster dealer. Beaver is no longer in the lobster bait business, but instead focuses on selling salt to herring operations all over the region including in Rockland and Kittery, ME, Gloucester, MA and Rhode Island. The salt business is easier than the herring business, because salt "keeps" whereas herring deteriorates quickly.

Beaver is probably the largest salt purveyor in the region for the fishing industry. The owner started small, but was able to grow large enough quickly enough to develop "buying power". He buys directly from the three largest producers, Morton, Cargill's and U.S. Salt. Beaver Enterprises averages deliveries of two trailer-truck loads per day of salt.

Without herring, Beaver Enterprises would be out of business. Herring fishermen have always salted their product. Typically, of 400 pounds of barreled herring, 80 pounds is salt (i.e., 20% of herring bait weight is salt). The ASMFC landing days restrictions has increased salt demand.

The cost of overhead is higher than it was in the past with the need for cold storage, plus bait is more expensive, as is the cost of fuel. It is harder for the "little guys," who used to be able to make a day's pay with one truckload of fish, for example.

Beaver Enterprises does do some fish hauling. For example, they recently transported a ton of pogies (22 vats) from Lund's (Cape May, NJ) to O'Hara's (Rockland, ME), spending $1000 in fuel. (Wayne Stinson 2011, personal communication)

Maritime International (New Bedford, MA)

Much of the processed product from NORPEL (Section 1.6.1.9.2) is shipped overseas via Maritime International Inc. (http://www.maritimeinternational.org/), with a facility adjacent to NORPEL in New Bedford. Overseas shipment occurs in high cube refrigerated containers designed to hold the product at the optimal temperature of –18°F (0°C) to ensure freshness. Maritime International can arrange for either containerized cargo shipments or bulk/tramper carriage of nearly 4,000 mt per shipment.

During the scoping process for Amendment 1, Maritime International provided estimates of financial expenditures associated with NORPEL cargo vessel loading operations - based on one cargo vessel remaining in port for three days and spending money in the community for transportation, restaurants and entertainment, doctors, propane suppliers, and other associated industries. Estimates of expenditures associated with pilot boat operators, vessel agents, customs agents, lift trucks, courier services, and other items required to prepare the cargo ship for transport were also provided. With a potential of 15 cargo vessels per year, Maritime International estimated expenditures of at least $3.2 million in addition to those associated with processing, storage, container shipments, and local distribution.

1.6.1.2 Atlantic Herring Research Set-Aside Program [update]

1.6.2 Other Managed Resources and Fisheries

In addition to Atlantic herring, many other fisheries could be impacted by the Alternatives under Consideration. The mackerel and herring fisheries are often prosecuted in conjunction, and the lobster fishery is highly dependent on herring as bait. Herring is either a fishery bait source and/or a natural prey item for bluefin tuna, groundfish, and striped bass, which have commercial and recreational fisheries associated with them. Herring is also a prey for whales, other marine mammals, and sea birds, which have ecotourism industries associated with them.

1.6.2.1 Atlantic Mackerel Fishery

***Population status*:** The Atlantic mackerel stock was most recently assessed via a Transboundary Resource Assessment Committee in 2010, which analyzed data through 2008. The overfished and overfishing status is unknown as a result of that assessment (TRAC 2010), though mackerel will be assessed in November 2017 by the NEFSC.

Management: Many vessels that participate in the Atlantic herring fishery are also active in the Atlantic mackerel fishery, which is managed by the Mid-Atlantic Fishery Management Council through the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan. More information about mackerel management is at: http://www.mafmc.org/msb.

Fishery: There are three commercial limited access Atlantic mackerel permit categories. When the directed fishery is open, there are no trip limits for Tier 1, Tier 2 has a 135,000 lb. trip limit and Tier 3 has a 100,000 lb. trip limit, which is reduced to 20,000 lb. if it catches 7% of the commercial quota. Open access incidental permits have a 20,000 lb. trip limit. There is also a smaller recreational fishery for mackerel (including private/rental and party/charter).

The directed fishery is primarily comprised of Tier 1 vessels. In 2016, there were 30 Tier 1 vessels (Table 54), 24 of which also had an Atlantic herring Category A permit (67% of all Herring Category A vessels also had a Tier 1 Mackerel permit in 2016). The Tier 1 vessels are primarily (70%) over 80’ in length (Table 55).

Total landings of Atlantic mackerel (foreign and domestic) peaked at about 400,000 mt in 1973, but have been under 100,000 mt per year since 1977. Except for a peak in the early 2000s of about 40,000-55,000 mt, U.S. domestic landings have generally been under 30,000 mt since the 1960s (MAFMC 2015) and under 10,000 mt since 2011 (Table 56). Mackerel catches since 2008 have generally been under 50% of the total mackerel quota (NEFSC 2016). Revenue from the mackerel fishery has been under $5M per year since 2010 (MAFMC 2016c).

Table 54 - Number of vessels with Atlantic mackerel permits stratified by Atlantic herring permit category, 2016

Mackerel Permit Category	Herring permit categories							
	A	B/C	C	D	D/E	E	none	Total
Tier 1	24	0	5	0	1	0	0	**30**
Tier 2	2	1	5	2	14	0	0	**24**
Tier 3	1	2	11	25	38	1	1	**79**

Source: NMFS Permit database: https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html. Data as of September 2016.

Table 55 - Vessel length for vessels with a limited access Atlantic mackerel permit, 2016

		Tier 1	Tier 2	Tier 3	Total
Vessel length	<60	1	2	22	**25**
	60-80	8	13	50	**71**
	>80	21	9	7	**37**
	Total	**30**	**24**	**79**	**133**

Source: NMFS Permit database: https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html. Data as of September 2016.

Table 56 – Atlantic mackerel catch (mt) and quota 2005-2015 [check]

Year	U.S. Domestic			Canadian Landings	Total Catch	Quota (U.S. + Canada)	% Quota Caught (US + Canada)
	Commercial Landings	Commercial Discards	Recreational Landings + Discards (Mostly Landings)				
2005	42,209	1,083	1,029	55,282	99,603	335,000	30%
2006	56,640	135	1,690	53,960	112,425	335,000	34%
2007	25,546	159	633	53,394	79,732	238,000	34%
2008	21,734	747	857	29,671	53,009	211,000	25%
2009	22,634	125	684	42,232	65,675	211,000	31%
2010	9,877	97	938	38,736	49,648	211,000	24%
2011	533	38	1,042	11,534	13,147	80,000	16%
2012	5,333	33	767	6,468	12,601	80,000	16%
2013	4,372	20	951	9,017	14,360	80,000	18%
2014	5,905	52	1,142	6,872	13,971	80,000	17%
2015*	5,616	13	1,384	4,937	11,950	40,165	30%

Source: NEFSC (2016, Tables 1 & 2).
* preliminary

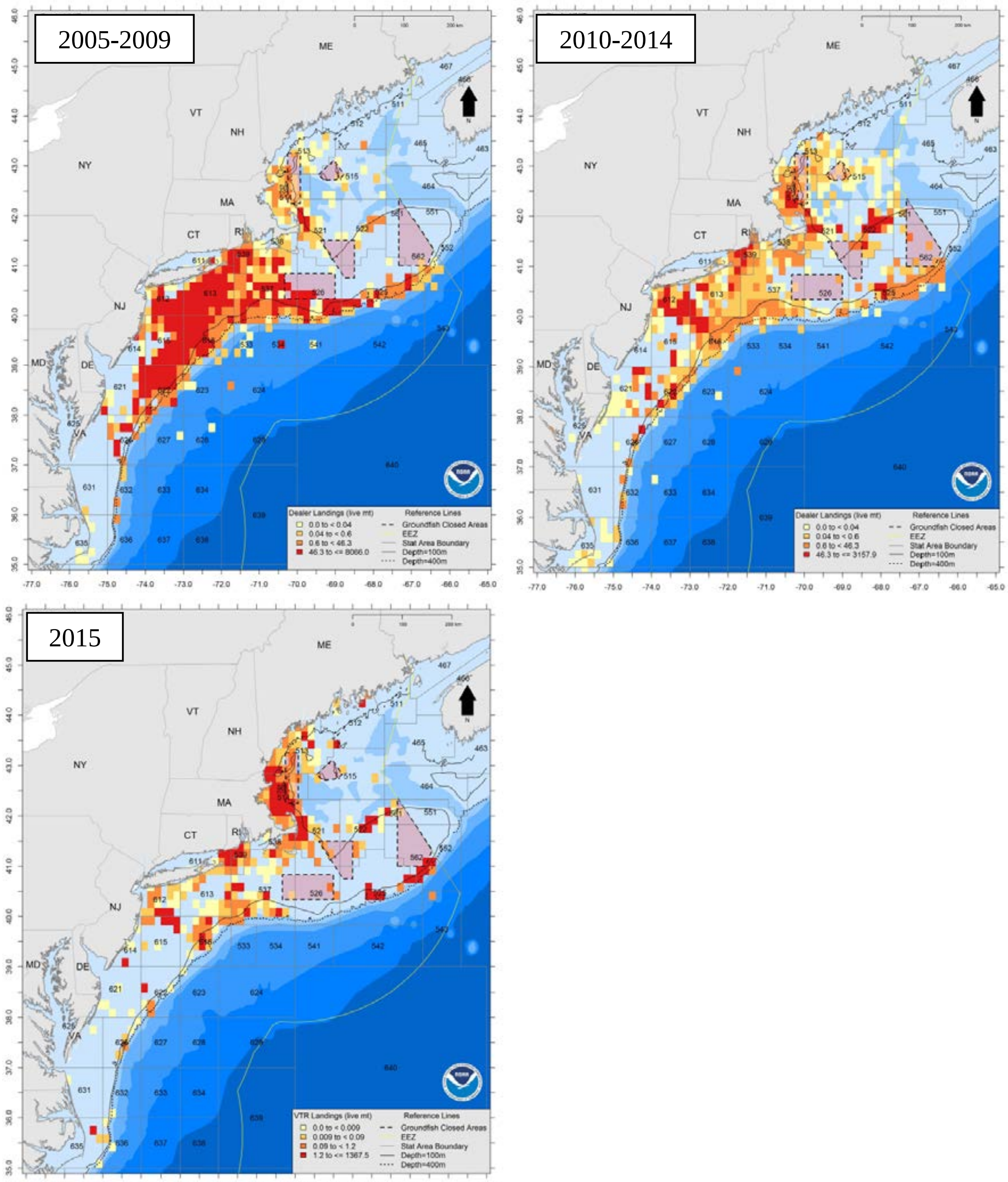
There is no resource sharing agreement between Canada and the U.S. for Atlantic mackerel. The U.S. sets an upper limit on total catch, and simply deducts expected Canadian catch from the total catch. This has not caused issues to date but at the current low quotas, if Canada raises its quota/catches, then the U.S. may be shut out of the fishery under the current FMP.

In 2013, the first year that the mackerel fishery became a limited access fishery, and there were 149 vessels issued a limited access mackerel permit (Tier 1-3). Of those, 45 (30%) had over 1% of their total revenue from mackerel, but just 9 (6%) had over 25% of their total revenue from mackerel. Generally, mackerel is a primary fishery for a small handful of vessels (MAFMC 2015).

During 2005-2009, when annual domestic mackerel landings were 23,000-58,000 mt, the fishery was primarily focused in the waters of Mid-Atlantic and Southern New England, though there was fishing in the Gulf of Maine and the southern flank of Georges Bank (Map 8). In more recent years, with much lower landings, the fishery has been less concentrated in the Mid-Atlantic, and waters of Rhode Island and in the Gulf of Maine have continued to be important, as have both the northern and southern flank of Georges Bank.

Members of the MAFMC MSB Advisory Panel reported in May 2016 that shifting of thermal habitat suitability is likely impacting the distribution and/or productivity of MSB species, a topic that will be examined in the 2017 mackerel assessment. The AP also noted that Atlantic herring management limits mackerel fishing, such as the summer closure of Herring Management Area 1A to midwater trawl gear, herring spawning closures, and recently, the Georges Bank haddock catch cap accountability measure, which closed most of Georges Bank to herring fishing October 22, 2015 to April 30, 2016 (MAFMC 2016a).

Map 8 - Atlantic mackerel commercial landings, 2005-2015



Source: NEFSC (2016). NMFS Dealer data for 2005-2014, VTR data for 2015.

1.6.2.2 American Lobster Fishery

Population status: American lobsters (*Homarus americanus*) are benthic crustaceans found in U.S. waters from Maine to New Jersey inshore and Maine to North Carolina offshore. Lobsters tend to be solitary, territorial, and exhibit a relatively small home range of 5-10 km^2, although large mature lobsters living in offshore areas may migrate inshore seasonally to reproduce, and southern inshore lobsters may move to deeper areas to seek cooler temperatures on a seasonal or permanent basis.

The 2015 peer-reviewed stock assessment report indicated a mixed picture of the American lobster resource, with record high stock abundance throughout most of the Gulf of Maine (GOM) and Georges Bank (GBK) and record low abundance and recruitment in Southern New England (SNE). The 2015 peer reviewed stock assessment (ASMFC, 2015) used a new model which incorporated lobster size and a broader range of data. GOM and GBK were previously assessed as separate stock units; however, due to evidence of seasonal migrations by egg-bearing females between the two stocks, the areas were combined into one biological unit.

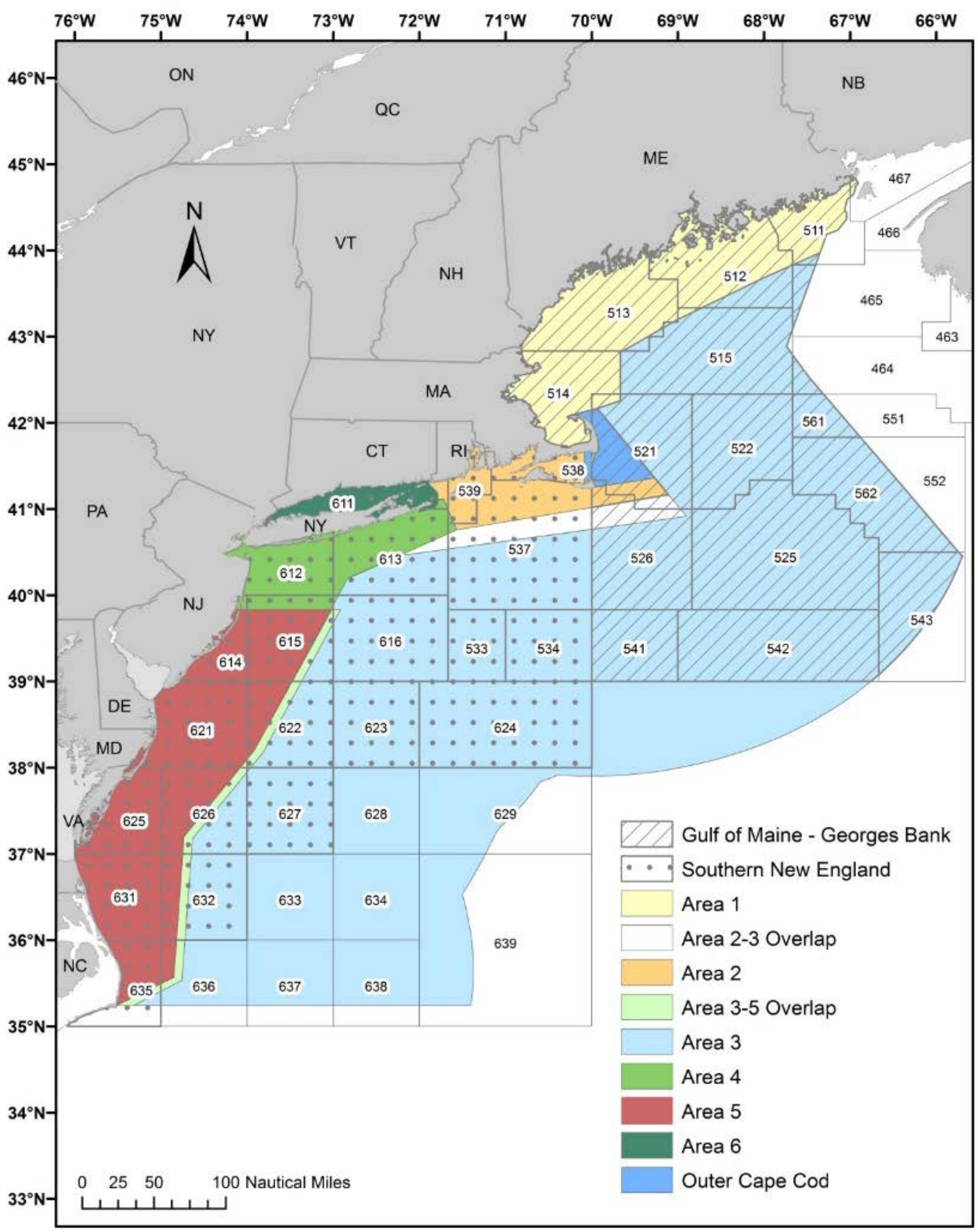
The assessment found the GOM/GBK stock was experiencing record stock abundance and recruitment (not overfished, not experiencing overfishing). While model results show a dramatic overall increase in stock abundance in the GOM/GBK, population indicators show young-of-year estimates are trending downward. This indicates a potential decline in recruitment in the coming years, and the Panel recommended that the ASMFC be prepared to impose restrictions should recruitment decline. The Panel also noted that productivity has been lower in the past, and warned that current levels of fishing would not be sustainable if recruitment were to decline again.

Conversely, the assessment found the SNE stock is severely depleted, though overfishing was not occurring. Abundance indices were determined to be at or near time-series lows. Recruitment indices show the stock has continued to decline and is in recruitment failure. However, the overfishing determination for SNE may be misleading and unreliable, because the methods used to estimate fishing mortality are not designed for such low biomass situations. The inshore portion of the SNE stock is in particularly poor condition with surveys showing a contraction of the population. This decline is expected to impact the offshore portion of the stock, which is dependent on recruitment from inshore. Landings in SNE are expected to decline since the extremely poor year classes which have settled since 2008 have yet to recruit to the fishery (ASMFC 2015a). The distress experienced by the SNE stock had been examined in 2010, and it was found that the stock was continuing to fall lower than the assessment. It was suggested that a combination of environmental and biological changes, as well as continued fishing was leading the stock to experience a recruitment failure. This recruitment failure was in turn preventing the stock from rebuilding (ASMFC 2010).

Management: Lobster is jointly managed, by the Atlantic States Marine Fisheries Commission in state waters (0-3 nm from shore) and by NMFS in federal waters (3-200 mi from shore). The fishery occurs within the three stock units: Gulf of Maine, Georges Bank, and Southern New England, each with an inshore and offshore component. Today, American lobster is managed under Amendment 3, which provides the flexibility to make changes to the management program through addenda, allowing resource and fishery concerns to be addressed promptly. Seven lobster management areas (LMAs; Map 9) were created through Amendment 3, as well as a Lobster Conservation Management Team (LCMT) for each management area. Made up of industry representatives, the LCMTs are responsible for recommending changes to their management plans. The documents for each addenda can be found at the Commission's website: www.asmfc.org.

The fishery is managed using minimum and maximum carapace length; limits on the number and configuration of traps; possession prohibitions on egg-bearing (buried) and v-notched female lobsters, lobster meat, or lobster parts; prohibitions on spearing lobsters; and limits on non-trap landings and entry into the fishery (ASMFC 2015a). The most recent addendum, Addendum XVIII, reduces trap allocations by 50% for LCMA 2 and 25% for LCMA 3.

Map 9 - ASMFC lobster management areas



Fishery: The American lobster fishery has seen incredible expansion in effort and landings over the last 40 years and is now one of the top fisheries on the U.S. Atlantic coast. In the 1920s, lobster landings were about 11M lbs. Landings were fairly stable between 1950 and 1975, around 30M pounds; however, from 1976 – 2008, landings tripled, reaching 92M pounds in 2006. Landings continued to increase and peaked in 2013 at over 150M pounds. Landings leveled off, but remained high at 147M pounds in both 2014 and 2015 (Table 57), but again jumped to over 158M pounds ($666.7 M) in 2016. The largest contributors to the fishery are Maine and Massachusetts, with 83% and 11% of the recent landings, respectively. Landings, in descending order, also occurred in New Hampshire, Rhode Island, New Jersey, Connecticut, New York, Maryland, Delaware, and Virginia.

Table 57 - Total lobster landings (lbs) by state, 2009-2015

	ME	**NH**	**MA**	**RI**	**CT**	**NY**	**NJ + south[a]**	**Total**
2009	81,175,847	2,985,166	11,781,490	3,174,618	451,156	731,811	238,267	**100,538,355**
2010	95,506,383	3,658,894	12,768,448	3,258,221	432,491	813,513	692,480	**117,130,430**
2011	104,693,316	3,917,461	13,717,192	2,513,255	191,594	344,232	689,000	**126,066,050**
2012	125,759,424	4,236,740	14,917,238	2,932,388	236,846	275,220	978,767	**149,336,623**
2013	127,773,264	3,822,844	15,738,792	2,149,266	133,008	248,267	756,494	**150,621,935**
2014	124,440,799	4,939,310	15,060,352	2,387,321	141,988	216,630	619,565	**147,805,965**
2015	122,212,133	4,716,084	16,418,796	2,879,874	158,354	146,624	505,985	**147,037,850**
Average	**111,651,595 (83%)**	**4,039,500 (3.0%)**	**14,343,187 (11%)**	**2,756,420 (2.1%)**	**249,348 (0.19%)**	**396,614 (0.30%)**	**640,080 (0.48%)**	**134,076,744 (100%)**

Source: ASMFC lobster data warehouse (M. Cieri, pers. comm., 2017).
[a] "South" includes Delaware, Maryland and Virginia.

Landings typically occur from inshore areas, and lobsters are most abundant inshore from Maine through New Jersey, with abundance declining from north to south. Offshore, lobsters occur from Maine through North Carolina. Area 1 (inshore Gulf of Maine) has the highest landings, 80% of total harvest between 1981 and 2012. This is followed by LCMA 3 (offshore), 9% of total landings. Dramatic declines in the catch from inshore SNE since 1999 have been attributed to waters increasingly exceeding the lobster thermal stress threshold of 20°C (ASMFC 2015a).

In Maine, the fishery is most active during the months of July to November. For the years 2004-2016, about 85% of the pounds landed were landed in those months (Table 58). Just 4% of landings occurred in the months of January to April (www.maine.gov).

There was an average of 8,315 vessels issued commercial lobster permits for the fishery in state waters each year between 2009 and 2013, and 3,080 vessels were issued federal permits (Table 59), though in most cases, a vessel holding a federal permit also holds a state permit. Thus, there are about 8,300 vessels in the lobster fishery. The State of Maine has issued the largest number of state permits, recently averaging 5,163 (62%). For Maine, about 85% of the permits are active (~4,400). For New Hampshire, about 70% of the permits issued were active during 2009-2013.

Table 58 - Average Maine commercial lobster landings (pounds and value) by month, 2004-2016

	Average pounds		Average value	
January	1,308,027	1%	$5,975,882	2%
February	570,693	1%	$3,225,004	1%
March	561,699	1%	$3,577,798	1%
April	1,102,204	1%	$6,478,832	2%
May	2,471,323	3%	$11,669,067	3%
June	4,218,268	4%	$18,237,197	5%
July	14,296,658	15%	$47,888,908	14%
August	20,949,668	22%	$67,362,446	19%
September	18,286,093	19%	$63,786,998	18%
October	18,086,518	19%	$64,513,527	18%
November	11,101,952	11%	$39,496,026	11%
December	4,322,768	4%	$16,618,840	5%
Total	**97,275,872**	**100%**	**$348,830,527**	**100%**
Source: www.maine.gov, accessed July 2017. Note: 2016 data are preliminary.				

Table 59 – Commercial lobster licenses issued by jurisdiction, 2009-2013

Year	ME	NH	MA	RI	CT	NY	NJ	State total	NMFS	Total
2009	5,376	365	1,314	979	220	375	109	**8,738**	3,176	**11,914**
2010	5,226	347	1,278	948	206	360	109	**8,474**	3,141	**11,615**
2011	5,155	333	1,245	922	180	344	109	**8,288**	3,119	**11,407**
2012	5,079	334	1,214	905	161	334	109	**8,136**	3,003	**11,139**
2013	4,979	322	1,188	874	142	326	109	**7,940**	2,963	**10,903**
Average	**5,163**	**340**	**1,248**	**926**	**182**	**348**	**109**	**8,315**	**3,080**	**11,396**
Source: ASMFC (2015a).										

Reliance on herring as bait: The lobster industry depends greatly on herring bait to sustain itself. Between 1981 and 2013, 96% of all lobster landed was harvested using traps (ASMFC 2015a). Small-scale truckers, bait shop owners, and related business all participate in the commercial bait venture. Bait can be delivered dockside via trucks. In the past, trucks picked up the bait from canneries and community sites up and down the coast to service smaller bait shops or lobster fishing 'gangs' (Acheson 1987). The canneries are gone now, but herring is still delivered to important lobster communities. Island-bound and isolated lobster fishermen may also pick up bait directly off herring vessels, or have it brought out on ferries. In recent years, the shift has been towards herring vessels landing directly in island ports (e.g., Vinalhaven). A small proportion of lobster bait has been supplied by the freezer plants in Massachusetts (Cape Seafoods, NORPEL). While bait choices vary with individual fishermen's preferences and fishery, lobster vessels in the State of Maine are perhaps the most dependent on herring for bait. Recently, however, pogies (menhaden) have also proved popular. Major dealers in Maine offer herring, pogies, redfish and flounder, haddock, carp racks, tuna heads, and Pacific rockfish, with prices ranging from $0.15 - $0.44. In part due to the ASMFC limits on landing days, much of the herring is salted and frozen. Initially, lobstermen found the frozen product to be difficult to handle, but according to reports from dealers, they have adjusted. Lobster vessels in Massachusetts and New Hampshire also depend on herring for bait, but this dependency on herring decreases in more southern areas. Section 1.6.1.12 contains more information about Atlantic herring as a bait source.

1.6.2.3 Bluefin Tuna Fishery

Section 1.3.1 summarizes the population status and management of buefin tuna. This section will focus on information about the commercial and recreational tuna fisheries. Bluefin tuna in are known to feed on herring, and the tuna fishery is dependent upon herring for bait. The bluefin tuna fishery (recreational and commercial combined) landed an average of 862.3 mt between the years 2012 and 2016, with the majority of catch coming from the commercial rod and reel and longline fisheries in the northwest Atlantic (Table 60). The importance of the bluefin tuna fishery to the U.S. in 2015 can be seen in Table 61. A total of over 856 mt was caught by commercial vessels in U.S. waters, with revenues of $8,820,000.

Table 60 - U.S. landings (mt) of Atlantic bluefin tuna by area and gear, 2012-2016

Area	Gear	2012 (%)	2013 (%)	2014 (%)	2015 (%)	2016
NW Atlantic	Longline	189.4 (20.9)	153.0 (16.9)	171.7 (19.0)	70.1 (7.8)	80.1
	Handline	1.3 (0.1)	0.5 (0.1)	0.0 (0)	0.0 (0)	1.1
	Purse seine	1.7(0.2)	42.5 (4.7)	41.8 (4.6)	38.8 (4.3)	0.0
	Harpoon	52.3 (5.8)	45.0 (5.0)	67.5 (7.5)	77.1 (8.5)	52.9
	Commercial Rod and reel	419.5 (46.4)	249.5 (27.6)	378.9 (41.9)	581.4 (64.3)	722.1
	Recreational rod and reel	148.7 (16.4)	131.4 (14.5)	99.6 (11.0)	112.9 (12.5)	143.7
	Trawl	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	
Gulf of Mexico	Longline	101.2 (11.2)	33.5 (3.7)	41.3 (4.6)	9.3 (0.8)	10.6
	Recreational rod and reel	0.0	0.0	0.0	0.0	1.7
NC Area 94a	Longline	3.9 (0.4)	3.5 (0.4)	8.9 (1.0)	8.3 (0.9)	12.7
Caribbean	Longline	0.9 (0.1)	0.4 (<0.1)	0.0 (0)	0.0 (0)	0.2
All areas	All gears	919.0	658.9	810.0	898.2	1,025.0
Source: NMFS (2017).						

Table 61 - Commercial landings and revenue of all U.S. caught bluefin tuna by catch location, 2015

	0 - 3 mi. from U.S. coast	3 - 200 mi. from U.S. coast	High Seas or off foreign coasts	Total U.S. Landings
Landings (mt)	16	840	0	856
Revenue ($ thousands)	$31	$8,789	$0	$8,820
Source: NOAA (2015).				

Recreational Bluefin Fishery: The bluefin tuna recreational fishery targets school, large school and small medium, (27 >73” curved fork length) bluefin tuna, and provides for a small trophy fishery on bluefin ≥73”. The fishery generally occurs off of North Carolina from December through January, and becomes active off of Cape Cod and in the Gulf of Maine in summer and early fall. The recreational fishery requires use of handgear (i.e. rod and reel, handline), with the exception that charter and headboats may also fish with bandit gear (vertical hook and line gear attached to vessel; retrieved by manual, electric, or hydraulic reels) or a green-stick (actively trolled mainline elevated above surface of water with up to 10 hooks or gangions).

HMS Charter/Headboat permitted vessels may fish under either the recreational or the commercial handgear size/retention limits on a given trip. The rules are based on the size category of the first bluefin retained on each trip, and whether that tuna fits under the size limit of the recreational or General category commercial fishery. Landings on charter/headboats are counted toward the corresponding quota category determined by the size of fish landed on that trip.

Commercial Bluefin Fishery: Commercial handgear vessels that wish to sell catch must obtain one of the three types of commercial handgear permits. These include Atlantic Tunas General (rod and reel, harpoon, handline, bandit gear), Atlantic Tunas Harpoon (harpoon only), and HMS Charter/Headboat. Any catch sold by these vessels must be sold to permitted Atlantic tuna dealers, and must comply with Coast Guard regulations and regulations for the state in which catch is landed.

The commercial bluefin fishery is predominantly in New England, however a winter fishery has solidified in southern states including North Carolina and Virginia. Vessels commonly use bait and fish anywhere from 8 to 200 km from shore. The fleet is largely composed of privately owned vessels that are over 7 m in length. Preferred bluefin baits include herring, mackerel, mullet, butterfish, squid, whiting, ballyhoo, and menhaden. Fishing area and catch rates are highly variable due to bluefin abundance and distribution, which is influenced by oceanographic and ecological conditions, including forage availability.

Commercial bluefin tuna fishermen work off an annual quota which is divided up among the three categories. The general category receives the largest allocation (466.7 mt) and has seasonal subquotas (Table 62). If the catch limit is reached before the end of a time period, the fishery will close and reopen again in at the start of the next time period. Inseason transfers can be made from the Reserve following criteria identified at 50 CFR 635.27(a)(8). Prior to closures in 2017, the fishery had not closed due to reaching any of these within season quotas since the 1990s. The bluefin season occurs when there are ample fish to catch, but generally runs from June through October or November off New England, and December – March off North Carolina.

Table 62 - General category time period subquotas.

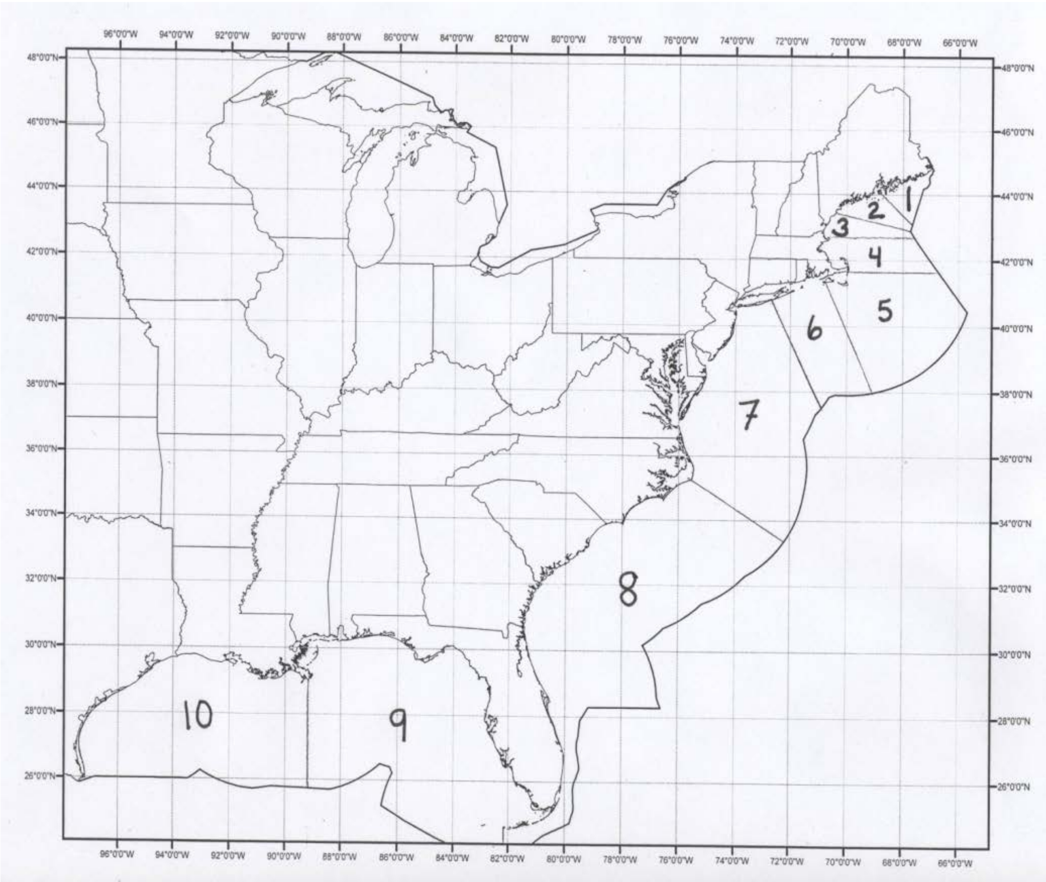
Time Period	January	June-August	September	October – November	December	TOTAL
Subquotas (MT)	34.4	233.3	123.0	60.0	16.0	466.7

Bluefin Tuna and Herring Fishery Overlaps:

Of the ten U.S. Atlantic HMS reporting areas (Map 10), Areas 1 to 7 fall overlap with the Atlantic herring stock area (Map 7). Since 1996, 93% of all U.S. bluefin tuna landings are from these areas (Table 63). Areas 4 and 5 are the areas with the highest proportion of total landings during this time period, 27% and 36%, respectively. These are the areas to the east and southeast of Massachusetts.

The two months with the highest bluefin tuna landings from 1996-2015 are September (26%) and October (25%) (Table 64). From only HMS Area 4, July (24%) and September (28%) had the highest landings, though since 2011, September and October had the highest landings (Table 65). However, in Areas 1-3 to the north, the fishery occurs primarily in July-September; October landings were just 8% of the total from 1996-2015 (Table 66).

Map 10 - Highly Migratory Species reporting areas



Source: NMFS Highly Migratory Species (HMS) office.

Table 63 – Bluefin tuna landings (dressed weight, lbs) by HMS reporting area, 1996-2015

Area	1996-2000		2001-2005		2006-2010		2011-2015		Total	
1	54,010	1%	13,139	0%	2,416	0%	80,823	2%	150,388	1%
2	899,461	14%	485,765	9%	207,718	8%	657,995	16%	2,250,939	12%
3	1,408,474	22%	506,456	9%	321,435	12%	443,337	11%	2,679,702	14%
4	1,826,228	28%	788,045	14%	918,798	34%	1,643,206	39%	5,176,277	27%
5	2,149,052	33%	3,122,402	55%	778,324	29%	870,192	21%	6,919,970	36%
6	32,830	1%	50,687	1%	44,305	2%	83,042	2%	210,864	1%
7	22,143	0%	184,607	3%	37,221	1%	292,713	7%	536,684	3%
Other	97,880	2%	495,940	9%	354,318	13%	100,132	2%	1,048,270	6%
Total	**6,490,078**	**100%**	**5,647,041**	**100%**	**2,664,535**	**100%**	**4,171,440**	**100%**	**18,973,094**	**100%**
Source: NMFS/GARFO/HMS office. Data as of October 2016.										

Table 64 – Bluefin tuna landings (dressed weight, lbs) by month, 1996-2015

Month	1996-2000		2001-2005		2006-2010		2011-2015		Total	
June	371,237	6%	200,947	4%	170,300	6%	345,587	8%	1,088,071	6%
July	1,645,787	25%	635,682	11%	229,511	9%	626,707	15%	3,137,687	17%
Aug.	1,257,806	19%	645,229	11%	392,388	15%	516,404	12%	2,811,827	15%
Sept.	2,006,236	31%	1,210,802	21%	666,003	25%	1,096,067	26%	4,979,108	26%
Oct	1,091,708	17%	2,247,095	40%	551,757	21%	801,267	19%	4,691,827	25%
Nov.	54,732	1%	138,323	2%	279,619	10%	340,650	8%	813,324	4%
Dec.	62,572	1%	462,541	8%	214,214	8%	187,716	5%	927,043	5%
Jan.-May	0	0%	106,422	2%	160,743	6%	257,042	6%	524,207	3%
Total	**6,490,078**	**100%**	**5,647,041**	**100%**	**2,664,535**	**100%**	**4,171,440**	**100%**	**18,973,094**	**100%**

Table 65 – Bluefin tuna landings (dressed weight, lbs) by month in HMS Area 4, 1996-2015

Month	1996-2000		2001-2005		2006-2010		2011-2015		Total	
June	158,669	9%	56,360	7%	75,697	8%	153,110	9%	443,836	9%
July	641,452	35%	185,828	24%	105,677	12%	296,916	18%	1,229,873	24%
Aug.	361,261	20%	212,621	27%	168,200	18%	211,271	13%	953,353	18%
Sept.	494,086	27%	158,571	20%	300,019	33%	476,433	29%	1,429,109	28%
Oct	170,216	9%	149,282	19%	224,704	24%	373,026	23%	917,228	18%
Nov.-Jan.	544	0%	25,383	3%	44,501	5%	132,450	8%	202,878	4%
Total	**1,826,228**	**100%**	**788,045**	**100%**	**918,798**	**100%**	**1,643,206**	**100%**	**5,176,277**	**100%**

Table 66 – Bluefin tuna landings (dressed weight, lbs) by month in HMS Areas 1-3, 1996-2015

Month	1996-2000		2001-2005		2006-2010		2011-2015		Total	
June	171,849	7%	109,158	11%	80,903	15%	101,174	9%	463,084	9%
July	772,334	33%	311,437	31%	109,088	21%	251,428	21%	1,444,287	28%
Aug.	598,242	25%	335,977	33%	177,978	33%	264,473	22%	1,376,670	27%
Sept.	686,993	29%	173,736	17%	133,617	25%	354,697	30%	1,349,043	27%
Oct	132,527	6%	74,062	7%	28,128	5%	163,260	14%	397,977	8%
Nov.-May	0	0%	990	0%	1,855	0%	47,123	4%	49,968	1%
Total	**2,361,945**	**100%**	**1,005,360**	**100%**	**531,569**	**100%**	**1,182,155**	**100%**	**5,081,029**	**100%**

1.6.2.4 Large Mesh Multispecies (Groundfish)

The overall trend since the start of sector management through 2013 has been a decline in groundfish landings (42.3M lbs (19,200 mt) in FY2013), revenue ($58.7M in FY2013), the number of vessels with a limited access groundfish permit (1,119 in FY2013), and the number of vessels with revenue from at least one groundfish trip (316 in FY2013). The groundfish fishery has had a diverse fleet of vessels sizes and gear types. Over the years, as vessels entered and exited the fishery, the typical characteristics defining the fleet changed as well. The decline in active vessels has occurred across all vessel size categories. Since FY2009, the 30' to < 50' vessel size category, which has the largest number of active groundfish vessels, experienced a 38% decline (305 - 159 active vessels). The <30' vessel size category, containing the least number of active groundfish vessels, experienced the largest (50%) reduction since FY2009 (34 - 17 vessels). The vessels in the largest (≥75') vessel size category experienced the least reduction (30%) since FY2009 (Murphy et al 2013).

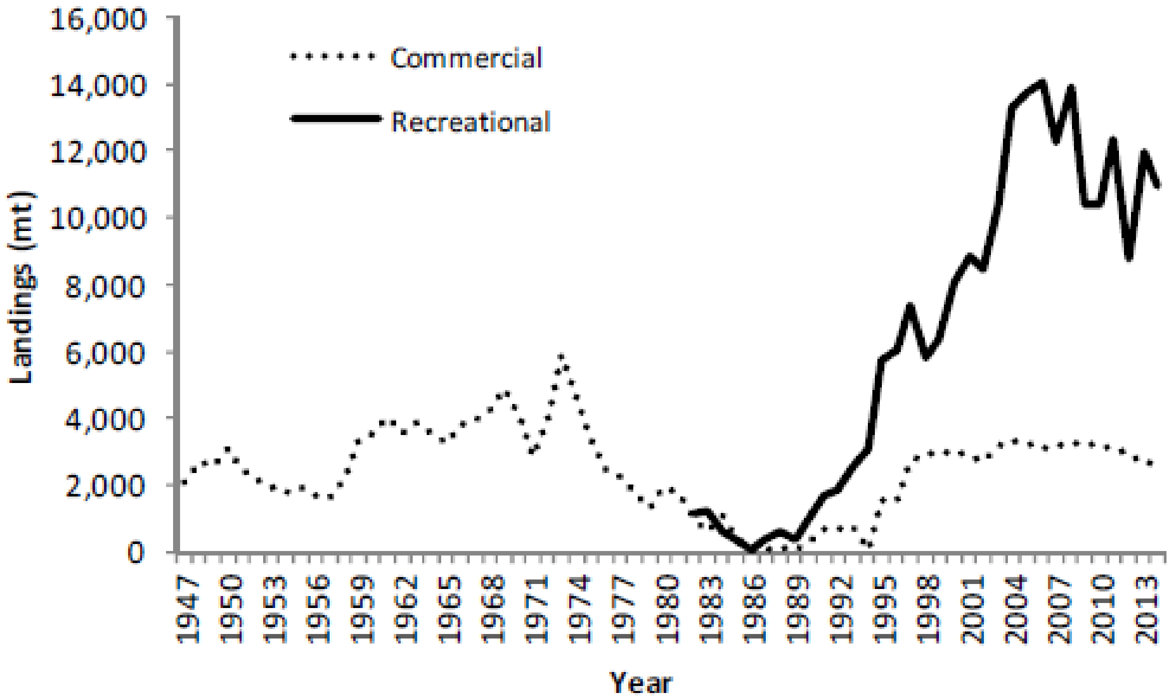
1.6.2.5 Striped Bass Fishery

The striped bass fishery occurs from Maine to North Carolina. The recreational fishery for striped bass has increased from 1982 through 2014 (1,010 mt in 1990) with a peak in 2006 (14,082 mt) (Figure 23). The recreational fishery has occurred since the 1990s in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina (no NC harvest in 2012 -2014). In 2014, the three states with the most recreational striped bass harvested (by numbers) were Maryland (33%), New York (23%), and Massachusetts (15%) (ASMFC 2015b).

For the commercial striped bass fishery, it has occurred since the 1990s in Massachusetts, Rhode Island, New York, Delaware, Maryland, Virginia, North Carolina (no NC harvest in 2013 and 2014), and the Potomac River Fisheries Commission. Total commercial landings harvest from 2005 to 2014 averaged 3,162 mt, with a slight decline in recent years. The commercial harvest primarily occurs in Maryland and states to its south. In 2014, 7.9% of the commercial striped bass harvested (by numbers) occurred in Massachusetts, 1.4% in Rhode Island, and 6.9% in New York (ASMFC 2015b).

For the recreational fishery, the only data are collected through the Marine Recreational Information Program (MRIP). However, MRIP includes no spatial data for catch locations at sea.

Figure 23 - Coast-wide commercial and recreational striped bass harvest, 1940s - present



Source: ASMFC (2015b).

Table 67 - 2014 commercial and recreational harvest (numbers) of striped bass by state

State	Commercial		Recreational	
	(#)	(% total)	(#)	(% total)
ME			20,750	1.2%
NH			6,415	0.4%
MA	60,619	7.9%	277,138	15.5%
RI	10,468	1.4%	103,516	5.8%
CT			86,763	4.8%
NY	52,903	6.9%	409,342	22.9%
NJ			225,910	12.6%
DE	14,894	1.9%	8,774	0.5%
MD	370,661	48.4%	583,028	32.6%
PRFC	81,429	10.6%	n/a	
VA	175,324	22.9%	67,486	3.8%
NC	0	0.0%	0	0.0%
Total	**766,298**	100.0%	**1,789,122**	100.0%

Source: ASMFC (2015b).
Note: MA commercial includes fish for personal consumption.

The Massachusetts Division of Marine Fisheries manages the fishery using 14 statistical areas within state waters. Figure 24 and Figure 25 map the landings and CPUE (pounds per fishing hours) within each area from 2010 to 2014. Area 9, to the east of Cape Cod, has had relatively high landings throughout the time series, and areas to the east and south of Cape Cod have had relatively high CPUE. Figure 26 tracks the landings and CPUE over time each year, showing that most of the landings have occurred between mid-July and mid-August. Decreased CPUE over the length of the season could be an indicator of decreased striped bass availability, but the landings data do not show consistent increases or decreases in CPUE across seasons.

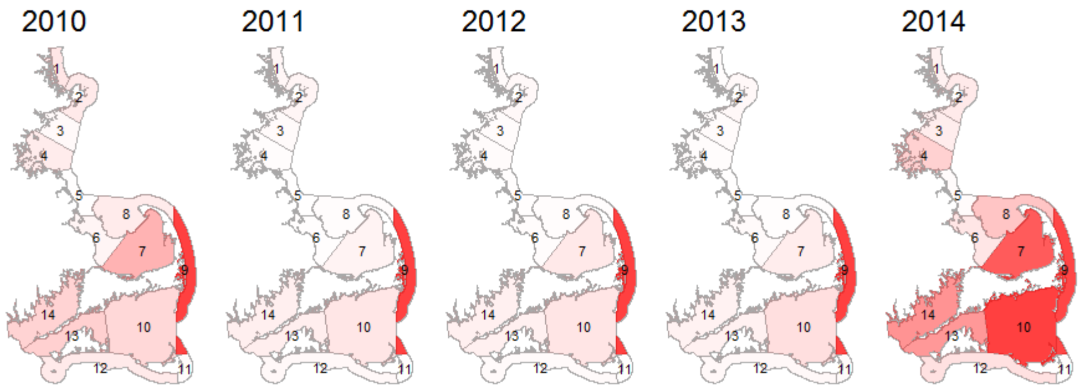
Striped bass are typically present in Massachusetts waters between May and October, yet the commercial fishery (the only source of spatial fishery-dependent data) occurs over a much narrower timeframe (Kneebone et al. 2014b). Prior to 2014, the commercial striped bass fishery began each year on July 11 and closed when the quota was exhausted, which was typically in 5-7 weeks. In 2013, the fishery closed after 5 weeks, and then reopened for an additional two weeks in late August, after it became evident that there was quota remaining. In 2014, regulations changed the fishery start date to June 23rd, and a reduced trip limit led to a more protracted season (11 weeks).

Neither recreational nor commercial striped bass fishing is allowed outside of state waters, per federal law. However, striped bass are abundant in federal waters and frequently cross this state/federal jurisdictional boundary (Kneebone et al. 2014a). Coast-wide, the recreational fishery accounts for 60-70% of total removals in recent years. In Massachusetts, the recreational/commercial ratio is about 85%/15%.

As part of an effort to estimate the predation mortality of striped bass on Atlantic menhaden, all available data sources for diet composition of striped bass were assembled and summarized (SEDAR 2015). A total of 28 data sources were identified that included over 40,000 individual stomachs examined. On a coast-wide and annual basis, herring species comprise <10% of striped bass diets. At specific times and regions (e.g., Gulf of Maine in summer/fall), Atlantic herring may comprise up to 30% of the diet.

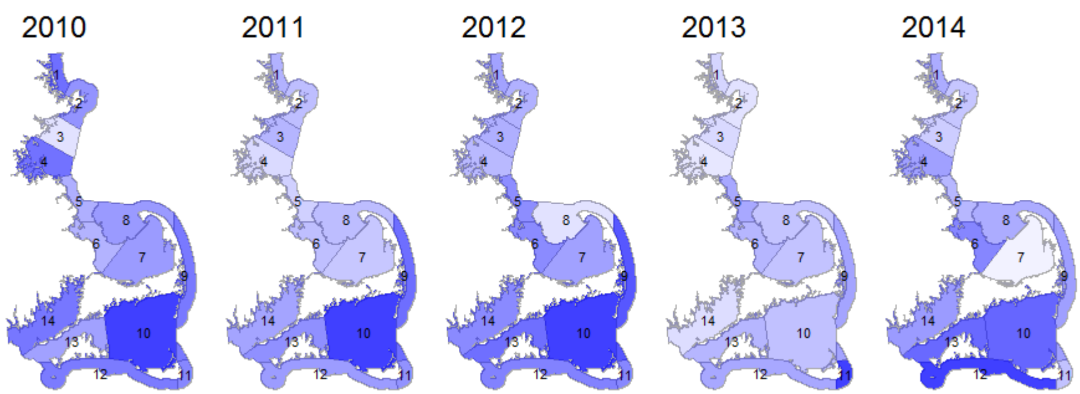
While there are no specific rules that explicitly prevent midwater trawling for herring in Massachusetts state waters, there are regulations that effectively prohibit this activity: 1) There is no exemption from the 6" minimum mesh size for herring fishing (as there is for the whiting and squid fisheries); and 2) A "coastal access permit" is required to fish with mobile gear in MA state waters, which has a maximum vessel length of 72 feet. There are very few coastal access permits (CAP), and there has been a moratorium on issuing new CAP permits since 1995.

Figure 24 - Spatial pattern in landings (pounds) for Massachusetts striped bass commercial fishery, 2010-2014



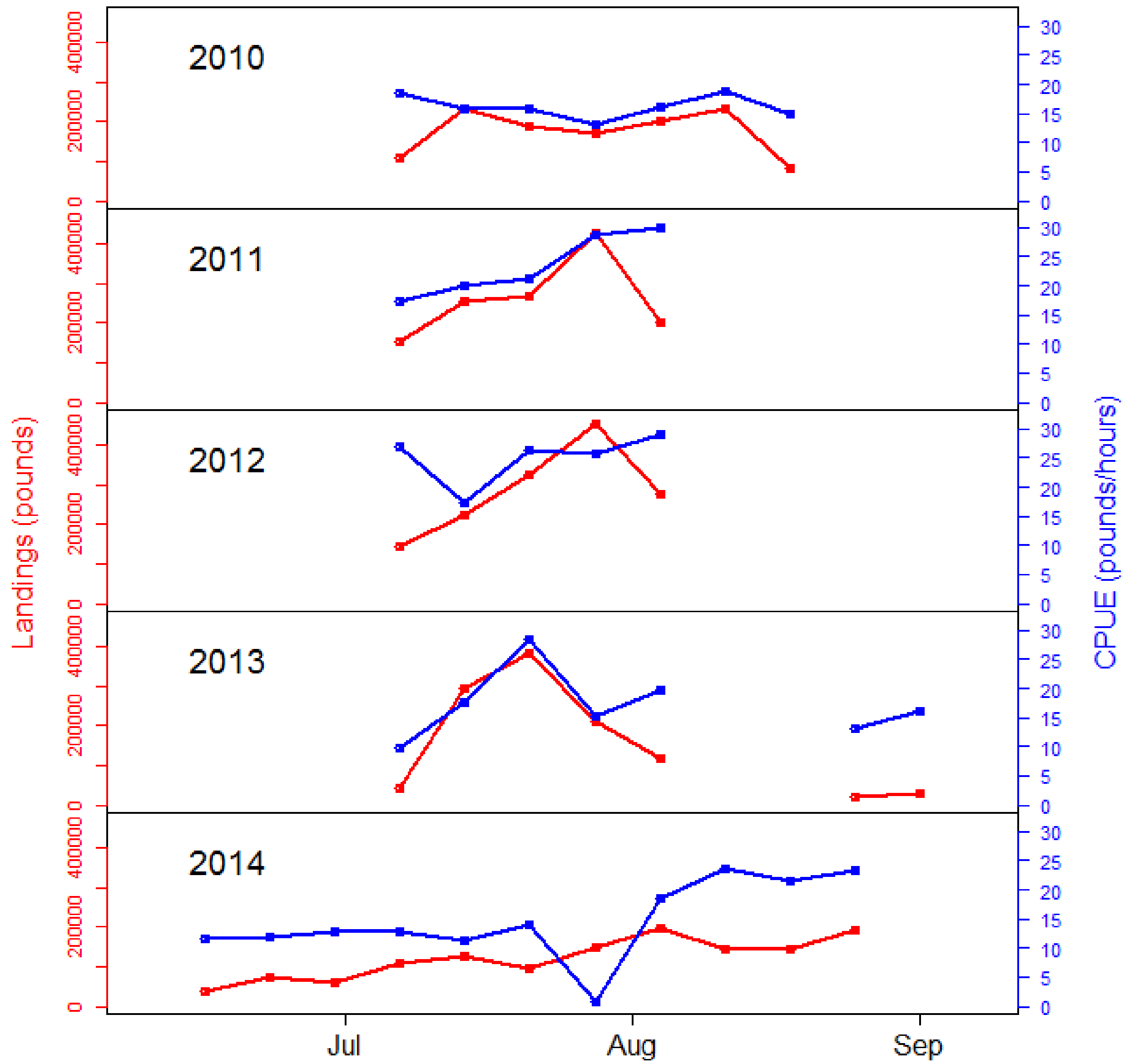
Source: MADMF (2016).

Figure 25 - Spatial pattern in CPUE (pounds / fishing-hours) for Massachusetts striped bass commercial fishery, 2010-2014



Source: MADMF (2016).

Figure 26 - Seasonal profile of Massachusetts commercial striped bass fishery, 2010-2014



Source: MADMF (2016).

1.6.2.6 Other Recreational Fisheries

Many recreational fisheries exist in the Northeast, and several depend on herring as a source of bait as well as a source of food for the fish that they target. The following review of recreational fisheries comes from the fisheries of the United States, which offers a comprehensive overview of recreational fisheries in the U.S. A full breakdown of the different recreationally fished species by year and weight is offered therein, as well as by distance from shore and by number of live releases.

The recreational fisheries serve many purposes for the residents of the Atlantic Coast states. In 2009, there were close to 44M trips that caught over 198M fish, trips which serviced nearly 6.4M residents. Over 31% of those trips were made in the waters managed by the NEFMC. Commonly caught fish on the trips that occurred in federally managed waters include black sea bass, summer flounder, Atlantic cod, dolphinfish, and bluefish. 62% of all the prior mentioned trips were ones in which the fishing was done mostly in inland waters.

States stand to benefit from recreational activity as well. In 2009, the state of New Jersey, New York, and Massachusetts had the most number of angler trips, with 5,444 trips; 4,917 trips, and 3,603 trips, respectively. Connecticut had 1,462 trips; while Maine had 1,014, and Rhode Island 1,042. The state of New Hampshire had the fewest, with 414 trips. The numbers of trips taken in 2008 were similar in magnitude by state. The trend in states is similarly mimicked in the number of finfish both harvested and released by recreational fishermen in 2008 and 2009, however Connecticut was much closer in ranking to Massachusetts.

Due to the eclectic nature of the fisheries entailed in the recreational community, there is no one management body that oversees all recreational fisheries. Instead, there is a mixture of management from the NMFS, NEFMC, MAFMC, ASMFC, and state agencies that are not divided by the value of the resource. For instance, some stocks such as black sea bass are managed by the ASMFC and represent 1,022 mt of harvest in 2008 and 1,269 mt in 2009. Atlantic cod, however, are managed under the NEFMCs Groundfish FMP, and represent 1,905 mt of recreational catch in 2008 and 1,677 mt in 2009. The MAFMC manages bluefish, which were worth 8,717 mt of recreational catch in 2008 and 6,290 mt in 2009. There are a wide range of bodies that assess the health and status of the stocks that are recreationally fished as well.

There are multiple forms of data on recreational fisheries available. Data is gathered through state and regional logbook programs, a coastal household telephone survey, a telephone survey of for-hire fishing vessel operators, and a field intercept survey of completed angler fishing trips. Amendment 16 to the Groundfish FMP used data that came from the Marine Recreational Information Program (MRIP, formerly the MRFSS) and recreational party/charter logbook data. The party/charter mode logbook data can be used to characterize numbers of participating vessels, trips, and passengers.

The MRIP is a source for catch statistics including harvested and released catch, distance from shore, size distribution of harvested catch, catch class (numbers of fish per angler trip), and seasonal distribution of harvested catch. The MRIP is a relatively new initiative from NMFS which is focused on counting and reporting marine recreational catch and effort. The point of MRIP is to provide the detailed, timely, scientifically sound estimates that fisheries managers, stock assessors and marine scientists need to ensure the sustainability of ocean resources, as well as address head-on stakeholder concerns about the reliability and credibility of recreational fishing catch and effort estimates.

1.6.2.7 Ecotourism Industries

Atlantic herring is a forage species for whales, other marine mammals and birds in the Northeast. Thus, the whale and bird watching industries have an interest in the health of the Atlantic herring population. If fewer marine mammals or birds are in the area to observe, the industry would be able to provide fewer boats and tours to the public. Furthermore, whales and some sea birds are known to respond to prey availability, and may become increasingly difficult to find. The number of marine mammals and birds needed to support the industries is unknown, but limited economic data on the whale watching industry does exist.

Whale watching: The whale watching season runs from April to October, occasionally into November, with fin, humpback, and minke whales being the key species of interest. Humpback whales are known to feed on herring, particularly in the Gulf of Maine, but also sand lance and other small fish. Humpbacks feed during the spring, summer and fall in the western North Atlantic (Waring et al. 2015). Their distribution in this region is largely correlated with prey, though behavior and bathymetry are factors as well (Payne et al. 1986; Payne et al. 1990).

Whales tend to congregate on large oceanographic features, which is where schooling prey can be found. A good portion of a whale watching trip involves finding the whales, which results in spent fuel. If schools of herring were to stop schooling or reduce in number and whales were to subsequently stop congregating, the whale watching industry could be affected by the extra expenditure of fuel to find them, even if whales are present in the area (Lee 2010).

O'Conner et al. (2009) characterized the whale watching industry in 2008 as attracting 910,071 passengers participating boat-based trips by 31 operators from ports in Maine, New Hampshire, Massachusetts and Rhode Island, with $35M total revenue (Table 68). This snapshot represents a decline in the number of passengers and operators, but an increase in revenue from a similar snapshot in 1998. Ticket prices in 2008 were around $40 for adults and $30 for children on a 4-hour cruise. Up to 400 passengers can fit on some vessels. The industry was estimated to employ 730 people.

Table 68 - New England whale watching, 1998 and 2008

Year	Whale watchers (#)	Operators (#)	Direct expenditure	Indirect expenditure	Total expenditure
1998	1,240,00	36	$30,600,000	$76,650,000	$107,250,000
2008	910,07	31	$35,000,000	$91,000,000	$126,000,000
Source: O'Conner et al (2009).					

In 2017, there are 22 dedicated whale watching companies with 34 vessels from Maine to New Jersey and several in Delaware and Virginia (Table 69). There are roughly 30 smaller, charter and 6-pack whale watch operations as well in the Northeast (GARFO). Important ports for whale watching in the Gulf of Maine include Bar Harbor, Maine; Rye, New Hampshire; and Gloucester, Boston, and Provincetown, Massachusetts (Lee 2010).

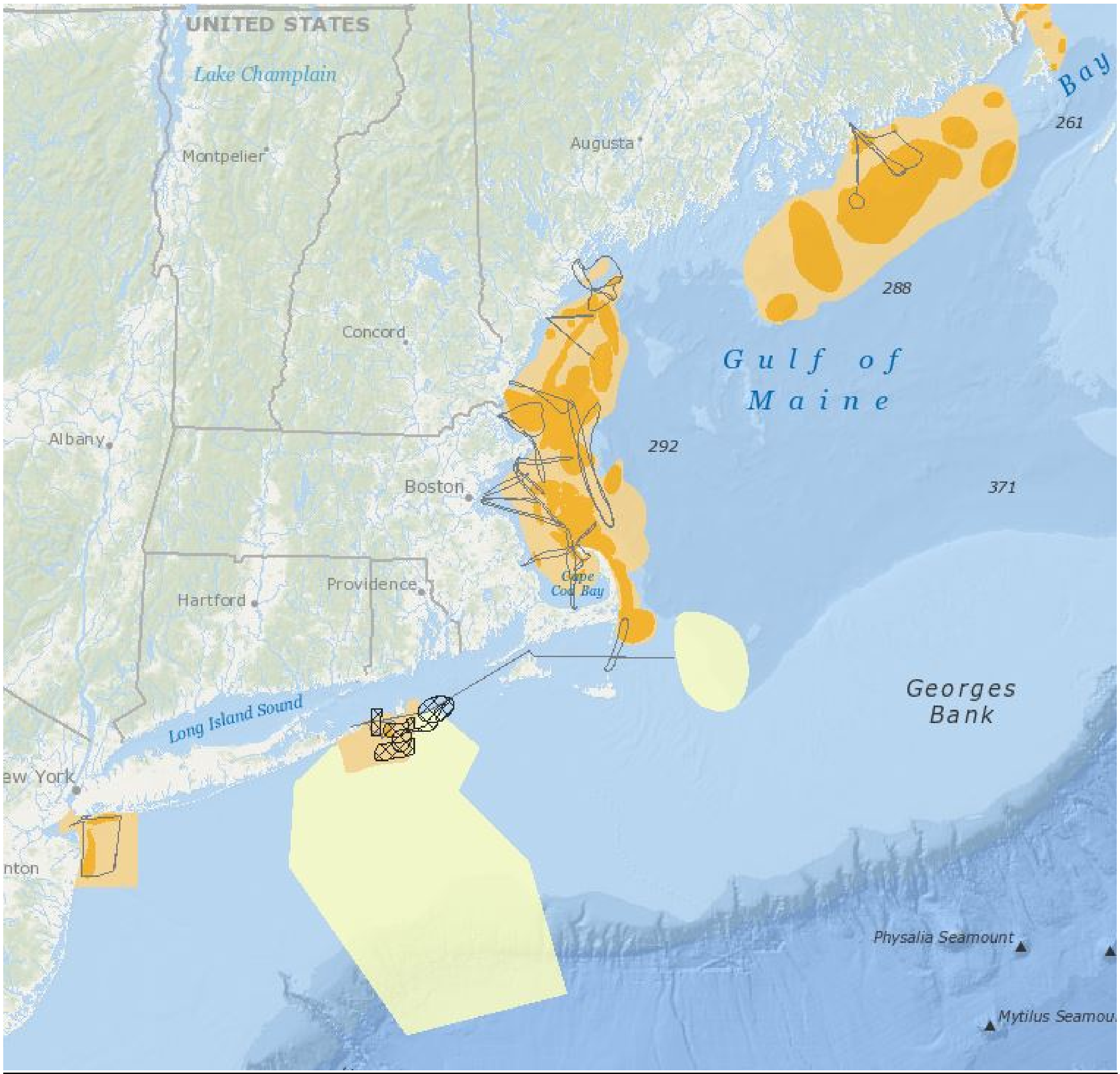
Whale watch companies do not report to NMFS where they go and what protected species they see. However, many, if not all, whale watch vessels carry naturalists on board to collect data. The naturalists are from research or conservation organizations. The Bar Harbor Whale Watch Company has been collecting data (e.g., number of humpbacks and finbacks, location and date) since the 1990s, but in 2003, started carrying scientists from Allied Whale on every trip. Their data are digitized, and he has offered to help obtain the data. The Blue Ocean Society, The Whale and Dolphin Conservation, Provincetown Center for Coastal Studies, and College of the Atlantic also provide scientists for trips by other companies that do excursions to Jeffries Ledge, Stellwagen Bank, and other areas (Z. Klyver, pers. comm., 2015).

Table 69 - Whale watching companies in the Northeast U.S., 2017

State	Company name	Port	Number of vessels
ME	Bar Harbor Whale Watch	Bar Harbor	2
	Boothbay Harbor Capt. Fish's Whale Watch	Boothbay Harbor	3
	First Chance Whale Watch	Kennebunk	1
	Odyssey Whale Watch	Portland	1
NH	Atlantic Fleet Whale Watch	Rye	1
	Granite State Whale Watch	Rye	1
MA	Boston Harbor Cruises/New England Aquarium	Boston	4
	Cape Ann Whale Watch	Gloucester	1
	Capt Bill and Sons Whale Watch	Gloucester	1
	Captain John Boats	Plymouth	2
	Dolphin Fleet of Provincetown	Provincetown	4
	Hyannis Whale Watch Cruises	Barnstable	1
	Newburyport Whale Watch	Newburyport	1
	Seven Seas Whale Watch	Gloucester	1
	Shearwater Excursions Whale Watch	Nantucket	1
RI	Frances Fleet	Narragansett	2
	Seven B's V	Narragansett	1
NY	American Princess Fleet	Neponset	1
	Viking Fleet	Montauk	1
	Joseph DiLiberto	Montauk	1
NJ	Cape May Whale Watcher	Cape May	1
	Cape May WW & Research Center & Starlight Fleet	Cape May	2
Source: GARFO			

Figure 27 shows commercial whale watching areas as mapped by whale watch industry participants in the Northeast Coastal and Marine Recreational Use Characterization Study conducted by SeaPlan, the Surfrider Foundation, and Point 97 under the direction of the Northeast Regional Planning Body. Whale watch owners, operators, naturalists, and data managers attended participatory mapping workshops to map areas where whale watching takes place in the region, while also providing information about seasonality, species, and overall industry trends.

Figure 27 - Map of commercial whale watching areas



Source: Northeast Ocean Data Explorer, http://www.northeastoceandata.org/data-explorer/

Legend:

- **Light orange = General use areas.** The full footprint of whale watch activity in 2010 – 2014.
- **Dark orange = Dominant use areas.** Areas routinely used by most users.
- **Lines = Transit routes.** Areas used for transit to and from general or dominant use areas.
- **Yellow = Supplemental areas.** Areas used for closely-related activities and infrequent specialty trips.
- **Hatched = RI Ocean Special Area Management Plan areas.** Areas that are part of the Rhode Island Ocean Special Area Management plan and are symbolized separately to reflect different data collection methodologies.

Seabird watching: New England is a popular destination for seabird watching, particularly Petit Manan and Machias Seal islands within the Maine Coastal Islands National Wildlife Refuge (off the coast of Steuben and Machiasport). The seabird tourism industry in Maine generally runs May-July, when most seabirds come to land to nest. In 2001, 120 companies were identified as providing recreational seabird viewing in Maine, with about two thirds located in the Penobscot Bay area or to the east. Seabird viewing is a primary focus of 10-15% of these companies; it is an incidental service for the remainder. Trip prices ranged from $36 for a one to four hour excursion to $425 for multi-day excursions. It was estimated that 5,000-7,500 trips were taken annually with seabird viewing as a primary purpose and 350,000 to 450,000 trips with seabird viewing as a secondary purpose (e.g., whale watching trips). The value of seabird tourism in Maine was estimated at $5 to $10 million in 2001. An earlier survey in 1996 of active bird watchers in Maine, indicated that 45% of respondents lived out of state, in over 30 states and one Canadian province (USFWS 2005, p. 3-13). The Friends of Maine Coastal Islands National Wildlife Refuge website has links to 17 seabird tour boat operators in Downeast and Midcoast Maine (Table 70; mainecoastislands.org).

Table 70 – Seabird watching companies in Maine, 2017

Region	Port	Company names
Downeast	Bar Harbor	Bar Harbor Whalewatch
	Cutler	Bold Coast Charter
	Milbridge	Downeast Coastal Cruises; Robertson Sea Tour Adventures
	Stonington	Old Quarry Ocean Adventures; The Mail Boat
Midcoast	Rockland	Breakwater Kayak; Maine Windjammer Association; Matinicus Excursions
	Boothbay	Cap’n Fish Whale Watch Cruises; Maine Kayak; Tidal Transit Kayak
	New Harbor	Hardy Boat Cruises
	Bath	Long Reach Cruises
	Damariscotta	Midcoast Kayak
	Port Clyde	Monhegan Boat Line
	Bremen	Sail Muscongus

Source: Friends of Maine Coastal Islands National Wildlife Refuge (mainecoastislands.org, accessed July 2017).

Seabird watching also occurs in New Hampshire (e.g., Rye, Hampton) and Massachusetts (Newburyport) in conjunction with whale watching (www.auduon.org).

1.6.3 Fishing Communities

1.6.3.1 Overview

Consideration of the economic and social impacts on fishing communities from proposed fishery regulations is required by the National Environmental Policy Act (NEPA 1970) and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA 2007).

National Standard 8 of the MSFCMA (16 U.S.C. § 1851(a)(8)) 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.*

A "fishing community" is defined in the MSFCMA (16 U.S.C. § 1802(17)), 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.*

Determining which fishing communities are "substantially dependent" on and "substantially engaged" in the Atlantic herring 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.

To gain a better perspective on the nature of the Atlantic herring fishery and the character of the affected human environment, a broader interpretation of fishing community has been applied to include almost all communities with a substantial involvement in or dependence on the Atlantic herring fishery. In terms of National Standard 8 (NS 8), some of the communities identified in this section may not fit the strict interpretation of the criteria for substantial dependence on fishing. The fishing communities that meet the legal definition (as promulgated through NS 8) are likely to be considered a subset of the broader group of communities of interest that are engaged in the herring fishery and identified in this document.

Because Atlantic herring is widely used as bait for the lobster fishery, especially in Maine, it is impractical to identify every community with substantial involvement in the lobster fishery (and consequently some level of dependence on the herring fishery) for assessment in this document. Instead, some of the communities of interest are selected, in part, because of their involvement in or dependence on the lobster fishery; assessment of the impacts of measures on these communities should provide enough context to understand the potential impacts on any community with substantial involvement in the lobster fishery. Parallels can be drawn between the communities that are identified in this section and other similar communities engaged in the lobster fishery.

National Standard 8 requires the Council to consider the importance of fishery resources to affected communities and provide those communities with continuing access to fishery resources, but it does not allow the Council to compromise the conservation objectives of the management measures. “Sustained participation” is interpreted as continued access to the fishery within the constraints of the condition of the resource.

1.6.3.2 Communities of Interest

There have been over 150 communities that have been a homeport or landing port to one or more active Atlantic herring fishing vessels since 1997. These ports primarily occur from Maine to Virginia. The level of activity in the herring fishery has varied across time. This section seeks to identify the communities for which Atlantic herring is particularly important, including communities active in the Atlantic herring fishery, and those dependent on herring as a bait source or prey item in the ecosystem. Information in this section is largely based on demographic data collected by the U.S. Census and fishery data collected by NMFS, much of which are available on the NEFSC website (NEFSC 2013). Clay et al. (2007) has a detailed profile of each port, including important social and demographic information. While these data describe a community’s dependence on the Atlantic herring fishery, it is important to remember that at least some of the individual vessels therein are even more dependent on Atlantic herring. In some cases, the groups of communities identified above have been disaggregated so that information specific to certain communities can be provided and so that important details about individual communities are not lost.

1.6.3.2.1 Atlantic Herring Fishery

Engagement in and reliance on the Atlantic herring fishery: Using the NMFS Community Vulnerability Indicators provides a broader view of the degree of involvement of communities in fisheries than simply using pounds or revenue of landed fish (Jepson & Colburn 2013). The indicators portray the importance or level of dependence of commercial or recreational fishing to coastal communities, and are used to help identify the Atlantic herring Communities of Interest for this action. The degree of engagement in or reliance on the Atlantic herring fishery is based on multiple sources of information, averaged over five years, 2011-2015, using dealer data.

- *The engagement index* incorporates the pounds and value of landed Atlantic herring, the number of herring dealers buying fish in that community, and the number of vessels with herring landings.
- *The reliance index* is a per capita measure using the same data as the engagement index, but divided by total population in the community.

Using a principal component and single solution factor analysis, each community receives a factor score, which is translated into a ranking of low, medium, medium-high, or high. A score of 1.0 or more places the community at 1 standard deviation above the mean (or average) and is considered highly engaged or reliant. Communities with scores of 0.0-0.49 have low engagement. More information about the indicators may be found at: http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/index

The indicators reveal that there are 71 communities that have an Atlantic herring fishery engagement and reliance index in the range of low to high. Reported in Table 71 are the 19 communities that have a ranking of at least medium for either engagement or reliance. In general, the fishing communities with low populations (e.g., in eastern Maine) have a medium to low engagement index, but a relatively higher reliance index. Portland, Gloucester, and New Bedford are highly engaged in the Atlantic herring fishery, but have high populations, so have lower reliance indices. Just one community scores high on both engagement and reliance indices: Rockland, Maine.

Table 71 – Atlantic herring fishing community engagement and reliance indicators

State	Community	Community Index	
		Engagement	Reliance
ME	Machiasport	Low	Medium
	Jonesport	Low	High
	Gouldsboro	Medium	High
	Stonington	Medium	High
	Rockland	High	High
	Vinalhaven	Low	High
	Matinicus	Low	Med-High
	Friendship	Low	Medium
	South Bristol	Low	High
	Portland	High	Medium
MA	Gloucester	High	Med-High
	New Bedford	High	Low
RI	N. Kingstown	Medium	Low
	Narragansett/Pt. Judith	High	Medium
NY	Montauk	Med-High	Med-High
	Hampton Bays/Shinnecock	Med-High	Low
NJ	Belford	Low	Medium
	Barnegat Light	Low	Med-High
	Cape May	Medium	Medium
Source: http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/index			

Community of Interest Criteria. The *Communities of Interest* for the Atlantic herring fishery meet at least one of the following criteria:

1. Atlantic herring landings of at least 10M pounds (4,536 mt) per year from 2007-2016, or anticipated landings above this level based on interviews and documented fishery-related developments.
2. Port infrastructure dependent in part or whole on Atlantic herring (e.g., herring dealers, pump stations).
3. Dependence on herring as bait (e.g., for lobster and/or tuna fisheries).
4. Geographic isolation in combination with some level of dependence on the Atlantic herring fishery.
5. Use of Atlantic herring for value-added production.
6. A ranking of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

Updates to these criteria since their use in Amendment 5 are: a) updating the timeframe for herring landings in Criterion #1 (from 1997-2008 to 2007-2016); and b) adding Criterion #6, as the information for which has since become available from the NEFSC/Social Sciences Branch.

Communities identified. There are 18 communities that meet one or more of these criteria (Table 72). For Criteria #3, as there are well-over 5,000 vessels landing lobster in ports from Maine to Virginia, a subset of representative ports are included here. Herring is used as bait primarily in ports from Maine to Massachusetts. Ports with landings over 10M lbs each year from 1997-2008, a criterion in Amendment 5, is included for comparison purposes. The communities meeting this criterion are unchanged, with the exception of New Bedford, which meets the criterion under the more recent time period. In Amendment 5, Lubec/Eastport, Maine was a *Community of Interest*, but this community is not included in Table 72, as the value-added production plant (for pearl essence) that was located there is now closed. Of these 17 communities, 11 have non-confidential landings and are described further in Section 1.1.1.1.

Table 72 - *Communities of Interest* in the Atlantic herring fishery

State	Community	Landings >10M lbs.		Infra-struct.	Bait	Isolation	Value-added	Rank
		(97-08)	(07-16)					
ME	Jonesport			√	L	√		√
	Gouldsboro			√	L	√		√
	Stonington			√	L	√		√
	Rockland	√	√	√	L			√
	Vinalhaven			√	L	√		√
	Matinicus			√	L	√		√
	South Bristol			√	L			√
	Sebasco			√	L			
	Portland	√	√	√	L			√
MA	Gloucester	√	√	√	L,T			√
	New Bedford		√	√	L,T		√	√
RI	Newport			√	L			
	N. Kingstown			√				
	Narragansett/ Pt. Judith			√	L		√	√
NY	Montauk			√	T			√
	Hampton Bays/ Shinnecock			√				√
NJ	Barnegat Light			√	T			√
	Cape May			√	T			

L = port reliant on herring bait for the lobster fishery.
T = port identified as a Highly Migratory Species community in the HMS FMP. A portion of the tuna fishery uses herring as bait.

States and Landing Ports. During the period 2007-2016, Atlantic herring was landed in eight states (not including confidential states), with the most landings occurring in Maine and Massachusetts, averaging 82M and 79M lbs., respectively, per year (Table 73). Within these states, Atlantic herring was landed in 130 ports. Gloucester and Portland have been the top two landing ports during this time period.

Table 73 – Landings revenue to states, and Atlantic herring *Communities of Interest*, 2007-2016

State/Port	Top port ranking	2007-2016 Landings		Herring Permits [a]	Herring Dealers [a]
		Total	Average		
Maine		822M	82M	62	103
Portland	#2	374M	37M	33	80
Rockland	#4	294M	29M	20	67
Stonington	#6	52M	5.2M	12	33
Vinalhaven	#10	20M	2.0M	8	7
Jonesport	#12	17M	1.7M	8	13
S. Bristol	#19	5.1M	0.5M	6	4
Other (n=35)*		59M	5.9M	39	72
New Hampshire		47M	4.7M	26	32
Massachusetts		793M	79M	66	97
Gloucester	#1	439M	44M	39	83
New Bedford	#3	324M	32M	28	63
Other (n=11)		31M	3.1M	29	45
Rhode Island		117	12M	58	35
Point Judith	#5	71M	7.1M	171	29
Other (n=9)		46M	4.6M	20	14
Connecticut		1.4M	0.1M	11	6
New York		0.9M	0.1M	73	30
Montauk	#39	0.2M	0.0M	45	16
Hampton Bays/ Shinnecock	#37	0.3M	0.0M	29	16
Other (n=12)		0.4M	0.0M	14	13
New Jersey		47M	4.7M	56	12
Maryland		0.1M	0.0M	11	3
Confidential state(s)		6.7M	0.7M	9	7
Total	**130**	**1,806M**	**181M**	**291**	**190**

[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
*Prospect Harbor, Maine is the top 9th port in terms of landings during this time period (27M total, 2.7M average), yet it does not qualify as an Atlantic herring *Community of Interest*.
Source: Dealer data, accessed July 2017.

Home Ports

Of the Atlantic herring *Communities of Interest*, Gloucester and New Bedford, Southern RI, and Cape May are homeports with largest concentrations of vessels that have Atlantic Herring limited access directed fishery permits, Categories A and B (Table 74). Mid-Coast ME, Portland and Seacoast NH also are home to a few of these permit holders. Beyond the communities of interest, a few Category A and B permit holders have homeports in Bath, Cundys Harbor, Hampden, and Matinicus ME; Boston and Woods Hole MA; and Wanchese NC. For the most part, these vessels use a community of interest as a landing port. The distribution of important homeports for Atlantic herring vessels is largely unchanged between 2011 and 2016, particularly for the limited access vessels.

Table 74 - Distribution of vessels with herring permits which have an Atlantic herring community of interest as a homeport, 2011 and 2016

Homeport		Atlantic Herring Permit Category					
		Limited Access (A, B, C)		Open Access (D, E)		Total	
		2011	2016	2011	2016	2011	2016
ME	Portland	3	3	37	33	40	36
	Rockland	1	1	2	2	3	3
	Stonington/Deer Isle	1	0	1	2	2	2
	Vinalhaven	0	0	2	3	2	3
	Lubec/Eastport	0	0	2	1	2	1
	Sebasco Estates	0	0	3	2	3	2
	Maine, other	11	7	213	150	224	159
NH	Seacoast	6	4	104	94	110	98
MA	Gloucester	8	6	191	116	199	122
	New Bedford	12	10	210	183	222	193
	Massachusetts, other	10	8	407	329	417	337
RI		15	14	124	112	139	126
NJ	Cape May	14	12	100	77	114	89
	New Jersey, other	0	0	207	173	207	173
Other		12	12	521	393	533	405

Source: NMFS permit database: https://www.greateratlantic.fisheries.noaa.gov/aps/permits/data/index.html. Accessed September 2016.

Between 2007 and 2010, the majority of herring was landed in Massachusetts, Maine, New Jersey, and Rhode Island. Table 75 characterizes each state that fish were landed in from vessels that held a herring permit by the species landed and year, by showing the revenue and landings for each. Massachusetts landed the most herring, and Maine had the second highest landings in all years. Menhaden caught by herring permit holders were landed primarily in New Jersey, and mackerel caught by herring permit holders were landed primarily in Massachusetts. Squid landed by herring permit holders was caught primarily in New Jersey and Rhode Island.

Table 75 - Total revenue (thousands of dollars) and landings (thousands of pounds) of all species by landed states and species for vessels with Atlantic herring permits, 2007-2010[update]

		2,008		2,009		2,010	
		Revenue	Landings	Revenue	Landings	Revenue	Landings
CT	Herring	*C	*C	*C	*C	*C	*C
	Menhaden	*C	*C	*C	*C	*C	*C
	Mackerel	17	83	33	119	12	39
	Squid	562	488	497	484	662	554
	Other	12,211	5,004	11,772	5,671	12,381	5,771
MA	Herring	11,702	100,864	12,399	130,778	7,986	69,574
	Menhaden	1,780	15,264	871	9,240	676	6,843
	Mackerel	4,064	37,511	3,498	31,324	1,358	12,394
	Squid	1,543	1,596	1,112	1,242	1,606	1,374
	Other	264,674	102,846	263,253	104,692	328,976	110,172
ME	Herring	9,001	71,133	8,793	69,275	9,103	59,267
	Menhaden	279	2,744	45	467	*C	*C
	Mackerel	2	18	2	6	34	183
	Squid	6	7	*C	*C	1	1
	Other	19,270	13,779	16,804	12,277	19,347	13,210
NH	Herring	120	979	350	3,306	430	3,730
	Menhaden	0	0	0	0	0	0
	Mackerel	3	19	6	21	2	7
	Squid	1	1	0	0	0	0
	Other	13,497	7,522	13,828	8,617	15,614	7,471
NJ	Herring	404	6,256	1,176	13,261	227	3,701
	Menhaden	2,573	38,556	1,210	17,622	1,662	24,097
	Mackerel	1,308	8,857	1,998	10,071	428	4,392
	Squid	8,273	23,902	7,177	28,256	7,619	21,721
	Other	88,232	21,222	87,647	24,712	101,870	24,000
NY	Herring	4	25	4	21	2	13
	Menhaden	8	49	10	58	8	54
	Mackerel	43	167	44	141	23	90
	Squid	5,480	5,617	4,713	4,494	4,525	4,013
	Other	22,768	11,219	30,272	13,456	18,882	12,029
RI	Herring	645	4,495	1,412	10,331	1,167	8,854
	Menhaden	*C	*C	*C	*C	0	0
	Mackerel	910	2,534	3,103	8,588	1,415	4,422
	Squid	17,826	27,011	14,917	25,762	12,770	20,422
	Other	29,266	26,862	24,002	23,248	25,624	24,955

Source: Dealer data
*C = confidential

1.6.3.2.2 Other Fisheries/Ecotourism

There are several other fisheries, as well as the ecotourism industry, that are potentially impacted by this action. Summarized below are the key port communities that are important to each of these fisheries, as identified by the lead management entity for each. Where the management entity has not previously identified the relevant communities, a method was developed through this action and explained below. Many ports have co-existing fisheries, including the Atlantic herring fishery (

Table 78).

Atlantic Mackerel: Many vessels that participate in the Atlantic herring fishery are also active in the Atlantic mackerel fishery. Primary ports identified in the Mackerel, Squid, Butterfish FMP had at least $100,000 in ex-vessel revenues from mackerel during 2012-2014 (combined) included (from more mackerel dollars to less): North Kingstown, RI; Gloucester, MA; New Bedford, MA; Portland, ME; Cape May, NJ; Marshfield, MA; Provincetown, MA; and Point Judith, RI (

Table 78) (MAFMC 2016b). For purposes of this action, these are considered the primary mackerel ports. There are 11 other ports that are either a homeport or a primary landing port for ≥1 Atlantic mackerel vessel(s) (MAFMC 2015). Section 1.6.2.1 contains more information about the mackerel fishery.

American Lobster: The American lobster fishery is the primary end user of Atlantic herring as bait. American lobster is landed in many port communities on the Atlantic coast. The ASMFC does not identify key ports in the FMP for this fishery. In 2015, 18 of the top 20 ports for lobster landed value were in Maine (primarily midcoast to eastern Maine), and two were in Massachusetts (Table 76). For purposes of this action, these 20 top ports are considered the primary lobster ports. Also in 2015, there were 2,297 federal lobster licenses issued to vessels from 279 home ports (15 states) and 273 primary landing ports (12 states). Of these, there were 63 ports that were either the home port or primary landing port to at least 10 federal lobster vessels (

Table 78). Since roughly 8,000 state waters-only lobster licenses are issued annually, it is likely that many more ports have over 10 lobster licenses issued per port. Section 1.6.2.2 contains more information about the lobster fishery.

Bluefin Tuna: Atlantic herring is important to tuna as a prey item in the ecosystem as well as a bait source for a subset of the fishery. NMFS has identified 28 fishing communities important to the Highly Migratory Species fishery (including 53 species of tunas, swordfish, sharks, etc.) defined by the proportion of HMS landings in the town, the relationship between the geographic communities and the fishing fleets, socioeconomic research, community studies, and input from advisory bodies. The communities in Maine to New Jersey are: Gloucester and New Bedford, MA; Wakefield RI; Montauk, NY; and Brielle, Barnegat Light, and Cape May, NJ (NMFS 2011b). For purposes of this action, these 7 top ports are considered the primary tuna ports (

Table 78). As of October, 2017, there were 6,620 current tuna permits issued (GARFO 2017), 4,009 (61%) of which were in states from Maine to New Jersey. Within these states, 82 communities have ≥10 bluefin tuna vessels as its principal port. Section 1.6.2.3 contains more information about the tuna fishery.

Commercial Groundfish: Atlantic herring is important to groundfish as a prey item in the ecosystem as well; it is a bait source for a very minor subset of the commercial fishery (more important for recreational bait).There are over 400 communities that have been the homeport or landing port to one or more commercial Northeast groundfish fishing vessels since 2008. Of these, 10 ports have been identified as primary commercial groundfish port communities (and 22 secondary ports), based on the level of commercial groundfish activity in the port (

Table 78). Primary ports have, during FY 2009-FY 2013, at least $100,000 average annual revenue (for all species, not just groundfish) and are in the top ten ranking in regional quotient or local quotient (confidential ports excluded). For purposes of this action, these 10 top ports are considered the primary commercial groundfish ports. Secondary ports are in the top 11-30 ranking in regional or local quotient (same revenue threshold) (NEFMC 2017). Section 1.6.2.4 contains more information about the groundfish fishery.

Table 76 – Top 20 landing ports by lobster revenue, 2015, Maine to New Jersey

State	Port	Top 20 landing port for lobster revenue		
		Revenue	# of vessels	# of dealers
ME	Jonesport	$9.8M	178	6
	Beals	$20M	234	5
	Milbridge	$11M	76	13
	Steuben	$9.4M	71	11
	Winter Harbor	$8.4M	39	3
	Southwest Harbor	$11M	109	8
	Bass Harbor	$11M	91	7
	Swans Island	$11M	93	4
	Stonington	$62M	367	10
	Rockland	$13M	163	4
	Vinalhaven	$39M	222	12
	Owls Head	$10M	71	4
	S. Thomaston/Spruce Head	$17M	130	10
	Port Clyde	$10M	103	10
	Tenants Harbor	$9.7M	92	11
	Cushing	$9.1M	68	9
	Friendship	$21M	165	10
	Portland	$17M	230	21
MA	Gloucester	$16M	202	24
	New Bedford/Fairhaven	$8.3M	91	22
Source: ACCSP, accessed August 2017.				

Recreational: Atlantic herring is important to recreational fisheries as a prey item in the ecosystem as well as a bait source for a subset of the fishery. The relevant recreational fisheries are primarily tuna, striped bass, and groundfish. In the fishery management plans for these fisheries, criteria for identifying key recreational fishing communities have not been identified. For this action, a community is considered a recreational fishing community if it is (Table 77):

- If the community has a high level of engagement or reliance in recreational fishing using the NMFS Community Vulnerability Indicators, which portray the importance or level of dependence on recreational fishing by coastal communities (Jepson & Colburn 2013). *The engagement index* incorporates the number of recreational fishing trips in 2011-2015 by fishing mode (private boat, charter boat, shore fishing) originating in the community (using MRIP data). *The reliance index* is a per capita measure using the same data as the engagement index, but divided by total population in the community.

- Located on or near the coast in a coastal state from Maine to New Jersey. *These are the states adjacent to the Atlantic herring stock area.*

Between 2011-2015, there were 191 fishing communities between Maine and New Jersey identified as the principal port for the 571 vessels with Northeast multispecies charter/party permits (Category I). Montauk, NY had the most number of permits (annual average of 52). There were 12 ports with an annual average of ten or more permits that also met the above criteria. For this action, these are considered the primary recreational fishing communities (Table 78).

Ecotourism: The Friends of the Maine Coastal Island National Wildlife Refuge lists several seabird watching businesses in Maine on its website. These businesses are located 11 communities in Maine. GARFO records indicate there are currently 17 whale watching businesses, in communities from Maine to New Jersey (Section 1.6.2.7; Table 78).

Table 77 – Ports with a "high" recreational fishing community engagement or reliance indicator and number of party/charter permits on average in 2011-2015 (if ≥10)

State	Community	Community Index		# of vessels with party/charter permits
		Engagement	Reliance	
ME	Biddeford	High	Low	
NH	Hampton	High	Medium	12
	Seabrook	High	Medium	
MA	Salisbury	High	Med-High	
	Newburyport	High	Medium	11
	Gloucester	High	Medium	20
	Plymouth	High	Low	11
	Marshfield (Green Harbor-Cedar Crest/ Marshfield Hills/Ocean Bluff-Brant Rock)	High	Medium	27
	Sandwich (E. Sandwich/Forestdale)	High	Medium	
	Barnstable	High	Medium	
	Yarmouth (S. Yarmouth/W. Yarmouth/ Yarmouth Port)	High	Low	
	Dennis	High	High	
	Chatham	Med-High	High	
	Harwich Port	Med-High	High	
	Falmouth	High	High	
	Bourne	High	High	
	Wareham (W. Wareham/Onset)	High	Low	
	Nantucket	High	Med-High	
	Westport	High	Medium	
RI	Tiverton	High	Low	

State	Community	Community Index		# of vessels with party/charter permits
		Engagement	Reliance	
	Bristol	High	Low	
	Jamestown	High	Medium	
	Warwick	High	Low	
	Narragansett (Point Judith)	High	Med-High	22
	S. Kingstown (Kingston/Wakefield-Peacedale)	High	Low	
	Charlestown (Carolina)	High	Medium	
CT	Stonington (Mystic/Pawcatuck)	High	Medium	
	Groton	High	Medium	
	Waterford	High	Medium	
	East Lyme (Niantic)	High	Medium	
	Old Lyme	High	Medium	
	Old Saybrook	High	Med-High	
	Milford	High	Low	
NY	Northport	High	Medium	
	Port Jefferson	High	Medium	
	Mt. Sinai	High	Medium	
	Moriches	High	High	
	Shirley	High	Low	
	Mastic Beach	High	Low	
	Orient	High	High	
	Montauk	High	High	52
	Hampton Bays	High	High	
	Babylon	High	High	
	Oak Beach-Captree	Low	High	
	Wantagh	High	Medium	
	Point Lookout	High	High	
	Long Beach	High	Low	
	Brooklyn (Sheepshead Bay)	High	Low	12
	Queens	High	Low	
NJ	Keyport	High	Med-High	
	N. Middletown	High	Medium	
	Port Monmouth	High	Medium	
	Leonardo	High	High	
	Atlantic Highlands	High	High	
	Belmar (South Belmar)	High	High	15
	Manasquan	High	Medium	
	Brielle	High	Med-High	
	Pt. Pleasant	High	Med-High	15
	Berkeley (Bayville)	High	Low	
	Barnegat Light	High	High	10
	Port Republic	Med-High	High	

State	Community	Community Index		# of vessels with party/charter permits
		Engagement	Reliance	
	Brigantine	High	Medium	
	Abesecon	High	Medium	
	Margate City	High	Med-High	
	Somers Point	High	Medium	
	Ocean City	High	Medium	
	Sea Isle City	High	High	
	Stone Harbor	High	High	
	Wildwood	High	High	
	Lower (Erma/North Cape May/Villas)	High	Low	
	Cape May	High	High	29
	Maurice River (Leesburg)	High	Medium	
	Downe (Fortesque)/Newport	High	High	

Table 78 – Port communities for the herring fishery and other fisheries/industries potentially impacted by Amendment 8, Maine to New Jersey

State	Port	Herring	Mackerel	Lobster	Tuna	Groundfish	Recreational	Ecotourism
ME	Cutler			L				B
	Machiasport	H						
	Bucks Harbor			L				
	Jonesport	H*		L*				
	Beals			L*				
	Addison			L				
	Harrington			L				
	Milbridge			L*				B
	Steuben			L*				
	Gouldsboro (Corea)	H*		L				
	Winter Harbor			L*				
	Bar Harbor			L				B/W
	Southwest Harbor			L*				
	Bass Harbor			L*				
	Swans Island			L*				
	Stonington	H*		L*				B
	Deer Isle			L				
	Rockland	H*	M	L*				B
	Vinalhaven	H*	M	L*				
	Owls Head			L*				
	Matinicus	H*						
	S. Thomaston (Spruce Head)			L*		G		

	Port Clyde			L*		G		B
	Tenants Harbor			L*				
	Cushing			L*	T			
	Friendship	H		L*	T			
	Bremen							B
	New Harbor			L	T			B
	South Bristol	H*		L				
	Damariscotta							B
	Boothbay (Boothbay Harbor)			L	T	G		B/W
	Bath		M					B
	Phippsburg (Sebasco)	H*		L	T			
	Harpswell (Bailey Island/Cundy's Harbor)		M	L	T	G		
	Portland	H*	M*	L*	T	G*		W
	South Portland				T			
	Saco				T	G		
	Biddeford				T		R	
	Kennebunkport (Cape Porpoise)			L	T	G		W
	Wells				T			
	Ogunquit			L	T			
	York							
	Kittery			L	T			
	Elliot				T			
	Portsmouth			L	T	G*		
	New Castle				T			
	Newington		M	L	T			
NH	Dover				T			
	Rye			L	T	G*		B/W
	Hampton			L	T	G	R*	B/W
	Seabrook			L	T	G*	R	
	Salisbury				T		R	
	Newburyport				T	G	R*	B/W
	Rockport			L	T	G*		B
	Gloucester	H*	M*	L*	T*	G*	R*	W
	Manchester (Manchester-By-The-Sea)				T			
	Beverly			L	T			
	Salem				T			
MA	Marblehead			L				
	Winthrop				T			
	Boston		M	L	T	G*		B/W
	Quincy				T			
	Hingham				T			
	Scituate			L	T	G*		B/W
	Marshfield (Green Harbor/Cedar Crest)		M*	L	T	G	R*	B
	Plymouth				T	G	R*	B/W

	Sandwich (East Sandwich/Forestdale)				T	G	R	
	Barnstable (Osterville)				T	G	R	W
	Yarmouth (S. Yarmouth/W. Yarmouth/ Yarmouth Port)						R	
	Dennis (East Dennis)				T	G	R	
	Provincetown		M*	L	T	G		W
	Truro				T			
	Wellfleet				T			
	Bass River				T			
	Orleans				T			
	Chatham			L	T	G*	R	B
	Harwich (Harwich Port)				T	G*	R	
	Hyannis				T			
	Falmouth				T		R	
	Woods Hole		M			G		
	Bourne				T		R	
	Wareham (W. Wareham/Onset)						R	
	Nantucket				T	G*	R	W
	Edgartown				T			
	Menemsha			L				
	New Bedford/Fairhaven	H*	M*	L*	T*	G*		
	Westport			L			R	
RI	Tiverton		M				R	
	Bristol						R	
	Portsmouth				T			
	Newport	H*		L	T	G		
	Jamestown						R	
	Warwick				T		R	
	N. Kingstown (Davisville)	H*	M*					
	Narragansett (Pt. Judith)	H*	M*	L	T	G*	R*	W
	South Kingstown (Kingston/Wakefield-Peacedale)				T		R	
	Charlestown (Carolina)						R	
CT	Stonington (Mystic/Pawcatuck)			L	T	G	R	
	Groton (Noank)				T		R	
	New London				T			
	Waterford						R	
	East Lyme (Niantic)				T		R	
	Old Lyme						R	
	Old Saybrook				T		R	
	Milford						R	
NY	Northport						R	
	Brookhaven (Port Jefferson/Mt. Siani/ Moriches/Shirley/Mastic Beach)						R	
	Greenport		M					

	Orient						R	
	Montauk	H*	M	L	T*	G	R*	W
	Hampton Bays/Shinnecock	H*			T		R	
	Bay Shore				T			
	Babylon (Oak Beach-Captree)				T		R	
	Hempstead (Freeport/Wantagh/Pt. Lookout)				T		R	
	Long Beach						R	
	New York(Brooklyn (Sheepshead Bay)/ Queens (Neponset))			L			R*	W
NJ	Keyport						R	
	Middletown (N. Middleton/Port Monmouth/ Belford/Leonardo)	H		L			R	
	Atlantic Highlands						R	
	Highlands				T			
	Neptune				T			
	Belmar (South Belmar)				T		R*	
	Manasquan				T		R	
	Brielle				T*		R	
	Point Pleasant			L	T		R*	
	Brick				T			
	Berkeley (Bayville)						R	
	Forked River				T			
	Waretown				T			
	Barnegat Light	H*		L	T*		R*	
	Beach Haven				T			
	Port Republic						R	
	Brigantine						R	
	Abesecon						R	
	Atlantic City				T			
	Margate City						R	
	Somers Point						R	
	Ocean City				T		R	
	Sea Isle City						R	
	Stone Harbor						R	
	Wildwood		M		T		R	
	Lower (Erma/N. Cape May/Villas)						R	
	Cape May	H*	M*	L	T*		R*	W
	Maurice River (Leesburg)						R	
	Downe (Fortesque)/Newport						R	

H = herring; M = mackerel; L = lobster; T = tuna; G = groundfish; B = seabird watching; W = whale watching
* = primary/key port.

1.6.3.3 Port Descriptions

Described here are the 11 fishing communities that have a "high" Atlantic herring fishery engagement and/or reliance index (Section 1.6.3.2.1).

1.6.3.3.1 Maine ports

Jonesport, ME

General: Jonesport is a fishing community in Washington County, Maine, with a population of 1,370 as of 2010. In 2011-15, 22% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Jonesport; the poverty rate was 16%; and the population was 99% white, non-Hispanic (U.S. Census 2017). Jonesport has a high fishing engagement index and a high fishing reliance index (Colburn & Jepson 2012).

In 2015, Jonesport was the homeport and primary landing port listed by GARFO for 60 and 66 federal fishing permits, respectively (GARFO 2017). Total landings in Jonesport were valued at over $11M, 2% of the state-wide total ($591M). American lobster accounted for $9.8M (89%) of the 2015 landings in Jonesport, landed by 157 vessels and sold to 6 dealers (Table 79; ACCSP, 2017).

Herring fishery: Since 2007, Jonesport has been the 12th highest port in terms of Atlantic herring landings (average 1.7M/year; 1% of total; Table 73). These landings are attributed to eight Atlantic herring federal permits, sold to 13 dealers. In 2015, Jonesport was the homeport and primary landing port listed by GARFO for four and five Category D federal fishing permits, respectively (GARFO 2017). Thus, Jonesport is likely not the primary port for several herring vessels. Jonesport is involved in the Atlantic herring fishery primarily through its dependence on herring for lobster bait and for its geographic isolation (Section 1.6.3.2.1). Jonesport shares characteristics with many other small, somewhat isolated communities in Maine dependent on herring for lobster bait. The Atlantic herring fishing engagement and reliance indices are low and high, respectively, for Jonesport (Colburn & Jepson 2012).

Table 79 - Top five species landed by value in Jonesport ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$9.8M	157	6
Sea scallop	$0.89M	94	3
Sea mussel	$0.55M	7	3
Atlantic halibut	$0.071M	34	3
Note: Data for one of the five top species landed are confidential. *Source:* ACCSP, as of August 2017.			

Stonington, ME

General: Stonington is a fishing community in Hancock County, Maine, with a population of 1,043, as of 2010. In 2011-2015, 33% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Stonington; the poverty rate was 15%; and the population was 97% white, non-Hispanic (U.S. Census 2017). Stonington has a high fishing engagement index and a high fishing reliance index (Colburn & Jepson 2012).

In 2015, Stonington was the homeport and primary landing port listed by GARFO for 89 and 90 federal fishing permits, respectively (GARFO 2017). Total landings in Stonington were valued at over $63M, 11% of the state-wide total ($591M). American lobster accounted for $62M (98%) of the 2015 landings in Stonington, landed by 372 vessels and sold to 10 dealers (Table 80; ACCSP, 2017).

Shoreside support services and fishing-related organizations based in Stonington include the Maine Center for Coastal Fisheries (coastalfisheries.org), the Stonington Lobster Cooperative (http://www.stoningtonlobstercoop.com), Island Fishermen's Wives Association (http://islandfishermenswivesassociation.org), and Commercial Fisheries News (www.fish-news.com/cfn/).

Herring fishery: Since 2007, Stonington has been the 6th highest port in terms of Atlantic herring landings (average 5.2M/year; 3% of total; Table 73). These landings are attributed to 12 Atlantic herring federal permits, sold to 33 dealers. In 2015, Stonington was the homeport listed by GARFO for no Atlantic herring federal fishing permits and the primary landing port listed for two Category D permits (GARFO 2017). Thus, Stonington is likely not the primary port for several herring vessels. Stonington is involved in the Atlantic herring fishery primarily through its dependence on herring for lobster bait and for its geographic isolation (Section 1.6.3.2.1). Stonington shares characteristics with many other small, somewhat isolated communities in Maine dependent on herring for lobster bait. The Atlantic herring fishing engagement and reliance indices are medium and high, respectively, for Stonington (Colburn & Jepson 2012).

Other fisheries/ecotourism: Stonington is a bird watching destination, with two companies located in town: Old Quarry Ocean Adventures (www.oldquarry.com) and The Mail Boat (isleauhautferryservice.com; Table 70).

Table 80 - Top five species landed by value in Stonington ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$62M	372	10
Sea scallop	$0.48M	38	11
Atlantic halibut	$0.23M	39	5
Atlantic rock crab	$0.034M	33	5
Note: Data for one of the five top species landed are confidential. *Source:* ACCSP, as of August 2017.			

Rockland, ME

General: Rockland is a fishing community in Knox County, Maine, with a population of 7,297, as of 2010. In 2011-2015, 4% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Rockland, the poverty rate was 14%; and the population was 96% white, non-Hispanic (U.S. Census 2017). Rockland has a high fishing engagement index and a medium fishing reliance index (Colburn & Jepson 2012).

In 2015, Rockland was the homeport and primary landing port listed by GARFO for 14 and 12 federal fishing permits, respectively (GARFO 2017). Total landings in Rockland were valued at over $18M, 3% of the state-wide total ($591M). American lobster accounted for $13M (72%) of the 2015 landings in Rockland, landed by 141 vessels and sold to 4 dealers (Table 81; ACCSP, 2017).

Herring fishery: Since 2007, Rockland has been the 4th highest port in terms of Atlantic herring landings (average 29M/year; 16% of total; Table 73). In 2015, herring was one of the top five species landed in Rockland, valued at $4.4M, landed by 6 vessels and sold to 31 dealers (Table 81; ACCSP, 2017). Rockland meets Criterion #1 for an Atlantic herring *Community of Interest*: having at least 10M pounds of landings per year from 2007-2016. These landings are attributed to 20 Atlantic herring federal permits, sold to 67 dealers. In 2015, Rockland was the homeport listed by GARFO for no Atlantic herring federal fishing permits and the primary landing port listed for two Category A and two Category D permits (GARFO 2017). Thus, Rockland is likely not the primary port for several herring vessels.

Rockland is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait (Section 1.6.3.2.1). Shoreside support services based in Rockland include several lobster bait dealers, large and small, and a pumping station for offloading herring, which is trucked to other ports. In addition, there are freezer facilities to store lobster bait and ice services in Rockland. The Atlantic herring fishing engagement and reliance indices are high and high, respectively, for Rockland (Colburn & Jepson 2012).

Other fisheries/ecotourism: Rockland is a bird watching destination, with three companies located in town: Breakwater Kayak, Maine Windjammer Assoc., and Matinicus Excursions (Table 70).

Table 81 - Top five species landed by value in Rockland ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$13M	141	4
Atlantic herring	$4.4M	6	31
Note: Data for three of the five top species landed are confidential. *Source:* ACCSP, as of August 2017.			

Vinalhaven, ME

General: Vinalhaven is an island fishing community in Knox County, Maine, with a year-round population of 1,165, as of 2010 (swells in the summer). In 2011-2015, 36% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry in Vinalhaven, the poverty rate was 12%; and the population was 94% white, non-Hispanic (U.S. Census 2017). Vinalhaven has a high fishing engagement index and a medium-high fishing reliance index (Colburn & Jepson 2012).

In 2015, Vinalhaven was the homeport and primary landing port listed by GARFO for 49 and 51 federal fishing permits, respectively (GARFO 2017). Total landings in Vinalhaven were valued at over $40M, 7% of the state-wide total ($591M). American lobster accounted for $39M (98%) of the 2015 landings in Vinalhaven, landed by 221 vessels and sold to 12 dealers (Table 82; ACCSP, 2017).

Herring fishery: Since 2007, Vinalhaven has been the 10th highest port in terms of Atlantic herring landings (average 2.0M/year; 1% of total; Table 73). These landings are attributed to eight Atlantic herring federal permits, sold to seven dealers. In 2015, Vinalhaven was the homeport listed by GARFO for no Atlantic herring federal fishing permits and the primary landing port listed for two Category A and five Category D permits (GARFO 2017). Thus, the

Atlantic herring vessels that offload on Vinalhaven are primary based on the mainland. There is a public ferry service from Rockland, but its storage capacity is too small to satisfy the bait market.

Vinalhaven is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait and its geographic isolation (Section 1.6.3.2.1). Shoreside support services based in Vinalhaven include the Vinalhaven Fishermen's Cooperative, locally owned by lobstermen and supplying the island with bait and fuel and distributing their lobsters to customers globally (vinalhavencoop.com). There are several lobster wholesale and packaging companies operating on Vinalhaven. There is little on-island bait storage capacity, so islanders are dependent on deliveries by herring vessels. Bait dealers on Vinalhaven pay a higher price for bait than dealers on the mainland, as there is limited bait storage capacity on the island and insufficient space on the ferry that transports goods and people from the mainland to make regular bait transshipments during the height of the lobster season. The Atlantic herring fishing engagement and reliance indices are low and high, respectively, for Vinalhaven (Colburn & Jepson 2012).

Other fisheries: Vinalhaven is a key port for the mackerel fishery (

Table **78**).

Table 82 - Top five species landed by value in Vinalhaven, ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$39M	221	12
Sea scallop	$0.064M	7	3
Atlantic halibut	$0.018M	10	3
Atlantic rock crab	$0.016M	53	8
Note: Data for one of the five top species landed are confidential. *Source:* ACCSP, as of April 2017.			

South Bristol, ME:

General: South Bristol is a fishing community in Lincoln County, Maine, with a population of 892 as of 2010. In 2011-2015, 5% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in South Bristol; the poverty rate was 11%; and the population was 99% white, non-Hispanic (U.S. Census 2017). South Bristol has a medium-high fishing engagement index and a medium-high high fishing reliance index (Colburn & Jepson 2012).

In 2015, South Bristol was the homeport and primary landing port listed by GARFO for 26 and 27 federal fishing permits, respectively (GARFO 2017). Total landings in South Bristol were valued at over $5.9M, 1% of the state-wide total ($591M). American lobster accounted for $5.9M of the 2015 landings in South Bristol, landed by 77 vessels and sold to 4 dealers (Table 83; ACCSP, 2017).

Herring fishery: Since 2007, South Bristol has been the 19th highest port in terms of Atlantic herring landings (average 0.5M/year; 0.3% of total; Table 73). These landings are attributed to six Atlantic herring federal permits, sold to four dealers. In 2015, South Bristol was the homeport listed by GARFO for two Category C and six Category D Atlantic herring federal fishing permits and the primary landing port listed for one Category A permit, two category C permits, and six

Category D permits (GARFO 2017). Thus, the Atlantic herring vessels that offload in South Bristol may primarily be based in South Bristol.

South Bristol is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait (Section 1.6.3.2.1). Shoreside support services based in South Bristol include the South Bristol Fisherman's Cooperative, which was created in the 1970s and has a current membership of over 35 fishermen, supplying the community with bait and fuel and distributing their lobsters (e.g., packing and shipping) to customers (www.southbristolcoop.com). The Atlantic herring fishing engagement and reliance indices are low and high, respectively, for South Bristol (Colburn & Jepson 2012).

Table 83 - Top five species landed by value in South Bristol ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$5.9M	77	4
Note: Data for four of the five top species landed are confidential. *Source:* ACCSP, as of August 2017.			

Portland, ME

General: Portland is a fishing community in Cumberland County, Maine, with a population of 66,194, as of 2010. In 2011-2015, 0.5% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Portland; the poverty rate was 20%; and the population was 83% white, non-Hispanic (U.S. Census 2017). Portland has a high fishing engagement index and a low fishing reliance index (Colburn & Jepson 2012). In 2015, Portland was the homeport and primary landing port listed by GARFO for 69 and 95 federal fishing permits, respectively (GARFO 2017). Total landings in Portland were valued at $35M, 6% of the state-wide total ($591M). American lobster accounted for $17M (49%) of the 2015 landings in Portland, landed by 218 vessels and sold to 21 dealers (Table 84; ACCSP, 2017).

Herring fishery: Since 2007, Portland has been the 2nd highest port in terms of Atlantic herring landings (average 37M/year; 20% of total; Table 73). Portland meets Criterion #1 for an Atlantic herring *Community of Interest*: having at least 10M pounds of landings per year from 2007-2016. These landings are attributed to 33 Atlantic herring federal permits, sold to 80 dealers. In 2015, Portland was the homeport listed by GARFO for two Category A, one Category C, 30 Category D, and one Category D/E Atlantic herring federal fishing permits. Portland was the primary landing port listed for three Category A permits, one category C permit, and 30 Category D permits, and one Category D/E permits (GARFO 2017). Thus, more Atlantic herring vessels offload in Portland than are based there.

Portland is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait (Section 1.6.3.2.1). Shoreside support services based in Portland include several dealers, processors, and other infrastructure that supports the herring fishery. Opening in 1986, the Portland Fish Exchange is America's first all-display seafood auction (www.pfex.org). In addition to serving as a herring dealer, it rents space to store salted herring. Several lobster bait dealers and a pumping station for offloading herring are located in Portland. Several facilities in Portland process lobsters including Cozy Harbor Seafood, Inc. (www.cozyharbor.com), and Inland Seafood (www.inlandseafood.com). Portland's infrastructure includes major highways, shipping terminals, and an airport. The port also provides many additional fishing-related services including ice, fuel, and vessel maintenance/repair services. The Atlantic herring fishing engagement and reliance indices are high and medium, respectively (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: Portland is a primary port for the groundfish fishery (

Table **78**). Recreational fishing companies based in Portland (or South Portland) include: Go Fish! Charters (www.gofishmaine.com), Fishing with Matt and Josh (www.mainecharterfishing.com), and Morning Flight Charters (www.morningflightcharters.com). Portland is home to one whale watching company, Odyssey Whale Watch (Table 69).

Table 84 - Top five species landed by value in Portland ME, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$17M	218	21
Atlantic herring	$8.1M	8	50
Pollock	$1.9M	32	5
White hake	$0.90M	27	3
Goosefish (monkfish)	$0.58M	27	4
Source: ACCSP, as of August 2017.			

1.6.3.3.2 Massachusetts ports

Gloucester, MA

General: Gloucester is a fishing community in Essex County, Massachusetts, with a population of 28,789, as of 2010. In 2011-2015, 1% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Gloucester; the poverty rate was 9%; and the population was 94% white, non-Hispanic (U.S. Census 2017a). Gloucester has a high fishing engagement index and a medium fishing reliance index (Colburn & Jepson 2012).

In 2015, Gloucester was the homeport and primary landing port listed by GARFO for 214 and 232 federal fishing permits, respectively (GARFO 2017). Total landings in Gloucester were valued at $44M, 8% of the state-wide total ($524M). American lobster accounted for $16M (36%) of the 2015 landings in Gloucester, landed by 199 vessels and sold to 24 dealers (Table 85; ACCSP, 2017).

Herring fishery: Since 2007, Gloucester has been the highest port in terms of Atlantic herring landings (average 44M/year; 24% of total; Table 73). Gloucester meets Criterion #1 for an Atlantic herring *Community of Interest*: having at least 10M pounds of landings per year from 2007-2016. These landings are attributed to 39 Atlantic herring federal permits, sold to 83 dealers. In 2015, Gloucester was the homeport listed by GARFO for five Category A, three Category C, and 128 Category D Atlantic herring federal fishing permits. Gloucester was the primary landing port listed for four Category A permits, three category C permit, and 137 Category D permits (GARFO 2017). Thus, more Atlantic herring vessels register their vessels (are based) in Gloucester than have actively landed there.

Gloucester is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait (Section 1.6.3.2.1). Shoreside support services based in Gloucester include several dealers, processors, and other infrastructure that supports the herring fishery. Several lobster bait dealers and a pumping station for offloading herring are located in Gloucester. The port also provides many additional fishing-related services including ice, fuel, and vessel maintenance/repair services. Cape Seafoods, one of the largest processors of herring for frozen export, is located at the State Pier and owns several dedicated pelagic fishing vessels. The Atlantic herring fishing engagement and reliance indices are high and medium-high, respectively, for Gloucester (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: Gloucester is home to three whale watching companies: Cape Ann Whale watch, Capt. Bill and sons Whale Watch, and Seven Seas Whale Watch (Table 69). Gloucester is a key port for the tuna and mackerel fisheries and a primary port for the groundfish fishery (

Table **78**).

Table 85 - Top five species landed by value in Gloucester MA, 2015

Species	Revenue ($)	Vessels	Dealers
American lobster	$16M	199	24
Atlantic herring	$5.3M	9	25
Haddock	$3.8M	70	13
Goosefish (monkfish)	$2.5M	70	9
Acadian redfish	$2.5M	55	12
Source: ACCSP, as of August 2017.			

New Bedford, MA

General: is a fishing community in Bristol County, Massachusetts, with a population of 95,072, as of 2010. In 2011-2015, 2% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry in New Bedford; the poverty rate was 23%; and the population was 66% white, non-Hispanic (U.S. Census 2017a). New Bedford has a high fishing engagement index and a medium fishing reliance index (Colburn & Jepson 2012). In 2015, New Bedford was the homeport and primary landing port listed by GARFO for 220 and 242 federal fishing permits, respectively (GARFO 2017). Total landings in New Bedford were valued at $322M, 62% of the state-wide total ($524M). Sea scallops accounted for $245M (76%) of the 2015 landings in New Bedford, landed by 276 vessels and sold to 28 dealers (Table 86; ACCSP, 2017).

Herring fishery: Since 2007, New Bedford has been the 3rd highest port in terms of Atlantic herring landings (average 32M/year; 18% of total; Table 73). New Bedford meets Criterion #1 for an Atlantic herring *Community of Interest*: having at least 10M pounds of landings per year from 2007-2016. These landings are attributed to 28 Atlantic herring federal permits, sold to 63 dealers. In 2015, New Bedford was the homeport listed by GARFO for eight Category A, three Category C, 174 Category D, and nine Category D/E Atlantic herring federal fishing permits. New Bedford was the primary landing port listed for eight Category A permits, two category C permits, and 189 Category D permits, and nine Category D/E permits (GARFO 2017). Thus, New Bedford is the homeport and primary landing port for the largest number of permits in the fishery.

New Bedford is also involved in the Atlantic herring fishery in its dependence on herring for lobster bait (Section 1.6.3.2.1). Shoreside support services based in New Bedford include several dealers, processors, and other infrastructure that supports the herring fishery. Several lobster bait dealers and a pumping station for offloading herring are located in New Bedford. NORPEL, one of the largest processors of herring for frozen export, is located in New Bedford (Section 1.6.1.9.2). New Bedford's infrastructure includes shipping terminals (Maritime International, Section 1.6.1.1) and access to major highways and nearby airports. The port also provides many additional fishing-related services including ice, fuel, and vessel maintenance/repair services. The Atlantic herring fishing engagement and reliance indices are high and low, respectively, for New Bedford (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: New Bedford is a primary port for the groundfish fishery (

Table **78**). Recreational fishing companies based in New Bedford include: Captain Leroy's Deep Sea Fishing, Mac-atac Sportfishing, Viking Fleet, and Walsh's Deep Sea Fishing (www.portofnewbedford.org). Viking Fleet also offers whale watching trips. New Bedford is a key port for the tuna and mackerel fisheries.

Table 86 - Top five species landed by value in New Bedford MA, 2015

Species	Revenue ($)	Vessels	Dealers
Sea scallop	$245M	276	28
Atlantic surfclam	$12M	18	11
American lobster	$8.3M	103	22
Haddock	$6.4M	50	9
Winter flounder	$5.7M	57	8
Source: ACCSP, as of August 2017.			

1.6.3.3.3 Rhode Island ports

Narragansett/Point Judith

General: Point Judith is a fishing community in the town of Narragansett, in Washington County, Rhode Island. Narragansett has a population of 15,865, as of 2010. In 2011-2015, 1% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Narragansett; the poverty rate was 16%; and the population was 95% white, non-Hispanic (U.S. Census 2017). Narragansett/Point Judith has a high fishing engagement index and a medium fishing reliance index (Colburn & Jepson 2012).

In 2015, Point Judith was the homeport and primary landing port listed by GARFO for 112 and 138 federal fishing permits, respectively (GARFO 2017). Total landings in Point Judith were valued at $46M, 56% of the state-wide total ($82M). Many of Point Judith's vessels are active in fisheries managed by the MAFMC. Inshore longfin squid accounted for $13M (29%) of the 2015 landings in Point Judith, landed by 98 vessels and sold to 17 dealers (Table 87; ACCSP, 2017).

Herring fishery: Since 2007, Point Judith has been the 5th highest port in terms of Atlantic herring landings (average 7.1M/year; 4% of total; Table 73). These landings are attributed to 171 Atlantic herring federal permits (the most of any *Community of Interest*), sold to 29 dealers. In 2015, Point Judith was the homeport listed by GARFO for two Category A, two Category B/C permits, seven Category C, 54 Category D, and eight Category D/E Atlantic herring federal fishing permits. Point Judith was the primary landing port listed for two Category A permits, three Category B/C permits, seven category C permits, 60 Category D permits, and 12 Category

D/E permits (GARFO 2017). Thus, the Atlantic herring vessels that offload in Point Judith may primarily be based in Point Judith.

Shoreside support services based in Point Judith include several dealers, processors, and other infrastructure that supports the herring fishery. Several lobster bait dealers and a pumping station for offloading herring are located in Point Judith. The port also provides many additional fishing-related services including ice, fuel, and vessel maintenance/repair services. Herring is also trucked to Maine for processing. The Atlantic herring fishing engagement and reliance indices are high and medium, respectively, for Point Judith (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: Point Judith is a primary port for the groundfish fishery (

Table 78). Recreational fishing companies based in Point Judith include: L'il Toot Charters (tuna, July – October; cod, April – November) and Captain Sheriff's Fishing Charters (tuna, cod). Point Judith is a key port for the mackerel fishery. At least two whale watch companies are based in Narragansett.

Table 87 - Top five species landed by value in Point Judith, RI 2015

Species	Revenue ($)	Vessels	Dealers
Inshore longfin squid	$13M	98	17
American lobster	$7.0M	109	14
Sea scallop	$5.7M	36	14
Summer flounder	$5.3M	326	20
Scup	$3.6M	254	21
Source: ACCSP, as of August 2017.			

1.6.3.3.4 New York ports

Montauk

General: Montauk is a fishing community in the town of East Hampton in Suffolk County, New York. Montauk has a population of 3,326 as of 2010. In 2011-2015, 2% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Montauk; the poverty rate was 12.6%; and the population was 83% white, non-Hispanic (U.S. Census 2017). Montauk has a medium-high fishing engagement index and a medium-high fishing reliance index (Colburn & Jepson 2012).

In 2015, Montauk was the homeport and primary landing port listed by GARFO for 128 federal fishing permits (GARFO 2017). Total landings in Montauk were valued at over $12M, 24% of the state-wide total ($51M). Many of Montauk's vessels are active in fisheries managed by the MAFMC. Inshore longfin squid accounted for $3.5M of the 2015 landings in Montauk, landed by 50 vessels and sold to 21 dealers (Table 88; ACCSP, 2017).

Herring fishery: Since 2007, Montauk has been the 38th highest port in terms of Atlantic herring landings (average 0.0M/year; >1% of total; Table 73). These landings are attributed to 45 Atlantic herring federal permits, sold to 16 dealers. In 2015, Montauk was the homeport and primary landing port listed by GARFO for one Category A, four Category C, 78 Category D, and four Category D/E Atlantic herring federal fishing permits (GARFO 2017). Thus, the Atlantic herring vessels that offload in Montauk may primarily be based in Montauk. Though landings are minor in Montauk, there are a number of vessels participating in the fishery.

Shoreside support services based in Montauk include several dealers, processors, and other infrastructure that supports the herring fishery. The port also provides additional fishing-related services including ice, fuel, and vessel maintenance/repair services. The Long Island Commercial Fishermen's Association is based in Montauk. Inlet Seafood Restaurant is owned by six commercial fishermen and opened in 2006 as an offshoot of Montauk Inlet Seafood, which claims to be the largest packer/shipper of fresh seafood in New York (www.inletseafood.com). The Atlantic herring fishing engagement and reliance indices are medium-high for Montauk (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: Montauk is a secondary port for the groundfish fishery (

Table 78). Charter fishing companies based in Montauk tend to focus on tuna, striped bass and include Double D Charters and Montauk Fishing Charters. At least two whale watch companies are based in Montauk (Table 69). Montauk is a key port for the tuna fishery.

Table 88 - Top five species landed by value in Montauk, NY 2015

Species	Revenue ($)	Vessels	Dealers
Longfin inshore squid	$3.5M	50	21
Tilefish	$3.2M	7	10
Scup	$2.6M	117	18
Summer flounder	$1.7M	98	23
Silver hake	$1.3M	37	15
Source: ACCSP, as of August 2017.			

Hampton Bays/Shinnecock

General: Hampton Bays and Shinnecock here are considered to be the same community. Shinnecock is the name of the fishing port located in Hampton Bays in Suffolk County, New York, on the barrier island next to Shinnecock Inlet, and does not actually refer to a geopolitical entity. Fishermen use either port name in reporting their catch, but they are considered to be the same physical place.

Hampton Bays has a population of 13,603 as of 2010. In 2011-2015, 0.4% of the civilian employed population aged 16 years and over worked in farming, fishing, and forestry occupations in Hampton Bays; the poverty rate was 6.6%; and the population was 67% white, non-Hispanic (U.S. Census 2017). Hampton Bays/Shinnecock has a medium-high fishing engagement index and a low fishing reliance index (Colburn & Jepson 2012). In 2015, Hampton Bays/Shinnecock was the homeport and primary landing port listed by GARFO for 42 federal fishing permits (GARFO 2017). Total landings in Hampton Bays and Shinnecock were valued at over $4M and over $0.38M, respectively. Collectively, this accounts for 8% of the state-wide total ($51M). Many of Hampton Bays and Shinnecock's vessels are active in fisheries managed by the MAFMC. Inshore longfin squid accounted for $1.9M of the 2015 landings in Hampton Bays and Shinnecock, landed by at least 39 vessels and sold to 13 dealers (Table 89, Table 90; ACCSP, 2017).

Herring fishery: Since 2007, Hampton Bays/Shinnecock has been the 37th highest port in terms of Atlantic herring landings (average 0.0M/year; >1% of total; Table 73). These landings are attributed to 29 Atlantic herring federal permits, sold to 16 dealers. In 2015, Hampton Bays/Shinnecock was the homeport and primary landing port listed by GARFO for 27 and 28

Category D Atlantic herring federal fishing permits, respectively (GARFO 2017). Thus, the Atlantic herring vessels that offload in Hampton Bays/Shinnecock may primarily be based in Hampton Bays/Shinnecock. Though landings are minor in Hampton Bays/Shinnecock, there are a number of vessels participating in the fishery. The Atlantic herring fishing engagement and reliance indices are medium-high and low for Hampton Bays/Shinnecock, respectively (Colburn & Jepson 2012).

Other Fisheries/Ecotourism: Charter fishing companies based in Hampton Bays/Shinnecock tend to focus on cod, porgies, bluefish, tuna, striped bass and include Shinnecock Star and Outlaw Charters.

Table 89 - Top five species landed by value in Hampton Bays, NY 2015

Species	Revenue ($)	Vessels	Dealers
Longfin inshore squid	$1.8M	39	13
Goosefish (monkfish)	$0.73M	29	14
Sea scallop	$0.56M	6	7
Summer flounder	$0.53M	34	18
Scup	$0.17M	37	15
Source: ACCSP, as of August 2017.			

Table 90 - Top five species landed by value in Hampton Bays/Shinnecock, NY 2015

Species	Revenue ($)	Vessels	Dealers
Summer flounder	$0.15M	19	11
Longfin inshore squid	$0.090M	9	7
Scup	$0.051M	13	9
Bluefish	$0.51M	21	10
Goosefish (monkfish)	$0.30M	13	10
Source: ACCSP, as of August 2017.			

2.0BACKGROUND ON LOCALIZED DEPLETION

Localized depletion has been a topic discussed in the herring management arena since at least the mid-2000s, when Amendment 1 to the Atlantic Herring FMP was developed. Through Amendment 1, midwater trawl (MWT) gears were excluded from management Area 1A from June-September. No evidence or data linking midwater trawling to localized depletion, however, was used at the time to support this action. The Council's rationale was to ensure access to herring for the purse-seine and fixed gear components of the fishery and to address concerns raised by the public and the SSC about concentrated catch inshore and need for precaution due, in part, to lack of data on the inshore resource. There was a concern that midwater trawl gear was particularly prone to causing localized depletion (NEFMC 2006).

More details will be added to this section:

Summary of the LD references appendix

Summary of Amendment 1 LD measure

Summary of scoping input – primary concerns expressed

Example themes from scoping comments

1. If ABC CR cannot address temporal concerns other measures should be considered. Desire to have enough herring when and where predators need herring.
2. Complication surrounding "depletion" of a resource that migrates.
3. Declines of other prey species (i.e. mackerel and menhaden), increases the importance of herring as forage.
4. MWT too efficient.
5. Can sub-ACLs be divided up differently to address LD concerns – do current sub-ACLs do enough now?

Some tuna specific input:

Bluefin tuna fishermen and other stakeholders have testified that midwater trawl herring fisheries are causing localized depletion of the herring resource, resulting in both ecological harm as well as economic impacts to their fishery. These stakeholders claim that these vessels cover such a large amount of area and catch such an immense amount of fish that tuna are forced to leave the area to find available prey. The tuna fishermen are then left with nothing to fish for, and must also move in search of a new area with abundant tuna. This causes a loss in revenue due to reduced catch, and increases fishing time and supply costs (e.g. fuel) associated with finding new and productive fishing grounds.

Connection to user conflicts: Summarize discussion from Cmte meetings, MSA sections and standards that apply to user conflicts. Clarify that the action is NOT considering gear conflicts.

3.0 PDT ANALYSIS OF LOCALIZED DEPLETION

The PDT defines localized depletion as described in the Council's public scoping document for Amendment 8:

> *"In general, localized depletion is when harvesting takes more fish than can be replaced either locally or through fish migrating into the catch area within a given time period."*

The occurrence of localized depletion suggests that the removal of prey from a given area would either leave relatively immobile predators (e.g., monkfish) with insufficient prey for some time, or that relatively mobile predators (e.g., cod, tuna) would leave the area in search of alternative prey.

To the degree that temporal and spatial fishery catch data is available, it is relatively simple to describe where and when fishing has occurred for predator fisheries. As described below, this may not be so straight forward for tuna fisheries and perhaps striped bass fisheries. It is challenging to identify if and how other fisheries have been impacted by herring catches. There are many constraints that determine where and when a fishery is prosecuted (e.g., area closures, weather windows, mobility of fish) that need to be understood in an investigation of whether there is causality to any correlations.

In Amendment 1 and more recently, much attention has been given to midwater trawls as the gear responsible for causing localized depletion. The method of removal, however, should not be relevant to the evaluation of localized depletion. If predators are responding only to herring abundance in an area, then given the same amount of catch, the same level of depletion occurs regardless of gear type and would subsequently have the same effect on predators. That said, as a relatively large and mobile gear, midwater trawls likely have different effects on predators than other gears commonly used to harvest similar amounts of herring (e.g., purse seines). Both gear types can be used to fish in a concentrated fashion. Issues of gear conflict should be kept distinct from issues of localized depletion. Are herring predators responding to depletion of herring (which should not depend on the gear used to remove herring), or are the predators responding to a trawl gear passing through an area (and would respond the same way regardless of herring depletion)? The former is localized depletion while the latter is not. These issues are also not mutually exclusive. Conducting field research would help determine if correlations indicate causality and avoid speculation.

Include a summary of the PDT tasking memos on LD (2 memos prepared and included as A8 Appendix). Briefly review what was explored.

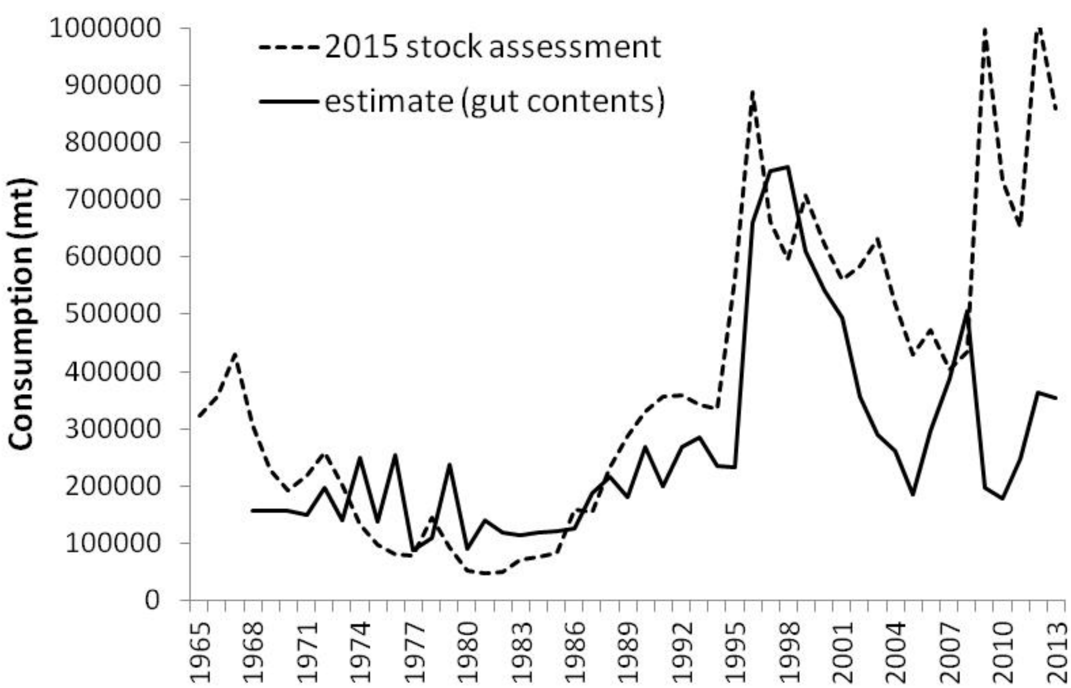
3.1 HERRING AS FORAGE

In the Atlantic herring stock assessment, the amount of herring assumed to be ***taken*** by predators (e.g., piscivorous fish, seabirds, highly migratory species, marine mammals) has varied annually (Figure 6, dashed line). The 2015 stock assessment assumed that, during 2009-2013, an annual average of 852,000 mt of Atlantic herring was eaten by predators, which equaled 44% of average total biomass (1.92 million mt) over the same period. The amount of herring assumed to be consumed by predators in the assessment is based on natural mortality rates and estimates of herring consumption largely based on gut contents data, which also vary annually (Figure 6, solid line), with an annual average of 268,000 mt during that time. The gut contents data are from NMFS surveys, and are highly imprecise and likely biased. The short-term projections used to provide catch advice (overfishing limit, acceptable biological catch) assume a similar amount of herring are consumed as assumed in the stock assessment. More information is available in the 2015 Atlantic Herring Operational Assessment report (Deroba 2015).

The Ecosystem-Based Fishery Management PDT report on scientific advice for accounting for ecosystem forage requirements (NEFMC 2015) and assessment reports (e.g., Deroba 2015) may be referenced for sample estimates of predator consumption. In recent years, marine mammal consumption of herring is similar to commercial fishery landings, averaging 105,000 mt/year. Bluefin tuna and blue sharks have recently consumed 20-25,000 mt/year. Seabirds consume a relatively small amount of herring, conservatively estimated at about 3-5 mt/year. According to the NEFSC diet database, herring constitutes roughly 20% of the diet of cod and spiny dogfish. There is also some evidence which suggest it is not just volume of herring available, but the age structure of that forage base that is important in the energy budgets of predators (Diamond & Devlin 2003; Golet et al. 2015).

During development of this action, the Herring Committee asked the PDT to estimate forage needs of herring in the ecosystem. The PDT assumes that the amount of Atlantic herring ***needed*** for forage is the amount below which predators are negatively impacted. Estimates of this need do not currently exist and would vary by the abundance of predators and other prey. To summarize, consumption estimates can be generated, but that is different than what is necessary – which is a difficult question to answer definitively.

Figure 28 - Atlantic herring consumption by predators



Source: Deroba (2015).

3.2 FOOTPRINT ON HERRING AND PREDATOR FISHERIES

The Greater Atlantic Regional Fisheries Office (GARFO) has created an online "story map" describing current management areas for the scallop fishery, and a similar interactive map product has been developed for the Atlantic herring fishery, particularly in support of Amendment 8. The interactive map of the Atlantic herring fishery is available at: http://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=5d3a684fe2844eedb6beacf1169ca854

Herring fishery locations are mapped using the method that combines Vessel Trip Report and observer data developed by DePiper (2014). Many caveats are needed to understand the maps. For example, fishery locations and intensity should not be confused as measures of abundance (or depletion) given the numerous regulations constraining a fishery (e.g., catch limits, time/area closures).

Many reference layers are available including herring management areas, spawning areas, depth, cat cap areas to name a few. The fishery data includes annual summaries for both herring and mackerel landings, as well as several key predators that forage on herring and are subject to VTR reporting requirements (cod, dogfish, and pollock). Several examples have been provided below, but this website is live and stakeholders are encouraged to view these maps to see how these fisheries have overlapped over time (Figure 29).

During development of this action, the PDT has also overlayed herring fishing effort by gear type with the range of alternatives considered for years before Amendment 1, as well as more recent years Figure 30 and Figure 31.

Figure 29 – Example of annual landings web app developed by GARFO to support development of Amendment 8 (Mackerel landings from 2006 (left) and mackerel landings from 2014 (right)

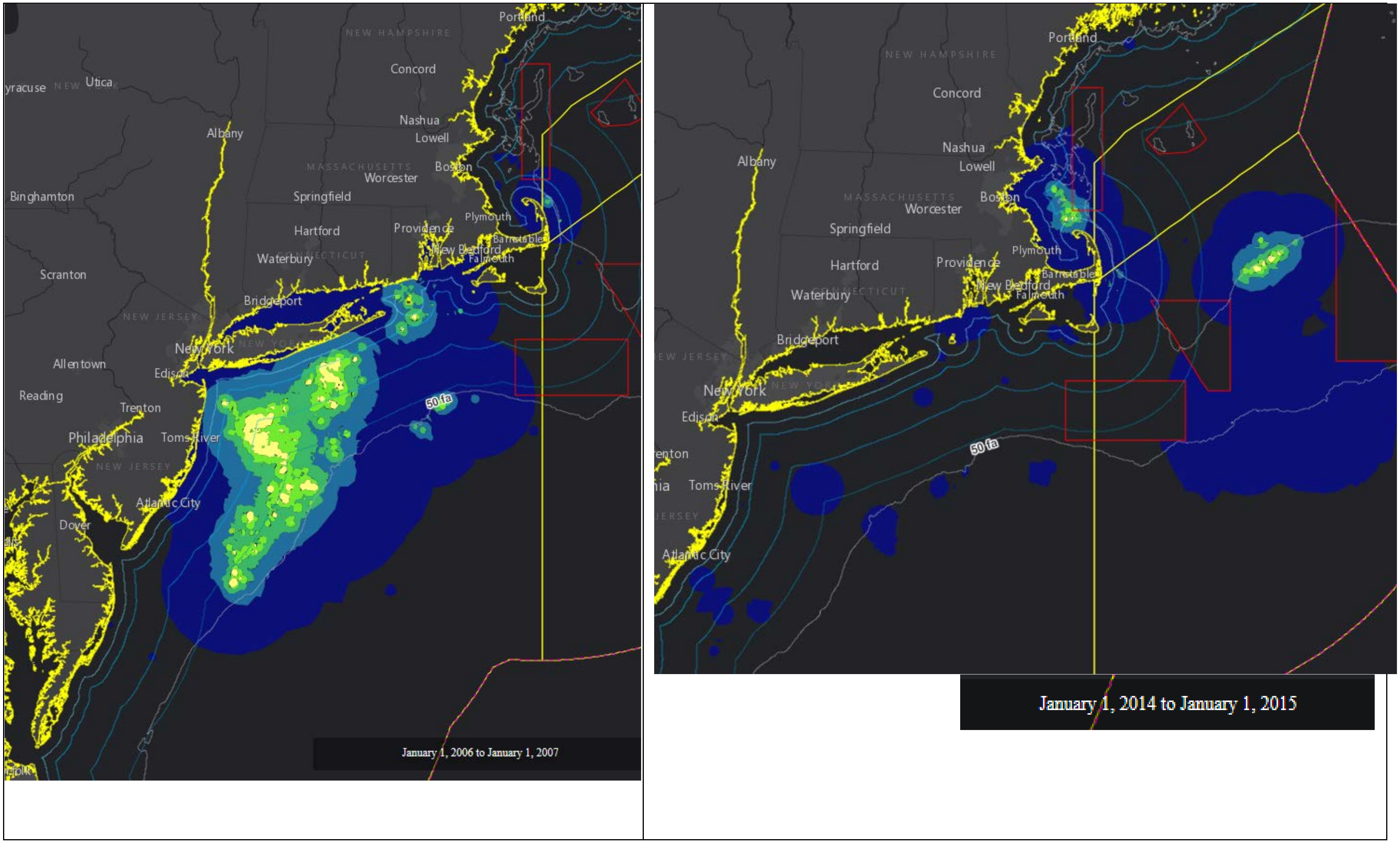


Figure 30 – Herring catch for all gear types combined (left) and MWT only (right) for 2001-2005 (Pre-A1)

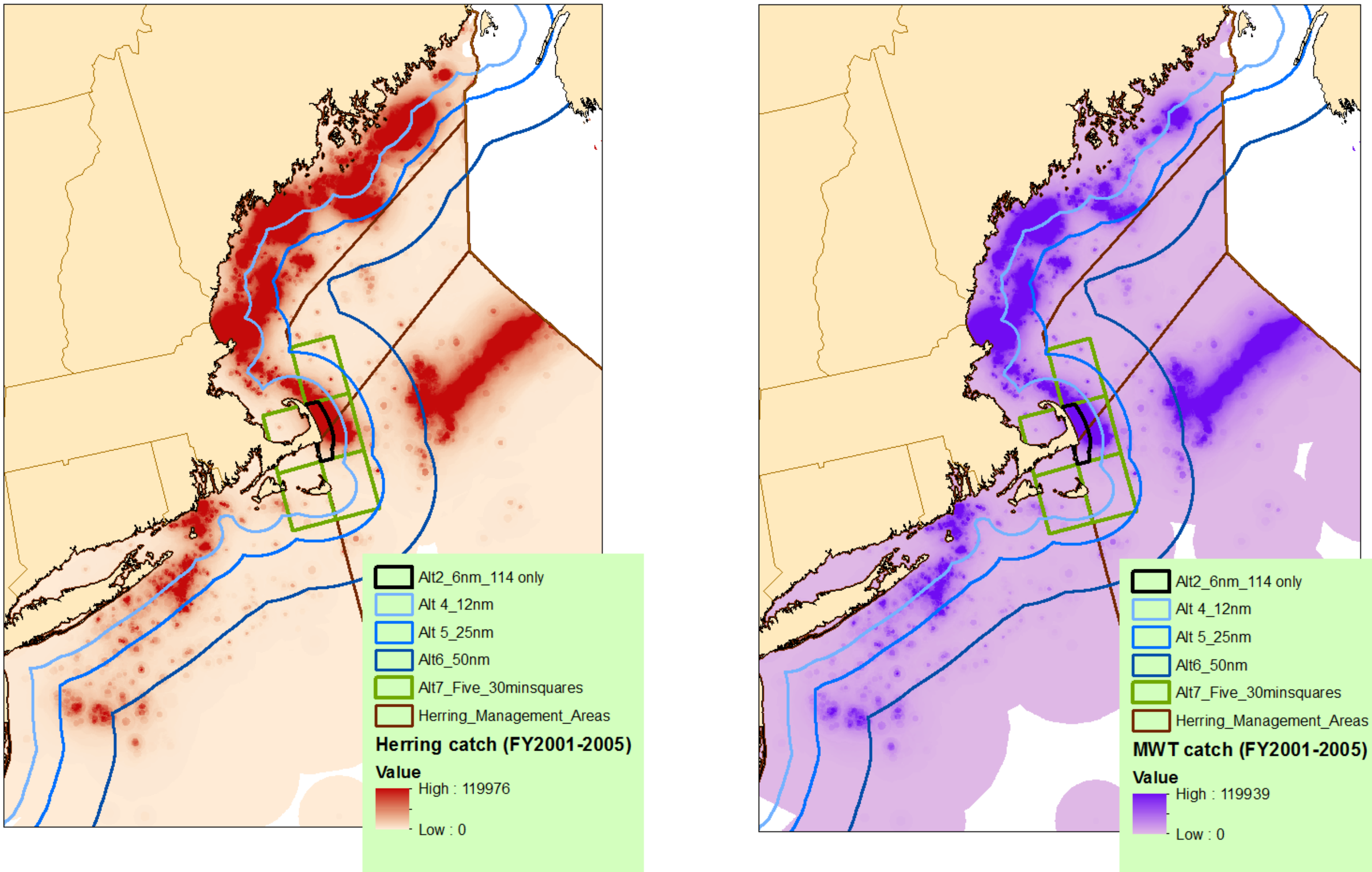
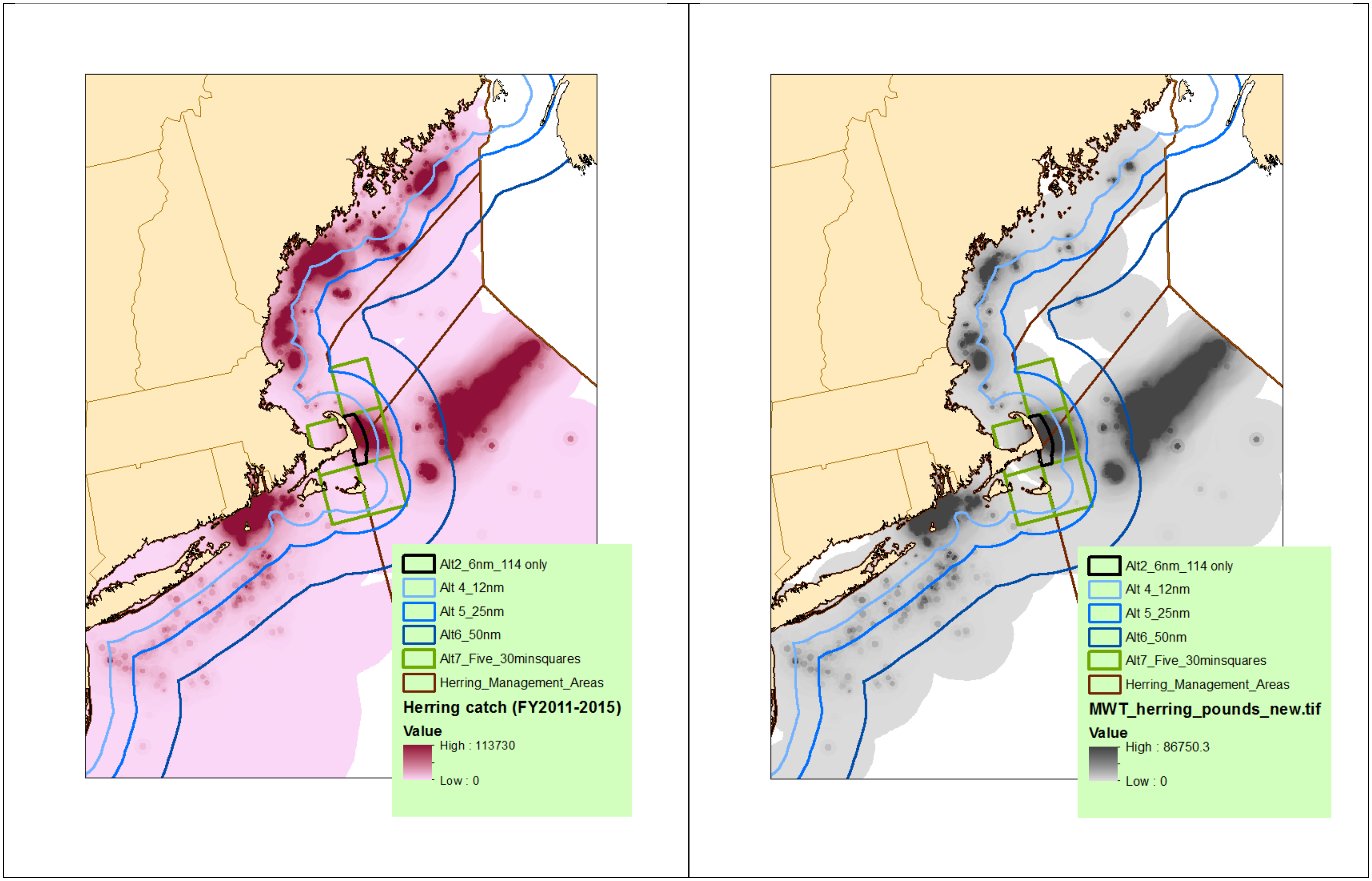


Figure 31 – Herring catch for all gear types combined (left) and MWT only (right) for 2011-2015



3.3 CORRELATION BETWEEN CATCHES OF HERRING AND PREDATOR FISHERIES

The Herring PDT completed a preliminary analysis attempting to inform the discussion on localized depletion of herring for components of the groundfish fishery in early 2016. The analysis was intended to test if predator fisheries move after herring MWT fishing occurs, is there a tendency for predators to vacate an area in search of better foraging grounds after herring MWT fishing activity. In this analysis, herring catch was compared to the reported catch per trip of Atlantic cod, pollock, and spiny dogfish in both the week following herring catch and two weeks following herring catch (similar spatial catch data do not exist for other important predator fiheries such as tuna and striped bass). The data was taken from statistical areas contained in each of Herring Management Areas 1A, 2, and 3 (Stat Areas 511, 512, 513, 514, 522, 537, 539, and 613) between 1996 and 2014. The analysis did not find any evidence of localized depletion. However, the finding of this analysis comes with many caveats, including that the data is only applicable to spatial and temporal resolution of the analyses and to the predators included.

In addition, localized depletion was examined on the scale of statistical area and week. So, if conditions within a statistical area were unchanged after one or two weeks, then no evidence of localized depletion would be found. This analysis also focused on three predators and combined them for analysis, but different predators may respond differently to the removal of herring. Conducting analysis by individual predator or groups of predators thought to react similarly to herring removals should likely be considered in the future. Likewise, varying the temporal and spatial scale of analysis by predator might also be considered, and other predators of interest could be examined. This analysis also used VTR data, which is self-reported and may contain errors (e.g., incorrect spatial assignments). Other data sources might be considered in the future. This method assumes that catch per tow is an index of predator abundance.

Finally, data from all times of year were combined in this analysis, but perhaps analysis by season may have had different results. Herring migrate during certain times of year, so localized depletion is unlikely to occur during these times because the herring will be in a different location in the near future regardless of catches. Analysis of a time of year when herring are likely to be confined in a single region might be more appropriate (summer feeding grounds or fall spawning). However, having included data from all times of year in this analysis would only increase the chances of finding a negative correlation, which may support the occurrence of localized depletion. In summary, these analyses did not find evidence of localized depletion from the data available and how the data were summarized. In addition to this analysis, the PDT also evaluated the potential impacts on predators and predator fisheries in terms of potential user conflicts, and how fisheries overlap (Section 5.6 in impacts on human communities section).

3.4 POTENTIAL EFFORT SHIFTS

The types and degree of effort shifts that could be expected vary for the alternatives under consideration. For example, Alternative 2 is a seasonal closure that would impact all herring gear types in a relatively small area 6 miles off the backside of Cape Cod. Therefore, potential effort shifts from that alternative are less than other alternatives and would likely be to shift displaced effort to areas just beyond that closure, or to times of year just before or after the closure. On the other hand, all of the other alternatives are MWT gear only prohibitions. Therefore, vessels could decide to switch gear types if they do not want to be displaced by the LD measure. The likelihood of a vessel converting gear type depends on the alternative selected, as well as the individual vessels. Some vessels currently switch gears now to maintain access in Area 1A during the current MWT prohibition from June 1 through September 30. While other MWT vessels have no intention of changing gear types. However, if a LD measure is adopted that prohibits MWT fishing in a large area or for a long period of time, the incentives to switch gear may change. It is very expensive to invest in new gear, and time consuming to convert a vessel from one gear to another.

AP input needed

The Herring PDT has developed the list of questions below, and through the Committee Chair, requests the Herring AP discuss and provide input on each at this meeting. How fishing effort is expected to shift as a result of these measures influences the potential impacts of the measures.

1. If MWT vessels are prohibited in an area, how will their fishing behavior most likely change? Is it more likely that vessels will shift seasonally and fish in the same area, or is it more likely that vessels will shift effort to a new area? How will this change in fishing behavior vary for the different seasonal and spatial alternatives?
2. How many MWT vessels currently switch gear types during the year, less than five? Is it only MWT to purse seine and vice versa? How many more vessels could reasonably covert? What is the initial cost of rigging a MWT vessel with a purse seine? After the initial cost, what is the cost to switch gears back and forth? Any input on potential costs between switching from MWT and bottom trawl?
3. Is there a threshold that would change the current incentives to switch gear types? Is it more likely that MWT vessels would convert to purse seine or bottom trawl if faced with LD measures with large potential impacts? Rather than switch gear type, is there a threshold that a MWT vessel would likely stop fishing, or potentially consider re-location?
4. How likely is it for a MWT vessel to become a carrier vessel under the various alternatives under consideration? When a MWT vessel acts as a carrier for the PS fishery, how is the carrier vessel paid, by the PS vessel or the dealer, is it a flat fee per day/trip or a fraction of total revenues from the trip?
5. How has the purse seine fishery changed since Amendment 1 was implemented? How has capacity changed for those vessels (have vessels been upgraded, has use of carriers changed)? Why is the PS fleet primarily located in Area 1A and active primarily in the summer and early fall only? Are there operational barriers to fishing purse seines in the winter or other areas (e.g. weather, sea conditions, water depth), or is it primarily driven by regulations and demand for bait?
6. If MWT vessels are prohibited from an area (seasonally or year round), how will other herring vessels that use purse seines or bottom trawl gear respond? Is it likely for other gears to enter from other areas, or will the same number of vessels remain in the area as in previous years? Would effort increase, decrease, or stay the same?
7. Alternative 9 is considering a removal of the current January-April seasonal closure of Area 1B. How is effort likely to shift if that area is open during those months? Would opening the area earlier impact the market? If so, how?
8. What drives bait preference in the lobster fishery and why?
   For example, is it primarily a lobster's preference for certain species, whichever bait type is cheapest, fresh vs. frozen, salted vs unsalted, geography/port region, fishing location (inshore vs offshore, mud vs hard bottom)? Does the market prefer fresh herring year-round?

4.0SUMMARY OF ALTERNATIVES TO ADDRESS POTENTIAL LOCALIZED DEPLETION AND USER CONFLICTS

Table 91 – Summary of alternatives to address potential localized depletion and user conflict under consideration in Amendment 8

Alternative	Description	Section #	Page # in DEIS
1	**No Action**	**2.2.1**	**43**
2	**Closure within 6nm from shore in Area 114 to ALL vessels fishing for herring**	**2.2.2**	**45**
	Seasonal Sub-option A (Jun1-Aug31)	2.2.2.1.1	47
	Seasonal Sub-option B (Jun1-Oct31)	2.2.2.1.2	47
3	**Prohibit MWT in Area 1A (year round)**	**2.2.3**	**48**
4	**Prohibit MWT inside of 12nm south of Area 1A**	**2.2.4**	**50**
	Area Sub-option A (Areas 1B, 2 and 3)	2.2.4.1.1	51
	Area Sub-option B (Areas 1B and 3)	2.2.4.1.2	51
	Seasonal Sub-option A (year round)	2.2.4.2.1	52
	Seasonal Sub-option B (Jun1-Sept30)	2.2.4.2.2	52
5	**Prohibit MWT inside of 25nm south of Area 1A**	**2.2.5**	**52**
	Area Sub-option A (Areas 1B, 2 and 3)	2.2.5.1.1	53
	Area Sub-option B (Areas 1B and 3)	2.2.5.1.2	54
	Seasonal Sub-option A (year round)	2.2.5.2.1	54
	Seasonal Sub-option B (Jun1-Sept30)	2.2.5.2.2	54
6	**Prohibit MWT inside of 50nm south of Area 1A**	**2.2.6**	**55**
	Area Sub-option A (Areas 1B, 2 and 3)	2.2.6.1.1	56
	Area Sub-option B (Areas 1B and 3)	2.2.6.1.2	56
	Seasonal Sub-option A (year round)	2.2.6.2.1	56
	Seasonal Sub-option B (Jun1-Sept30)	2.2.6.2.2	56
7	**Prohibit MWT within 30minute squares off Cape Cod (99, 100, 114, 115, and 123)**	**2.2.7**	**58**
	Area Sub-option A (All squares in Areas 1B, 2, and 3)	2.2.6.1.1	60
	Area Sub-option B (All squares in Areas 1B and 3)	2.2.6.1.2	60
	Seasonal Sub-option A (year round)	2.2.6.2.1	60
	Seasonal Sub-option B (Jun1-Sept30)	2.2.6.2.2	60
8	**Revert boundary between Areas 1B and 3 to original boundary**	**2.2.8**	**61**
9	**Remove seasonal closure of Area 1B**	**2.2.9**	**62**

5.0DRAFT IMPACTS OF MEASURES TO ADDRESS POTENTIAL LOCALIZED DEPLETION AND USER CONFLICTS

5.1 BIOLOGICAL IMPACTS ON THE HERRING RESOURCE

5.1.1 Alternative 1 (No Action: prohibit MWT gear in Area 1A from June – September)

Amendment 1 implemented a handful of measures that have likely had beneficial impacts on the herring resource over the years. Furthermore, ASMFC has also implemented simultaneous actions in recent years that have likely contributed to overall positive impacts on the herring resource, especially in Area 1A. In this case for Amendment 8, the No Action alternative is limited to the one measure that was implemented to address potential concerns of localized depletion, a prohibition of MWT gear in Area 1A from June 1 through September 30. However, it is very difficult to tease out the potential benefits of one measure independently, when in reality it is more likely that the combination of many measures implemented simultaneously have collectively had positive benefits overall.

Since Amendment 1 was implemented in 2007 the herring resource has increased and based on the last assessment is in healthy condition and is far from an overfished status (Section 1.1.5). Amendment 1 implemented a handful of measures that have likely helped with improved resource conditions. The Herring PDT discussed that the measure that has likely had the greatest direct positive impacts on the herring resource in Area 1A is the output control, or the overall ACL. Before Amendment 1 was implemented, the Area 1A sub-ACL (now sub-ACL) was 60,000 mt, and since then it has hovered near 30,000 mt, a 50% reduction in a relatively short amount of time (Table ???). In addition, the number of participants has decreased substantially since pre-Amendment 1.

In general, protecting spawning fish is thought to have positive impacts on fishery resources overall, or at a minimum neutral impacts, but certainly not negative impacts. Herring typically spawn in late summer through the fall (see Section 1.1.4). The No Action alternative does overlap with a portion of the spawning season within the GOM (September); however, peak spawning often occurs in October and even into November. There are separate spawning closures within the GOM that are implemented by ASMFC that are triggered when observations of female herring eggs indicate spawning is imminent (See Map 2). These spawning closures are thought to have potentially beneficial impacts on the herring resource because they overlap better with peak spawning time periods, and they prohibit all herring fishing gear types, not just MWT gear; compared to the NO Action alternative that is only June-September and only prohibits one gear type (MWT).

To date, the PDT is not aware of any research available in this region that evaluates direct impacts of fishing activity on spawning Atlantic herring, or whether there are any differential impacts by gear type, (i.e. one gear type having more negative impacts than another). Therefore, in terms of impacts on spawning fish, the No Action alternative was not primarily designed to reduce potential impacts on spawning fish, and is not expected to have direct positive or negative impacts on spawning fish.

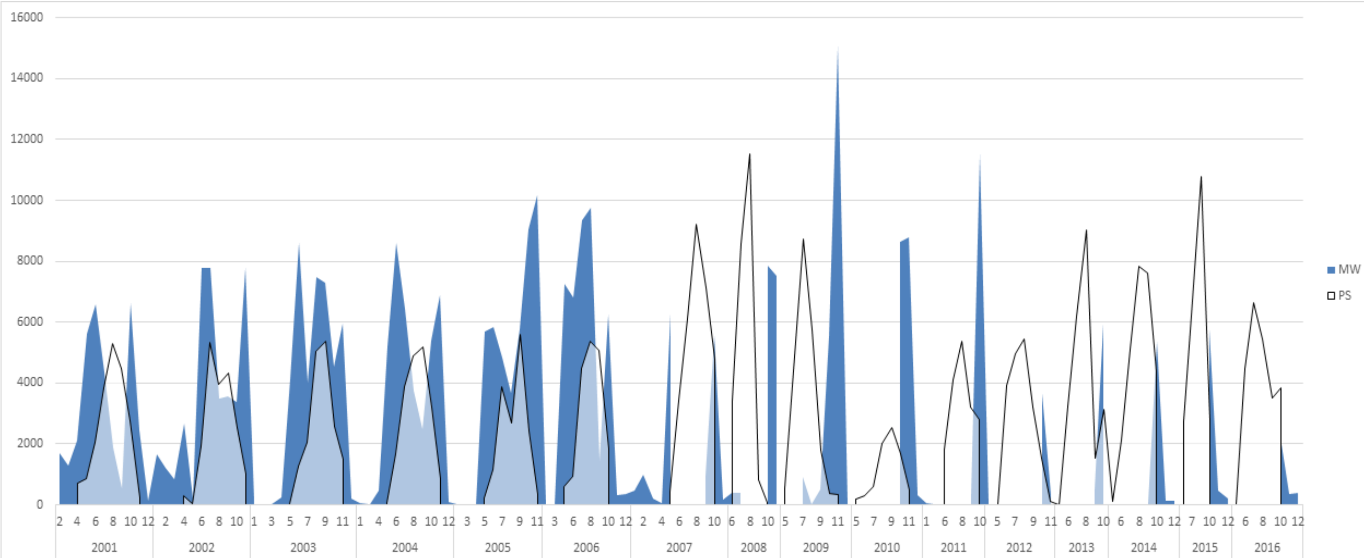
Section 6.5 of Amendment 1 reviewed the Council rationale at that time for supporting the No Action alternative that prohibited MWT gear in Area 1A from June 1 – September 30. Overall, it was a precautionary approach to restrict a high-volume fishery that targets an important prey species in the ecosystem. Addressing potential localized depletion concerns was not the only element considered; the Council also referenced concerns about the health of the inshore GOM stock, impacts of MWT gear on the resource and ecosystem, importance of herring as forage, and potential research opportunities. In summary, Amendment 1 stated that the long-term benefits to the herring resource and GOM ecosystem far outweighed the short-term costs to the industry, particularly MWT vessels, which are better able to fish father offshore and travel to other grounds in a safe manner.

The No Action alternative has been in place for about ten years. While herring resource conditions have improved over that time, those benefits cannot be directly linked back to this measure. Reducing ACLs has likely had the most direct positive benefits on the herring resource. Furthermore, the herring resource is still assessed on a stockwide basis, and to date the status of the herring resource is not evaluated based on smaller sub-components (e.g. GOM, GB). Thus, it is not possible to evaluate the impacts of a localized closure when the resource is assessed on a stockwide level.

Furthermore, while MWT vessels are not allowed in the area from June – September, the purse seine fleet is, and similar levels of herring are still being removed, just from another gear type. Similar to impacts on spawning fish, there is no research available that evaluates whether there are differential impacts on the herring resource based on gear type. There are no studies available in this area that have compared the biological impacts of fishing for Atlantic herring with different gear types when overall removals are similar. The PDT has discussed that vessel capacity is really the limiting factor; a smaller purse seine vessel that works with a carrier, or in some cases two carriers, can have similar capacity to a much larger MWT vessel.

In general, herring fishing methods are efficient, regardless of gear type, and are capable of removing large amounts of fish in a relatively short amount of time (reference LPUE tables in AE section???) When thinking about depletion it is important to consider the overall rate of removals from a particular area. Since Amendment 1, the fishery in Area 1A has become more truncated. Before Amendment 1 herring catches were spread out over a longer period of time, and now most catch from Area 1A takes place June through November (Figure 32). Many management measures and changing conditions have contributed to this trend including the fact that Area 1A is now closed to all fishing January – May, and MWT gear is prohibited in June – Sept (the No Action alternative for Amendment 8). While ASMFC has implemented several effort control measures designed to slow removals and extend the fishing season, in many cases herring removals in some months are greater now than before. This increase in the rate of removals over shorter time periods is further compounded by ASMFC spawning closures that further limit when vessels can fish.

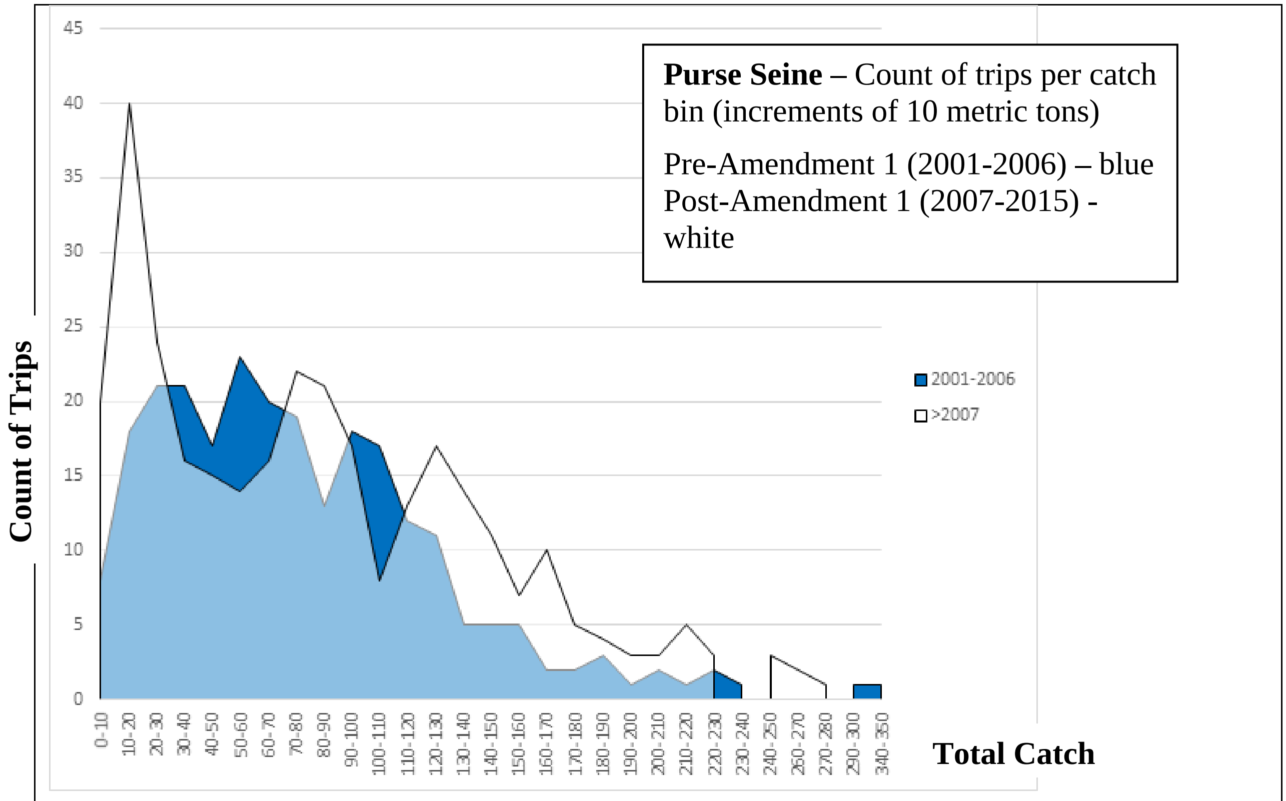
Figure 32 – Area 1A herring landings by month and gear type (MW and PS) for 2001-2016 (VTR data including all federal and ME state permitted vessels)

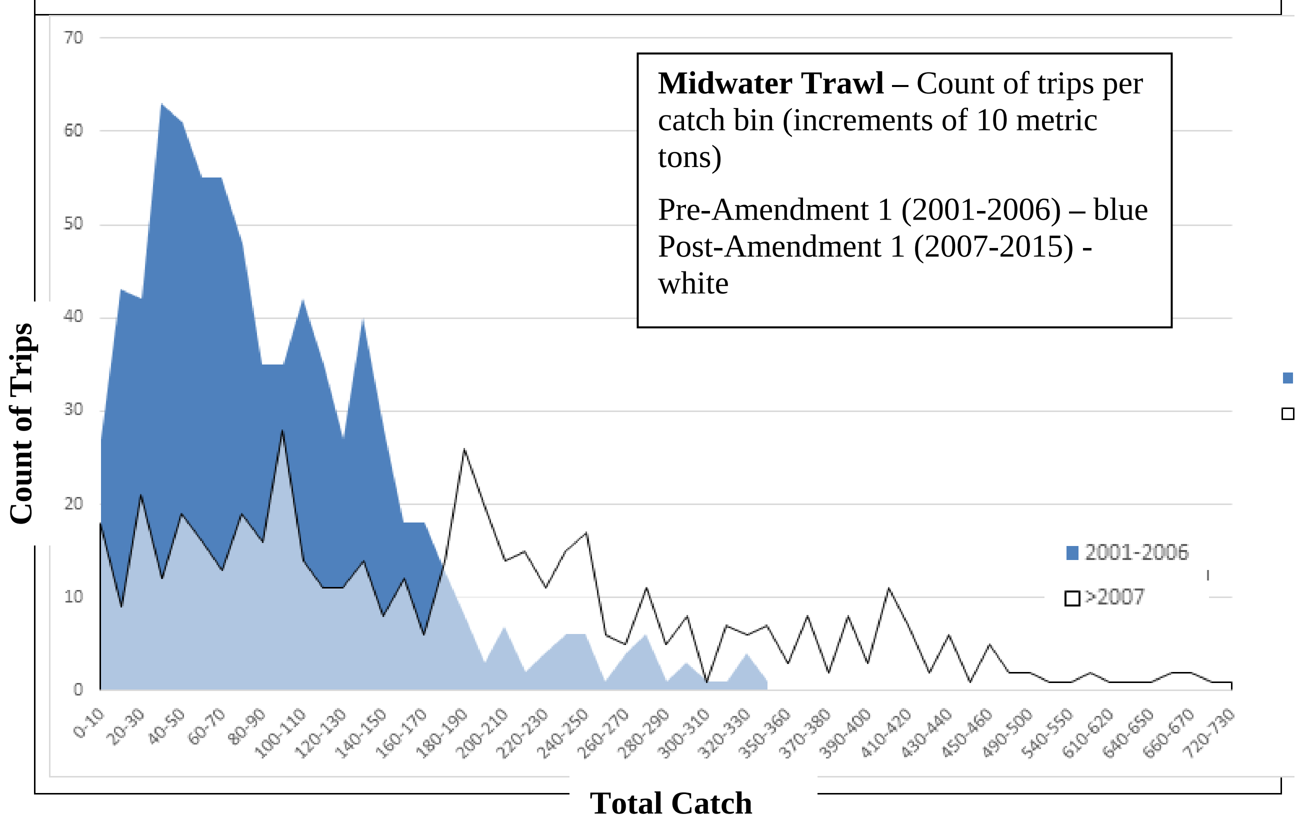


On average, larger catches now occur for both gear types in more recent years compared to pre-Amendment 1 (Figure 33). Prior to Amendment 1, there were more MWT trips in Area 1A and the majority were less than 200,000 pounds per trip. Post Amendment 1, there are fewer MWT trips overall and more of the trips are larger, 300-700,000 pounds. This is not surprising when you consider all the different measures in place that constrain when MWT vessels can access Area 1A. The total potential season is now three months, October through December, and when spawning closures are implemented as well as days out measures, the number of potential fishing days is greatly reduced.

At the same time, the number of PS trips have increased and the total catches per trip have increased as well, but still not has high as some of the MWT catch amounts per trip. The No Action alternative (Amendment 1) alone has not caused these shifts in fishing effort. The combination of many measures, as well as changes in storage capabilities and ability to freeze product have collectively played a part in these changes in fishing effort trends through time.

Figure 33 – Number of trips by landings category (in 10mt bins) and gear type (MW on bottom and PS on top) pre Amendment 1 (2001-2006) compared to post Amendment 1 (2007-2015) in Area 1A for Trimester 3 (October-December)





Both before and after Amendment 1 prohibited MWT gear from June – Sept, approximately 70% of the Area 1A sub-ACL is caught before the end of Trimester 2. However, the gear type landing these fish has changed from mixed gear types to all purse seine. Overall, in isolation the No Action alternative has had neutral impacts on the herring resource; the resource is still experiencing similar levels of herring removals during this season, just by a different gear type.

Finally, when this measure was adopted in Amendment 1 it was discussed that implementing a seasonal prohibition on MWT fishing would create an opportunity to evaluate the potential localized depletion impacts of that activity. One study was funded through the RSA program in 2008, but due to logistical and budget constraints, efforts were re-focused and the project was limited in scope and that aspect of the project was not completed. Therefore, there have not been any direct research focused on defining and evaluating localized depletion in Area 1A since adoption of this measure.

In summary, it is not possible to determine whether the No Action alternative for Amendment 8 has had direct beneficial impacts in isolation of all the other measures that have been adopted. ***Because total removals of herring are controlled by a sub-ACL for the area, the direct impacts of the No Action alternative are likely neutral; the same amount of herring is being removed from the area, regardless of the gear type landing the fish.***

5.1.2 Alternative 2 (Closure within 6nm in Area 114 to all vessels fishing for herring)

This alternative is not expected to have positive or negative impacts on the herring resource. Because this area is relatively small, and does not overlap a primary herring fishing area, it is not expected to have major impacts, and would likely not prevent the fishery from harvesting the full ACL. Whether the fish are caught in this area or just outside of this area, there is an overall ACL, so there is a limit on harvest, which controls any direct impacts on the herring resource. ***Therefore, the overall impacts of Alternative 2 on the herring resource are expected to be neutral.*** Furthermore, this area is primarily a migratory corridor for Atlantic herring. Therefore, this seasonal area closure alternative would not have any potential benefits related to protection of spawning fish. Table 97 summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative.

5.1.2.1 Seasonal sub-options (A: June – August or B: June – October)

Neither of these seasonal sub-options are expected to have direct impacts on the herring resource. The alternative overall is expected to have neutral impacts regardless of the seasonal sub-option of three months (Option A) or five months (Option B). While the longer seasonal sub-option extends through October, a time of year when herring typically spawn, this is not an area that is important for spawning herring. ***Therefore, the impacts on the herring resource are neutral from both seasonal sub-options under consideration.***

5.1.3 Alternative 3 (Prohibit MWT gear in Area 1A year-round)

As described under the No Action alternative, the most direct impact on the herring resource in Area 1A is the SUB-ACL for the area, which is broken out by trimester: 0% for January-May, about 70% for June – September, and about 30% for October - December. If this measure is adopted, it would effectively eliminate access to Area 1A for MWT gear in Area 1A for the entire year, since other measures already prohibit access the remaining months (Jan-Sept). Any fishing in Area 1A by MWT vessels is already constrained to these three months (October-December), unless the vessel is fishing under the RSA program.

If MWT gear is prohibited from the area year-round, the Area 1A sub-ACL is still expected to be harvested. There would still be sufficient capacity among the vessels that fish with purse seine gear to harvest the full sub-ACL. If the full sub-ACL was not harvested it is possible there could be low positive impacts on the resource if more herring remains in the ecosystem, but in this case the Area 1A sub-ACL would still likely be harvested by existing vessels using purse seine gear, and potentially some vessels with MWT gear would convert to purse seine gear in order to access Area 1A. ***Therefore, this measure is expected to have neutral direct impacts on the herring resource because it is not expected to prevent the full ACL from being harvested; the same amount of herring would likely be removed from the area, just with a different gear type, which is not expected to have differential impacts on the herring resource.*** Table 102 summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative.

It should be noted, there are other measures in place under ASMFC that would control weekly removals of herring catch (e.g. days out, weekly catch limits, and possession limits). These effort control measures could and do extend into the late fall and winter if necessary.

5.1.4 Alternative 4 (Prohibit MWT gear inside 12 nm south of Area 1A)

As described under the No Action alternative, the measure in the herring plan that has the most direct impact on the herring resource is the sub-ACL by management area. That measure ultimately dictates and controls how much herring is allowed to be removed from an area. Therefore, alternatives that prohibit one gear type, but allow another gear type that likely have similar biological impacts on the herring resource, would not be expected to have differential impacts on the resource that is managed under an overall quota. Because this alternative includes portions of several herring management areas (Areas 1B, 2 and 3), it could have different impacts on the ability to harvest one sub-ACL depending on the degree of overlap within each management area.

For Area 1B, this alternative could make it difficult to catch the sub-ACL for that area. The Area 1B sub-ACL is relatively small, about 4,000 mt in recent years, and it is typically caught within the 30 minute square 114 off the back side of the cape in relatively nearshore waters by MWT gear only. If this alternative was adopted and MWT vessels could no longer fish within 12 miles, it would become more difficult for the fishery to harvest the Area 1B sub-ACL. This could have low positive impacts on the herring resource if the sub-ACL is not harvested and more fish are left in the water. MWT vessels may shift fishing efforts just outside of 12 nm within Area 1B and still harvest the sub-ACL, but most fishing in Area 1B is currently inside of 12 nm. Overall, Area 1B is a small fraction of the total ACL; therefore, any low positive impacts from unutilized Area 1B catch, would likely have minimal impacts on the resource overall.

As for Area 3, the majority of catch for that management area is outside of 12nm, so the fishery has more ability to harvest the sub-ACL for Area 3. There is a portion of total Area 3 landings that is consistently caught within 12nm that would be impacted, mostly off the back side of the Cape east of Chatham. If adopting this alternative makes it more difficult to harvest the sub-ACL for Area 3, there could be low positive impacts on the herring resource because more fish would be left in the water. However, since the majority of Area 3 fishing takes place farther offshore, this alternative may have more neutral impacts if the fishery can harvest the sub-ACL from waters farther offshore.

Finally, in Area 2 more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the area sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years; therefore, implementing this measure could make it even more difficult. Furthermore, it is uncertain if underutilizing sub-ACLs would have measurable benefits on the overall resource anyway. The herring resource is currently well above biomass thresholds; therefore, relatively small amounts of additional herring may not have any measurable benefits overall.

Finally, any potential low positive impacts from less fish being harvested by the MWT fishery could be neutralized if other allowable gear types increase effort. For example, if bottom trawl activity increased as a result of less MWT effort in an area, then the overall impacts would be neutral – same level of catch controlled by the areas sub-ACL, just landed by a vessel using a different gear type. ***In the end, this measure could make it more difficult for the fishery to harvest area sub-ACLS, which can have low positive impacts on the resource. However, if the fishery is able to change gear type, or catch the same amount of herring in a different area or season, any potential low positive impacts would be neutralized.*** In addition, some of the seasonal and spatial sub-options under consideration for this alternative could reduce some of the potential low positive impacts by maintaining more of the current access MWT vessels have to fish. There is one sub-option to reduce the length of time an area is closed, and another sub-option to reduce the overall footprint of the potential restriction. More details about the potential impacts of the sub-options are described below. Table 105summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative. For more recent years (2007-2015), the average percent of MWT catch within this alternative for all areas and all year is about 20%, and including the sub-options to exclude Area 2 and limit the season to June-September brings the average percent of MWT catch to about 4%.

5.1.4.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

This action is considering two sub-options for spatial boundaries for this alternative: Option A that includes Area 1B, 2 and 3; and Option B that includes Areas 1B and 3 only. The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACL s) to neutral (fishery able to harvest the ACL despite the LD measure). When the spatial sup-option to remove Area 2 is added, any low positive impacts are potentially more neutralized. Because a large portion of MWT effort in Area 2 is within 12 nm, restricting this measure to Area 1B and 3 only would have lower potential impacts in terms of preventing the fishery from harvesting the sub-ACL.

5.1.4.2 Seasonal sub-options (A: year-round or B: June-September)

This action is considering two sub-options for seasonal prohibitions of MWT gear: Option A that would prohibit MWT gear year round; and Option B that would prohibit MWT gear in this area June – September (4 months). The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACLs) to neutral (fishery able to harvest sub-ACL despite LD measure). When the seasonal sup-option to limit the prohibition to June-September is added, any low positive impacts are potentially more neutralized, because the fishery is more likely to harvest the sub-ACLs. Furthermore, if both sub-options are adopted, not include Area 2 and limit the prohibition to June – September, the combined impacts likely neutralize any potentially low positive impacts on the resource.

5.1.5 Alternative 5 (Prohibit MWT gear inside 25 nm south of Area 1A)

The potential biological impacts of Alternative 5 are generally similar to the potential impacts described above for Alternative 4, except the likelihood of this measure inhibiting the ability for the fishery to harvest the sub-ACLs for Areas 1B, 3 and 2 may be greater since it covers more area that is traditionally fished by the MWT fishery. A larger fraction of total MWT effort occurs within 25 nm, compared to 12nm. It is possible that vessels could increase fishing effort in waters farther offshore, but it may be more difficult to harvest the sub-ACL. Table 105 summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative. For more recent years (2007-2015), the average percent of MWT catch within this alternative for all areas and all year is about 28%, and including the sub-options to exclude Area 2 and limit the season to June-September brings the average percent of MWT catch to about 5%. In general, this measure would only have low positive impacts on the resource if vessels are not able to harvest the sub-ACL; if vessels are able to harvest the sub-ACL in waters farther offshore this will have neutral impacts on the resource.

As described under Alternative 4, this alternative includes portions of several herring management areas (Areas 1B, 2 and 3), it could have different impacts on the ability to harvest one sub-ACL depending on the degree of overlap within each management area. Essentially all of Area 1B fishing takes place within 25 nm, so this alternative would make it very difficult to harvest that sub-ACL, unless the seasonal sub-option is adopted, or vessels are able to successfully convert to purse seine gear, which is unlikely. The fishery may be able to catch more of the Area 3 sub-ACL relative to other management areas because more of the fishing activity is farther offshore, but a substantial amount is within 25 miles as well. Fishing the full Area 2 sub-ACL would be more difficult if the first 25 nm were closed to MWT gear.

Finally, any potential low positive impacts from less fish being harvested by the MWT fishery could be neutralized if other allowable gear types increase effort. For example, if bottom trawl activity increased as a result of less MWT effort in an area, then the overall impacts would be neutral – same level of catch controlled by the areas sub-ACL, just landed by a vessel using a different gear type. ***In the end, this measure could make it more difficult for the fishery to harvest area sub-ACLS, which can have low positive impacts on the resource. However, if the fishery is able to change gear type, or catch the same amount of herring in a different area or season, any low positive impacts would be neutralized.*** In addition, some of the seasonal and spatial sub-options under consideration for this alternative could reduce some of the potential low positive impacts by maintaining more of the current access MWT vessels have to fish. There is one sub-option to reduce the length of time an area is closed, and another sub-option to reduce the overall footprint of the potential restriction. More details about the potential impacts of the sub-options are described below.

5.1.5.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

This action is considering two sub-options for spatial boundaries for this alternative: Option A that includes Area 1B, 2 and 3; and Option B that includes Areas 1B and 3 only. The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACL s) to neutral (fishery able to harvest sub-ACL despite LD measure). When the spatial sup-option to remove Area 2 is added, any low positive impacts are potentially more neutralized. Because a large portion of MWT effort in Area 2 is within 25 nm, restricting this measure to Area 1B and 3 only would have lower potential impacts in terms of preventing the fishery from harvesting the sub-ACL.

5.1.5.2 Seasonal sub-options (A: year-round or B: June-September)

This action is considering two sub-options for seasonal prohibitions of MWT gear: Option A that would prohibit MWT gear year round; and Option B that would prohibit MWT gear in this area June – September (4 months). The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACL s) to neutral (fishery able to harvest sub-ACL despite LD measure). When the seasonal sup-option to limit the prohibition to June-September is added, any low positive impacts are potentially more neutralized, because the fishery is more likely to harvest the sub-ACLs. Furthermore, if both sub-options are adopted, not include Area 2 and limit the prohibition to June – September, the combined impacts likely neutralize any potentially low positive impacts on the resource.

5.1.6 Alternative 6 (Prohibit MWT gear inside 50 nm south of Area 1A)

The potential biological impacts of Alternative 6 are generally similar to the potential impacts described above for Alternative 4 and 5, except the likelihood of this measure inhibiting the ability for the fishery to harvest the sub-ACLs for Areas 1B, 3 and 2 is greater. A larger fraction of total MWT effort occurs within 50 nm, compared to 12nm and 25nm. Table 105 summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative. For more recent years (2007-2015), the average percent of MWT catch within this alternative for all areas and all year is over 40%, and including the sub-options to exclude Area 2 and limit the season to June-September brings the average percent of MWT catch to about 20%. In general, because this measure overlaps with more area where MWT fishing currently takes place, closing the area to that gear type would make it much more difficult to harvest the sub-ACL, and more likely the sub-ACL would be underutilized, leaving more fish in the water, with potentially low positive impacts on the resource.

As described under Alternative 4, this alternative includes portions of several herring management areas (Areas 1B, 2 and 3), it could have different impacts on the ability to harvest one sub-ACL depending on the degree of overlap within each management area. There is little to no fishable areas for MWT gear outside of 50nm, based on historical fishing locations. Therefore closing this area to MWT gear would make it very difficult to harvest that sub-ACL, unless the seasonal sub-option is adopted, or vessels are able to successfully convert to purse seine gear, which is unlikely. The fishery may be able to catch more of the Area 3 sub-ACL relative to other management areas because more of the fishing activity is farther offshore, but a substantial amount is within 50 miles as well. Fishing the full Area 2 sub-ACL would also be much more difficult if the first 50 nm were closed to MWT gear.

Finally, any potential low positive impacts from less fish being harvested by the MWT fishery could be neutralized if other allowable gear types increase effort. For example, if bottom trawl activity increased as a result of less MWT effort in an area, then the overall impacts would be neutral – same level of catch controlled by the areas sub-ACL, just landed by a vessel using a different gear type. ***In the end, this measure could make it more difficult for the fishery to harvest area sub-ACLS, which can have low positive impacts on the resource. However, if the fishery is able to change gear type, or catch the same amount of herring in a different area or season, any low positive impacts could be neutralized.*** In addition, some of the seasonal and spatial sub-options under consideration for this alternative could reduce some of the potential low positive impacts by maintaining more of the current access MWT vessels have to fish. There is one sub-option to reduce the length of time an area is closed, and another sub-option to reduce the overall footprint of the potential restriction. More details about the potential impacts of the sub-options are described below.

5.1.6.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

This action is considering two sub-options for spatial boundaries for this alternative: Option A that includes Area 1B, 2 and 3; and Option B that includes Areas 1B and 3 only. The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACL s) to neutral (fishery able to harvest sub-ACL despite LD measure). When the spatial sup-option to remove Area 2 is added, any low positive impacts are potentially more neutralized. Because a large portion of MWT effort in Area 2 is within 50 nm, restricting this measure to Area 1B and 3 only would have lower potential impacts in terms of preventing the fishery from harvesting the sub-ACL.

5.1.6.2 Seasonal sub-options (A: year-round or B: June-September)

This action is considering two sub-options for seasonal prohibitions of MWT gear: Option A that would prohibit MWT gear year round; and Option B that would prohibit MWT gear in this area June – September (4 months). The potential impacts of this alternative overall are low positive (if more difficult to harvest sub-ACL s) to neutral (fishery able to harvest sub-ACL despite LD measure). When the seasonal sup-option to limit the prohibition to June-September is added, any low positive impacts are potentially more neutralized, but for this alternative a larger fraction of MWT catch is harvested during the summer, so it may be more difficult for the fishery to harvest the sub-ACLs. If both sub-options are adopted, not include Area 2 and limit the prohibition to June – September, the combined impacts may neutralize any potentially low positive impacts on the resource, but it may be difficult to make up all the herring catch within 50nm of shore during the summer from Areas 3 and 1B.

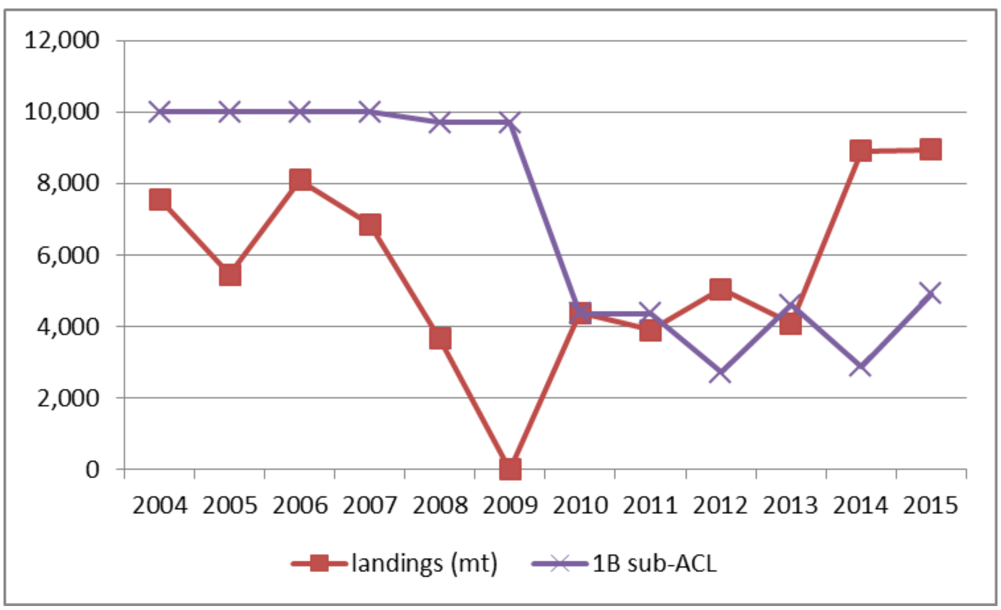
5.1.7 Alternative 7 (Prohibit MWT gear in thirty minute squares off Cape Cod)

This alternative is not expected to have positive or negative impacts on the herring resource overall. This alternative includes essentially the entire area MWT fishing currently effort takes place in Area 1B; therefore, if adopted it would be very difficult for the fishery to harvest the sub-ACL for that area, unless a seasonal component was also adopted, or vessels switched gear type. Even if the entire Area 1B quota was underutilized, any potential low positive impacts on the herring resource from more fish being left in the water is somewhat uncertain. The herring resource is currently well above biomass thresholds; therefore, relatively small amounts of additional herring potentially underutilized from Area 1B may not have any measurable benefits on the herring resource overall. In addition, the Area 1B quota is a relatively minor component of the overall fishery, representing less than 5% of the overall ACL.

Several herring management areas are included in this region, fishing within this region can either be part of Area 1B, Area 3 and Area 2. By far the area that has the most herring fishing activity is Area 114 west of Chatham, which is split between Area 1B and 3. Before Amendment 1 changed the boundaries, Area 114 was completely within Area 1B. Overall all sub-ACLs have declined in recent years, so the Area 1B sub-ACL has gone from 10,000mt to about 5,000 mt. Over the last ten years total removals form Area 114 declined at first, but are now higher than they were pre-Amendment 1 (Figure 34). Since part of Area 114 is in Herring Management Area 3, catch from that portion of the 30 minute square is under the Area 3 sub-ACL, which is much larger.

While catches from this area are similar to pre-Amendment 1 levels, or slightly higher even, there are still neutral impacts on the herring resource overall. Whether the fish are caught in this area or just outside of this area, there is an overall sub-ACL for both Area 1B and Area 3, so there is a limit on harvest, which controls any direct impacts on the herring resource. ***Therefore, the overall direct impacts of Alternative 7 on the herring resource are expected to be neutral.*** Furthermore, this area is primarily a migratory corridor for Atlantic herring. Therefore, this seasonal area closure alternative would not have any potential benefits related to protection of spawning fish. Table 120 summarizes the potential herring revenues impacted by this alternative, which gives a sense of the fraction of landings that could be impacted during the time and area proposed by this alternative.

Figure 34 – Herring landings from 30 minute square 114 off the backside of Cape Cod (red) compared to Area 1B sub-ACL (purple)

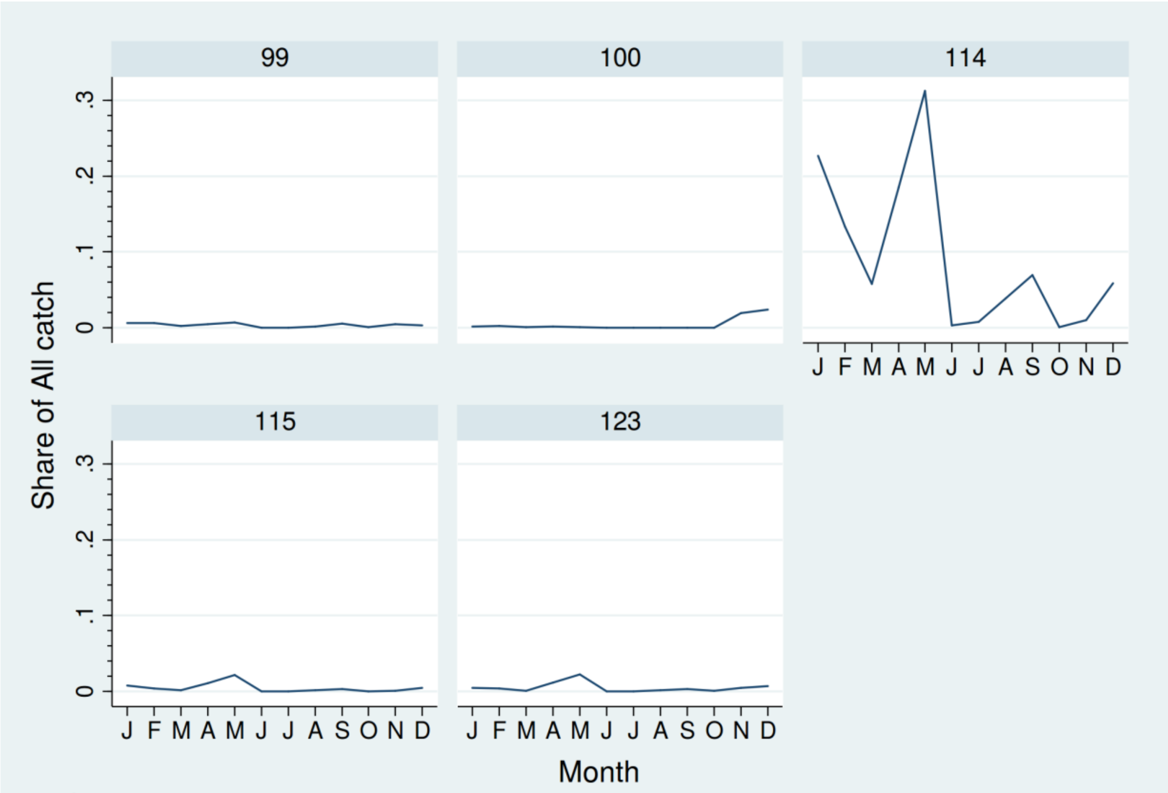


Note: Area 114 is split between herring management areas 1B and 3. Therefore, landings above the sub-ACL for Area 1B do not necessarily mean the fishery exceeded the sub-ACL, a portion of those landings are from the western half of Area 114, which is part of Area 3.

5.1.7.1 Area sub-options (A: five 30-minute squares in Areas 1B, 2 and 3 or three 30-minute squares in Areas 1B and 3 only)

This action is considering two sub-options for spatial boundaries for this alternative: Option A that includes Area 1B, 2 and 3; and Option B that includes Areas 1B and 3 only. The potential impacts of this alternative overall are neutral, and there are no essentially no differences between the area sub-options in terms of potential impacts on the herring resource. Very little herring fishing effort currently takes place within the 30-minute squares that are within Area 2 (areas 100 and 115); ***therefore, there are essentially no differences between these area sub-options in terms of potential impacts on the herring resource, which are neutral overall*** (Figure 35).

Figure 35 – Herring landings (2010-2015) by thirty minute square, share of all catch from within Alternative 7



5.1.7.2 Seasonal sub-options (A: year-round or B: June-September)

This action is considering two sub-options for seasonal prohibitions of MWT gear: Option A that would prohibit MWT gear year round; and Option B that would prohibit MWT gear in this area June – September (4 months). The potential impacts of this alternative overall are expected to be neutral. Adding the seasonal sup-option to limit the prohibition to June-September could help enable the fishery better utilize the sub-ACL; however, the majority of herring fishing takes place in this area during other months, mostly in May when the area now reopens after the January-April closure of Area 1B. Therefore, under current fishing patterns, adding the seasonal sub-option would not have any measurable differences in terms of potential impacts on the resource, compared to closing the area year-round.

5.1.8 Alternative 8 (Revert boundary between Area 1B and 3 back to original boundary)

The change in the management boundaries under Amendment 1 were intended, in part, to better reflect the distribution of the spawning components of the stock. Therefore, if the boundaries change back there may be increased risk of fishing one spawning component harder than another, which could have low negative impacts on that segment of the overall resource. This is supported by hydroacoustic sampling of the offshore component of the resource that was done before Amendment 1 was implemented (Figure 36, Figure 37).

Overall, neutral impacts are expected on the herring resource stockwide. If sub-ACL s remain the same as they are now despite the boundary shifting then there could be positive impacts on the nearshore herring resource if the boundary is pushed farther offshore and the Area 1B sub-ACL remains at the current level. But if the Area 1B sub-ACL increases as a result of a boundary change, then impacts may be more neutral since similar fishery removals would be expected overall from the same general area. A future specifications document would set the specific sub-ACL s per area, not Amendment 8. Regardless, whether the sub-ACL for Area 1B increases as a result of this boundary shift, or if it remains at current levels, the likelihood of this change having direct measurable impacts on the resource overall are minimal. However, if future sub-ACL s are set too high for Area 1B and fishing pressure is higher on one sub-component there could be low negative impacts on the resource. But again, there is currently not sufficient information available for this region that has documented the direct impacts of fishing activity on spawning Atlantic herring.

5.1.9 Alternative 9 (Remove seasonal closure of Area 1B from January – April)

In general, when herring are in this area there is a mixture of inshore and offshore fish moving. If the existing seasonal closure was removed and vessels could fish that area earlier in the year it is possible effort would shift. There are fish in that area in the winter and fishing used to take place in Area 1B during those months. However, managers implemented the existing closure primarily to prevent the Area 1B sub-ACL from being harvested too quickly at the start of the fishing year. This measure was not put in place for biological reasons, it was primarily an allocation issue, and having the quota available later in the year does provide more time to determine if there were any overages or underages from the previous year before the final sub-ACL is known.

Whether the area is open or closed during these months, there would still be a sub-ACL for the area that would control direct impacts on the herring resource; therefore, generally neutral impacts are expected from this alternative. This is not an important area for spawning.

Figure 36 Results of 2000 NMFS Hydroacoustic Survey Superimposed on Current Management Area Boundaries and Proposed Revisions to Area 3

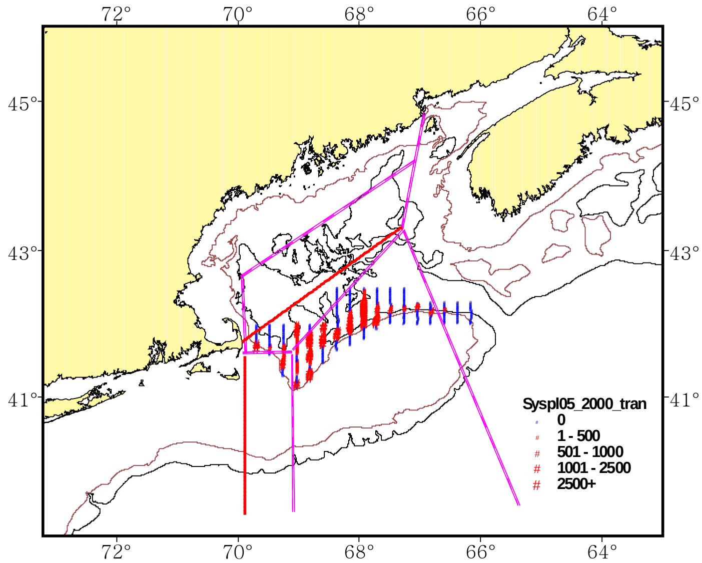
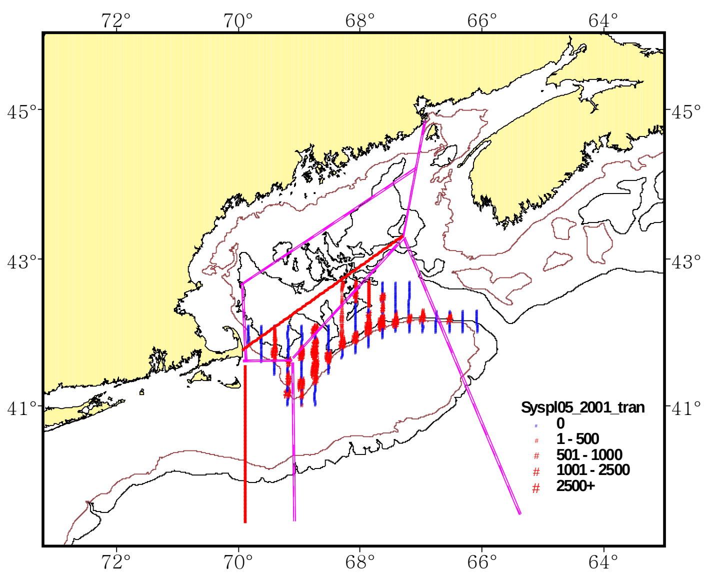


Figure 37 Results of 2001 NMFS Hydroacoustic Survey Superimposed on Current Management Area Boundaries and Proposed Revisions to Area 3



5.2 BIOLOGICAL IMPACTS ON NON-TARGET SPECIES (BYCATCH)

The primary non-target species in the directed Atlantic herring fishery are **groundfish (particularly haddock)** and the **river herring/shad (RH/S) species**.

The primary analyses prepared by the PDT to assess the potential impacts of these measures on bycatch is an estimate of bycatch rates within an alternative, compared to other areas outside an alternative based on at-sea observer data for fishing years 2010-2016. For example, for the alternatives that would prohibit MWT gear in a certain area, are the bycatch rates within that area higher or lower than other areas or seasons that effort may shift into. Would there potentially be any "savings" in terms of bycatch if effort shifts from an area with higher bycatch rates to an area with lower bycatch rates. This analysis has been done for the primary bycatch species in this fishery as well as several other bycatch species that are relative to Amendment 8. The list of species included in these analyses are: river herring/shad, haddock, spiny dogfish, individual animal log (IAL) species (sharks, tunas, swordfish, and rays) and birds.

The PDT has also developed bycatch maps that overlay observed bycatch events with the range of alternatives under consideration. The maps summarize hauls with catch of relevant bycatch species for observed trips where the target species (1 or 2) was Atlantic herring, as well as identify locations with very low amounts of bycatch of that species (Figure 38 - Figure 43).

In most cases, there are too many unknowns in terms of future bycatch rates and how the herring fishery will respond to these measures to draw conclusions about potential direct impacts on bycatch. If the fleet responds one way the impacts on bycatch may be "x", but if the fleet responds another way, the impacts could be "y". Furthermore, there could be positive impacts on one bycatch species, but effort shifts could lead to increased negative impacts on a different bycatch species.

While these analyses include some measure of potential relative effects of shifting effort from one area to another, they need to be considered with great caution in terms of the actual impacts on bycatch. For alternatives that encompass all or most of the areas known to have higher bycatch, then there could be potential benefits. But many of the alternatives close only a portion of the area known to have higher bycatch interactions, and depending on where that effort shifts, the impacts could be neutralized, or even negative if effort shits to an area/season with higher bycatch rates. In very general terms, any measures that have the potential to shift effort into Area 2 in the winter could have negative impacts on river herring, and any measures that likely shift effort to GB in the fall, could have negative impacts on GB haddock. Overall, if measures reduce flexibility for the fleet, and close areas that include more efficient fishing, or fishing with lower bycatch, it is possible that an unintended consequence in general could be increased bycatch if vessels have to fish in areas that have higher bycatch rates, if more desirable areas with lower bycatch rates are closed.

The PDT also notes that the herring fishery does not currently target herring in all areas where herring exist, so there is some uncertainty in what impacts there would be on bycatch if effort shifts to an area that is not currently fished. Furthermore, the herring MWT fishery is under two hard sub-ACLs for bycatch of haddock and river herring. Thus current fishing behavior is already influenced by bycatch caps; therefore, maps based on previous fishing locations may already be more concentrated in areas that do not overlap with highest bycatch levels since the fishery already has incentives to avoid bycatch to remain under the existing bycatch caps. Ultimately, the existing caps control the impact of this fishery on bycatch, so there is a limit on the impact of the herring fishery on bycatch species that have sub-ACLs.

The measures under consideration in Amendment 8 were not specifically designed to minimize bycatch or address bycatch concerns directly. Some alternatives may have potentially positive or negative impacts on bycatch species, but the intent of these measures is to address potential localized depletion and user conflicts, not to directly address bycatch concerns. The Magnuson Act does require that all management measures minimize the potential impacts on bycatch, to the extent practicable. However, the main driver behind development of these measures was to address potential concerns of localized depletion and user conflicts, not to reduce bycatch.

Example tables of bycatch rates within and outside of alternatives under consideration

Below is an example of the analyses that are being completed. There was not sufficient time to complete tables like this for all the alternatives and sub-options under consideration for this meeting. The PDT is actively working on these tables and they will be available before the DEIS is submitted for public hearings. The PDT also plans to convert these bycatch data from pounds to rates.

Alternative 7 (2010-16)
Year Round, MWT

Species group	Inside proposed area weight (lbs) or count*	Outside proposed area weight (lbs) or count*
River herring/shad	124,257.5	294,085.8
Haddock	15,164.9	1,106,703.3
Spiny Dogfish	152,325.9	265,992.2
IAL species (count)	19	256
Birds (count)	17	147

*Count of individuals for IAL species and birds, weight (lbs) for all other groups

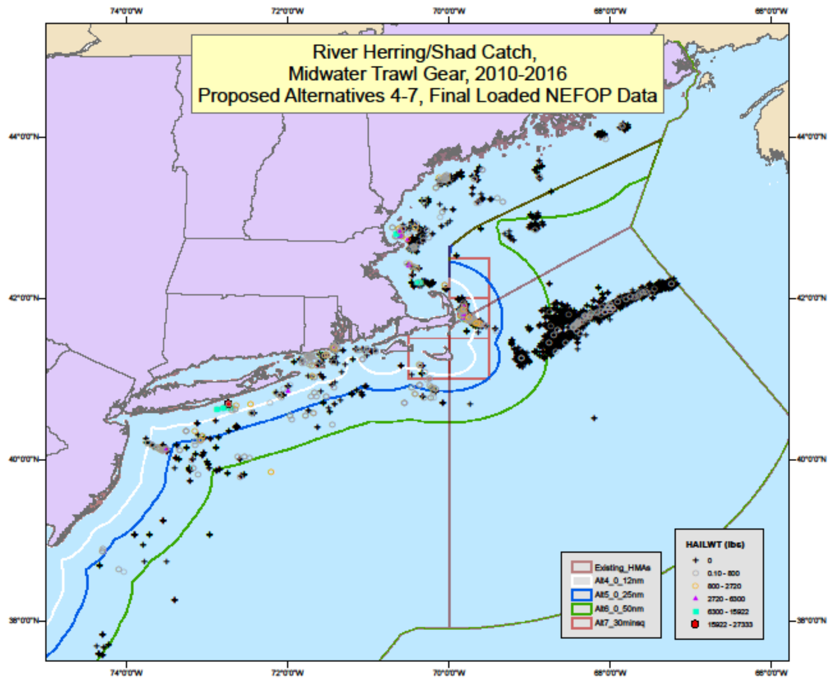
Alt. 7 (2010-16)
June-September, MWT

Species group	Inside area weight/count*	Outside area weight/count*
River herring/shad	4,204.8	3,641.5
Haddock	13,030.3	837,943.4
Spiny Dogfish	151,942.4	131,887.8
IAL species (count)**	-	173
Birds (count)	0	139

*Count of individuals for IAL species and birds, weight (lbs) for all other groups
**Too few records to display IAL data inside the area proposed under Alternative 7, does not meet confidentiality standards.

Bycatch Maps for Amendment 8 Alternatives

Figure 38 – Observed hauls of river herring/shad bycatch in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. Year round data on TOP and zoomed in on BOTTOM.



Note the scales are different for annual vs. seasonal bycatch

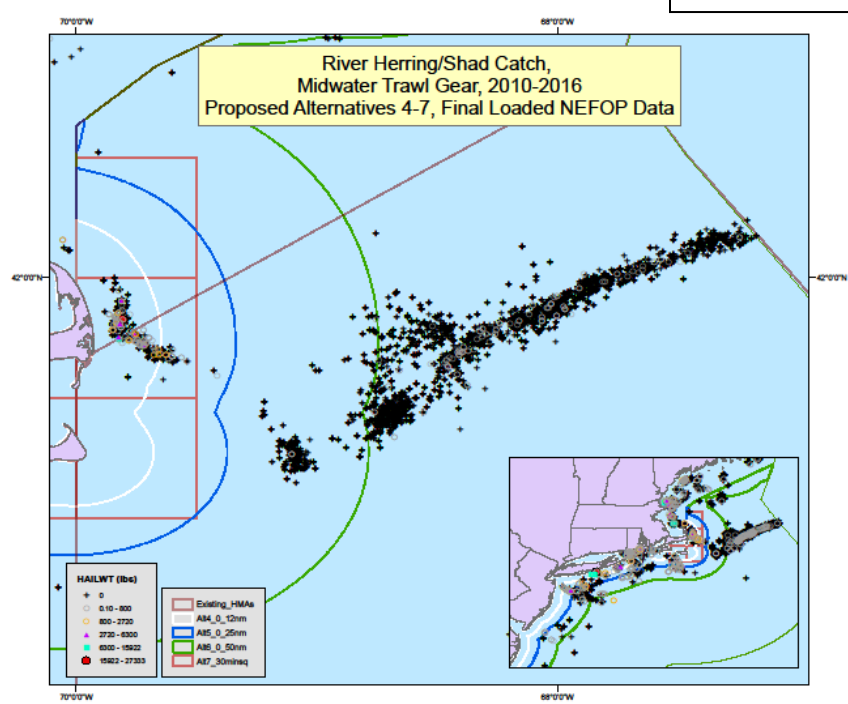
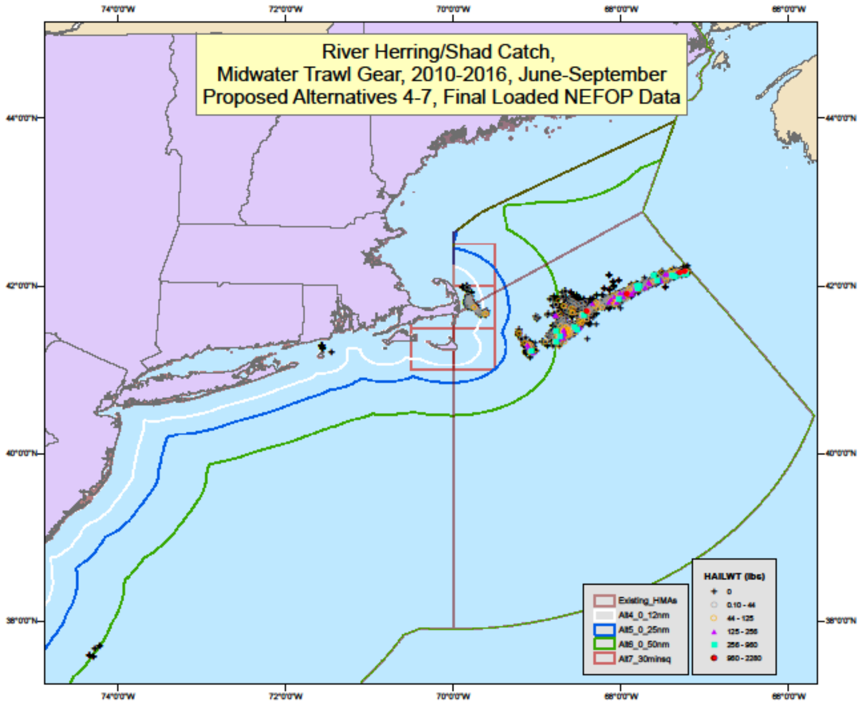
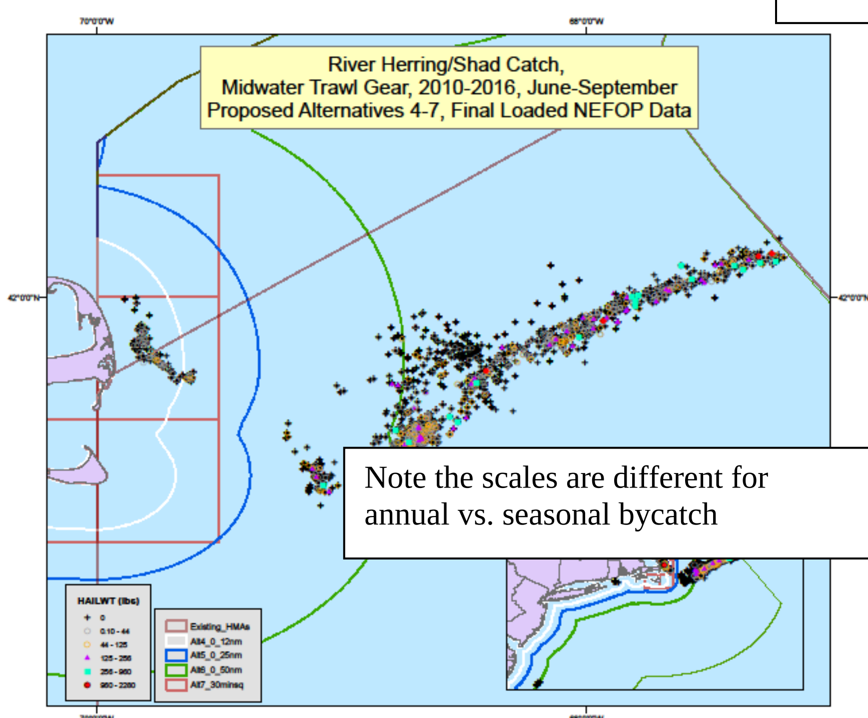


Figure 39 – Observed hauls of river herring/shad bycatch in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. June – September only on TOP and zoomed in for the same season on BOTTOM.

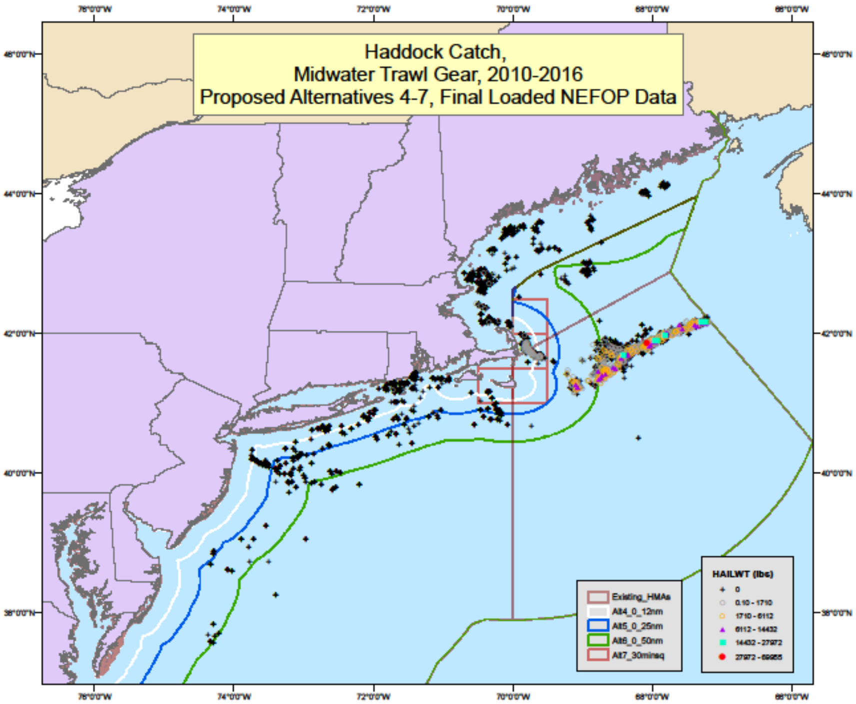


Note the scales are different for annual vs. seasonal bycatch



Note the scales are different for annual vs. seasonal bycatch

Figure 40 – Observed hauls of haddock bycatch in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. Year round data on TOP and zoomed in on BOTTOM.



Note the scales are different for annual vs. seasonal bycatch

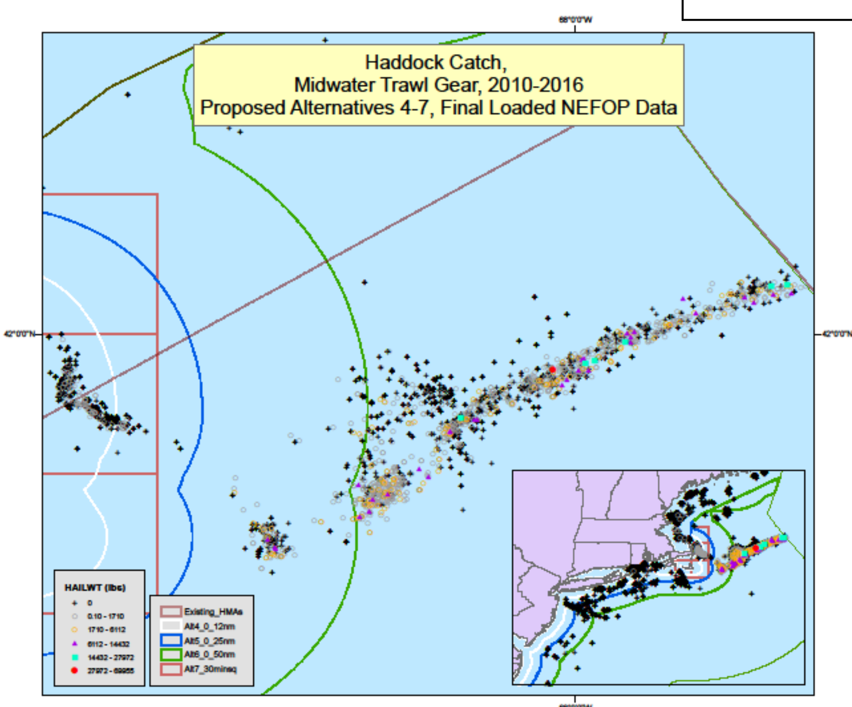


Figure 41 – Observed hauls of haddock bycatch in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. June – September only on TOP and zoomed in for the same season on BOTTOM.

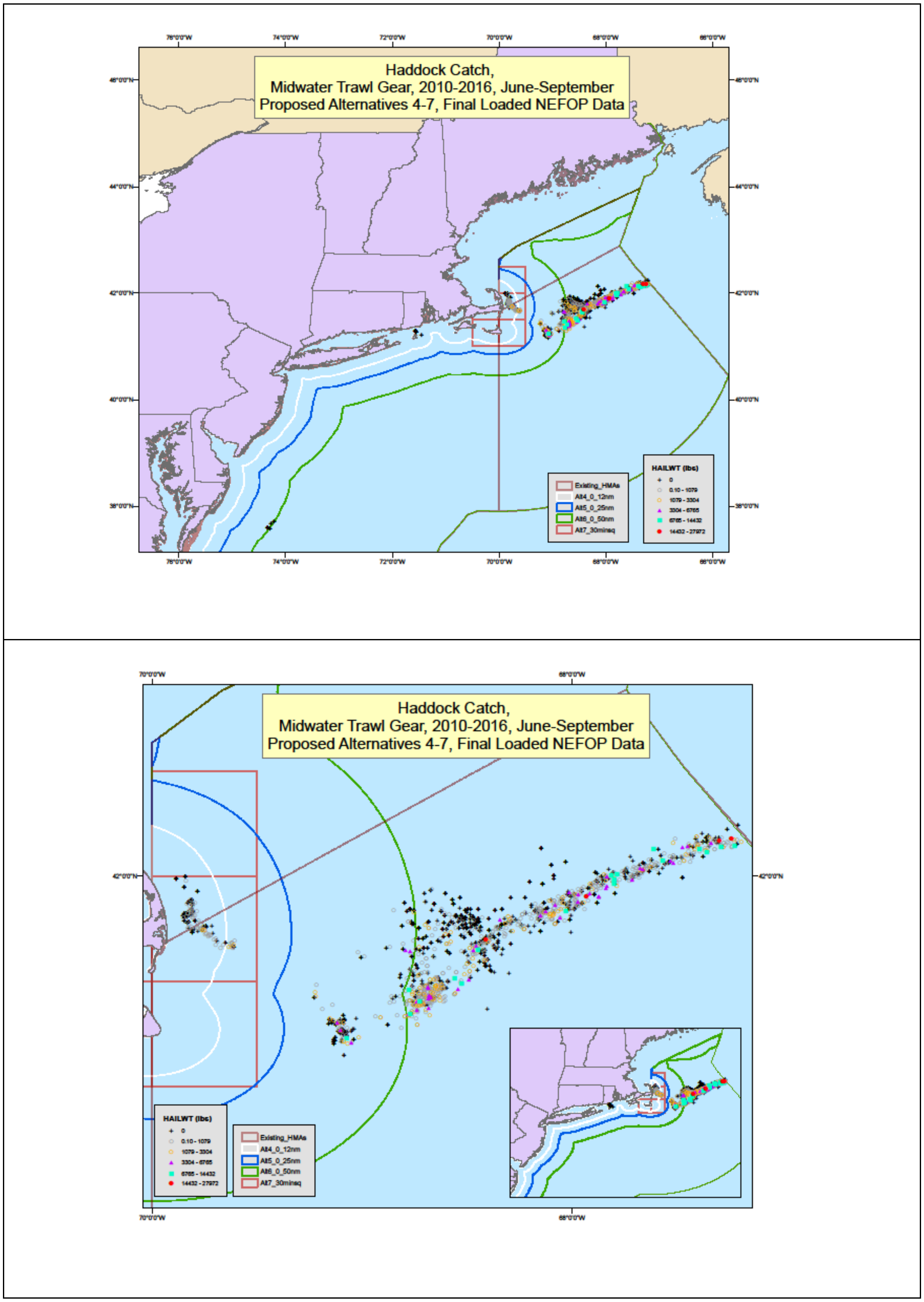


Figure 42 – Observed hauls of shark, tuna, and ray bycatch from the individual animal log (IAL) in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. Year round data on LEFT and seasonal data for June-Sept on RIGHT.

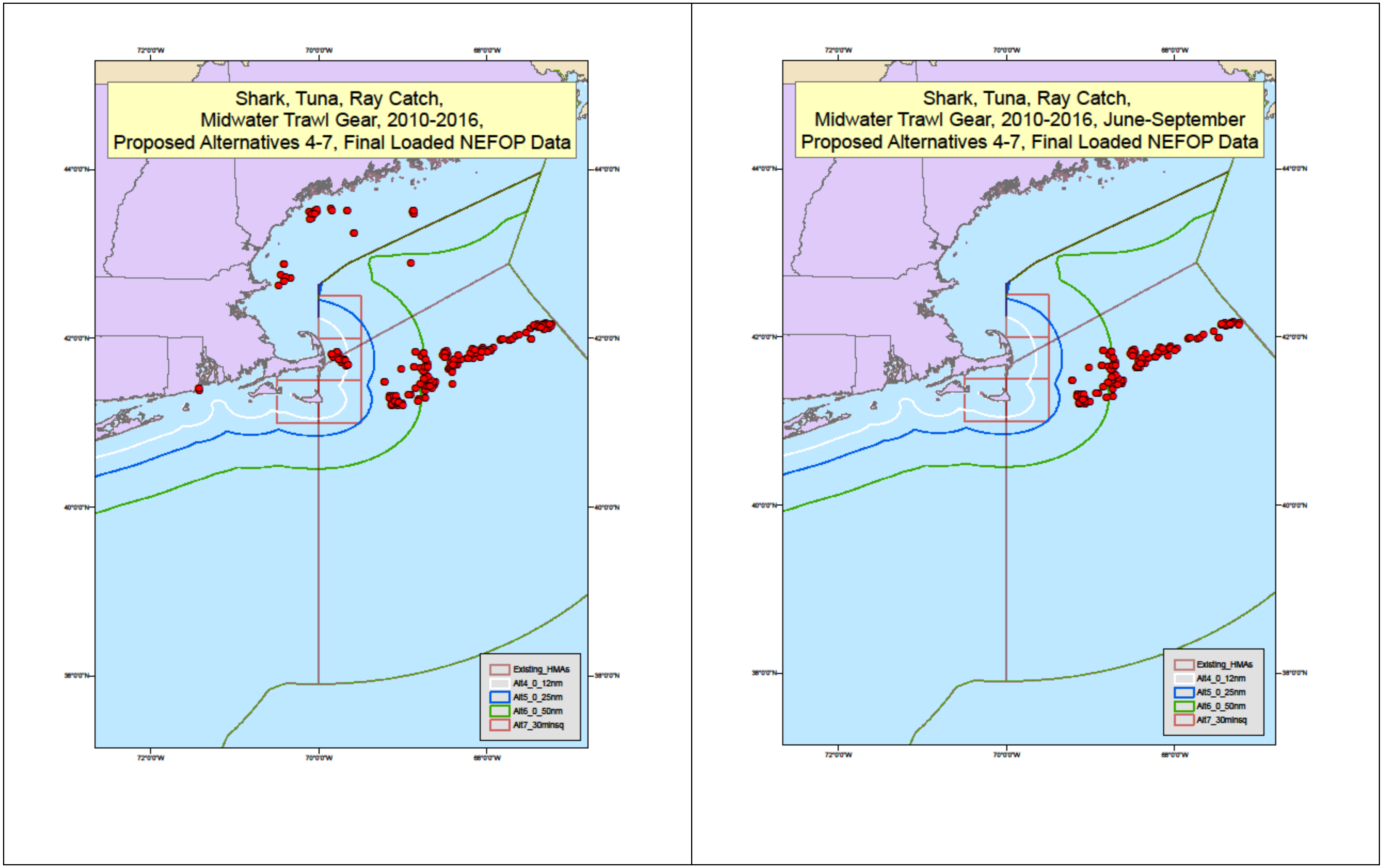
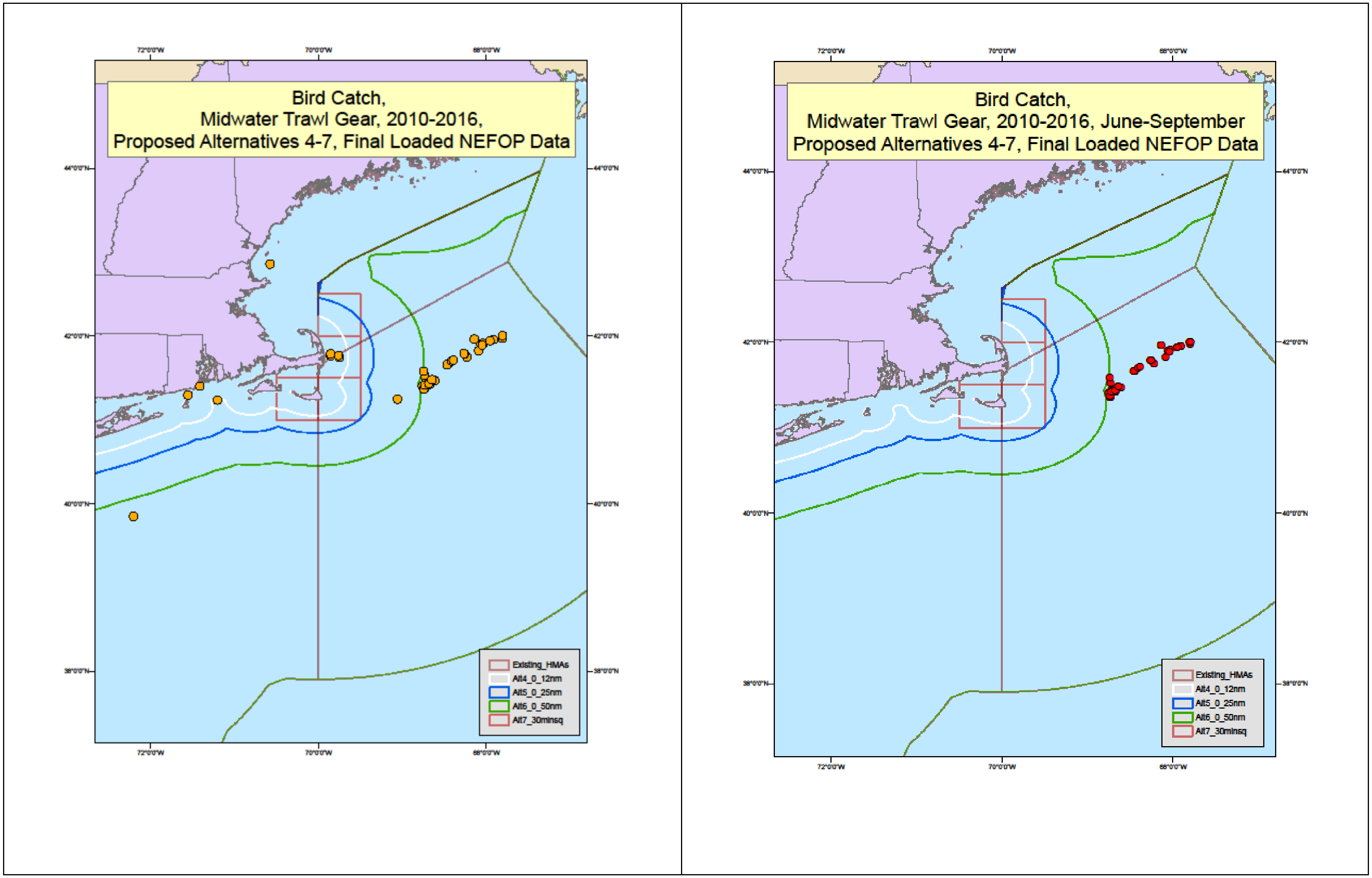


Figure 43 – Observed hauls of seabird bycatch in the herring MWT fishery (2010-2016) overlayed with Amendment 8 alternatives. Year round data on LEFT and seasonal data for June-Sept on RIGHT.



5.2.1 Alternative 1 (No Action: prohibit MWT gear in Area 1A from June – September)

To assess the potential impacts of the No Action alternative on bycatch the bycatch occurring on MWT vessels in Area 1A before Amendment 1 could be compared to bycatch levels now. However, as mentioned in Section 5.1.1, it is not really possible to connect any direct impacts back to this measure in isolation of all the other measures that have likely contributed to changes in fishing effort, thus bycatch in this fishery. Multiple measures collectively impact when and where vessels fish, and that changes each season, sometimes due to natural variations in fishing conditions, and often due to management measures that restrict when and where vessels can fish by both NMFS and action taken by ASMFC. Furthermore, the observer coverage rates have been very variable over the years, making it difficult to evaluate if there have been actual changes in bycatch interactions. Finally, the primary bycatch species in this fishery are managed under a hard bycatch cap; therefore, there is a hard limit in place that will cap the total impact on bycatch in this fishery. Thus, regardless of measures that may or may not impact bycatch, in the end the total amount of mortality from this fishery is capped; therefore, other measures may have more indirect impacts on bycatch, but the bycatch caps in place will limit the overall impact of this fishery on species with sub-ACLs (river herring and haddock).

If most MWT effort from June – Sept in Area 1A pre-Amendment 1moved to other areas outside of the GOM it is possible that impacts on GOM haddock bycatch have reduced as a result of No Action. However, if effort shifted to GB, then impacts on GB haddock bycatch have potentially increased as a result of No Action. As for river herring, bycatch is usually higher inshore, and rates are highest in Area 2 and the backside of the Cape. If MWT effort has moved from Area 1A to these inshore areas, it is possible that bycatch impacts on river herring have increased as a result of No Action. In reality, total effort has declined in all areas since Amendment 1, so overall bycatch interactions are likely lower than previous years. In summary, there are too many uncertainties about how effort shifts from year to year to say if overall bycatch will be higher or lower under No Action.

5.2.2 Alternative 2 (Closure within 6nm in Area 114 to all vessels fishing for herring)

In a very qualitative sense, river herring bycatch is generally higher in nearshore areas, especially off the back side of the Cape (Figure 38). Therefore, if MWT effort is removed from this area it is possible that impacts on river herring bycatch could be reduced. However, if effort shifts just outside of this closure, bycatch rates are likely very similar, which would have generally neutral impacts. If effort shifts from the summer/fall to other times of the year but in the same area, then bycatch of river herring could increase if it is more concentrated in the time of year river herring bycatch rates are generally higher (i.e. winter). Overall, it is not possible to know how vessels will respond, so the impacts on bycatch are uncertain. In this case, this area does not overlap with a large fraction of herring fishing activity, so any shifts would be minor, and are not likely to change overall bycatch impacts; therefore neutral impacts on bycatch expected.

5.2.2.1 Seasonal sub-options (A: June – August or B: June – October)

Both of the seasonal options for this alternative focus on either the summer (Option A) or the summer and early fall (Option B), which are generally lower bycatch seasons for river herring (Figure 38). Again, if effort shifts from the summer/fall to other times of the year but in the same area, then bycatch of river herring could increase if it is more concentrated in the time of year river herring bycatch rates are generally higher (i.e. winter). But this area does not overlap with a large fraction of herring fishing activity, so any shifts would be minor, and are not likely to change overall bycatch impacts; therefore neutral impacts on bycatch expected.

5.2.3 Alternative 3 (Prohibit MWT gear in Area 1A year-round)

If the MWT fishery is excluded from Area 1A for the entire year the purse seine fleet would likely harvest that entire sub-ACL. MWT effort would be constrained to Area 1B, Area 2, and Area 3. Bycatch interactions with species within Area 1A would be lower, but many of those species are also found in other herring management areas, so any positive impacts from less effort in Area 1A, would be neutralized. If effort shifts to Area 3, especially in the fall, it is possible that impacts on GB haddock would increase. But again, there is an overall bycatch cap, so the sub-ACL for GB haddock will limit the total level of impact from the MWT fishery.

5.2.4 Alternative 4 (Prohibit MWT gear inside 12 nm south of Area 1A)

Herring MWT landings within 12 miles are highest during the months of November – February; therefore the highest impact of a closure would be the winter months, especially November and December (figure in eco section???). If there is an area closure during those months effort will likely shift spatially or temporally. The PDT discussed that effort shifts can have different impacts on bycatch species, especially river herring and shad because they are typically found in nearshore areas. For example, a buffer closure could have negative fence effects that could shift all inshore effort and concentrate it just outside the boundary, if that boundary happens to overlap an important ocean feature, the impacts could be intensified, e.g. the great south channel. The timing of the closure could have very different impacts on bycatch and other fisheries as well.

5.2.4.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

If Area 2 is excluded (Option B), MWT effort may shift into that area if those vessels are excluded from Area 1B and nearshore areas of Area 3. If effort shifts to nearshore waters in Area 2, especially in the winter, impacts on river herring could be increased. But again, there are bycatch caps in place that will limit the total impact on river herring, regardless of any LD measure adopted. If nearshore waters throughout the range are closed to MWT fishing (Option A) MWT effort will likely shift farther offshore. The species that could face increased impacts would be GB haddock. Those impacts would have a maximum since there is a bycatch cap for GB haddock.

5.2.4.2 Seasonal sub-options (A: year-round or B: June-September)

The year-round sub-option (Option A) may have more positive impacts on river herring, especially if paired with the sub-option that includes Area 2 because that would encompass the areas and times when river herring bycatch are highest. While river herring is caught farther offshore of 12 nm, the largest observed tows of river herring bycatch have been inshore of 12nm (Figure 38). The seasonal option that would restrict this gear prohibition to June-September, is expected to have more neutral impacts on river herring, but interactions could be less on the backside of the Cape based on recent observer data.

5.2.5 Alternative 5 (Prohibit MWT gear inside 25 nm south of Area 1A)

Encompasses basically all of RH bycatch – thus positive – more likely caps would not be reached.

5.2.5.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

Option that excludes Area 2 more neutral impacts on river herring.

5.2.5.2 Seasonal sub-options (A: year-round or B: June-September)

Year round more positive impacts on river herring.

5.2.6 Alternative 6 (Prohibit MWT gear inside 50 nm south of Area 1A)

Encompasses basically all of RH bycatch – thus positive – more likely caps would not be reached.

5.2.6.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

Option that excludes Area 2 more neutral impacts on river herring.

5.2.6.2 Seasonal sub-options (A: year-round or B: June-September)

Year round more positive impacts on river herring.

5.2.7 Alternative 7 (Prohibit MWT gear in thirty minute squares off Cape Cod)

Could be some positive impacts on RH, unless effort shifts to other nearshore areas also with RH bycatch. Some positive impacts on haddock in area 114, but if effort shifts offshore some areas have higher GB haddock bycatch rates. Both have caps so limits on bycatch impacts in place.

5.2.7.1 Area sub-options (A: five 30-minute squares in Areas 1B, 2 and 3 or three 30-minute squares in Areas 1B and 3 only)

If Area 2 left out may be lower potential benefits on bycatch compared to option A that includes Area 2. But again, there are caps in place.

5.2.7.2 Seasonal sub-options (A: year-round or B: June-September)

5.2.8 Alternative 8 (Revert boundary between Area 1B and 3 back to original boundary)

Overall this measure should not impact bycatch since the bycatch caps in place will limit the overall impact of this fishery on non-target species such as river herring and haddock. Similar to Section 5.1.8, a future action would determine the future sub-ACL s for Areas 1B and 3 if the boundary changes under Amendment 8. If the sub-ACL increases in Area 1B it is possible that there may be increased impacts on bycatch of near shore species such as river herring. However, the hard sub-ACL in place would limit the overall impacts so they would not increase above already assessed levels. Furthermore, if Area 3 quotas are higher as a result of this boundary shift, potential impacts on offshore bycatch species such as GB haddock could increase. But again, there is an overall bycatch cap so impacts would not increase already assessed levels. Therefore, while the boundary shift could impact fishing efforts levels (increase or decrease compared to current levels), the bycatch caps in place would prevent increased impacts on bycatch.

5.2.9 Alternative 9 (Remove seasonal closure of Area 1B from January – April)

The area with the highest concentration of river herring bycatch from the herring MWT fishing is off the back side of Cape Cod, and then south of Rhode Island. If the current seasonal closure of Area 1B was lifted, and vessels shifted from mostly fishing in that area in May to earlier in the year (January/February as well as the end of the year November/December), it is possible that river herring bycatch impacts could increase. River herring bycatch rates are generally higher in the winter compared to the spring.

If Area 1B opens earlier in the year it is possible that MWT fishing that typically takes place in Area 2 in the winter could shift to Area 1B instead. Therefore, bycatch of river herring in Area 2 could decrease, but impacts on river herring father north could increase. Conversely, if Area 2 effort remains what it is, but effort that takes place in Area 1B (typically in May in recent years) shifts earlier in the year, there could be increased risks to river herring because winter typically has higher bycatch rates. However, in the end, the bycatch caps control total impacts on non-target species. If bycatch rates of river herring increase in the winter as a result of the seasonal closure being lifted, then the caps would still be in place and would restrict fishing if estimated bycatch exceeded the sub-ACL by implementing in-seasonal closures (Figure 8). In summary, because there are bycatch caps in place, any increased risk of bycatch is somewhat neutralized because there is a limit on the potential impact on bycatch for those species.

5.3 IMPACTS ON NON-PROTECTED PREDATOR SPECIES THAT FORAGE ON HERRING (TUNA, GROUNDFISH, STRIPED BASS)

Analysis will reference maps being developed for tuna and gf fisheries as well as assessment documents.

If herring fishery removed the same amount of herring farther offshore what are the impacts on predators within these LD alternatives?

Since there is not much direct research on herring and predators – will rely on potential impacts on predator fisheries and overlap analysis, rather than predators themselves.

General – From EBFM: This system is comparatively complex and unlike many of the ecosystems analyzed in other reports. It is not an upwelling system with strong linkages between primary prey species and predators. Many of the herring predators are generalists, so it is important to consider the effect that the abundance and nutritional value of alternative prey species (e.g. sand lance, squid, silver hake) could have.

5.3.1 Alternative 1 (No Action: prohibit MWT gear in Area 1A from June – September)

5.3.2 Alternative 2 (Closure within 6nm in Area 114 to all vessels fishing for herring)

5.3.2.1 Seasonal sub-options (A: June – August or B: June – October)

5.3.3 Alternative 3 (Prohibit MWT gear in Area 1A year-round)

5.3.4 Alternative 4 (Prohibit MWT gear inside 12 nm south of Area 1A)

5.3.4.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

5.3.4.2 Seasonal sub-options (A: year-round or B: June-September)

5.3.5 Alternative 5 (Prohibit MWT gear inside 25 nm south of Area 1A)

5.3.5.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

5.3.5.2 Seasonal sub-options (A: year-round or B: June-September)

5.3.6 Alternative 6 (Prohibit MWT gear inside 50 nm south of Area 1A)

5.3.6.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

5.3.6.2 Seasonal sub-options (A: year-round or B: June-September)

5.3.7 Alternative 7 (Prohibit MWT gear in thirty minute squares off Cape Cod)

5.3.7.1 Area sub-options (A: five 30-minute squares in Areas 1B, 2 and 3 or three 30-minute squares in Areas 1B and 3 only)

5.3.7.2 Seasonal sub-options (A: year-round or B: June-September)

5.3.8 Alternative 8 (Revert boundary between Area 1B and 3 back to original boundary)

5.3.9 Alternative 9 (Remove seasonal closure of Area 1B from January – April)

5.4 IMPACTS ON PROTECTED SPECIES (FISH, SEA TURTLES, MARINE MAMMALS, AND SEABIRDS)

This section will describe potential impacts of LD measures on protected species in terms of potential impacts relative to forage, as well as potential impacts in terms of incidental take of protected species. The primary protected species of concern are marine mammals and sea birds.

When looking at any of the LD alternatives, one of the main considerations to assist in the analysis of protected species impacts is ***where will effort (and associated gear type) shift to*** and ***how will fishing behavior change in the area relative to current conditions***.

The PDT has drafted some questions for the AP to consider about potential effort shifts. When those responses are complete the PDT will update this section.

Most of the analyses completed to date focuses on potential impacts in terms of incidental take of protected species – more analysis will be added relative to potential forage impacts on protected species.

5.4.1 Incidental take maps

The protected species incidental take maps will help in assessing protected impacts; however, there's always the caveat, depending on observer coverage rates and area observed, an area on a map that is absent of documented takes may not mean interactions do not occur in that area. Instead, it may just mean, observers were never onboard vessels fishing in that area and therefore, we have no take information available for that site. In situations like this, the best we can do is take a look at observed interactions (with gear of interest) in surrounding areas, as well as information on species distribution in space and time to see if co-occurrence is likely when vessels are expected to be in the area.

Figure 44 – Observed marine mammal interactions pre-Amendment 1 (top) and post Amendment 1 (bottom) with relevant herring management areas

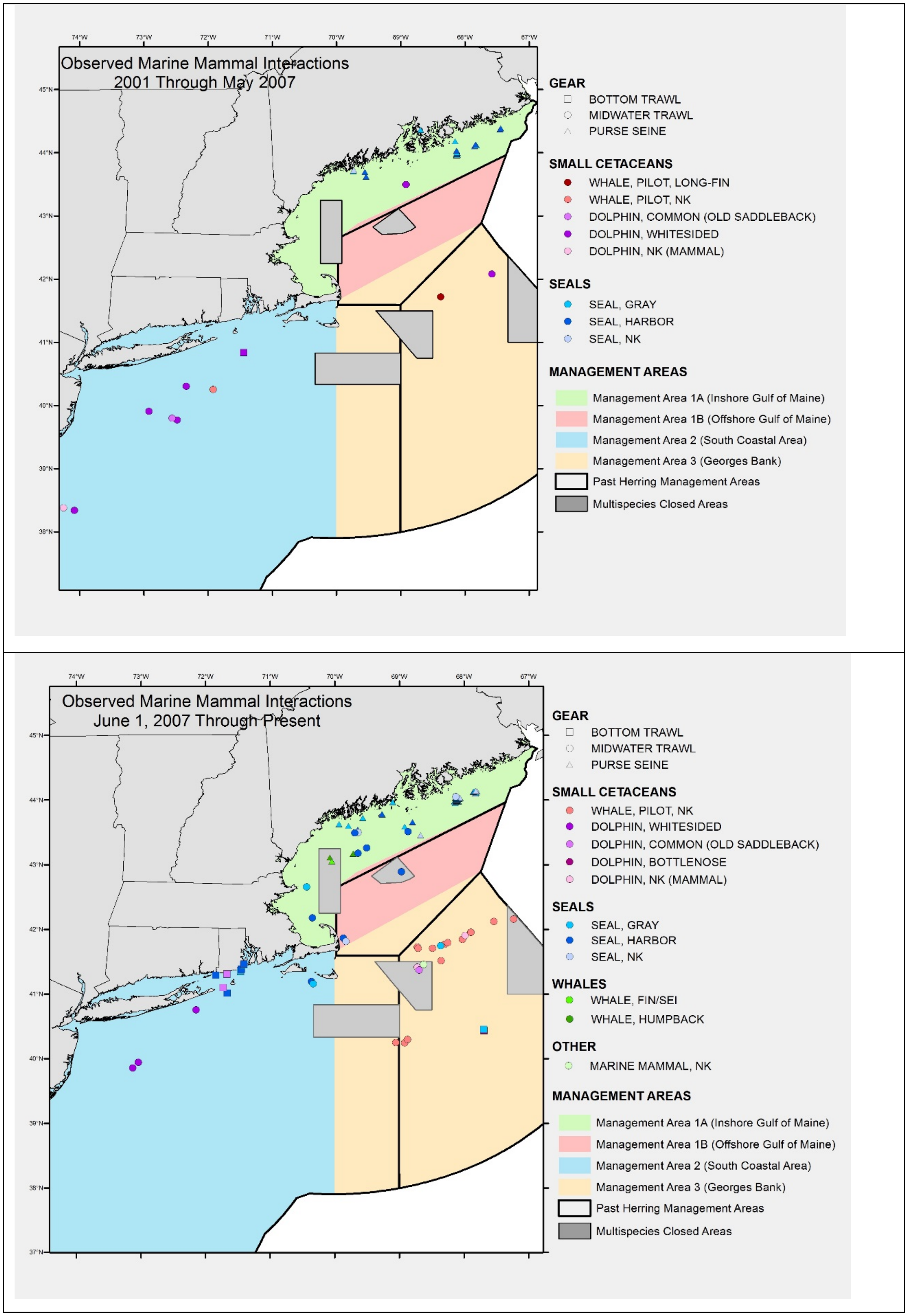
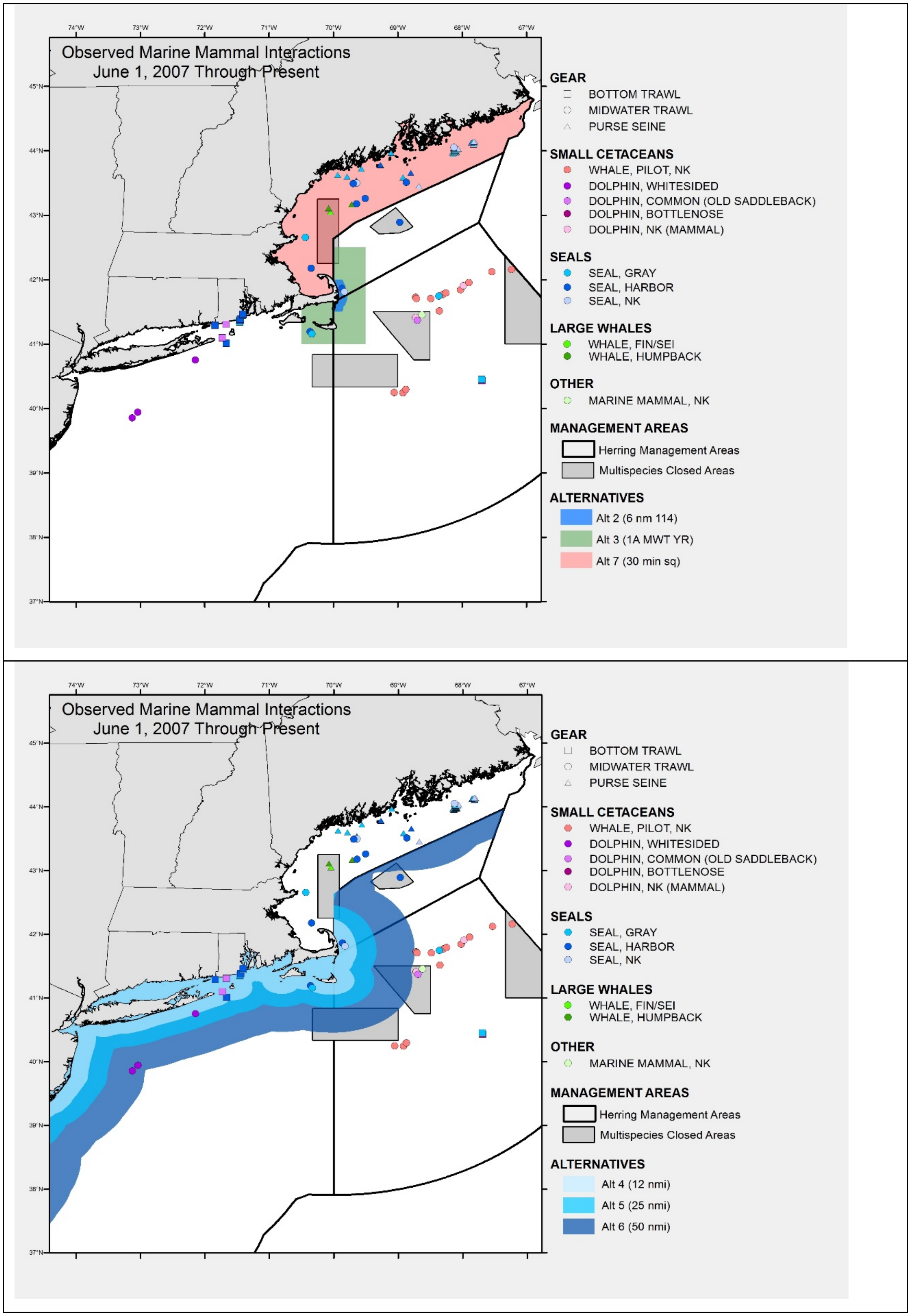


Figure 45 – Observed marine mammal interactions overlayed with Alternatives 2, 3 and 7 (top) and Alternatives 4, 5, and 6 (bottom) with relevant herring management areas



(Real) Example scenario to consider: The Northern GOM has numerous observed purse seine interactions with protected species. If MWT vessels convert to purse seines and decide to shift into this area, the number of purse seine vessels will have increased in this area relative to current conditions. With an increase in the amount of purse seines in this area, interactions could increase; however, the magnitude of the interaction risk will depend on tow times.

General findings

- Looking at the protected species incidental take maps (2007-present), there have been numerous observed MWT takes in the GB area. Consideration of each LD alternative and how each may change existing effort in GB is needed. For example, any LD alternative that may result in more MWT vessels on GB, relative to current conditions, may result in more interactions in this area (again magnitude of interaction risk is in part associated with tow times). Alternatively, if an LD alternative resulted in a shift in MWT effort out of the GB area, there could be some benefits experienced by protected species as effort is moving out of a relatively high interaction area, and potentially being redistributed to an area with a lower risk of an interaction (which we would need to define and provide information to support that the area is a "low risk" area).
- An alternative consideration is purse seines. Taking a look at the protected species observed interaction maps, purse seine interactions in the Northern GOM are high. Similar to the considerations made for MWT vessels, under each LD alternative, how will purse seine presence and effort potentially change if MWT vessels are prohibited (seasonally or year round). Any increase in the number of purse seines or the duration of tows in this area, has the potential to increase interactions in this area.

5.4.2 No Action – Prohibition of MWT gear in Area 1A June – September

Under the No Action, management measures implemented by Amendment 1 would be maintained. As a result, significant changes in effort (e.g., gear quantity, soak/tow time, area fished) are not expected under this Option.

Understanding expected fishing behavior/effort in a fishery informs potential interaction risks with protected species (ESA listed and MMPA protected species). Specifically, interaction risks with protected species are strongly associated with amount, time, and location of gear in the water with vulnerability of an interaction increasing with increases in any or all of these factors. Taking into consideration the latter, as well as fishing behavior/effort under the No Action, impacts of the No Action to protected species are provided below.

MMPA (Non-ESA listed) Protected Species Impacts

Species of marine mammals are known to interact with the Atlantic herring fishery (see Section 1.4). Impacts of the No Action on marine mammals (i.e., minke whales, species of small cetaceans, and pinnipeds) are somewhat uncertain as quantitative analysis has not been performed. However, we have considered, to the best of our ability, available information on marine mammal interactions with commercial fisheries, including the herring fishery over the last 5 or more years (Hayes et al. 2017; See Marine Mammal Stock Assessment Reports: http://www.nmfs.noaa.gov/pr/sars/region.htm; and NEFSC NEFOP reports: http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html).

Aside from several large whale species, harbor porpoise, pilot whales, and several stocks of bottlenose dolphin, there has been no indication that takes of any other marine mammal species in commercial fisheries has exceeded potential biological removal (PBR) thresholds, and therefore, gone above and beyond levels which would result in the inability of each species population to sustain itself (Hayes et al. 2017; http://www.nmfs.noaa.gov/pr/sars/region.htm). Although, as noted above, several species of large whales, harbor porpoise, pilot whales, and several stocks of bottlenose dolphin have experienced levels of take that have resulted in the exceedance of each species PBR threshold, take reduction plans or strategies have been implemented to reduce bycatch in the fisheries affecting these species; these plans/strategies are still in place and are continuing to assist in decreasing bycatch levels for these species. Although the information presented in Hayes et al. (2017) and past marine mammal stock assessment reports are a collective representation of commercial fishery interactions with marine mammals, and does not address the effects of any FMP specifically, the information does demonstrate that fishery operations over the last 5 or more years have not resulted in a collective level of take that threatens the continued existence of marine mammal populations (aside from those species noted above).

Based on this information, and the fact that voluntary measures exist that reduce serious injury and mortality to marine mammal species incidentally caught in trawl fisheries (i.e., Atlantic Trawl Gear Take Reduction Team; see Section 1.4), it is not expected that the No Action, which will maintain status quo conditions, will result in levels of take that will affect the continued existence of marine mammals. For these reasons, the No Action is expected to have low negative impacts on marine mammals.

ESA Listed Species Impacts

As provided in Section 1.4, ESA listed species interactions with the Atlantic herring fishery are non-existent. However, the fishery does use some gear types known to interact with species; therefore, risk does exist. As the no action will maintain current operating conditions, changes in fishing effort or behavior above and beyond that which has been characteristic of the fishery over the last several years is not expected. As interactions with ESA listed species over this time frame have remained non-existent, the no action alternative is not expected to introduce any new risks (e.g., changes in gear or effort) to ESA listed species that have not already been considered by NMFS and deemed "not likely to adversely affect" these species (NMFS 2012a,b, 2013, 2014a,b). In fact, in NMFS most recent assessment of the Atlantic Herring FMP it was concluded that the Atlantic Herring FMP may affect, but is not adversely affect or jeopardize the continued existence of any ESA listed species (NMFS 2014a,b). As a result, the effects of the no action alternative on ESA listed species are expected to be *neutral*.

5.4.3 Alternative 2 (Closure within 6nm in Area 114 to all vessels fishing for herring)

Alternative 2 will result in a closure within 6nm in Area 114 to all vessels fishing for herring. This closure encompasses a relatively small area and does not represent a primary herring fishing area. Vessels may respond to Alternative 2 by shifting effort to just outside the closure; however, overall, relative to current operating conditions, significant changes in fishing behavior and effort are not expected in the fishery as a result of Alternative 2.

As Alternative 2 is not expected to result in any significant changes in fishing behavior/effort, the potential for protected species interactions with herring fishing gear and therefore, serious injury or mortality, are not expected to go above and beyond that which has been considered in the fishery to date http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; http://www.nmfs.noaa.gov/pr/sars/region.htm; NMFS 2014a,b; Hayes et al. 2017). Specifically, as ESA listed species have never been taken in the herring fishing to date, nor has the fishery resulted in levels of take of MMPA protected species that jeopardize the continued existence of marine mammal populations (i.e., resulted in exceedance of PBR), we do not expect Option 2 to introduce any new risks or additional takes to protected species that have not already been considered and/or authorized by NMFS to date (NMFS 2014a,b; Hayes et al. 2017; http://www.nmfs.noaa.gov/pr/sars/region.htm; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). For these, and the reasons provided in Section 1.1.1, we expect impacts of Alternative 2 on protected species (ESA listed and MMPA protected species) to be similar to those described in Alternative 1 (i.e., MMPA protected species: low negative; ESA listed species: neutral).

Relative to the No Action (Alternative 1), Alternative 2 would have neutral impacts on protected resources for the reasons provided in Section 1.1.1 (Alternative 1).

5.4.3.1 Seasonal sub-options (A: June – August or B: June – October)

There are two seasonal sub-options for Alternative 2, sub-option A: June-August or sub-option B: June October; during these periods of time, herring fishing would be prohibited within 6nm in Area 114. Regardless of the seasonal sub-option chosen, neither sub-option will result in significant changes in fishing behavior or effort relative to current operating conditions. As provided in Alternative 2, at most, there may be a shift in effort to areas just outside the closure during the specified timeframe. However, as this area does not represent a prime area for herring fishing and comprises a relatively small area, whether a seasonal window is in place or not, overall effort and fishing behavior is not expected to differ significantly from current operating conditions. As a result, interaction risks to protected species are not expected to be any greater than those provided in Alternative 1 (No Action). Based on this, impacts to protected species from either Alternative 2 seasonal sub-option are expected to be neutral (ESA listed species) to low negative (MMPA protected species) similar to those provided in Alternative 1.

5.4.4 Alternative 3 (Prohibit MWT gear in Area 1A year-round)

Alternative 3 will result in a year round prohibition of MWT gear from management area 1A. The response of the herring fishery from such a restriction is likely varied, with the following changes in fishing effort/behavior possible:

1. MWT vessels shift effort, year round, to Management Area 1B, 2, and/or 3 (Georges Bank specifically);
2. MWT vessels convert to purse seine gear and shift effort into Management Area 1A; and/or;
3. Existing purse seine effort increases in Area 1A.

Taking into consideration the above, there is likely to be a range of potential impacts to protected species. For instance, as provided in scenario 1, the MWT fleet may respond to Alternative 3 by shifting effort to other herring Management Areas. During the current MWT seasonal restriction (June-September) in Management Area 1A, MWT effort has primarily shifted to Management Area 3. It is likely that MWT vessels would respond in a similar manner under Alternative 3, at least during June-September, the seasonal window they are accustomed to fish in Area 3. However, as the option for MWT vessels to shift to Management Area 1A during October through December is no longer available to the MWT fleet, effort will need to remain in Area 3 or be redirected to Management Area 1B or 2.

If effort remains in Area 3 year round, there is the potential for interactions with protected species, specifically MMPA protected species, to increase. Reviewing Figure 44 and Figure 45, as well as NEFOP observer data, there is a high incidence of observed marine mammal (non-ESA listed; dolphin species, pilot whales, and seal species) interactions with MWT gear in Area 3, specifically the northern edge of Georges Bank. The incidences of observed interactions coincide with the months in which the seasonal restrictions in herring Management Area 1A are currently in affect (June-Sept) for MWT vessels. As marine mammal species (non-ESA listed) observed to interact with MWT gear on Georges Bank during June through September will still be present at various times from October through May, if MWT vessels remain in this area year round, marine mammal species will be exposed to MWT gear and therefore, interaction risks, they were previously exposed to during this timeframe, but at lower levels. Based on this, under this scenario, impacts to MMPA protected species are likely to be negative. However, interactions that could have occurred within the GOM would be lower, which could neutralize some of these potentially negative impacts.

Alternatively, outside of the June-September timeframe, the MWT fleet may decide to redirect effort from Area 3 to Area 1B and/or 2 for the remainder of the year, similar to what is currently done in the fishery. Under this scenario, interactions with protected species, specifically MMPA protected species, would not be expected to be any greater than current operating conditions.

Based on Figure 44 and Figure 45 (marine mammal interaction maps), as well as NEFOP observer data, since 2007, there have only been a small number (i.e., eight) of observed marine mammal (non-ESA listed; dolphin species, pilot whales, and seal species) interactions with MWT gear in herring Management Areas 1B and 2; these interactions were observed during November through May.

Based on this information, while marine mammals (e.g.., dolphin species, pilot whales, and seal species) may occur in the waters of herring Management Area 1B and 2 throughout the year, there appears to be a low co-occurrence of effort and marine mammals from October through May. As a result, it is not expected that any effort that is redirected from Area 3 to Area 1B or 2 during October-May would result in any significant increase in interactions with MMPA protected species relative to what has currently been observed in these regions during these timeframes to date. Based on this, under this scenario, impacts to MMPA protected species are expected to remain similar to current operating conditions, that is low negative. In regards to ESA listed species, scenario 1 is expected to result in neutral impacts to ESA listed as there has never been an ESA listed species taken in the Herring fishery, including the MWT fleet, and interaction risks with this gear type in general are rare to non-existent.

As provided above in scenario 2, another possible response of the MWT fleet to Alternative 3 is to convert to purse seine gear in order to attain access to Area 1A year round (i.e., June through December). Should this occur, interactions with protected species, specifically MMPA protected species, could increase in Area 1A. Reviewing Figure 44 and Figure 45 (marine mammal interaction maps), as well as NEFOP observer data, numerous purse seine interactions with marine mammals (non-ESA listed species; primarily species of seals) occur in Management Area 1A. If MWT vessels convert to purse seine gear, these vessels, combined with the existing purse seine fleet operating in Management Area 1A will equate to an in increase in the amount of purse seine gear operating in this management area.

As interaction risks with protected species are strongly associated with amount, time, and location of gear in the water, vulnerability of an interaction increases with increases in any or all of these factors. Based on this, with a currently high co-occurrence of marine mammals and purse seine gear in management 1A (as evidenced by the numerous interactions observed in this area), combined with an increase in the amount of purse seine gear operating in Management Area 1A, the potential for an interaction with a marine mammal species (non-ESA listed) is likely to increase and therefore, impacts to MMPA protected species are expected to be negative. In regards to ESA listed species, scenario 2 is expected to result in neutral impacts to ESA listed species as there has never been an ESA listed species taken in the Herring fishery, including the purse seine fleet, and interaction risks with this gear type in general are rare to non-existent.

In regards to scenario 3, assuming that MWT vessels do not convert to purse seine gear, the existing purse seine fleet could increase effort/activity in Area 1A if MWT vessels are prohibited from this herring management area year round. As provided above, numerous purse seine interactions with marine mammals (primarily species of seals) occur in Management Area 1A. Should the purse seine fleet increase effort (e.g., tow times) in this management area, interactions with MMPA protected species are likely to increase. Based on this, impacts to MMPA protected species under scenario 3 are likely to be negative, while impacts to ESA listed species will be neutral; see scenario 2 for additional information to support this determination.

Based on the above scenarios, depending on the response of the MWT fleet to Alternative 3, impacts to MMPA protected species may range from negative to low negative, while for ESA listed species they will be neutral. Relative to the No Action (Alternative 1), Alternative 3 will result in neutral to negative impacts to MMPA species due to the potential for interactions with MMPA protected species to increase relative to current operating conditions; impacts to ESA listed species relative to the No Action will be neutral.

5.4.5 Alternative 4 (Prohibit MWT gear inside 12 nm south of Area 1A)

Alternative 4 will prohibit MWT gear inside 12nm south of Area 1A. Because this alternative includes portions of several herring management areas (Areas 1B, 2, and 3), how MWT vessels respond to this Alternative may vary based on the ability of the vessels to still catch the TAC allocated to the respective herring management area. In herring Management Area 1B, MWT vessels typically catch their Area 1B TAC within the 30 minute square 114 off the back side of the Cape. If this alternative is chosen, MWT vessels could no longer access this area, making it difficult to harvest their Area 1B TAC. In regards to Area 3, the majority of catch for this management area occurs outside of the 12nm boundary, so MWT fishing behavior and effort is unlikely to be affected in this management area. In Area 2, most MWT fishing effort occurs closer to shore, and therefore, similar to Area 1B, this Alternative would prevent MWT vessels from accessing these waters, thereby making it somewhat difficult to harvest the area TAC.

Based on the above, fishing behavior/effort is most likely to be affected in herring Management Area 1B and 2, with some potential changes in Area 3. As MWT vessels will be prohibited from accessing the nearshore waters needed to attain the TAC for each respective management area, fishing behavior/effort in these areas may change in several possible ways:

1. MWT vessels fish just outside the 12nm boundary in Area 1B and 2;
2. MWT vessels shift effort to offshore waters within Area 3;
3. Existing bottom trawl effort increases in nearshore waters of Area 1B, 2, and 3; and/or
4. MWT vessels convert to bottom trawl gear (aside from MWT gear, the most common gear used in nearshore waters south of Area 1A to catch herring).

Depending on the response of the vessels, impact to protected species will vary. Considering scenario 1, if vessels just shift to areas just outside the 12nm boundary in Area 1B and 2, effort may remain similar to current conditions in these areas or, it may decrease due to the vessels inability to access nearshore waters needed to attain the respective management area TAC. Under these circumstances, protected species risk of interacting with MWT vessels are not expected to be any greater than those under current operating conditions; that is impacts to MMPA protected species under scenario 1 are likely to be low negative and neutral for ESA listed species.

If we consider scenario 2, MWT vessels that once fished within the nearshore waters (within 12nm) of Areas 1B and 2 would shift effort to offshore waters within Area 3, where there is more ability to harvest the area TAC due to the accessibility to the herring resource. Depending on the number of vessels operating in Area 3 at a specific time, effort in this management area has the potential to increase or remain similar to current operating conditions. As provided in Alternative 3, numerous marine mammal (non ESA listed species) interactions with MWT gear have been observed in Area 3. As interaction risks with protected species are strongly associated with amount, time, and location of gear in the water, vulnerability of an interaction increases with increases in any or all of these factors. Based on this, should effort increase in offshore areas within herring Management Area 3, there is the potential for interactions with MMPA protected species to increase (as provided in Alternative 3). Based on this, impacts to MMPA protected species may be low negative (no change in effort from current conditions) to negative (increase in effort), while impacts to ESA listed species are likely to be neutral.

Another possible scenario is that with no MWT vessels permitted within 12nm south of Area 1A, existing bottom trawl effort increases in the nearshore waters. Currently, bottom trawl effort represents a small component of the overall herring fishery. Based on NEFOP observer data, since 2007, there has been 21 observed MMPA protected species (i.e., harbor and gray seals, whitesided and common dolphins) interactions with bottom trawl gear associated with the herring fishery; no interactions with ESA listed species have been observed to date. These incidences occurred primarily in nearshore waters of Southern New England. Taking the latter into consideration, as well as the fact that both ESA listed and MMPA protected species are vulnerable to interactions with bottom trawl gear (irrespective of fishery), and are known to occur in nearshore waters of Management Areas 1B, 2, and 3, should bottom trawl effort increase to levels above those currently experienced in the fishery, interaction risks to both MMPA protected and ESA listed species are expected to increase. As a result, under this scenario, there is the potential for interactions with MMPA protected species to increase, and for interactions to occur with ESA listed species for the first time in the herring fishery. Based on this information, impacts of scenario 3 on MMPA protected species and ESA listed species are negative.

A fourth possible scenario is that existing MWT trawl vessels will convert to bottom trawl gear in order to attain the Management Area TAC allocated to Area 1B, 2, and 3. Combined with existing bottom trawls already operating in these herring management areas, should this scenario occur, bottom trawl effort in the nearshore waters is likely to increase. For the reasons provided above in scenario 3, impacts of scenario 4 on MMPA protected species and ESA listed species are expected to be negative.

Taking into consideration the above scenarios, Alternative 4 has the potential to result impacts ranging from low negative to negative for MMPA protected species, and neutral to negative impacts to ESA listed species. Relative to the No action (Alternative 1), Alternative 4 has the potential to result in impacts that range from high negative (if effort shifts to areas with higher interactions or to gear types with higher interactions) to low positive impacts (if effort decreases and less herring is caught) to MMPA protected species, and ranging from neutral to high negative impacts to ESA listed species.

5.4.5.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

There are two area sub-options under Alternative 4, sub-option A: Areas 1B, 2, and 3 or sub-option B: Areas 1B and 3. Regardless of the sub-option chosen, effort and/or changes in fishing behavior are not expected to differ significantly from than that described above in section 1.1.4. As a result, both sub-options are expected to result in impacts to protected species that are similar to those provided in section 1.1.4 (i.e., low negative to negative impacts to MMPA protected species and neutral to negative impacts to ESA listed species). For rationale to support this determination, see section 1.1.4. Relative to the No Action (Alternative 1), either Alternative 4 area sub-option has the potential to result in impacts that range from high negative to low positive impacts to MMPA protected species, and ranging from neutral to high negative impacts to ESA listed species.

5.4.5.2 Seasonal sub-options (A: year-round or B: June-September)

There are two seasonal sub-options under Alternative 4, sub-option A: year round or sub-option B: June through September. Regardless of the sub-option chosen, effort and/or changes in fishing behavior are not expected to differ significantly from than that described above in. As a result, both sub-options are expected to result in impacts to protected species that are similar to those provided in section 1.1.4 (i.e., low negative to negative impacts to MMPA protected species and neutral to negative impacts to ESA listed species). For rationale to support this determination, see section 1.1.4. Relative to the No Action (Alternative 1), either Alternative 4 seasonal sub-option has the potential to result in impacts that range from high negative to low positive impacts to MMPA protected species, and ranging from neutral to high negative impacts to ESA listed species.

5.4.6 Alternative 5 (Prohibit MWT gear inside 25 nm south of Area 1A)

Alternative 5 = expect similar impacts as those in Alternative 4

5.4.6.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

5.4.6.2 Seasonal sub-options (A: year-round or B: June-September)

5.4.7 Alternative 6 (Prohibit MWT gear inside 50 nm south of Area 1A)

Alternative 6 = expect similar impacts as those in Alternative 4

5.4.7.1 Area sub-options (A: Areas 1B, 2 and 3 or B: Areas 1B and 3 only)

5.4.7.2 Seasonal sub-options (A: year-round or B: June-September)

5.4.8 Alternative 7 (Prohibit MWT gear in thirty minute squares off Cape Cod)

5.4.8.1 Area sub-options (A: five 30-minute squares in Areas 1B, 2 and 3 or three 30-minute squares in Areas 1B and 3 only)

5.4.8.2 Seasonal sub-options (A: year-round or B: June-September)

5.4.9 Alternative 8 (Revert boundary between Area 1B and 3 back to original boundary)

5.4.10 Alternative 9 (Remove seasonal closure of Area 1B from January – April)

Most Area 1B effort occurs in May - if effort shifts earlier may be positive for whales, before they are in the area. Most critical time that whales use herring is typically???

However, Many whale (e.g., humpback, and minke), small cetaceans (e.g., white sided dolphins, harbor porpoise), and seals are present earlier than May. For instance, humpbacks are present as early as March on the foraging grounds. In terms of incidental take you would really need to see how effort responds to the removal of the closure in 1B.

5.4.11 Potential impacts on seabirds

Seabird fledging success is determined not only by the abundance of forage species, but also, more specifically, by the availability of forage species near breeding colonies during the breeding season (Clay et al. 2014). Some seabirds migrate great distances and require suitable habitat, including suitable food sources, at key locations along their migratory routes. During development of this action, stakeholders provided specific information about the species of birds that are potentially more dependent on herring. Staff from USFWS helped to identify the subset of species that are known to consume herring from the overall list of priority species for this region (Table 11). Furthermore, the MSE analysis prepared for the ABC control rule section of Amendment 8 included a specific metric for common tern, a species that generally has a higher proportion of herring in its dies and has more extensive data on counts of breeding pairs and estimates of fledging success.

Correspondence to the Council included references about seabird diet and foraging behavior that are considered in these draft impacts (Goyert 2015 and Goyert 2014). Herring is among the top prey items fed to tern chicks in Massachusetts, comprising over 20% of their diet (Table 92). Outer Cape Cod is known as a foraging hot spot for Common and Roseate terms, especially near Monomoy Island; the largest breeding ground for Common terns in New England. Breeding typically takes place form May-July and foraging offshore typically takes place in August – September, before the birds migrate to South America (Goyert et al., 2014). Based on tagging data, the foraging range during breeding and post-breeding has been documented as far as 50(km) or 27nm between sites. However, a more typical foraging distance may be 30km, or 16nm, as shown in the figure below (Figure 46). Common tern colonies are found along the coast throughout New England, and as far south as Long Island, NY and coastal New Jersey.

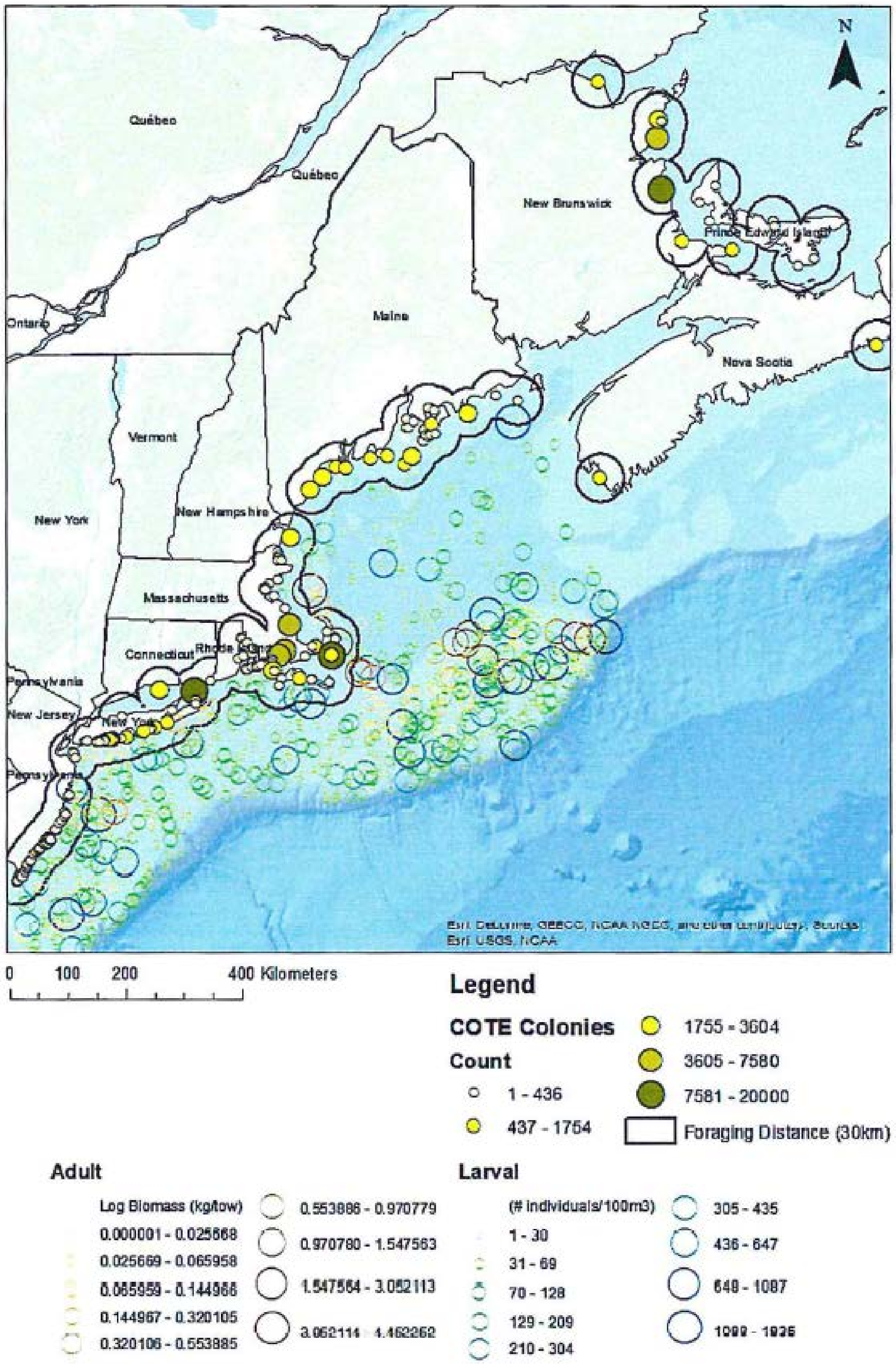
Table 92 – Prey composition (proportion) of nest-provisioning at Bird Island, 2009-2011 (Source: Goyert 2015).

	2009		2010		2011	
	CT	RT	CT	RT	CT	RT
Sandlance	0.41	0.87	0.31	0.64	0.17	0.57
Herring	0.16	0.08	0.27	0.28	0.20	0.18
Anchovy	0.05	0.02	0.01	0.00	0.20	0.13
Shrimp	0.10	0.00	0.04	0.00	0.09	0.00
Other	0.12	0.01	0.10	0.00	0.04	0.00
Unknown	0.16	0.02	0.27	0.08	0.30	0.12
N	385	245	169	88	359	169

Proportions indicate the relative number of prey delivered to chicks by common (CT) and roseate terns (RT), from June–July, by year (*N*).

Figure 46 – Common tern colony size and foraging distance

Note: Adult and larval biomass in open circles is sandlance biomass, not Atlantic herring; data from NOAA Ecosystems Monitoring Survey 2005-2015



5.5 PHYSICAL ENVIRONMENT AND ESSENTIAL FISH HABITAT

NMFS' Guidelines for identifying essential fish habitat (EFH) and adverse impacts on EFH also reflect the importance of keystone species like Atlantic herring to the overall health of the ecosystem as well as the importance of prey abundance for other species (50 CFR 600, 1/17/02, p. 2378):

> *Prey species.* Loss of prey may be an adverse effect on EFH and managed species because the presence of prey makes waters and substrate function as feeding habitat, and the definition of EFH includes waters and substrate necessary to fish for feeding. Therefore, actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species, may be considered adverse effects on EFH if such actions reduce the quality of EFH. FMPs should list the major prey species for the species in the fishery management unit and discuss the location of prey species' habitat. Adverse effects on prey species and their habitats may result from fishing and non-fishing activities.

If LD measures are expected to greatly restrict MWT effort so that vessels may convert to other gear types there could be different impacts on EFH. Specifically, if vessels converted to SMBT – how likely is that? What would that mean for EFH? If more vessels fish with gear that is in contact with the bottom there could be increased impacts, but if the bottom trawl gear is fished "midwater", actual impacts may not be that different. Also, Omnibus Amendment 2 identified the areas that are most vulnerable to mobile gear and closed them, so increase BT effort would be in areas that are less vulnerable to impacts.

5.5.1 No Action – Prohibition of MWT gear in Area 1A June – September

The Area 1A gear prohibition likely shifted midwater trawling effort from the inner Gulf of Maine on to Georges Bank during June-September. However, this is not expected to adversely impact EFH. This conclusion is based on information in the Gear Effects Evaluation (Appendix VI, Volume II of Amendment 1) indicating that bottom contact by midwater trawls occurs only occasionally, and that the use of bottom trawls and dredges, which contact the bottom continuously, far exceeds the use of herring midwater trawls. Bottom habitats in open access areas where the use of midwater trawls could increase are already subjected to disturbance by bottom trawls and/or dredges, so any additional disturbance of bottom habitats caused by gears used in the directed herring fishery would be negligible. Bottom habitats in areas that are closed to bottom trawls and dredges are more susceptible to disturbance, but there is no reason to believe that closed areas on GB – where midwater trawling may have increased under No Action – are any more vulnerable to bottom contact than closed areas in the GOM – where midwater trawling likely decreased. In fact, bottom contact may be more likely to occur in the GB closed areas because the predominant sediment type on the bank is sand, which is less likely to damage the nets than hard bottom substrates in the western GOM. However, sandy bottom habitats on GB are naturally disturbed to a greater extent by bottom currents and are therefore less vulnerable to bottom disturbance than hard bottom habitats in the western GOM. Hard bottom substrates also support a greater diversity and biomass of epifaunal organisms which are highly vulnerable to contact by fishing gear. Therefore, the No Action alternative has likely had neutral to low positive impacts on EFH.

5.5.2 Spatial closures and gear prohibitions: back of Cape (large and small), Area 1A, buffer areas (12, 25, 50)

Reference to proposed cod HAPC alternatives in EFH Omnibus action. These areas overlap LD alternatives, but the gears do not impact benthic impacts. However, forage is an element of EFH as well. But juvenile cod do not eat herring to the same degree as adult cod.

Species that consume herring and at what sizes. Generally adults, not juveniles.

Plaice – larger adults 41-70 cm
Cod – med and larger adults, 50 cm+
Halibut
Haddock – large adults
Pollock – adults
White hake – larger adults, 50+ cm
Silver hake – larger juveniles and adults
Monkfish – adults > 50 cm
Skates – thorny, barndoor, little, winter - adults

5.5.2.1 Seasonal sub-options

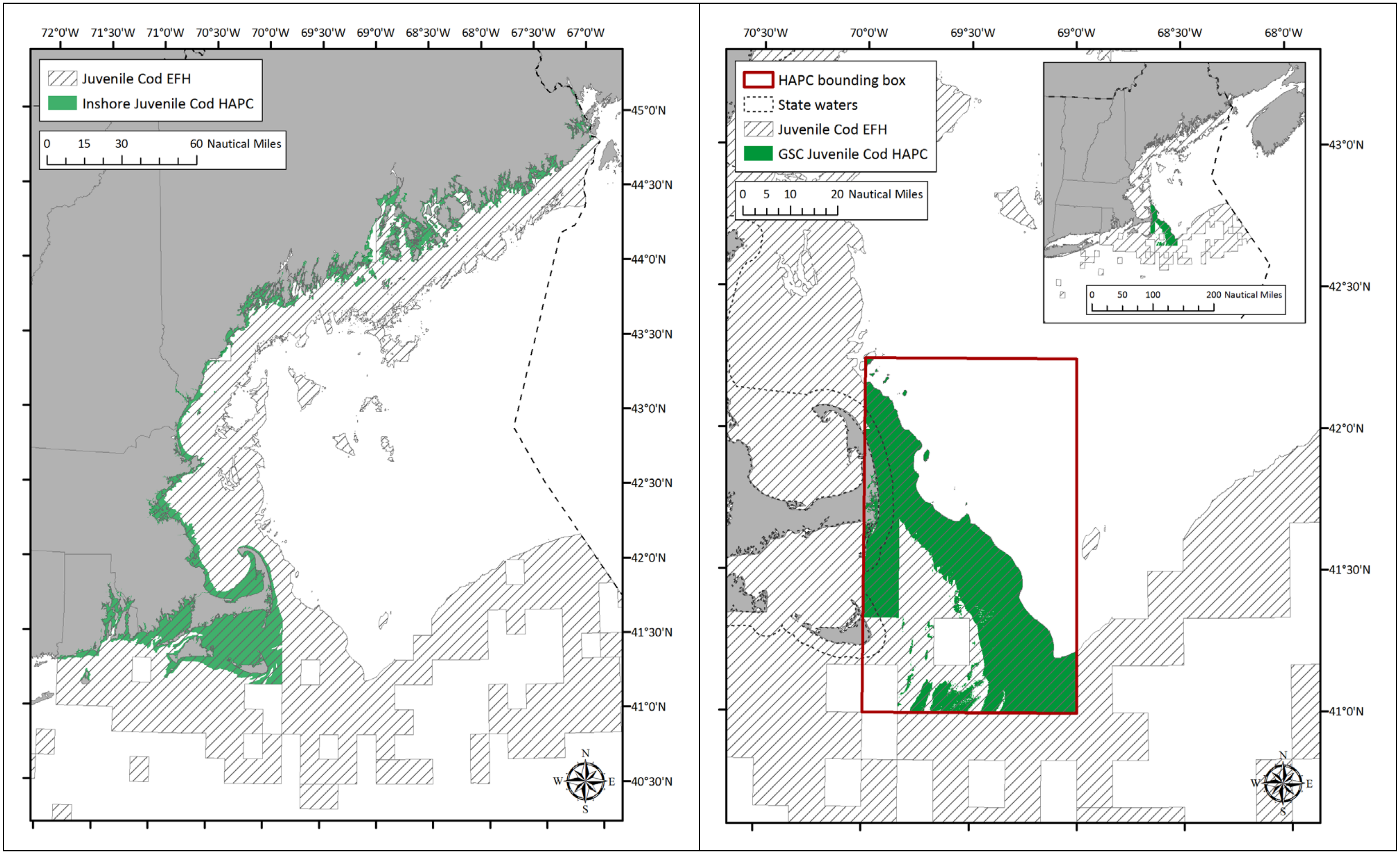
5.5.2.2 Spatial sub-options

5.5.3 Boundary change between 1B and 3

From A1 - This measure could affect area-specific sub-ACL allocations and cause some minor shifts in fishing effort in the herring fishery, but any adverse habitat effects associated with the fishery will continue to be minimal and/or temporary. sub-ACL allocations and their associated impacts will continue to be assessed through the fishery specification process.

5.5.4 Remove seasonal closure of Area 1B

Figure 47 – Juvenile cod EFH (left) and proposed HAPC for juvenile cod from Omnibus Amendment 2



5.6 IMPACTS ON HUMAN COMMUNITIES

5.6.1 Measures to Address Potential Localized Depletion and User Conflicts

5.6.1.1 Introduction

5.6.1.1.1 Information to support impacts analysis

The impacts analysis of the localized depletion and user conflict alternatives is based primarily on analyses to identify fishing locations for the Atlantic herring fishery and overlaps with the fisheries for the predators of herring (including whale watching). These analyses are first described here, preceding the discussion of impacts of specific alternatives. There is also information provided about the bluefin tuna fishery, in addition to that provided in the Affected Environment.

5.6.1.1.1.1 Confidentiality requirements

MSFCMA section 402(b), 16 U.S.C. 1881a(b) states that no information gathered in compliance with the Act can be disclosed, unless aggregated to a level that obfuscates the identity of individual submitters. The fishery data in this amendment is thus aggregated to at least three reporting units, to preserve confidentiality. Any data with less than three reporting units is censored to comply with this federal law. Additional standards are applied to reporting the fishing activity of particular states or fishing communities. To report landings activity to a specific geographic location, the landings have been attributed to at least three fishing permit numbers and the landings must be sold to three dealer numbers. However, the dealers do not necessarily have to be located in the same specific geographic location.

5.6.1.1.1.2 VTR analysis

Vessel trip reports (VTR) and observer data are the primary sources of data used here to understand herring fishing location, landings/revenue, and number of vessels and ports that might be affected by a particular alternative. VTRs are required for all vessels fishing with a federal permit (unless the only federal permit is lobster). For a trip where VTR is required, the vessel must submit a VTR for each gear type used and/or statistical area fished in, including a single point location for where fishing occurred relative to that VTR. However, previous studies indicate that this self-reporting underreports switches in gear type and statistical area (Palmer & Wigley 2007; 2009). Furthermore, and perhaps more importantly, given that commercial fishing trips can be quite long, a single spatial point is unlikely to adequately represent the actual footprint of fishing. Because of this, a statistical approach was used, referred in this action as the “VTR analysis,” to better represent the footprint of fishing (DePiper 2014). This analysis was developed for the Omnibus Habitat Amendment (NEFMC 2017, Volume 4) and used in several actions of the NEFMC and MAFMC since. This is the best approach to identifying the locations of Atlantic herring fishing and is briefly summarized here.

Briefly, VTR data are matched to observer data. A statistical model is then estimated to explain the distance between hauls and the corresponding VTR coordinate. Days absent and gear used are major explanatory factors. The results are used to expand the VTR coordinate to a circular region. Fourth, portions of circular regions that cannot be fished (such as land or areas closed to fishing) are removed and landings or fishing time from the VTR data are assigned to the remaining region. Finally, the individual trips are aggregated to the appropriate level.

Using this method, the PDT developed the tables herein estimating the amount of landings harvested from the various areas/seasons considered under the alternatives. Note that the model output is the location of herring landings rather than catch. However, for the Atlantic herring fishery, landings generally approximate catch, as Atlantic herring discards represent a very small fraction of total Atlantic herring catch (generally <0.3%). Because the landings data are model outputs, the data should be considered estimates.

5.6.1.1.1.3 Herring fishery costs

To estimate the economic impact of moving fishing effort by the midwater trawl (paired and single) fleet from inshore to offshore waters, observer data were binned into one of four ranges of distance from shore (Table 93 and Table 94). The four ranges align with localized depletion Alternatives 4-6. The total number of trips, average catch (kept, discarded combined), days absent (trip start to trip end), steam time (time from dock until net first set) are included. The average cost of damages incurred during the trip, food, fuel (used and cost), oil, supplies, and water are also calculated for each range. Data are summarized based on observed trips, 2014-2017, using final loaded NEFOP data. A number of trips (32) were fished in more than one of the ranges; for these trips, the trip was assigned to the range which was furthest from shore. Average catches are the same for all the distance categories, but costs and steam time generally increase for trips farther offshore.

Table 93 - Atlantic herring fishery trip data, by distance from shore, 2014-2017

Distance (nm)	Trips	Catch (lbs.)	Days absent	Steam time (hours)	Fuel used (gal.)	Fuel price
<12	56	340,511	2.6	13	1,599	$2.43
12-25	47	325,329	3.4	18.3	2,562	$2.71
25-50	12	234,949	4.3	28.4	3,342	$2.78
>50	130	338,830	4.2	20.8	3,298	$2.51
Source = NEFOP data.						

Table 94 - Atlantic herring fishery trip costs, by distance from shore, 2014-2017

Distance (nm)	Fuel	Damage	Food	Oil	Supply	Water	Total
<12	$3,886	$231	$338	$159	$9	$3	$4,626
12-25	$6,943	$1,615	$511	$308	$109	$2	$9,488
25-50	$9,291	$25	$393	$335	$13	$0	$10,057
>50	$8,278	$78	$556	$206	$125	$6	$9,250
Source = NEFOP data.							

5.6.1.1.1.4 Fishery overlap

An analysis was conducted to identify the seasons and areas that have been important to the herring midwater trawl fishery, the commercial fisheries for groundfish and bluefin tuna, and the commercial whale watching industry (Figure 48; Appendix XXX and figures therein). Spatial, monthly overlaps were identified between the predator user groups and the herring MWT fishery under three different time periods: 1) pre-Amendment 1 (2000-2006); 2) post-Amendment 1 (2007-2015); and 3) recent (2013-2015).

Summary of overlaps: The level of overlap between the herring MWT fishery and all other predator users analyzed dropped significantly in 2007 with the passing of Amendment 1 (Figure 49). The seasonal profile of overlap has also changed since 2007 (Figure 50), with less overlap in summer months in recent years. These changes in seasonal overlap are due in part to Amendment 1, but also to changes in the distribution of landings in the predator fisheries caused by modifications to the spatial measures for those fisheries.

Overlap with commercial groundfish fishery: In all three time periods, the greatest amount of overlap between the herring MWT and groundfish predator fisheries occurred near Cape Ann in October-November. Prior to Amendment 1, significant overlap also occurred in this area during the summer months; however, this interaction has been minimal since 2007. In the recent time period, the most important herring-groundfish overlap *outside of* Area 1A occurred along the northern edge of Georges Bank in May, off outer Cape Cod in July-August, the Great South Channel in September, and near Block Island in December-January.

Overlap with bluefin tuna fishery: In all three time periods, the overlap between the herring MWT and bluefin tuna fisheries is greatest during October near Cape Ann. Prior to Amendment 1, overlap between these two fisheries also occurred in Area 1A during July-September. More recently, there has also been relatively high overlap along the northern edge of Georges Bank during November.

Overlap with the whale watch industry: Prior to Amendment 1, the greatest overlap between the herring MWT herring MWT fishery and commercial whale watch operators occurred in several areas within Area 1A from May-November. As with the other user groups focused on herring predators, the summer Area 1A overlap no longer exists, and currently the area with the greatest overlap is near Cape Ann during October-November. It should be noted that any inference about the change over time in overlap with whale watching comes entirely from the herring MWT dataset, as the spatial/seasonal pattern for whale watching was assumed time-invariant.

Overlap relative to the alternatives: Alternative 3 (year-round prohibition of herring MWT fishing in Area 1A) and the widest shoreline buffer alternatives (Alt 5 and Alt 6) with the year-round sub-option encompassed the largest portion of overlap with the groundfish predator fisheries (up to 20-45%). For the commercial tuna fishery, Alternative 3 by far encompassed the greatest portion overlap with the herring MWT fishery (50-60%), with all other alternatives covering <20%. Similarly, Alternative 3 encompassed >90% of the overlap with the whale watching industry, with all other alternatives covering <10%.

Figure 48 – Percentage of fishery overlap for each A8 localized depletion alternative

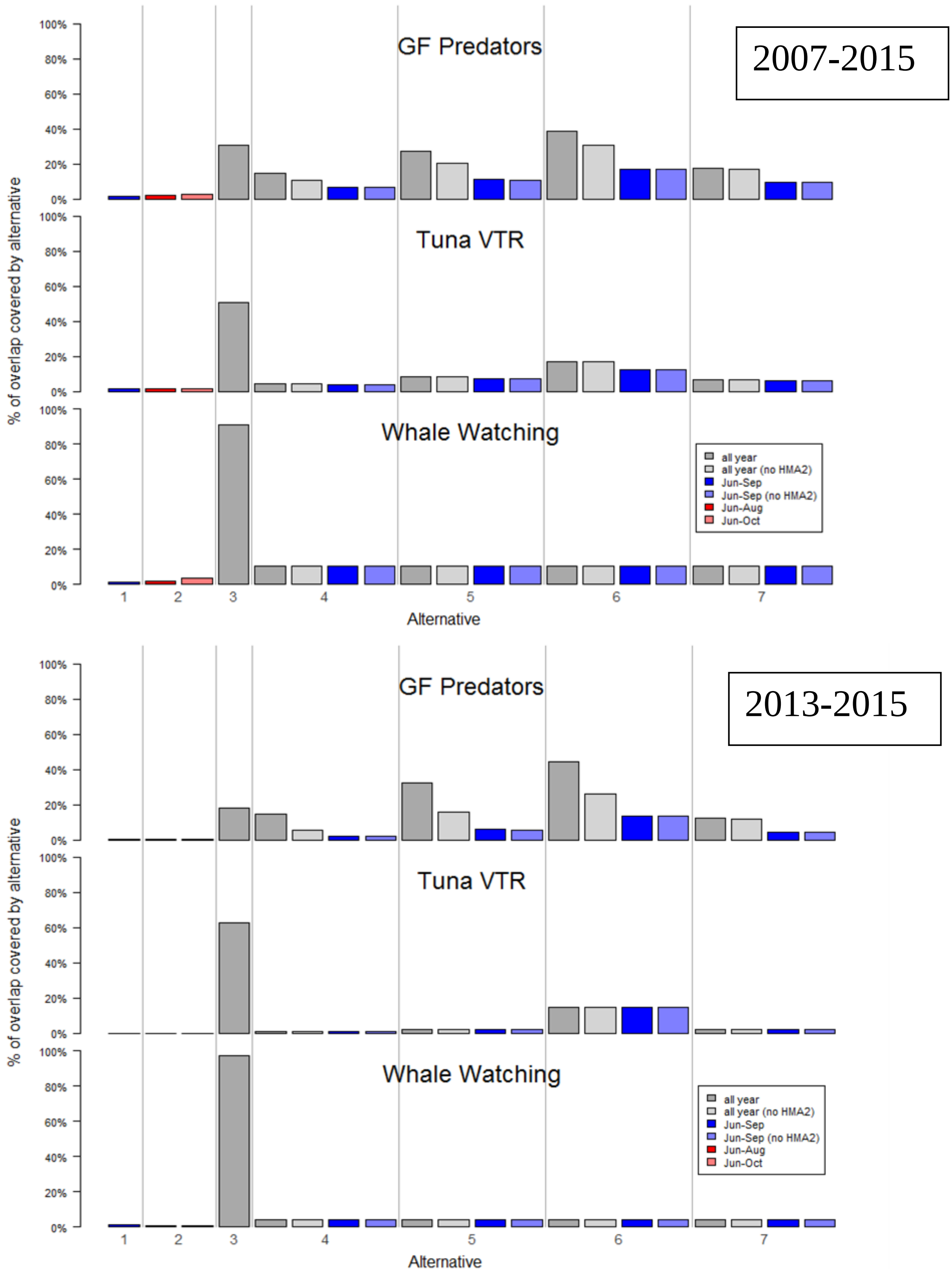


Figure 49 – Annual index of overlap between the herring MWT fishery and other predator-focused user groups, 2000-2015

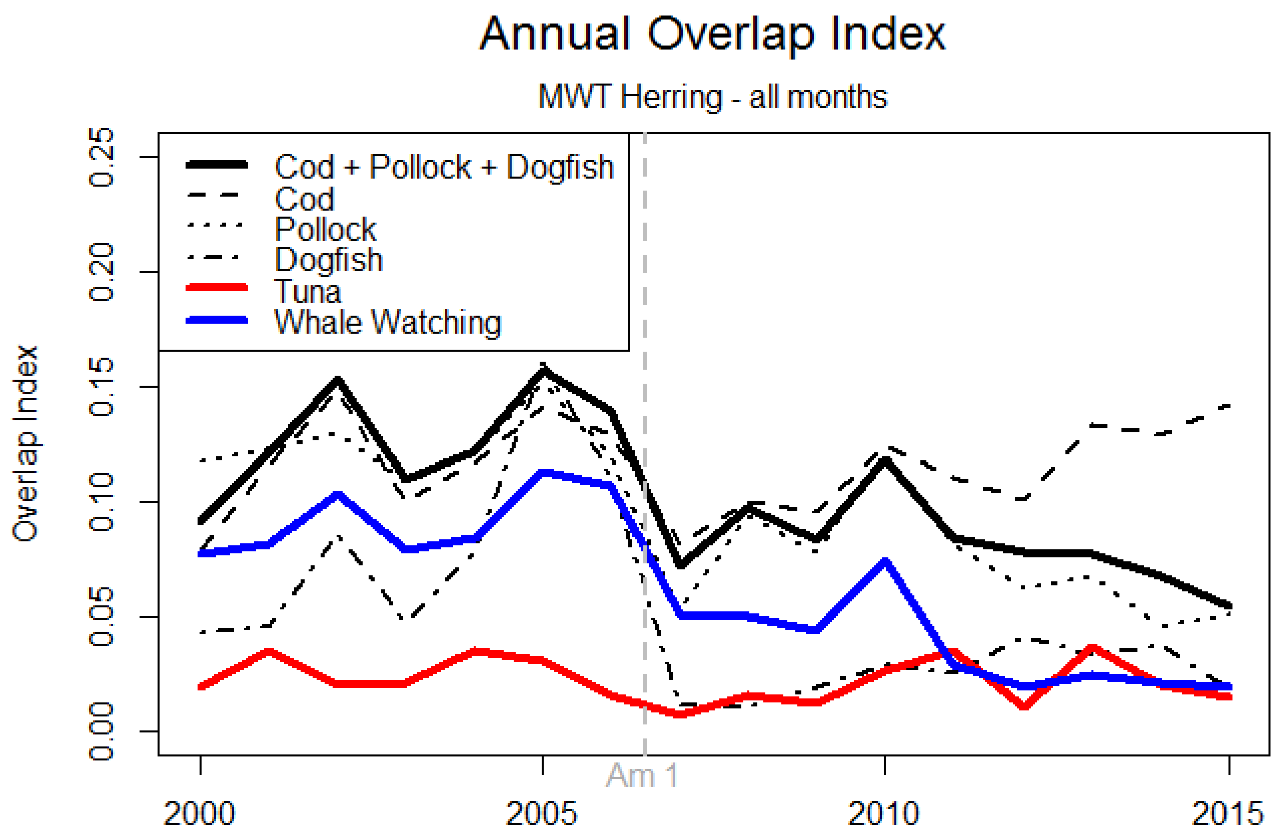
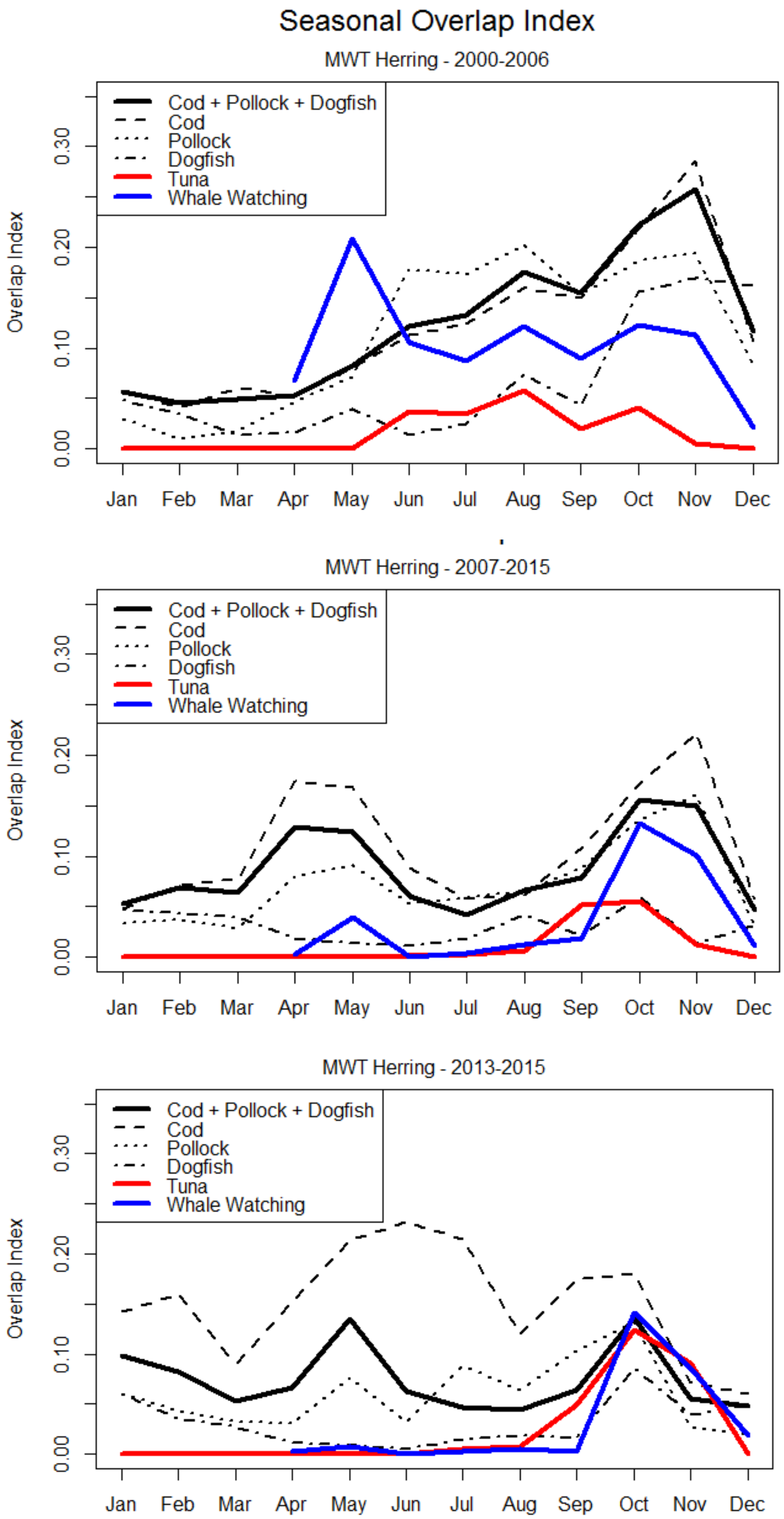


Figure 50 – Seasonal index of overlap between the herring MWT fishery and other predator-focused user groups, under three different time periods



5.6.1.1.1.5 Additional information on bluefin tuna fishery

Recent commercial bluefin tuna catch data indicate that the fishery occurs in January-March, is closed April and May, peaks in September and October, with catch slowing in November and December (Table 95). Within Herring Management Area 1A (inshore Gulf of Maine), the bluefin tuna fishery primarily overlaps with the herring purse seine fishery, largely due to the seasonal exclusion of midwater (MWT) trawl gear from Area 1A. From June 1 through September 30, 72.8% of the annual Area 1A quota is available to purse seine and fixed gear fisheries only. The herring fishery in Area 1A opens to all gear types (including MWT) on October 1 (subject to spawning closures which may cause a delay up to a few weeks). The period from October 1 through December 31 is allocated the remaining 27.2% of the quota. Overlap between MWT and bluefin tuna vessels generally is heaviest during October (after the herring spawning closures), when tuna catch rates are still high, and MWT vessels have access to 1A quota. The Area 1A herring quota is generally harvested by late October or early November, and fishing for herring in this area thereafter is only for research purposes. In spite of overlap with MWT fisheries in Area 1A, October is similar to September in monthly bluefin catch average, and October of 2016 recorded the highest bluefin catch of any month in this five year period. Overlap between bluefin tuna fisheries and MWT gear may occur in other herring management areas throughout the traditional bluefin fishing season.

Table 95 - Monthly Commercial General and Harpoon Category Landings (mt), 2012-2016.

	2012	**2013**	**2014**	**2015**	**2016**	**Monthly Average**
Jan-March*	37.1	32.4	36.3	31.4	51.5	**37.76**
June	39.6	38.9	38.2	24.9	54.8	**39.28**
July	71.2	53.4	48	120.5	118.4	**82.3**
August	61.2	37.7	55.2	82.9	73.1	**62.02**
September	106.8	41.6	101.3	177.2	185.7	**122.52**
October	106	25.8	113.3	111	243.7	**119.96**
November	23.9	8.4	40.1	99.7	51.8	**44.78**
December	27.6	56.9	38.7	11	0	**26.84**

*No bluefin fishery in April and May.
Source: NMFS HMS Division

High resolution spatial data for bluefin tuna catches are limited. There are some spatial data for the recreational fishery, collected by the Large Pelagic Survey. The commercial catch location is recorded in the bluefin dealer data and trip reports, but the bluefin tuna reporting areas are broader in scope and differ from GARFO Statistical areas (Map 10). There is some level of overlap with vessels holding both bluefin tuna and GARFO permits, thereby triggering the VTR requirement, but that overlap and consistency in reporting bluefin in the VTRs has yet to be assessed.

Currently, no known studies have addressed the effect of localized depletion of herring on bluefin tuna and other predators. Dr. Walt Golet (GMRI/UMO) has not examined localized depletion questions specifically, but has done a lot of research on bluefin migration and diet, and has identified correlations between Atlantic herring and bluefin tuna schools. Golet has been given access by tuna fishermen and dealers to their logbooks, which has spatial catch data at a finer resolution than what is submitted to NMFS. However, these data are proprietary and not readily available to the PDT. He indicated that an investigation of localized depletion would be possible, but would need to draw on many areas of expertise and involve using acoustics, vessels, and the logbook data, be a long-term project, and involve a diverse array of investigators to ensure that causality is appropriately attributed (e.g. tuna fishermen are constrained by weather windows). The biggest concern is study design; this would have to be carefully thought out and by a diverse team. Such an open process is critical for the transparency of results, the most efficient use of any funds which may be available to support this work, and for proper study design (e.g. to ensure causality is correctly identified). Given the complexities of this proposed study, the PDT does not expect any information to be available for this action.

Analysis of localized depletion of herring in the tuna fishery is a complex problem. Data clearly show that herring abundance and condition impact the condition and behavior of bluefin tuna. What is not clear is if or how the herring fishery, and specifically the MWT fleet, contributes to this. The lack of precise spatial data available to the PDT from the tuna fishery limits the amount analysis that can be performed on both the scientific and economic impacts of localized depletion due to the herring fishery. These impacts are especially difficult to quantify given the relatively high recent catch rates in the commercial General and Harpoon category bluefin fishery, even during periods of overlap with herring MWT fisheries.

5.6.1.2 Impacts applicable to all alternatives

This action considers a range of spatial and temporal closures for either the Atlantic herring fishery or just for midwater trawl gear. The following is a description of the economic and social impacts that can generally occur as a result of area closures.

Area closure alternatives can have numerous social impacts across various fisheries and communities. The most direct impacts would be on vessels currently fishing in these areas that would no longer have access to those areas. The addition of new closures would force the fishing operations that would be constrained to modify where and how they fish, having a negative impact on the *Historical Dependence on and Participation* in the affected fisheries. This would also have a negative social impact on the *Size and Demographic Characteristics* of the affected fisheries, because of a probable reduction in fishing opportunity, revenue, and employment. Negative social impacts would be expected in the *Non-economic Social Aspects* of the fishery, as fishermen would have less flexibility in choosing where to fish.

There are numerous caveats associated with landings/revenue estimates. Redistribution of effort into other locations may mitigate negative effects, but alternative fishing choices are difficult to predict. Relocation may be challenging if other locations are already crowded with gear or if it is difficult to catch the target species outside the closed area. If effort can be redistributed outside closed areas, net losses to displaced fishermen will be dependent on changes in efficiency and costs of fishing in alternate fishing grounds. The impacts analysis explores, qualitatively, possible alternative fishing location choices, based on current distributions of effort. While a relatively small fraction of revenue in a particular fishery may come from a particular area/season, the revenue may be concentrated amongst a small number of individuals and/or communities.

In response area closures, some Atlantic herring vessels may have to change the times and areas within which they operate, moving to less desirable fishing grounds. The fishermen have developed agreements over time about sharing fishing grounds, so it may be difficult to adjust to new area closures. When deploying and fishing their nets, fishermen account for bathymetry, current, wind, and area restrictions. These factors may prevent them from fishing efficiently outside a particular area/season. The impact on these operations may be some combination of increased costs and/or decreased revenues. Increased costs may occur if operations have to travel further to reach alternative fishing grounds, or if they must fish in areas with lower catch-per-unit of effort (and thus incur increased costly fishing effort to catch the same amount of fish). Decreased revenues may occur if fishing operations find that they are unable to catch the same amount of fish, because increased travel or fishing time makes it impossible to catch the same amount of fish in the time available. Decreased revenues may also occur if shifts in fishing activity also make it harder to deliver a quality product.

The ability to adapt to a new closure is highly variable. Less mobile fishermen may bear a larger impact as they are less able to easily switch harvest areas. Smaller vessels would be less adaptable to near shore closures, as their range is limited and they cannot easily prosecute the fishery in offshore areas. Any change in fishing behavior by less mobile fishing businesses that attempt to employ more mobile fishing strategies would likely have additional social costs, such as disruptions to family and community life, as well as increase the likelihood of safety risks. Increased risk can result when fishermen spend longer periods at sea to access offshore areas that would not be affected by the closures. Fishermen severely impacted by the new closed areas may leave fishing entirely or at least seek temporary opportunities in another fishery or gear type that is less affected by the management alternatives. Both possibilities would cause a change in the *Size and Demographic Characteristics* of the different fisheries.

If an area is closed to some but not all fishing gears (e.g., closed to MWTs only), fishermen who may remain active within a given area may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This may cause resentment among fishermen who would be affected by the restrictions. This could negatively affect the *Social Structure and Organization* of a community.

There are many instances in which fishermen have differing views than those held by ocean and fisheries scientists. A fisherman’s view is based largely on personal experience and their own proximal environment, which can be at odds with the larger environment described by fisheries scientists. This continued lack of faith in the science used to inform management decisions could undermine the perceived legitimacy of future management actions and have a negative social impact on the formation of *Attitudes, Beliefs, and Values* about management. The impact of new closures on the *Attitudes, Beliefs, and Values* of fishermen is uncertain and is largely related to the level of acceptance and belief in the efficacy of the new closures to adequately address concerns about localized depletion.

There is the potential for positive social impacts derived from new closures. These are generally associated with the potential future and long-term benefits that the closures would have on the improvement of fish stocks. These benefits are difficult to analyze, because of the uncertainty associated with the magnitude of the benefit, how these benefits would be distributed among fishing communities, and the timing of these impacts. For example, vessels that are unable to adapt to new restrictions in the short-term may not be able to benefit from the potential stock increases in the long term. Additionally, the short term impacts on markets, processing capability, and other infrastructure during the period of adjustment to the new closures may be such that these shoreside resources are lost and unable to recover in the future when potential stock increases occur.

Those communities that are more dependent on the Atlantic herring fishery and are located in proximity to the proposed closures would have larger social impacts than those that participate in a range of fisheries. The full impacts of this action would ripple through the economy (e.g, fuel, bait, ice suppliers). After the first point of sale, a host of other related industries, including seafood retailers, restaurants, transportation firms, all of their suppliers, and ultimately the consumers that frequent these establishments are also impacted by area management decisions. Because the primary focus in this document is on ex-vessel revenues, the information provided should be considered a partial analysis; optimally, broader societal impacts would be determined.

5.6.1.3 Alternative 1 (No Action: prohibit MWT gear in Area 1A from June – September)

No Action. Vessels fishing for herring with midwater trawl gear are excluded from fishing in Area 1A June 1 through September 30.

Impacts on Atlantic herring fishery

The impacts of Alternative 1 on the Atlantic herring fishery are expected to be neutral. The seasonal midwater trawl closure implemented in 2007 would be maintained, resulting in no additional economic or social impacts on fishery-related businesses and communities. The *Size and Demographic Characteristics* of the fishery-related workforce would likely be unchanged. Since 2004, the Area 1A sub-ACL of Atlantic herring has been over 96% harvested each year, with two exceptions: 2012 (88%) and 2016 (91%). Thus, the gear closure, by itself has likely not limited the ability of the fishery to adapt and harvest the resource. There have been many changes to the management of Atlantic herring since 2007, causing substantial changes within the fishery. Some of these changes may be caused, in part, by this closure, but identifying causality is difficult.

The Atlantic herring fishery has undergone multiple changes to its management structure in Area 1A and elsewhere. In addition to MWTs being excluded from Area 1A in June-September, starting in 2007, quota reductions in Area 1A and elsewhere have also impacted the fishery. Since 2000, there has been a marked change in removals by area (Figure 51). Post 2007, catches in the offshore areas (Areas 2 & 3) increased while catches inshore decreased. This is likely due to a number of factors, including the reduction in Area 1A quota from ~60,000 mt in 2005 to ~27,000 by 2010. Catches over all have decreased and then increased, due in part to changes in Optimum Yield and overall quotas fishery-wide. While fishery-wide catch has declined since 2000, price has increased from $0.05 to >$0.15 per pound, a three-fold increase (Figure 52). This increase is thought to be largely due to the reductions in overall catch, the shift to more off-shore harvest and consolidation of the fleet given management actions to control access [reference figures in biological impacts].

The purse seine fishery has become dominant in Area 1A since 2007, both in terms of the proportion of annual Atlantic herring catch (Figure 53), the number of trips (Figure 54), and catch per trip (figure in bio impacts). Within June-September, the number of active permits in Area 1A fluctuated between 20 to 25 pre-2007, but declined to under ten by 2014 (Figure 55).

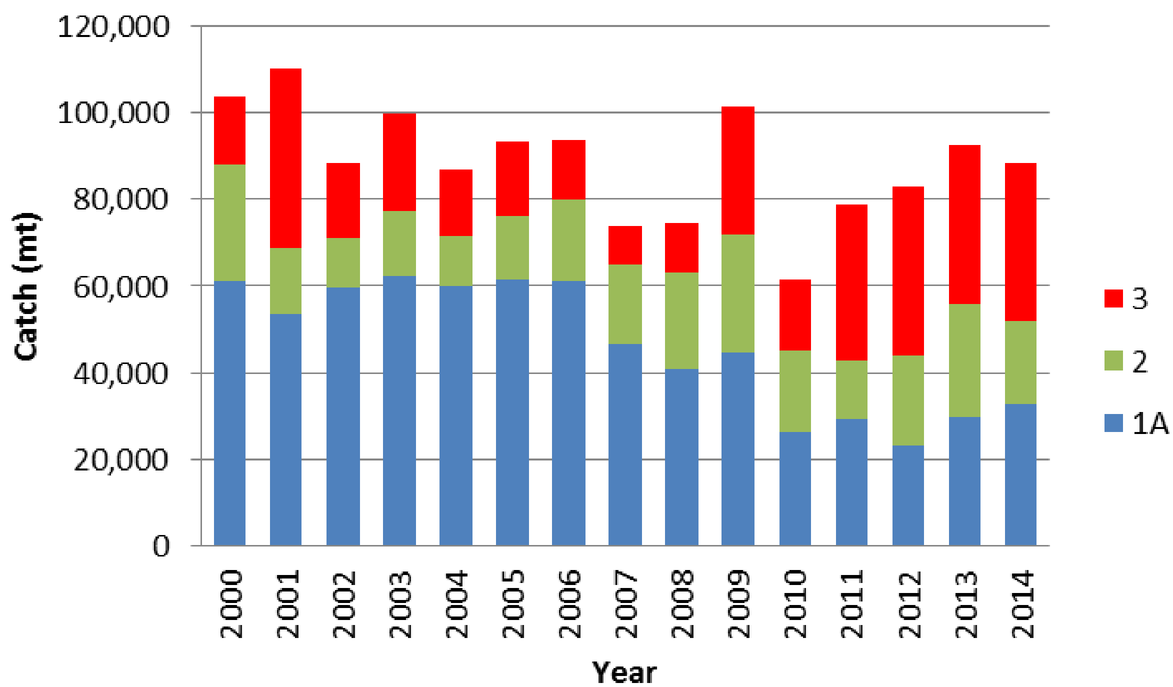
Summertime revenue per permit has also increased in Area 1A above pre-2007 levels, from $100K-$300K in 2000-2007 to $800K in 2014.

Some vessels fishing with MWT prior to Amendment 1 have remained active in Area 1A in June-September by adjusting their operations. Some have acted as carrier vessels for the purse seine fishery. Use of a carrier vessel, which also occurred prior to the MWT closure, allows a purse seine vessel to increase fishing capacity per trip. Region-wide, the number of vessels with carrier Letters of Authorization increased from six in 2006 to 13-18 in 2007-2010 (Table 40, p. 85). It is likely, though, that the revenue for a MWT vessel derived from acting as a carrier vessel is lower than if it is actively fishing. Additionally, some MWT vessels have been reconfigured to allow switching between purse seine and MWT, such that the vessel may continue in the directed fishery.

Thus, for the purse seine fishery, the impacts of No Action are expected to be positive as they would continue to benefit to the seasonal 1A MWT closure. By contrast, the MWT fishery is expected to have continued negative impacts. To some degree, negative impacts would be mitigated by the ability of MWT vessels to act as carrier vessels, switch between gear types, and to fish in all other management areas at other times of year (herring is mostly in Area 1A in the summer), particularly offshore, which is inaccessible to the purse seine fleet due to gear logistics. However, there are increased operational costs of fishing offshore (Table 94).

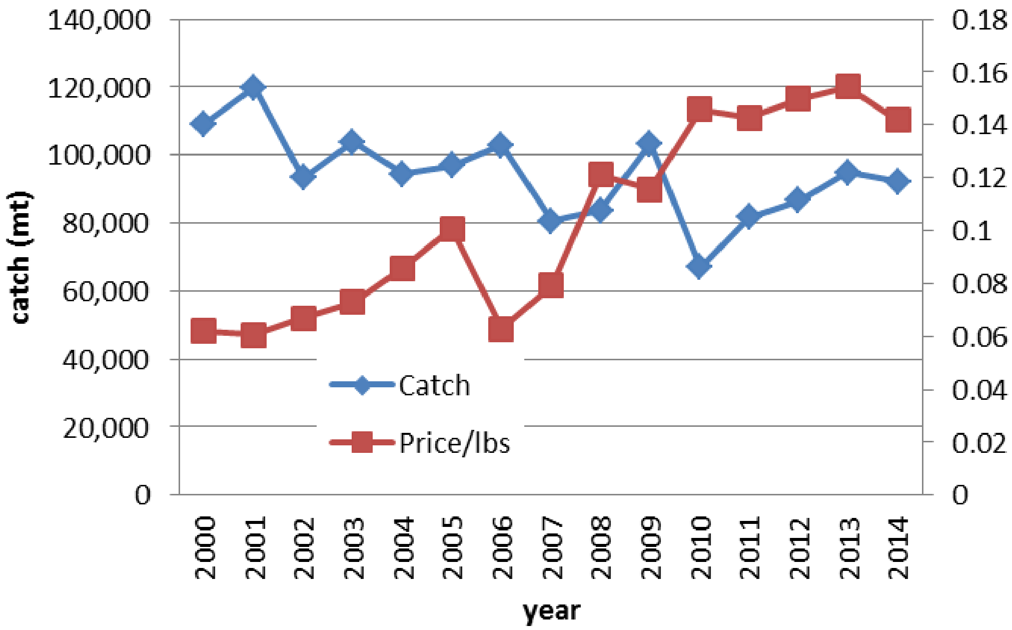
For the fishery overall, the long-term impacts are likely neutral. Although the herring resource has improved since the implementation of Amendment 1, to the long-term benefit of the fishery, those benefits cannot be directly linked to this seasonal MWT closure, in isolation of all other measures that have been adopted (Section 5.1.1, p. 167).

Fig**u**re 51 – Atlantic herring catch by all gear types by herring management area by year



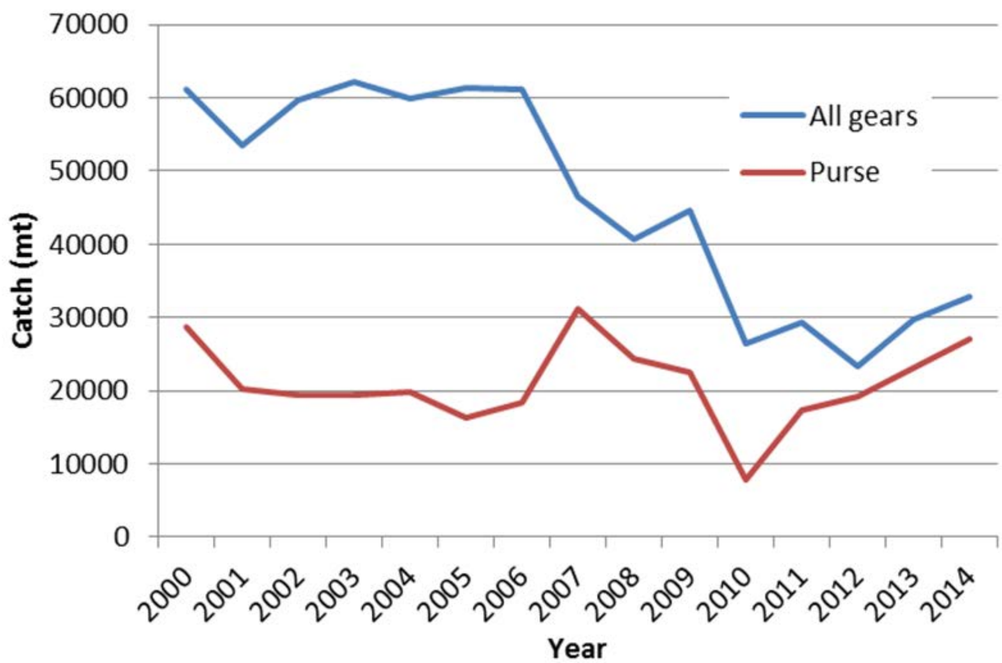
Note: Only catches >6,600 lbs. are included. Area 1B excluded.
Source: VTR data, accessed 2016.

Figure 52 – Atlantic herring catch and price per lbs., all gears all areas



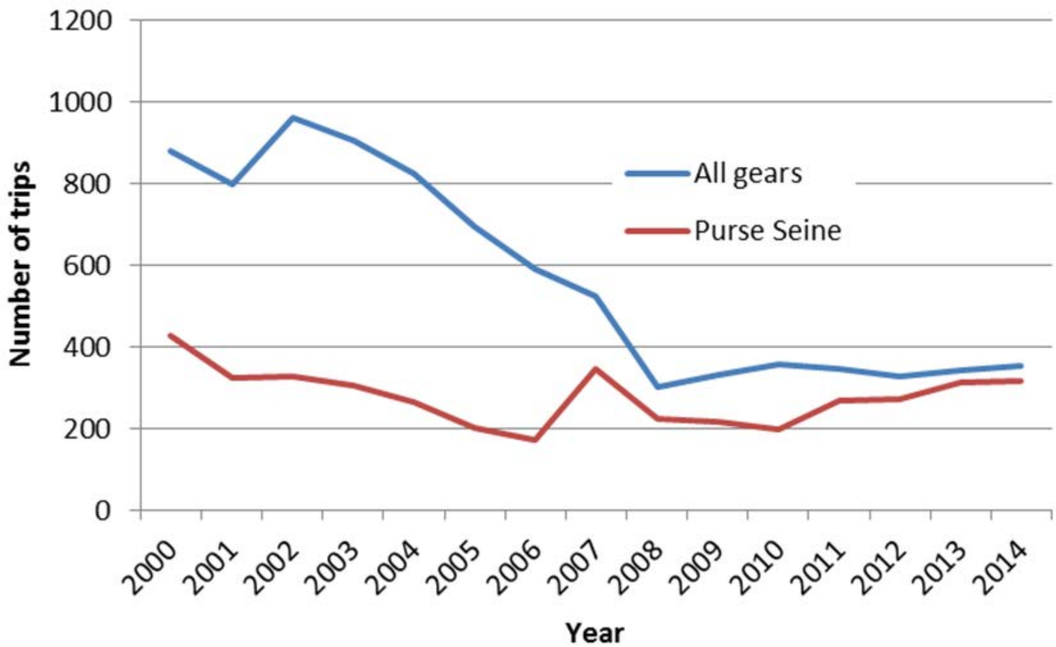
Note: Only catches >6,600 lbs. are included. *Source:* VTR data, accessed 2016.

Figure 53 - Annual Atlantic herring catch in Area 1A for purse seines and all gears



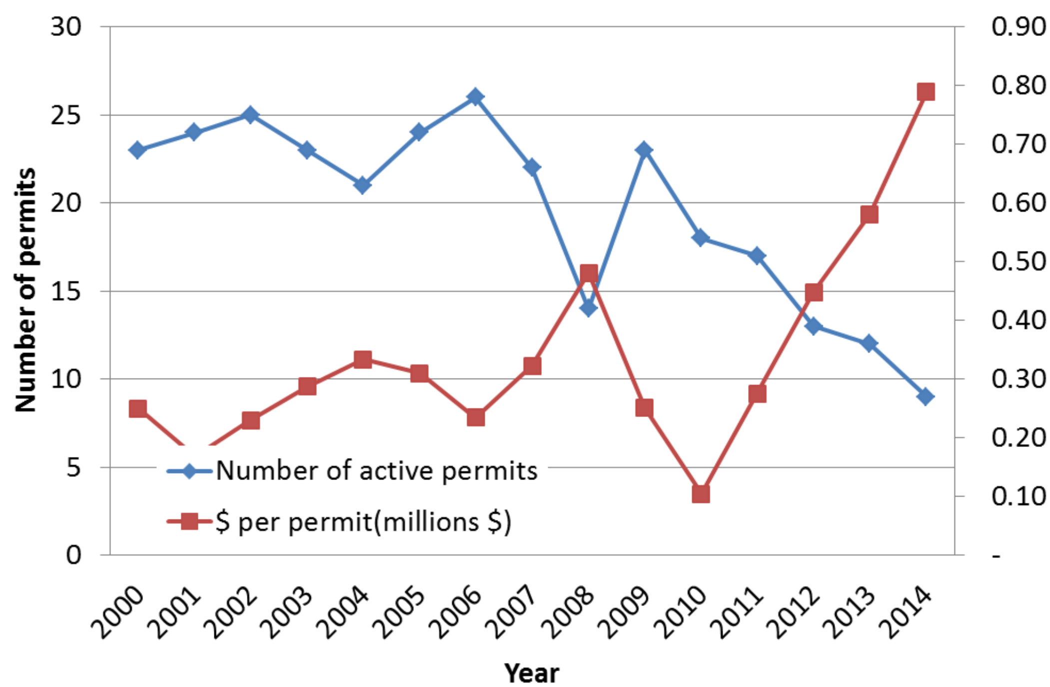
Note: Only catches >6,600 lbs. are included. *Source:* VTR data, accessed 2016.

Figure 54 - Annual number of trips in Area 1A for purse seines and all gears



Note: Only catches >6,600 lbs. are included. *Source:* VTR data, accessed 2016.

Figure 55 - Number of active permits and average total revenue (average catch times average price/lbs summed) in Area 1A, June through September by year



Note: Only catches >6,600 lbs. are included. *Source:* VTR data, accessed 2016.

Impacts on Atlantic mackerel fishery

The impacts on the Atlantic mackerel fishery of No Action are expected to be negative. The mackerel fishery is pursued primarily with midwater trawl gear and in conjunction with Atlantic herring fishing. Thus the MWT fishery for mackerel is also prohibited in Area 1A June-September. To some degree, negative impacts would be mitigated by the ability of MWT vessels to act as carrier vessels and to fish in all other management areas at other times of year, particularly offshore, which is inaccessible to the purse seine fleet due to vessel size. However, there are increased operational costs of fishing offshore (Table 94).

Impacts on American lobster fishery

The impacts on the American lobster fishery of No Action are expected to be neutral. Since 2004, the Area 1A sub-ACL of Atlantic herring has been over 96% harvested each year, with two exceptions: 2012 (88%) and 2016 (91%). Thus, the gear closure, by itself, has likely not limited the ability of the herring fishery overall to adapt and harvest the resource to supply the bait market.

Impacts on predator fisheries and ecotourism

The impacts on the predator fisheries and ecotourism of No Action are expected to be positive, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX) and assuming that a low degree of overlap between the Atlantic herring midwater trawl and predator fisheries and ecotourism is a positive outcome. Prior to Amendment 1, substantial overlap with the commercial groundfish fishery occurred near Cape Ann (MA) during the summer months. Since 2007, however, the overlap analysis suggests that interaction has been minimal (2%). The greatest overlap with the bluefin tuna fishery has been in October, but prior to Amendment 1, there was some overlap in July-September in Area 1A. Prior to Amendment 1, the greatest overlap between the herring MWT fishery and commercial whale watch operators occurred in several areas within Area 1A from May-November.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that from 2000-2006, the Atlantic herring landings revenue from midwater trawl gear in Area 1A was about $4.5M annually, attributed to 44 permits (Table 96). In order from greatest to least, most of the revenue was from herring landed in Portland, Rockland, Gloucester, Newington, Prospect Harbor, Bath, and 17 other (confidential) ports in the Northeast U.S.

The named ports above are the top (non-confidential) herring ports that were likely impacted by the Area 1A closure, and are all physically located adjacent to Area 1A. Of the five named ports, Portland, Rockland and Gloucester are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 1 are primarily located in Maine, New Hampshire, and Massachusetts. The herring MWT revenue attributed to these states from Area 1A during 2000-2006 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 96 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) in Area 1A, June-September, 2000-06

State/Port	Average revenue, 2000-2006	Total permits, 2000-2006[a]
Maine	$3.4M	33
Portland	$2.1M	17
Rockland	$0.7M	5
Prospect Harbor	$0.1M	6
Bath	$0.0M	3
New Hampshire	$0.3M	6
Newington	$0.2M	4
Massachusetts	$0.8M	14
Gloucester	$0.7M	11
Other state(s)[b]	$0.0M	2
Total $ & permits	**$4.5M**	**44**
Total ports	**23**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 1 may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Maine, New Hampshire, and Massachusetts, 10 communities adjacent to Area 1A have been identified as being particularly important to the mackerel fishery (Table 78– Port communities for the herring fishery and other fisheries/industries potentially impacted by Amendment 8, Maine to New Jersey (Table 78; p. 141), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 46 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 52 communities adjacent to Area 1A have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with continuing the Area 1A closure for the herring midwater trawl fishery are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure likely changed the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Since Area 1A was closed seasonally to just MWT vessels, fishermen who remained active within a given area likely experienced indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could have caused resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may have improved during the summer months, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons have not fully resolved the user conflicts. Relative to Alternatives 2-6, Alternative 1 would likely result in continued conflicts between user groups, a negative impact on the *Non-Economic Social Aspects* within human communities.

5.6.1.4 Alternative 2 (Closure inside 6 nm in Area 114 to all vessels fishing for herring)

Under Alternative 2, waters inside 6 nautical miles in the thirty minute square 114 would be closed to all vessels fishing for Atlantic herring, regardless of gear type or herring permit type, according to the seasonal option selected (Figure X). This alternative includes a two-year sunset provision from the date of implementation and would be additive to Alternative 1 (No Action). RSA fishing would be not be constrained by this alternative.

- Seasonal options
    - Sub-option A - June 1 – August 31 (3 months)
    - Sub-option B - June 1 – October 31 (5 months)

5.6.1.4.1 Seasonal sub-option A (June – August)

Impacts on Atlantic herring fishery

The impacts of Alternative 2, seasonal sub-option A on the Atlantic herring fishery are expected to be low negative, and given the two-year sunset of Alternative 2, any associated impacts are expected to be short-term. From 2000-2007, Atlantic herring landings attributed to fishing in statistical area 114 inside 6 nm in June-August are just 0.1% of the annual total of that area (Table 97). Since 2007, these months have become slightly more important, comprising 7% of the total. Atlantic herring and mackerel revenue attributed to fishing in this portion of statistical area 114 inside 6 nm in June-August has been ≤0.5% of total fishery revenue (from all areas) during those months since 2000 (Table 98). Thus, the fishery is predominantly located elsewhere during those months. Still, any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the herring fishery in the past, Alternative 2, sub-option A, by itself, likely would not impede the ability to harvest optimum yield.

To some degree, negative impacts would be mitigated by the ability of herring vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternative 1, the impacts would be more negative for the herring fishery, as there would be more times and areas closed to the fishery. Relative to sub-option B, the impacts would be more positive, as there would be less times and areas closed to the fishery.

Table 97 – Annualized Atlantic herring landings (mt) within 6 nm in statistical area 114 and in all areas, in two seasons, all gears (Alternative 2)

Sub-Option	Season	Herring landings (mt)	
		2000 - 2007	2007 – 2015
A	June – August	0.3 (0.1%)	124.2 (6.9%)
B	June – October	216.2 (9.8%)	310.5 (17%)
n/a	Year-round	2,212 (100%)	1,794 (100%)

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward. "Total" for all rows includes all landings south of 1A.
Source: VTR analysis.

Table 98 – Annualized Atlantic herring and mackerel revenue within 6 nm of statistical area 114 and in all areas, in two seasons, all gears (Alternative 2)

Sub-Option	Season	Atlantic herring and mackerel average nominal revenue			
		2000 - 2006		2007 – 2015	
		Area 114, inside 6 nm	Total all areas	Area 114, inside 6 nm	Total all areas
A	June – August	$54	$8,317, 093 (0.0%)	$44,845	$9,903,620 (0.5%)
B	June – October	$64,986	$14,374,704 (0.5%)	$104,781	$17,062,596 (0.6%)

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward.
Source: VTR analysis.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 2, sub-option A on the Atlantic mackerel fishery are expected to be low negative, and given the two-year sunset of Alternative 2, any associated impacts are expected to be short-term. From 2000-2015, Atlantic mackerel landings attributed to fishing in statistical area 114 inside 6 nm in June-August have been <1% of the total for all areas during those months (Table 99). Atlantic herring and mackerel revenue attributed to fishing in this portion of statistical area 114 inside 6 nm in June-August has been ≤0.5% of total fishery revenue (from all areas) during those months since 2000 (Table 98). Thus, the fishery is predominantly located elsewhere during those months. Still, any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the herring fishery in the past, Alternative 2, sub-option A, by itself, likely would not impede the ability to harvest optimum yield. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to sub-option B, the impacts would be more positive, as there would be less times and areas closed to the fishery.

Table 99 – Annualized Atlantic mackerel landings (mt) within 6 nm of statistical area 114 and in all areas, in two seasons, all gears (Alternative 2)

Season	January 2000 - May 2007		June 2007 – December 2015	
	Area 114, inside 6 nm	Total all areas	Area 114, inside 6 nm	Total all areas
June 1 – August 31 (Sub-option A)	<1 (<0.5%)	183	<5 (<1%)	394
June 1 – October 31 (Sub-option B)	<1 (<0.3%)	391	<10 (<0.9%)	1,098

Impacts on American lobster fishery

The impacts of Alternative 2, sub-option A on the American lobster fishery are expected to be neutral to low negative. Given the low importance of this area and season to the herring fishery in the past, Alternative 2, sub-option A, by itself, likely would not impede the ability to harvest optimum yield for that fishery, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery. Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to sub-option B, the impacts would be more positive, as there would be less times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 2, sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, Alternative 2, sub-option A would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Alternative 2, sub-option A would have a positive effect. However, since 2007, there has been minimal overlap (2%) between the Atlantic herring midwater trawl fishery and the commercial groundfish, commercial bluefin tuna and commercial whale watch operators during the months of June-August in the area under consideration (Figure 48). Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

The area off the “back side of the Cape” is known to be of high importance for the recreational fishery in the summer, so overlaps with this fishery would be reduced under Alternative 2, sub-option A (data limitations precluded quantitative analysis). However, some recreational fisheries (e.g., striped bass) occur only in state waters.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring fishery. Relative to sub-option B, the impacts would be more negative, as there would be less times and areas closed to the herring fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that from 2000-2006, the Atlantic herring landings revenue from within 6 nm in Area 114, during June-August is attributed to five permits landing in five Northeast U.S. ports. The revenue is very low, just a $56 per year annual average. Further details are considered confidential. From 2007-2015, there were five permits with herring landings attributed to this area/season, with a total revenue of $43K/year (Table 100). Most of the revenue is attributed to Gloucester and 4 other (confidential) ports in the Northeast U.S.

Gloucester is the top (non-confidential) herring port likely impacted by this alternative/option, and is identified as a herring *Community of Interest*, according to the criteria in Section 1.6.3.2.1; p. 131). It has a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators. Gloucester is the port with the most landings under either sub-option A or B.

The herring fishing communities that could be impacted by this alternative/option are primarily located in Maine and Massachusetts. The herring revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 100 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (all gears) within 6 nm in Area 114, during June 1-August 31, 2007-2015 (Alternative 2, sub-option A)

State/Port	Average revenue, 2007-2015	Total permits, 2007-2015[a]
Sub-Option A (June 1 – August 31)		
Maine	$13K	3
Massachusetts	$30K	4
Gloucester	$30K	4
Other state(s)[b]	$0K	2
Total $ & permits	**$43K**	**5**
Total ports	**5**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential.
Source: VTR analysis

Alternative 2, sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Off the "back side of the Cape," (within Massachusetts), just one community, Provincetown, has been identified as being particularly important to the mackerel fishery (Table 78; p. 141), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, two adjacent communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about 10 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports, particularly within Massachusetts.

Sociocultural impacts

The sociocultural impacts associated with Alternative 2, sub-option A for the herring fishery are expected to be negative for the fishermen and fishing communities constrained. Establishing this closure may change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities. If effort shifts, fishermen active outside the area may have negative impacts due to crowding.

Conflicts between the various user groups of the herring resource may be reduced during the summer months, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users and human communities. Relative to Alternatives 3-7, Alternative 2 would be a lower cost means to reduce user conflicts.

5.6.1.4.2 Seasonal sub-option B (June – October)

Impacts on Atlantic herring fishery

The impacts of Alternative 2, seasonal sub-option B on the Atlantic herring fishery are expected to be low negative, and given the two-year sunset of Alternative 2, any associated impacts are expected to be short-term. From 2000-2007, Atlantic herring landings attributed to fishing in statistical area 114 inside 6 nm in June-October are 10% of the annual total for that area (Table 97, p. 226). Since 2007, these months have become slightly more important, comprising 17% of the total. Atlantic herring and mackerel revenue attributed to fishing in this portion of statistical area 114 inside 6 nm in June-October has been ≤0.6% of total fishery revenue (from all areas) during those months since 2000 (Table 98, p. 226). Thus, the fishery is predominantly located elsewhere during those months. Still, any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the herring fishery in the past, Alternative 2, sub-option B, by itself, likely would not impede the ability to harvest optimum yield. Relative to Alternative 1, the impacts would be more negative for the herring fishery, as there would be more times and areas closed to the fishery.

To some degree, negative impacts would be mitigated by the ability of herring vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to sub-option A, the impacts would be more negative, as there would be more times and areas closed to the fishery. Although low relative to fishery-wide totals, there has been substantially more herring fishing activity in September and October in this area (and all areas) than in June-August (sub-option A).

Impacts on Atlantic mackerel fishery

The impacts of Alternative 2, sub-option B on the Atlantic mackerel fishery are expected to be low negative, and given the two-year sunset of Alternative 2, any associated impacts are expected to be short-term. From 2000-2015, Atlantic mackerel landings attributed to fishing in statistical area 114 inside 6 nm in June-October have been <0.9% of the total for all areas during those months (Table 99). Atlantic herring and mackerel revenue attributed to fishing in this portion of statistical area 114 inside 6 nm in June-October has been ≤0.6% of total fishery revenue (from all areas) during those months since 2000 (Table 98). Thus, the fishery is predominantly located elsewhere during those months. Still, any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the mackerel fishery in the past, Alternative 2, sub-option B, by itself, likely would not impede the ability to harvest optimum yield. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to sub-option A, the impacts would be more negative, as there would be more times and areas closed to the fishery.

Impacts on American lobster fishery

The impacts of Alternative 2, sub-option B on the American lobster fishery are expected to be neutral to low negative. Given the low importance of this area and season to the herring fishery in the past, this alternative, by itself, likely would not impede the ability to harvest optimum yield for that fishery, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery. Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to sub-option A, the impacts would be more negative, as there would be more times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 2, sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations. However, since 2007, there has been minimal overlap (3%) between the Atlantic herring midwater trawl fishery and the commercial groundfish, commercial bluefin tuna and commercial whale watch operators during the months of June-September in the area under consideration (Figure 48). Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

The area off the "back side of the Cape" is known to be of high importance for the recreational fishery in the summer, so overlaps with this fishery would be reduced under Alternative 2, sub-option B (data limitations precluded quantitative analysis). However, some recreational fisheries (e.g., striped bass) occur only in state waters.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring fishery. Relative to sub-option A, the impacts would be more positive, as there would be more times and areas closed to the herring fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that from 2000-2006, the Atlantic herring landings revenue from within 6 nm in Area 114, during June-October, from 2000-2006, was $69K/year, attributed to 19 permits landing in Gloucester, Portland and nine other (confidential) ports in the Northeast U.S. (Table 101). From 2007-2015, there was an increase in average revenue, $99K, attributed to fewer permits (16) and ports (seven, including Gloucester), from herring landings attributed to this area/season. Gloucester is the port with the most landings under either sub-option A or B.

Gloucester is the top (non-confidential) herring port likely impacted by this alternative/option, and is identified as a herring *Community of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). It has a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by this alternative/option are primarily located in Maine and Massachusetts. The herring revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 101 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (all gears) within 6 nm in Area 114, during June 1-October 31, 2000-2015 (Alternative 2, sub-option B)

State/Port	**June-Oct, 2000-2006**		**June-Oct, 2007-2015**	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$11K	5	$37K	4
Portland	$9K	4	[b]	[b]
Massachusetts	$58K	15	$60K	11
Gloucester	$56K	10	$57	8
Other state(s)[b]	$0K	4	$1K	3
Total $ & permits	**$69K**	**19**	**$99K**	**16**
Total ports	**11**		**7**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential.
Source: VTR analysis

Alternative 2, sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Off the "back side of the Cape," (within Massachusetts), just one community, Provincetown, has been identified as being particularly important to the mackerel fishery (Table 78; p. 141), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, two adjacent communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about 10 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from ports, particularly within Massachusetts.

Sociocultural impacts

The sociocultural impacts associated with Alternative 2, sub-option B for the herring fishery are expected to be negative for the fishermen and fishing communities constrained. Establishing this closure may change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities. If effort shifts, fishermen active outside the area may have negative impacts due to crowding.

Conflicts between the various user groups of the herring resource may be reduced during the summer months, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users and human communities. Relative to Alternatives 3-7, Alternative 2 would be a lower cost means to reduce user conflicts.

5.6.1.5 Alternative 3 (Prohibit MWT gear in Area 1A year-round)

Under Alternative 3, the seasonal midwater trawl gear prohibition in Area 1A would be extended to be a year-round restriction. Since June 2007, this gear has been prohibited from June to September (under Amendment 1), and since 2010???[8] , all herring fishing in Area 1A has been closed January-May. Also, Area 1A spawning closures often reach well into October. RSA fishing would be not be constrained by this alternative. Alternative 3 would be additive to Alternative 1 (No Action).

Impacts on Atlantic herring fishery

The impacts of Alternative 3 on the overall Atlantic herring fishery are expected to be neutral. If midwater trawls are prohibited from Area 1A year-round (except for RSA fishing), the Area 1A sub-ACL is still expected to be harvested. There exists sufficient capacity among the purse seine vessels to harvest the full sub-ACL, assuming that herring remain in areas and depths accessible to purse seine gear. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand into the Gulf of Maine. There has been some purse seine activity in the fall in Area 1A (see March 25, 2016 PDT memo), and this activity could expand under this alternative. Thus, the same amount of herring would likely be removed from the area, just with a different gear type.

For the midwater trawl vessels, the impacts of Alternative 3 are expected to be negative, since fall fishing in Area 1A has been important to these vessels in the past. From 2000, Atlantic herring and mackerel revenue attributed to MWT fishing in Area 1A were $8.7M, or 30% of the annual total attributed to that gear type (Table 102). Since 2007, with the June-September MWT closure in Area 1A, the annual average dropped to $3.3M, or 18% of the annual total attributed

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[8] ASMFC first restricted fishing in Jan – May under the days out regulations, and then the federal FMP continued by allocating 0% for Trimester 1 (Jan – April) in specs 2013-2015 and 2016-2018???).

to that gear type. Alternative 3 may hamper adaptability to changing conditions and may result in some foregone revenue.

It is difficult to determine if MWT vessels would be precluded from fishing altogether or be able to shift effort to other areas. To some degree, negative impacts to MWT vessels would be mitigated if they can act as carrier vessels and fish in other management areas, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). Since Amendment 1 implementation, some MWT vessels were retrofitted to be able to switch back and forth between using MWTs and purse seine gear, so that they could continue fishing in Area 1A in the summer. Though this comes at substantial cost, it is expected that additional MWT vessels would do the same, rather than be precluded from Area 1A altogether.

Relative to Alternative 1, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 2, the impacts would also be negative, as Area 1A in October-December has been more important to the fishery than the times/area of closure under Alternative 2.

For the purse seine fishery, the impacts of Alternative 3 are expected to be positive. These vessels would benefit from the year-round Area 1A MWT closure. However, since additional MWT vessels may be retrofitted to also use purse seines, benefits to the current purse seine vessels may not substantially improve.

Table 102 – Annualized Atlantic herring and mackerel revenue year-round within Area 1A, MWT gear only (Alternative 3)

Jan 2000 – May 2007		**June 2007 – December 2015**	
Inside 1A	**All areas**	**Inside 1A**	**All areas**
$8,723,038	$28,860,674 (30.2%)	$3,338,647	$18,734,867 (17.8%)

Impacts on Atlantic mackerel fishery

The impacts of Alternative 3 on the Atlantic mackerel fishery are expected to be negative. From 2000-2007, annual Atlantic mackerel landings attributed to fishing with midwater trawl in Area 1A were just 0.1% of the total for all areas by that gear type (Table 103). Since then, the contribution has increased to 6.1%, though total mackerel landings declined by 77%. However, from January 2000 to May 2007, Atlantic herring and mackerel revenue attributed to MWT fishing in Area 1A were $8.7M, or 30% of the annual total attributed to that gear type (Table 102). Since June 2007, with the June-September MWT closure in Area 1A, the annual average dropped to $3.3M, or 18% of the annual total attributed to that gear type.

Alternative 3 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 2, the impacts would also be negative, as Area 1A in October-December has been more important to the fishery than the times/area of closure under Alternative 2.

Table 103 – Annualized Atlantic mackerel landings (mt) within Area 1A, midwater trawl only (Alternative 3)

January 2000 - May 2007		June 2007 – December 2015	
Inside Area A1	**All areas**	**Inside Area A1**	**All areas**
21	30,082 (0.1%)	424	6,993 (6.1%)

Impacts on American lobster fishery

The impacts of Alternative 3 on the American lobster fishery are expected to be neutral to low negative. The same amount of herring would likely be removed from the area, just with a different gear type. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery. Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to a portion of the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 3 on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, Alternative 3 would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been moderate to high degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (31%), commercial bluefin tuna (51%), and commercial whale watch operators (91%) in Area 1A year-round (Figure 48). Midwater trawl fishing may shift to other areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing in Area 1A is replaced by purse seines, negative outcomes for predator fisheries may result from overlap with purse seines.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the MWT herring fishery. For the commercial tuna fishery and whale watch fishery, the overlap analysis indicates that Alternative 3 may have the most overlap of all the alternatives.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring midwater trawl landings revenue from Area 1A, during October-December, from 2000-2006, was $2.4M/year, attributed to 32 permits (Table 104). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, Rockland, New Bedford, Prospect Harbor and 11 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $2.8M, attributed to fewer permits (16) and ports (15), from herring landings attributed to this area/season. Gloucester is the port with the most landings under either time period. New Bedford, Fall River and ports in states south of Massachusetts became more active in Area 1A MWT fishing in the recent time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by extending the Area 1A closure year-round. Of these, Portland, Rockland, Gloucester, and New Bedford are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1; p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 3 are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from Area 1A during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

This alternative may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Maine, New Hampshire, and Massachusetts, 10 communities adjacent to Area 1A have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 46 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 52 communities adjacent to Area 1A have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 104 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) in Area 1A, October-December, 2000-2015 (Alternative 3)

State/Port	October-December, 2000-2006		October-December, 2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$0.7M	20	$1.0M	12
Portland	$0.4M	16	$0.7M	10
Rockland	$0.1M	3	[b]	[b]
Prospect Harbor	$0.0M	4	[b]	[b]
New Hampshire	$0.2M	7	[b]	[b]
Newington	$0.1M	3	[b]	[b]
Portsmouth	$0.0M	6	[b]	[b]
Massachusetts	$1.5M	21	$1.7M	17
Gloucester	$1.4M	17	$1.2M	9
New Bedford	$0.1M	4	$0.4M	10
Fall River	[b]	[b]	$0.0M	3
Rhode Island	$0.0M	5	[b]	[b]
Other state(s)[b]	$0.0M	2	$0.1M	7
Total $ & permits	**$2.4M**	**32**	**$2.8M**	**20**
Total ports	**16**		**15**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential.
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with extending the Area 1A closure for the herring midwater trawl fishery year-round are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure likely changed the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities. Additional changes would be expected.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 3 results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.6 Alternative 4 (Prohibit MWT gear inside 12 nm south of Area 1A)

Under Alternative 4, waters inside 12 nautical miles south of Area 1A would be closed to midwater trawl gear, according to the area and seasonal options selected (Figure X, alternatives section). RSA fishing would be not be constrained by this alternative. Alternative 4 would be additive to Alternative 1 (No Action).

- Area options
  - Sub-option A – Herring Management Areas 1B, 2 and 3
  - Sub-option B - Herring Management areas 1B and 3 only
- Seasonal options
  - Sub-option A – Year round (12 months)
  - Sub-option B – June 1 – September 30 (4 months)

5.6.1.6.1 Area sub-option A (1B, 2 & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option A on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 12 nm in Areas 1B, 2, and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the "back side of the Cape" in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (AE, Tables 15 & 16). Under this alternative/option, MWT vessels could no longer fish within 12 miles, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 12 nm within Area 1B and still harvest the sub-ACL, but most fishing in Area 1B is currently inside of 12 nm.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 12 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 12 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl vessels, the impacts of Alternative 4, area sub-option A, seasonal sub-option A are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 12 nm in Areas 1B, 2, and 3 were 15% of the annual herring MWT landings for these Areas (Table 105). Since 2007, the 12 nm zone became more important, comprising 20% of the total. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $3.3-3.7M/year, 13-18% of the fishery-wide MWT revenue since 2000 (

Table 106).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore. NEFOP data suggest that costs for trips occurring outside of 12 nm are generally double those occurring inside 12 nm (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternative 1, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the herring fishery. Relative to the other Alternative 4 sub-options, this combination would be most negative for the MWT fishery, as it would result in the most times/areas closed to it.

Table 105 – Annualized Atlantic herring MWT landings south of Area 1A (Alternatives 4, 5, 6)

Sub-options		Description	Time period	Herring MWT landings south of Area 1A (mt)			
Area	**Season**			**Inside 12 nm**	**Inside 25 nm**	**Inside 50 nm**	**Total**
A	A	Areas 1B, 2 & 3; year round	2000-2007	9,793 (15%)	14,072 (21%)	19,913 (30%)	66,979 (100%)
			2007-2015	11,457 (20%)	15,583 (28%)	23,338 (42%)	56,205 (100%)
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	102 (0.3%)	194 (0.6%)	1,748 (5.8%)	29,911 (100%)
			2007-2015	780 (3.7%)	1,175 (5.5%)	4,173 (20%)	21,286 (100%)
B	A	Areas 1B & 3; year round	2000-2007	5,125 (7.7%)	6,696 (10%)	9,179 (14%)	66,979 (100%)
			2007-2015	4,326 (7.7%)	5,960 (11%)	10,315 (18%)	56,205 (100%)
B	B	Areas 1B & 3; June-Sept	2000-2007	75 (0.3%)	166 (0.6%)	1,720 (5.8%)	29,911 (100%)

			2007-2015	760 (3.6%)	1,155 (5.4%)	4,154 (20%)	21,286 (100%)

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward. "Total" for all rows includes all landings south of 1A.
Source: VTR analysis.

Table 106 – Annualized Atlantic herring and mackerel MWT revenue (Alternatives 4, 5, 6)

Sub-options		Description	Time period	Herring/mackerel MWT average nominal revenue			
				South of Area 1A			Total all areas
Area	Season			Inside 12 nm	Inside 25 nm	Inside 50 nm	
A	A	Areas 1B, 2 & 3; year round	2000-2007	$3.7M (13%)	$6.8M (24%)	$13M (45%)	$28.9M (100%)
			2007-2015	$3.3M (18%)	$4.9M (26%)	$8.0M (43%)	$18.7M (100%)
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	$29K (0.4%)	$52K (0.7%)	$0.5M (5.8%)	$7.9M (100%)
			2007-2015	$0.3M (3.8%)	$0.4M (5.7%)	$1.3M (19%)	$6.8M (5.7%)
B	A	Areas 1B & 3; year round	2000-2007	$1.4M (4.8%)	$1.8M (6.4%)	$2.6M (8.9%)	$28.9M (100%)
			2007-2015	$1.2M (6.3%)	$1.6M (8.6%)	$2.9M (16%)	$18.7M (100%)
B	B	Areas 1B & 3; June-Sept	2000-2007	$22K (0.3%)	$45K (0.6%)	$0.4M (5.1%)	$7.9M (100%)
			2007-2015	$0.2M (2.5%)	$0.4M (5.1%)	$1.3M (16%)	$7.9M (100%)

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward.
Source: VTR analysis.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option A on the Atlantic mackerel fishery are expected to be negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl year-round in areas inside 12 nm, south of Area 1A were 8.7% of the total for all areas by that gear type (Table 107). Since then, the contribution has increased to 12%, though total mackerel landings declined by 77%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $3.3-3.7M/year, 13-18% of the fishery-wide MWT revenue since 2000 (

Table 106).

Alternative 4 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the mackerel fishery. Relative to the other Alternative 4 sub-options, this combination would be most negative for the MWT fishery, as it would result in the most times/areas closed to it.

Table 107 – Annualized Atlantic mackerel landings (mt) south of Area 1A, midwater trawl only (Alternative 4, 5, 6)

Sub-options		Description	Mackerel MWT landings south of Area 1A (mt)				
Area	**Season**		**Time period**	**Inside 12 nm**	**Inside 25 nm**	**Inside 50 nm**	**Total**
A	A	Areas 1B, 2 & 3; year round	2000-2007	2,618 (8.7%)	7,499 (25%)	21,341 (71%)	30,082 (100%)
			2007-2015	842 (12%)	2,116 (30%)	4,790 (69%)	6,993 (100%)
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	0	0	0	<10
			2007-2015	<1	<1	<1	<10
B	A	Areas 1B & 3; year round	2000-2007	59 (0.2%)	73 (0.2%)	146 (0.5%)	30,082 (100%)
			2007-2015	145 (2.1%)	203 (2.9%)	249 (3.6%)	6,993 (100%)
B	B	Areas 1B & 3; June-Sept	2000-2007	0	0	0	<10
			2007-2015	<1	<1	<1	<10

Impacts on American lobster fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option A on the American lobster are expected to be negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, this alternative may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area/season), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the lobster fishery. Relative to the other Alternative 4 sub-options, this combination would be most negative for the lobster fishery, as it would result in the most times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 4, area sub-option A, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been minimal to low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (15%), commercial bluefin tuna (5%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to Alternatives 5 and 6, impacts would be less positive for the predator fisheries and ecotourism. Relative to the other Alternative 4 sub-options, this combination would be most positive for the predator fisheries and ecotourism, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 12 nm in Areas 1B, 2, and 3 year-round, from 2000-2006, was $2.7M/year, attributed to 33 permits (Table 108). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, Point Judith, North Kingstown, Providence, Portland, and 12 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $3.1M, attributed to about the same number of permits (34), but fewer ports (12), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under the earlier time period, but New Bedford had the most revenue more recently. New Bedford, Fall River and ports in states south of Massachusetts became more active in MWT fishing in the recent time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, New Bedford, Point Judith, N. Kingstown, and Portland are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators, except for N. Kingstown which has medium and low rankings.

The herring fishing communities that could be impacted by Alternative 4, Area sub-option A, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 4, Area sub-option A, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 108 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 12 nm in Areas 1B, 2, and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.1M	9	$0.4M	7
Portland	$0.1M	7	$0.3M	6
New Hampshire	$0.0M	4	[b]	[b]
Massachusetts	$1.5M	24	$2.3M	23
Gloucester	$1.1M	19	$0.8M	9
New Bedford	$0.4M	11	$1.4M	21
Fall River	[b]	[b]	$0.5M	7
Rhode Island	$1.1M	19	$0.3M	9
Point Judith	$0.4M	10	$0.3M	6
North Kingstown	$0.3M	6	[b]	[b]
Providence	$0.3M	5	[b]	[b]
Other state(s)[b]	$0.0M	7	$0.1M	11
Total $ & permits	**$2.7M**	**33**	**$3.1M**	**34**
Total ports	**18**		**12**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 12 nm year-round in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 4, Area sub-option A, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.6.2 Area sub-option A (1B, 2 & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 12 nm in Areas 1B, 2, and 3 in June-September, the Area 1B sub-ACL still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (AE, Tables 15 & 16). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 12 nm within Area 1B in June-September.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 12 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 12 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult. However, fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56).

For the midwater trawl vessels, the impacts of Alternative 4, area sub-option A, seasonal sub-option A are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 12 nm, June-September, in Areas 1B, 2, and 3 were 0.3% of the herring MWT landings for that season (or 0.2% of annual) for these Areas (Table 105, p. 238). Since 2007, the 12 nm zone became slightly more important, comprising 4% of the seasonal total (or 0.2% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $29-300K/year, 0.4-6% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types or if MWT effort shifts seasonally.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore. NEFOP data suggest that costs for trips occurring outside of 12nm are generally double those occurring inside 12 nm (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternative 1, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the herring fishery.

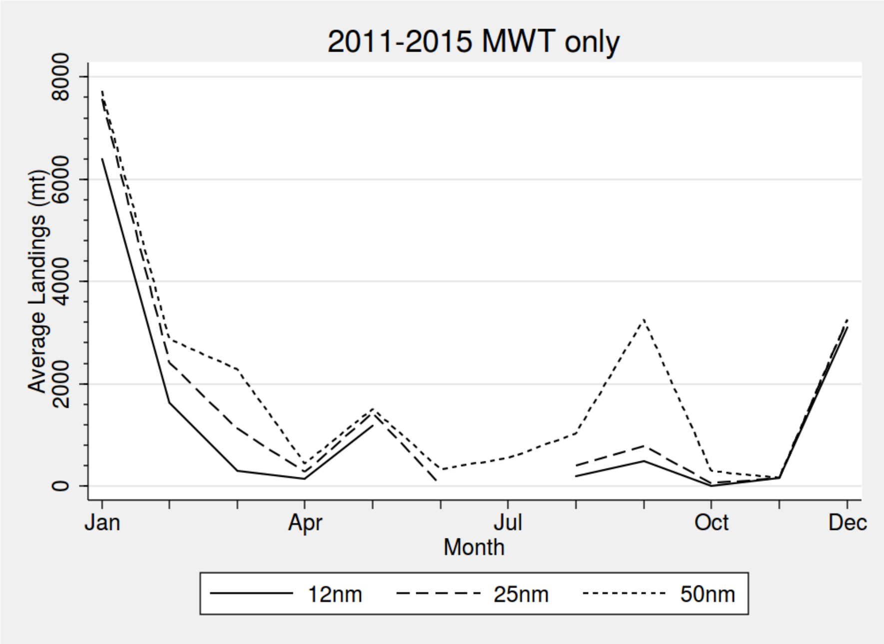
Impacts on Atlantic mackerel fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 12 nm, south of Area 1A were virtually zero, and was very small for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $29-300K/year, 0.4-5.7% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 4 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the mackerel fishery.

Figure 56 - Average monthly MWT landings from areas south of Area 1A, 12 nm, 25, and 50 nm from shore, 2011-2015



Impacts on American lobster fishery

The impacts of Alternative 4, area sub-option A, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the lobster fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 4, area sub-option A, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX).

However, since 2007, there has been low overlap between the Atlantic herring MWT fishery and the commercial groundfish (11%), commercial bluefin tuna (5%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48). This degree of overlap is very similar to that of the year-round option (Alternative 4, area sub-option A, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 49, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be less positive for the predator fisheries and ecotourism.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 12 nm in Areas 1B, 2, and 3 June-September, from 2000-2006, was $31K/year, attributed to 11 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, and 7 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $312K, attributed to about the same number of permits (11), but fewer ports (5), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

Gloucester is the top (non-confidential) herring port likely impacted by this alternative/option, and is identified as a herring *Community of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). It has a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by this alternative/option are primarily located in Maine and Massachusetts. The herring revenue attributed to these states from this area/season during 2007-2015 is about XXX% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 4, Area sub-option A, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 109 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 12 nm in Areas 1B, 2, and 3, June-September, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$12K	5	$103K	4
Portland	$9.7K	3	[b]	[b]
Massachusetts	$18K	6	$210K	7
Gloucester	$11K	4	$152K	5
Other state(s)[b]	$0.0K	2	[b]	[b]
Total $ & permits	**$31K**	**11**	**$312K**	**10**
Total ports	**9**		**5**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 12 nm June-September in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 4, area sub-option A, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.6.3 Area sub-option B (1B & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option A on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 12 nm in Areas 1B and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the "back side of the Cape" in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, MWT vessels could no longer fish within 12 miles, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on "the back side of the Cape" and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 12 nm within Area 1B and still harvest the sub-ACL, but most fishing in Area 1B is currently inside of 12 nm.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 12 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 12 nm that would be impacted, mostly off the "back side of the Cape" east of Chatham. It should be noted that the fishery has not utilized the full Area 3 sub-ACLs in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl vessels, the impacts of Alternative 4, area sub-option A, seasonal sub-option A are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 12 nm year-round in Areas 1B and 3 were 8% of the annual herring MWT landings for Areas 1B, 2 and 3 (Table 105, p. 238). Since 2007, the percentage remained the same. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.2-1.4M/year, 5-6% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore. NEFOP data suggest that costs for trips occurring outside of 12nm are generally double those occurring inside 12 nm (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternative 1, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the herring fishery.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option A on the Atlantic mackerel fishery are expected to be low negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl inside 12 nm in Areas 1B and 3 were just 0.2% of the total for all areas by that gear type (Table 107). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.2-1.4M/year, 5-6% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 4 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the mackerel fishery.

Impacts on American lobster fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option A on the American lobster are expected to be low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the lobster fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 4, area sub-option B, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (7%), commercial bluefin tuna (4%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to Alternatives 5 and 6, impacts would be less positive for the predator fisheries and ecotourism.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 12 nm in Areas 1B and 3 year-round, from 2000-2006, was $1.2M/year, attributed to 27 permits (Table 108). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, Portland, Point Judith, and 10 other ports in the Northeast U.S. From 2007-2015, average revenue remained constant, but was attributed to fewer permits (20) and ports (11), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. They are all identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 4, Area sub-option B, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 110 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 12 nm in Areas 1B and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.1M	9	$0.3M	6
Portland	$0.1M	7	$0.3M	5
Massachusetts	$1.1M	21	$0.9M	17
Gloucester	$1.0M	19	$0.7M	9
New Bedford	$0.1M	6	$0.2M	12
Rhode Island	$0.0M	5	$0.0M	3
Point Judith	$0.0M	4	[b]	[b]
Other state(s)[b]	$0.0M	3	$0.0M	1
Total $ & permits	**$1.2M**	**27**	**$1.2M**	**20**
Total ports	**14**		**11**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 4, Area sub-option B, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 12 nm year-round in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 4, Area sub-option B, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.6.4 Area sub-option B (1B & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 12 nm in Areas 1B and 3 in June-September, the Area 1B sub-ACL still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 12 nm within Area 1B in June-September.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 12 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 12 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. It should be noted that the fishery has not utilized the full Area 3 sub-ACL in recent years. Implementing this measure could make it even more difficult. However, fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246).

For the midwater trawl vessels, the impacts of Alternative 4, area sub-option B, seasonal sub-option B are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 12 nm, June-September, in Areas 1B and 3 were 0.3% of the herring MWT landings for that season for Areas 1B, 2 and 3 (or 0.1% of annual; Table 105, p. 238). Since 2007, the 12 nm zone became slightly more important, comprising 4% of the seasonal total (or 1% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $22-200K/year, 0.3-3% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types or if MWT effort shifts seasonally.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore. NEFOP data suggest that costs for trips occurring outside of 12nm are generally double those occurring inside 12 nm (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternative 1, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the herring fishery. Relative to the other Alternative 4 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 12 nm, in Areas 1B and 3 were virtually zero, and very small (<10 mt) for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $22-200K/year, 0.3-2.5% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 4 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the mackerel fishery. Relative to the other Alternative 4 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 4, area sub-option B, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternative 1, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be more positive for the lobster fishery. Relative to the other Alternative 4 sub-options, this combination would be least negative for the lobster fishery, as it would result in the least times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 4, area sub-option B, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). However, since 2007, there has been low overlap between the Atlantic herring MWT fishery and the commercial groundfish (7%), commercial bluefin tuna (4%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48). This degree of overlap is the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 12 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternative 1, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring fishery. Relative to Alternatives 5 and 6, impacts would be less positive for the predator fisheries and ecotourism. Relative to the other Alternative 4 sub-options, this combination would be least positive for the predator fisheries and ecotourism, as it would result in the least times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 12 nm in Areas 1B and 3 June-September, from 2000-2006, was $24K/year, attributed to 11 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, and 7 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $237K, attributed to about the same number of permits (10), but fewer ports (5), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

Gloucester and Portland are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. They are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 4, Area sub-option B, seasonal sub-option B are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 4, Area sub-option B, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 111 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 12 nm in Areas 1B and 3, June-September, 2000-2015

State/Port	**2000-2006**		**2007-2015**	
	Average revenue	**Total permits**[a]	**Average revenue**	**Total permits**[a]
Maine	$12K	5	$78K	5
Portland	$9K	3	$34K	3
Massachusetts	$12K	5	$159K	5
Gloucester	$11K	4	$148K	4
Other state(s)[b]	$0.2K	2	[b]	[b]
Total $ & permits	**$24K**	**11**	**$237K**	**10**
Total ports	**9**		**5**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 12 nm June-September in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 4, area sub-option B, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.7 Alternative 5 (Prohibit MWT gear inside 25 nm south of Area 1A)

Under Alternative 5, waters within 25 nautical miles south of Area 1A would be closed to midwater trawl gear, according to the area and seasonal options selected (Figure X, alternatives section). RSA fishing would be not be constrained by this alternative. Alternative 5 would be additive to Alternative 1 (No Action).

- Area options
    - Sub-option A – Herring Management Areas 1B, 2 and 3
    - Sub-option B - Herring Management areas 1B and 3 only
- Seasonal options
    - Sub-option A – Year round (12 months)
    - Sub-option B – June 1 – September 30 (4 months)

5.6.1.7.1 Area sub-option A (1B, 2 & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option A on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 25 nm in Areas 1B, 2, and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, MWT vessels could no longer fish within 25 miles, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 25 nm within Area 1B and harvest some of the sub-ACL, but most fishing in Area 1B is currently inside of 25 nm.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 25 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 25 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For midwater trawl vessels, the impacts of Alternative 5, area sub-option A, seasonal sub-option A are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 25 nm in Areas 1B, 2, and 3 were 21% of the annual herring MWT landings for these Areas (Table 105, p. 238). Since 2007, the 25 nm zone became more important, comprising 28% of the total. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $4.9-6.8M/year, 24-26% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly further offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 4, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it. Relative to Alternative 6, impacts would be more positive for the fishery. Relative to the other Alternative 5 sub-options, this combination would be most negative for the fishery, as it would result in the most times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option A on the Atlantic mackerel fishery are expected to be negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl year-round in areas inside 25 nm, south of Area 1A were 25% of the total for all areas by that gear type (Table 107). Since then, the contribution has increased to 30%, though total mackerel landings declined by 77%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $4.9-6.8M/year, 24-26% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 5 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 4, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the fishery. Relative to the other Alternative 5 sub-options, this combination would be most negative for the fishery, as it would result in the most times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option A on the American lobster are expected to be negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, this alternative may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area/season), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 4, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternative 6, impacts would be more positive for the lobster fishery. Relative to the other Alternative 5 sub-options, this combination would be most negative for the lobster fishery, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 5, area sub-option A, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been low to moderate degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (27%), commercial bluefin tuna (9%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 25 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1 and 4, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to Alternative 6, impacts would be less positive for predator fisheries and ecotourism. Relative to the other Alternative 5 sub-options, this combination would be most positive for predator fisheries and ecotourism, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 25 nm in Areas 1B, 2, and 3 year-round, from 2000-2006, was $3.8M/year, attributed to 34 permits (Table 112). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, North Kingstown, Point Judith, Providence, Portland, and 13 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $5.4M, attributed to the same number of permits (34), but fewer ports (14), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under the earlier time period, but New Bedford had the most revenue more recently. New Bedford, Fall River and ports in states south of Massachusetts became more active in MWT fishing in the recent time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, New Bedford, Point Judith, N. Kingstown, and Portland are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators, except for N. Kingstown which has medium and low rankings.

The herring fishing communities that could be impacted by Alternative 5, Area sub-option A, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 5, Area sub-option A, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 112 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 25 nm in Areas 1B, 2, and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.2M	10	$0.7M	11
Portland	$0.1M	8	$0.5M	10
New Hampshire	$0.1M	6	[b]	[b]
Massachusetts	$1.9M	26	$4.1M	23
Gloucester	$1.3M	21	$1.5M	10
New Bedford	$0.6M	11	$2.5M	21
Fall River	$0.0M	5	$0.1M	8
Rhode Island	$1.6M	19	$0.4M	9

North Kingstown	$0.6M	6	[b]	[b]
Point Judith	$0.5M	10	$0.4M	6
Providence	$0.4M	5	[b]	[b]
Other state(s)[b]	$0.1M	7	$0.2M	12
Total $ & permits	**$3.8M**	**34**	**$5.4M**	**34**
Total ports	**19**		**14**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 25 nm year-round in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 5, Area sub-option A, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.7.2 Area sub-option A (1, 2 & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 25 nm in Areas 1B, 2, and 3 in June-September, the Area 1B sub-ACL still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 25 nm within Area 1B and harvest some of the sub-ACL, but most fishing in Area 1B is currently inside of 25 nm.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 25 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 25 nm that would be impacted, mostly off the "back side of the Cape" east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult. Fishing within 25 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246).

For midwater trawl vessels, the impacts of Alternative 5, area sub-option A, seasonal sub-option B are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 25 nm, June-September, in Areas 1B, 2, and 3 were 0.6% of the herring MWT landings for that season (or 0.3% of annual) for these Areas (Table 105, p. 238). Since 2007, the 25 nm zone became more important, comprising 5% of the seasonal total (or 2% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $52-400K/year, 0.7-6% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types or if MWT effort shifts seasonally. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 4, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it. Relative to Alternative 6, impacts would be more positive for the fishery.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 25 nm, south of Area 1A were virtually zero, and was very small for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $52-400K/year, 0.7-6% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 5 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 4, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the fishery.

Impacts on American lobster fishery

The impacts of Alternative 5, area sub-option A, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 4, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternative 6, impacts would be more positive for the lobster fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 5, area sub-option A, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). However, since 2007, there has been low to moderate overlap between the Atlantic herring MWT fishery and the commercial groundfish (20%), commercial bluefin tuna (8%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48). This degree of overlap is very similar to that of the year-round option (Alternative 4, area sub-option A, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 25 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1 and 4, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to Alternative 6, impacts would be less positive for predator fisheries and ecotourism.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 25 nm in Areas 1B, 2, and 3 June-September, from 2000-2006, was $55K/year, attributed to 18 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, and 9 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $366K, attributed to fewer permits (15) and ports (7), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

Gloucester, Portland and New Bedford are the top (non-confidential) herring ports likely impacted by this alternative/option, and are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by this alternative/option are primarily located in Maine and Massachusetts. The herring revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 5, Area sub-option A, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 113 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 25 nm in Areas 1B, 2, and 3, June-September, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$18K	6	$107K	8
Portland	$13K	4	$47K	5
Massachusetts	$36K	11	$260K	11
Gloucester	$25K	8	$243K	6
New Bedford	[b]	[b]	$17K	7
Other state(s)[b]	$1K	6	[b]	[b]
Total $ & permits	**$55K**	**18**	**$366K**	**15**
Total ports	**11**		**7**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 25 nm June-September in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 5, area sub-option A, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.7.3 Area sub-option B (1B & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option A on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 12 nm in Areas 1B and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, MWT vessels could no longer fish within 25 nm, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 25 nm within Area 1B and harvest some of the sub-ACL, but most fishing in Area 1B is currently inside of 25 nm.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 25 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 25 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For midwater trawl vessels, the impacts of Alternative 5, area sub-option B, seasonal sub-option A on the Atlantic herring midwater trawl fishery are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 25 nm year-round in Areas 1B and 3 were 10% of the annual herring MWT landings for Areas 1B, 2 and 3 (Table 105, p. 238). Since 2007, the percentage was 11%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.8M/year, 6-9% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 4, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the herring fishery.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option A on the Atlantic mackerel fishery are expected to be low negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl inside 25 nm in Areas 1B and 3 were just 0.2% of the total for all areas by that gear type (Table 107). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.8M/year, 6-9% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 5 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternative 1 and 4, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the mackerel fishery.

Impacts on American lobster fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option A on the American lobster are expected to be negative. Given the moderate importance of this area and season to the herring midwater trawl fishery in the past, Alternative 5 may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 4, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternative 6, impacts would be more positive for the lobster fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 5, area sub-option B, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been low to moderate degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (11%), commercial bluefin tuna (7%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1 and 4, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to Alternative 6, impacts would be less positive for the predator fisheries and ecotourism.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 25 nm in Areas 1B and 3 year-round, from 2000-2006, was $1.6M/year, attributed to 31 permits (Table 108). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, Portland, Point Judith, and 12 other ports in the Northeast U.S. (Table 108). From 2007-2015, average revenue increased slightly ($1.7M), but was attributed to fewer permits (21) and ports (13), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. They are all identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

Table 114 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 25 nm in Areas 1B and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$0.2M	10	$0.5M	10
Portland	$0.1M	8	$0.3M	9
Rockland	$0.0M	3	[b]	[b]
New Hampshire	$0.0M	4	[b]	[b]
Massachusetts	$1.4M	24	$1.2M	18
Gloucester	$1.2M	21	$0.9M	10
New Bedford	$0.1M	6	$0.3M	12
Rhode Island	$0.1M	8	$0.0M	3
Point Judith	$0.0M	4	[b]	[b]
Other state(s)[b]	$0.0M	1	$0.0M	2
Total $ & permits	**$1.6M**	**31**	**$1.7M**	**21**
Total ports	**16**		**13**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

The herring fishing communities that could be impacted by Alternative 5, Area sub-option B, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 5, Area sub-option B, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 25 nm year-round in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 5, Area sub-option B, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.7.4 Area sub-option B (1B & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing inside 25 nm in Areas 1B and 3 in June-September, the Area 1B sub-ACL still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (AE, Tables 15 & 16). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 12 nm within Area 1B and still harvest some the sub-ACL, but most fishing in Area 1B is currently inside of 25 nm.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 25 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 25 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. It should be noted that the fishery has not utilized the full Area 4 sub-ACL in recent years. Implementing this measure could make it even more difficult. Fishing within 25 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246).

For the midwater trawl fishery, the impacts of Alternative 5, area sub-option B, seasonal sub-option B are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 25 nm, June-September, in Areas 1B and 3 were 0.6% of the herring MWT landings for that season for Areas 1B, 2 and 3 (or 0.2% of annual; Table 105, p. 238). Since 2007, the 25 nm zone became slightly more important, comprising 5% of the seasonal total (or 2% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $45-400K/year, 0.6-5% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types, or if MWT effort shifts seasonally.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 4, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the herring fishery. Relative to the other Alternative 5 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 25 nm, in Areas 1B and 3 were virtually zero, and very small (<10 mt) for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $45-400K/year, 0.6-5% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 5 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 4, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to Alternative 6, impacts would be more positive for the mackerel fishery. Relative to the other Alternative 5 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 5, area sub-option B, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 4, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to Alternative 6, impacts would be more positive for the lobster fishery. Relative to the other Alternative 5 sub-options, this combination would be least negative for the lobster fishery, as it would result in the least times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 5, area sub-option B, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). However, since 2007, there has been low overlap between the Atlantic herring MWT fishery and the commercial groundfish (11%), commercial bluefin tuna (7%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48). This degree of overlap is the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 25 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternative 1 and 4, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring fishery. Relative to Alternative 6, impacts would be less positive for the predator fisheries and ecotourism. Relative to the other Alternative 5 sub-options, this combination would be least positive for the predator fisheries and ecotourism, as it would result in the least times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 25 nm in Areas 1B and 3 June-September, from 2000-2006, was $48K/year, attributed to 18 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, and 9 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $360K, attributed to fewer permits (15) and fewer ports (7), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

Gloucester, Portland, and New Bedford are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. They are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 5, Area sub-option B, seasonal sub-option B are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 5, Area sub-option B, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 115 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 25 nm in Areas 1B and 3, June-September, 2000-2015

State/Port	**2000-2006**		**2007-2015**	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$18K	6	$104K	8
Portland	$13K	4	$46K	5
Massachusetts	$29K	10	$256K	11
Gloucester	$25K	8	$239K	6
New Bedford	[b]	[b]	$16K	7
Other state(s)[b]	$1K	6	[b]	[b]
Total $ & permits	**$48K**	**18**	**$360K**	**15**
Total ports	**11**		**7**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 25 nm June-September in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 5, area sub-option B, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.8 Alternative 6 (Prohibit MWT gear inside 50 nm south of Area 1A)

Under Alternative 6, waters within 50 nautical miles south of Area 1A would be closed to midwater trawl gear, according to the area and seasonal options selected (Figure X, alternatives section). RSA fishing would be not be constrained by this alternative. Alternative 3 would be additive to Alternative 1 (No Action).

- Area options
    - Sub-option A – Herring Management Areas 1B, 2 and 3
    - Sub-option B - Herring Management areas 1B and 3 only
- Seasonal options
    - Sub-option A – Year round (12 months)
    - Sub-option B – June 1 – September 30 (4 months)

5.6.1.8.1 Area sub-option A (1, 2 & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option A on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 50 nm in Areas 1B, 2, and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, MWT vessels could no longer fish within 50 nm, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 50 nm within Area 1B, but virtually all fishing in Area 1B is currently inside of 50 nm.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 50 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 50 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For midwater trawl vessels, the impacts of Alternative 5, area sub-option A, seasonal sub-option A are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 50 nm in Areas 1B, 2, and 3 were 30% of the annual herring MWT landings for these Areas (Table 105, p. 238). Since 2007, the 50 nm zone became more important, comprising 42% of the total. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $8-13M/year, 43-45% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly further offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it. Relative to the other Alternative 6 sub-options, this combination would be most negative for the fishery, as it would result in the most times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option A on the Atlantic mackerel fishery are expected to be negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl year-round in areas inside 50 nm, south of Area 1A were 71% of the total for all areas by that gear type (Table 107, p. 241). Since then, the contribution has decreased slightly to 69%, though total mackerel landings declined by 77%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $8-13M/year, 43-45% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 6 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 6 sub-options, this combination would be most negative for the fishery, as it would result in the most times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option A on the American lobster are expected to be negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, this alternative may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area/season), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to the other Alternative 6 sub-options, this combination would be most negative for the lobster fishery, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 6, area sub-option A, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix 1). Since 2007, there has been moderate degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (39%), commercial bluefin tuna (17%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1, 4 and 5, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to the other Alternative 6 sub-options, this combination would be most positive for predator fisheries and ecotourism, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 50 nm in Areas 1B, 2, and 3 year-round, from 2000-2006, was $5.2M/year, attributed to 40 permits (Table 116). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, North Kingstown, Point Judith, Providence, Portland, Fall River and 19 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $6.5M, attributed to fewer permits (35) and ports (17), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under the earlier time period, but New Bedford had the most revenue more recently. New Bedford, Fall River and ports in states south of Massachusetts became more active in MWT fishing in the recent time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, New Bedford, Point Judith, N. Kingstown, and Portland are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators, except for N. Kingstown which has medium and low rankings.

The herring fishing communities that could be impacted by Alternative 6, Area sub-option A, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 116 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 50 nm in Areas 1B, 2, and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$0.4M	22	$1.0M	15
Portland	$0.3M	17	$0.7M	13
New Hampshire	$0.1M	9	[b]	[b]
Massachusetts	$2.6M	27	$4.7M	23
Gloucester	$1.6M	21	$1.8M	10
New Bedford	$0.9M	13	$2.8M	21
Fall River	$0.0M	6	$0.1M	8
Rhode Island	$2.0M	19	$0.3M	10
North Kingstown	$0.7M	6	[b]	[b]
Point Judith	$0.7M	10	$0.3M	6
Providence	$0.5M	5	[b]	[b]
Other state(s)[b]	$0.1M	11	$0.4M	12
Total $ & permits	**$5.2M**	**40**	**$6.5M**	**35**
Total ports	**26**		**17**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 6, Area sub-option A, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 50 nm year-round in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 6, Area sub-option A, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.8.2 Area sub-option A (1, 2 & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option B on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 50 nm in Areas 1B, 2, and 3 in June-September, the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 50 nm within Area 1B, but virtually all fishing in Area 1B is currently inside of 50 nm.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of 50 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 50 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult. Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246).

The impacts of Alternative 6, area sub-option A, seasonal sub-option B on the Atlantic herring midwater trawl fishery are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 50 nm, June-September, in Areas 1B, 2, and 3 were 6% of the herring MWT landings for that season (or 3% of annual) for these Areas (Table 105, p. 238). Since 2007, the 50 nm zone became more important, comprising 20% of the seasonal total (or 7% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.5-1.3M/year, 6-19% of the fishery-wide MWT revenue since 2007 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the recent past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 50 nm, south of Area 1A were virtually zero, and was very small for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.5-1.3M/year, 6-19% of the fishery-wide MWT revenue since 2007 (

Table 106, p. 240).

Alternative 6 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery.

Impacts on American lobster fishery

The impacts of Alternative 6, area sub-option A, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, this alternative may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area/season), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 6, area sub-option A, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been low to moderate overlap between the Atlantic herring MWT fishery and the commercial groundfish (31%), commercial bluefin tuna (17%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48). This degree of overlap is the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1, 4 and 5, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 50 nm in Areas 1B, 2, and 3 June-September, from 2000-2006, was $0.5M/year, attributed to 30 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, Rockland, Bath, Newington, Prospect Harbor and 14 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $1.3M, attributed to fewer permits (18) and ports

(12), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods. New Bedford and Jonesport were also active during the later time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, Portland, Rockland, New Bedford, and Jonesport are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by this alternative/option are primarily located in Maine and Massachusetts. The herring revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 6, Area sub-option A, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts to New Jersey (states adjacent to Areas 1B, 2 and 3), 13 adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, 21 such communities have been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 71 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Table 117 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 50 nm in Areas 1B, 2, and 3, June-September, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.2M	18	$0.5M	11
Portland	$0.1M	12	$0.5M	7
Rockland	$0.0M	5	[b]	[b]
Bath	$0.0M	3	[b]	[b]
Prospect Harbor	$0.0M	4	[b]	[b]
Jonesport			$0.0M	5
New Hampshire	$0.0M	7	[b]	[b]
Newington	$0.0M	3		
Massachusetts	$0.2M	15	$0.7M	13
Gloucester	$0.2M	11	$0.5M	7
New Bedford	[b]	[b]	$0.2M	8
Other state(s)[b]	$0.0M	5	$0.0M	5
Total $ & permits	**$0.5M**	**30**	**$1.3M**	**18**
Total ports	**20**		**12**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 50 nm June-September in Areas 1B, 2 and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 6, area sub-option A, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.8.3 Area sub-option B (1B & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option A on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 50 nm in Areas 1B and 3 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, MWT vessels could no longer fish within 50 nm, and it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 50 nm within Area 1B, but virtually all fishing in Area 1B is currently inside of 50 nm.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 50 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 50 nm that would be impacted, mostly off the "back side of the Cape" east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full Area 3 sub-ACL in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl fishery, the impacts of Alternative 6, area sub-option B, seasonal sub-option A are expected to be negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 50 nm year-round in Areas 1B and 3 were 14% of the annual herring MWT landings for Areas 1B, 2 and 3 (Table 105, p. 238). Since 2007, the percentage increased to 18%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $2.6-2.9M/year, 9-16% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94, p. 214). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option A on the Atlantic mackerel fishery are expected to be low negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with midwater trawl inside 50 nm in Areas 1B and 3 were just 0.5% of the total for all areas by that gear type (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $2.6-2.9M/year, 9-16% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 6 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery.

Impacts on American lobster fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option A on the American lobster are expected to be negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, Alternative 6 may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 6, area sub-option B, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has been low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (17%), commercial bluefin tuna (13%), and commercial whale watch operators (11%) in this area/season (Figure 48). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1, 4 and 5, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 50 nm in Areas 1B and 3 year-round, from 2000-2006, was $2.3M/year, attributed to 37 permits (Table 118). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, New Bedford, Point Judith, Rockland, Bath, Newington, Prospect Harbor and 15 other ports in the Northeast U.S. From 2007-2015, average revenue increased to $3.0M, but was attributed to fewer permits (23) and ports (17), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods. Jonesport was also active during the later time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, Portland, New Bedford, Point Judith, Rockland, and Jonesport are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

Table 118 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 50 nm in Areas 1B and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.4M	22	$0.9M	14
Portland	$0.3M	17	$0.7M	12
Rockland	$0.0M	7	[b]	[b]
Bath	$0.0M	3	[b]	[b]
Prospect Harbor	$0.0M	4	[b]	[b]
Jonesport	[b]	[b]	$0.0M	5
New Hampshire	$0.1M	7	[b]	[b]
Newington	$0.0M	3	[b]	[b]
Massachusetts	$1.8M	24	$2.0M	18
Gloucester	$1.5M	21	$1.4M	10
New Bedford	$0.2M	7	$0.6M	12
Rhode Island	$0.1M	8	$0.0M	4
Point Judith	$0.1M	4	[b]	[b]
Other state(s)[b]	$0.0M	2	$0.0M	3
Total $ & permits	**$2.3M**	**37**	**$3.0M**	**23**
Total ports	**23**		**17**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

The herring fishing communities that could be impacted by Alternative 6, Area sub-option B, seasonal sub-option A are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 6, Area sub-option B, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 50 nm year-round in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 6, Area sub-option B, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.8.4 Area sub-option B (1B & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option B on the overall Atlantic herring fishery are expected to be negative. If midwater trawls are prohibited from fishing inside 50 nm in Areas 1B 3 in June-September, the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within the 30 minute square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of 50 nm within Area 1B, but virtually all fishing in Area 1B is currently inside of 50 nm.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of 50 nm, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within 50 nm that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult. Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246).

For the midwater trawl vessels, the impacts of Alternative 6, area sub-option B, seasonal sub-option B are expected to be low negative. From 2000-2007, Atlantic herring landings attributed to MWT fishing inside 50 nm, June-September, in Areas 1B and 3 were 6% of the herring MWT landings for that season for Areas 1B, 2 and 3 (or 3% of annual; Table 105, p. 238). Since 2007, the 50 nm zone became more important, comprising 20% of the seasonal total (or 7% of annual). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.4-1.3M/year, 5-16% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the importance of this area and season to the MWT fishery in the past, this alternative/option may impede the ability to harvest optimum yield, unless the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the herring MWT fishery, as there would be more times and areas closed to it. Relative to the other Alternative 6 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, Atlantic mackerel landings attributed to fishing with midwater trawl in June-September in areas inside 50 nm, in Areas 1B and 3 were virtually zero, and very small (<10 mt) for all areas (Table 107, p. 241). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.4-1.3M/year, 5-16% of the fishery-wide MWT revenue since 2000 (

Table 106, p. 240).

Alternative 6 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 6 sub-options, this combination would be the least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 6, area sub-option B, seasonal sub-option B on the American lobster are expected to be negative. Given the importance of this area and season to the herring midwater trawl fishery in the past, Alternative 6 may impede the ability to harvest Atlantic herring optimum yield (unless another gear type expands into this area), potentially impairing the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1, 4 and 5, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to the other Alternative 6 sub-options, this combination would be least negative for the lobster fishery, as it would result in the least times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 6, area sub-option B, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). However, since 2007, there has been low overlap between the Atlantic herring MWT fishery and the commercial groundfish (17%), commercial bluefin tuna (13%) and commercial whale watch operators (11%) during the months of June-September in the area under consideration (Figure 48, p. 213). This degree of overlap is the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Herring fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas.

Fishing within 50 nm in Areas 1B, 2 and 3 is most important to the herring MWT fishery during December and January (Figure 56, p. 246), which is not when user conflicts are expected to be highest with the predator fisheries and ecotourism, which tend to be most active in the late spring-fall.

Relative to Alternatives 1, 4 and 5, the impacts would be more positive for predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to the other Alternative 6 sub-options, this combination would be least positive for the predator fisheries and ecotourism, as it would result in the least times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings revenue from within 50 nm in Areas 1B and 3 June-September, from 2000-2006, was $$0.5M/year, attributed to 30 permits (Table 109). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, Rockland, Bath, Newington, Prospect Harbor and 14 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $1.3M, attributed to fewer permits (18) and ports (12), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods. Jonesport was also active during the later time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. Of these, Gloucester, Portland, New Bedford, Point Judith, Rockland, and Jonesport are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 6, Area sub-option B, seasonal sub-option B are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 119 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 50 nm in Areas 1B and 3, June-September, 2000-2015

State/Port	**2000-2006**		**2007-2015**	
	Average revenue	**Total permits[a]**	**Average revenue**	**Total permits[a]**
Maine	$0.2M	18	$0.5M	11
Portland	$0.1M	12	$0.3M	6
Rockland	$0.0M	5	[b]	[b]
Bath	$0.0M	3	[b]	[b]
Prospect Harbor	$0.0M	4	[b]	[b]
Jonesport			$0.0M	5
New Hampshire	$0.0M	7	[b]	[b]
Newington	$0.0M	3	[b]	[b]
Massachusetts	$0.2M	15	$0.7M	13
Gloucester	$0.2M	11	$0.5M	7
New Bedford	[b]	[b]	$0.2M	8
Other state(s)[b]	$0.0M	5	$0.0M	5
Total $ & permits	**$0.5M**	**30**	**$1.3M**	**18**
Total ports	**20**		**12**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 6, Area sub-option B, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. From Massachusetts, the state adjacent to Areas 1B and 3, no adjacent communities have been identified as being particularly important to the mackerel fishery (AE, Table 61), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one such community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, 7 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 50 nm June-September in Areas 1B and 3 are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes*, *Beliefs*, *and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes*, *Beliefs*, *and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 6, area sub-option B, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.9 Alternative 7 (Prohibit MWT gear in thirty minute squares off Cape Cod)

Under Alternative 7, vessels with midwater trawl gear would be prohibited to fish within several thirty minute squares (Areas 99, 100, 114, 115, and 123), according to the area and seasonal options selected (Figure X, alternatives section). RSA fishing would be not be constrained by this alternative. Alternative 3 would be additive to Alternative 1 (No Action).

- Area options
  - Sub-option A – all five thirty minute squares within Herring Management Areas 1B, 2 and 3
  - Sub-option B – subset of thirty minute squares within Herring Management Areas 1B and 3 only (Areas 99, 114, and 123 only)
- Seasonal options
  - Sub-option A – Year round (12 months)
  - Sub-option B – June 1 – September 30 (4 months)

5.6.1.9.1 Area sub-option A (1, 2 & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option A on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing within 30 minute squares 99, 100, 114, 115, and 123 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within Square 114 off the "back side of the Cape" in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on "the back side of the Cape" and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of these squares within Area 1B, but virtually all fishing in Area 1B is currently inside Square 114.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of these squares, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within these squares that would be impacted, mostly off the "back side of the Cape" east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For midwater trawl vessels, the impacts of Alternative 7, area sub-option A, seasonal sub-option A are expected to be negative. From 2000-2015, 99-100% of the Atlantic herring landings from fishing within 30 minute squares 99, 100, 114, 115, and 123 year-round were by MWT vessels (Table 120). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.9M/year, 7-9% of total MWT revenue since 2000 (Table 121).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 2, the impacts would be more negative for the MWT fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 7 sub-options, this combination would be most negative for the MWT fishery, as it would result in the most times/areas closed to it.

Table 120 – Annualized Atlantic herring landings within 30 min squares: 99, 100, 114, 115 and 123 (Alternative 7)

Sub-options		Description	Time period	Herring landings within 30 min squares (mt)		
Area	Season			MWT only		All gear
A	A	Areas 1B, 2 & 3; year round	2000-2007	6,824	99%	6,917
			2007-2015	5,999	100%	6,020
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	132	95%	139
			2007-2015	1,100	100%	1,102
B	A	Areas 1B, 2 & 3; year round	2000-2007	6,401	99%	6,474
			2007-2015	5,600	100%	5,605
B	B	Areas 1B, 2 & 3; June-Sept	2000-2007	99	99%	100
			2007-2015	1,015	100%	1,016

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward. "Total" for all rows includes all landings south of 1A.
Source: VTR analysis.

Table 121 – Annualized Atlantic herring and mackerel MWT revenue within 30 min squares: 99, 100, 114, 115 and 123 (Alternative 7)

Sub-options		Description	Time period	Herring/mackerel MWT revenue		
Area	Season			Inside		Total all areas
A	A	Areas 1B, 2 & 3; year round	2000-2007	$1.9M	6.6%	$28.9M
			2007-2015	$1.6M	8.7%	$18.7M
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	$0.0M	0.5%	$7.9M
			2007-2015	$0.4M	5.3%	$6.8M
B	A	Areas 1B, 2 & 3; year round	2000-2007	$1.9M	6.6%	$28.9M
			2007-2015	$1.6M	8.7%	$18.7M
B	B	Areas 1B, 2 & 3; June-Sept	2000-2007	$0.4M	5.3%	$6.8M
			2007-2015	$0.0M	0.5%	$7.9M

Note: "2000-2007" includes data through May 2007, pre-Amendment 1 implementation. "2007-2015" includes data from June 2007 onward.
Source: VTR analysis.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option A on the Atlantic mackerel fishery are expected to be low negative. From 2000-2007, Atlantic mackerel landings attributed to MWT fishing within 30 minute squares 99, 100, 114, 115, and 123 year-round were 0.4% of the total for all areas by that gear type (Table 122). Since then, the contribution has increased to 3.2%, though total mackerel landings declined by 77%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.9M/year, 7-9% of total MWT revenue since 2000 (Table 121).

Alternative 7 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 2, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 7 sub-options, this combination would be most negative for the MWT fishery, as it would result in the most times/areas closed to it.

Table 122 – Annualized Atlantic mackerel landings within 30 min squares: 99, 100, 114, 115 and 123 (Alternative 7)

Sub-options		Description	Mackerel MWT landings south of Area 1A (mt)			
Area	Season		Time period	Inside		Total
A	A	Areas 1B, 2 & 3; year round	2000-2007	113	0.4%	30,082
			2007-2015	224	3.2%	6,994
A	B	Areas 1B, 2 & 3; June-Sept	2000-2007	0	0%	<10
			2007-2015	0	0%	<10
B	A	Areas 1B & 3; year round	2000-2007	70	0.2%	30,082
			2007-2015	224	3.2%	6,994
B	B	Areas 1B & 3; June-Sept	2000-2007	0	0%	<10
			2007-2015	0	0%	<10

Impacts on American lobster fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option A on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 2, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to the other Alternative 7 sub-options, this combination would be most negative for the lobster fishery, as it would result in the most times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 7, area sub-option A, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (17%), commercial bluefin tuna (7%), and commercial whale watch operators (11%) in this area/season (Figure 48, p. 213). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Relative to Alternatives 1 and 2, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to the other Alternative 7 sub-options, this combination would be most positive for the predator fisheries and ecotourism, as it would result in the most times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings attributed to fishing within 30 minute squares 99, 100, 114, 115, and 123 year-round, from 2000-2006, was $1.7M/year, attributed to 30 permits (Table 123). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, Portland, Point Judith, North Kingstown, and 11 other ports in the Northeast U.S. From 2007-2015, there average revenue remained constant, but was attributed to fewer permits (20) and ports (13), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. These are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators, except for N. Kingstown which has medium and low rankings.

Table 123 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 30 min squares in Areas 1B, 2, and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$0.1M	10	$0.4M	9
Portland	$0.1M	8	$0.3M	7
Massachusetts	$1.4M	24	$1.2M	18
Gloucester	$1.3M	20	$0.9M	9
New Bedford	$0.2	8	$0.3M	12
Rhode Island	$0.0M	11	$0.0M	3
Point Judith	$0.0M	5	[b]	[b]
North Kingstown	$0.0M	6	[b]	[b]
Other state(s)[b]	$0.0M	2	$0.0M	1
Total $ & permits	**$1.7M**	**30**	**$1.7M**	**20**
Total ports	**16**		**13**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

The herring fishing communities that could be impacted by Alternative 7, Area sub-option A, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 7, area sub-option A, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Massachusetts, no adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one adjacent community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about 9 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports, particularly within Massachusetts.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 30 minute squares 99, 100, 114, 115, and 123 year-round, are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 7, Area sub-option A, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.9.2 Area sub-option A (1, 2 & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing within 30 minute squares 99, 100, 114, 115, and 123 in June-September, the Area 1B sub-ACL is still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within Square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (AE, Tables 15 & 16). Under this alternative/option, it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of these squares/season within Area 1B, but virtually all fishing in Area 1B is currently inside Square 114.

Fishing may also be negatively impacted in Areas 3 and 2. For Area 3, the majority of catch is from outside of these squares, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within these squares that would be impacted, mostly off the “back side of the Cape” east of Chatham. For Area 2, more fishing takes place closer to shore compared to Area 3; therefore, the potential impact of this measure in terms of making it difficult to harvest the sub-ACL is greater. It should be noted that the fishery has not utilized the full area sub-ACLs for Areas 2 and 3 in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl fishery, the impacts of Alternative 7, area sub-option A, seasonal sub-option B are expected to be low negative. From 2000-2015, 95-100% of the Atlantic herring landings from fishing within 30 minute squares 99, 100, 114, 115, and 123 June-September were by MWT vessels (Table 120, p. 300). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.0-0.4M/year, 0.5-5% of total MWT revenue since 2000 (Table 121, p. 300).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 2, the impacts would be more negative for the MWT fishery, as there would be more times and areas closed to the fishery.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, there were no Atlantic mackerel landings attributed to fishing with MWT within 30 minute squares 99, 100, 114, 115, and 123 June-September (Table 122). From January 2000 to May 2007, Atlantic herring and mackerel revenue attributed to midwater trawl fishing in this area/season were $3.7M, or 13% of the annual total attributed to that gear type (

Table 106). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0.0-0.4M/year, 0.5-5% of total MWT revenue since 2000 (Table 121, p. 300).

Alternative 7 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 2, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery.

Impacts on American lobster fishery

The impacts of Alternative 7, area sub-option A, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 2, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 7, area sub-option A, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (17%), commercial bluefin tuna (7%), and commercial whale watch operators (11%) in this area/season (Figure 48, p. 213). This degree of overlap is the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Relative to Alternatives 1 and 2, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings attributed to fishing within 30 minute squares 99, 100, 114, 115, and 123 June-September, from 2000-2006, was $40K/year, attributed to 16 permits (Table 123). In order from greatest to least, most of the revenue was from Gloucester, Portland, and 8 other ports in the Northeast U.S. From 2007-2015, there was an increase in average revenue, to $343K, attributed to fewer permits (13) and ports (7), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods. New Bedford was active during the later time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. These are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or “high” for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 7, Area sub-option A, seasonal sub-option B are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 124 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 30 min squares in Areas 1B, 2, and 3, June-September, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$18K	6	$102K	6
Portland	$13K	4	$43K	3
Massachusetts	$19K	8	$242K	8
Gloucester	$17K	4	$228K	5
New Bedford	[b]	[b]	$14K	5
Other state(s)[b]	$3K	4	$0K	1
Total $ & permits	**$40K**	**16**	**$343K**	**13**
Total ports	**10**		**7**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 7, area sub-option A, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Massachusetts, no adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one adjacent community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about 9 adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports, particularly within Massachusetts.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 30 minute squares 99, 100, 114, 115, and 123 June-September, are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the

Social Structure and Organization of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 7, Area sub-option A, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.9.3 Area sub-option B (1B & 3), seasonal sub-option A (year-round)

Impacts on Atlantic herring fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option A on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing within 30 minute squares 99, 114 and 123 year-round (except for RSA fishing), the Area 1B sub-ACL is not expected to be fully harvested, though Area 1B is a small fraction of the total sub-ACL. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within Square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of these squares within Area 1B, but virtually all fishing in Area 1B is currently inside Square 114.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of these squares, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within these squares that would be impacted, mostly off the “back side of the Cape” east of Chatham. It should be noted that the fishery has not utilized the full Area 4 sub-ACL in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl fishery, the impacts of Alternative 7, area sub-option B, seasonal sub-option A are expected to be negative. From 2000-2015, 99-100% of the Atlantic herring landings from fishing within 30 minute squares 99, 114, and 123 year-round were by MWT vessels (Table 120, p. 300). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.9M/year, 7-9% of total MWT revenue since 2000 (Table 121, p. 300).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on "the back side of the Cape", as purse seining is difficult in strong tides and rough ocean conditions.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 2, the impacts would be more negative for the MWT fishery, as there would be more times and areas closed to the fishery.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option A on the Atlantic mackerel fishery are expected to be low negative. From 2000-2007, Atlantic mackerel landings attributed to fishing with MWT within 30 minute squares 99, 114, and 123 year-round were 0.2% of the total for all areas by that gear type (Table 122). Since then, the contribution has increased to 3.2%, though total mackerel landings declined by 77%. Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $1.6-1.9M/year, 7-9% of total MWT revenue since 2000 (Table 121, p. 300).

Alternative 7 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 2, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery.

Impacts on American lobster fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option A on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 2, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 7, area sub-option B, seasonal sub-option A on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (10%), commercial bluefin tuna (6%), and commercial whale watch operators (11%) in this area/season (Figure 48, p. 213). Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Relative to Alternatives 1 and 2, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings attributed to fishing within 30 minute squares 99, 114, and 123 year-round, from 2000-2006, was $1.6M/year, attributed to 29 permits (Table 123). In order from greatest to least, most of the revenue was from herring landed in Gloucester, New Bedford, Portland, Point Judith, Rockland, and 11 other ports in the Northeast U.S. From 2007-2015, there average revenue increased slightly ($1.7M), but was attributed to fewer permits (20) and ports (13), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. These are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of "medium-high" or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 7, Area sub-option B, seasonal sub-option A are primarily located in Maine, Massachusetts, and Rhode Island. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Table 125 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 30 min squares in Areas 1B and 3, year-round, 2000-2015

State/Port	2000-2006		2007-2015	
	Average revenue	Total permits[a]	Average revenue	Total permits[a]
Maine	$0.1M	10	$0.4M	9
Portland	$0.1M	7	$0.3M	7
Rockland	$0.0M	3	[b]	[b]
Massachusetts	$1.4M	24	$1.2M	17
Gloucester	$1.2M	20	$0.9M	9
New Bedford	$0.1M	7	$0.3M	12
Rhode Island	$0.0M	8	$0.0M	3
Point Judith	$0.0M	4	[b]	[b]
Other state(s)[b]	$0.0M	3	$0.0M	1
Total $ & permits	**$1.6M**	**29**	**$1.7M**	**20**
Total ports	**16**		**13**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Alternative 7, area sub-option B, seasonal sub-option A may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Massachusetts, no adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one adjacent community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about six adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports, particularly within Massachusetts.

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 30 minute squares 99, 114, and 123 year-round, are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 7, Area sub-option B, seasonal sub-option A results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.9.4 Area sub-option B (1B & 3), seasonal sub-option B (June-September)

Impacts on Atlantic herring fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option B on the overall Atlantic herring fishery are expected to be low negative. If midwater trawls are prohibited from fishing within 30 minute squares 99, 114, and 123 June-September, the Area 1B sub-ACL is still expected to be fully harvested. This sub-ACL is small, about 4,000 mt in recent years, and typically caught within Square 114 off the “back side of the Cape” in nearshore waters by MWT vessels. During 2008-2014, 54% of the 1B sub-ACL was caught by MWT, 9% by purse seines, and 37% by small mesh bottom trawls (Table 30 and Table 31, p. 80). Under this alternative/option, it would become more difficult for the fishery to harvest the Area 1B sub-ACL. Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3. Use of purse seines is unlikely on “the back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water. MWT vessels may shift to fishing outside of these squares/season within Area 1B, but virtually all fishing in Area 1B is currently inside Square 114.

Fishing may also be negatively impacted in Area 3, where the majority of catch is from outside of these squares, so the fishery has more ability to harvest the Area 3 sub-ACL. There is a portion of total Area 3 landings that is consistently caught within these squares that would be impacted, mostly off the "back side of the Cape" east of Chatham. It should be noted that the fishery has not utilized the full Area 3 sub-ACLs in recent years. Implementing this measure could make it even more difficult.

For the midwater trawl fishery, the impacts of Alternative 7, area sub-option B, seasonal sub-option B on the Atlantic herring midwater trawl fishery are expected to be low negative. From 2000-2015, 99-100% of the Atlantic herring landings from fishing within 30 minute squares 99, 114 and 123 June-September were by MWT vessels (Table 120, p. 300). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0-0.4M/year, 0.5-5% of total MWT revenue since 2000 (Table 121, p. 300).

Any closure to the fishery may hamper adaptability to changing conditions and may result in some foregone revenue. Given the low importance of this area and season to the MWT fishery in the past, this alternative/option may not impede the ability to harvest optimum yield, particularly if the allowable catch is fished with other gear types.

To some degree, negative impacts would be mitigated by the ability of herring MWT vessels to fish in other management areas/seasons, particularly offshore, which is more accessible to the MWT fleet than other gear types. However, there are increased operational costs of fishing offshore (Table 94). It is difficult to determine if fishermen would be precluded from fishing altogether or be able to shift effort to other areas.

Relative to Alternatives 1 and 2, the impacts would be more negative for the MWT fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 7 sub-options, this combination would be least negative for the MWT fishery, as it would result in the least most times/areas closed to it.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option B on the Atlantic mackerel fishery are expected to be low negative. From 2000-2015, there were no Atlantic mackerel landings attributed to fishing with MWT within 30 minute squares 99, 114, and 123 June-September (Table 122, p. 301). Atlantic herring and mackerel revenue attributed to MWT fishing in this area/season has been about $0-0.4M/year, 0.5-5% of total MWT revenue since 2000 (Table 121, p. 300).

Alternative 7 may hamper adaptability to changing conditions and may result in some foregone revenue. Relative to Alternatives 1 and 2, the impacts would be more negative for the mackerel fishery, as there would be more times and areas closed to the fishery. Relative to the other Alternative 7 sub-options, this combination would be least negative for the MWT fishery, as it would result in the least times/areas closed to it.

Impacts on American lobster fishery

The impacts of Alternative 7, area sub-option B, seasonal sub-option B on the American lobster are expected to be neutral to low negative. Given the low importance of this area and season to the herring midwater trawl fishery in the past, this alternative, by itself, likely would not impede the ability to harvest Atlantic herring optimum yield, and thus would have minimal impact on the bait market. If herring landings are reduced by this measure, then the price of herring for bait could increase, potentially increasing costs for the lobster fishery.

Relative to Alternatives 1 and 2, the impacts would be more negative for the lobster fishery, as there would be more times and areas closed to the herring fishery. Relative to the other Alternative 7 sub-options, this combination would be least negative for the lobster fishery, as it would result in the least times/areas closed to the herring fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 7, area sub-option B, seasonal sub-option B on predator fisheries and ecotourism are expected to be low positive. Assuming that removing overlap between the midwater trawl Atlantic herring and predator fisheries and ecotourism is a positive outcome for the predator fisheries and ecotourism, this alternative would have a positive effect, based on the overlap analysis, with its assumptions and known limitations (Section 5.6.1.1.1.3; Appendix XXX). Since 2007, there has low degrees of overlap between the Atlantic herring MWT fishery and the commercial groundfish (10%), commercial bluefin tuna (7%), and commercial whale watch operators (11%) in this area/season (Figure 48, p. 213). This degree of overlap is almost the same as that of the year-round option (Alternative 4, area sub-option B, seasonal sub-option A). Many of the recreational users (recreational fishing and whale watching) are active during fair weather. Therefore, measures that reduce user conflicts in the summer and fall are likely to be nearly as effective as year-round measures. Midwater trawl fishing may shift to other times and areas remaining open, so there may be negative impacts to the degree such effort shifts cause overlaps in other times and areas. If MWT fishing is replaced by other gear types, negative outcomes for predator fisheries may result from overlap with these gears.

Relative to Alternatives 1 and 2, the impacts would be more positive for the predator fisheries and ecotourism, as there would be more times and areas closed to the herring MWT fishery. Relative to the other Alternative 7 sub-options, this combination would be least positive for the predator fisheries and ecotourism, as it would result in the least times/areas closed to the herring MWT fishery.

Impacts on communities

General community impacts of the alternatives under consideration are described in Section 5.6.1.2 (p. 217). Although the VTR analysis has some degree of error, it is estimated that the Atlantic herring MWT landings attributed to fishing within 30 minute squares 99, 114, and 123 June-September, from 2000-2006, was $40K/year, attributed to 16 permits (Table 123). In order from greatest to least, most of the revenue was from herring landed in Gloucester, Portland, and 8 other ports in the Northeast U.S. From 2007-2015, there average revenue increased to $342K, but was attributed to fewer permits (13) and ports (7), from herring MWT landings attributed to this area/season. Gloucester had the most revenue under both time periods. New Bedford was active during the later time period.

The named ports above are the top (non-confidential) herring ports that would most likely be impacted by this alternative/option. These are identified as herring *Communities of Interest*, according to the criteria in Section 1.6.3.2.1 (p. 131). They have a rank of “medium-high” or "high" for engagement in or reliance on the Atlantic herring fishery, according to the NMFS Community Vulnerability Indicators.

The herring fishing communities that could be impacted by Alternative 7, Area sub-option B, seasonal sub-option B are primarily located in Maine and Massachusetts. The herring MWT revenue attributed to these states from this area/season during 2007-2015 is about X% of all herring revenue for these states during that time period. Certain individual permit holders could have much more of their revenue attributed to fishing from this area/time.

Alternative 7, area sub-option B, seasonal sub-option B may impact other users of Atlantic herring and their associated communities, many of which co-exist (with each other and with the herring fishery) within communities. Within Massachusetts, no adjacent communities have been identified as being particularly important to the mackerel fishery (Table 78), though mackerel communities impacted by this alternative/option would likely mirror the herring communities. For the lobster fishery, one adjacent community has been identified, though herring as bait is distributed to the lobster fishery region-wide. Additionally, about six adjacent communities have been identified as being particularly important to the fisheries and ecotourism that rely on herring as a prey item in the ecosystem, though these users are known to hail from other ports, particularly within Massachusetts.

Table 126 – Landings revenue to states, regions, and top ports attributed to Atlantic herring fishing (MWT only) within 30 min squares in Areas 1B and 3, June-September, 2000-2015

State/Port	**2000-2006**		**2007-2015**	
	Average revenue	**Total permits**[a]	**Average revenue**	**Total permits**[a]
Maine	$18K	6	$101K	6
Portland	$13K	4	$43K	3
Massachusetts	$19K	8	$241K	8
Gloucester	$17K	7	$227K	5
New Bedford	b	b	$14K	5
Other state(s)[b]	$3K	4	$0K	1
Total $ & permits	**$40K**	**16**	**$342K**	**13**
Total ports	**10**		**7**	

Notes: Ports listed are the top ten ports by landing revenue that are non-confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports/states.
[b] Confidential
Source: VTR analysis

Sociocultural impacts

The sociocultural impacts associated with excluding the herring midwater trawl fishery within 30 minute squares 99, 114, and 123 June-September, are expected to be negative for the fishermen and fishing communities constrained. Establishing the closure would likely change the *Social Structure and Organization* of communities as well as *Historical Dependence on and Participation* in the fishery by individuals and communities.

Fishermen who remain active within this area/season may experience indirect positive benefits via reduced gear conflicts – though fishermen active outside the area may have negative impacts due to crowding. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. This could cause resentment among the subset of fishermen constrained by the closure, negatively affecting the *Social Structure and Organization* of communities.

Conflicts between the various user groups of the herring resource may be improved, a positive impact on the *Non-Economic Social* aspects and the *Attitudes, Beliefs, and Values* of users. However, effort shifts to other gear types and to other areas/seasons may continue conflicts. If Alternative 7, Area sub-option B, seasonal sub-option B results in reduced user conflicts, there would be a positive impact on the *Non-Economic Social Aspects* of the human communities.

5.6.1.10 Alternative 8 (Revert boundary between Areas 1B and 3 back to original boundary)

Under Alternative 8, the boundary between Areas 1B and 3 would revert back to what it was under the original Herring FMP. The current boundary between Areas 2 and 3 would be maintained. (Figure X, alternatives section). Alternative 8 would be additive to Alternative 1 (No Action).

Impacts on Atlantic herring fishery

The impacts of Alternative 8 on the Atlantic herring fishery are expected to be low negative. The change in the management boundaries under Amendment 1 was intended, in part, to better reflect the distribution of the spawning components of the Atlantic herring stock. Therefore, if the boundaries change back, there may be increased risk of fishing one spawning component harder than another, which could have low negative impacts on the resource. This, in turn, could have long-term negative social impacts to the *Historical Dependence on and Participation in* the herring fishery if the long-term sustainability of the resource is jeopardized, a threat to continued access to fishery resources. There may be a negative impact on the *Attitudes, Beliefs, and Values* of stakeholders towards management should there be a perceived inability of regulators to properly manage fishery resources. In the short-term, Alternative 8 may make it more difficult to harvest the Area 3 sub-ACL and make the fishery only accessible to those vessels capable of fishing offshore. Alternative 8 would directly impact the vessels fishing off the “Back side of the Cape” and on Georges Bank – primarily midwater trawls, impacts may be felt fishery-wide should stock conditions deteriorate.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 8 on the Atlantic mackerel fishery are expected to be low negative, due to the interconnectedness between the Atlantic herring and Atlantic mackerel fisheries.

Impacts on American lobster fishery

The impacts of Alternative 8 on the American lobster fishery are expected to be low negative, due to the interconnectedness between the Atlantic herring and its bait market, primarily the Atlantic lobster fishery.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 8 on predator fisheries and ecotourism are expected to be neutral. This alternative may move some midwater trawl fishing activity offshore, reducing the potential for user conflicts inshore, a positive impact. However, should Atlantic herring stock conditions deteriorate, negative impacts to all users of Atlantic herring are expected.

Impacts on communities

The impacts of Alternative 8 on fishing communities is expected to be negative. There could be negative impacts to the *Size and Demographic Characteristics* of the fishery-related workforce within communities should a deterioration occur in the Atlantic herring fishery or in other fisheries/users of Atlantic herring.

5.6.1.11 Alternative 9 (Remove seasonal closure of Area 1B from January – April)

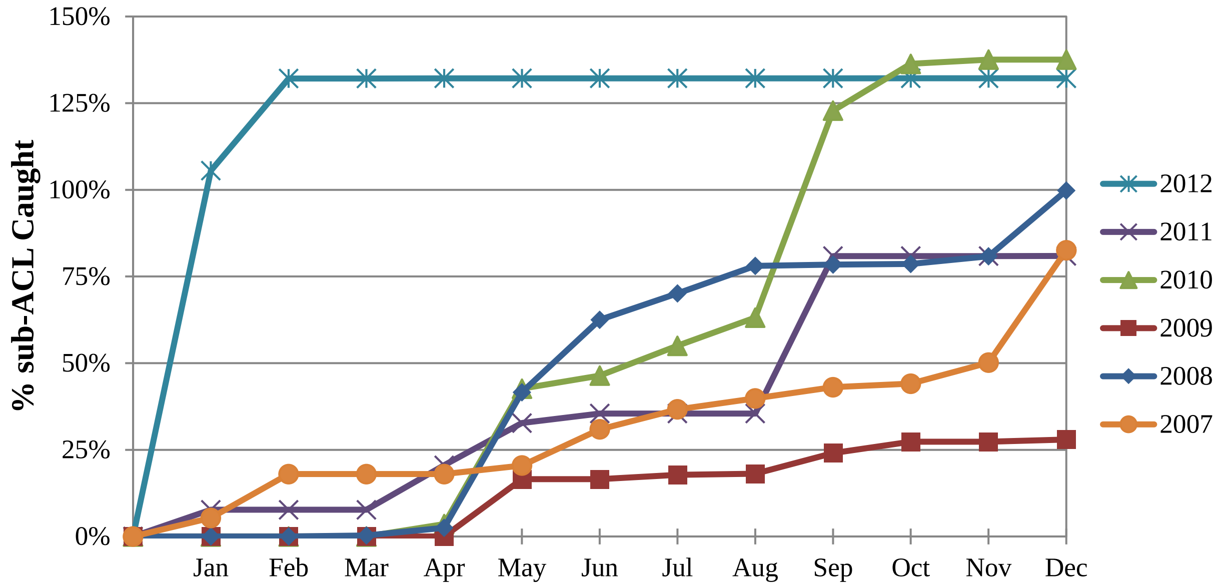
Under Alternative 9, the seasonal closure (January 1 – April 30) in Area 1B that has existed since implementation of the 2013-2015 specifications would be removed. Alternative 9 would be additive to Alternative 1 (No Action).

Impacts on Atlantic herring fishery

The impacts of Alternative 9 on the Atlantic herring fishery are expected to be low negative. Generally, herring prices are lower in winter, with reduced demand from the lobster fishery. Under Alternative 9, it is more likely that herring fishermen would fish early in the year, rather than wait for more favorable prices, due to a preference for some share of the resource prior to the sub-ACL being fully harvested. There would be some benefits to increased flexibility, but negative impacts on fishery revenue are expected.

Between 2007 and 2011, 21% or less of the Area 1B sub-ACL had been caught by the end of April each year (Figure 57). However, in 2012, the sub-ACL was fully harvested before the end of January. It is likely that due to a 1B overage in 2010, the industry maximized 1B quota in 2012 before an overage deduction would have been implemented. Removing the delay of the opening of Area 1B may not allow sufficient time for overage or carryover determinations, so it may be more difficult to harvest within the sub-ACL.

Figure 57 - Area 1B sub-ACL use by month, 2007-2012



Source: NERO DIMS database, queried 12/7/2012.

Impacts on Atlantic mackerel fishery

The impacts of Alternative 9 on the Atlantic mackerel fishery are expected to be low positive, as this would enable landings in the fishery earlier in the year.

Impacts on American lobster fishery

The impacts of Alternative 9 on the American lobster fishery are expected to be low positive. Generally, herring prices are lower in winter, with reduced demand from the lobster fishery. Under Alternative 9, the lobster fishery would benefit from access to herring at lower cost.

Impacts on predator fisheries and ecotourism

The impacts of Alternative 9 on predator fisheries and ecotourism are expected to be low positive. With this seasonal closure removed, Atlantic herring fishing in Area 1B is expected to shift earlier in the year when user conflicts are expected to be less. In fact, the 2013-2015 specifications predicted that the seasonal closure of Area 1B may result in user group conflicts, particularly between the midwater trawl herring vessels and recreational striped bass anglers, which use Area 1B in June. With the exception of 2011 and 2012, Area 1B had been open year-round to the herring fishery (only in 2012 was it closed in June) without significant conflict with other user groups. Removal of the seasonal split may decrease herring vessel activity in Area 1B in June.

Impacts on communities

With the impacts of Alternative 9 on the users of Atlantic herring are expected to be mixed, reducing conflict among users is expected to lead to positive impacts among human communities.

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7.0 GLOSSARY

ABC Control Rule (ABC CR). The specified approach to setting the ABC for a stock or stock complex as a function of scientific uncertainty in the estimate of OFL and any other scientific uncertainty. The ABC control rule will consider uncertainty in factors such as stock assessment issues, retrospective patterns, predator-prey issues, and projection results. The ABC control rule will be specified and may be modified based on guidance from the SSC during the specifications process. Modifications to the ABC control rule can be implemented through specifications or framework adjustments to the Herring FMP (in addition to future amendments), as appropriate.

Acceptable Biological Catch (ABC). The maximum catch that is recommended for harvest, consistent with meeting the biological objectives of the management plan. The MSA interpretation of ABC includes consideration of biological uncertainty (stock structure, stock mixing, other biological/ecological issues), and recommendations for ABC should come from the NEFMC SSC. ABC can equal but never exceed the OFL.

OFL – Scientific Uncertainty = ABC (Determined by SSC)

Annual Catch Limit (ACL). A stockwide ACL accounts for both scientific uncertainty (through the specification of ABC) and management uncertainty (through the specification of the stockwide ACL and buffer between ABC and the ACL). The ACL is the annual catch level specified such that the risk of exceeding the ABC is consistent with the management program. The ACL can equal but never exceed the ABC. ACL should be set lower than the ABC as necessary due to uncertainty over the effectiveness of management measures. The stockwide Atlantic herring ACL equates to the U.S. optimum yield (OY) for the Atlantic herring fishery and serves as the level of catch that determines whether accountability measures (AMs) become effective. The AM for the stockwide ACL, total fishery closure at 95%, reduces the risk of overfishing.

ABC – Management Uncertainty = Stockwide ACL = OY

Bycatch: (v.) The capture of nontarget species in directed fisheries which occurs because fishing gear and methods are not selective enough to catch only target species. (n.) Fish which are harvested in a fishery but are not sold or kept for personal use, including economic discards and regulatory discards but not fish released alive under a recreational catch and release fishery management program.

Capacity: The level of output a fishing fleet is able to produce given specified conditions and constraints. Maximum fishing capacity results when all fishing capital is applied over the maximum amount of available (or permitted) fishing time, assuming that all variable inputs are utilized efficiently.

Catch: The sum total of fish killed in a fishery in a given period. Catch is given in either weight or number of fish and may include landings, unreported landings, discards, and incidental deaths.

Continental shelf waters: The waters overlying the continental shelf, which extends seaward from the shoreline and deepens gradually to the point where the sea floor begins a slightly steeper descent to the deep ocean floor; the depth of the shelf edge varies, but is approximately 200 m in many regions.

Days absent: An estimate by port agents of trip length. This data was collected as part of the NMFS weighout system prior to May 1, 1994.

Discards: Animals returned to sea after being caught; see *bycatch (n.).*

Essential Fish Habitat (EFH): Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The EFH designation for most managed species in this region is based on a legal text definition and geographical area that are described in the Habitat Omnibus Amendment (NEFMC 1998).

Exclusive Economic Zone (EEZ): A zone in which the inner boundary is a line coterminous with the seaward boundary of each of the coastal States and the outer boundary is line 200 miles away and parallel to the inner boundary

Exempt fisheries: Any fishery determined by the Regional Director to have <5% regulated species as a bycatch (by weight) of total catch according to 50 CFR 648.80(a)(7).

Fishing effort: The amount of time and fishing power used to harvest fish. Fishing power is a function of gear size, boat size and horsepower.

Framework adjustments: Adjustments within a range of measures previously specified in a fishery management plan (FMP). A change usually can be made more quickly and easily by a framework adjustment than through an amendment. For plans developed by the NEFMC, the procedure requires at least two Council meetings including at least one public hearing and an evaluation of environmental impacts not already analyzed as part of the FMP.

Landings: The portion of the catch that is harvested for personal use or sold.

Limited-access permits: Permits issued to vessels that met certain qualification criteria by a specified date (the "control date").

Localized depletion: When harvesting takes more fish than can be replaced either locally or through fish migrating into the catch area within a given time period.

Metric ton: A unit of weight equal to a thousand kilograms (1kgs = 2.2 lbs.). A metric ton is equivalent to 2,205 lbs. A thousand metric tons is equivalent to 2.2 million lbs.

Northeast Shelf Ecosystem: The Northeast U.S. Shelf Ecosystem has been described as including 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.

Overfishing Limit (OFL): The catch that results from applying the maximum fishing mortality threshold to a current or projected estimate of stock size. When the stock is not overfished and overfishing is not occurring, this is usually F_{MSY} or its proxy.

OFL ≥ ABC ≥ ACL.

Statistical area: A delineated area of ocean used to track where fish were caught. NMFS overlays a grid of statistical areas onto nautical charts to accurately identify specific areas of the ocean. Statistical areas are approximately one degree square although in many cases they do not correspond exactly to specific latitudes and longitudes.

Stock: A grouping of fish usually based on genetic relationship, geographic distribution and movement patterns. A species, subspecies, geographical grouping, or other category of fish capable of management as a unit.

Stock area: A group of connected statistical areas that defines the geographic distribution of a particular population of an individual species. For example, the Gulf of Maine (GOM) cod stock area comprises statistical areas 464, 465, 467, 510, 511, 512, 513, 514, and 515. All catch of cod in any of these stock areas is attributed to the GOM cod stock.

Total Allowable Catch (TAC): The amount (in metric tons) of a stock that is permitted to be caught during a fishing year. This value is calculated by applying a target fishing mortality rate to exploitable biomass.

Valued Ecosystem Component (VEC): A resource or environmental feature that is important (not only economically) to a local human population, or has a national or international profile, or if altered from its existing status, will be important for the evaluation of environmental impacts of industrial developments, and the focusing of administrative efforts.