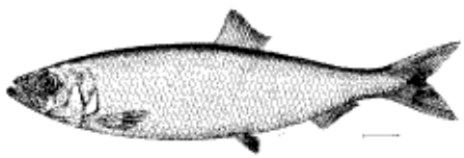
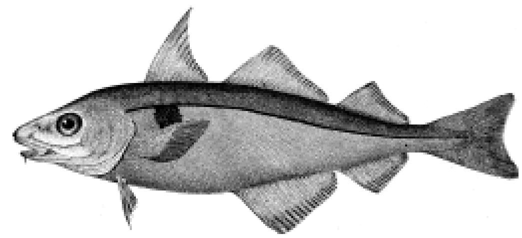
DRAFT (Jan13, 2017)

Framework Adjustment 5 to the

Atlantic Herring Fishery Management Plan





Action to consider modifications to the Georges Bank haddock accountability measures for the Atlantic herring fishery

Prepared by the
New England Fishery Management Council
In consultation with the
Mid-Atlantic Fishery Management Council
National Marine Fisheries Service

Initial Framework Meeting:	April 2016
Final Framework Meeting:	January 2017
Presubmission Draft Submitted:	
Final Submission:	

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1.0 INTRODUCTION AND BACKGROUND

This action will consider a range of alternatives to amend the Georges Bank (GB) haddock accountability measures (AMs) for the herring fishery.

1.1 BACKGROUND ABOUT CURRENT GEORGES BANK HADDOCK ACCOUNTABILITY MEASURE

The Council decided to add a 2016 work priority to potentially amend the AMs for GB haddock. At the January 2016 Council meeting, the Council requested that the Herring and Groundfish Committees consider if other measures should be explored as well related to how the accountability measures are implemented. Specifically, could the trigger be modified so that AMs do not go into effect unless the herring fishery exceeds their sub-ACL by more than 50% or unless the total ACL is harvested as well as the sub-ACL for the herring fishery.

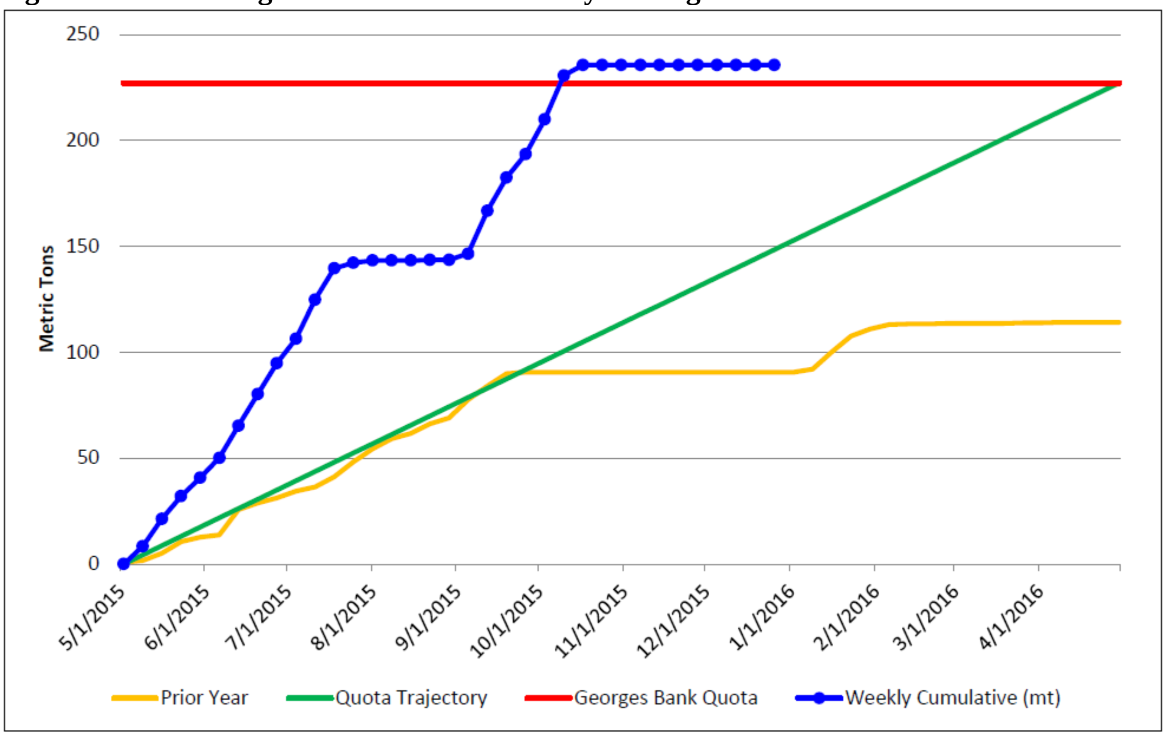
These motions are the result of concerns raised by the herring industry after the GB Haddock AM was triggered in October 2015, when it had been determined that the 2015GB haddock sub-ACL for the herring fishery had been exceeded. For groundfish fishing year 2015 (May 1, 2015 – April 30, 2016), the GB haddock sub-ACL for the herring midwater trawl fishery was 227 mt. Based on data reported through August 12, 2015, almost 8% of the GB sub-ACL had been used by the midwater trawl fleet. Subsequently, additional observer data became available and was included in catch estimate updates, such that by the end of October, 103.76% of the cap had been used (Table 1, Figure 1).

On October 22, 2015, NMFS/GARFO closed the directed herring fishery in the Herring GB Haddock AM Area after it determined that the GB haddock sub-ACL had been harvested. Midwater vessels were then restricted to the 2,000 lb possession limit in the AM Area for the remainder of the groundfish fishing year (through April 30, 2016; *Federal Register* 80(204), p. 63929-63930). This AM limits the midwater trawl fishery in most of Herring Management Area 3 to 2,000 lb of herring per trip/day until May 1, 2016, because Area 3 falls within the GB Haddock AM Area (Figure 2). Category A and B herring vessels may land haddock from the Herring GB Haddock AM Area, provided they have a Northeast Multispecies permit and are on a declared Northeast Multispecies Day-at-Sea. However, this provision is not applicable to the majority of the directed herring fishery.

Table 1 – 2015 Georges Bank haddock catch by herring midwater trawl vessels

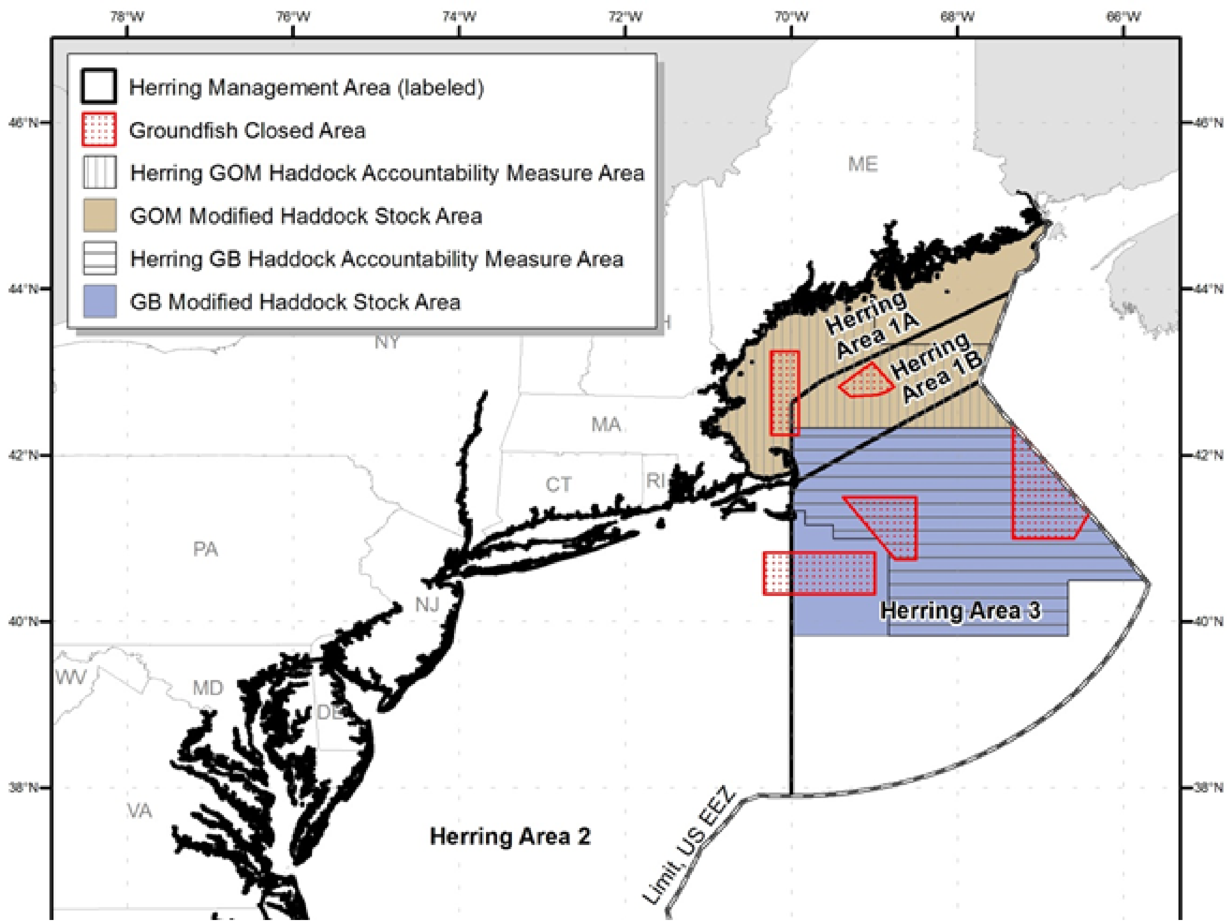
Month	Monthly estimated haddock catch (mt)	Cumulative estimated haddock catch (mt)	Cumulative percent of quota (227 mt)
May	43.09	43.09	18.98%
June	54.51	97.59	42.99%
July	45.70	143.29	63.12%
August	0.25	143.54	63.23%
September	66.32	209.87	92.45%
October	25.68	235.54	103.76%
November	0.00	235.54	103.76%
December	0.00	235.54	103.76%
Source: GARFO quota monitoring website: http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm Data reported through December 27, 2015.			

Figure 1 - 2015 Georges Bank haddock catch by herring midwater trawl vessels



Source: GARFO quota monitoring website (updated through 12/27/2015): http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm

Figure 2 – Herring and haddock management areas



From late October 2015 through April 30, 2016 no directed herring fishing took place in the GB Haddock AM area (inshore portion of Area 1B and the majority of Area 3). The AM restriction lifted on May 1, 2016 when the next groundfish fishing year began and a new sub-ACL was available for FY2016. Final catch estimates for FY2015 from Area 3 were lower than years past, about 25% of the TAC was remaining when the AM was triggered, in part due to the AM closure (Table 2). However, it should be noted that in some years Area 3 harvest has ended before the end of October, either because the herring TAC for that area was harvested before that time of year, or trawl vessels shift activity to Area 1A after October 1 when that area reopens to MWT gear. Finally, Area 1B catch for FY2015 was also below allowable levels, just under 60% of the Area 1B TAC was harvested before the area closed due to the GB haddock AM.

Table 2 – Summary of herring catches by area for FY2013-FY2016 (to date)

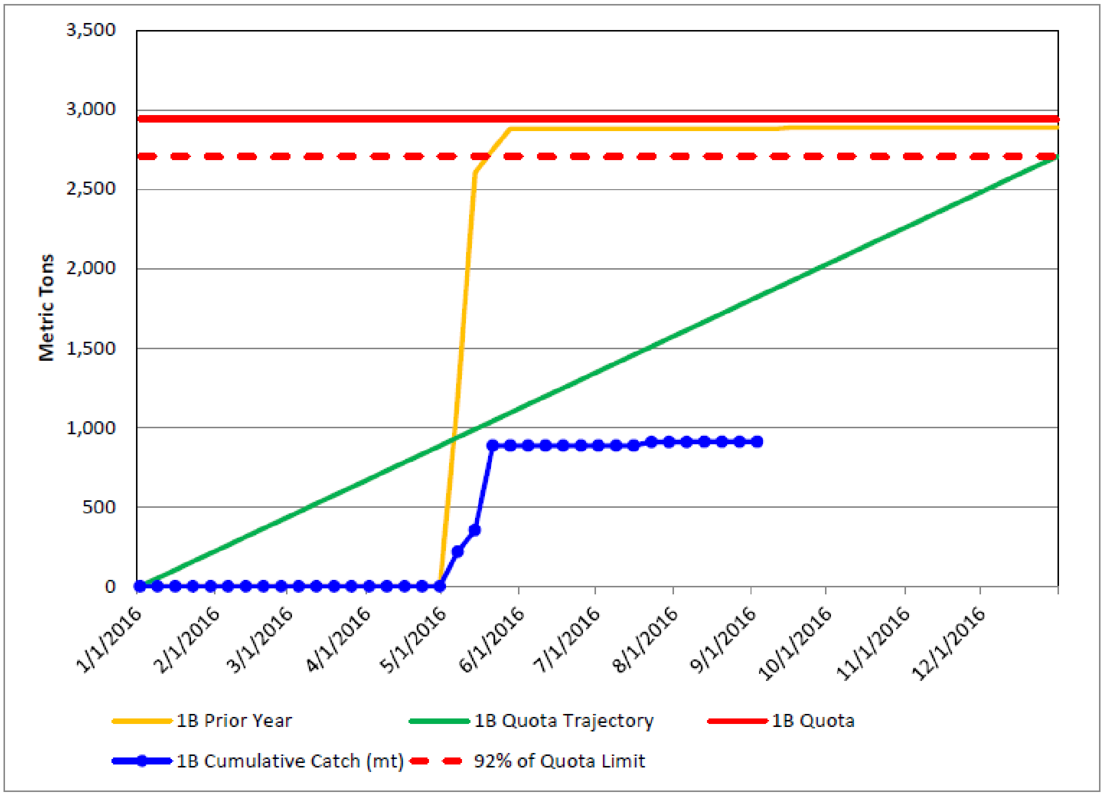
	2013	2014	2015	2016*
Area 1A Catch	29,820	33,428	29,406	17,761
Area 1A TAC	29,775	4,733	30,580	30,102
% of Area 1A harvested	100.15%	101.20%	96.16%	59.00%
Area 1B Catch	2,458	4,733	2,889	910
Area 1B TAC	4,600	2,878	4,922	2,941
% of Area 1B harvested	53.44%	164.46%	58.69%	30.90%
Area 2 Catch	27,569	19,624	15,214	9,793
Area 2 TAC	30,000	28,764	32,100	32,100
% of Area 2 harvested	91.90%	68.22%	47.40%	30.50%
Area 3 Catch	37,833	37,252	33,256	8,700
Area 3 TAC	42,000	39,415	44,910	43,832
% of Area 3 harvested	90.08%	94.51%	74.05%	19.80%
Total Catch	97,680	95,037	80,766	37,164
Total TAC	106,375	104,088	104,566	108,975
Total % harvested	91.83%	91.30%	77.24%	34.10%

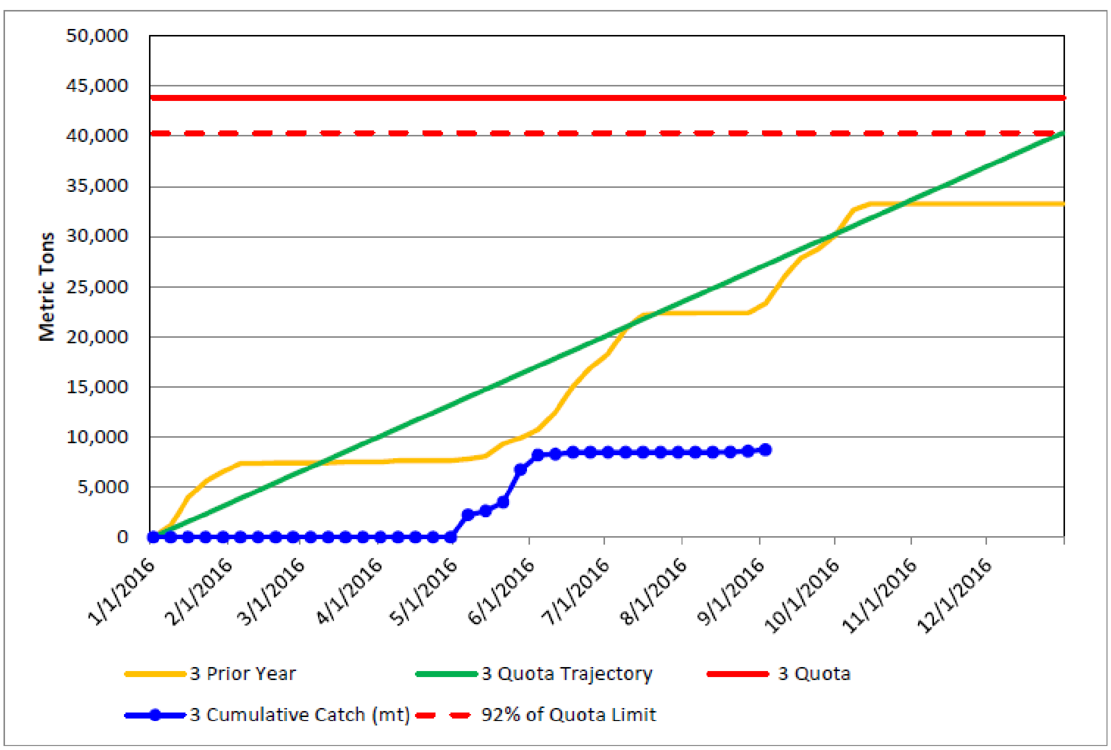
*** FY2016 not complete, data through September 1, 2016**

Source: NMFS Quota monitoring for the Atlantic Herring fishery
https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/herring/archives/herringarchives.html

If 90% of the TACs for both areas were fully utilized in FY2015, an additional 8,700 mt could have been landed (about 1,500 from Area 1B and 7,200 from Area 3). This catch is not guaranteed of course, but to give a sense of the potential impacts on FY2015 revenues, 8,700 mt at about $300 per mt is equivalent to about $2.6 million dollars. It is possible that herring catches for FY2016 could increase in Area 1B and 3 in the last few months of the fishing year to balance out the fact both areas were closed to the fishery for the first four months of the herring fishing year (January – April), but to date both areas are behind catch trends from previous years, about 30% for Area 1B and 20% for Area 3 (Figure 3).

Figure 3 – FY2016 Area 1B (top) and Area 3 (bottom) Atlantic Herring catch to date (through September 1, 2016)





1.1.1 Summary of Previous Council actions to address haddock bycatch in the herring fishery

The multispecies and herring fisheries take place in the same areas and seasons. Throughout the recent history of these two fisheries concerns have been raised that herring fishing vessels may catch groundfish species and that these catches may affect the rebuilding of overfished groundfish stocks. As a result, herring vessels were prohibited from catching groundfish when the Northeast Multispecies FMP was amended in 1996. There were also concerns that measures designed to reduce catches of groundfish by the herring fishery reduced the ability of the herring fishery to achieve optimum yield. These concerns led to herring vessels being allowed to fish in multispecies closed areas in 1998 through Framework 18, because the gear was not expected to catch groundfish.

These two competing issues came to a head in 2005 when herring midwater trawl vessels caught haddock from a large haddock year class on George Bank. This led to the adoption of Framework Adjustment 43 to the Northeast Multispecies FMP in 2006. FW 43 modified the restrictions for herring vessels so that herring fishing could continue on Georges Bank. This framework prohibited certain herring vessels from discarding haddock and limited possession of other groundfish to small amounts. It also adopted a cap on the amount of haddock that could be caught by certain midwater herring vessels. The cap was set at 0.2 percent of the combined GB and GOM haddock target total allowable catch (TTAC). When the cap was reached, catches of herring from a large part of the GOM and GB areas were limited to 2,000 pounds per trip for all herring vessels.

As the haddock resource grew, the fixed 0.2% cap on haddock catch by the herring fleet risked creating a great constraint on herring catch despite the fact overall haddock catches were far below the ABC for that stock. Framework 46 was initiated in January 2011 to modify the 0.2% cap to reflect the current conditions in the haddock fishery and enable the herring midwater trawl fishery to fish on GB. The need statement from Framework 46 was that the current catch cap had the potential to create such an interruption in the herring fishery that would have negative impacts on the fishery participants and action is needed to avoid potential impacts to the supply of herring used as bait for the lobster fishery. Framework 46 was also needed to avoid reducing opportunities for the herring TAC in Area 3 (and OY) to be fully utilized. The action also highlighted that adjustments were needed because reduced herring fishing effort in the Area 3 may result in a shift of effort into Area 1A during the summer and fall, exacerbating concerns about the inshore GOM component of the resource and the impacts of concentrated midwater trawl fishing effort in this area. Since 2007 there has been a seasonal closure in Area 1A to midwater trawl fishing between June and September, but if GB is closed herring effort could shift into Area 1A as soon as that seasonal restriction ends (October 1).

Framework 55 to the Multispecies FMP increased the GB haddock sub-ACL for the herring fishery from 227mt in Multispecies FY2015 to 521mt in FY2016, due to an increase in the GB haddock ACL, not changing the allocation percentage. This relatively substantial increase should provide a better opportunity for the Atlantic herring fishery to avoid triggering AMs if haddock bycatch rates do not increase as well. When the FY2016 sub-ACL was being considered in FW55 the Groundfish PDT evaluated the potential impacts, specifically the loss in revenue from the FY2015 AMs by estimating annual herring revenue from herring trips to statistical areas within the AM area.

Average annual Atlantic herring revenue from herring trips to statistical areas within the current AM area (521, 522, 525, 561, and 562) were summarized for the months of November-April during FYs 2011-2014. Table 3 shows that average herring revenue from these stat areas during this six month duration is nearly $2,000,000. The average volume of herring landings on the considered trips was slightly over 373,000 pounds (16,434,386/44), over 180 times the 2,000 lb. legal possession limit under the AMs.

Table 3 - Atlantic herring trips, landings, and revenue from statistical reporting areas 521, 522, 525, 561, or 652 from November through April during groundfish FY 2011 – 2014. Trip locations from VTRs.

Groundfish Fishing Year	# of Herring Trips (In stat areas 521, 522, 525, 561, or 562 during Nov-Apr)	Herring Landed	Herring Revenue (2010 $)
2011	27	10,320,385	$1,112,396
2012	43	11,934,138	$1,498,469
2013	69	27,199,795	$2,859,290
2014	38	16,283,224	$1,731,738
Avg. 2011-2014	44	16,434,386	$1,800,473

Framework 55 concluded that the AMs, in place to limit incidental catch of GB haddock in FY 2015, likely offer no long term economic benefit to the groundfish fishery at this point. The GB haddock stock is well above B_{MSY} and utilization rates have been low in recent fishing years. During May-October 2015, incidental catch of GB haddock by the Atlantic herring fishery totaled 291 mt. This number is more or less insignificant when considering the commercial groundfish sub-ACL for GB haddock is nearly 22,000 mt in 2015??? and utilization rates in recent fishing years have been well below 50%.

In terms of pending actions, in June 2016 the Council decided to consider increasing the sub-ACL of GB haddock for the herring fishery from 1% (No Action) to either 1.5% or 2% of the US ABC. Those measures will be considered in Framework 56 to the Groundfish FMP.

1.2 PURPOSE AND NEED FOR ACTION

The purpose of this action is to propose measures that would incentivize the herring midwater trawl vessels to minimize the incidental catch of haddock while provide the opportunity to fully harvest the herring sub-ACLs in Herring Management Areas 3 and 1B. Therefore, this action is needed to: 1) reduce the potential negative economic impacts on midwater trawl herring vessels resulting from GB haddock AM closures reducing the opportunity to harvest the herring sub-ACLs in Area 3 and 1B; 2) avoid potential impacts to the supply of herring used as bait for the lobster fishery; and 3) reduce the potential negative economic impacts on the mackerel fishery from GB haddock AM closures reducing the opportunity to harvest mackerel on Georges Bank.

Further, this action is needed to further promote long-term sustainable management of the Atlantic herring fishery and better meet the goals and objectives of the Atlantic herring management program, particularly the goal to achieve, on a continuing basis, optimum yield (OY), and the objectives to achieve full utilization from the catch of herring, including minimizing waste from discards (and incidental catch) in the fishery and to promote the utilization of the resource in a manner which maximizes social and economic benefits to the nation, while taking into account the protection of marine ecosystems.

2.0 ALTERNATIVES UNDER CONSIDERATION

2.1 GEORGES BANK HADDOCK ACCOUNTABILITY MEASURES FOR THE HERRING FISHERY

2.1.1 No Action (Alternative 1)

When the GB haddock sub-ACL has been caught, all herring vessels fishing with midwater trawl gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the GB Haddock AM area (Figure 2) for the remainder of the multispecies fishing year (April 30). In addition, the haddock possession limit is reduced to 0 lb in that area, for the following vessels: 1) all vessels that have a Federal herring permit and are fishing with midwater trawl gear; and 2) all vessels that have an All Areas Limited Access Herring Permit and/or an Areas 2/3 Limited Access Herring Permit fishing on a declared herring trip. A vessel can possess haddock after the sub-ACL has been caught, provided the vessel possesses a Northeast multispecies permit and is operating on a declared Northeast multispecies trip.

If NMFS determines that total catch exceeded any ACL or sub-ACL for a fishing year, then the amount of the overage shall be subtracted from that ACL or sub-ACL for the fishing year following total catch determination. NMFS shall make such determinations and implement any changes to ACLs or sub-ACLs, in accordance with the APA, through notification in the Federal Register, prior to the start of the fishing year, if possible, during which the reduction would occur.

Rationale: This AM was implemented in September 2011 through Framework 46. The boundary encompasses where 90% of commercial haddock was caught based on 2006-2009 fishing years. By closing the majority of area where haddock is fished on GB, the likelihood of the herring fishery exceeding the sub-ACL of GB haddock is very low, helping to prevent overfishing of the GB haddock resource. If there is an overage of the sub-ACL, the second year sub-ACL is reduced by the overage to help prevent overfishing and minimize bycatch by keeping the herring fishery accountable for any overages.

2.1.2 Alternative 2 – Implement a proactive AM closure and maintain the current reactive AM closure

The AM area would be modified based on new information, including an evaluation of where haddock bycatch is estimated to be highest within the GB haddock stock area.

Due to the relatively narrow footprint of previous MWT fishing effort on GB, the analyses are limited in terms of identifying AM alternatives based solely on observations of MWT bycatch rates (Northeast Fisheries Observer Program (NEFOP) data). Therefore, the Herring PDT developed a spatial model of the distribution of GB haddock and herring using auxiliary datasets (NEFSC bottom trawl surveys, and NEFOP bottom trawl data), to evaluate the model's ability to predict MWT bycatch rates. These distribution models were then used to identify candidate AM alternatives and examine the impact of AM closures on expected herring catch and haddock bycatch. There is a detailed description of the methods and results of this analysis provided in Appendix A of Herring PDT memo to GF PDT.

The series of options developed under this option would implement a smaller, more explicit AM closure proactively that would overlap the areas and seasons with the highest expected bycatch rates of haddock in the herring midwater trawl fishery based on historical observer and survey data. **Each option could be implemented year round, or seasonally. If one of the proactive AMs is selected, a proactive seasonal closure AM season needs to be identified as well.** For the seasonal sub-option, the sub-ACL of haddock would still be monitored and estimated from remaining fishing areas, and if it is not reached before the proactive closure season is over, the smaller AM areas would reopen to herring fishing later in the season. If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after the smaller AM is implemented), the existing AM closure would be implemented (Figure 2) to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

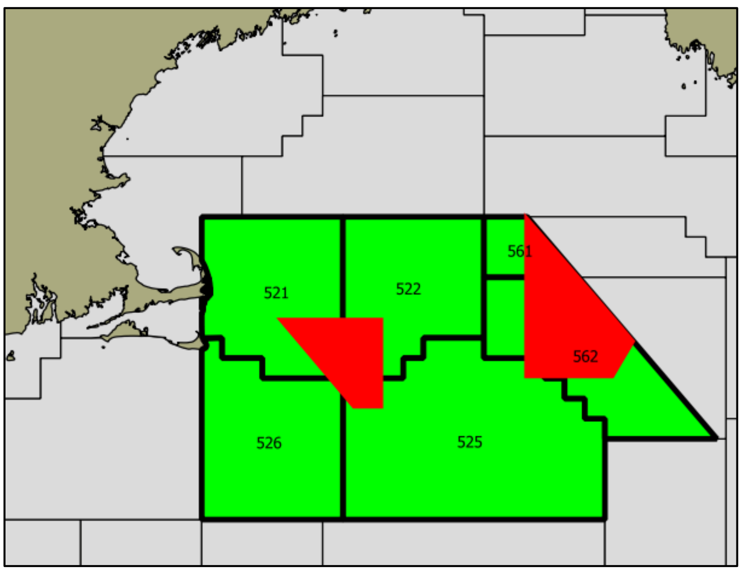
Rationale: When this action was first initiated the Herring PDT discussed several different ideas for data that could be used to modify the AM area: 1) commercial fishing data to identify where most haddock catch is located; 2) trawl survey data to identify where haddock is present; and 3) observer data to identify areas where the herring fishery had the highest haddock catch rates. The Herring Committee recommended that the last item should be the main data source used to prioritize developing options for the AM area based on areas with higher GB haddock catch rates. If an AM closure is focused on areas with highest bycatch rates compared to all areas haddock bycatch is encountered, it may reduce potential negative impacts on the herring and mackerel fisheries compared to larger closures that encompass the majority of GB.

The need for this action is to reduce the potential negative economic impacts on midwater trawl herring vessels, including associated impacts on the lobster and mackerel fisheries resulting from GB haddock AM closures, which reduce the opportunity to harvest the herring sub-ACLs in Area 3 and 1B. Therefore, these alternatives consider a modified accountability measure (AM) for the GB haddock sub-ACL, which is designed to provide greater access to the MWT fishery, but at the same time reduce haddock bycatch. This group of alternatives is designed to slow bycatch down during the season to help prevent the current AM from being implemented, which can have negative impacts on the midwater trawl herring fishery, and associated fisheries.

2.1.2.1 Alternative 2 Option 1 – Proactive AM closure of GF mortality Closed Areas I and II

Either year-round, or seasonally the current GF closed areas I and II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2). If selected, the length of time the proactive AM would be in place is a subsequent decision, Section 2.1.2.1.1. Regardless of the estimated haddock catch in the herring fishery, these areas would be closed to the herring MWT fishery as a proactive measure to potentially extend the season of herring fishing of GB and reduce the likelihood of the sub-ACL being harvested and triggering the larger reactive AM that closes most of GB.

Figure 4 – Areas in red would be implemented in-season for a specified season to reduce haddock catch. Herring MWT fishing would be prohibited to fish in those areas during the closure season.



2.1.2.1.1 Sub-option for proactive AM season

For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place:

a) year-round proactive closure;

b) May-October proactive closure; and

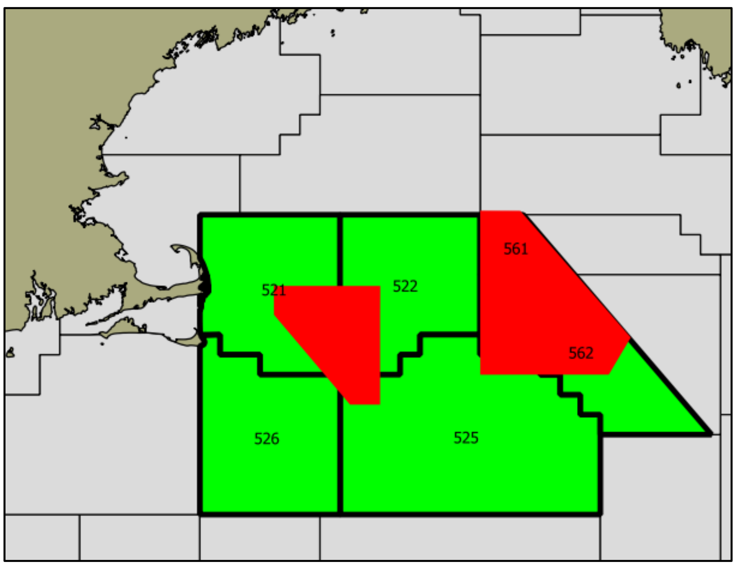
c) June-August proactive closure.

The proactive AM closure would close to the MWT herring fishery for the length of time selected, either year round, for six months, or for three months.

2.1.2.2 Alternative 2 Option 2 – Proactive AM closure of GF mortality Closed Areas I and II with 15 nm buffer north of Closed Area 1 and west of Closed Area II

Either year-round, or seasonally the current GF closed areas I and II, including extended areas to the north of Closed Area I and west of Closed Area II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2). If selected, the length of time the proactive AM would be in place is a subsequent decision, Section 2.1.2.2.1. Regardless of the estimated haddock catch in the herring fishery, these areas would be closed to the herring MWT fishery as a proactive measure to potentially extend the season of herring fishing of GB and reduce the likelihood of the sub-ACL being harvested and triggering the larger reactive AM that closes most of GB.

Figure 5 – Areas in red would be implemented in-season for a specified season to reduce haddock catch. Herring MWT fishing would be prohibited to fish in those areas during the closure season.



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b) May-October proactive closure; and

c) June-August proactive closure.

The proactive AM closure would close to the MWT herring fishery for the length of time selected, either year round, for six months, or for three months.

2.2 IMPLEMENTATION OF GEORGES BANK HADDOCK ACCOUNTABILITY MEASURES FOR THE HERRING FISHERY

For this section, more than one alternative can be selected in some cases.

2.2.1 No Action (Alternative 1)

This section focuses on how the AM is implemented, not the AM itself, or the sub-ACL allocation amount. Specifically, measures related to the timing of when the AM is triggered, and how it is implemented in terms of the methods or data used to monitor and trigger the AM. Under No Action, the AM is triggered in-season based on an extrapolation of observed catch to the entire fishery using the cumulative method.

Rationale:
An in-season AM would help prevent the total ACL from being exceeded and reduce the potential for overfishing of the GB haddock stock. An in-season AM reduces the risk of exceeding the sub-ACL by a large amount compared to allowing the fishery to continue to fish in the GB haddock stock area after the sub-ACL has been caught. Since any overage of the sub-ACL in year 1 is deducted from the sub-ACL the following year, an in-season AM may reduce future impacts on the herring and groundfish fisheries. If the sub-ACL is exceeded and the herring fishery continues to catch GB haddock, the final overage may be large, potentially reducing future fishing opportunities all together in the GB haddock stock area.

2.2.2 Alternative 2 - Seasonal split of GB haddock sub-ACL (80%/20%)

Eighty percent of the haddock sub-ACL would be available to the herring fishery on May 1 and the remaining 20% would be added on November 1. If the herring fishery catches more than 80% before November 1, then the existing AM would close to direct midwater trawl herring fishing from that time through October 31. The remaining 20% would become available on November 1 to support a winter herring fishery. If the herring fishery catches more than 20% of the remaining GB haddock sub-ACL after November 1 the existing AM area would again close to directed herring midwater trawl gear from that date through April 30.

The Council clarified that this alternative would not be automatic percentages for splitting the sub-ACL; if adopted, the Council would have the ability to select the seasonal split of the haddock sub-ACL in each specification process. Furthermore, selecting this alternative would not automatically split the sub-ACL 80% and 20%, instead it would enable the Council to do that through future action.

2.2.2.1 Seasonal split of GB haddock sub-ACL for FY2017 and FY2018

The sub-ACL of GB haddock will be divided seasonally for FY2017 and FY2018. The herring specifications have been set already for those years, and when the GB haddock sub-ACL is allocated to the herring fishery the total will be divided by season, as described in Section 2.2.2. If adopted, the seasonal split for the GB haddock sub-ACL for FY2017 and FY2018 shall be set at 80% for May 1, and the remaining 20% would be available on November 1, including any underage from the first season (May-October).

Rationale: This alternative may reduce negative impacts on the herring and associated fisheries by reserving a portion of the haddock sub-ACL for the winter fishery. Haddock bycatch rates tend to be lower in the winter compared to other season; therefore, reserving some haddock for that time of year should provide sufficient bycatch to support a winter fishery. This alternative could increase the likelihood of triggering an AM closure since it is based on a lower proportion of haddock catch (80% compared to 100%), but that could be outweighed by providing access to the GB later in the year.

2.2.3 Alternative 3 - Amend how estimated catch is calculated in the herring fishery – incorporate state portside data

This alternative would require that state portside data be incorporated in the monitoring of haddock catch in the midwater trawl herring fishery, if available. Currently the haddock bycatch estimate is based on data from the Northeast Fisheries Observer Program only, and is not informed by state portside data.

Rationale: The Council sent a letter to NMFS in January 2016 requesting state portside data be used to monitor the current haddock sub-ACLs for the herring fishery. NMFS responded in April 2016 that they are looking into whether that is feasible and at subsequent meetings NMFS has explained that the request is still being reviewed and a response is forthcoming. It is possible that a response may not be available before the Council takes final action. It was also explained that the peer review of in-season bycatch estimation methods scheduled for fall 2016, will not be evaluating the feasibility of using state portside data to monitor the haddock sub-ACL in the herring fishery.

The Council discussed this timing issue at the September Council meeting and decided that if a response from NMFS is not available before the Council is scheduled to take final action then this alternative will be removed from the document. It would not make sense to recommend using state portside data in the estimate of bycatch until it is known whether it is feasible and appropriate to do so.

2.3 CONSIDERED AND REJECTED ALTERNATIVES

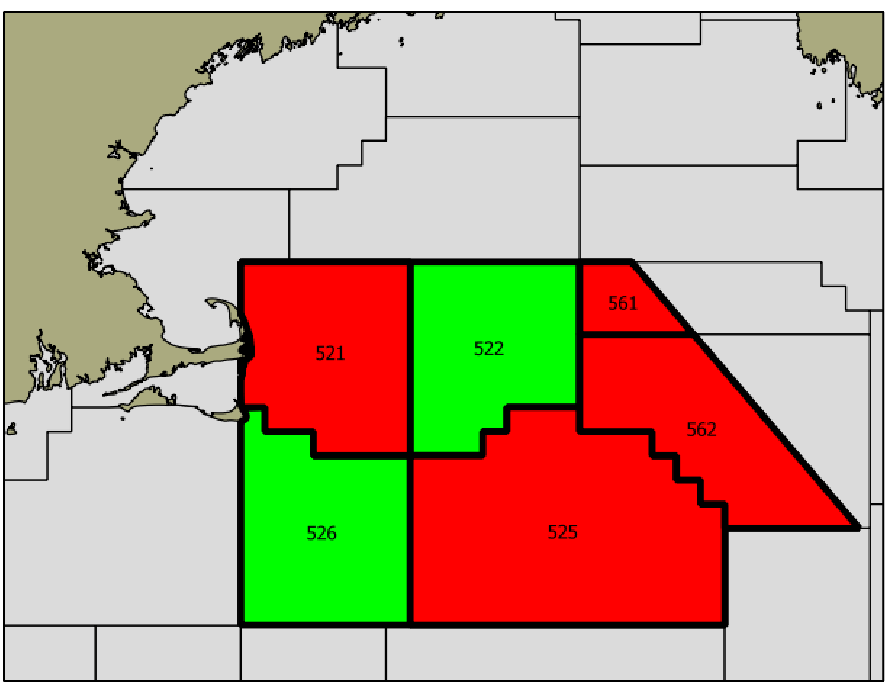
2.3.1 Alternative 2 Option 3 – Proactive AM closure of statistical areas 521, 561, 562, and 525

This option would implement a proactive AM closure that would close areas with higher expected bycatch rates of haddock in the herring midwater trawl fishery based on historical observer and survey data, but would leave some area open to herring fishing. This option used statistical area boundaries, if it was found during development that using statistical area boundaries are important for effective monitoring of the sub-ACL in-season.

If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after this proactive AM option is implemented), the existing AM closure would be implemented (Figure 2) to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

Rationale for rejection: This option was developed with statistical area boundaries in the event that other boundaries would not enable effective monitoring of the haddock sub-ACL in season. However, as the PDT developed these alternatives it was determined that other boundaries could be used. The preliminary analyses of these alternatives suggest that other options would afford similar protections for haddock in a more efficient way, smaller areas. This option would close a relatively large proportion of the stock area proactively, which could have negative impacts on the herring fishery, regardless of whether the fishery is approaching the sub-ACL.

Figure 6 – Areas in red would be implemented in-season for a specified season to reduce haddock catch. Herring MWT fishing would be prohibited to fish in those areas during the closure season.



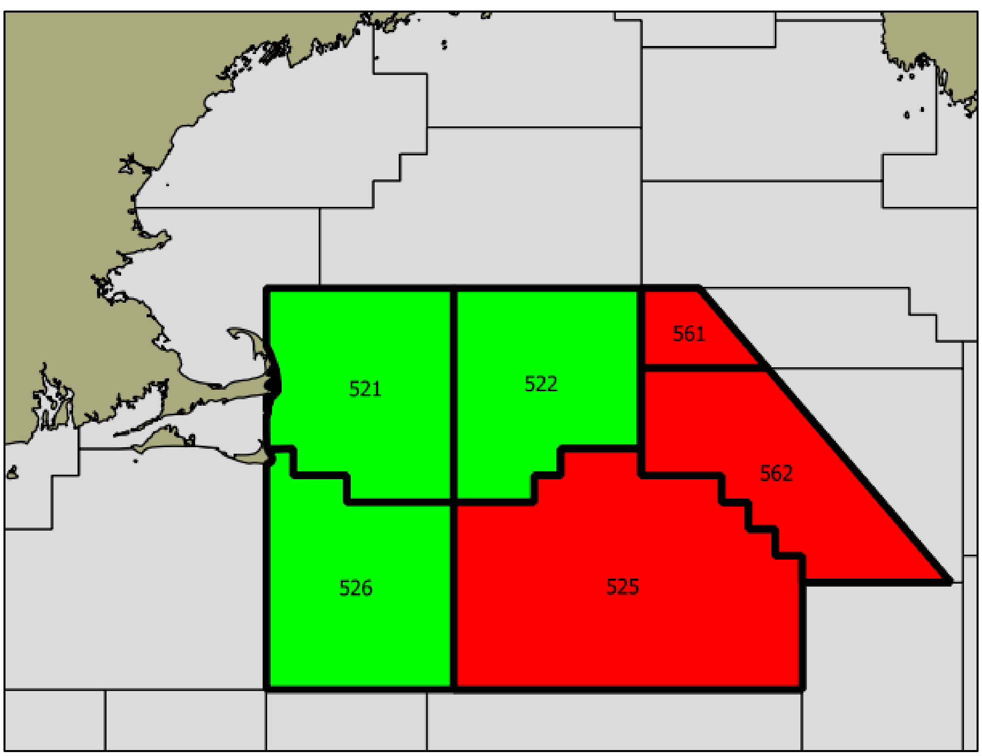
2.3.2 Alternative 2 Option 4 – Proactive AM closure of statistical areas 561, 562, and 525

This option would implement a proactive AM closure that would close areas with higher expected bycatch rates of haddock in the herring midwater trawl fishery based on historical observer and survey data, but would leave more area open to herring fishing compared to Option 3. This option used statistical area boundaries, if it was found during development that using statistical area boundaries are important for effective monitoring of the sub-ACL inseason.

If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after this proactive AM option is implemented), the existing AM closure would be implemented (Figure 2) to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

Rationale for rejection: This option was developed with statistical area boundaries in the event that other boundaries would not enable effective monitoring of the haddock sub-ACL in season. However, as the PDT developed these alternatives it was determined that other boundaries could be used. The preliminary analyses of these alternatives suggest that other options would afford similar protections for haddock in a more efficient way, smaller areas. This option would close a relatively large proportion of the stock area proactively, which could have negative impacts on the herring fishery, regardless of whether the fishery is approaching the sub-ACL.

Figure 7 – Areas in red would be implemented in-season for a specified season to reduce haddock catch. Herring MWT fishing would be prohibited to fish in those areas during the closure season.



2.3.3 Establish an AM season (higher bycatch rate months)

Currently there is no AM season. When the AM is triggered the closure for directed herring midwater trawls is in place for the remainder of the GF fishing year (through April 30). If the data supports it, it may be possible to only implement a seasonal closure rather than a closure that would be in effect until the end of the GF fishing year.

Based on the PDT analyses described in Appendix A, the season with the highest haddock bycatch rates on Georges Bank are during the summer and early fall. However, because of the timing of the GF sub-ACL (May – April) compared to the herring fishing year (Jan-Dec), the nature of the large volume herring fishery that tends to increase effort on GB at the start of the GF fishing year, and the method used to monitor the in-season sub-ACL, it does not seem practical to implement an AM season.

Rationale for rejection: The PDT recommended removing this alternative as a standalone alternative because the time period that would likely reduce haddock catches the most is in the beginning of the sub-ACL monitoring season (which starts on the GF fishing year – May through April). Therefore, it does not seem practical to have an in-season reactive AM because the season expected to provide the greatest benefits for haddock are earlier in the season. Instead, seasonal provisions have been incorporated in the proactive AMs because they can be effective before a sub-ACL is harvested. At one point the PDT also explored a potential alternative that would consider a "speed bump" AM, a smaller AM area would be implemented first when a portion of the sub-ACL is caught (e.g. 80%), and the current, larger AM when 100% is caught. But as the PDT evaluated the idea further it did not seem feasible at this time.

2.3.4 Modify the pound for pound payback provision for the GB haddock sub-ACL in the herring fishery

This alternative would modify the existing accountability measure related to overages. If selected, the herring fishery sub-ACL in year 2 would not be reduced by overages from Year 1 unless the total GB haddock sub-ACL was exceeded.

Rationale for rejection: The Council expressed concern that this alternative could reduce incentive for herring MWT vessels to avoid haddock bycatch. While an accountability measures would still be in place that would close most of GB in-season, the Council viewed the pound for pound payback as part of the AM and a contributing factor to providing incentive for vessels to reduce bycatch. In addition, because the Council supported an overall increase in the sub-ACL from 1% to 1.5%, it was argued that measures should not be taken that could further increase catches of haddock in the herring MWT fishery.

3.0 AFFECTED ENVIRONMENT

3.1 TARGET SPECIES

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 and 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.

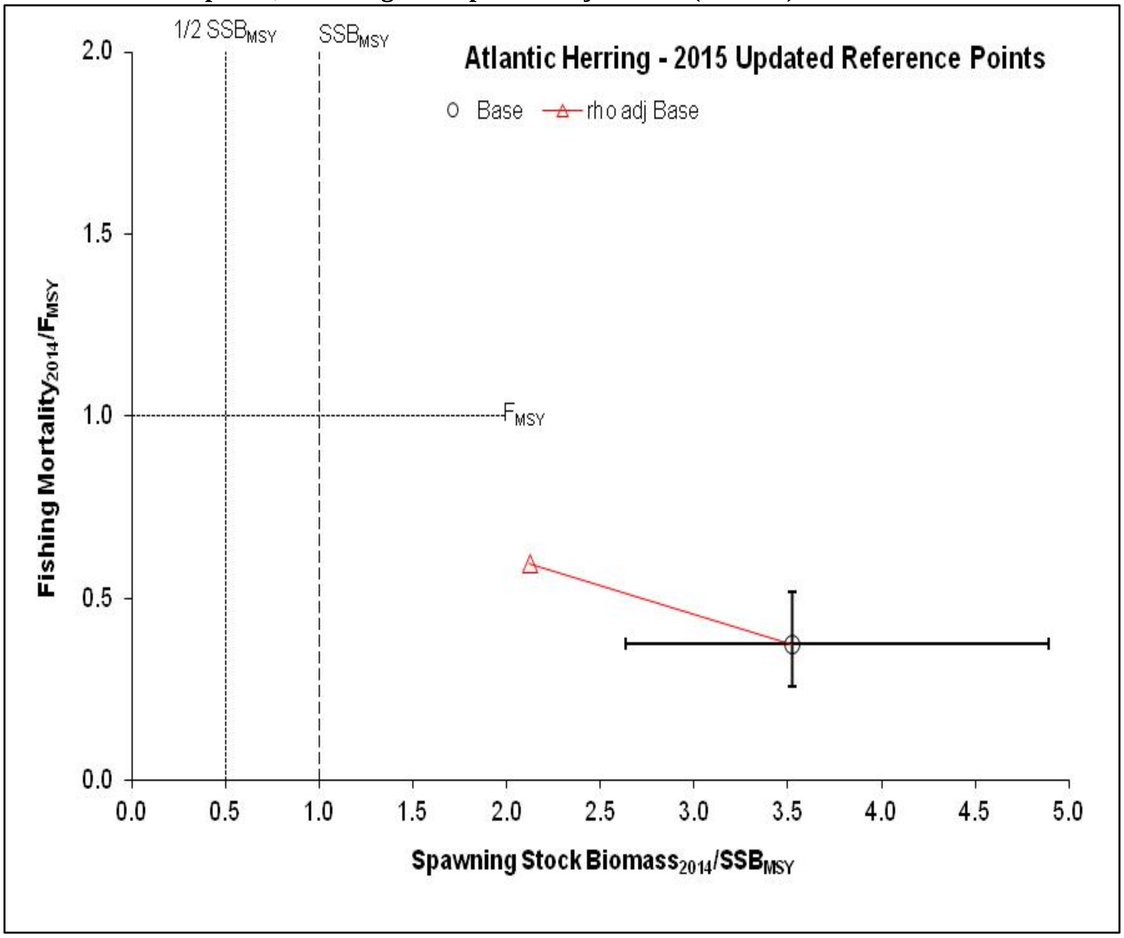
3.1.1 Atlantic Herring Stock Status

The Atlantic herring operational (update) assessment in 2015indicatedthat 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 reemerged 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 4, **Figure 8**).

Table 4 - 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	
Source: Deroba (2015).			

Figure 8 - Atlantic herring operational assessment: 2014 fishing mortality and SSB relative to F_{MSY} and SSB_{MSY} reference points, including retrospective adjustment (red line)



Source: Deroba (2015).
Note: Error bars represent 10th and 90th percentiles of 2014 F/SSB estimates.

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. 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 2008 year class has persisted through the fishery as the strongest on record (Deroba 2015).

3.1.2 Herring as forage in the ecosystem

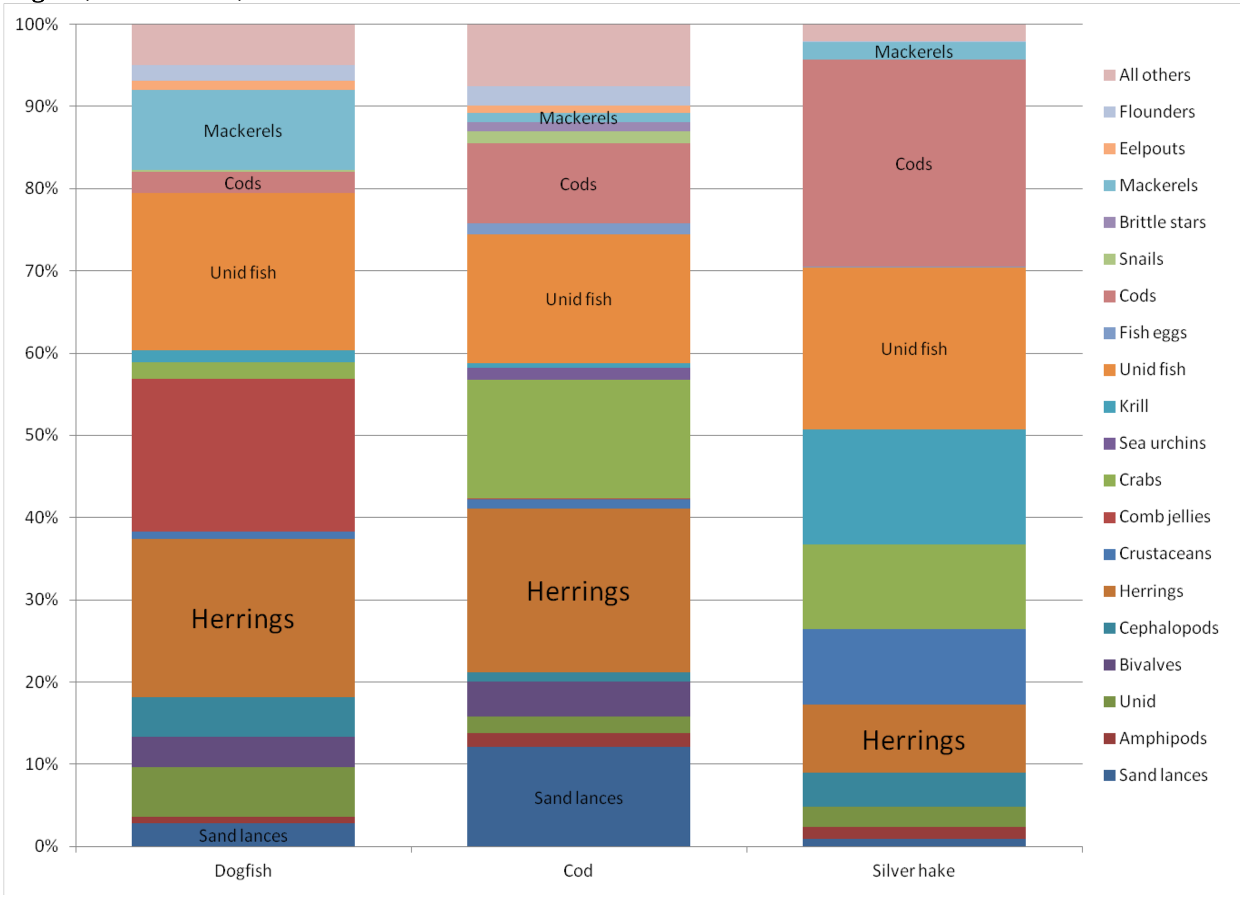
Atlantic herring play an important role as forage in the Northeast U.S. shelf ecosystem. They are eaten by a wide variety of fish, marine mammals, birds, and (historically) by humans in the region. The structure of the Northeast U.S. shelf ecosystem features multiple forage species rather than a single 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 (NEFSC) fish food habits database, Atlantic herring are found most often in the stomachs of spiny dogfish, Atlantic cod, and silver hake. These predators are generalists. Although they most commonly have herring in their diets, herring make up no more than 20% of the diet composition for any of these predators (Smith and Link 2010; Link and Almeida 2000). 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, Shannon, and O'Neall 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, Kress, and Griffin 2000). Endangered Species Act-listed Atlantic salmon, as adults at sea, feed on forage fish 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, Golet, and Lutcavage 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 fish 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 and 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).

Figure 9 - 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

3.2 NONTARGET SPECIES

Nontarget 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 nontarget 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 nontarget 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 nontarget species.

Due to the high-volume nature of the Atlantic herring fishery, nontarget 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 nontarget 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 nontarget species that are landed. Dealer and VTR data can be used to identify/cross-check incidental landings of some nontarget species that may be separated from Atlantic herring.

The primary nontarget 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 nontarget species in the directed Atlantic herring fishery (mackerel and some other nontarget 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 (River Herring/Shad) and 3.3 (Other Nontarget Species) of Framework 3 to the Atlantic Herring FMP. Summary information is below, updated where possible. For this management action, particular focus is given to RH/S and the potential impacts of the proposed RH/S catch caps.

3.2.1 Observer coverage (updates still being developed)

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). Table 5 summarize NEFOP observer coverage rates by gear type and herring management area during the 2011-2016 fishing years for trips taken by the primary gears involved in the Atlantic herring fishery. Coverage rates are calculated based on NEFOP observed herring pounds caught/VTR-reported herring pounds landed.

All NEFOP data are final audited data (through 07/16); VTR data were pulled to match the fully audited and loaded NEFOP data (also through 07/16). NEFOP data were pulled based on gear type fished (single midwater trawl, paired midwater trawl, purse seine, or bottom otter trawl – including fish, Ruhle, haddock separator, large mesh belly, scallop and shrimp trawl), year, and target species (Atlantic Herring and Herring, nk). Observed trips landing > 2000 lbs of herring only were included. VTR data were pulled based on gear type fished (bottom otter trawl, purse seine, single midwater trawl, paired midwater trawl for all trips that landed herring.

Trips (NEFOP and VTR) were assigned to a herring management area based on either the reported lat/long for the trip (VTR) or reported lat/long for the haul (NEFOP). NEFOP data from a given trip could be split between herring management areas while VTR data were assigned to a single management area at the trip level only.

Herring management areas were defined using the GIS shapefiles available on the GARFO website. NEFOP hauls or VTRs missing lat/long data were not included in this summary.

Table 5 – NEFOP observer coverage rates by gear type and herring management area for 2011-2016

2011	1A	1B	3	2
BOT	20.41	0	0	9.41
SMWT	34.96	41.86	65.89	34.58
PMWT	24.38	61.77	35.67	71.46
PUR	25.64	N/A	N/A	N/A

2012	1A	1B	3	2
BOT	7.83	0	0	32.52
SMWT	6.47	0	69.50	2.30
PMWT	14.42	36.10	61.84	24.35
PUR	16.45	N/A	0	N/A

2013	1A	1B	3	2
BOT	21.83	0	0.56	18.83
SMWT	142.08	14.94	31.46	0.53
PMWT	21.63	51.74	34.40	14.14
PUR	13.81	0	N/A	N/A

2014	1A	1B	3	2
BOT	9.08	0	0	17.93
SMWT	84.78	9.63	42.22	5.29
PMWT	68.47	30.40	39.88	7.26
PUR	6.54	N/A	N/A	62.76

2015	1A	1B	3	2
BOT	12.28	0	0	12.70
SMWT	3.91	0.27	1.22	1.22
PMWT	4.36	0	6.78	1.10
PUR	5.12	N/A	N/A	N/A

2016	1A	1B	3	2
BOT	0.00	N/A	0	26.94
SMWT	N/A	82.39	13.13	5.84
PMWT	N/A	62.50	18.46	2.85
PUR	7.82	N/A	N/A	N/A

Table 6 provides a preliminary summary of observer coverage in the Atlantic herring fishery by month for 2013-2015. The observed trips were identified based on VMS gear declaration, and declared gear type and target species for small mesh bottom trawl vessels. VMS gear declarations do not specify single midwater trawl versus pair trawl, so the numbers in **Table 6** account for single and paired midwater trawl combined. The data are still considered preliminary and require further investigation to cross-check errors in VMS declarations (for example, 120% coverage on small mesh bottom trawl vessels during December 2014 is likely the result of an error with a gear declaration.

In 2014, NEFOP observers covered almost 41% of all declared midwater trawl trips (single and paired), 8.7% of all declared purse seine trips, and 26.2% of all declared small mesh bottom trawl trips targeting Atlantic herring. Observer coverage decreased dramatically during the first half of 2015, primarily due to budget restrictions and funding limitations imposed by the omnibus amendment to revise the Region's standardized bycatch reporting methodology (SBRM). From January – June 2015, preliminary estimates indicate that observer coverage on declared midwater trawl trips was just under 6%, just under 7% on declared purse seine trips, and just over 31% on small mesh bottom trawl trips targeting Atlantic herring.

Table 6 - NEFOP observer coverage on trips in the Atlantic herring fishery, 2013-2015

2013	Midwater Trawl Observed Trips	Midwater Trawl VMS Declared Trips	Midwater Trawl % Coverage	Purse Seine Observed Trips	Purse Seine VMS Declared Trips	Purse Seine % Coverage	Small Mesh Bottom Trawl Observed Trips	Small Mesh Bottom Trawl VMS Declared Trips	Small Mesh Bottom Trawl % Coverage
JAN	9	64	14.06	0	0	0.00	7	41	17.07
FEB	7	47	14.89	0	0	0.00	5	21	23.81
MAR	13	51	25.49	0	0	0.00	5	16	31.25
APR	2	16	12.50	0	0	0.00	5	4	125.00
MAY	11	18	61.11	0	0	0.00	0	0	0.00
JUN	18	37	48.65	6	60	10.00	0	1	0.00
JUL	10	49	20.41	18	88	20.45	3	25	12.00
AUG	11	49	22.45	19	114	16.67	4	57	7.02
SEP	25	45	55.56	4	14	28.57	2	34	5.88
OCT	19	37	51.35	10	43	23.26	1	11	9.09
NOV	2	0	0.00	0	0	0.00	0	4	0.00
DEC	12	26	46.15	0	0	0.00	14	10	140.00

2014	Midwater Trawl Observed Trips	Midwater Trawl VMS Declared Trips	Midwater Trawl % Coverage	Purse Seine Observed Trips	Purse Seine VMS Declared Trips	Purse Seine % Coverage	Small Mesh Bottom Trawl Observed Trips	Small Mesh Bottom Trawl VMS Declared Trips	Small Mesh Bottom Trawl % Coverage
JAN	15	55	27.27	1	1	100.00	13	30	43.33
FEB	22	56	39.29	0	0	0.00	4	23	17.39
MAR	11	31	35.48	0	0	0.00	2	10	20.00
APR	2	3	66.67	0	0	0.00	0	2	0.00
MAY	13	26	50.00	0	0	0.00	0	0	0.00
JUN	18	39	46.15	7	33	21.21	0	1	0.00
JUL	5	34	14.71	6	65	9.23	2	23	8.70
AUG	11	44	25.00	5	91	5.49	5	34	14.71
SEP	29	34	85.29	6	83	7.23	9	13	69.23
OCT	35	37	94.59	3	43	6.98	0	3	0.00
NOV	5	14	35.71	0	0	0.00	0	0	0.00
DEC	5	16	31.25	0	0	0.00	14	6	233.33

2015	Midwater Trawl			Purse Seine			Small Mesh Bottom Trawl		
	Observed Trips	VMS Declared Trips	% Coverage	Observed Trips	VMS Declared Trips	% Coverage	Observed Trips	VMS Declared Trips	% Coverage
JAN	6	60	10.00	0	0	0.00	16	6	266.67
FEB	0	24	0.00	0	0	0.00	2	3	66.67
MAR	3	49	6.12	0	0	0.00	1	1	100.00
APR	1	15	6.67	0	0	0.00	2	0	0.00
MAY	1	31	3.23	0	0	0.00	0	0	0.00
JUN	2	39	5.13	3	38	7.89	0	0	0.00
JUL	2	40	5.00	5	93	5.38	5	15	33.33
AUG	2	11	18.18	3	87	3.45	5	29	17.24
SEP	6	52	11.54	0	0	0.00	2	21	9.52
OCT	4	51	7.84	3	25	12.00	0	0	0.00
NOV	1	32	3.13	1	1	100.00	1	1	100.00
DEC	3	11	27.27	0	0	0.00	6	4	150.00

3.2.2 Atlantic haddock

Life History

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

GOM Haddock Population Status

The GOM haddock underwent a benchmark assessment in 2014 (SAW 59), which indicated that the stock was not overfished, and overfishing was not occurring. The 2013 SSB was estimated at 4,153 mt, above the <2,452 mt overfishing threshold, a change from the 2012 assessment update when the stock was experiencing overfishing (NEFSC 2014). As of the 2015 groundfish operational assessments, the stock is **not overfished** and **overfishing is not occurring**, with SSB estimated to be at 223% of the biomass target (NEFSC 2015).

GB Haddock Population Status

The GB haddock stock is a transboundary stock co-managed by the U.S. and Canada. The stock is **not overfished** and **overfishing is not occurring** (NEFSC 2015). The fishing mortality rate for this stock has been low in recent years. There has been a steady increase in SSB from ~15,000 mt in the early 1990s, to about 252,000 mt in 2007. The dramatic increase 2005 - 2007 is due to the exceptionally large 2003 year class reaching maturity. From 2007 - 2010, SSB decreased 35% as that 2003 year class decreased due to natural and fishing mortality. The fishing mortality rate for this stock has been low in recent years. Substantial declines have recently occurred in the weights at age due to slower than average growth. This was particularly true of the 2003 year-class. This decline is affecting productivity in the short-term. The growth of subsequent year-classes is returning to the earlier rates (NEFSC 2012b).

Fishery Bycatch

Haddock comprises the largest component of groundfish bycatch by midwater trawl vessels, and the catch of haddock by these vessels is managed by the Council through a catch cap (Framework 46 to the Multispecies FMP) and increased sampling/monitoring (Amendment 5 to the Atlantic Herring FMP). Vessels issued a Category A/B Atlantic herring permit and on a declared herring trip, regardless of gear or area fished, and or a vessel issued a Category C permit and/or an Category D permit (open access) that fishes with midwater trawl gear in Areas 1A, 1B, and 3 are prohibited from discarding haddock at-sea. These vessels are limited to possessing/landing up to 100 lb. of other NE multispecies. Atlantic herring processors and dealers are required to separate out, and retain such haddock for at least 12 hours for inspection by authorized NMFS officers. However, haddock or other NE multispecies separated from the herring catch may not be sold, purchased, received, traded, bartered, or transferred, or attempted to be sold, purchased, received, traded, bartered, or transferred for, or intended for, human consumption.

Table 7 summarizes haddock catch by the herring midwater trawl vessels from 2011-2014. Starting in 2011, data used to estimate/monitor the cap include observer data, vessel trip reports (VTR), and dealer reports. During the 2012 groundfish fishing year, the haddock catch cap was fully utilized in the GB area. The 2013 Georges Bank cap was slightly exceeded. As a result, the 2014 catch cap was adjusted downward from 179 mt to 162 mt to account for the overage. There remains very little catch of Gulf of Maine haddock by midwater trawl vessels in the Atlantic herring fishery.

Table 7 - Haddock catch by midwater trawl vessels subject to haddock catch cap, 2011-2015

FY	**Georges Bank**			**Gulf of Maine**		
	Haddock cap (mt)	**Haddock catch (mt)**	**% caught**	**Haddock cap (mt)**	**Haddock catch (mt)**	**% caught**
2011	318	101	32%	11	3	23%
2012	286	285	100%	9	0	0%
2013	273	285	105%	3	0.1	2%
2014	162	114	70%	3	0	0%
2015	227	235.54*	104%*	14	0*	0%*

Note: Catch Caps are based on groundfish fishing year (May 1 – April 30).
Source: NOAA/NMFS (http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm)
*Preliminary totals

The haddock catch caps for FY2015 (May 1, 2015 – April 30, 2016) are 227 mt for the Georges Bank stock and 14 mt for the Gulf of Maine stock. Based on data reported through August 12, 2015, almost 8% of the GB catch cap and none of the GOM catch cap had been used by the midwater trawl fleet.

3.2.3 River Herring and Shad

Life History

River herring and shad (RH/S) are nontarget species of particular concern, and catch of RH/S in the directed Atlantic herring fishery is managed through gear and area-specific catch caps. The term “river herring” refers here to the species of alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), and “shad” refers to the species of American shad (*Alosa sapidissima*) and hickory shad (*Alosa mediocris*). Collectively, these four species are referred to throughout this document as “RH/S.” The following section provides some updated information about RH/S as nontarget species in the Atlantic herring fishery; a comprehensive description of the RH/S resources is in Section 3.2 of Framework 3 to the Atlantic Herring FMP (NEFMC, 2014). RH/S catch by Atlantic herring vessels is summarized in Section 3.2.4.4 of the Framework 3 document and updated in Appendix I to this document.

River herring and shad are anadromous fish that spend the majority of their adult lives at sea, only returning to freshwater in the spring to spawn. Historically, RH/S spawned in virtually every river and tributary along the coast. The oceanic ranges of all four species extend beyond the northern and southern latitudinal range of the NEFSC spring and fall surveys, which occur from the Gulf of Maine to Cape Hatteras, NC (35^{o} 30’ to 44^{o} 30’ N). The geographic range of blueback herring in the northwest Atlantic extends from Cape Breton, Nova Scotia, to the St. Johns River in FL and the range of American shad extends from the Sand Hill River in Labrador to the St. John’s River in FL (Page and Burr 1991). The geographic range of alewife extends from Red Bay, Labrador, to SC. Hickory shad have a narrower geographic range than these three species and is most abundant between Cape Cod, MA and the St. John’s River in FL, but is also infrequently found in the Gulf of Maine (Munroe 2002).

Targeting RH/S occurs almost exclusively in State waters, and river herring and shad are managed under the Atlantic States Marine Fisheries Commission (ASMFC) Shad and River Herring Fishery Management Plan (FMP), which was developed in 1985. A more detailed description of the ASMFC Interstate Management Program for RH/S is in Section 3.2.3 of Framework Adjustment 3 (NEFMC 2014).

RH/S Stock Status

A stock assessment for American shad was completed in 1997 and submitted for peer review in early 1998 based on new information and the Board recommended terms of reference. The 1998 assessment estimated fishing mortality rates for nine shad stocks and general trends in abundance for 13 shad stocks. A coastwide American shad stock assessment was completed and accepted in 2007 and found that American shad stocks are currently at all-time lows and do not appear to be recovering (ASMFC 2007). Recent declines of American shad were reported for Maine, New Hampshire, Rhode Island, and Georgia stocks, and for the Hudson (NY), Susquehanna (PA), James (VA), and Edisto (SC) rivers. Low and stable stock abundance was indicated for Massachusetts, Connecticut, Delaware, the Chesapeake Bay, the Rappahannock River (VA), and some South Carolina and Florida stocks. Stocks in the Potomac and York Rivers (VA) have shown some signs of recovery in recent years. There are no coastwide reference points for American shad. There is currently no stock assessment available for hickory shad.

The 2007 assessment of American shad identified primary causes for stock decline as a combination of overfishing, pollution, and habitat loss due to dam construction. In recent years, coastwide harvests have been on the order of 500-900 mt, nearly two orders of magnitude lower than in the late 19th century. Given these findings, the peer review panel recommended that current restoration actions need to be reviewed and new ones need to be identified and applied. The peer review panel suggested considering multiple approaches including a reduction in fishing mortality, enhancement of dam passage, mitigation of dam-related fish mortality, stocking, and habitat restoration.

The ASMFC completed the river herring benchmark stock assessment and peer review in 2012, examining 52 stocks of alewife and blueback herring with available data in U.S. waters. The stock assessment technical team examined indices from fishery-dependent (directed river herring landings and bycatch estimates in ocean fisheries) and fishery-independent (young-of-year indices, adult net and electrofishing indices, coastal waters trawl surveys, and run count indices) datasets. From this information, the status of 23 stocks was determined to be *depleted* relative to historic levels, and one stock was increasing. Statuses of the remaining 28 stocks could not be determined, citing times-series of available data being too short. The term "d*epleted*" was used, rather than "*overfished* and "*overfishing.*" It was determined that many factors (i.e., directed fishing, incidental fishing/bycatch, habitat loss, predation, and climate change) contributed to the decline of river herring populations, and the stock assessment did not determine estimates of river herring abundance and fishing mortality due to lack of adequate data. For many of these reasons, the stock assessment team suggested reducing the full range of impacts on river herring populations.

NMFS River Herring ESA Determination

On August 12, 2013, NMFS published its determination in the *Federal Register* regarding the 2011 petition to list alewife and blueback herring as threatened or endangered throughout all or a significant portion of their range under the Endangered Species Act (ESA). Based on the best scientific and commercial information available, NMFS determined that listing alewife and blueback herring as threatened or endangered under the ESA is not warranted at this time. While neither species of river herring is currently considered endangered or threatened, both species are at low abundance compared to historical levels, and NMFS indicated that monitoring both species is warranted. Given the uncertainties and data deficiencies for both species, NMFS committed to revisiting both species of river herring in 3 – 5 years. During this 3- to 5-year period, NMFS is coordinating with ASMFC, the Mid-Atlantic Fishery Management Council (MAFMC), and the NEFMC on a strategy to develop a long-term and dynamic conservation plan (e.g., priority activities and areas) for river herring considering the full range of both species and with the goal of addressing many of the high priority data gaps for river herring (see TEWG below).

River Herring Technical Expert Working Group (TEWG)

When NOAA Fisheries published the ESA listing decision for river herring in August 2013, NMFS indicated that it would partner with ASMFC to form a Technical Expert Working Group (TEWG). The TEWG is focused on developing a dynamic conservation plan to help restore river herring throughout their range from Canada to Florida, identifying and implementing important conservation efforts, and conducting research to fill in some of the critical data gaps for the river herring species, including the following:

- Identify threats to both species throughout their range
- Identify and create a priority list of conservation actions to address critical threats and associated costs
- Identify key data gaps
- Create a priority list of research projects and associated costs to fill existing data gaps
- Provide/compile information for NMFS/ASMFC to use in the development of a dynamic, long term conservation plan

- Track and monitor progress of conservation actions and research
- Revise actions as needed

The goal of the TEWG meetings was information gathering, whereby individual expert opinion on data, ideas, or recommendations will be sought from all participants. The meetings were not consensus-driven.

Because of its comprehensive scope and extensive membership, the TEWG includes subgroups (by topic) to focus discussions, as well as an overarching committee comprised of chairs/co-chairs from the subgroups. The TEWG first met in March 2014 to discuss river herring conservation planning and the structure and process for TEWG participation. Additional meetings were held in June, September, and December 2014, and subgroups are also meeting in between larger TEWG meetings. As this effort expands, NOAA Fisheries continues to coordinate with all of management partners including the Mid-Atlantic and the New England Councils to maximize resources and identify ways to complement ongoing efforts to promote river herring restoration. The TEWG's work products, including recommendations for a comprehensive restoration plan, were recently released (see http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/conserv/index.html). NMFS is scheduled to brief the Council regarding the conservation/restoration plan at an upcoming Council meeting.

As part of the effort for conservation planning, NMFS recently provided a grant to ASMFC ($295K) to support research projects that seek to address data gaps identified through the TEWG process – (1) *Linking life stages: marine bycatch mortality, freshwater productivity, and spawning stock recruitment*; (2) *Determination of extant herring runs in the Barnegat Bay and Raritan River watersheds*. Continued leadership by ASMFC and NMFS is expected to stimulate additional research efforts. For example, *NMFS has provided funds to the NEFSC to develop habitat models to predict river herring (and shad) distribution in relation to Atlantic herring and Atlantic mackerel distribution. These environmentally-driven, predictive species distribution models would be used to try to forecast river herring and shad catch, and be iteratively improved through close cooperation with fishing industry partners* (GARFO, personal communication).

Ongoing Efforts to Minimize RH/S Bycatch (NEFMC and MAFMC)

In Federal waters, the NEFMC continues to manage and minimize RH/S interactions through the Atlantic Herring FMP and its associated amendments and framework adjustments. Most recently, Framework 3 to the Atlantic Herring FMP established catch caps for RH/S and related provisions to manage and minimize interactions with these species in the directed Atlantic herring fishery. The RH/S catch caps established in Framework 3 became effective in late 2014. 2015 is the first full fishing year in which the directed Atlantic herring fishery will operate under RH/S catch caps.

The Mid-Atlantic Fishery Management Council (MAFMC) manages RH/S bycatch issues in the Atlantic mackerel fishery primarily through its Mackerel, Squid, and Butterfish (MSB) FMP. Recently, Amendment 14 to the MSB FMP (MAFMC 2013) was developed in coordination with Amendment 5 to the Herring FMP and implemented a comprehensive catch monitoring system for the MSB fishery. Many of the actions contained with both amendments were developed to compliment and/or replicate each other to avoid conflicting overlaps of restrictions on vessels that participate in both the herring and mackerel fisheries. Similarly, the MAFMC implemented a RH/S catch cap for the directed mackerel fishery through its specifications process. During the MSB specifications process (June 2015), the MAFMC recommended a catch cap of 82 mt for the directed mackerel fishery for the 2016 fishing year. This is a reduction from the 89 mt catch cap during 2015. The MAFMC's intent is to continue to provide a strong incentive for vessels participating in the Atlantic mackerel fishery to avoid RH/S to preserve their ability to harvest the mackerel quota.

The MAFMC also formed the RH/S Committee as part of a proactive coordinated effort to conserve RH/S stocks. Three members of the NEFMC currently serve on the RH/S Committee. The RH/S Committee held its first meeting in April 2014. There will be opportunity for the two Councils to better align the catch caps in the overlapping southern New England/Mid-Atlantic area for the 2016 fishing year and beyond. This has been identified as an important objective by the MAFMC RH/S Committee. The NEFMC built flexibility into the RH/S catch cap process in Framework 3 to allow development of a joint herring/mackerel fishery RH/S catch cap for the southern New England/Mid-Atlantic area with the MAFMC.

Fishery Bycatch

To develop alternatives for the 2016-2018 RH/S catch caps, the Herring PDT updated RH/S catch data and estimates of RH/S catch by gear type and RH/S catch cap area for the 2013 and 2014 fishing years, providing a longer time series of data (2008-2014) than Framework 3 (2008-2012). A complete discussion of the Herring PDT analysis and updated RH/S catch data is in Appendix I (*Development of Options for River Herring and Shad Catch Caps in the Atlantic Herring Fishery, 2016-2018*, Herring PDT). RH/S Catch YTD Under 2015 Catch Caps.
As previously noted, RH/S catch in the directed Atlantic herring fishery is managed through gear-specific and area-specific caps implemented through Framework 3 to the Atlantic Herring FMP (November 2014). The RH/S catch caps are monitored based on the Atlantic herring fishing year (January 1-December 31). Once a RH/S catch cap is harvested, a 2,000 pound Atlantic herring possession limit goes into effect for that Catch Cap AM Area and gear type for the remainder of the fishing year.

In 2015, small mesh bottom trawl vessels directing on Atlantic herring in Area 2 caught 113% of the RH/S catch cap, and midwater trawl vessels caught 52% of their SNE/MA catch cap. In 2016 to date, ….??. There has been a voluntary river herring bycatch avoidance program in place for several years with the midwater trawl fishery (Sustainable Fisheries Coalition, SFC) joined with the Massachusetts Division of Marine Fisheries (MADMF) and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). A more complete description of the SMAST/SFC/MADMF river herring avoidance program is in Section 3.6.4 of Framework 3 to the Atlantic Herring FMP.

3.2.3.1 State portside bycatch data

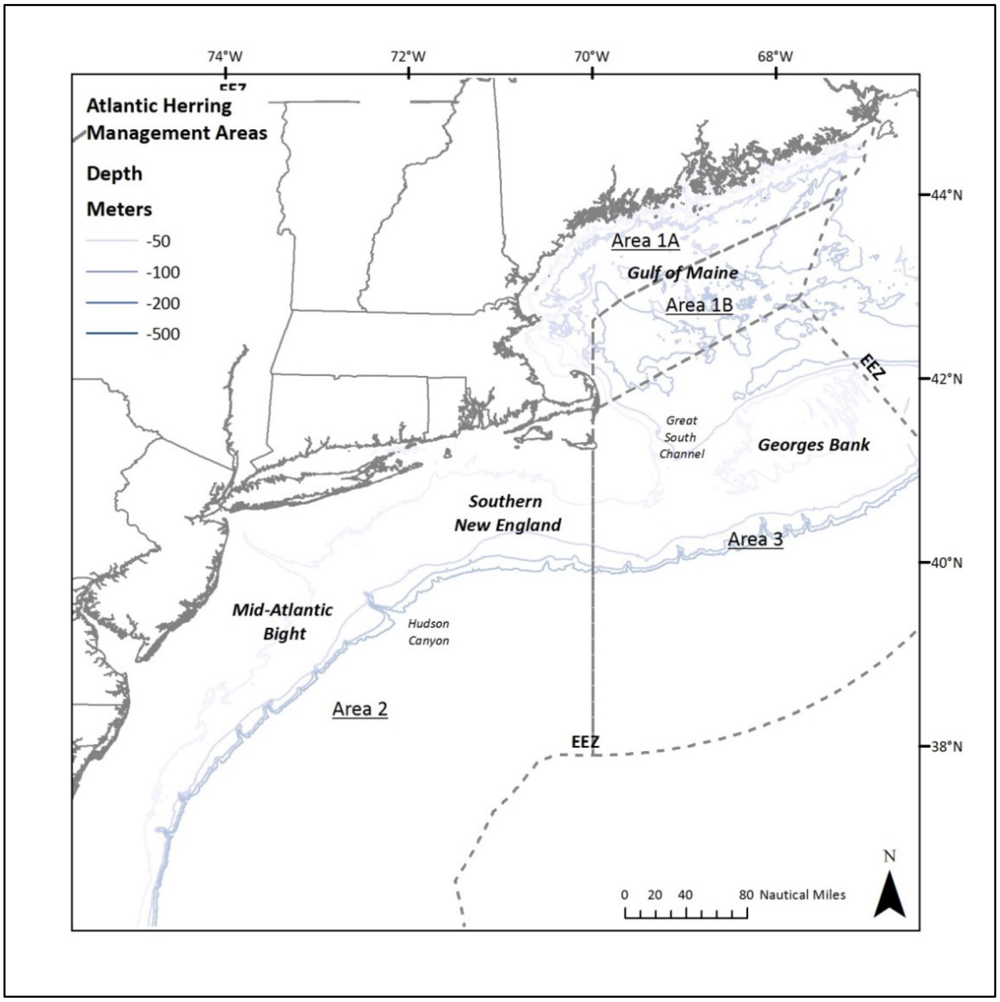
PDT can draft a summary of the MA and ME programs here?

3.3 PHYSICAL ENVIRONMENT/EFH

3.3.1 Physical Environment

The Atlantic herring fishery is prosecuted in four areas defined as Areas 1A, 1B, 2, and 3 (Figure 10). 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, Jaworski, and Smayda 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 10 - Atlantic Herring Management Areas and the Northeast U.S. shelf ecosystem



3.3.2 Essential Fish Habitat

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 expected to be published early this year. 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 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 1. 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 2, and in the bays and estuaries listed in **Table 8**. 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 3, including the bays and estuaries listed in **Table 8**. 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.

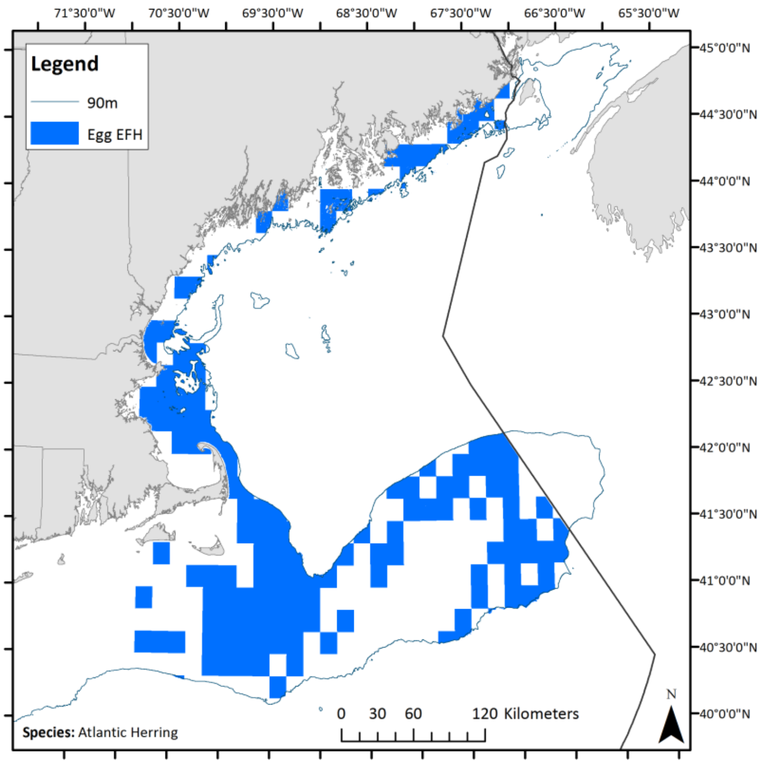
Adults: Sub-tidal pelagic habitats with maximum depths of 300 meters throughout the region, as shown on
Map 3, including the bays and estuaries listed in **Table 8**. Adults make extensive seasonal migrations between summer and fall spawning grounds on Georges Bank and the Gulf of Maine and overwintering 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 8 – Atlantic herring EFH designation for estuaries and embayments.

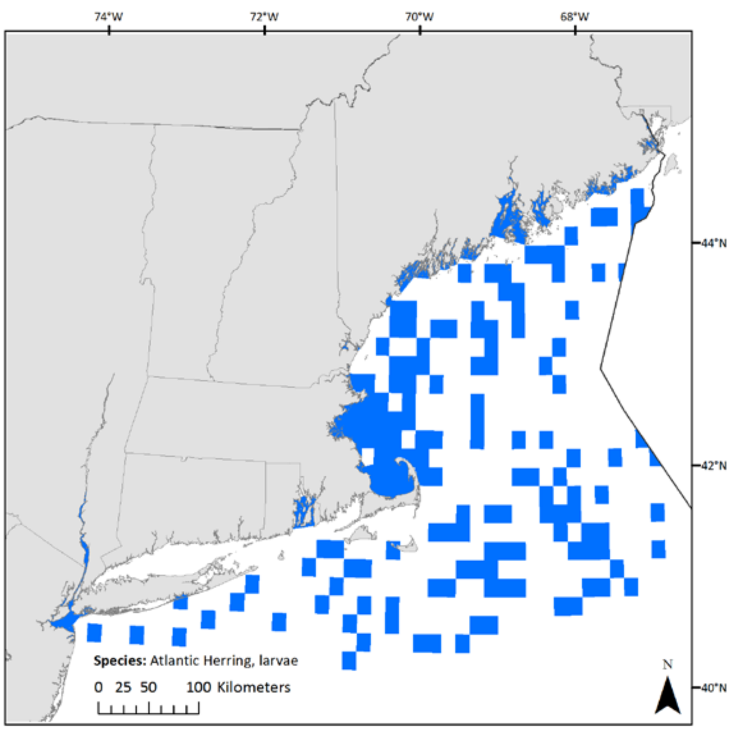
Estuaries and Embayments	Larvae	Juveniles	Adults
Passamaquoddy Bay	S,M	S,M	S,M
Englishman/Machias Bay	S,M	S,M	S,M
Narraguagus Bay	S,M	S,M	S,M
Blue Hill Bay	S,M	S,M	S,M
Penobscot Bay	S,M	S,M	S,M
Muscongus Bay	S,M	S,M	S,M
Damariscotta River	S,M	S,M	S,M
Sheepscot River	S,M	S,M	S,M
Kennebec / Androscoggin	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
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.*

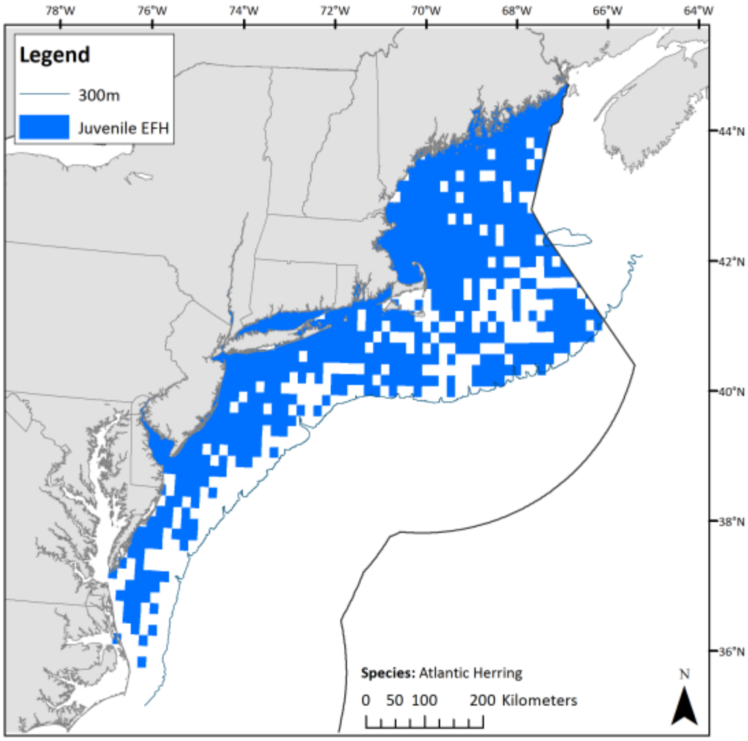
Map 1 – Atlantic herring egg EFH.



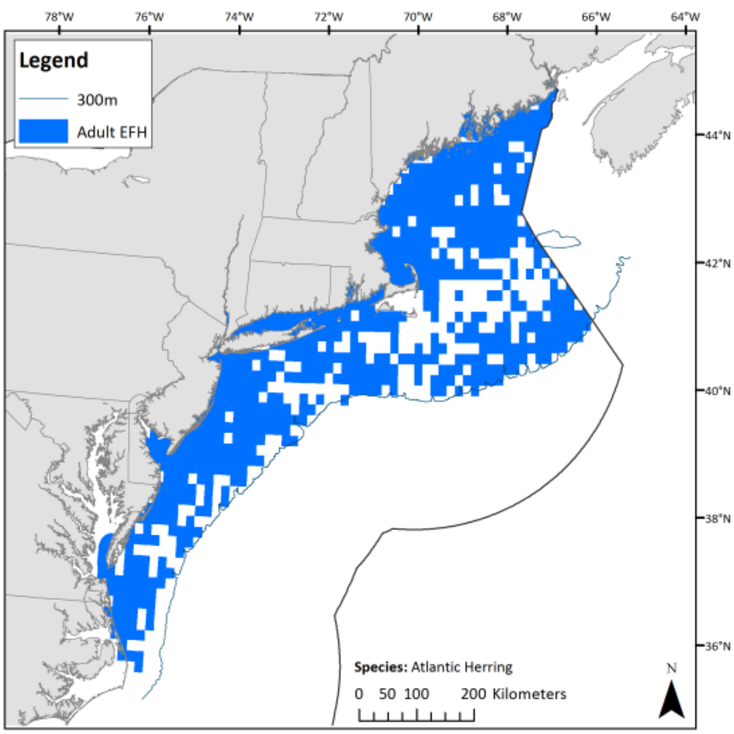
Map 2 – Atlantic herring larval EFH.



Map 3 – Atlantic herring juvenile EFH.



Map 4 – Atlantic herring adult EFH.



EFH 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 9. Additional information is in the FMP document that most recently updated each species' EFH designation (last column in Table 9), or on the EFH mapper referenced above.

Table 9 - 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

Species	Authority	Plan Managed Under	Last update
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

3.4 PROTECTED RESOURCES

There are numerous protected species that inhabit the affected environment of the Atlantic Herring FMP management unit (Table 10). These species are afforded protection under the Endangered Species Act (ESA) of 1973 (i.e., for those designated as threatened or endangered) and/or the Marine Mammal Protection Act (MMPA) of 1972, and are under NMFS' jurisdiction. Table 10 also includes two candidate fish species (species being considered for listing as endangered or threatened), as identified under the ESA.

Table 10 - Species and/or critical habitat protected under the ESA and/or MMPA that occur in the Affected Environment of the Atlantic herring fishery. 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).

Species	Status[2]	Potentially affected by this action?
Cetaceans		
North Atlantic right whale (Eubalaena glacialis)	***Endangered***	***No***
Humpback whale, West Indies DPS (Megaptera novaeangliae)[3]	***Protected (MMPA)***	***Yes***
Fin whale (Balaenoptera physalus)	***Endangered***	***Yes***
Sei whale (Balaenoptera borealis)	***Endangered***	***Yes***
Blue whale (Balaenoptera musculus)	***Endangered***	***No***
Sperm whale (Physeter macrocephalus	***Endangered***	***No***
Minke whale (*Balaenoptera acutorostrata*)	Protected (MMPA)	Yes
Pilot whale (*Globicephala spp.*)[4]	Protected (MMPA)	Yes
Risso's dolphin (*Grampus griseus*)	Protected (MMPA)	Yes
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected (MMPA)	Yes
Short Beaked Common dolphin (*Delphinus delphis*)[5]	Protected (MMPA)	Yes
Bottlenose dolphin (Tursiops truncatus)[6]	***Protected*** (MMPA)	***No***
Harbor porpoise (*Phocoena phocoena*)	Protected (MMPA)	No

Species	Status[2]	Potentially affected by this action?
Pygmy sperm whale (*Kogia breviceps*)	Protected (MMPA)	No
Dwarf sperm whale (*Kogia sima*)	Protected (MMPA)	No
Striped dolphin (*Stenella coeruleoalba*)	Protected (MMPA)	No
Atlantic spotted dolphin (*Stenella frontalis*)	Protected (MMPA)	No
Beaked whales (*Ziphius and Mesoplodon spp*)[7]	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[8]	Yes
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Ocean DPS	Threatened	Yes
Hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	No
Fish		
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered	No
Atlantic salmon (*Salmo salar*)	Endangered	No
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Thorny Skate (*Amblyraja radiate)*	Candidate	No
Cusk (*Brosme brosme)*	Candidate	No
Pinnipeds		
Harbor seal (*Phoca vitulina*)	Protected (MMPA)	Yes
Gray seal (*Halichoerus grypus*)	Protected (MMPA)	Yes
Harp seal (*Phoca groenlandicus*)	Protected (MMPA)	No
Hooded seal (*Cystophora cristata*)	Protected (MMPA)	No

Species	Status[2]	Potentially affected by this action?
Critical Habitat		
North Atlantic Right Whale Critical Habitat[9]		No
Northwest Atlantic DPS of Loggerhead Sea Turtle Critical Habitat		No

Notes:

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

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

[3] On September 8, 2016, a final rule was issued revising the ESA listing status of humpback whales (81 FR 62259). Fourteen DPSs were designated: one as threatened, four as endangered, and nine as not warranting listing. The DPS found in U.S. Atlantic waters, the West Indies DPS, is delisted under the ESA; however, this DPS is still protected under the MMPA.[4] There are two species of pilot whales: short finned (*G. melas melas*) and long finned (*G. macrorhynchus*). Due to the difficulties in identifying the species at sea, they are often just referred to as *Globicephala spp*.

[5] Prior to 2008, this species was called "common dolphin."

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

[7] 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*; however, are difficult to identify at sea, and therefore, much of the available characterization for beaked whales is to the genus level only.

[8] On April 6, 2016, a final rule was issued removing the current range-wide listing of green sea turtles and, in its place, listing eight green sea turtle DPSs as threatened and three DPSs as endangered (81 FR 20057). The green sea turtle DPS located in the Northwest Atlantic is the North Atlantic DPS of green sea turtles; this DPS is considered threatened under the ESA.

[9] Originally designated June 3, 1994 (59 FR 28805); Expanded on January 27, 2016 (81 FR 4837).

Cusk and thorny skate are NMFS "candidate species" under the ESA(**Table 10**). Candidate species are those petitioned species that NMFS is actively considering for listing as endangered or threatened under the ESA and also include those species for which NMFS has initiated an ESA status review through an announcement in the Federal Register. Once a species is proposed for listing the conference provisions of the ESA apply (50 CFR 402.10); however, candidate species receive no substantive or procedural protection under the ESA. As a result, these species will not be discussed further in this section. Additional information on cusk and thorny skate can be found at http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm

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

Based on available information, it has been determined that this action is not likely to affect multiple ESA listed and/or marine mammal protected species or any designated critical habitat (see Table 8).This determination has been made because either the occurrence of the species is not known to overlap with the Atlantic herring fishery and/or there have never been documented interactions between the species and the primary gear type (i.e., purse seine and mid-water trawl) used to prosecute the Atlantic herring fishery (see Waring *et al*. 2014, 2015, 2016; NMFS NEFSC FSB 2016; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). In the case of critical habitat, this determination has been made because 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).

3.4.2 Species Potentially Affected by the Proposed Action

As provided in Table 8, multiple ESA listed and/or MMPA protected species occur in the affected environment of the Atlantic herring fishery and may be affected by the operation of this fishery. In this section, information on the distribution and occurrence of these species in the affected environment of the Atlantic herring fishery is provided.

3.4.2.1 Sea Turtles

During the development of the 2016-2018 fishery specifications to the Atlantic herring fishery, the PDT used various sources of information to describe the occurrence and distribution of sea turtles in the affected environment of the Atlantic herring fishery. Below, the PDT provides a summary of the information provided in that action, with any updates since the issuance of the framework provided. For additional details on the sources of information used to develop this section, please refer to Section ??? of the 2016-2018 specifications.

Hard-shelled sea turtles

In U.S. Northwest Atlantic waters, hard-shelled turtles commonly occur throughout the continental shelf from Florida (FL) to the Gulf of Maine, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly et al. 1995; Epperly, Braun, and Chester 1995; Braun and Epperly 1996; Mitchell et al. 2003; Braun-McNeill et al. 2008; TEWG 2009).[1] Specifically, 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, Braun, and Chester 1995; Epperly et al. 1995; Epperly, Braun, and Veishlow 1995; Braun-McNeill and Epperly 2004; Morreale and Standora 2005; Griffin et al. 2013), occurring in Virginia (VA) foraging areas as early as late April and on the most northern foraging grounds in the GOM in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the GOM by September, but some remain in Mid-Atlantic and Northeast areas until late fall. By December, sea turtles have migrated south to waters offshore of NC, particularly south of Cape Hatteras, and further south (Shoop and Kenney 1992; Epperly et al. 1995; Hawkes et al. 2011; Griffin et al. 2013).

[1] While hard-shelled turtles are most common south of Cape Cod, MA, loggerhead sea turtles are known to occur in the Gulf of Maine (GOM), feeding as far north as southern Canada (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003; NMFS NEFSC 2011, 2012, 2013)

Leatherback sea turtles

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

3.4.2.2 Large Whales

As provided in Table 8, the following large whale species may occur in the affected environment of the Atlantic herring fishery and may be affected by the fishery: humpback, fin, sei, and minke. During the development of the 2016-2018 specifications package to the Atlantic herring fishery, the PDT used various sources of information to describe the occurrence and distribution of these large whale species in the affected environment of the Atlantic herring fishery; Table 10 summarizes this information. For additional details on large whales, as well as the sources of information used to develop this section, please refer to Waring et al. 2014, 2015, 2016, as well as Section ??? of the 2016-2018 specifications package.

Table 11 - 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 (SNE included), GOM, and GB throughout the year. • New England waters (GOM and GB 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).
Fin	• Distributed throughout all continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB throughout the year. • Mid-Atlantic waters: migratory pathway to/from northern (high latitude) foraging and southern (low latitude) calving grounds; possible offshore calving area (October-January) • New England/SNE waters (GOM, GB, and SNE regions): **Foraging Grounds** (greatest densities March-August; lower densities September-November). Important foraging grounds include: Massachusetts Bay (esp. Stellwagen Bank), Great South Channel, Waters off Cape Cod (~40-50 meter contour), GOM, Eastern perimeter of GB, and Mid-shelf area off the east end of Long Island. • Evidence of wintering areas in mid-shelf areas east of New Jersey, Stellwagen Bank; and eastern perimeter of GB.
Sei	• Uncommon in shallow, inshore waters of the Mid-Atlantic (SNE included), GB, and GOM; however, occasional incursions during peak prey availability and abundance. • Primarily found in deep waters along the shelf edge, shelf break, and ocean basins between banks. • Spring through summer, found in greatest densities in offshore waters of the GOM and GB; sightings concentrated along the northern, eastern (into Northeast Channel) and southwestern (in the area of Hydrographer Canyon) edge of GB.
Minke	• Widely distributed throughout continental shelf waters (<100m deep) of the Mid-Atlantic (SNE included), GOM, and GB. • Most common in the EEZ from spring through fall, with greatest abundance found in New England waters.
Sources: Baumgartner et al. (2011), CETAP (1982), Clapham et al. (1993), NMFS (2011, 2010, 1991), Hain et al. (1992), Payne et al. (1984; 1990), Risch et al. (2013), Swingle et al. (1993), Vu et al. (2012), Waring et al. (2015a, 2014).	

3.4.2.3 Small Cetaceans

As provided in Table 8, the following MMPA protected small cetaceans may occur in the affected environment of the Atlantic herring fishery and may be affected by the fishery: Atlantic white sided dolphins, short and long finned pilot whales, Risso's dolphins, and short beaked common dolphins. These species can be found throughout the year in waters of the Northwest Atlantic Ocean (Waring et al. 2015a, 2014). Within this range; however, there are seasonal shifts in species distribution and abundance. To further assist in understanding how the Atlantic herring fishery may overlap in time and space with the occurrence of small cetaceans, a general overview of species occurrence and distribution in the affected environment of the Atlantic herring fishery is in **Table 12**. Waring et al. (2015a, 2014) has additional information on the biology, status, and range-wide distribution of each species.

Table 12 - Small cetacean 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 35°N), Southern New England, GB, and GOM ; however, most common in continental shelf waters from Hudson Canyon (~ 39°N) onto GB, and into the GOM. • **January-May**: low densities found from GB to Jeffreys Ledge. • **June-September**: large densities found from GB, through the GOM. • **October-December**: intermediate densities found from southern GB to southern GOM. • South of GB (SNE and Mid-Atlantic), low densities found year round, with waters off VA 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 100-2,000 m) of the Mid-Atlantic, SNE, and GB (esp. in Oceanographer, Hydrographer, Block, and Hudson Canyons). • Less common south of Cape Hatteras, NC, although schools have been reported as far south as the Georgia (GA)/South Carolina (SC) border. • **January-May**: occur from waters off Cape Hatteras, NC, to GB (35° to 42°N). • **Mid-summer-autumn**: Occur primarily on GB with small numbers present in the GOM; *Peak abundance* found on GB in the autumn.
Risso's Dolphin	• **Spring through fall**: Distributed along the continental shelf edge from Cape Hatteras, NC, to GB. • **Winter**: distributed in the Mid-Atlantic Bight, extending into oceanic waters. Rarely seen in the GOM; primarily a Mid-Atlantic continental shelf edge species (can be found year round).

Pilot Whales: *Short- and Long-Finned*	**<u>Short- Finned Pilot Whales</u>** • Except for area of overlap (see below), primarily occur south of 40ºN (Mid-Atl and SNE waters); although low numbers have been found along the southern flank of GB, but no further than 41ºN. • May through December (approximately): distributed primarily near the continental shelf break of the Mid-Atlantic and SNE; individuals begin shifting to southern waters (i.e., 35ºN and south) beginning in the fall. **<u>Long-Finned Pilot Whales</u>** • Except for area of overlap (see below), primarily north of 42ºN. • Winter to early spring (November through April): primarily distributed along the continental shelf edge-slope of the Mid-Atlantic, SNE, and GB. • Late spring through fall (May through October): movements and distribution shift onto/within GB, the Great South Channel, and the GOM. **<u>Area of Species Overlap:</u>** between 38ºN and 41ºN
[1] Information is representative of small cetacean occurrence in the Northwest Atlantic continental shelf waters out to the 2,000 meter isobath. *Sources:* Waring et al. (2015a, 2014; 2007; 1992), Payne and Heinemann (1993), Payne et al. (1984); Jefferson et al. (2009).	

3.4.2.4 Pinnipeds

The following MMPA protected species of pinnipeds occur in the affected environment of the Atlantic herring fishery and may be affected by the fishery: Harbor, and grey, harp seals. Pinnipeds are found in the nearshore, coastal waters of the Northwest Atlantic Ocean; however, to further assist in understanding how the Atlantic herring fishery may overlap in time and space with the occurrence of pinnipeds, a general overview of species occurrence and distribution in the affected environment of the Atlantic herring fishery is in **Table 13**. For additional information on the biology, status, and range-wide distribution of each species of pinniped, refer to Waring et al. (2015a, 2014).

Table 13 - Pinniped occurrence in the Affected Environment of the Atlantic herring fishery

Species	Prevalence
Harbor Seal	• 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 (35ºN). • Year Round - Waters of Maine • September-May - Waters from New England to NJ .
Gray Seal	• Distributed in waters from NJ to ME. • Year Round - Waters from ME to MA. • September-May - Waters from Rhode Island to NJ.
Sources: Waring et al. (2015a, 2014).	

3.4.2.5 Atlantic Sturgeon DPSs

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. All five DPSs of Atlantic sturgeon have the potential to be located anywhere in this marine range (ASSRT 2007; Dovel and Berggren 1983; Wirgin et al. 2012; Dadswell 2006; Dadswell et al. 1984; Kynard et al. 2000; Stein, Friedland, and Sutherland 2004b; Laney et al. 2007; Dunton et al. 2010; Erickson et al. 2011; Waldman et al. 2013; O'Leary et al. 2014; Wirgin et al. 2015). In fact, results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast (O'Leary et al. 2014; Wirgin et al. 2015; Waldman et al. 2013; Wirgin et al. 2012; Damon-Randall, Colligan, and Crocker 2013).

Based on fishery- independent and dependent data, as well as data collected from tracking and tagging studies, in the marine environment, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Stein, Friedland, and Sutherland 2004a, 2004b; Dunton et al. 2010; Erickson et al. 2011); however, Atlantic sturgeon are not restricted to these depths, as excursions into deeper continental shelf waters have been documented (Stein, Friedland, and Sutherland 2004a, 2004b; Dunton et al. 2010; Erickson et al. 2011; Timoshkin 1968; Collins and Smith 1997). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon undertake seasonal movements along the coast; however, there is no evidence to date that all Atlantic sturgeon make these seasonal movements and therefore, may be present throughout the marine environment throughout the year ((Dunton et al. 2010; Erickson et al. 2011).

3.4.3 Interactions Between Gear and Protected Resources

The Atlantic herring fishery is prosecuted primarily with midwater trawls, and purse seines. A subset of protected species of fish, marine mammals, and see turtles (**Table 10**) are known to be vulnerable to interactions with midwater and/or purse seines. The following sections contain available information on protected species interactions with these gear types. These sections are not a comprehensive review of all fishing gear types known to interact with a given species; emphasis is only being placed on those gear types primarily used to prosecute the Atlantic herring fishery.

3.4.3.1 Marine Mammals

Depending on species, marine mammal interactions have been observed in 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 2016 LOF (81 FR 20550 (April 8, 2016)) categorizes the Gulf of Maine herring purse seine fishery as a Category III fishery and commercial mid-water trawl fisheries (Northeast or Mid-Atlantic) as Category II fisheries.

3.4.3.1.1 Large Cetaceans

Midwater Trawl Gear

With the exception of minke whales, there have been no observed interactions with large whales and mid-water trawl gear. Over the past, 10 years, there have been two (2) observed minke whale incidentally taken in mid-water trawl gear. These incidences were observed in 2009 and 2013, with the 2009 incidence resulting from entanglement in NOAA research mid-water trawl gear (whale released alive, but seriously injured), and the 2013 incidence resulting from entanglement in a Northeast mid-water trawl (including pair trawl) fishery (whale was dead, moderately decomposed) (see http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; Waring *et al*. 2016). Based on the latter incidence, 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 during 2009 to 2013 is 0.2. Based on this information, mid-water trawl gear is likely to pose a low interaction risk to any large whale species and therefore, is expected to be a low source of serious injury or mortality to any large whale.

Purse Seine (GOM Atlantic herring fishery)

Since 2008, four humpback whales and one fin/sei whale have been documented as interacting with purse seines, specifically those operating in the GOM targeting Atlantic herring (Henry et al. 2016; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; Waring et al. 2014, 2015, 2016). (NEFSC 2015). All interactions; however, resulted in the animals being released from the nets unharmed (NEFSC 2015; Waring et al. 2015a). 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. This conclusion is further supported by the fact that the LOF 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 (**Error! Reference source not found.**).

3.4.3.1.2 Small Cetaceans and Pinnipeds

Midwater Trawl Gear

Midwater trawl fisheries (Northeast or Mid-Atlantic) are considered Category II fisheries under the LOF. Small cetacean and pinniped species are known to be seriously injured or killed by this gear type, and in fact, based on observer data, bycatch of small cetaceans and pinnipeds have been attributed to the Atlantic herring fishery (Waring et al. 2015a, 2014; NEFSC 2015). **Error! Reference source not found.** provides a list of small cetacean and pinniped species observed seriously injured and/or killed by midwater trawl Category II fisheries from 2007- -2013 (Waring et al. 2015a, 2014).

Table 14 - Cetacean and pinniped species observed seriously injured and/or killed by Category II midwater fisheries in the Affected Environment of the Atlantic herring fishery, 2007-2013

Category II	
Fishery/Gear Type	**Species Observed Injured/Killed**
Mid-Atlantic Midwater Trawl (Including Pair Trawl)	Risso's dolphin
	White-sided dolphin (*)
	Short-beaked common dolphin
	Long and short-finned pilot whales
	Gray seal
	Harbor seal
Northeast Midwater Trawl (Including Pair Trawl)	White-sided dolphin
	Short-beaked common dolphin
	Long pilot whales (*)
	Gray seal
	Harbor seal
* Species driving the fisheries classification. *Sources*: Waring et al. (2015a, 2014); April 8, 2016, MMPA List of Fisheries (81 FR20550).	

As provided in the 2016-2018 herring specifications document, based on observed midwater trawl interactions with long-finned pilot whales, short -finned pilot whales, common dolphins, and white sided dolphins, the Atlantic Trawl Gear Take Reduction Strategy (ATGTRS) was developed. The ATGTRS identifies informational and research tasks, education and outreach needs; as well as voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals (e.g., reducing the numbers of turns made by the fishing vessel and tow times while fishing at night; increasing radio communications between vessels about the presence and/or incidental capture of a marine mammal). For additional details on the ATGTRS, see: http://www.greateratlantic.fisheries.noaa.gov/Protected/mmp/atgtrp/

Purse Seine (GOM Atlantic Herring Fishery)

There have been no observed small cetacean interactions with purse seines operating in the GOM. As a result, this gear type is not expected to pose an interaction risk with small cetacean species. However, purse seines, specifically those operating in the GOM targeting Atlantic herring, are known to interact with pinniped species (i.e., gray and harbor seals) ; none of these interactions have resulted in confirmed mortality or serious injury to the seal (Table 15 (i.e., gray and harbor seals; Waring et al. 2015a, 2014; NEFSC 2015). As a result, although interactions are possible with seals, purse seines are not expected to pose a significant serious injury or mortality risk to these species. This conclusion is further supported by the fact that the LOF 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 (**Error! Reference source not found.**).

Table 15 - Observed gray and harbor seal interactions with the GOM Atlantic herring purse seine fishery, 2004-2014

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

3.4.3.2 Sea Turtles

Midwater Trawl

NEFOP and ASM observer data from 1989-2015 have recorded five leatherback sea turtle interactions with midwater trawl gear; the primary species landed during these interactions was tuna (NEFSC 2015). Based on the best available information, although interactions with this gear type are possible, the risk of a sea turtle interacting with midwater trawl gear targeting Atlantic herring is expected to be low. Further, with no observed sea turtle interactions attributed to the Atlantic herring midwater trawl fishery since 1989, midwater trawls targeting Atlantic herring are not expected to pose a significant serious injury or mortality risk to any sea turtle species.

Purse Seine (GOM Atlantic Herring Fishery)

NEFOP and ASM observer data from 1989-2015 have recorded no sea turtle interactions with purse seine gear where the primary species landed during these interactions was Atlantic herring (Waring et al. 2016; http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). However, purse seine interactions with sea turtles have been observed in other fisheries targeting other fish species (i.e., menhaden) in the Mid-Atlantic. Based on the best available information, although interactions with this gear type are possible, the risk of a sea turtle interacting with purse seine gear targeting Atlantic herring in the GOM is expected to be low. Further, with no observed sea turtle interactions attributed to the Atlantic herring GOM purse seine fishery since 1989, purse seines targeting Atlantic herring are not expected to pose a significant serious injury or mortality risk to these sea turtle species.

3.4.3.3 Atlantic Sturgeon

Midwater Trawl

To date, there have been no observed/documented interactions with Atlantic sturgeon and midwater trawl gear (NMFS NEFSC FSB 2016). As a result, this gear type is not expected to pose an interaction risk to the species.

Purse Seine (GOM Atlantic herring fishery)

Capture of sturgeon in purse seine gear is possible; however, interactions have been extremely rare over the past 25 years. NEFOP and ASM observer data from 1989-2015 have recorded two Atlantic sturgeon interactions with purse seine gear targeting Atlantic herring in the GOM (NMFS NEFSC FSB 2016). These interactions were recorded in 2004 and 2005, prior to the listing of Atlantic sturgeon under the ESA. Based on this information, while capture of sturgeon in this gear type is possible, the risk of an interaction is expected to be low. As a result, purse seine gear is not expected to pose a significant serious injury or mortality risk to this species.

3.5 HUMAN COMMUNITIES

Framework 5 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.

This section reviews the fisheries and human communities potentially impacted by the management alternatives. 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.

3.5.1 Atlantic Herring Fishery-Related Businesses

Atlantic herring has been integral to New England's industry and culture since at least the 1700s (Smylie 2004, p. 76-84). The U.S. Atlantic herring fishery occurs over the Mid-Atlantic shelf region from Cape Hatteras to Maine, including an active fishery in the inshore Gulf of Maine and seasonally on Georges Bank. 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.

3.5.1.1 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 permitted 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.
- 2010-2014 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 (Federal and State of Maine) with the addition of discard data from extrapolated observer data.

Table 16 summarizes recent Atlantic herring catch estimates by year and management area from 2010-2015. Catch of Atlantic herring by State-only permitted vessels (fishing in State waters) is tracked by the States and ASMFC. Recent information regarding state waters Atlantic herring catch is summarized in Section ???.

Table 16 - Atlantic herring catch by year and management area, 2010-2015

	ACL			Sub-ACL			
Year	**ACL (mt)**	**Catch (mt)**	**% Caught**	**Area**	**sub-ACL (mt)**	**Catch (mt)**	**% Caught**
2010	91,200	72,852	80%	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	93,905	86,245	92%	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	90,683	90,561	100%	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	106,375	95,764	90%	1A	29,775	29,454	99%
				1B	4,600	2,459	53%
				2	30,000	26,562	89%
				3	42,000	37,290	89%
2014	104,088	93,247	90%	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	104,566	80,766	77%	1A	30,585	28,861	94%
				1B	4,922	2,819	57%
				2	32,100	15,114	47%
				3	44,910	33,217	74%

Source: NMFS/GARFO.
Note: Shaded rows indicate overages.

Atlantic herring catch (**Table 17**) has been somewhat consistent over 2003-2015 (and in previous years), averaging about 91,000 mt from 2003-2015, with the highest catch of the time series observed in 2009 (103,943 mt) and lowest in 2010 (72,852 mt). However, the quota allocated to the fishery (stockwide ACL/OY) has decreased 50% over the 12-year period. Consequently, and without increasing fishing effort, the Atlantic herring fishery has become more fully used in recent years, and the fishery used 100% of the total Atlantic herring ACL for the first time in 2012. The 2013-2015 Atlantic herring fishery specifications increased the stockwide Atlantic herring ACL by more than 15,000 mt from the 2010-2012 specifications; an additional 5,000 mt was caught under the higher quota in 2013 and 2014, and overall, the fishery used about 90% of the stockwide Atlantic herring ACL. The 2016-2018 specifications were set at similar levels (**Table 19**).

Table 17 - Total U.S. annual Atlantic herring catch, 2003-2015

Year	Total Herring Catch (mt)	Total Quota Allocated (mt)	% Caught
2003	101,607	180,000	57%
2004	93,205	180,000	52%
2005	96,116	150,000	64%
2006	98,714	150,000	66%
2007	85,819	145,000	59%
2008	83,240	143,350	58%
2009	103,943	143,350	73%
2010	72,852	91,200	80%
2011	86,245	93,905	92%
2012	90,561	90,683	100%
2013	95,764	106,375	90%
2014	93,247	104,088	90%
2015	80,766	104,566	77%
Source: NMFS.			

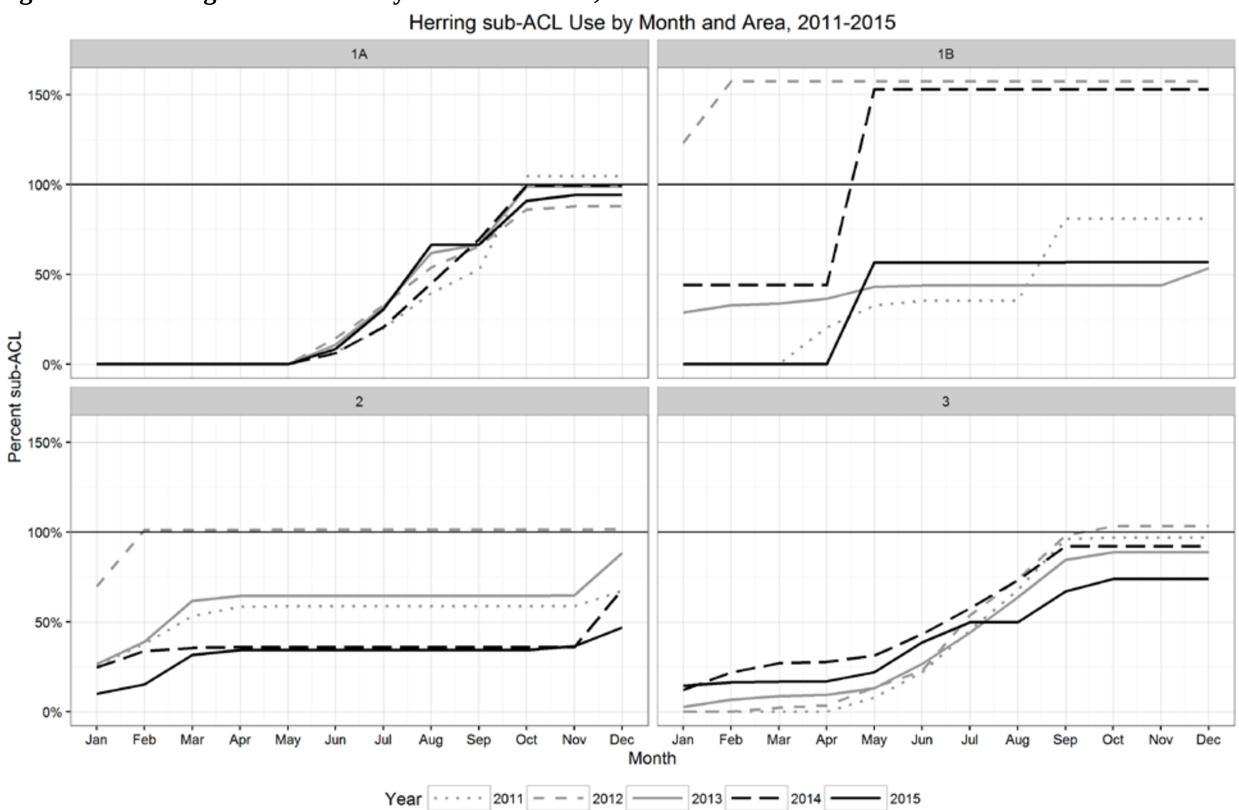
Table 18 provides the time series of Atlantic herring catch that was used in the 2015 Atlantic herring operational (update) assessment, including catch from the NB weir fishery through the 2014 fishing year.

Table 18 - Total Atlantic herring catch (mt), 1970-2014

Year	U.S. Mobile	U.S. Fixed	NB Weir (Incl. Shutoff)
1970	302,107	4,316	15,070
1971	327,980	5,712	12,136
1972	225,726	22,800	31,893
1973	247,025	7,475	19,053
1974	203,462	7,040	19,020
1975	190,689	11,954	30,816
1976	79,732	35,606	29,207
1977	56,665	26,947	19,973
1978	52,423	20,309	38,842
1979	33,756	47,292	37,828
1980	57,120	42,325	13,526
1981	26,883	58,739	19,080
1982	29,334	15,113	25,963
1983	29,369	3,861	11,383
1984	46,189	471	8,698
1985	27,316	6,036	27,864
1986	38,100	2,120	27,885
1987	47,971	1,986	27,320
1988	51,019	2,598	33,421
1989	54,082	1,761	44,112
1990	54,737	670	38,778
1991	78,032	2,133	24,574
1992	88,910	3,839	31,968
1993	74,593	2,288	31,572
1994	63,161	539	22,242
1995	106,179	6	18,248
1996	116,788	631	15,913
1997	123,824	275	20,551
1998	103,734	4,889	20,092
1999	110,200	654	18,644
2000	109,087	54	16,830
2001	120,548	27	20,210
2002	93,176	46	11,874
2003	102,320	152	9,008
2004	94,628	96	20,685
2005	93,670	68	13,055
2006	102,994	1,007	12,863
2007	81,116	403	30,944
2008	84,650	31	6,448
2009	103,458	98	4,031
2010	67,191	1,263	10,958
2011	82,022	421	3,711
2012	87,164	9	504
2013	95,182	9	6,431
2014	92,651	518	2,149
Source: NEFSC (2012).			

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. A more detailed description is in the 2013-2015 Atlantic herring fishery specifications (Section 3.5.1.2.3). **Figure 11** shows more recent herring catch by management area compared the TAC for each area by month for fishing years 2010-2015. The seasonal patterns are general consistent, except for Area 1B that had a bit more seasonal variation.

Figure 11. Herring sub-ACL use by area and month, 2011-2015



Source: GARFO Year-end Herring Reports

3.5.1.2 Current Specifications

The 2016-2018 Atlantic herring fishery specifications are summarized in **Table 19**. The Atlantic herring ABC is at the level recommended by the SSC (111,000 mt) and maintains the 2013-2015 specification of management uncertainty for 2016-2018. The management uncertainty buffer is 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 allows 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 19 - 2016-2018 Atlantic herring fishery specifications

Specifications	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 20 - 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 21**). The RH/S catch caps 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 shaded on Figure X) on all trips landing more than 6,600 pounds of Atlantic herring. No RH/S catch cap exists for the GB Catch Cap Area.

Table 21 - 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

3.5.1.3 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 22**). 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 22 - Atlantic herring permit categories

	Category	Description
Limited Access	A	limited access in all management areas
Limited Access	B	limited access in Areas 2 and 3 only
Limited Access	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
Open Access	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

3.5.1.4 Atlantic Herring Vessels

This section provides information regarding the vessels participating in the Atlantic herring fishery from 2008-present. Nominal revenues for "herring trips" are presented. Here, a herring trip is defined liberally as any trip in which at least one pound of Atlantic herring is retained.

Active Vessels in the Atlantic Herring Fishery

Since 2008, the number of vessels with either a limited access or an open access Atlantic herring permit has decreased annually (**Error! Reference source not found.** and **Error! Reference source not found.**). This includes a decrease in the limited access directed fishery vessels (Categories A and B), which comprise the majority of the herring fishery, with 43 permitted in 2014. In 2014, 44% of the limited access vessels were active (defined broadly as landing at least one pound of Atlantic herring during the fishing year). Many of the Category A, B, and C vessels are also active in the Atlantic mackerel fishery (managed by the MAFMC). 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.

For the open access vessels, just 3-5% of the Category D permits have been active since 2009 (**Error! Reference source not found.** and **Error! Reference source not found.**). The Category E permit was implemented during permit year 2013 (May-April). In 2014, there were just over 50 E permits issued, mostly to vessels with a D permit as well. About 11% of the E permits were active that year.

The last specifications document for FY2016-2018 provides much more detailed information about the vessels within each permit category including vessel characteristics, landings of other species, homeports, etc. This information has not been repeated here, but will be updated for the next specifications package.

Table 8. Fishing vessels with federal Atlantic herring permits, permit years 2008-2016[1] (May-Apr)

		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%)	40 (22.5%)
	Total	105 (38.1%)	101 (47.5%)	97 (43.3%)	93 (40.9%)	93 (44.1%)	87 (48.3%)	86 (43%)	87 (39.1%)	83 (39.8%)
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%)	1684 (2.5%)
	DE						6*	52 (9.6%)	54 (5.6%)	52*
	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%)	1737 (2.5%)

Source: GARFO Permit database and DMIS as of 2016-12-23.
[1]2016 data are incomplete
() Percent active vessels listed in parentheses
*Confidential vessel activity data

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

		Fishing Year (Jan-Dec)			
Permit Category		2013	2014	2015	2016[1]
Limited Access	A and BC	96.9%	98.0%	99.0%	99.0%
	C	2.6%	1.7%	0.9%	0.7%
	D, DE, and E	0.1%	0.1%	0.1%	0.2%

Source: GARFO Permit database and DMIS as of 2016-12-23.
[1]2016 data are incomplete

3.5.1.5 Atlantic Herring Fishing Gear

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 24**). 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.

Table 24 - 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.
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.

3.5.1.6 Fishery Effort

In this section, a herring trip is defined broadly as any trip in which at least one pound of Atlantic herring is retained. Table 25 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.

Table 26 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 25 - Herring trips, days, and herring landed (thousands of pounds) by area caught and category permit, 2008-2010

		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 26 - Herring trips, days, and herring landed (thousands of pounds) by area caught and gear type, 2008-2010

		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*

3.5.1.7 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 were estimated in previous specifications packages using VTR data; Category A and B permit holders rage from 4 people to 10 people. Crew sizes for Category C permit holders range from two to five people, the larger crews tending to come from ports in Massachusetts, New Jersey and New York. And Category D permit holders range from 1 to 4 people, smaller on average than Categories A, B or C.

3.5.1.8 Atlantic Herring Dealers and Processors

The number of Atlantic herring dealers has remained fairly constant since 2012 at just over 280. **Table 27** summarizes all issued Atlantic herring permits by state and permit type for the past few years. 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, 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.

Table 27 - Atlantic herring dealer permits issued, 2012-2015

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

Source: GARFO permit database as of 7/31/2015.

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.

Table 28 shows the revenue and landings, by state, of herring purchased by dealers from 2007 to 2010. ***Error! Reference source not found.*** 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. If this stays in it should be updated with more recent years.

Table 28 - Revenue (thousands of dollars) and landings (thousands of pounds) purchased by federally permitted dealers, by state of purchase

		MA	ME	NH	NJ	NY	RI
2007	Revenue	94	65	1	7	0	5
	Landings	12	8	0	1	0	1
2008	Revenue	133	62	3	14	0	10
	Landings	8	9	0	0	0	1
2009	Revenue	72	56	3	4	0	8
	Landings	38	33	1	2	0	4
2010	Revenue	372	254	8	30	0	30
	Landings	0	0	0	0	0	0
	Total Revenue	671	437	15	55	0	53
	Total Landings	58	49	1	4	0	6

Source: NMFS Dealer data

The 2007 data may have accuracy problems due to dealer serial numbering being un- or misreported.

3.5.1.9 Atlantic Herring Economics

Between 2008-2014, Atlantic herring catch ranged from 72,852-103,943 mt while nominal prices generally ranged from about $160-350 per mt (Figure 12 and **Figure 13**). 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. Some updates are planned for this section.

Figure 12 - Average nominal price per metric ton of Atlantic herring, 2008-2012

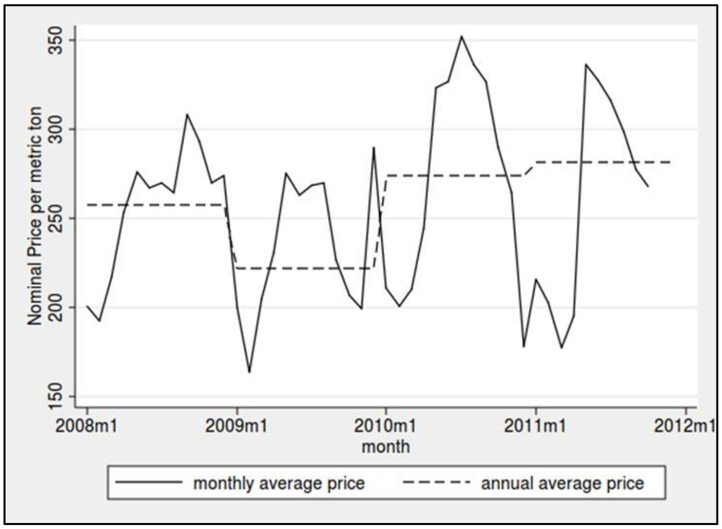


Figure 13 - Average nominal price per metric ton of Atlantic herring, 2010-2015

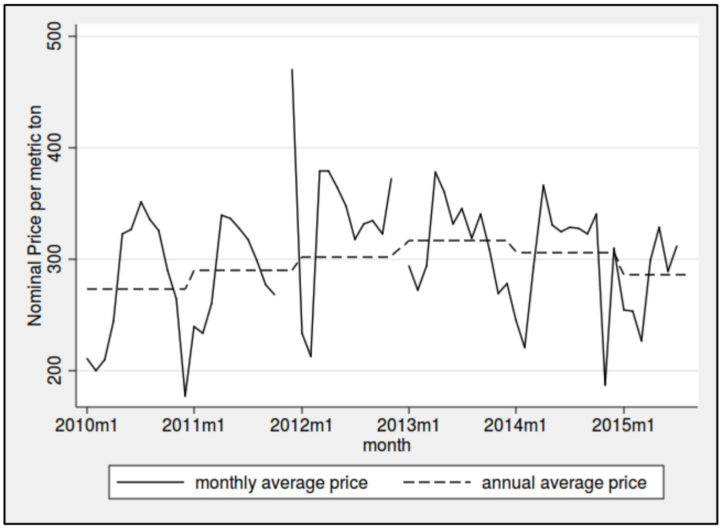


Table **29** provides percentage of total revenue from Atlantic herring by the total revenue for each permit category from 2008-2011 for trips landing Atlantic herring, showing the contribution of Atlantic herring revenues to those trips. Category A vessels catching Atlantic herring in Areas 1A, 1B, 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 29 - 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 30 updates **Table 29** 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. 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 30 - Importance of Atlantic herring for each permit category and management area, 2012-2014

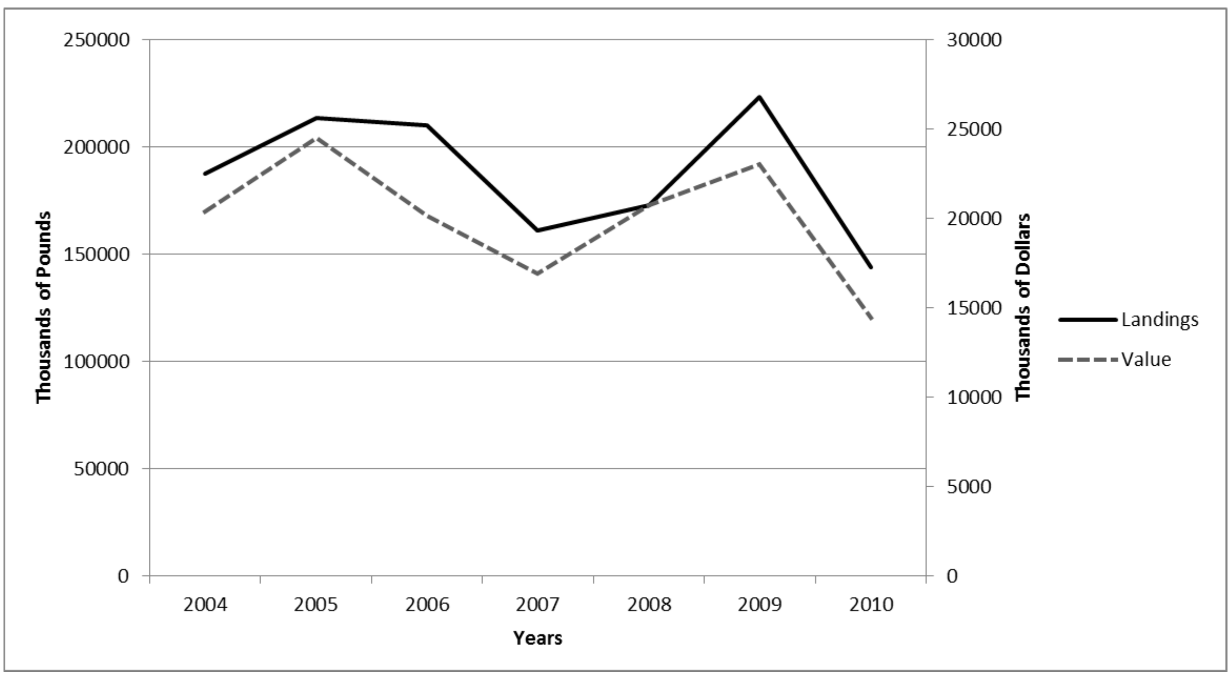
<table>
<tr><th></th><th>Category A</th><th>Category B or C</th><th>Category D or E</th></tr>
<tr><td>Area 1A</td><td>98%</td><td>42%</td><td>26%</td></tr>
<tr><td>Area 1B</td><td colspan="2">85%</td><td>minimal*</td></tr>
<tr><td>Area 2</td><td>85%</td><td>77%</td><td>9%</td></tr>
<tr><td>Area 3</td><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>

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.

Figure 14 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 27 million dollars for the over 200 million 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 15** 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.

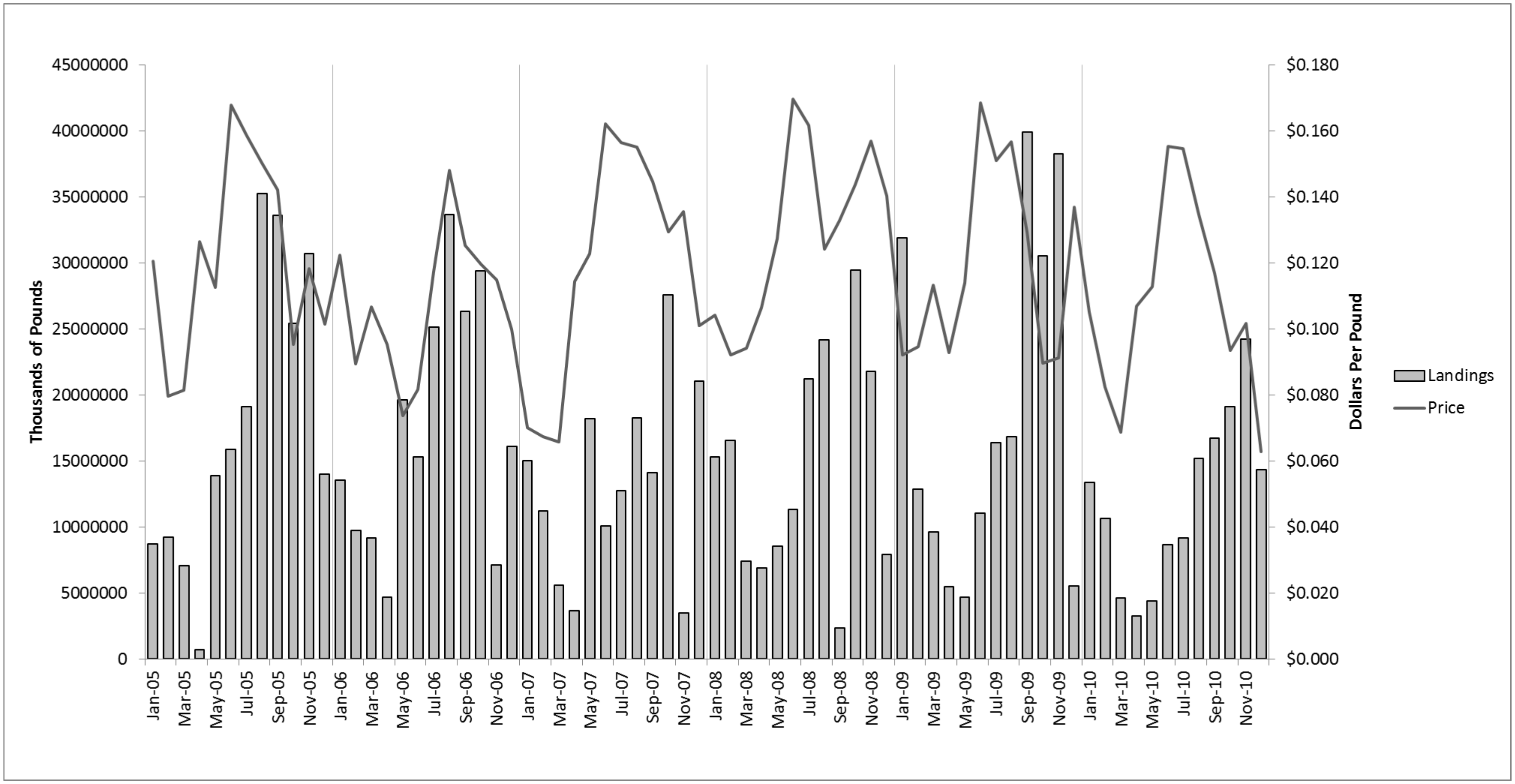
Figure 14 - Total annual landings (thousands of pounds) and value of herring (thousands of 2009 dollars), 2004 - 2010



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

Table 31 reports revenue, in thousands of dollars, and landings, in thousands of pounds, 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 15 - Total landings (thousands of pounds) and average price per pound (dollars), 2005 - 2010



Source: NMFS dealer data.

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

Table 31 - Total revenue (thousands of nominal dollars) and landings (thousands of pounds), by species caught and vessel category, 2007-2010

		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 32, 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 32 - 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 denotes a value for which under 3 boats reported, and cannot be reported for confidentiality reasons.

3.5.1.10 Use of Atlantic Herring and Substitute Goods

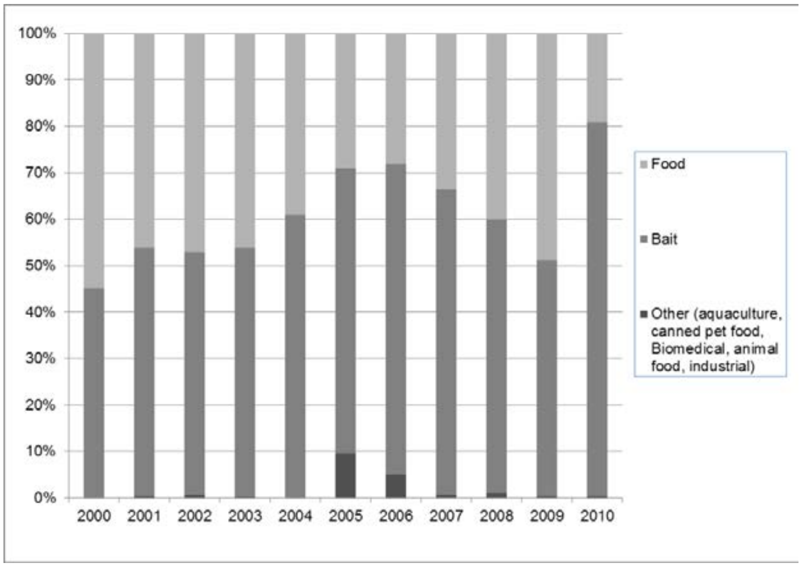
Limited amounts of Atlantic herring are consumed as food domestically. In the world market, there is likely one substitute: European herring. U.S. production of Atlantic herring is quite small relative to the worldwide production. Since total U.S. landings of Atlantic herring have been near 100,000 mt 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.

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 16 provides the percentage of reported herring landings used for bait and food from the dealer database during 2000-2010. Since 2001, more than 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.

Herring is currently used for many fisheries, such as the lobster industry (regional), tuna and various recreational fisheries. 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. A full description of herring bait dealers can also be found in Amendment 1, and updated descriptions of the bait dealers can be found below.

The bait industry has changed tremendously in the last seven years resulting in a much more centralized distribution structure. 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.

Figure 16 - Herring landings reported for food, bait, and other uses, 2000-2010 (updates?)



Source: NMFS Dealer Data

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 2015b). 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.

Atlantic herring is used as bait for many fisheries, such as lobster, tuna, and various recreational fisheries. A more detailed description of the bait sector of the industry is in Amendments 1 and 5 to the Herring FMP. According to NMFS dealer data, 77% of the Atlantic herring landed from 2012-2014 was sold as bait; most of the rest was used for human consumption. Ports in Maine (61%) and Massachusetts (36%) landed 97% of all herring used for bait.

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 33**)

Table 33 - 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 34**), 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 34 - Bait use in the lobster fishery in New Hampshire

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.						

3.5.1.11 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. Total Atlantic herring catch by vessels fishing in state waters was about 19 mt in 2015.

Amendment 1 to the Atlantic Herring FMP allows up to 500 mt of Atlantic herring to be set-aside until November 1 for fixed gear fishermen fishing West of Cutler. Amendment 2 to the Interstate FMP requires fishermen East of Cutler to report catch weekly through the federal IVR system. 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. The FGSA was set to 295 mt for the 2013-2015 specifications in Area 1A.

The non-federally permitted commercial landings of Atlantic herring are by fishermen in Maine Maine, primarily using fixed gear and a small number of seines. **Table 35**provides catch estimates from the fixed gear fishery through 2014. 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.

Table 35 - 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	60,071	49	0
2005	12/2/2005	60,000	61,570	53	0
2006	10/21/2006	50,000	59,980	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	27,741	823	0
2011	10/27/2011	29,251	29,359	23	0
2012	11/5/2012	27,668	25,057	0	0
2013	10/15/2013	29,775	29,820	C	C
2014	10/26/2014	33,031	33,428	C	C

Source: ASMFC.

Note: "C" denotes that the value cannot be reported due to confidentiality.

3.5.1.12 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).

Table X (Section 3.5.1.1) provides the time series of Atlantic herring catch that was used in the 2015 Atlantic herring operational (update) assessment, including catch from the NB weir fishery through the 2014 fishing year. 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 overall trend in landings since 1990 has been downward (**Error! Reference source not found.**), 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, which are presented separately in **Error! Reference source not found.** on the following page, from 1964 to 2011.

- 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 (**Error! Reference source not found.**).

Table 36 provides the number of active weirs and the average catch per weir reported for the NB weir fishery from 1978-2014. 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.

Table 37 provides 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 (November/December) averaged less than 4% of the total reported for the year from the fishery.

Table 36 - 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 37 - 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

3.5.2 Other Fishery-Related Businesses

3.5.2.1 American Lobster Fishery

The lobster industry (particularly in Maine) depends greatly on herring bait to sustain itself. Small-scale truckers, bait shop owners, and related business all participate in the commercial bait venture. Bait can be delivered dockside from trucks traveling up and down the coast. 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 coastal isolated lobster fishermen may also pick up bait directly off vessels, or have it brought out on ferries. In recent years, the shift has been towards vessels landing directly to island ports. A small proportion of lobster bait was supplied by the freezer plants in Massachusetts (Cape Seafoods and NORPEL). With both freezer plants in relative hiatus, however, it is unclear that they are the source of bait in 2011.

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 rock fish, all with varying 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.

Fishery Description

The fishery for American lobster, *Homarus americanus*, is one of the top fisheries on the Atlantic coast of the U.S., with landings of close to 96.6 million pounds and valued at close to \$299.5 million in 2009. Maine and Massachusetts together produced more than 92% of the total national landings. This represents an increase in landings but a decrease in value from 2008. Landings typically occur in inshore areas, and the species is managed jointly by the ASMFC and NOAA. The ASMFC manages the state waters (from 0 to 3 miles from shore), and NMFS manages from state water to the EEZ (3 to 200 miles from shore). Lobsters are most abundant inshore from Maine through New Jersey, with abundance declining from north to south, while offshore they occur from Maine through North Carolina. A more detailed description of the lobster industry can be found in Amendment 1 to the Atlantic Herring FMP.

Relevant Updated Regulations

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 are 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. Since 1999, 15 addenda to Amendment 3 have been approved. The documents for each addenda can be found at the Commission's website, www.asmfc.org. Major provisions within the Amendment and addendum include those such as: minimum and maximum carapace; length; maximum trap limits; prohibition on the possession of buried lobsters (lobster with eggs); prohibition on possession of lobster meat and lobster parts; trap configuration requirements; prohibition on spearing lobsters; prohibition on possession of female v-notched lobsters; limits on landings with non-trap gear, limits to entry into the fishery. Other addendum, such as the most recent Addendum XVI, address new reference points for each lobster stocks, based on recommendations from the Technical Committee and the Peer Review Panel from the 2009 stock assessment.

Stock Assessment/Landings

The resource is managed as three separate stocks: the Gulf of Maine (GOM), Georges Bank (GB), and Southern New England (SNE). The 2009 peer reviewed stock assessment (ASMFC, 2009) used a new model which incorporated lobster size and a broader range of data. It found that the GOM and GB stocks were experiencing record stock abundance and recruitment, while the SNE stock was experiencing low abundance and poor recruitment. While the success of the GOM and GB stocks meant that they were not depleted, and overfishing was not occurring, 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.

The assessment further found that the GOM supports the largest fishery, constituting about 76% of the U.S. landings between 1981 and 2007, while GB constitutes the smallest portion of the U.S. fishery, averaging 5%. Landings in the GOM averaged 33,000 mt from 2000-2007, and increased dramatically from 1990 to 2006. Landings in GB almost doubled between 2003 and 2007, with a high of 2,400 mt landed in 2005.

The SNE stock was determined to be depleted, although overfishing was not occurring. Abundance indices were determined to be at or near series lows. The distress experienced by the SNE stock was further examined in a Technical Committee Recruitment Failure in the SNE Stock (ASMFC, 2010) report, as additional monitoring information became available. The additional information indicated that the stock was continuing to fall lower than the assessment. The Technical Committee 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.

SNE has the second largest fishery, accounting for 19% of the U.S. landings between 1981 and 2007. Contrary to GB and GOM, the landings in SNE increased between the 1980's and 1990's, and peaked in 1997 at 9,935 mt. It was in 1999 that the fishery began to experience a decline, with landings only accounting for 9% of the U.S. landings.

3.5.2.2 Bluefin Tuna Fishery

The tuna fishery depends on herring as bait, and tuna is known to feed on herring as well (Section XX). The tuna fishery itself landed an average of 49,908 thousand pounds of total tuna between the years 2004 and 2008, with the majority of catch being comprised of Albacore, Bigeye, and Yellowfin tuna. The importance of the tuna fishery to the U.S. in 2009 can be seen in **Table 38**. A total of over 199,000 mt was caught by commercial vessels in and out of U.S. waters, with revenues of $267,777,000. The percentage of tuna caught within the 200 mile EEZ is a little under 11%, or 68,185 thousand dollars. The U.S. canned 167.5 thousand mt of tuna, without accounting for tuna canned in oil, in 2009.

Table 38 - Commercial landings and revenue of total tuna by catch location, 2009

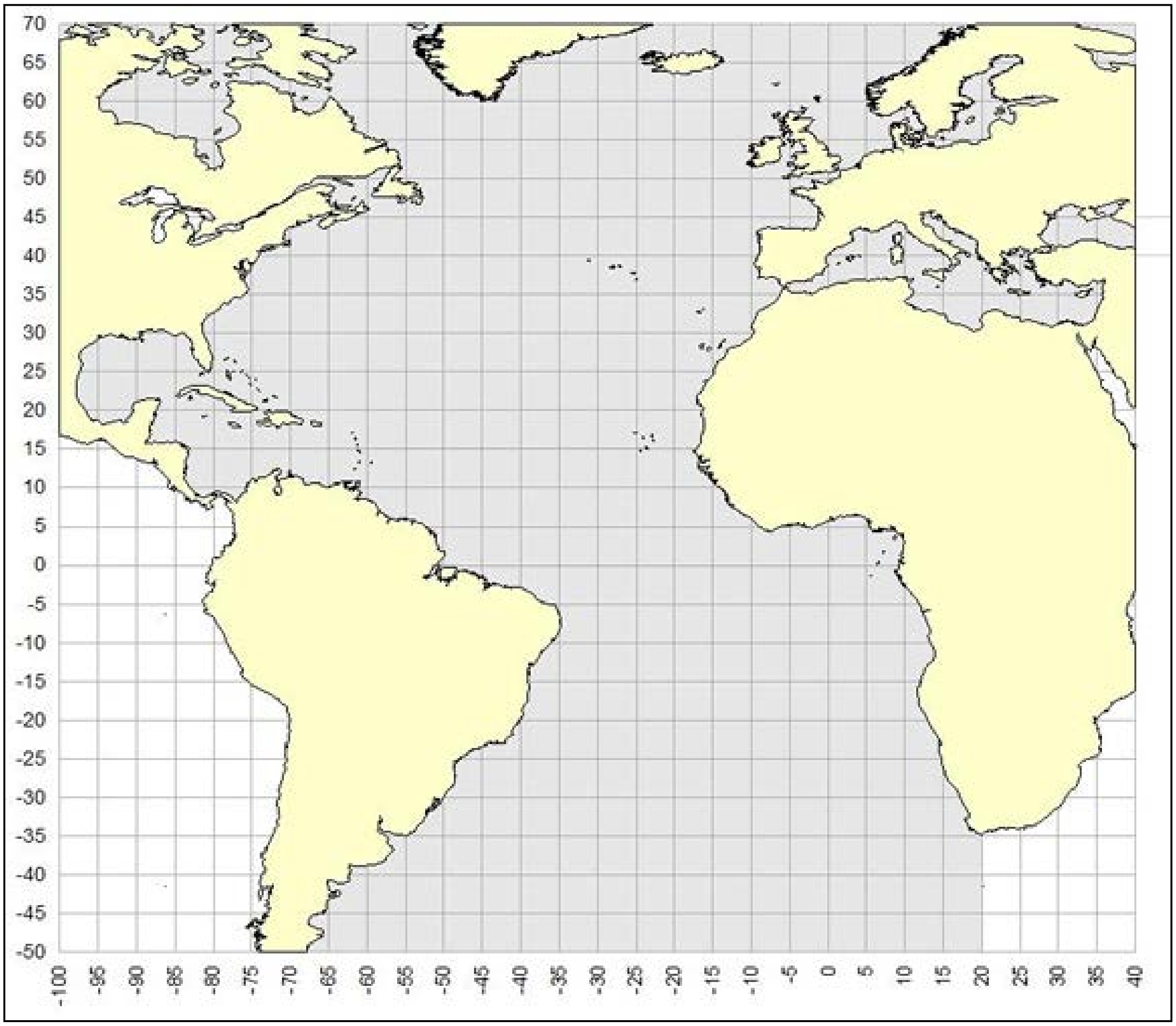
	0 - 3 miles from U.S. coast	3 - 200 miles from U.S. coast	High Seas or off foreign coasts	Total U.S. Landings
Landings (mt)	526	18,024	180,682	199,232
Revenue ($ thousands)	1,065	67,120	199,592	267,777

Source: Fisheries of the United States (2009).

Note: Total tuna includes Albacore, Bigeye, Bluefin, Little tunny, Skipjack, Yellowfin, and Unclassified tuna.

Tuna in the Atlantic Ocean and adjacent seas are jointly managed by NOAA and the International Commission for the Conservation of Atlantic Tunas (ICCAT). 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 has three official languages: English, French and Spanish. There are 48 Contracting Parties, including the U.S., Canada, and various other nations from the U.N., Africa, and Asia. The study and management of tuna and tuna-like species can only be undertaken by ICCAT, in accordance with the Convention ICCAT also compiles bycatch information caught during tuna fishing in the Convention area. **Figure 17** illustrates the ICCAT Convention area.

Figure 17 - International Commission for the Conservation of Atlantic Tunas (ICCAT) Convention Area



Source: www.iccat.es

Unless specifically stated in an exempted fishing permit, commercial bluefin tuna fisheries in the Gulf of Maine begin June 1st. There are three main gear types in the Gulf of Maine: general (rod and reel), harpoon, and purse seine. Bluefin tuna fishermen work off an annual TAC which is divided up amongst the categories. The general category receives the largest allocation and has within season allocations (e.g., X% of quota can be caught between June 1 and August 31). If the catch limit is reached before August 31, the fishery will close and reopen again in September. September has its own quota as does October, and then there is a winter allocation. The fishery has not closed due to reaching any of these within season quotas since the 1990s. Historically, the bluefin season runs from June through October, even into November and, in recent years, December. The length of the season is dependent on the catch rate in any particular year.

The bluefin tuna fishery is located throughout the entire Gulf of Maine. 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.

The Highly Migratory Species Division has informed the PDT that high resolution spatial data for bluefin tuna catches is limited. There is some spatial data for the recreational fishery as 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. 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.

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 et al. 2013). 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 available to the PDT. The fishermen have told him that there has been some confusion over time whether they were supposed to report to NMFS the area that they fished or the area of their homeport (it's supposed to be the former). 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).

Through current and prior work, Golet and colleagues have identified linkages 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). 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). Bluefin has declined in mean weight and lipid reserves over time, and these changes appear connected to declines in herring weight and size-at-age, despite high herring abundance (Golet, et al. 2015; Logan, et al. 2015). Golet et al (2013) have correlated herring and tuna schools, but a more thorough analysis could be completed. To date, the data have not been examined on sufficiently fine spatial and temporal scales to determine the specifics of co-location.

There are over 30 species of tuna managed ICCAT, including: Atlantic bluefin (*Thunnus thynnus thynnus*), skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), albacore (*Thunnus alalunga*) and bigeye tuna (*Thunnus obesus*); swordfish (*Xiphias gladius*); billfishes such as white marlin (*Tetrapturus albidus*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus albicans*) and spearfish (*Tetrapturus pfluegeri*); mackerels such as spotted Spanish mackerel (*Scomberomorus maculatus*) and king mackerel (*Scomberomorus cavalla*); and, small tunas like black skipjack (*Euthynnus alletteratus*), frigate tuna (*Auxis thazard*), and Atlantic bonito (*Sarda sarda*).

Six main species are caught by U.S. fisheries; Albacore, Bigeye, Bluefin, Little Tunny, Skipjack, and Yellowfin, and all seem to be experiencing a downward trend in stock size as fishery effort has increased. Similarly, all 6 have been experiencing difficulty in producing a stock assessment that does not suffer from uncertainty due to lack of data. According to the North Atlantic 2009 ICCAT Albacore stock assessment, the spawning stock size had declined in 2007 to one third of the peak levels that were estimated in the late 1940s. The Committee further concluded that it is likely that the stock was below the maximum sustainable yield (MSY) level and the stock had remained below B_{MSY} since the late 1960s. The 2010 Bigeye tuna assessment showed a slightly similar trend, but the Committee noted that while data quality continued to improve, considerable uncertainty in the stock status and productivity of the Bigeye still exist. Large declines in biomass and increases in mortality were evident, particularly in the 1990's, when fishing mortality was high. With the decline in the previous five or six years, there have been possible biomass increases, and replacement yield for 2011 was estimated to be at around MSY.

The Atlantic Bluefin 2010 ICCAT stock assessment was limited by a lack of data, and the Committee noted that historical fishery performance data would likely not be improved, and that therefore the assessment should be modified in future iterations. A similar trend to the two previous tuna was found, however, with spawning stock biomass declining since the 1970's, with increasing fishing pressure on age 2-5 fish. Older ages felt a decrease in fishing effort but a rapid increase in the 1990's, and recent recruitment levels remain uncertain. The Little tunny is such a data poor species that ICCAT has not performed a stock assessment on it or its 12 other small tuna species that it is lumped with.

The last ICCAT stock assessment for skipjack tuna was created in 2008, although another may occur in 2012. Skipjack is a typically tropical or sub-tropical species that exhibit continuous spawning and differences in growth by region. Making assessments even more difficult, the effort on the skipjack is not directed, and so data is variable. Conclusions for both the Eastern and Western stock were therefore difficult to create, but it was generally thought that neither was suffering from over exploitation.

For Yellowtail tuna, the last stock assessment was also in 2008, with another scheduled to take place in 2010. Between the age structured and production model, results varied. The age structured model suggested that overfishing had occurred in recent years, and the production model suggested that overfishing had been occurring and that the stock was overfished during those years. Both models indicated that overfishing was not occurring in 2006, however, the Committee urged consideration of uncertainty in both models.

3.5.2.3 Groundfish Fishery

Of the many recreational fisheries that exist in the Northeast, several depend on herring as a source of bait as well as a source of food for the fish that they hunt (Section X). 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 44 million trips that caught over 198 million fish, trips which serviced nearly 6.4 M. 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. For the Fisheries of the United States (2009), the data was 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 provides 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.

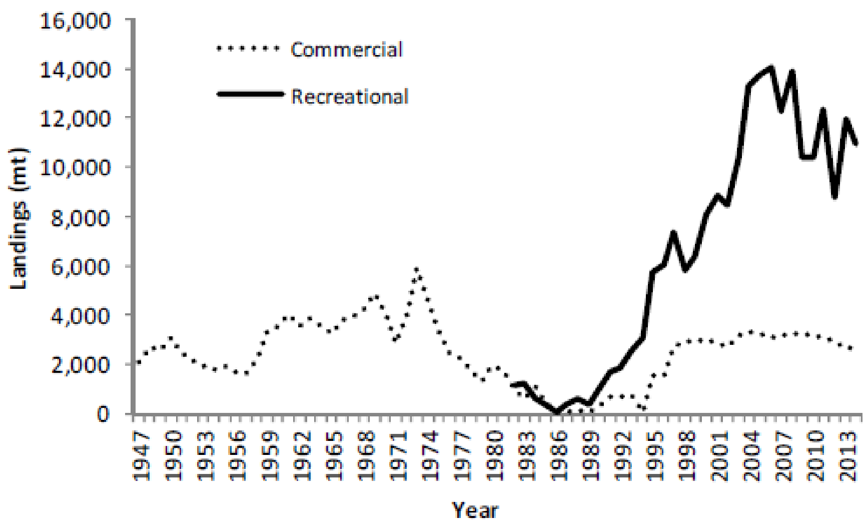
3.5.2.4 Striped Bass Fishery

Striped bass is a predator of Atlantic herring and its 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 18**). 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 2015a).

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 2015a).

Figure 18 - Coast-wide commercial and recreational striped bass harvest, 1940s - present



Source: ASMFC (2015a).

Table 39 - 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 (2015a).				

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.

The Massachusetts Division of Marine Fisheries manages the fishery using 14 statistical areas within state waters. **Figure 19** and Figure 20 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 21 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.

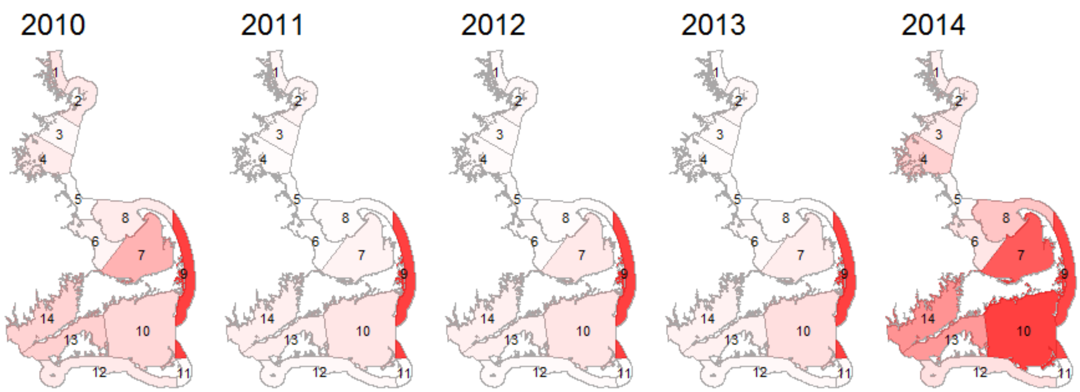
Striped bass are typically present in Massachusetts waters between May and October, yet the commercial fishery (the only source of spatial fishery-dependent data) occurs over a much narrower timeframe (Kneebone, Hoffman, Dean, Fox, et al. 2014). Prior to 2014, the commercial striped bass fishery began 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, Hoffman, Dean & Armstrong 2014). Coastwide, 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 coastwide 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.

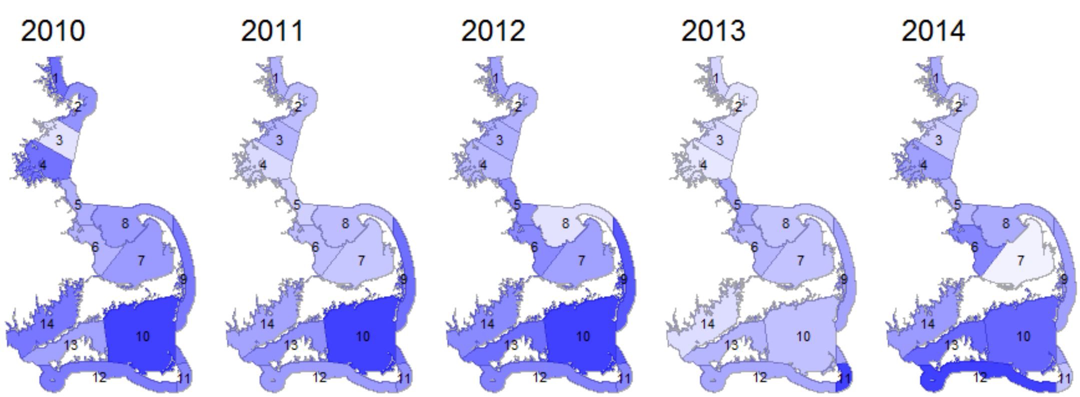
While there are no specific rules that explicitly prevent midwater trawling for herring in Massachusetts state waters, there are regulations that effectively prohibit this activity: 1) There is no exemption from the 6" minimum mesh size for herring fishing (as there is for the whiting and squid fisheries); 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 19 - Spatial pattern in landings (pounds) for Massachusetts striped bass commercial fishery, 2010-2014



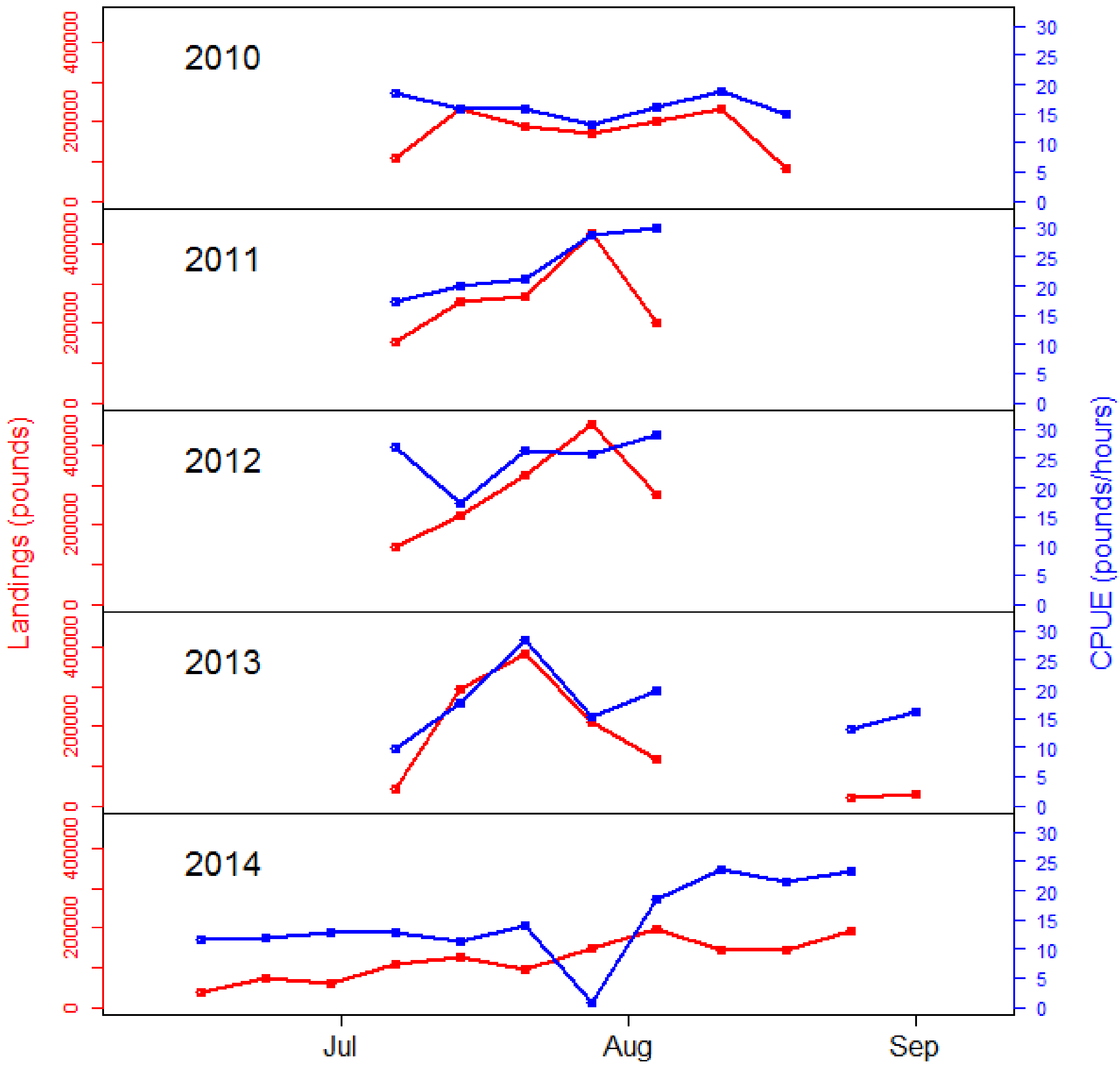
Source: MADMF (2016).

Figure 20 - Spatial pattern in CPUE (pounds / fishing-hours) for Massachusetts striped bass commercial fishery, 2010-2014



Source: MADMF (2016).

Figure 21 - Seasonal profile of Massachusetts commercial striped bass fishery, 2010-2014



Source: MADMF (2016).

3.5.2.5 Non-consumptive Industries

Whale watch companies do not report to NMFS where they go and what protected species they see. 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 is 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).

Key whale species of interest to the whale watching industry are humpback, finback, and minke whales. Humpback whales are known to feed on herring, particularly in the Gulf of Maine. 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 species, though behavior and bathymetry are factors as well (Payne et al. 1986; Payne et al. 1990). Prey include herring, sand lance and other small fish (Waring, et al. 2015).

Figure 22 is a map showing commercial whale watching areas from the Northeast Ocean Data portal. As described on the portal, the map:

> *"depicts activity areas mapped by whale watch industry experts in the Northeast Coastal and Marine Recreational Use Characterization Study which was 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."*

The effect of herring as a forage species on whales and other marine mammals and birds in the New England area is a key issue for non-consumptive use of Atlantic herring, and therefore the whale watching and bird watching industry. If fewer marine mammals or birds are in the area to observe, fewer boats and tours will be able to be supported in the industry. 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 needed to support the industry is unknown, but economic data on the whale watching industry does exist.

An economic study by O'Conner et al. (2009) characterized the whale watching industry in New England as being worth $30 million (revenue/year), with a growth rate of -3% a year (**Table 40**). Over 1 million people a year are said to go on trips, and the number of operators is around 30 (although it is not clear if charter vessels are included in the estimate). Main ports of sail include Massachusetts, Maine, New Hampshire and Rhode Island, and Stellwagen Bank National Marine Sanctuaries is one of the more popular destinations. Ticket prices are around $40 for adults and $30 for children on a 4 hour cruise. Up to 400 passengers can fit on some vessels.

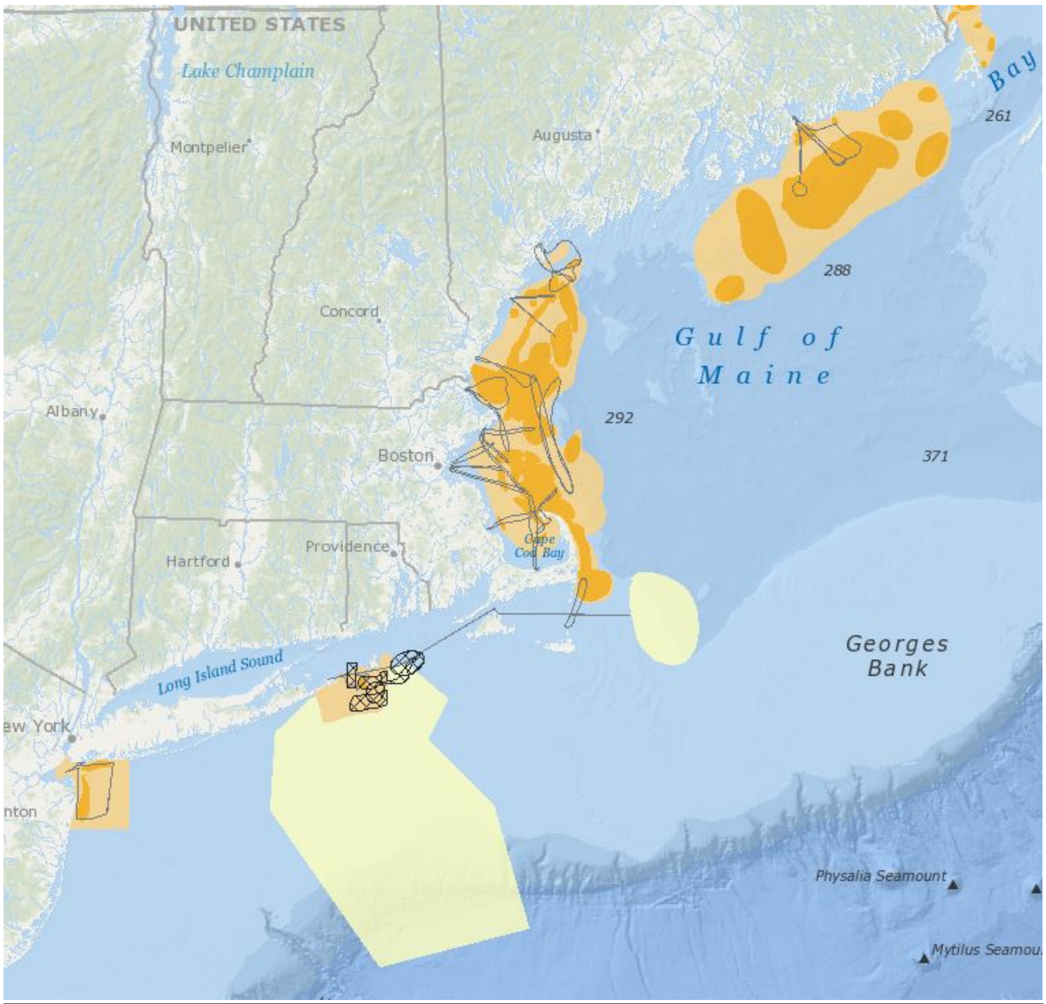
Table 40 - New England whale watching, 1998 and 2008

Year	Number of whale watchers	AAGR	Number of operators	Direct expenditure	Indirect expenditure	Total expenditure
1998	1,240,000	N/A	36	$30,600	$76,	$107,250,
2008	910,071	-3%	31	$35,000	$91,	$126,000,

Source: O'Conner et al (2009)

An economic study by Lee (2009) noted that the industry runs through the late spring to the early fall, with fin, humpback, and minke whales being the most commonly sighted. Whales tend to congregate on large oceanographic features, which is where schooling fish 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.

Figure 22 - Map showing commercial whale watching areas



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

Notes quoted from the Data Explorer:

"The data are classified by the following categories:

- **"General use areas** [light orange] reflect the full footprint of whale watch activity in the last 3 – 5 years (2010 – 2014) regardless of frequency or intensity
- **"Dominant use areas** [dark orange] include all areas routinely used by most users most of the time, according to seasonal patterns.
- **"Transit routes** [lines] include areas used for transit to and from general or dominant use areas

- **"Supplemental areas** [yellow] depict areas used for closely-related activities and infrequent specialty trips.
- **"RI Ocean Special Area Management Plan areas** [hatched] were mapped as part of the Rhode Island Ocean Special Area Management plan and are symbolized separately to reflect different data collection methodologies."

3.5.3 Fishing Communities

3.5.3.1 Introduction

There are over X communities that are a homeport or landing port to one or more Atlantic herring fishing vessels. These ports occur throughout the New England and Mid-Atlantic. Consideration of the economic and social impacts on these communities from proposed fishery regulations is required by the National Environmental Policy Act (NEPA 1970) and the 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 not practical 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.

Communities of Interest

The following five criteria were used in Amendments 1 and 5 to the Herring FMP to define *Communities of Interest* for the Atlantic herring fishery, which must meet at least one criterion:

1. Atlantic herring landings of at least 10M pounds (4,536 mt) per year from 1997-2008, or anticipated landings above this level based on interviews and documented fishery-related developments.
2. Infrastructure dependent in part or whole on Atlantic herring.
3. Dependence on herring as lobster and/or tuna bait.
4. Geographic isolation in combination with some level of dependence on the Atlantic herring fishery.
5. Use of Atlantic herring for value-added production.

Based on the above criteria, there are 11 *Communities of Interest* for the Atlantic herring fishery, identified below and further evaluated in Amendment 5 to the Atlantic Herring FMP (Section 4.5.3). Community profiles of each are available from the NEFSC Social Sciences Branch website (Clay et al. 2007). Since Amendment 1, this list has changed slightly with changes in harvesting and processing sectors. The Herring PDT plans to update the methods and criteria used to identify herring dependent communities for Amendment 8.

1. Portland, Maine
2. Rockland, Maine
3. Stonington/Deer Isle, Maine
4. Vinalhaven, Maine
5. Lubec/Eastport, Maine
6. Sebasco Estates, Maine
7. NH Seacoast (Newington, Portsmouth, Hampton/Seabrook)
8. Gloucester, Massachusetts
9. New Bedford, Massachusetts
10. Southern Rhode Island (Point Judith, Newport, North Kingstown)

11. Cape May, New Jersey

Information in this section is largely based on demographic data collected by the 2010 U.S. Census and fishery data collected by NMFS, much of which are available on the NEFSC website (NEFSC 2013). Clay et al. (2007) also provides 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.

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 41). 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 2015 (Table 41), particularly for the limited access vessels.

Table 41 - Distribution of herring permit holders which have an Atlantic herring community of interest as a homeport, 2011 and 2015

Homeport		Atlantic Herring Permit Category					
		Limited Access (A, B, C)		Open Access (D, E)		Total	
		2011	2015	2011	2015	2011	2015
ME	Portland	3	3	129	30	132	33
	Rockland	1	1	2	2	3	3
	Stonington/Deer Isle	1	0	0	2	1	2
	Vinalhaven	0	0	2	2	2	2
	Lubec/Eastport	0	0	2	1	2	2
	Sebasco Estates	0	0	3	1	3	2
	Maine, other	11	7	196	146	207	153
NH	Seacoast	6	5	96	93	102	98
MA	Gloucester	7	8	174	120	181	128
	New Bedford	9	8	201	178	210	186
	Massachusetts, other	9	8	377	324	386	332
RI		15	14	117	104	132	128
NJ	Cape May	12	13	93	83	105	96
	New Jersey, other	0	0	200	177	200	177
Other		12	12	494	388	506	400

Source: NMFS permit database. (*http://www.nero.noaa.gov/permits/permit.html*). 2011 data accessed September 2012. 2015 data accessed July 2015.

Landing Ports

From 2008-2011, Atlantic herring harvested from Areas 1A and 1B are landed in fishing communities in Maine, New Hampshire, and Massachusetts, whereas herring from Areas 2 and 3 are landed in a wider range of ports (**Table 42**). Communities in Rhode Island and New Jersey fish in Area 2 for herring almost exclusively. Portland, Rockland, Gloucester, and New Bedford are ports with the most herring landings in recent years. Within New Jersey, Cape May is the most active landing port.

Table 42 - Landing port distribution of Atlantic herring landings by fishing areas, 2008-2011

Landing Port		**Area 1A (mt)**	**Area 1B (mt)**	**Area 2 (mt)**	**Area 3 (mt)**
Maine	Portland	23%	22%	1%	23%
	Rockland	26%	15%	1%	10%
	Stonington/Deer Isle	8%	12%	0.5%	0%
	Vinalhaven	2%	5%	0%	2%
	Lubec/Eastport	0%	0%	0%	0%
	Sebasco Estates	0%	0%	0%	0%
	Maine, other	6%	0.3%	0.8%	4%
New Hampshire	Seacoast	3%	0.9%	0.4%	1%
Massachusetts	Gloucester	23%	42%	17%	45%
	New Bedford	8%	2%	45%	16%
	Massachusetts, other	1%	0.1%	4%	0%
Rhode Island	Southern	0%	0%	17%	0.1%
New Jersey	Cape May	0%	0%	13%	0%
	New Jersey, other	0%	0%	0%	0%
Other States		0%	0%	0.1%	0%
Total		**133,463 (100%)**	**19,555 (100%)**	**89,748 (100%)**	**91,466 (100%)**
Source: NMFS VTR database. September 2012.					

4.0 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

4.1 IMAPCTS ON ATLANTIC HERRING RESOURCE

In general, the alternatives developed to modify the GB haddock AM are not expected to result in any significant impacts on the Atlantic herring resource. The intent of the alternatives is to reduce the potential negative economic impacts on midwater trawl vessels resulting from GB haddock AM closures reducing the opportunity to harvest the herring sub-ACLs in Areas 3 and 1B, while continuing to minimize haddock bycatch. Overall, Atlantic herring biomass and fishing mortality are managed through the Council's Atlantic Herring FMP, which mandates that the annual catch limit (ACL) be distributed to four herring management areas (sub-ACLs) on an annual basis. The Council uses the best information available to estimate the proportion of each spawning component of the Atlantic herring stock complex in each area/season and distributes the sub-ACLs such that the risk of overfishing an individual spawning component is minimized.

The Atlantic herring fishery specifications were set for the 2016-2018 fishing years using the ACL/AM framework mandated by the Magnuson-Stevens Act and implemented through Amendment 4 to the Atlantic Herring FMP in 2011. The Atlantic herring resource is not considered to be in an overfished condition, and overfishing is not occurring. The alternatives in this action in general were developed, in part, to maximize the chance that the herring fishery can harvest the available herring yield (U.S. ACL/OY) provided for through the Atlantic herring fishery specifications. The direct and indirect impacts of the 2016-2018 ACL and sub-ACLs on the Atlantic herring resource were thoroughly assessed in the recent specifications package; the fishery specifications were determined to achieve the goals and objectives of the Herring FMP by preventing overfishing and maintaining the Atlantic herring resource at long-term sustainable levels.

None of the measures under consideration in Framework 5 are expected to have measurable effects on the overall herring population. Some may have potentially low positive or low negative impacts on portions of the resource caused by effort shifts, but any impacts are minor and likely to be within the noise of the overall uncertainty of total herring biomass estimates.

Some of the alternatives may change how the fishery interacts with spawning fish on GB. There is some supporting information about the timing of GB spawning (mostly in Sept – Nov), but not spatial information. Gonadal stages are sampled from various portside sampling programs, so the general timing of spawning on GB is more certain, but not the location. The last time the Herring PDT seriously devoted resources to summarize available information on herring spawning on GB was in January 2011, Appendix VIII in Amendment 5. Section 2.0 summarizes the work available related to spawning areas and times in Area 3, but several of the projects were not completed at that time and further research is needed.

4.1.1 Georges Bank haddock accountability measures for the herring fishery

4.1.1.1 No Action (Alternative 1)

When the GB haddock sub-ACL has been caught, all herring vessels fishing with midwater trawl gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the GB Haddock AM area (Figure 2) for the remainder of the multispecies fishing year (April 30). If NMFS determines that total catch exceeded any ACL or sub-ACL for a fishing year, then the amount of the overage shall be subtracted from that ACL or sub-ACL for the fishing year following total catch determination.

If the current AM closure is triggered, potentially low positive impacts on resource are expected. Since unused TAC cannot be harvested from another area, more herring would potentially remain in the water unharvested in Area 3 if the closure is implemented before the area TAC is reached. However, in some years the TAC in Area 3 is not fully harvested even when the fishery operates normally, without triggering the GB haddock AM closure. But if the AM is triggered, the potential of catching the full herring TAC is reduced. Figure ??? shows that in most years the Area 3 herring TAC was not fully harvested; however, in FY2015 the GB haddock AM was triggered in October and the total herring catch for Area 3 was ??% that year. Figure 23 shows that 100% of the area the fishery operates on GB is within the AM closure; hence removals could be impacted if the AM is triggered before the TAC is harvested.

In addition, if there is an overage of the GB haddock sub-ACL in year one, herring MWT fishing may be further restricted in year 2 to account for the overage. This could have low positive impacts on the herring resource if harvest levels are reduced, but these impacts could be relatively limited since the haddock sub-ACL is harvested real time, thus overages should not be very high.

If the current GB haddock AM is triggered it is possible that there could be differential impacts on spawning components of herring. The dynamics of when, where and how spawning components mix is uncertain, but if vessels shift effort from offshore and fish inshore instead the impacts on spawning components could be different. If the GB haddock AM area is closed vessels could fish the inshore quota more quickly; the total removal of herring would be the same, but it could be harvested earlier in the year, and depending on the season there could be different impacts on spawning fish. For example, if the AM is triggered earlier in the year and the Area 1A quota is fished faster before fish begin to spawn there could be low positive impacts on the herring resource. However, if the AM closure is triggered later in the year and herring fishing effort shifts inshore when spawning is occurring there could be greater impacts on the overall resource. There are inshore spawning closures in place that would mitigate some of these potential impacts.

Overall, the effects of fishing on different spawning components of the herring resource are based on where and when the stocks mix, but the information available to evaluate these impacts is limited. In general, if the No Action GB AM closure is triggered it is more likely that effort will displace somewhere else, and if fishing is concentrated in a smaller area there could be more impacts on the herring resource in areas that remain open to the fishery. It should also be noted that typically the MWT fishery shifts effort from GB to Area 1A when that area opens to that gear type (November 1). Therefore, if the current AM is triggered near that date, the impacts may not be very different since some level of effort would be expected to shift inshore regardless of an AM closure being triggered or not.

If the GB AM triggers it is also possible that effort could shift to Area 2 instead. The more difficult it is to fish on GB the more likely it is that effort would be displaced somewhere else and if this causes effort to concentrate in smaller areas there could be higher impacts on more localized areas if effort is not able to spread out due large AM closures offshore.

If the AM does *not* trigger under No Action there should be no direct impacts on the herring resource. Furthermore, if the fishery does not exceed the GB haddock sub-ACL and there is no reduction in Year 2 for any overage, herring fishing and removals are not expected to change; therefore, no direct impacts on the resource are expected.

Under No Action, there could be some indirect impacts on the resource if MWT vessels change their normal fishing behavior to stay under the haddock sub-ACL. These changes in fishing behavior are difficult to measure, but if vessels fish in different seasons, areas, or patterns to avoid haddock there could be indirect positive or negative impacts on the resource. For example, vessels could take shorter tows or fish during different times of the day to avoid haddock, which could have different impacts on the herring resource. In addition, some vessels participate in voluntary avoidance programs and communicate with each other about areas to avoid with higher haddock catches. If avoidance behavior changes normal fishing behavior there could be impacts on the herring resource by concentrating fishing pressure in other areas or times.

The Council is also considering an increase to the GB haddock sub-ACL under a separate action, Framework 56 to the Groundfish FMP. The current sub-ACL for the herring mid-water trawl fishery is 1% of the US ABC. The preferred alternative in FW56 is to increase that allocation to 1.5%. Overall, that level of increase is not expected to have any direct impacts on the herring resource. The increase may better enable the fishery to harvest the full herring TAC, but not above fishing levels assessed under the allocated herring specifications. The increase in the sub-ACL may better enable the fishery to harvest the herring ACL in Area 3 and Area 2B, but that could just mean fishing harder earlier, in the year, or lengthen the season. If the fishing season is longer (extending through the fall) there could be increased impacts on spawning fish on GB, which is typically Sept – Nov (Appendix VIII in Herring Amendment 5). When the Council developed spawning closures the intent was to ensure adequate protection of the herring resource because concentrated spawning aggregations make herring susceptible to harvesting and spawning behavior of uncaught herring was believed to be influenced by harvesting operations. However, these spawning closures were not approved by NMFS because the costs were not expected to outweigh the conservation benefits, which were uncertain, as well as other reasons.

Therefore, if the sub-ACL is increased in GF FW56 the overall impacts on the herring resource would be neutral because there is still an overall TAC for the area; impacts on spawning fish on GB could be increased if the fishing season extends longer into the fall compared to status quo, but the direct impacts on spawning fish is still somewhat uncertain.

4.1.1.2 Alternative 2 – Implement a proactive AM closure and maintain the current reactive AM closure

The series of options developed under this option would implement a smaller, more explicit AM closure proactively that would overlap the areas and seasons with the highest expected bycatch rates of haddock in the herring midwater trawl fishery based on historical observer and survey data. If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after the smaller AM is implemented), the existing AM closure would be implemented (Figure 2) to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

In general, proactive closures are expected to have neutral impacts on the herring resource assuming harvest levels remain the same from fishing activity in remaining areas within Area 3. However, if proactive closures inhibit the fishery from harvesting the full Area 3 TAC, then low positive impacts on the resource are expected if more herring is left in the water as a result of the proactive AM. However, there are years the Area 3 TAC is not fully harvested when AMs are not triggered, so direct impacts from the are likely very minimal. Furthermore, given the uncertainty of the biomass estimates for this fishery, the impacts on the resource are not measurable and likely within the noise of the overall biomass estimates.

4.1.1.2.1 Alternative 2 Option 1 – Proactive AM closure of GF mortality Closed Areas I and II

Either year-round, or seasonally the current GF closed areas I and II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2).

Figure 25 explains that about 10% of the estimated herring abundance is within this proactive AM area, and up to about 20% of the herring fishery footprint, depending on the season. Therefore, this proactive AM could impact total removals, and if less herring is caught as a result of the proactive closure, there could be low positive impacts on the resource. However, depending on the length of the proactive closure (sub-options between 3-12 months), there may be sufficient time to harvest herring outside of the area and season the proactive closure would be in place. Again, relatively small reductions in herring removals as a result of AMs are not expected to have more than minimal impacts on the herring resource.

Herring fishing activity within the GF closed areas is variable year to year. See table and figures in eco impacts section???. In some years it appears that a proactive closure overlapping the GF closed areas could have more impact on total herring removals, and in some years the fishery did not overlap the GF closed areas that much (reference figures for CA1 and 2 separately and show mt removals per year). Herring vessels are required to carry an observer to fish in the GF closed areas, and depending on the level of observer coverage available, that could also impact the level of fishing activity that takes place in those areas.

4.1.1.2.1.1 Sub-option for proactive AM season

For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place: a) year-round proactive closure; b) May-October proactive closure; and c) June-August proactive closure.

In terms of the seasonal sub-options, the options that are longer in length are expected to have potentially low positive impacts on the resource if total herring removals from Area 3 are reduced compared to No Action (Alternative 1), with low positive impacts on the resource. The shorter seasonal restrictions may have more neutral impacts on the herring resource if the fishery is better able to adjust around the proactive measures and catch the same amount of herring during other times of year.

4.1.1.2.2 Alternative 2 Option 2 – Proactive AM closure of GF mortality Closed Areas I and II with 15 nm buffer north of Closed Area 1 and west of Closed Area II

Either year-round, or seasonally the current GF closed areas I and II, including extended areas to the north of Closed Area I and west of Closed Area II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2).

Figure 27 shows that about 20% of the estimated herring abundance is within this proactive AM area, and up to about 35% of the herring fishery footprint, depending on the season. Therefore, this proactive AM could impact total removals, and if less herring is caught there could be low positive impacts on the resource compared to both Alternative 2 Option 1 as well as No Action (Alternative 1) that does not have proactive AMs. These differences are relatively small and not likely to have a measurable impact on the overall biomass.

Herring fishing activity within the GF closed areas, as well as the areas adjacent to them is variable year to year. See table and figures in eco impacts section???. In some years it appears that a proactive closure overlapping these areas could have more impact on total herring removals, and in some years the fishery did not overlap substantially with these areas (reference figures for CA1 and 2 separately and show mt removals per year). Herring vessels are required to carry an observer to fish in the GF closed areas, and depending on the level of observer coverage available, that could also impact the level of fishing activity that takes place in portions of these proactive AM areas.

4.1.1.2.2.1 Sub-option for proactive AM season

For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place: a) year-round proactive closure; b) May-October proactive closure; and c) June-August proactive closure.

In terms of the seasonal sub-options, the options that are longer in length are expected to have potentially low positive impacts on the resource if total herring removals from Area 3 are reduced compared to No Action (Alternative 1), with low positive impacts on the resource. The shorter seasonal restrictions may have more neutral impacts on the herring resource. The shorter seasonal restrictions may have more neutral impacts on the herring resource if the fishery is better able to adjust around the proactive measures and catch the same amount of herring during other times of year.

4.1.2 Implementation of Georges Bank haddock accountability measures for the herring fishery

4.1.2.1 No Action (Alternative 1)

Under No Action, the AM is triggered in-season based on an extrapolation of observed catch to the entire fishery using the cumulative method. If there is an overage of the GB haddock sub-ACL in year one, herring MWT fishing may be further restricted in year 2 to account for the overage. This could have low positive impacts on the herring resource if harvest levels are reduced. In some cases however, a reduction in haddock sub-ACL does not impact the fishery or herring resource because bycatch remains under both the original, as well as the reduced sub-ACL. In most years the Area 3 TAC is not fully harvested when AMs or payback provisions are not triggered, so direct impacts from a potential payback in year 2 are likely very minimal. Furthermore, given the uncertainty of the biomass estimates for this fishery, the impacts on the resource are not measurable and likely within the noise of the overall biomass estimates.

4.1.2.2 Alternative 2 - Seasonal split of GB haddock sub-ACL (80%/20%)

Eighty percent of the haddock sub-ACL would be available to the herring fishery on May 1 and the remaining 20% would be added on November 1. If the herring fishery catches more than 80% before November 1, then the existing AM would close to direct midwater trawl herring fishing from that time through October 31. The remaining 20% would become available on November 1 to support a winter herring fishery. The Council clarified that this alternative would not be automatic percentages for splitting the sub-ACL; if adopted, the Council would have the ability to select the seasonal split of the haddock sub-ACL in each specification process.

Overall this alternative is expected to have neutral impacts on the resource. By reserving some haddock sub-ACL for later in the year, the intent is that there is a greater chance the herring fishery will harvest the Area 3 TAC. Compared to a No Action scenario when the GB haddock AM is triggered, the impacts could be low negative because this alternative may increase the ability for the fishery to harvest the TAC. Under a No Action scenario when the AM is *not* triggered, the biological impacts of this alternative would be more neutral, because the fishery would have a better chance of harvesting the full Area 3 TAC. This alternative does not have any expected impacts on the Area 1B TAC. Typically the majority of that fishery begins in May and is usually finished before the fall when there is a greater chance the fishery would trigger the GB AM, which includes part of Area 1B. Overall, the biological impacts of the herring TAC have been evaluated in the specifications document, and since they are set at sustainable levels that prevent overfishing, the overall impacts on the resource would be the same regardless of whether the sub-ACL were allocated at the beginning of the year or sub-divided.

The PDT expressed concerns about monitoring the 80/20 split. When the TAC is split the size of the haddock quota is relatively small, especially the 20% split that would be available later in the season. The bycatch rate would reset after November 1 and there would not be much fishing activity later in the year to populate a new bycatch rate; therefore on older transition rate would be used which may or may not be different from actual conditions in the fishery. The accuracy of the bycatch estimates are strongly dependent on the amount of observer coverage available.

There may be unintended consequences of this alternative for some members of the fishery. Based on Figure ??? (reference eco figure) there are fewer areas to fish in the winter months. The proportion of MWT effort in Area 3 is highest in August and September, suggesting that access to Area 3 is most critical for this gear type during those months. There is a high demand for lobster bait during those months and the MWT fishery is prohibited from fishing in Area 1A during those months; therefore, there the options to fish in other areas is limited. If the GB AM is triggered earlier under this alternative because the haddock sub-ACL is reduced from 100% to something lower (80%), the risk of triggering the AM earlier in the season is higher. Trawl vessels are not permitted to fish in Area 1A until November, so these vessels would have limited options for fishing areas. Some fish in Area 2 in the winter, but some do not. Therefore, while this alternative may increase the ability for the fishery to harvest the full TAC by reserving some haddock sub-ACL for the winter, those potential positive impacts may benefit some segments of the fishery more than others (*will likely move this paragraph to the economic impacts section*).

This framework would enable future specification packages to adjust how the sub-ACL is allocated throughout the season. Specifically, the proportion that is available for different seasons. Overall, the distribution of when the sub-ACL is available to the herring fishery during the year is not expected to have direct impacts on the herring resource. Under this alternative, if less haddock is available at the beginning of the year it is possible that AMs could trigger sooner. If that is the case and an AM triggers before herring spawn on GB (thought to be Sept – November) there could be some positive impacts on the resource if fishing disturbance on GB is lower in the fall compared to No Action. However, under this option the remaining 20% of the haddock sub-ACL would be available on November 1, so fishing would resume during the latter part of the spawning season. Overall, the impact of herring fishing on spawning fish on GB is not thought to have detrimental impacts on the total population; therefore any low positive or low negative impacts would be minimal .

4.1.2.2.1 Seasonal split of GB haddock sub-ACL for FY2017 and FY2018

If adopted, the seasonal split for the GB haddock sub-ACL for FY2017 and FY2018 shall be set at 80% for May 1, and the remaining 20% would be available on November 1, including any underage from the first season (May-October). This option would maintain the split for these two fishing years, and future specification packages would consider whether a split would be used in the future. For FY2017 the split would be 360 mt (or 640.8mt if sub-ACL increased to 1.5% in GF FW56), and for FY2018 the specific values would be revisited next year through the GF specifications process, but they are expected to be even higher than 2017 (Table 43). No additional impacts beyond what was assessed in Section 4.1.2.2 are expected.

4.1.2.3 Alternative 3 – Amend how estimated catch is calculated in the herring fishery – incorporate state portside data

This alternative would require that state portside data be incorporated in the monitoring of haddock catch in the midwater trawl herring fishery, if available.

No direct impacts on the herring resource; this alternative will move to the considered and rejected section if GARFO analyses are not ready for final Council meeting (Jan).

4.2 IMPACTS ON NON-TARGET SPECIES

The primary bycatch species of interest for this action is haddock. The focus of this action is considering potential modifications to the GB haddock AM; therefore, the focus of this section will be on the expected impacts of these alternatives on the GB haddock resource and associated fishery.

4.2.1 Georges Bank haddock accountability measures for the herring fishery

4.2.1.1 No Action (Alternative 1)

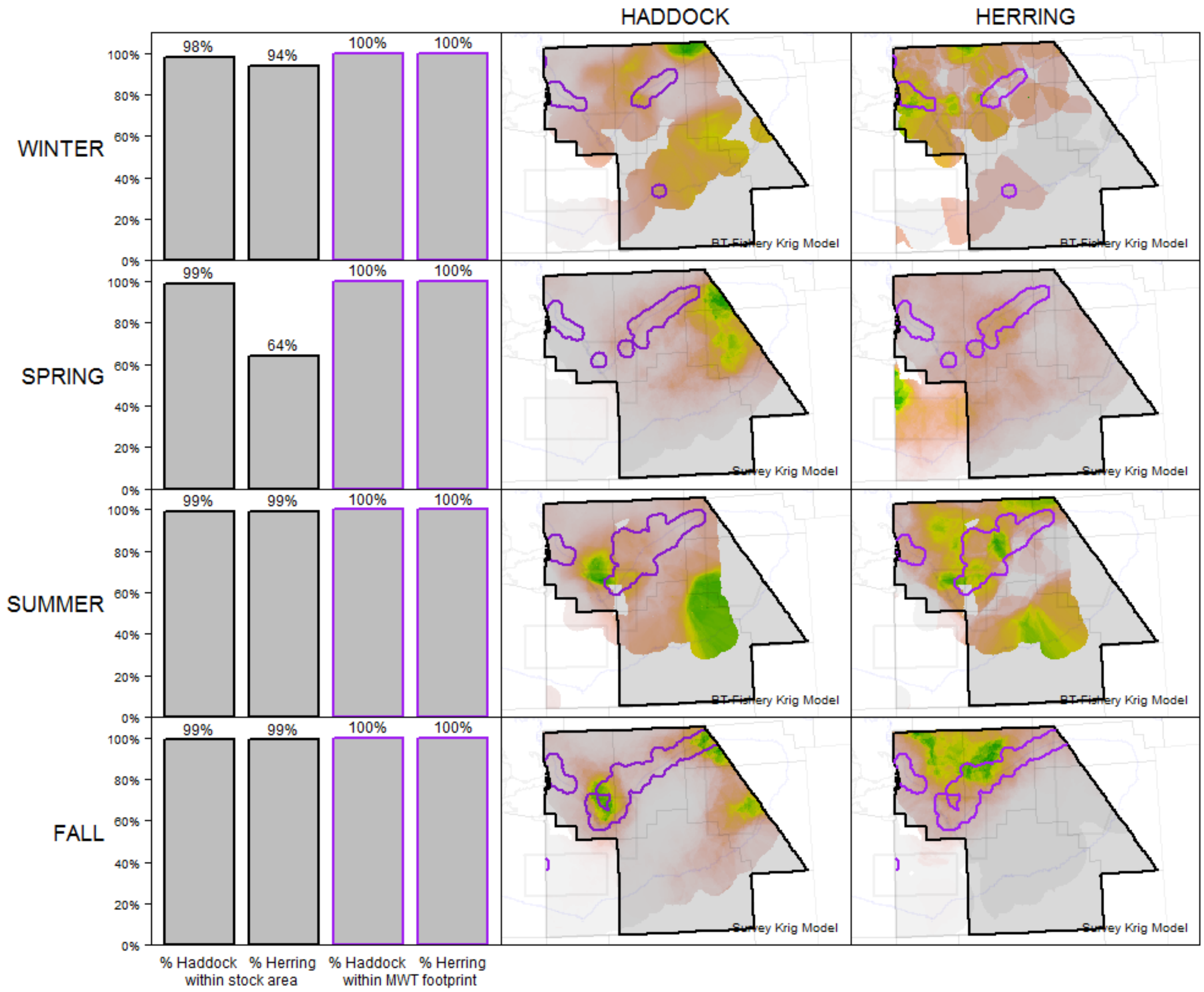
When the GB haddock sub-ACL has been caught, all herring vessels fishing with midwater trawl gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the GB Haddock AM area (Figure 2) for the remainder of the multispecies fishing year (April 30). If NMFS determines that total catch exceeded any ACL or sub-ACL for a fishing year, then the amount of the overage shall be subtracted from that ACL or sub-ACL for the fishing year following total catch determination.

The impacts of this alternative are expected to be generally positive on non-target species, specifically GB haddock, by essentially stopping all herring fishing on GB once the sub-ACL is caught. The AM in place is expected to help keep the herring fishery within the sub-ACL, limiting the overall impacts on GB haddock and helping to prevent overfishing of that stock.

Figure 23 shows that the current AM covers almost all of the estimated GB haddock biomass, as well as 100% of the herring fishery footprint within the GB haddock stock area for all four seasons. Therefore, once triggered, it is expected to be effective at reducing GB haddock catch and helping to prevent overfishing by the MWT herring fishery, having positive impacts on the GB haddock resource and fishery.

If the herring fishery shifts to another area as a result of this AM there could be increased impacts on other bycatch species. For example, if effort increases inshore, there could be increased river herring bycatch compared to lower levels that are typically caught offshore.

Figure 23 - Kriged distribution models for Georges Bank haddock (center) and herring (right), as compared to the current AM area (black polygon) and footprint of the MWT fishery (purple polygon)



The bar charts at left show the portion of the biomass of each species that are covered by the AM area, using data from the entire stock area (black outline) as well as just data from inside the MWT fishery footprint (purple outline)

4.2.1.2 Alternative 2 – Implement a proactive AM closure and maintain the current reactive AM closure

The series of options developed under this option would implement a smaller, more explicit AM closure proactively that would overlap the areas and seasons with the highest expected bycatch rates of haddock in the herring midwater trawl fishery based on historical observer and survey data. If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after the smaller AM is implemented), the existing AM closure would be implemented (Figure 2) to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

4.2.1.2.1 Alternative 2 Option 1 – Proactive AM closure of GF mortality Closed Areas I and II

Either year-round, or seasonally the current GF closed areas I and II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2).

In general, proactive AMs are designed to help slow bycatch and prevent reactive AMs from triggering. In this case, the current reactive AM is an in-season closure of most of GB when the sub-ACL of GB haddock is reached. This alternative would prohibit herring MWT fishing within Closed Area I and II proactively to potentially slow the catch of haddock in-season and better enable the MWT fishery to harvest the Area 3 TAC, and potentially Area 2B, before reactive GB haddock AMs are triggered.

Bycatch rates are higher in Closed Area I and II compared to the other areas on GB (Figure 24). The proportion of observed tows with haddock bycatch is always higher within the closed areas compared to outside (second panel of Figure 24). While the bycatch of haddock is variable, and many tows have zero catch, the median of haddock to kept all is higher within the closed areas for the months of July – October (forth panel of Figure 24). If those areas are closed proactively during the seasons with highest bycatch rates it is possible that the larger reactive AM would not trigger, which closes most of Georges Bank to the herring MWT fishery for the remainder of the year.

Figure 25 estimates the haddock and herring abundance within this proactive AM area by season. For example, if the proactive AM is triggered in the fall, almost 50% of the GB haddock abundance is estimated to be within the GF closed areas, while only 6% of the total herring resource on GB. In terms of the footprint of the fishery, about 43% of haddock abundance is within the area the herring fishery uses in the fall on GB, thus closing the areas in the fall could shift a substantial amount of effort to areas with potentially lower GB haddock catch rates, i.e. statistical area 522 compared to area 521 (Figure ???).

If proactive AMs help keep the herring fishery under the sub-ACL then impacts on non-target species, namely GB haddock, are positive. Because this alternative maintains the same reactive AMs, closure of the entire GB haddock stock area, the overall impacts of this alternative compared to No Action are neutral. If closed in time, haddock catches would not exceed the sub-ACL, thus total impacts on GB haddock would be the same as under No Action. In general, at these relatively low total removal levels, 1% or 1.5% of the total GB haddock ACL, the timing or speed of removals is not expected to have a substantial impact on the overall haddock resource. At these large biomass values, the removals from the herring fishery are not substantial enough to cause direct negative impacts on the groundfish fishery.

Figure 24 – Comparison of haddock bycatch rates inside and outside of Closed Area I and II

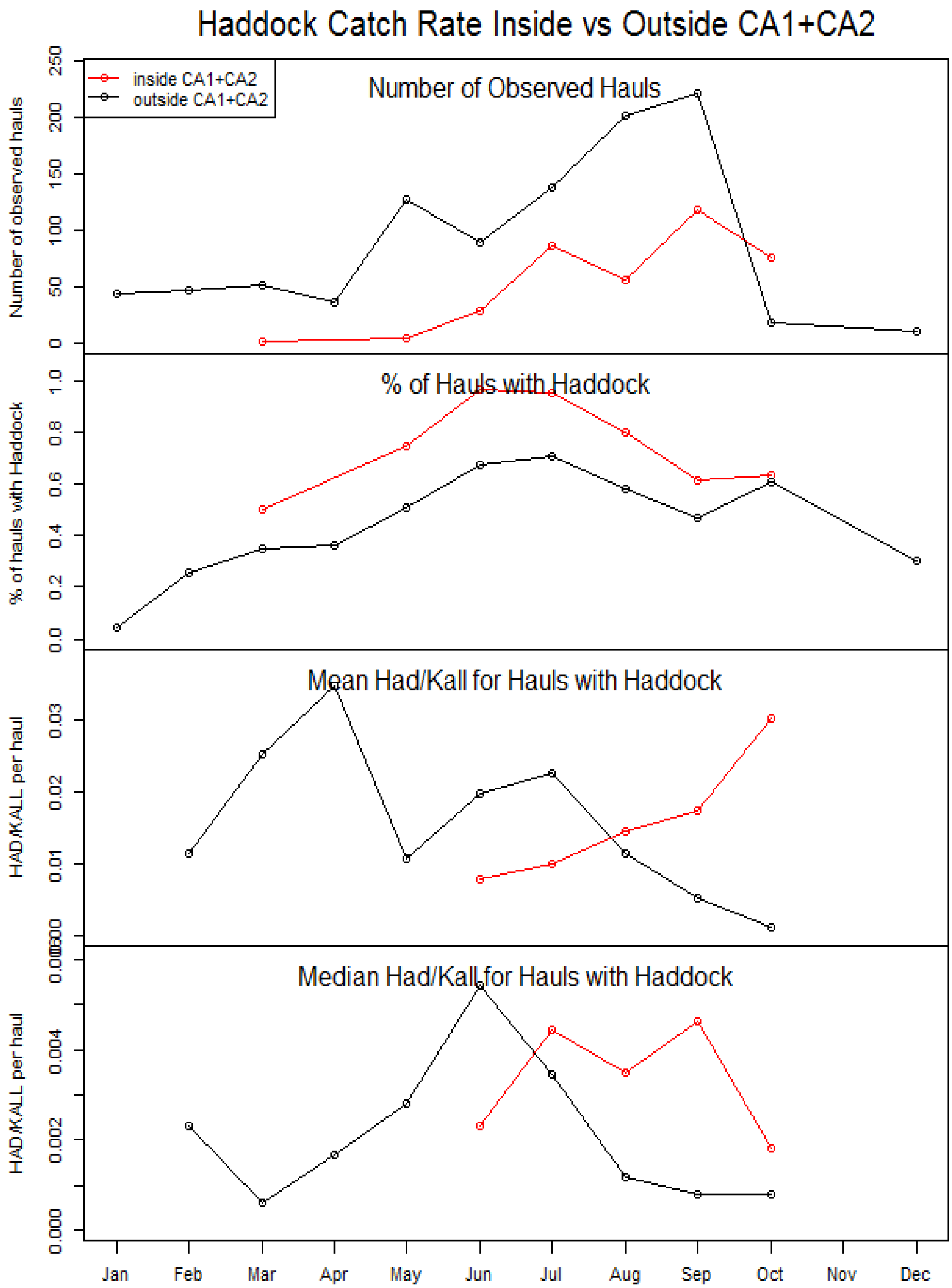
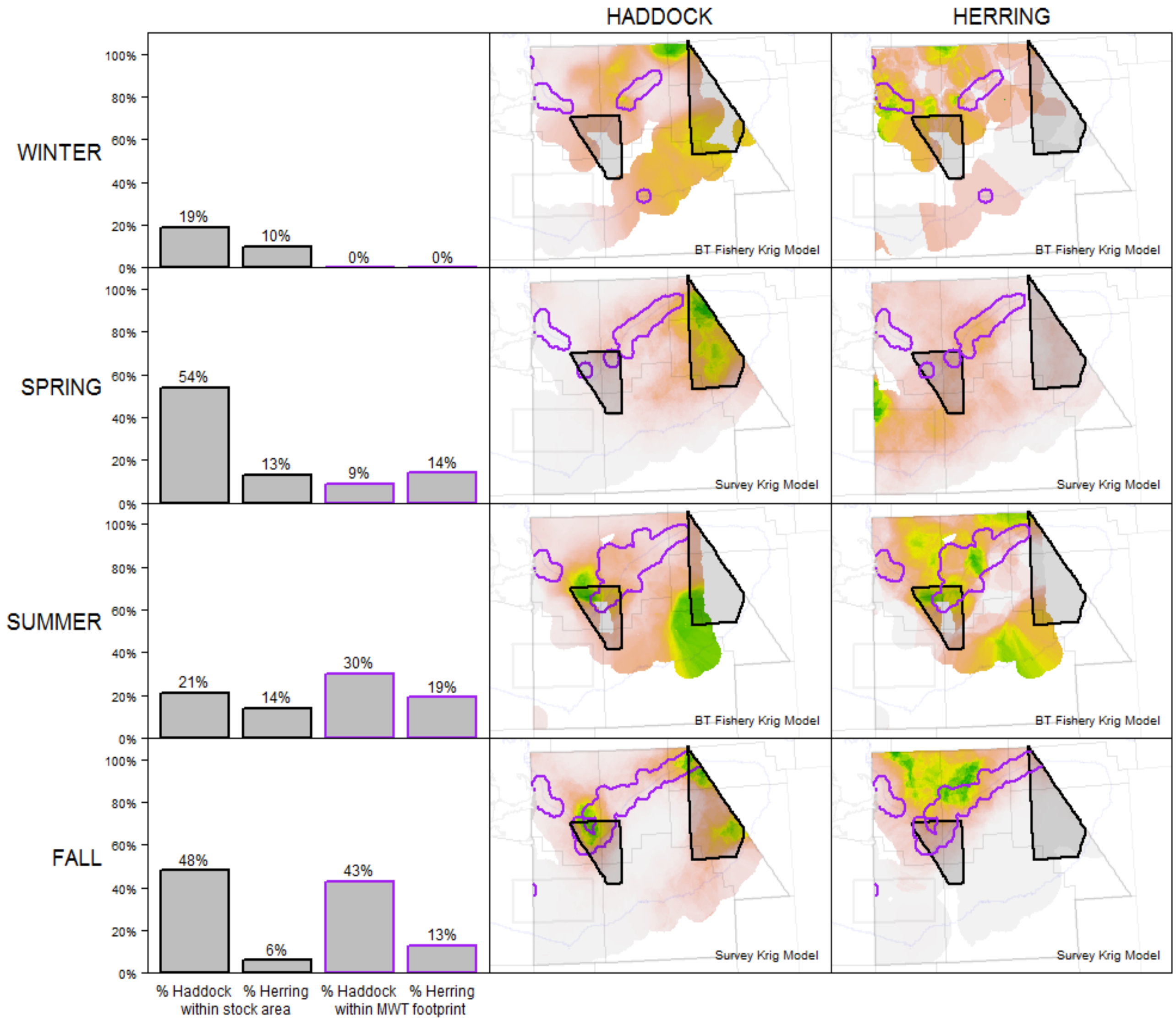


Figure 25 – Seasonal estimate of the proportion of haddock and herring abundance within CAI and II compared to all of GB, as well as compared to the footprint of the MWT herring fishery (in purple)



The bar charts at left show the portion of the biomass of each species that are covered by the AM area, using data from the entire stock area (black outline) as well as just data from inside the MWT fishery footprint (purple outline)

4.2.1.2.1.1 Sub-option for proactive AM season

For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place: a) year-round proactive closure; b) May-October proactive closure; and c) June-August proactive closure.

The median haddock catch rate for herring MWT hauls within Closed Area I and II is higher in the months of July through October (panel 4 in Figure 24). A closure during these months would limit herring fishing in areas with lower expected haddock catch rates. However, bycatch rates do vary from year to year and these data are variable. Option A, a year-round closure of these proactive AM areas would provide the most benefit for GB haddock since these areas on average have higher bycatch rates than areas outside. Option B would allow herring fishing in the winter months (Jan – April), and haddock abundance is lower in the GB closed areas during that season (19%) compared to other seasons (i.e. over 50% of GB haddock abundance is within the GF closed areas in the spring). Therefore, compared to Option A, Option B may have less positive impacts, but the differences are minor because haddock abundance within the closed areas is relatively low in the winter months. Option C, a proactive closure during the summer (June-August) likely has less positive impacts on haddock bycatch compared to Option B and C. About 30% of the haddock abundance on GB is within the closed areas during that season, but most of it is expected to be concentrated on the southern flank of GB as well as north of Closed Area I, areas that would still be open to the herring fishery.

Overall, these proactive AMs have a better chance of reducing haddock catch compared to No Action if the closure is during times of the year when a relatively large proportion of haddock abundance is expected to overlap fishing areas, i.e. in the fall when over 40% of the estimated haddock abundance is within the proactive AM area.

4.2.1.2.2 Alternative 2 Option 2 – Proactive AM closure of GF mortality Closed Areas I and II with 15 nm buffer north of Closed Area 1 and west of Closed Area II

Either year-round, or seasonally the current GF closed areas I and II, including extended areas to the north of Closed Area I and west of Closed Area II would be closed to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2).

In general, proactive AMs are designed to help slow bycatch and prevent reactive AMs from triggering. In this case, the current reactive AM is an in-season closure of most of GB when the sub-ACL of GB haddock is reached. This alternative would prohibit herring MWT fishing within Closed Area I and II “extended” proactively to potentially slow the catch of haddock in-season and better enable the MWT fishery to harvest the Area 3 TAC before reactive GB haddock AMs are triggered.

Bycatch rates are higher in Closed Area I and II compared to the other areas on GB (Figure 26). The proportion of observed tows with haddock bycatch is always higher within the closed areas compared to outside (second panel of Figure 26). While the bycatch of haddock is variable, and many tows have zero catch, the median of haddock to kept all is higher within the closed areas for the months of July – October (forth panel of Figure 26). If those areas are closed proactively during the seasons with highest bycatch rates it is possible that the larger reactive AM would not trigger, which closes most of Georges Bank to the herring MWT fishery for the remainder of the year.

Figure 27 estimates the haddock and herring abundance within this proactive AM area by season. For example, if the proactive AM is triggered in the fall, almost 70% of the GB haddock abundance is estimated to be within the GF closed areas, while only 18% of the total herring resource on GB. In terms of the footprint of the fishery, about 80% of haddock abundance is within the area the herring fishery uses in the fall on GB, thus closing the areas in the fall could shift a substantial amount of effort to areas with potentially lower GB haddock catch rates.

If proactive AMs help keep the herring fishery under the sub-ACL then impacts on non-target species, namely GB haddock, are positive. Because this alternative maintains the same reactive AMs, closure of the entire GB haddock stock area, the overall impacts of this alternative compared to No Action are neutral. If closed in time, haddock catches would not exceed the sub-ACL, thus total impacts on GB haddock would be the same as under No Action. In general, at these relatively low total removal levels, 1% or 1.5% of the total GB haddock ACL, the timing or speed of removals is not expected to have a substantial impact on the overall haddock resource. At these large biomass values, the removals from the herring fishery are not substantial enough to cause direct negative impacts on the groundfish fishery.

Figure 26 – Comparison of haddock bycatch rates inside and outside of "Closed Area I and II Extended"

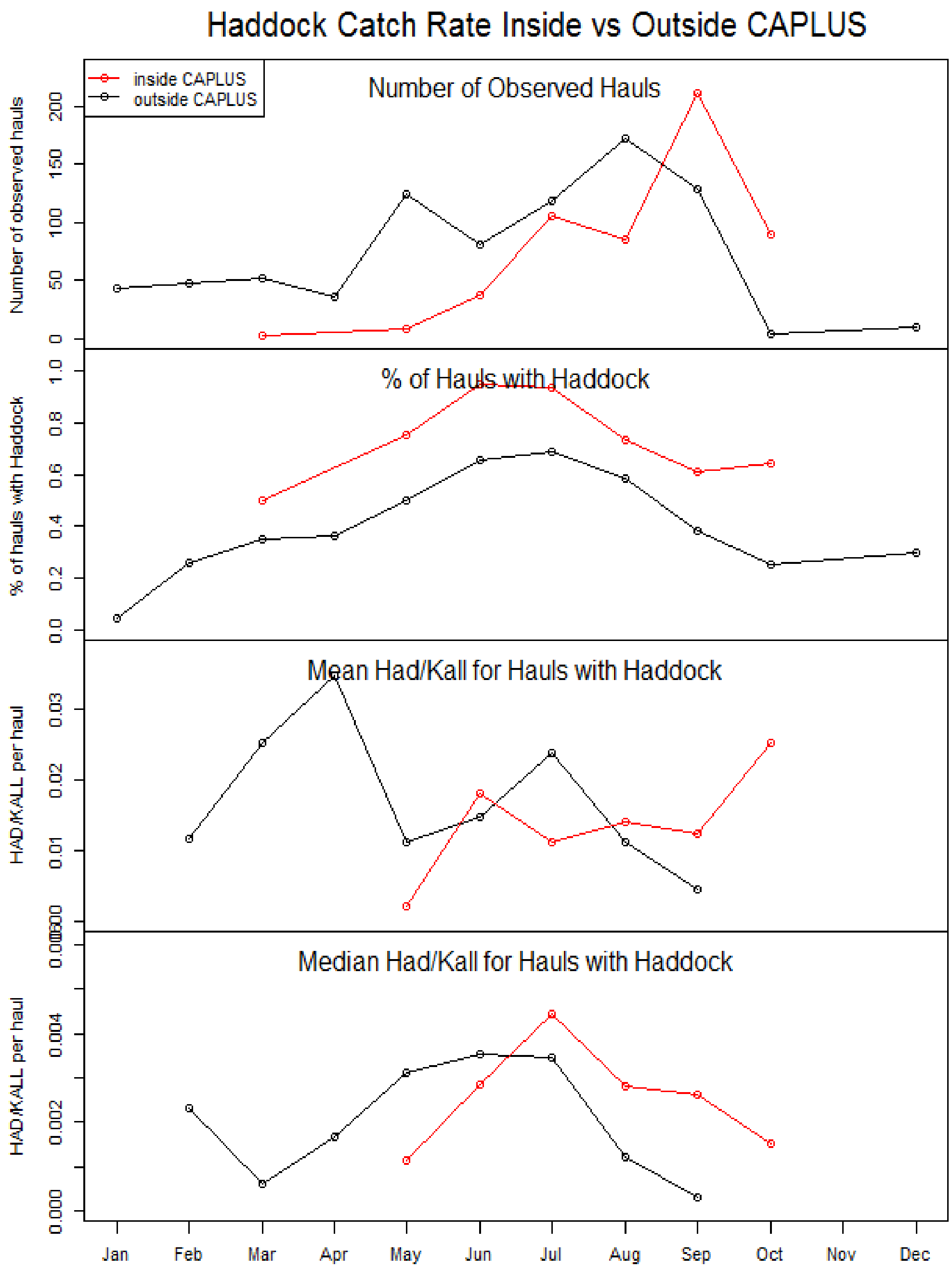
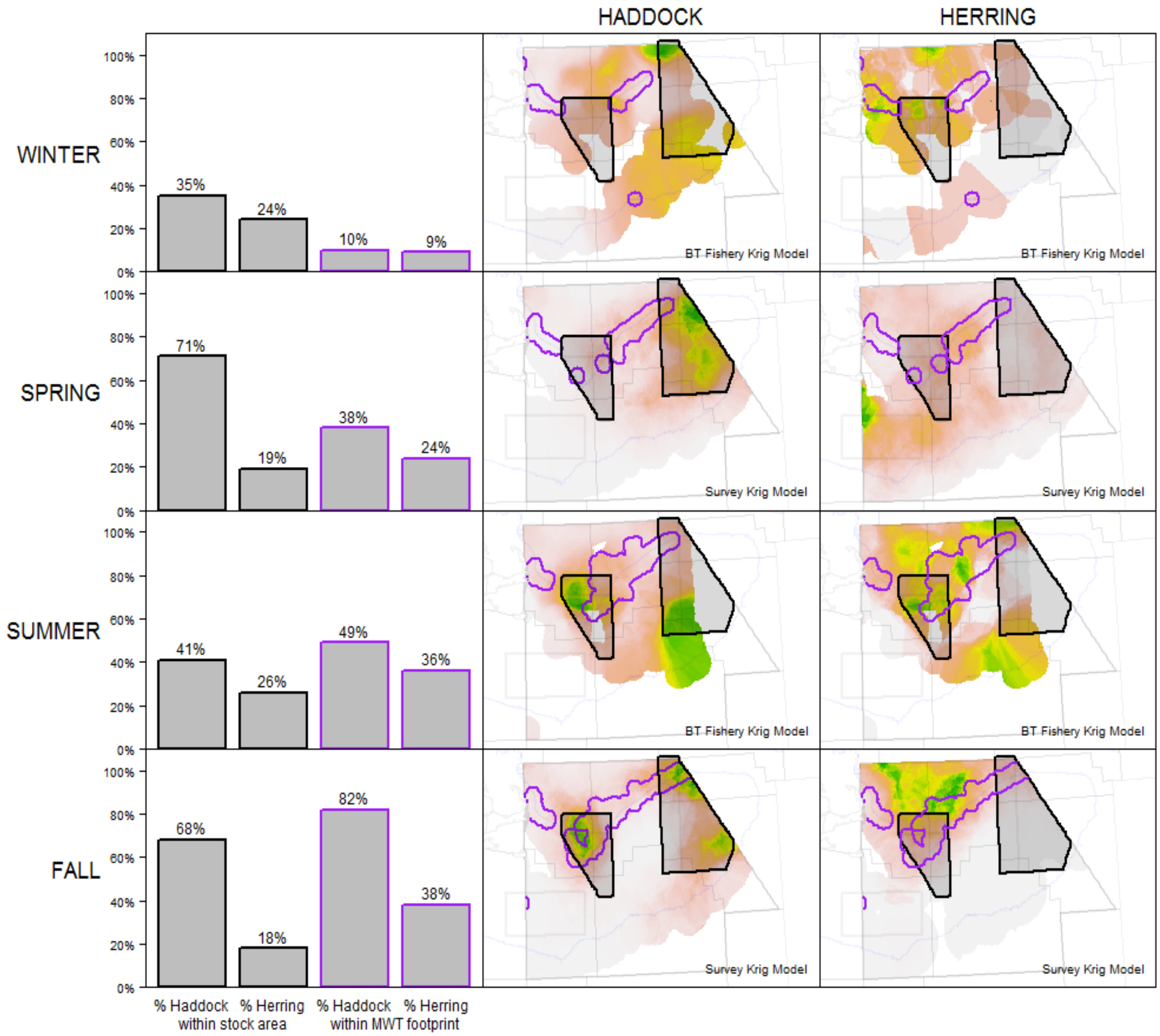


Figure 27 - Seasonal estimate of the proportion of haddock and herring abundance within CAI and II Extended compared to all of GB, as well as compared to the footprint of the MWT herring fishery (in purple)



The bar charts at left show the portion of the biomass of each species that are covered by the AM area, using data from the entire stock area (black outline) as well as just data from inside the MWT fishery footprint (purple outline)

4.2.1.2.2.1 Sub-option for proactive AM season

For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place: a) year-round proactive closure; b) May-October proactive closure; and c) June-August proactive closure.

The median haddock catch rate for herring MWT hauls within Closed Area I and II extended is higher in the months of July through October (panel 4 in Figure 26). A closure during these months would limit herring fishing in areas with lower expected haddock catch rates. However, bycatch rates do vary from year to year and these data are variable. Option A, a year-round closure of these proactive AM areas would provide the most benefit for GB haddock since these areas on average have higher bycatch rates than areas outside. Option B would allow herring fishing in the proactive AM areas in the winter months (Jan – April), and haddock abundance is lower in the GB closed areas during that season (35%) compared to other seasons (i.e. over 70% of GB haddock abundance is within the GF closed areas extended in the spring). Therefore, compared to Option A, Option B may have less positive impacts, but the differences are minor because haddock abundance within the closed areas extended is relatively low in the winter months. Option C, a proactive closure during the summer (June-August) likely has less positive impacts on haddock bycatch compared to Option B and C. About 40% of the estimated haddock abundance on GB is within the closed areas extended during that season, but most of it is expected to be concentrated on the southern flank of GB as well as north of Closed Area I, areas that would still be open to the herring fishery.

Overall, these proactive AMs have a better chance of reducing haddock catch compared to No Action if the closure is during times of the year when a relatively large proportion of haddock abundance is expected to overlap fishing areas, i.e. in the fall when over 80% of the estimated haddock abundance is within the proactive AM area.

4.2.2 Implementation of Georges Bank haddock accountability measures for the herring fishery

For this section, more than one alternative can be selected in some cases.

4.2.2.1 No Action (Alternative 1)

Under No Action, the AM is triggered in-season based on an extrapolation of observed catch to the entire fishery using the cumulative method.

4.2.2.2 Alternative 2 - Seasonal split of GB haddock sub-ACL (80%/20%)

Eighty percent of the haddock sub-ACL would be available to the herring fishery on May 1 and the remaining 20% would be added on November 1. If the herring fishery catches more than 80% before November 1, then the existing AM would close to direct midwater trawl herring fishing from that time through October 31. The remaining 20% would become available on November 1 to support a winter herring fishery. The Council clarified that this alternative would not be automatic percentages for splitting the sub-ACL; if adopted, the Council would have the ability to select the seasonal split of the haddock sub-ACL in each specification process. Impacts on haddock should be neutral to positive compared to No Action. If the herring MWT fishery catches 80% of the sub-ACL the reactive large AM closure will be implemented. Because the sub-ACL is split and the in-season AM would trigger at 80% rather than 100%, the reactive closure may happen earlier in the year, which could have beneficial impacts on haddock. In general haddock catch rates are low later in the season, so reserving 20% of the haddock for those months could reduce the overall haddock catch for the year.

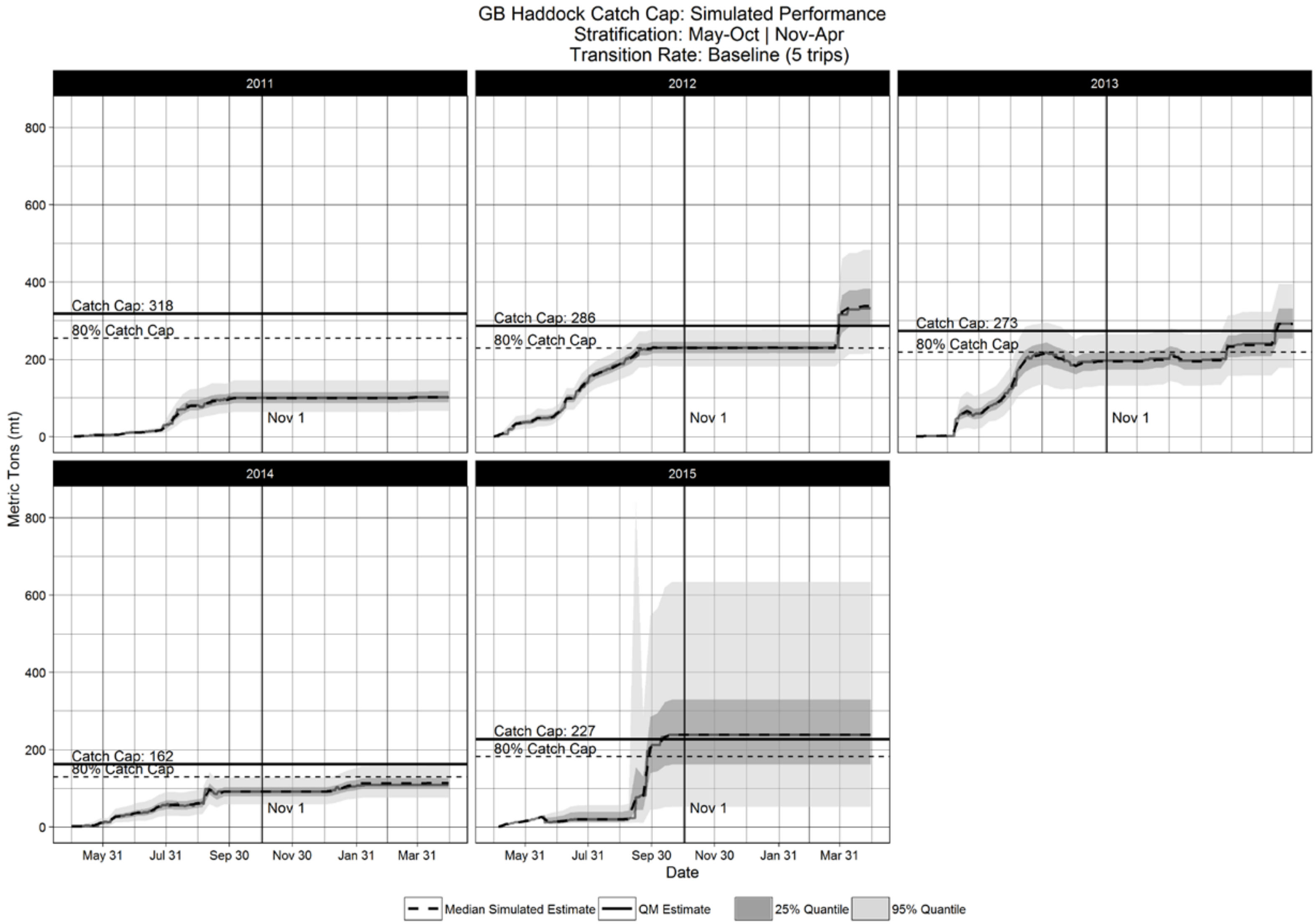
If haddock catch is high later in the year and the remaining 20% of the sub-ACL is harvested the reactive AM would be implemented again to help keep the herring fishery under the sub-ACL and reduce impacts on haddock. Therefore, overall the split could have neutral impacts compared to No Action if haddock catch remains to be higher later in the year. In general, at these relatively low total removal levels, 1% or 1.5% of the total GB haddock ACL, the timing or speed of removals is not expected to have a substantial impact on the overall haddock resource. At these large biomass values, the removals from the herring fishery are not substantial enough to cause direct negative impacts on the groundfish fishery.

Mackerel removal may be higher compared to No Action if this alternative better enables mackerel fishing to take place in the winter, but impacts on mackerel would not be higher than allocated specifications of mackerel.

Figure 28 was developed to illustrate whether an 80% allocation would have caused the GB haddock AMs to trigger using previous data from 2011-2015. If an 80% cap was available instead of 100%, then in both 2012 and 2013 AMs may have been triggered, compared to No Action, when 100% was available and AMs did not trigger. In 2012 the estimate was actually just below 80%, but with the confidence bar around the estimate it is possible that AMs could have been triggered. In 2015, the AM did trigger under an allocation of 100%, and under 80% it would have been triggered about a month sooner, late September rather than late October.

Providing some access in Area 3 in the winter could have positive impacts on river herring because bycatch rates are higher in Area 2. If Area 3 is closed to the herring fishery that could increase effort in Area 2, increasing impacts on river herring. But again, there is an overall TAC for Area 2 as well that would limit the magnitude of impact on river herring.

Figure 28 – Simulated performance of splitting the sub-ACL 80/20 using data from 2011-2015



4.2.2.2.1 Seasonal split of GB haddock sub-ACL for FY2017 and FY2018

If adopted, the seasonal split for the GB haddock sub-ACL for FY2017 and FY2018 shall be set at 80% for May 1, and the remaining 20% would be available on November 1, including any underage from the first season (May-October).

Specifying that the seasonal split be applied for FY2017 and 2018 is expected to have similar impacts to allowing this split in general, see above. If anything, the allocation of GB haddock is increasing in 2017 compared to 2015, so 80% of that value will be more than 100% of the 2016 allocation (Table 43). Therefore, more haddock would be available in May-October at 80% compared to years past at 100% because the haddock ACL is increasing. The GB haddock ACL is not set for 2018 yet; it is expected to increase again even higher than FY2017, but it will be reconsidered and is subject to the US Canada Resource Sharing Agreement. If this alternative is selected, the sub-ACL for the herring fishery would be split 80/20 for FY2018 as well. After that, the next herring specification package for FY2019-2021 will reconsider whether the GB Haddock sub-ACL should be split or not, or revert back to a full allocation at the start of the year in GF monitoring year in May.

Table 43 – Summary of GB haddock sub-ACL at 1% (No Action in Framework 56) for the herring fishery at 100% and 80%

Fishing Year	GB Haddock sub-ACL at 1% of total ABC (100%)	80% of 1% sub-ACL (May-October)	20% of 1% sub-ACL (November-April)
2015	227	182	45
2016	512.5	410	102.5
2017*	450 (801 for 1.5%)*	360 (640.8)*	90 (160.2)*

** Note the preferred alternative in GF FW56 is to increase the herring sub-ACL to 1.5%. Therefore, the sub-ACL would be 801mt, after changes are made related to US/Canada resource sharing agreement.*

4.2.2.3 Alternative 3 - Amend how estimated catch is calculated in the herring fishery – incorporate state portside data

This alternative would require that state portside data be incorporated in the monitoring of haddock catch in the midwater trawl herring fishery, if available.

- Need to wait until this work is available. In general there should not be direct impacts on bycatch from this measure. There could be indirect positive benefits if the estimates are more precise.

4.3 IMPACTS ON PHYSICAL ENVIRONMENT AND ESSENTIAL FISH HABITAT

Since 1996, the MSA has included a requirement to evaluate the potential adverse effects of the Atlantic herring fishery on Essential Fish Habitat (EFH) of Atlantic herring and other species. A general description of the physical environment and EFH is provided in Section 3.3 of this document. The EFH regulations specify that measures to minimize impacts should be enacted when adverse effects that are 'more than minimal' and 'not temporary in nature' are anticipated. The magnitude of adverse effects resulting from a fishery's operations is generally related to (1) the location of fishing effort, because habitat vulnerability is spatially heterogeneous, and (2) the amount of fishing effort, specifically the amount of seabed area swept or bottom time. To the extent that adoption of a particular management alternative would shift fishing to more vulnerable habitats, and/or increase seabed area swept, adoption would be expected to cause an increase in habitat impacts as compared to no action. If adoption of an alternative is expected to reduce seabed area swept or cause fishing effort to shift away from more vulnerable into less vulnerable habitats, a decrease in habitat impacts would be expected. The magnitude of an increase or decrease in adverse effects relates to the proportion of total fishing effort affected by a particular alternative.

Bearing in mind that both the direction and magnitude of changes are difficult to predict, because changes in fishing behavior in response to management actions can be difficult to predict, potential shifts in adverse effects are discussed for each of the alternatives proposed in this action. However, changes in the magnitude of fishing effort as a result of individual measures should be viewed in the context of the overall impacts that the herring fishery is estimated to have on seabed habitats. Specifically, previous analyses have concluded that adverse effect to EFH that result from operation of the herring fishery do not exceed the more than minimal or more than temporary thresholds.

An assessment of the potential effects of the directed Atlantic herring commercial fishery on EFH for Atlantic herring and other federally-managed species in the Northeast region of the U.S. was conducted as part of an EIS that evaluated impacts of the Atlantic herring fishery on EFH (NMFS 2005). This analysis was included in Appendix VI, Volume II of the FEIS for Amendment 1 to the Atlantic Herring FMP. It found that midwater trawls and purse seines do occasionally contact the seafloor and may adversely impact benthic habitats utilized by a number of federally-managed species, including EFH for Atlantic herring eggs. However, after reviewing all the available information, the conclusion was reached that if the quality of EFH is reduced as a result of this contact, the impacts are minimal and/or temporary and, pursuant to MSA, do not need to be minimized, i.e., that there was no need to take specific action at that time to minimize the adverse effects of the herring fishery on benthic EFH. This conclusion also applied to pelagic EFH for Atlantic herring larvae, juveniles, and adults, and to pelagic EFH for any other federally-managed species in the region.

The alternatives considered in this framework adjustment are intended to reduce the likelihood of the herring fishery catching the entire Georges Bank haddock sub-ACL. Once catches are projected to exceed the sub-ACL, the directed fishery closes in the Georges Bank haddock accountability measure area, which overlaps herring management areas 3 and 1B. In addition, pound for pound payback provisions apply in subsequent fishing years, even if the overall haddock ACL is not caught. The aim of these measures is to improve utilization of the Atlantic herring resource, and secondarily the Atlantic mackerel resource. Herring is an important bait species for the American lobster fishery and thus closures in the herring fishery indirect affect the lobster trap fishery. The potential habitat-related effects of each of the alternatives are discussed in the following subsections. Overall, given the minimal and temporary nature of adverse effects on EFH in the Atlantic herring fishery, the alternatives under consideration are expected to have a negligible impact on the physical environment and EFH.

4.3.1 Georges Bank haddock accountability measures for the herring fishery

4.3.1.1 No Action (Alternative 1)

Under No Action, when the GB haddock sub-ACL has been caught, all herring vessels fishing with midwater trawl gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the GB Haddock AM area for the remainder of the multispecies fishing year (April 30). This possession limit is much lower than the catches on typical directed midwater trawl trips in Area 3. There is also a pound for pound payback provision during the following year if the ACL is exceeded.

The Georges Bank haddock AM can be constraining on the Area 3 midwater trawl fishery. Area 3 and other herring quotas are fished on a January to December fishing year. In some fishing years, the fishery is unable to operate on Georges Bank prior to May 1 due to an overage of the ACL during the previous multispecies fishing year. Towards the end of the herring fishing year, if the Georges Bank haddock AM is triggered, much of Area 3, and all of the portions of Area 3 typically fished for herring, may be closed to the directed fishery. While effort could shift into other herring management areas if Area 3 closes to the directed fishery, this is dependent on the availability of herring in space and time, which varies somewhat between years. In addition, the other herring management areas must have quota remaining, and midwater trawls can only be fished in Area 1A (inshore GOM) between November 1 and December 31. On or shortly after this date, midwater trawl effort does tend to shift into Area 1A.

Thus, depending on a variety of factors, the patterns of effort in the fishery may shift spatially in response to the AM, or effort could generally be reduced. However, because the gear used in the fishery has been determined to have minimal and temporary impacts on habitat, there is no material effect on the fishery’s negligible impacts to EFH associated with these effort shifts or reductions.

4.3.1.2 Alternative 2 – Implement a proactive AM closure and maintain the current reactive AM closure

This alternative would add smaller, proactive AM closures to the existing AM area. There are two options, and each has three seasonal sub-options, as follows:

- Option 1 – Proactive closure of Closed Areas I and II
    - Sub-option A– Year-round
    - Sub-option B – May-October
    - Sub-option C – June-August

- Option 2 – Proactive closure of Closed Areas I and II, with 15 nm buffers north of CAI and west of CAII
    - Sub-option A – Year-round
    - Sub-option B – May-October
    - Sub-option C – June-August

Proactive closures in CAI and CAII (or expanded versions of these areas) will cause shifts in fishing effort within Area 3. As described in the section on impacts to non-targets species, haddock are caught at higher rates inside these two areas. Thus, these AMs should slow the attainment of the Georges Bank haddock sub-ACL, and allow harvest of more of the Area 3 quota.

For the existing closure boundaries, haddock catch rates (ratio of haddock catch to kept herring catch) are highest between July and October, so sub-option A may be unnecessarily restrictive and could have similar benefits to sub-option B in terms of reducing the likelihood of Area 3 closure. The shorter season proposed via sub-option C, June-August, could be less effective towards keeping catch below the sub-ACL.

Under Option 2, the expanded proactive closure areas have additional with overlap both the locations where haddock occur and the typical footprint of the herring fishery, particularly north of Closed Area I. Therefore, the Option 2 areas could further reduce the likelihood of attaining the sub-ACL. As for the existing CAI and CAII boundaries, haddock catch rates (haddock to kept herring) are higher July to October. Sub-option B would fully encompass this window, sub-option A would likely be unnecessarily lengthy, and sub-option C could miss higher bycatch times and areas.

As above, because the impacts of herring gears on habitat are minimal and temporary, while these proactive measures may benefit the fishery and help to achieve Area 3 quotas, this alternative and its associated options and sub-options are not likely to have a material effect on the fishery's overall negligible impacts to EFH.

4.3.2 Implementation of Georges Bank haddock accountability measures for the herring fishery

These alternatives, which could be adopted in combination, would adjust how the Georges Bank haddock AMs are implemented.

4.3.2.1 No Action (Alternative 1)

Under No Action, the AM is triggered in-season based on an extrapolation of observed catch to the entire fishery using the cumulative method. The accuracy and precision of these catch estimates therefore varies according to the rate of observer coverage in the midwater trawl fishery, which was over 40% during 2014 and below 10% during 2015. Overall, using observer data to estimate haddock bycatch and potentially trigger the AM area in-season could lead to possible shifts in effort as described in section 4.3.1.1. However, because the gear used in the fishery has been determined to have minimal and temporary impacts on habitat, there is no material effect on the fishery's negligible impacts to EFH.

4.3.2.2 Alternative 2 - Seasonal split of GB haddock sub-ACL (80%/20%)

This alternative would allow the ACL to be split, reserving some of the allocation for the fall/winter fishery. An 80% May/20% November split was suggested, but these percentages could be adjusted when setting herring specifications. In cases where the Georges Bank haddock sub-ACL proved limiting, an 80/20 or similar split could extend the Area 3 season into the fall and winter by leaving some haddock quota available until April 30, the conclusion of the Multispecies fishing year. This would likely benefit the fishery. Because the gear used in the fishery has been determined to have minimal and temporary impacts on habitat, this sort of a change is not expected to have a material effect on the fishery's negligible impacts to EFH.

4.3.2.2.1 Seasonal split of GB haddock sub-ACL for FY2017 and FY2018

This alternative would set an 80/20 split for fishing years 2017 and 2018. Again, while this would likely benefit the fishery in that it could ensure the availability of haddock sub-ACL for a winter herring fishery, fishery impacts to habitat are expected to be negligible, regardless of seasonal shifts in effort.

4.3.2.3 Alternative 3 - Amend how estimated catch is calculated in the herring fishery – incorporate state portside data

This alternative would require that state portside data be incorporated in the monitoring of haddock catch in the midwater trawl herring fishery, if available. If these data are available, they could indicate earlier, similarly timed, or later attainment of the Georges Bank haddock sub-ACL. It is difficult to estimate the effects of incorporating such data. As noted above, because the gear used in the fishery has been determined to have minimal and temporary impacts on habitat, this sort of a change is not expected to have a material effect on the fishery's negligible impacts to EFH.

4.4 IMAPCTS ON FISHERY-RELATED BUSINESSES AND COMMUNITIES

The analysis of impacts on fishery-related businesses and communities characterizes the magnitude and extent of the economic and social impacts likely to result from the alternatives considered For Framework 5 as compared to the no action alternatives. 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. Thus, continued overall access to fishery resources is a consideration, but not a guarantee that fishermen will be able to use a particular gear type, harvest a particular species of fish, fish in a particular area, or fish during a certain time of the year.

A fundamental difficulty exists in forecasting economic and social change relative to fishery management alternatives when communities or other societal groups are constantly evolving in response to numerous external factors, such as market conditions, technology, alternate uses of waterfront, and tourism. Certainly, management regulations influence the direction and magnitude of economic and social change, but attribution is difficult with the tools and data available. While this analysis focuses generally on the economic and social impacts of the proposed fishing regulations, external factors may also influence change, both positive and negative, in the affected communities. In many cases, these factors contribute to a community's vulnerability and ability to adapt to new or different fishing regulations.

When examining potential economic and social impacts of management measures, it is important to consider impacts on the following: the fishing fleet (vessels grouped by fishery, primary gear type, and/or size); vessel owners and employees (captains and crew); herring dealers and processors; final users of herring; community cooperatives; fishing industry associations; cultural components of the community; and fishing families. While some management measures may have a short-term negative impact on some communities, this should be weighed against potential long-term benefits to all communities which can be derived from a sustainable herring fishery.

The economic effects of regulations can be categorized into regulations that change costs (including transactions costs such as search, information, bargaining, and enforcement costs) or change revenues (by changing market prices or by changing the quantities supplied). These economic effects may be felt by the directly regulated entities. They may also be felt by related industries. For the herring fishery, this might include, for example, participants in the lobster fishery, zoos, and purchasers of herring for food.

The social impact factors outlined on the following page can be used to describe the Atlantic herring fishery, its sociocultural and community context and its participants. These factors or variables are considered relative to the management alternatives and used as a basis for comparison between alternatives. Use of these kinds of factors in social impact assessment is based on NMFS guidance (NMFS 2007) and other texts (e.g., Burdge 1998). Longitudinal data describing these social factors region-wide and in comparable terms is limited. While this analysis does not quantify the impacts of the management alternatives relative to the social impact factors, qualitative discussion of the potential changes to the factors characterizes the likely direction and magnitude of the impacts. The factors fit into five categories:

1. *Size and Demographic Characteristics* of the fishery-related workforce residing in the area; these determine demographic, income, and employment effects in relation to the workforce as a whole, by community and region.
2. The *Attitudes, Beliefs, and Values* of fishermen, fishery-related workers, other stakeholders and their communities; these are central to understanding the behavior of fishermen on the fishing grounds and in their communities.
3. The effects of the proposed action on *Social Structure and Organization*; that is, changes in the fishery's ability to provide necessary social support and services to families and communities.
4. The *Non-Economic Social Aspects* of the proposed action; these include lifestyle, health, and safety issues, and the non-consumptive and recreational uses of living marine resources and their habitats.
5. The *Historical Dependence on and Participation* in the fishery by fishermen and communities, reflected in the structure of fishing practices, income distribution, and rights (NMFS 2007).

Fishing Communities Impacted. The measures in Framework 5 are expected to primarily affect the communities that are homeports or landing ports used by herring vessels that fish in Areas 1B and 3.Gloucester, MA, has been the dominant community for Area 1B and 3 landings, recently averaging about 42% and 45% (Table 42). Other important ports include Portland and Rockland, ME, and New Bedford, MA.

4.4.1 Georges Bank haddock accountability measures for the herring fishery

4.4.1.1 Alternative 1 - No Action

No Action. When the Georges Bank haddock sub-ACL has been caught, all herring vessels fishing with midwater trawl (MWT) gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the GB Haddock AM area (Figure 2) for the remainder of the multispecies fishing year (April 30). If NMFS determines that total catch exceeded any ACL or sub-ACL for a fishing year, then the amount of the overage shall be subtracted from that ACL or sub-ACL for the fishing year following total catch determination.

The impacts of Alternative 1 on fishery-related businesses and communities (particularly those associated with MWT vessels) are likely to be ***negligible to low negative***. The status quo would be maintained: MWT vessels would continue to fish on Georges Bank and continue to risk near closure of the GB herring fishery if the GB haddock catch cap is reached. In years when the cap has not been reached, the current AM has not imposed direct costs on the fishery. However, fishing vessels may incur costs associated with trying to avoid haddock during all years, modifying normal fishing practices perhaps by fishing in less ideal places or less efficiently. This can have negative economic consequences by reducing herring catch rates, increasing costs, or both, though the magnitude is difficult to quantify. Alternative 1 is not expected to change the *Size and Demographic Characteristics* of the fishery-related workforce or the *Historical Dependence on and Participation in* the fishery, particularly if the AM is not triggered. The one time the AM was triggered (Fall 2015), total of the Area 3 sub-ACL was lower than normal in both FY2015 and FY2016, with associated negative economic impacts. The degree of negative impact would be impacted by the timing of when the AM is triggered, how much herring quota remains uncaught, and the degree of overage, which would reduce the following year's quota.

4.4.1.2 Alternative 2 – Implement a proactive AM closure and maintain the current reactive AM closure

Alternative 2 includes a series of options to implement a smaller closure proactively for MWT vessels that would overlap the areas and seasons with the highest expected bycatch rates of haddock in the herring midwater trawl fishery, based on historical observer and survey data. If the herring fishery is estimated to harvest the full sub-ACL (before, during, or after the smaller AM is implemented), the existing AM closure would be implemented to help reduce the likelihood of the herring fishery exceeding the annual sub-ACL of GB haddock, and to help prevent overfishing of the GB haddock resource.

Method to estimate economic impacts
To assess the potential economic impacts of proactive closures on the MWT fishery, the Herring PDT summarized monthly catches from 2007-2015 inside and outside of the alternative AM areas. This analysis is based on VTR-reported landings and fishing locations, prices constructed using dealer data, and the statistical model described by DePiper (2014). Because landings are constructed using VTR data, the reported figures differ slightly from the official quota monitoring statistics produced by GARFO.

In general, MWT vessels use Area 3 to catch Atlantic herring and mackerel during the spring and summer months (Figure 29). Area 3 is not particularly important in the late fall (November) and winter (December to February), but fishing does pick back up in the spring. Avoiding a summer closure due to high catch of haddock is likely to be important to the portion of industry that uses Area 3 during the winter.

During June-September, MWT vessels derive a very large fraction of their revenue from Area 3 (Figure 30). During those months, these vessels have little choice about where to fish with that gear type, due to the Area 1A MWT closure. During the rest of the year (October-May), there are more places for these vessels to fish (Areas 1A, 1B, and 2), and the share of landings from Area 3 is more variable year to year. For example, revenues shares in January-May are typically under 40%; however, in 2-3 years (out of the 9 years), revenues from Area 3 make up over 75% of monthly revenue for the MWT fleet.

General social impacts of area closures
Area closure alternatives can have numerous social impacts across various fisheries and communities. The most direct impacts of the alternatives here would be on the MWT vessels currently fishing in these areas that would no longer have access due to the new closures. The addition of new closures would force MWT fishing operations 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. Increased risk can result if fishermen spend longer periods at sea to access 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.

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 implementing proactive 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 protect GB haddock. The short-term impacts on markets, processing capability, and other infrastructure during the period of adjustment to the new closures may be such that shoreside resources may be impaired.

There is also 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.

Figure 29 – Total revenue from Area 3 estimated for MWT vessels by month and year

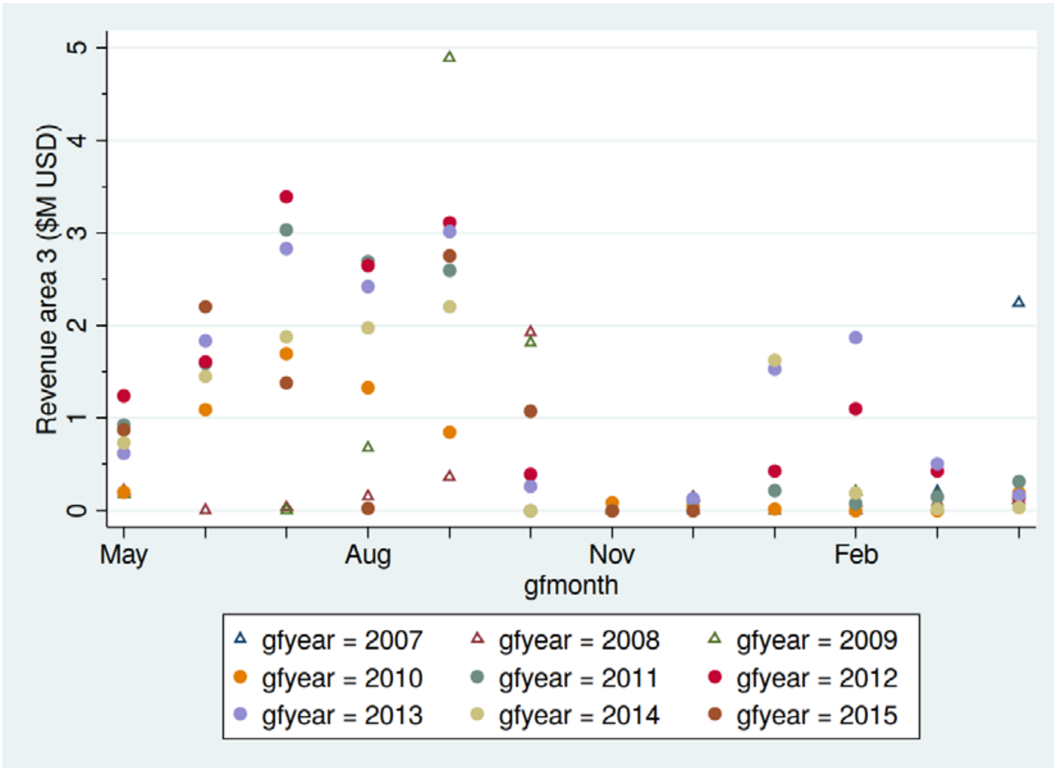
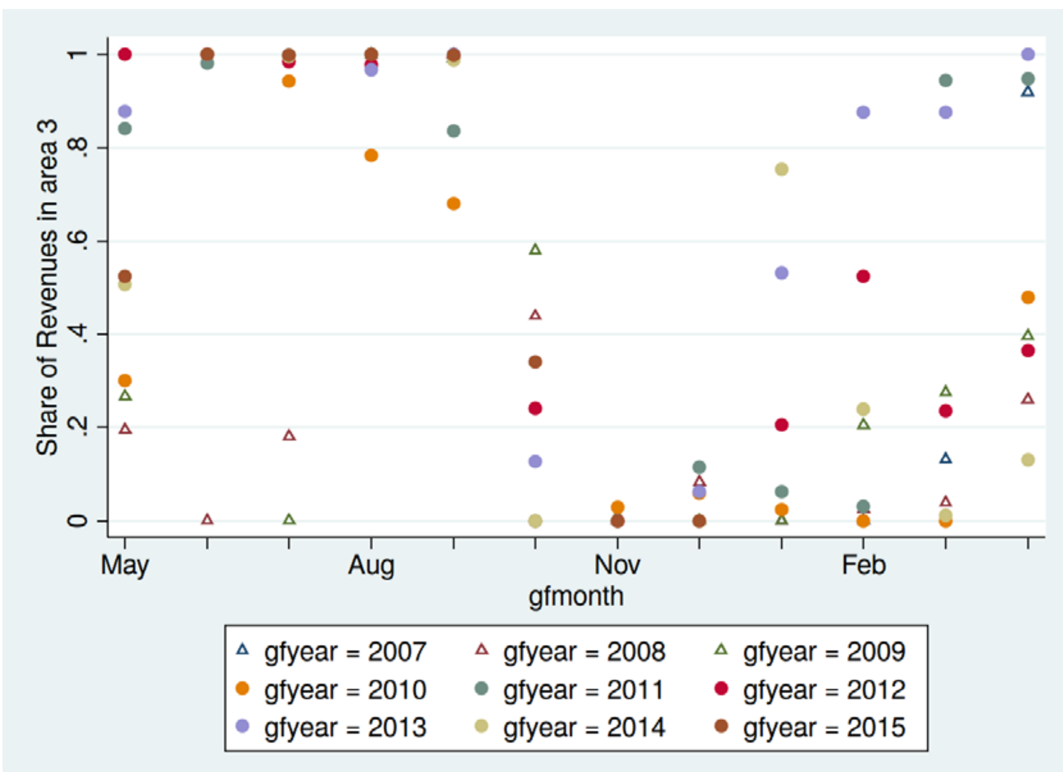


Figure 30 – Total revenue share from Area 3 for MWT vessels by month and year



4.4.1.2.1 Alternative 2, Option 1 – Proactive AM closure of GF mortality Closed Areas I and II

Under Option 1, the current GF closed areas I and II would be closed to the herring MWT fishery year-round or seasonally to minimize in-season bycatch and the likelihood of implementing the larger reactive in-season closure (Figure 2). If CA1 and CA2 are closed, MWT vessels will either fish outside these areas within Area 3, fish outside Area 3, or they will not fish at all.

Option 1 would have two impacts on the MWT herring fishery. First, there would be negative impacts by reducing the area available to fish. The magnitude of this impact is likely to vary based on ocean conditions. These impacts could be relatively large: for example in 2012, the share of MWT landings in CA1 and CA2 was 33% of total MWT landings during June-August. On the other hand, these impacts could be relatively small: in 2013, the share of MWT landings was just 3% of total MWT landings during June-August. The second impact is that these proactive closures would likely lower the catch of haddock and therefore avoid triggering the GB haddock AM area closure (that occurred in 2015). Avoidance of this larger closure would lead to (potentially) large increases in revenue, relative to the current reactive AM closure. The effectiveness of the proactive closures depends on whether the remaining areas are low haddock catch areas. That is, if herring vessels encounter haddock at the same (or higher) rate outside of the proactive closure areas, then these measures will be ineffective (or counterproductive) at reducing the probability that the Georges Bank herring fishery will be closed due to haddock bycatch.

<u>Sub-Options for closure timing</u>

For this proactive AM closure, there are three sub-options for the length of time the proactive measures would be in place: a) year-round; b) May-October; and c) June-August. The MWT fishery typically uses the proposed closure areas (CA1, CA2, CA1plus, and CA2plus) during the summer and fall; there is minimal use of these areas during the winter and spring. Therefore, the directly impacted fishing vessels and trips are very similar under sub-Options 1 and 2.

Sub-Option A – Year Round

Sub-Option A (year-round closure of CA1 and CA2) is expected to have *negative* impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be *neutral* relative to sub-Option B and *low negative* relative to sub-Option C. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic Social* impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the year-round proactive AM closures, particularly to Area 2 during the late fall and early winter; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 44) from these areas (i.e., estimates of associated revenues that could be impacted by year-round closures) ranges from 2% in 2015 to 20% in 2012 and 2009 (Table 47 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

Sub-Option B – May-October
Sub-Option B (May-October closure of CA1 and CA2) is expected to have ***negative*** impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be ***neutral*** relative to sub-Option A and ***low negative*** relative to sub-Option C. The directly impacted MWT trips are likely to be quite similar to the impacted trips in sub-Option A. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic Social* impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the seasonal proactive AM closure, particularly to Area 2; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 45) from these areas (i.e., estimates of associated revenues that could be impacted by seasonal closure) ranges from 4% in 2015 to 37% in 2009 (Table 48 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

Sub-Option C – June-August
Sub-Option C (June-August closure of CA1 and CA2) is expected to have ***negative*** impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be ***low positive*** relative to sub-Options A and B. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic Social* impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the seasonal proactive AM closure, particularly to Area 2; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 46) from these areas (i.e., estimates of associated revenues that could be impacted by seasonal closure) ranges from 3% in 2015 to 33% in 2012 (Table 49 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

4.4.1.2.2 Alternative 2, Option 2 – Proactive AM closure of GF mortality Closed Areas I and II with 15 nm buffer north of Closed Area 1 and west of Closed Area II

Under Option 2, current GF closed areas I and II, including extended areas to the north of Closed Area I and west of Closed Area II (i.e., "CA1-plus" and "CA2-plus") would be closed year-round or seasonally to the herring MWT fishery to minimize bycatch in-season and minimize the likelihood of implementing the larger reactive in-season closure (Figure 2). If CA1-plus and CA2-plus are closed, MWT vessels will either fish outside these areas (within Area 3), fish outside Area 3, or they will not fish at all.

The impacts of Option 2 are expected to be ***negative*** and ***negative*** relative to Option 1. Option 2 would increase regulatory complexity associated with adding a spatial closure, potentially resulting in negative impacts on the *Attitudes, Beliefs, and Values* of stakeholders and their communities towards management. The boundaries of CAI and CA2 are well known.

Modifications to these areas for the purposes of reducing haddock catch will increase regulatory complexity; vessels and enforcement agencies are not used to these boundaries, so adjustments will need to be made to ensure compliance, etc.

<u>Sub-Options for closure timing</u>
For this proactive AM closure, three sub-options have been developed for the length of time the proactive measures would be in place: a) year-round; b) May-October; and c) June-August.

Sub-Option A – Year Round
Sub-Option A (year-round proactive closures of CA1plus and CA2plus) is expected to have ***negative*** impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be ***neutral*** relative to sub-Option B and ***low negative*** relative to sub-Option C. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic Social* impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the year-round proactive AM closures, particularly to Area 2 during the late fall and early winter; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 44) from these areas (i.e., estimates of associated revenues that could be impacted by year-round closures) ranges from 11% in 2010 to 29% in 2009 (Table 47 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

Sub-Option B – May-October
Sub-Option B (May-October closure of CA1plus and CA2plus) is expected to have ***negative*** impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be ***neutral*** relative to sub-Option A and ***low negative*** relative to sub-Option C. The directly impacted MWT trips are likely to be quite similar to the impacted trips in sub-Option A. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic Social* impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the seasonal proactive AM closure, particularly to Area 2; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 45) from these areas (i.e., estimates of associated revenues that could be impacted by seasonal closure) ranges from 19% in 2014 to 55% in 2009 (Table 48 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

Sub-Option C – June-August
Sub-Option C (June-August closure of CA1plus and CA2plus) is expected to have ***negative*** impacts on the midwater trawl fishery, but impacts would be variable from year to year. Impacts are expected to be ***low positive*** relative to sub-Options A and B. Heavier use of the open portion of Area 3 is expected, which may cause crowding on fishing grounds, leading to *Non-Economic*

Social impacts such as gear conflict and compromised safety. If the midwater trawl fleet moves to other herring management areas as a result of the seasonal proactive AM closure, particularly to Area 2; this may increase gear conflict and concerns about harder fishing pressure in nearshore areas. The percent of recent herring landings (Table 46) from these areas (i.e., estimates of associated revenues that could be impacted by seasonal closure) ranges from 4% in 2008 to 43% in 2012 (Table 49 summarizes the percentage of mackerel landings). However, if the proactive closures help prevent the larger reactive AMs from triggering, then some of these potentially negative impacts could be countered by the positive impacts associated with avoiding triggering the larger reactive AM that closes GB entirely for the remainder of the year.

Table 44 – All herring landings, MWT herring landings, and share of MWT herring landings from the CA1 and CA2 areas in January-December (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008	80,406	51,592	4,806	9%	6,469	13%
2009	96,750	70,452	13,832	20%	20,206	29%
2010	64,098	51,941	2,735	5%	5,894	11%
2011	79,549	58,669	2,568	4%	10,146	17%
2012	85,497	61,859	12,170	20%	16,650	27%
2013	93,665	62,039	3,596	6%	13,247	21%
2014	90,000	56,918	4,083	7%	6,512	11%
2015	77,582	51,281	1,234	2%	9,288	18%

Table 45 – All herring landings, MWT herring landings, and share of MWT herring landings from the CA1 and CA2 areas in May-October (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008	47,668	20,859	4,692	22%	6,207	30%
2009	58,486	37,012	13,820	37%	20,173	55%
2010	34,690	26,348	2,727	10%	5,816	22%
2011	65,862	49,002	2,557	5%	10,052	21%
2012	60,155	40,606	12,151	30%	16,551	41%
2013	61,417	38,082	3,550	9%	12,973	34%
2014	60,175	33,240	4,043	12%	6,150	19%
2015	56,369	33,297	1,217	4%	9,156	27%

Table 46 – All herring landings, MWT herring landings, and share of MWT herring landings from the CA1 and CA2 areas in June-August (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008	27,811	2,367			96	4%
2009	21,920	3,079	351	11%	864	28%
2010	15,604	12,480	2,133	17%	4,477	36%
2011	33,981	23,183	1,169	5%	4,564	20%
2012	37,785	23,218	7,554	33%	9,892	43%
2013	39,555	20,917	665	3%	4,583	22%
2014	31,444	16,456	525	3%	1,934	12%
2015	32,267	11,941	340	3%	2,349	20%

Table 47 – All mackerel landings, MWT mackerel landings, and share of MWT mackerel landings from the CA1 and CA2 areas in January-December (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008	20,734	20,734		0%		0%
2009	19,275	19,275		0%		0%
2010	9,037	9,037		0%		0%
2011	484	484		0%		1%
2012	5,005	5,005		0%		0%
2013	3,941	3,941	31	1%	399	10%
2014	5,922	5,922		0%	164	3%
2015	5,615	5,615		0%		0%

Table 48 – All mackerel landings, MWT mackerel landings, and share of MWT mackerel landings from the CA1 and CA2 areas in May-October (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008	33	33		0%		0%
2009	67	67		0%		5%
2010	148	148		0%		0%
2011	39	39		0%		5%
2012	76	76		0%		8%
2013	112	112		1%		6%
2014	414	414		0%		1%
2015	462	462		0%		1%

Table 49 – All mackerel landings, MWT mackerel landings, and share of MWT mackerel landings from the CA1 and CA2 areas in June-August (landings in mt).

Year	All Areas		CA1 and CA2		CA1plus & CA2plus	
	All landings	MWT landings	All landings	MWT Share	All landings	MWT Share
2008				0%		0%
2009	17	17		0%		4%
2010	45	45		0%		0%
2011	13	13		0%		0%
2012				0%		1%
2013	66	66		2%		8%
2014	51	51		0%		1%
2015	184	184		0%		1%

4.4.2 Implementation of Georges Bank haddock accountability measures for the herring fishery

4.4.2.1 Alternative 1 - No Action

Under No Action, the AM is triggered in-season based on an extrapolation of observed catch to the entire fishery using the cumulative method. If there is an overage of the GB haddock sub-ACL in year one, herring MWT fishing may be further restricted in year 2 to account for the overage.

The impacts of Alternative 1 on fishery-related businesses and communities (particularly those associated with MWT vessels) are expected to be ***negligible to low negative,*** depending on if harvest levels are reduced as a result of lower haddock sub-ACL. In some cases, however, a reduction in haddock sub-ACL does not impact the fishery, because the herring fishery catch of haddock is below the sub-ACL, even if it is further reduced from an overage from previous years. In most years when AMs or payback provisions are not triggered, the Area 3 sub-ACL is not fully harvested; therefore, direct impacts from a potential payback in year 2 are likely very minimal.

4.4.2.2 Alternative 2 - Seasonal split of GB haddock sub-ACL (80%/20%)

Under Alternative 2, 80% of the GB haddock sub-ACL would be available to the herring fishery on May 1 and the remaining 20% would be added on November 1. If the herring fishery catches more than 80% before November 1, then the existing AM would trigger, closing the AM area to directed MWT herring fishing from that time through October 31. The remaining 20% would become available on November 1 to support a winter herring fishery. The Council clarified that this alternative would not be automatic percentages for splitting the sub-ACL; if adopted, the Council would have the ability to select the seasonal split of the haddock sub-ACL in each specification process. A sub option was included that considers splitting the sub-ACL for FY2017 and FY2018 (Section 4.4.2.2.1).

The impacts of Alternative 2 on fishery-related businesses and communities are expected to be neutral and neutral relative to Alternative 1. Alternative 2 is considered administrative, since enabling a seasonal split to be specified in not expected to directly impact fishery-related businesses and communities, because it would not, in and of itself affect fishing behavior. Should a split be specified under a sub-option in this action, or in a future action, Alternative 2 may increase the ability for the fishery to harvest the full TAC by reserving some haddock sub-ACL for later in the season, to enable a winter herring/mackerel fishery. Those potential positive impacts may not be shared by all participants in the fishery. Some integrated (or partially integrated) firms have the ability to store herring after it is landed and supply it at the appropriate time. Other firms do not have this ability or may not prefer to fish for herring and mackerel in the winter.

There may be negative economic impacts as well. If the GB AM is triggered earlier in the year under Alternative 2, because the haddock sub-ACL is reduced from 100% to something lower (e.g., 80%), there is a higher likelihood of triggering the AM earlier in the season is higher. This would have negative economic impacts on the MWT fishery. The proportion of MWT effort in Area 3 is highest in August and September (Figure 30), suggesting that access to Area 3 is most critical for this gear type during those months. There is a high demand for lobster bait during those months, and the MWT fishery is prohibited from fishing in Area 1A then. Therefore, the areas for MWT vessels to harvest herring during the season lobster bait is most critical is limited. Trawl vessels are not permitted to fish in Area 1A until November, so these vessels would have limited options for fishing areas if the larger AM is triggered before Area 1A is open to MWT vessels. Some MWT vessels fish in Area 2 in the winter, but some do not.

4.4.2.2.1 Seasonal split of GB haddock sub-ACL for FY2017 and FY2018

If adopted, the seasonal split for the GB haddock sub-ACL for FY2017 and FY2018 shall be set at 80% for May 1, and the remaining 20% would be available on November 1, including any underage from the first season (May-October). This would be the split for these two fishing years, and future specifications would consider whether a split would be used in the future. For FY2017, the split is expected to be would be 640.8 mt (if the GB haddock sub-ACL increases to 1.5% in Groundfish Framework 56). For FY2018, the specific value would be determined next year through the groundfish specifications process, but they are expected to be even higher than in 2017 (NEFMC 2017). No additional impacts beyond what was assessed in Section 4.1.2.2 are expected.

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APPENDIX I

Spatial distribution models of Georges Bank herring and haddock for the evaluation of haddock bycatch closure areas

Micah Dean – September 27, 2016

Introduction

Under current rules, once the midwater trawl (MWT) fishery exhausts their bycatch cap for Georges Bank (GB) haddock, nearly all of the GB haddock stock area closes to MWT for the remainder of the fishing year. A goal of Framework 5 (FW5) is to seek a modified accountability measure (AM) for the GB haddock bycatch cap that provides greater access to the MWT fishery, while at the same time achieving low levels haddock bycatch. Due to the relatively narrow footprint of previous MWT fishing effort on GB, we are limited in our ability to make recommendations for AM alternatives based solely on observations of MWT bycatch rates (NEFOP data). The goal of this analysis is to construct a spatial model of the distribution of GB haddock and herring using auxiliary datasets (NEFSC bottom trawl surveys, and NEFOP bottom trawl data), and to evaluate the model's ability to predict MWT bycatch rates. These distribution models are then used to examine the impact of AM alternatives on expected herring catch and haddock bycatch.

Methods

There are several attributes of the survey and observer datasets that need to be addressed before a geostatistics approach (i.e., "Kriging") can be used to generate a continuous spatial model of haddock or herring abundance. First, the distribution of CPUE values is heavily skewed and includes a high proportion of zeros (Figure 1). It is often difficult to discern the spatial relationship among tows from raw data such as these; therefore, a spatial equivalent of a delta-lognormal model (i.e., a "hurdle" model for continuous data) was constructed: The probability of occurrence was modeled separately from the log of the positive values (Figure 2); the two interpolated surfaces are later combined to provide a continuous estimate of CPUE across the entire stock area, which is assumed to be a proxy for population abundance (Figure 3).

In addition, Ordinary Kriging assumes a "stationary process," meaning that the expected mean and variance are stable throughout the dataset. This assumption can be violated when pooling several years of data together to achieve a general seasonal pattern (i.e., the values in a "high" abundance year can overwhelm those of a "low" year). Therefore, a generalized linear model (log(CPUE) ~ YEAR) was used to remove these year effects from the positive values, so that all spatial modeling was conducted on the residuals (Figure 4).

This analysis was restricted to the years after groundfish amendment 16 (“sectors”) went into place (2010-2015), as the regulations prior to that time might have resulted in different spatial patterns in observed bottom trawl CPUE. While the focus of the analysis is Georges Bank, data were assembled for a broader region so that the information contained in adjacent areas could be used in the Kriging process and to increase the sample size for model validations. For the NEFOP bottom trawl data, only trips on vessels using NEGEAR code 050 (‘regular’ bottom trawl) with mesh size between 5” and 7” were used, in an attempt to standardize effort units as much as possible. Tow coordinates were transformed to the Massachusetts State Plane Mainland projection so that distance units (meters) permitted interpolation. Areas beyond 20 km from observed tows were omitted from Kriging prediction.

For each dataset, the calendar year was split into four seasons: Winter (Dec-Feb); Spring (Mar-May); Summer (June-Aug); and Fall (Sep-Nov) (Table 1). Empirical variograms for both the occurrence and lognormal models were constructed for each season and then averaged across seasons. Several candidate models were fit to these average empirical variograms, and the model with the lowest residual sum of squared deviations was selected as the best model and used for spatial interpolation (Figures 5 and 6). The *gstat* package in R was used to fit variogram models and make Kriging predictions. A 1-km resolution reference grid was established for the limits of the GB Haddock Stock Area and used as a template to ensure conformity of predicted raster layers. The log(CPUE) predictions for positive values were back-transformed to native CPUE units, using the prediction variance to correct for the transformation bias: E(CPUE) = exp(E(logCPUE)+var(logCPUE)/2) (Robinson and Metternicht, 2006). These back-transformed positive CPUE predictions were multiplied by the predicted occurrence to achieve the final distribution model.

The predictive ability of the Kriged distribution models were evaluated in two separate ways: First, a leave-one-out cross-validation routine was used to determine how well each model could predict its source data set. This informs the consistency of the spatial process, or how similar the haddock or herring distributions are from one year to the next. Secondly, the Kriged distribution models were compared against observed CPUE of herring and haddock at NEFOP MWT haul locations. This informs how reliable the survey model is at predicting MWT catch rates.

A series of potential AM alternatives were evaluated using the resulting distribution models for herring and haddock. Due to the greater spatial coverage, gear consistency and similarity in mesh size (to the MWT fishery), the NEFSC survey dataset was given priority over the NEFOP bottom trawl dataset in the spring and fall, when survey data were available. NEFOP BT data were used in winter and summer, when survey data were unavailable. For each AM alternative, the relative haddock protection was calculated as the proportion of the modeled biomass within the GB haddock stock area covered by the AM area. The same process was followed to determine the proportion of the herring resource available to the MWT fishery.

The distribution models indicate that substantial herring biomass exists well outside the current footprint of the MWT fishery. This suggests that another factor, such as depth, gear conflicts, or mesh selectivity, effectively prevents the MWT fishery from accessing these herring; If this is the case, the “herring availability” metric based on the entire stock area may be an overestimate. As such, herring availability and haddock protection were also evaluated by calculating the proportion of the modeling biomass covered by an AM area within the footprint of the MWT fishery.

Results and Discussion

The Kriged distribution models were able to predict their source datasets reasonably well, under a leave-one-out cross validation exercise. The correlation coefficient between observed and predicted occurrence and log(CPUE) values was 0.6 or greater for haddock in both datasets (Figure 7). The correlation for herring was less in most cases, particularly for the NEFOP bottom trawl dataset, which has positive herring observations in <10% of hauls. However, the occurrence of herring in the NEFSC survey data was the most reliable measure of all, with a correlation between observed and predicted values of 0.73.

As expected, the Kriged distribution models had a lower correlation with the observed CPUE in the MWT fishery than with their own source datasets (Figure 8). Nonetheless, there were significant correlations between MWT observations and both haddock models. This indicates that the distribution models could be used to predict the bycatch rate of haddock outside the current footprint of the MWT fishery; however, the relatively low correlation here (Pearson's R = 0.15 to 0.35) suggests a noisy relationship. There was effectively no correlation between the distribution models and the observed MWT CPUE for herring. Several factors probably contribute to this result: First, herring are the target species of this fishery and there are very few zero or low observations; therefore, even if the distribution model predicts herring to be less abundant in a given area, the MWT fishery is effective at finding those fish and achieving a consistent catch rate (i.e., search time is not accounted for in the effort standardization); Second, the relatively narrow footprint of the fishery on Georges Bank provides a narrow range of values from the distribution models to compare against. Both of these factors limit the amount of contrast in the observed and predicted values, yielding a low signal-to-noise ratio and making a high correlation difficult to achieve.

Distinct seasonal patterns are evident from the distribution model based on NEFSC survey data (Figures 9 and 10). In the spring, haddock are distributed over a large portion of Georges Bank, with a peak in concentration inside CA2. In the fall, haddock are most abundant in CA1 and CA2, as well as the areas immediately adjacent to the closed areas. Herring also appear to be more widely distributed in the spring, with a concentration in the southwest corner of the stock area. In fall, herring are more abundant north of Georges Bank, with essentially none available on top of the bank.

The distribution model based on the NEFOP bottom trawl data shows similar patterns to the NEFSC dataset, where the two datasets overlap (i.e., spring and fall)(Figures 11 and 12); unfortunately, there are significant gaps in the spatial coverage of this model, owing the prohibition of bottom trawling inside of the closed areas. These areas are clearly very important for haddock distribution and interpretation of this model should recognize this shortcoming. Nonetheless, the NEFOP BT model is the only dataset available for the summer and winter seasons. The winter pattern for both herring and haddock appear similar to that of spring, with a wide distribution across the bank and to the north. In the summer, haddock appear to be concentrated in the vicinity of CA1 and CA2, but more widespread than in the fall. The summer distribution of herring is scattered along the northern edge and to a lesser extent, southern edge of Georges Bank.

When the current haddock bycatch AM area is compared against the Kriged distribution models, it is apparent that the measure is very effective at protecting haddock; it also prevents access to nearly all of the herring on Georges Bank (Figure 13). Most of the MWT herring fishing on Georges Bank occurs in statistical areas 522 and 521, both of which are included in the current AM area. If area 522 were removed from the AM area, 76%-84% of the haddock and 41%-70% of the herring would be covered, depending on the season (Figure 14). If area 521 were also removed, the coverage levels would drop to 54%-80% for haddock and 4%-41% for herring (Figure 15). While such an alternative might seem preferable to the *status quo*, it is important to note that most of the modeled biomass of haddock and herring occurs in areas outside the current footprint of the MWT fishery and would therefore have little impact on catch rates if enacted. For this reason, the level of haddock protection and herring availability was also calculated within the limits of the MWT footprint. With stat areas 521 and 522 removed from the current AM area, 5%-26% of the haddock and 3%-5% of the herring *inside the MWT footprint* would be covered. Another important caveat is that because the closed areas are poorly represented in the NEFOP BT dataset, the level of haddock protection in Summer and Winter is likely an underestimate.

Due to the importance of closed areas to the GB haddock stock, two AM alternatives centered on CA1 and CA2 were also evaluated. Using just the closed areas as the AM alternative, 19%-54% of the haddock biomass and 6%-14% of the herring biomass would be covered (0-43% haddock and 0-19% herring within the MWT footprint)(Figure 16). If the AM boundaries were extended 15 nautical miles north of CA1 and 15 nautical miles west of CA2, the coverage levels increase to 35%-70% for haddock and 18%-26% for herring (10%-82% haddock and 9%-38% herring within the MWT footprint)(Figure 17). Of the alternatives evaluated, this last option maximizes the difference between coverage levels of haddock and herring, and therefore appears to provide the best compromise between haddock protection and herring availability.

References

Robinson, T. P., and Mitternicht, G. 2006. Testing the performance of spatial interpolation techniques for mapping soil properties. Computers and Electronics in Agriculture. 50: 97-108.

Table 1. Total number of observed hauls for the Georges Bank haddock stock area, from the NEFOP midwater trawl dataset, NEFOP bottom trawl dataset, and the NEFSC survey dataset.

MWT Observed Hauls

	WINTER			SPRING			SUMMER			FALL			
YEAR	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
2010	2	0	0	16	7	9	20	39	93	55	0	0	241
2011	0	0	1	0	2	23	16	16	44	51	2	0	155
2012	0	11	3	7	0	52	30	115	61	59	30	0	368
2013	1	8	10	21	0	19	34	50	26	65	10	0	244
2014	0	22	29	7	4	15	15	5	26	40	0	0	163
2015	0	3	0	0	0	0	4	0	0	18	0	0	25
Total	3	44	43	51	13	118	119	225	250	288	42	0	1196

BT Observed Hauls

YEAR	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
2010	91	421	430	303	843	247	291	127	204	80	139	78	3254
2011	285	111	118	136	239	379	464	62	37	198	184	207	2420
2012	280	205	268	189	85	83	40	66	64	24	105	43	1452
2013	101	29	9	5	190	105	139	119	169	34	173	134	1207
2014	161	43	93	83	149	219	206	30	1	93	0	92	1170
2015	90	83	103	115	121	215	16	172	317	57	156	121	1566
Total	1008	892	1021	831	1627	1248	1156	576	792	486	757	675	11069

NEFSC Survey Hauls

YEAR	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
2010	0	0	0	0	75	12	0	0	0	0	60	26	173
2011	0	0	0	15	71	4	0	0	0	0	73	17	180
2012	0	0	0	4	93	0	0	0	0	2	87	0	186
2013	0	0	0	0	89	7	0	0	0	18	58	15	187
2014	0	0	0	0	27	56	0	0	0	0	133	9	225
2015	0	0	0	0	88	0	0	0	0	24	64	0	176
Total	0	0	0	19	443	79	0	0	0	44	475	67	1127

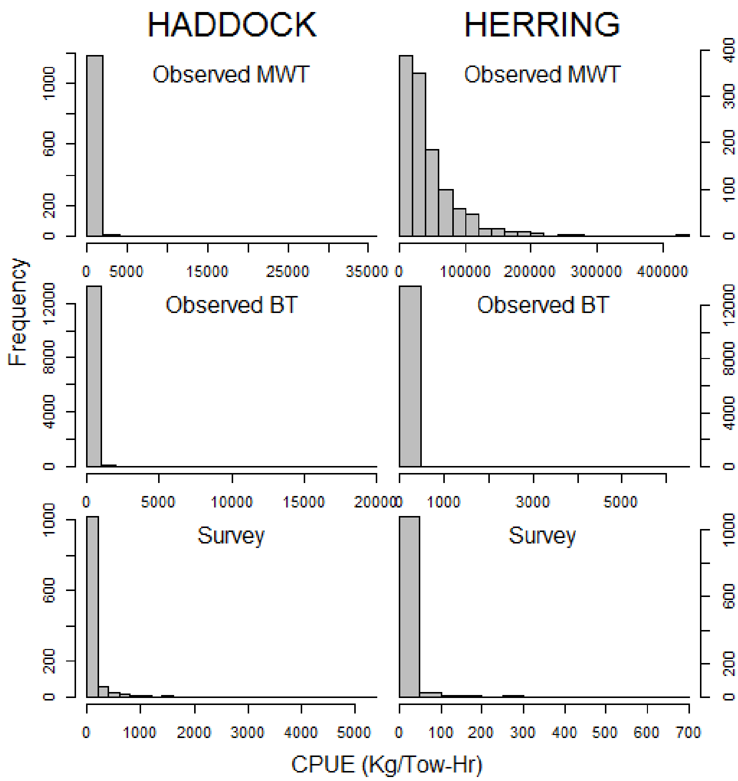

Figure 1. Raw CPUE on Georges Bank from the NEFOP midwater trawl dataset (top row), NEFOP bottom trawl dataset (middle row), and the NEFSC survey dataset(bottom row).

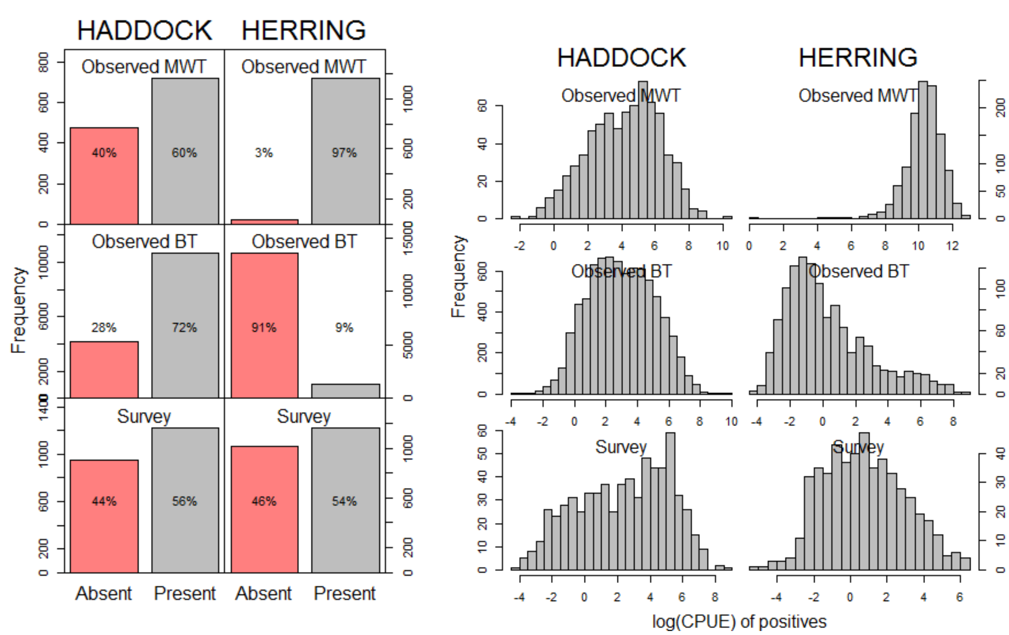

Figure 2. Separation of each dataset into occurrence (at left) and logged CPUE when present (at right).

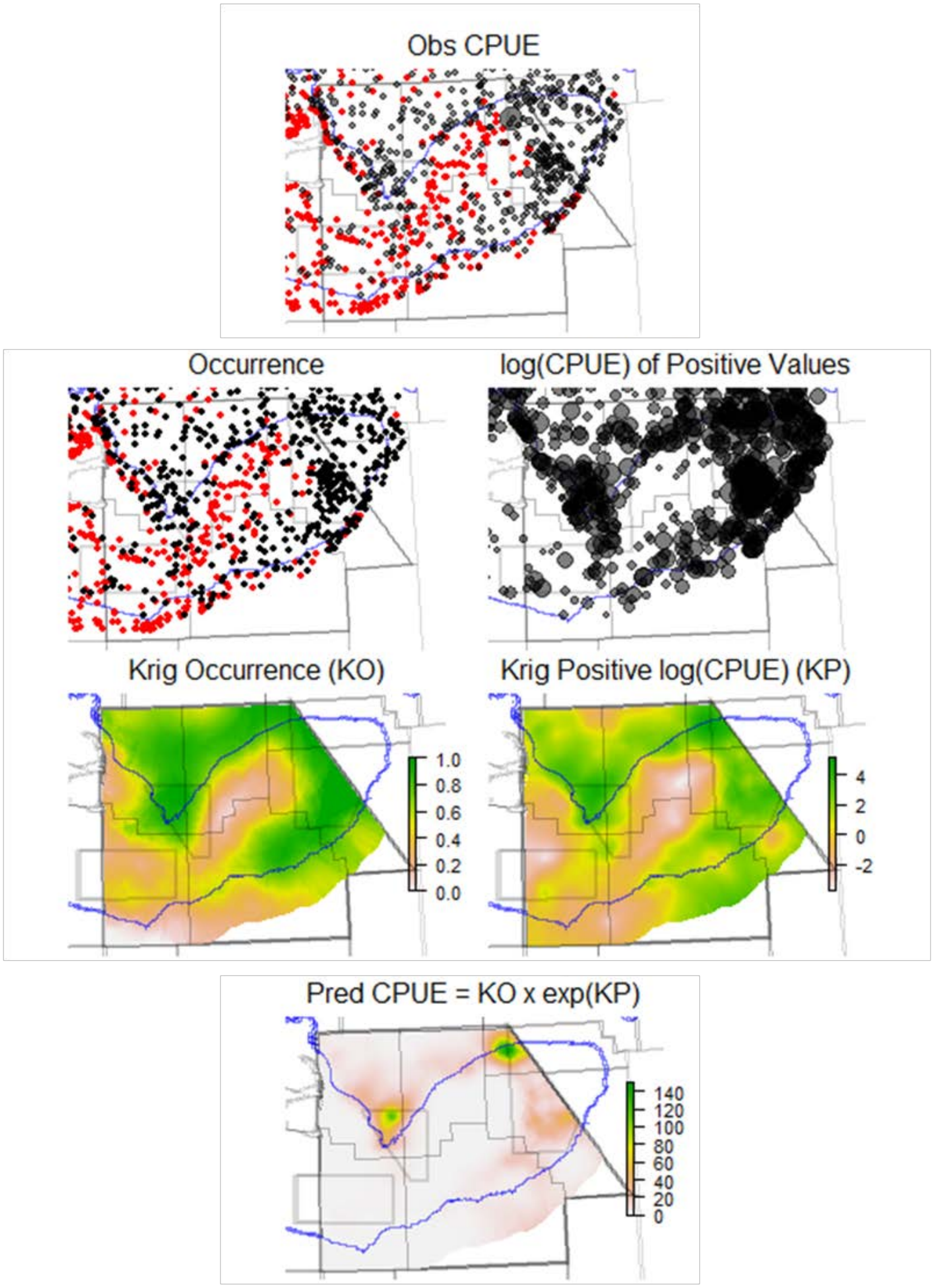

Figure 3. Diagram of the steps involved in the delta-lognormal Kriging process. Starting at the top, observed CPUE values are separated into occurrence (i.e., presence-absence) and log(CPUE) of positive values. A spatial model is developed for each component dataset, and then combined in the end to create the continuous surface of predicted CPUE.

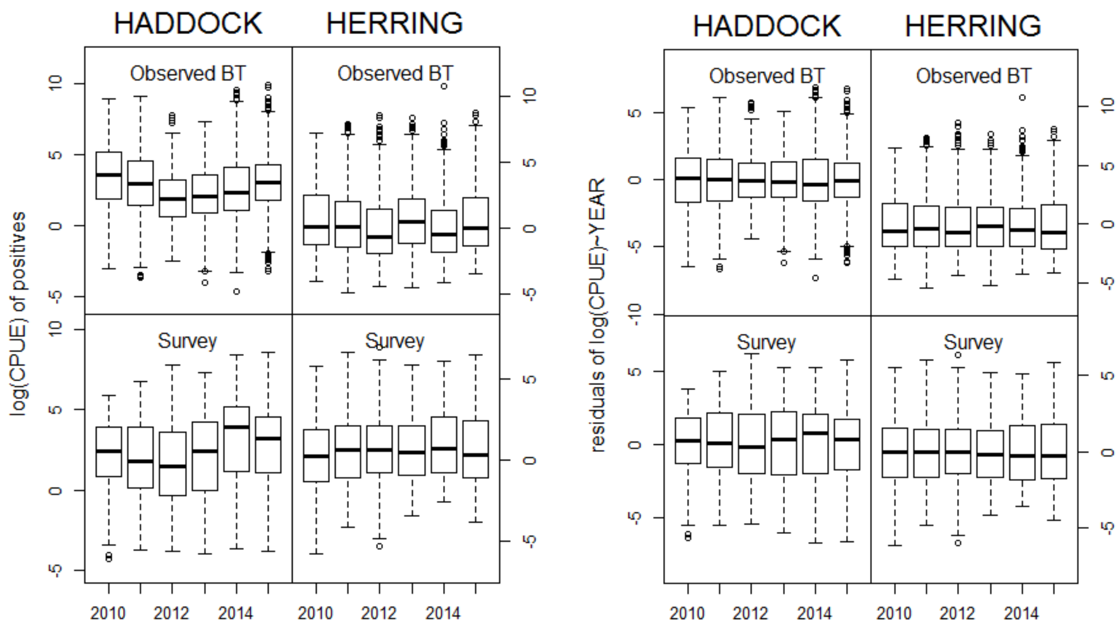

Figure 4. log(CPUE) of haddock and herring catch by year from the NEFOP BT and NEFSC survey datasets (at left). Residuals from a GLM model (logCPUE ~ YEAR) for the same datasets, by year (at right).

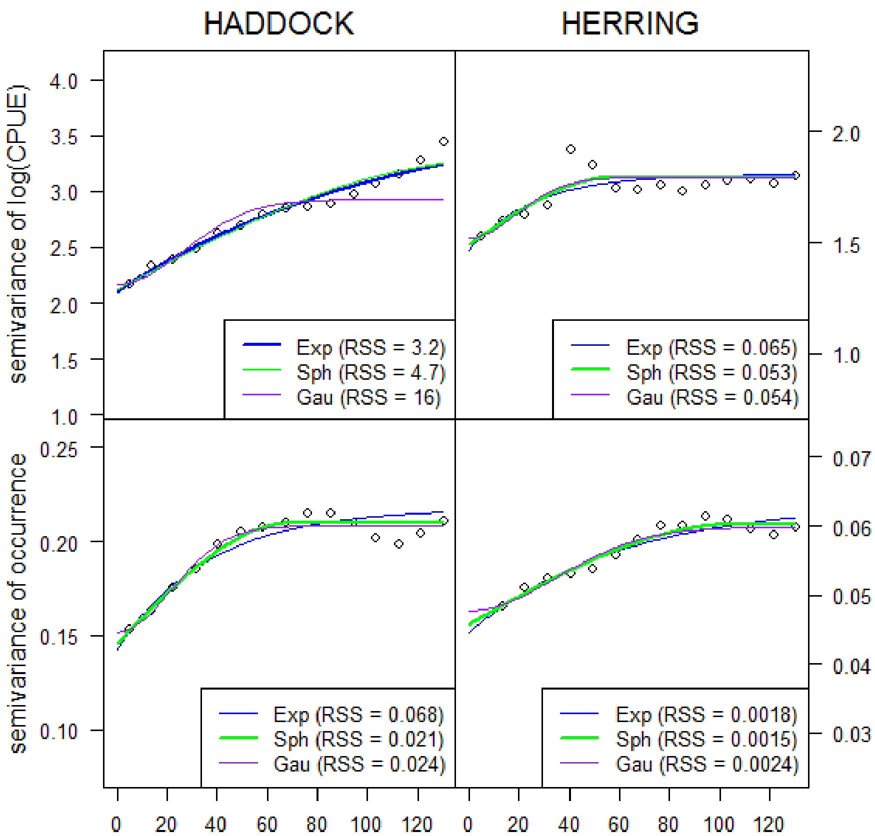

Figure 5. Average empirical variograms for the NEFOP bottom trawl dataset. Exponential and spherical variogram models provide the best fit for log(CPUE) of haddock and herring, respectively. The spherical variogram model provides the best fit for the occurrence of both species.

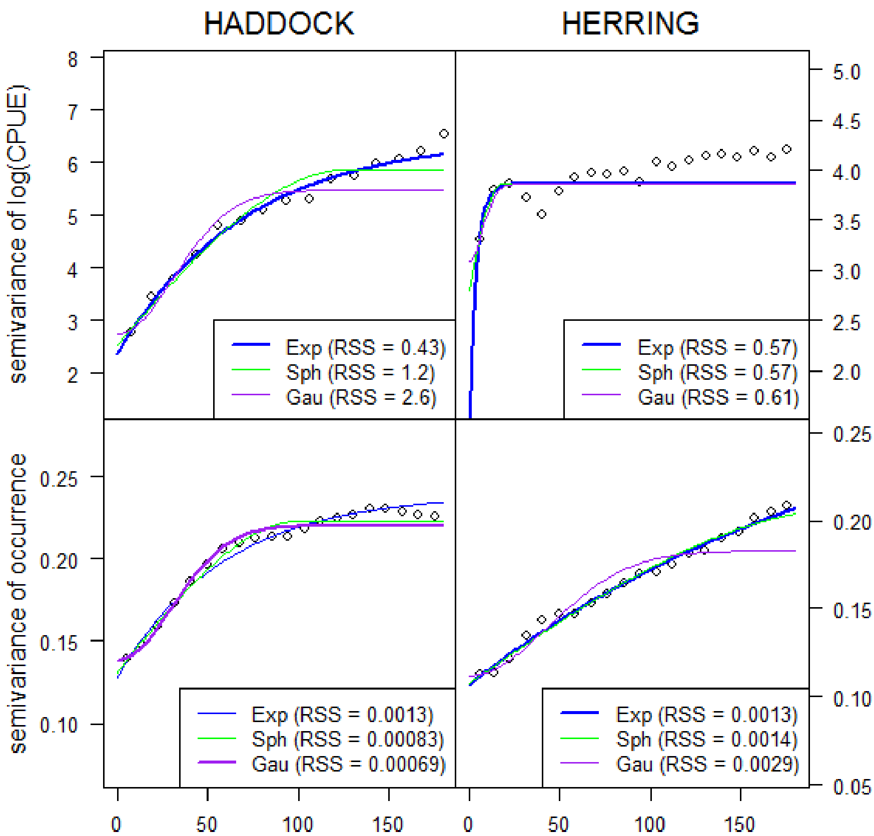

Figure 6. Average empirical variograms for the NEFSC survey dataset. The exponential variogram model provides the best fit to the log(CPUE) of both haddock and herring. For herring, a spatial relationship in log(CPUE) was only estimable for the fall survey and was used for both spring and fall. The Gaussian and exponential variogram model provided the best fit for the occurrence of haddock and herring, respectively.

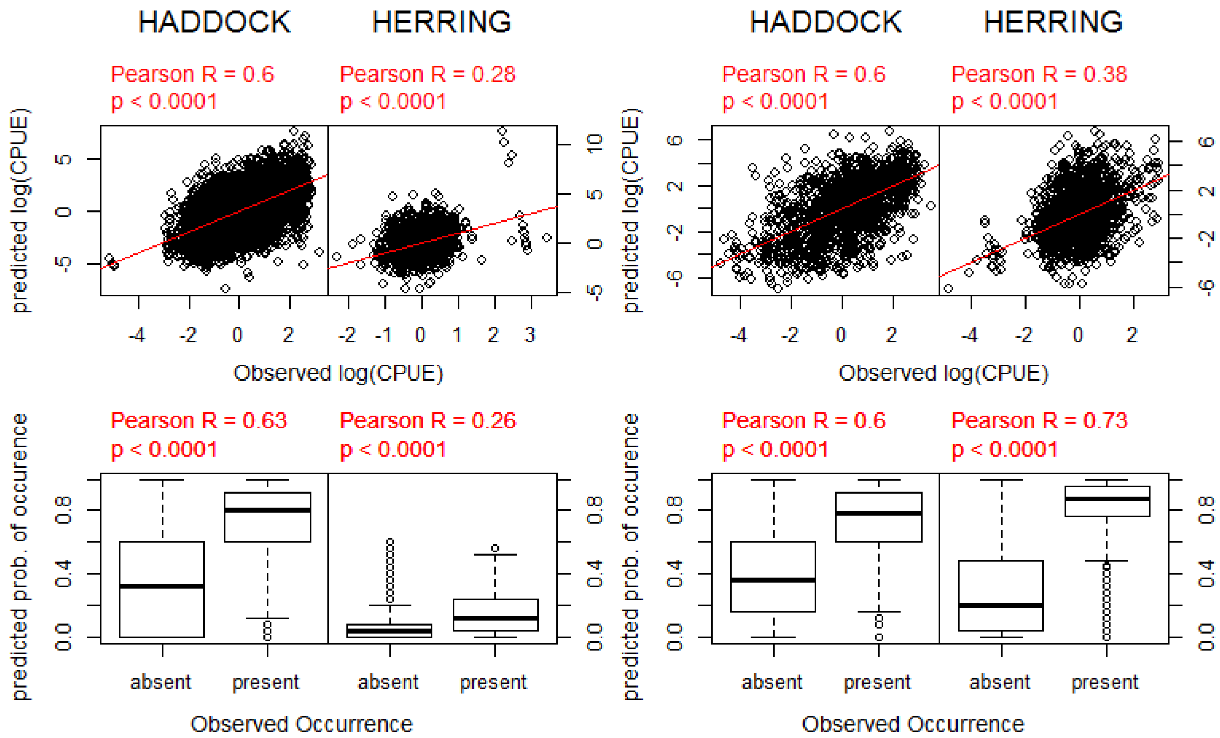

Figure 7. Results of leave-one-out cross-validation for NEFOP bottom trawl dataset (at left) and NEFSC survey dataset (at right).

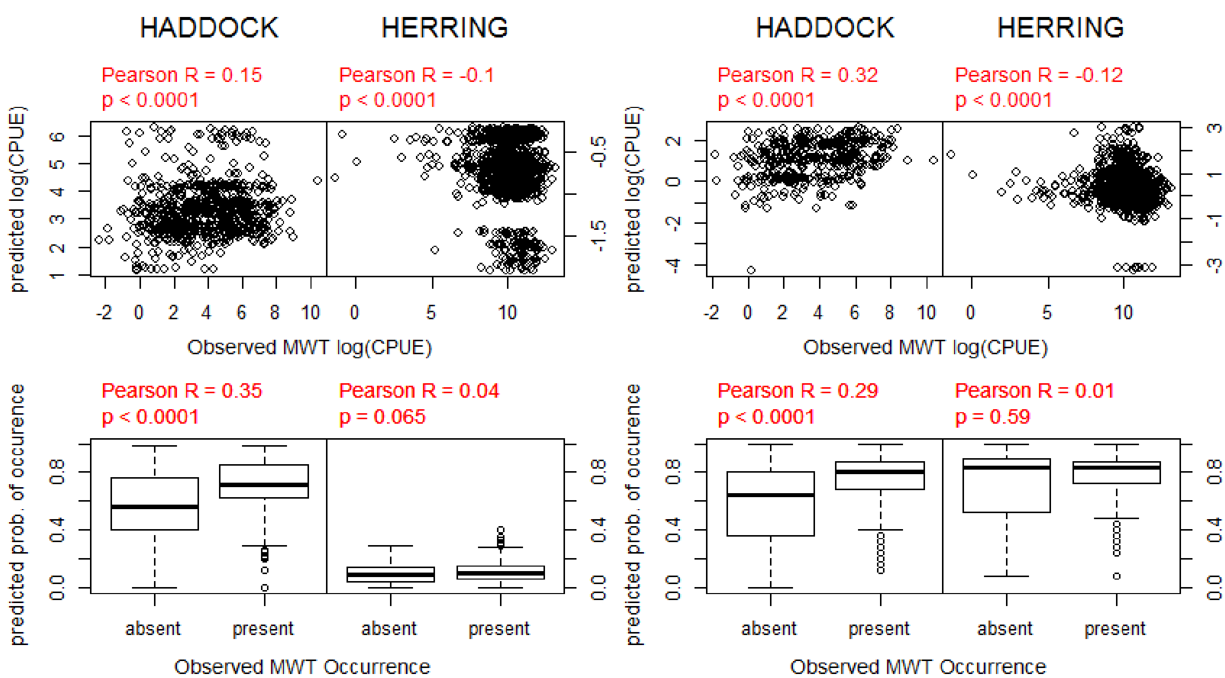

Figure 8. Results or comparison between Kriged distribution model and NEFOP midwater trawl hauls. Distribution model derived from the NEFOP bottom trawl dataset is shown at left, and the distribution model derived from the NEFSC survey dataset is shown at right.

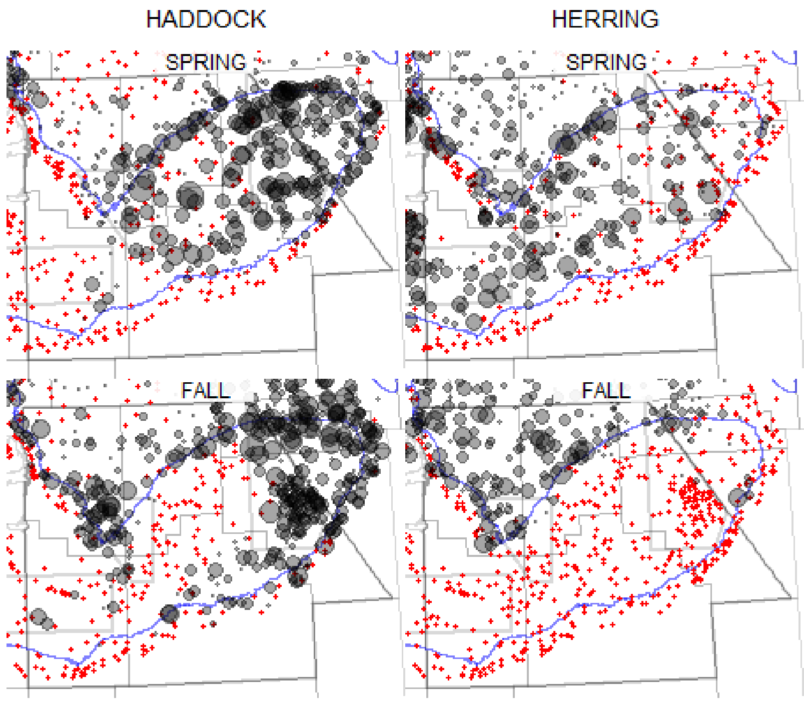

Figure 9. Log(CPUE) of positive values with year effects removed (black bubbles) from the NEFSC survey dataset. Red points indicate where haddock (above) or herring (below) were not caught.

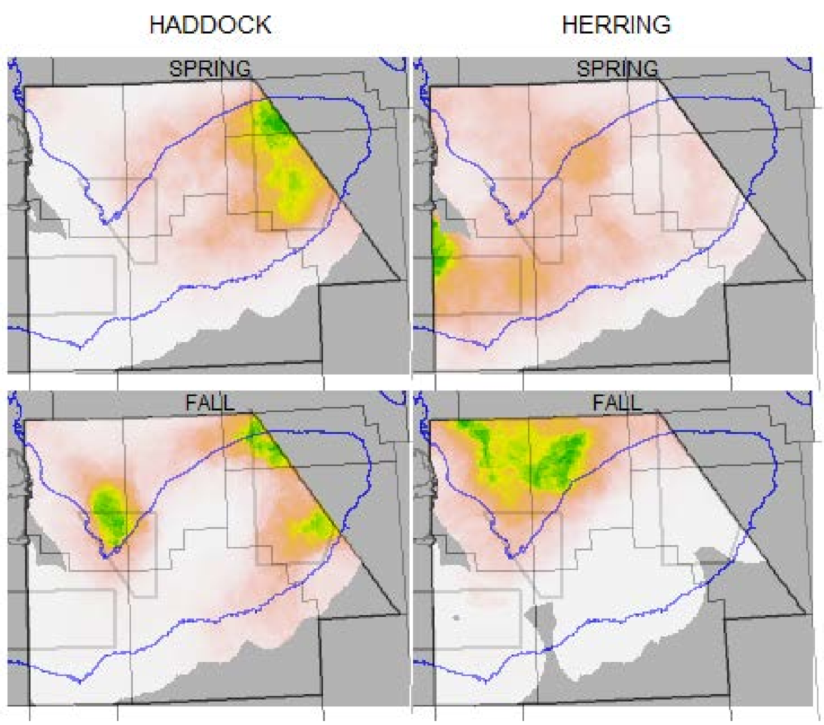

Figure 10. Delta-lognormal Kriged predictions for haddock (top) and herring (bottom) CPUE from the NEFSC survey dataset.

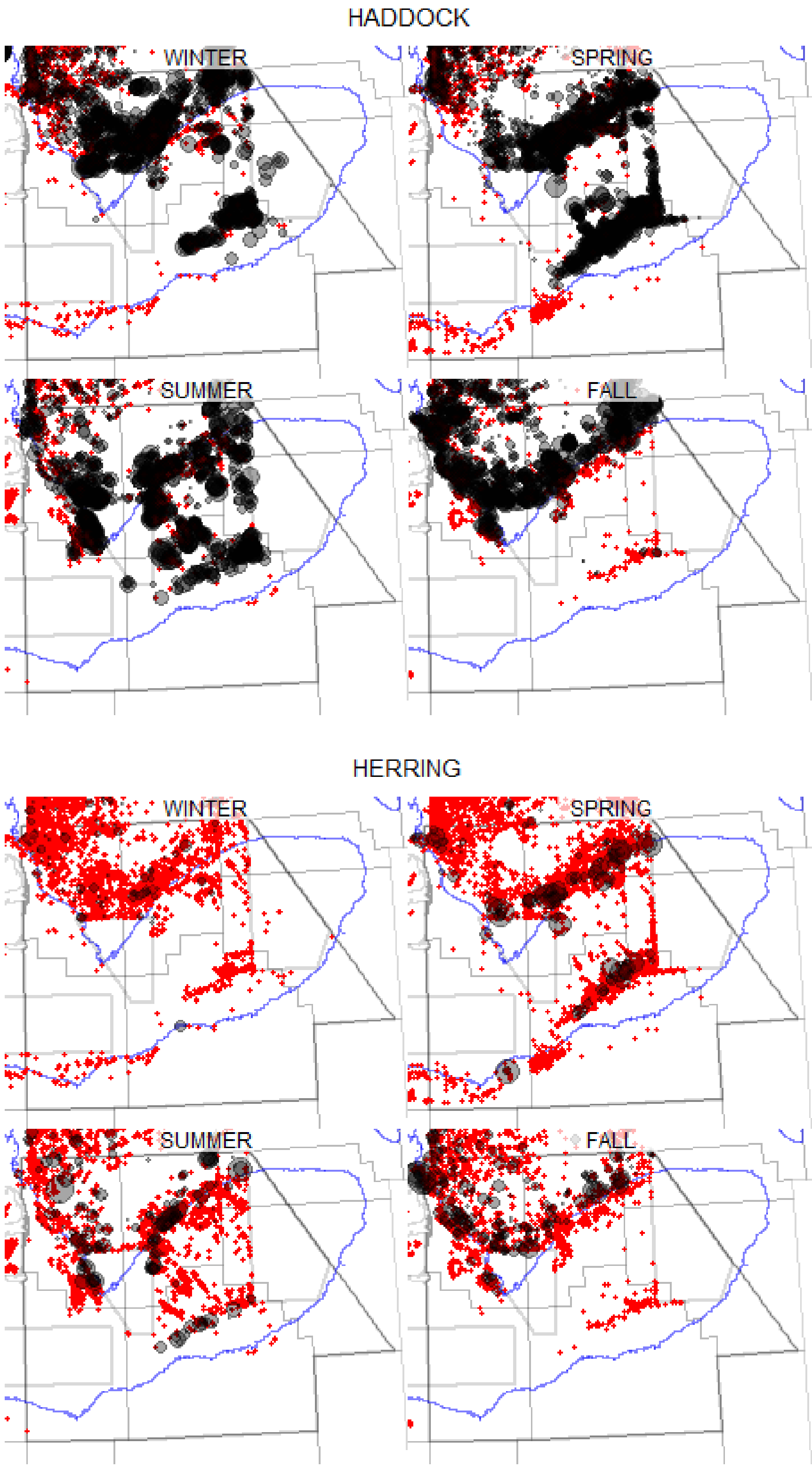

Figure 11. Log(CPUE) of positive values with year effects removed (black bubbles) from the NEFOP bottom trawl dataset. Red points indicate where haddock (above) or herring (below) were not caught.

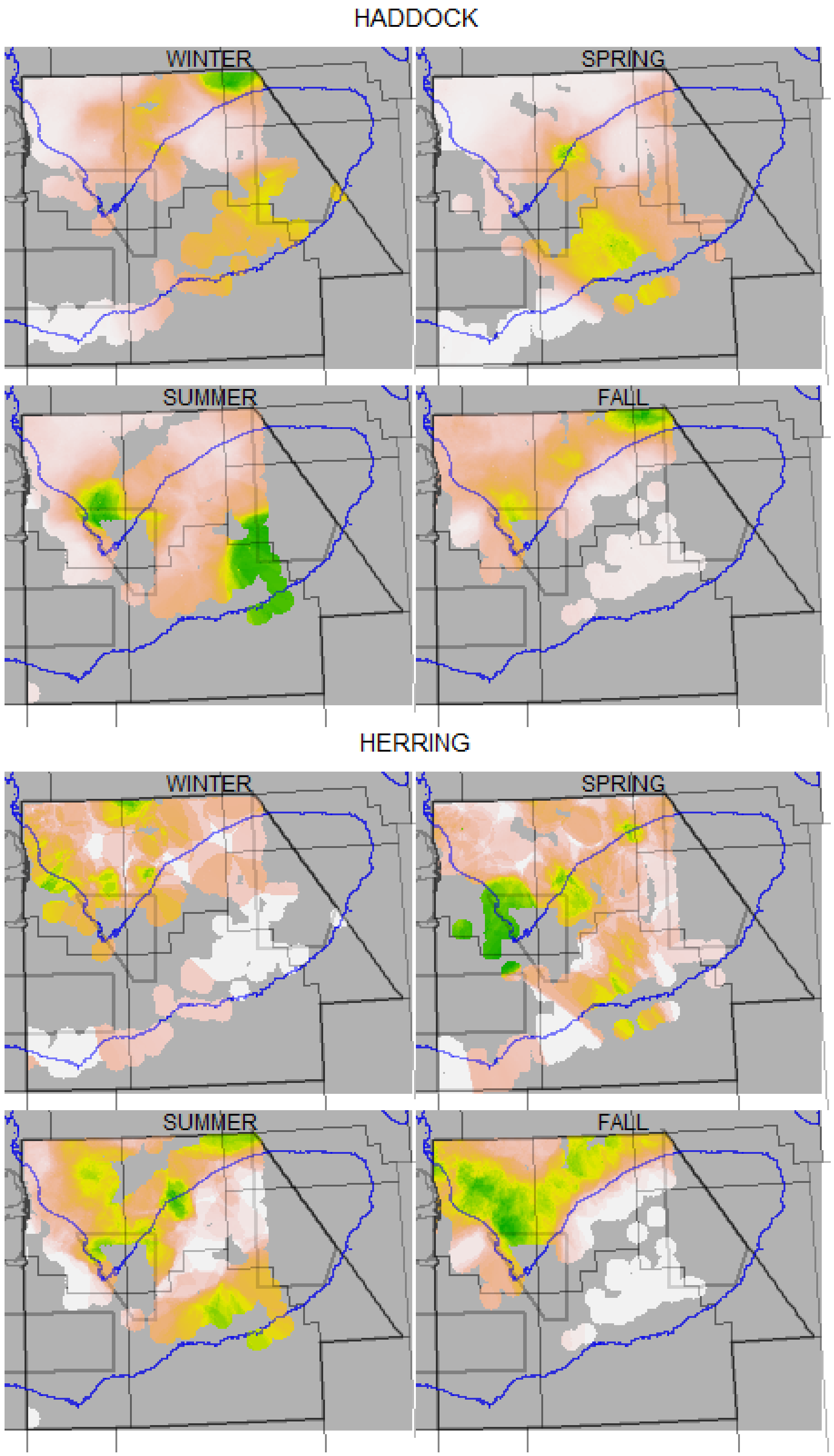

Figure 12. Delta-lognormal Kriged predictions for haddock (top) and herring (bottom) CPUE from the NEFOP bottom trawl dataset.

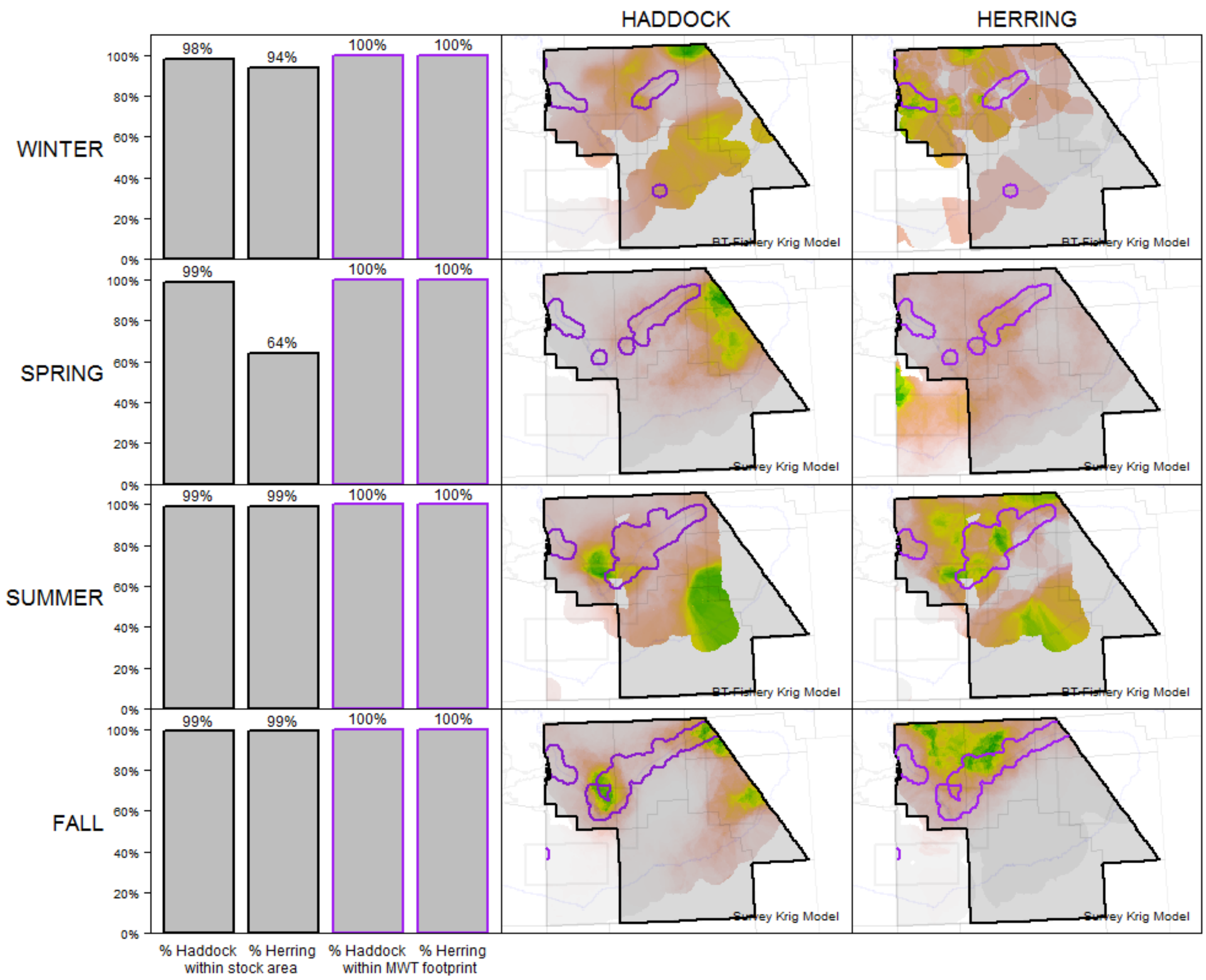

Figure 13. Kriged distribution models for Georges Bank haddock (center) and herring (right), as compared to the current AM area (black polygon) and footprint of the MWT fishery (purple polygon). The bar charts at left show the portion of the biomass of each species that are covered by the AM area, using data from the entire stock area (black outline) as well as just data from inside the MWT fishery footprint (purple outline).

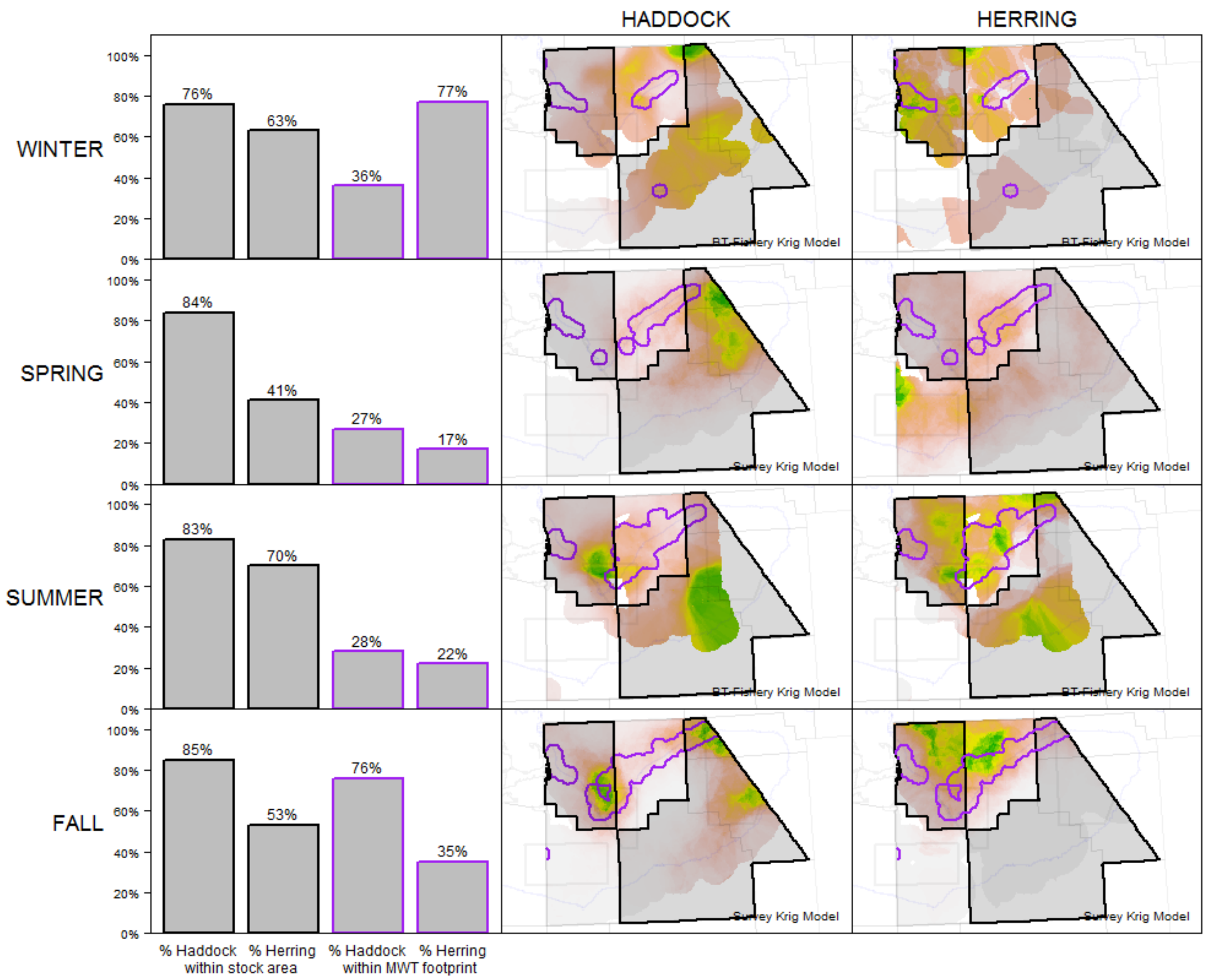

Figure 14. Same as Figure 13, but for an AM alternative that does not include statistical area 522.

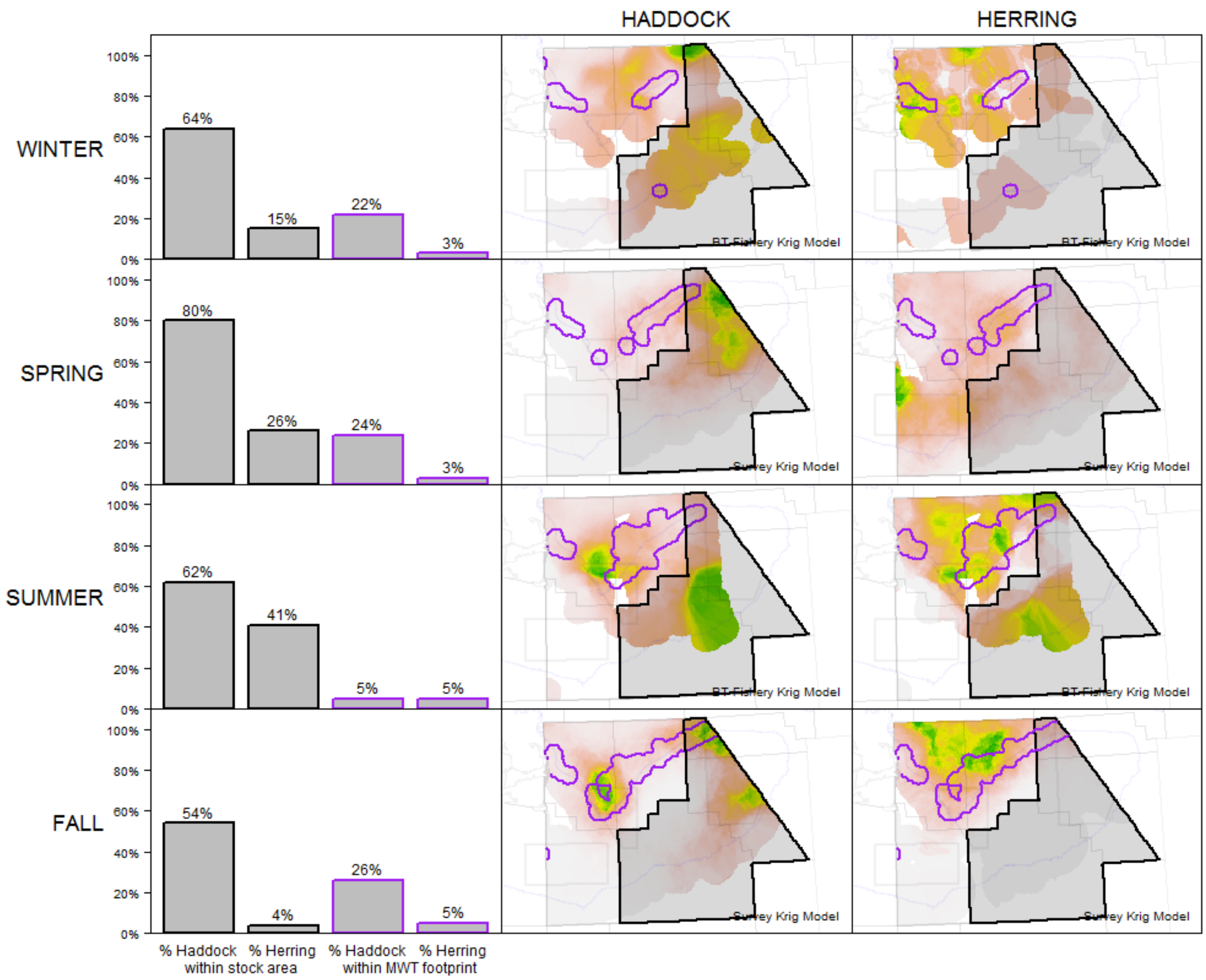

Figure 15. Same as Figure 13, but for an AM alternative that does not include statistical areas 522 or 521.

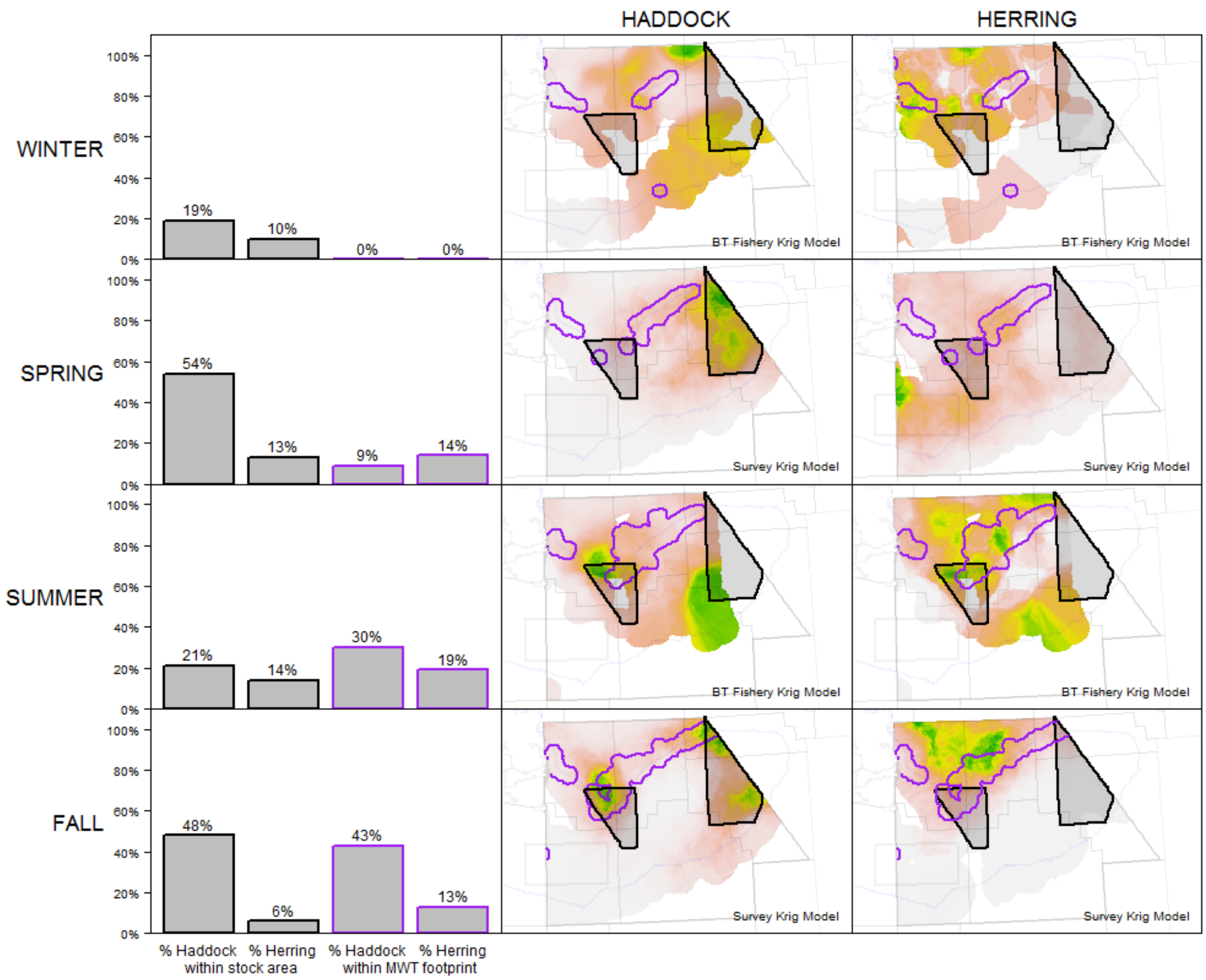

Figure 16. Same as Figure 13, but with an AM alternative that uses Closed Area I and Closed Area II as the AM area.

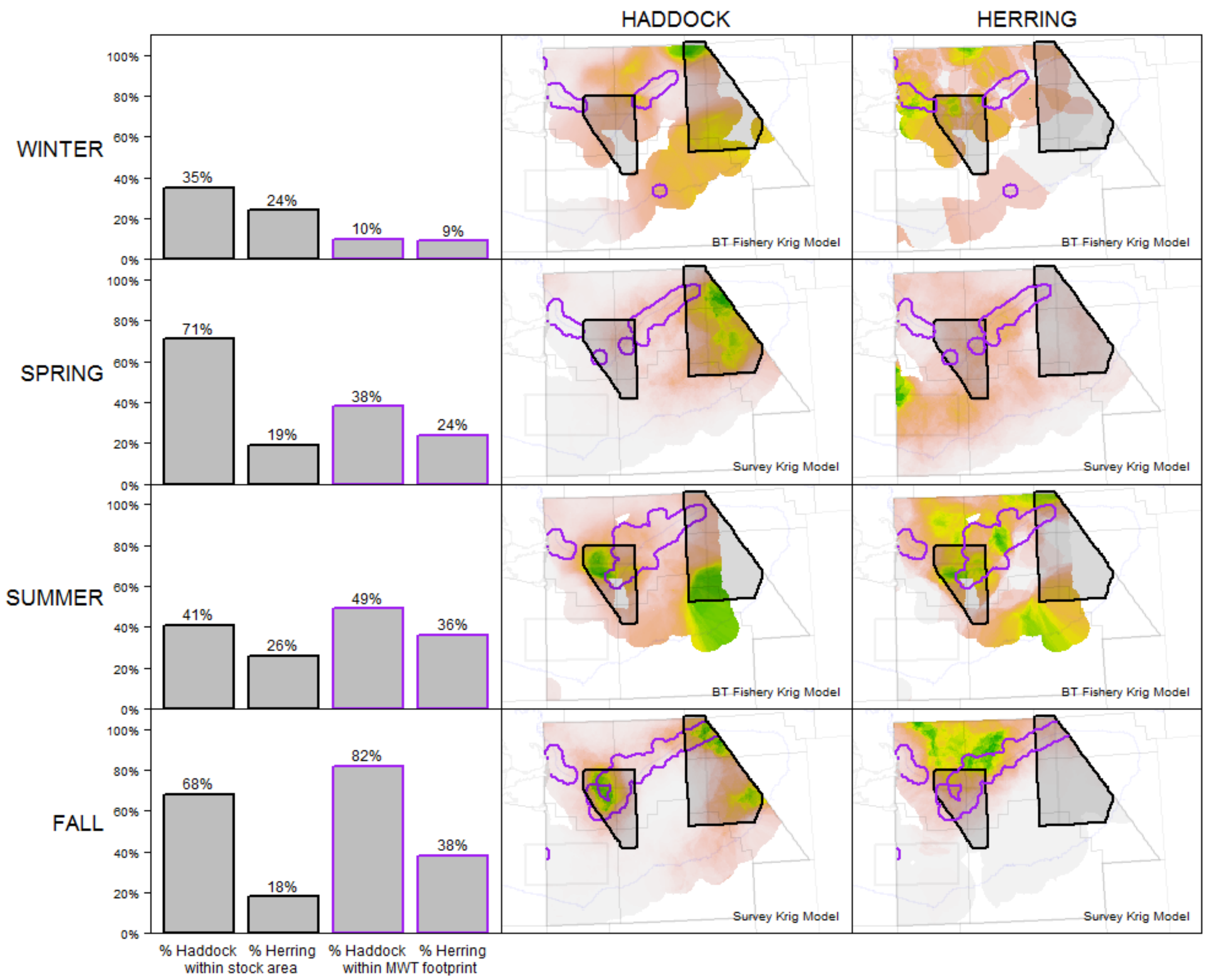

Figure 17. Same as Figure 13, but with an AM alternative that includes a 15 nm northward extension of Closed Area I, and a 15 nm westward extension of Closed Area II.